Review of
OPHTHALMOLOGY

A K Khurana

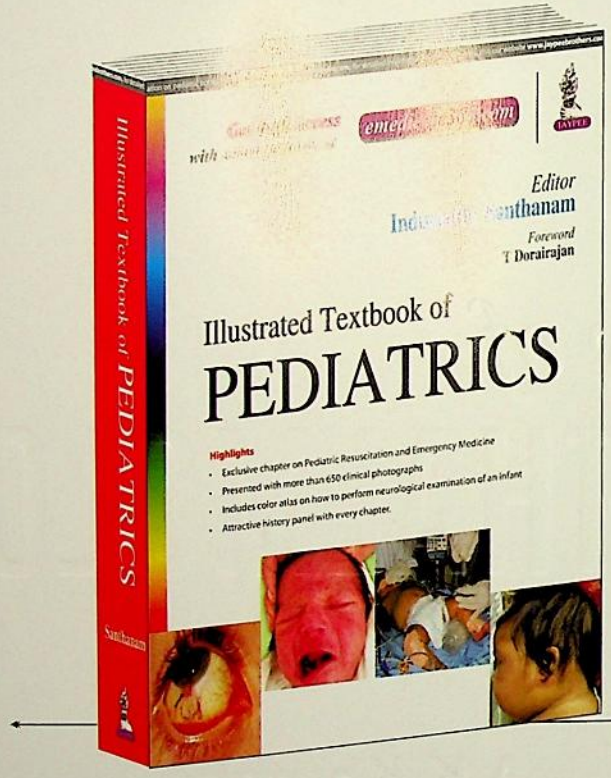
SEVENTH EDITION

A Free Companion to
Comprehensive Ophthalmology, 7/E

JAYPEE

Other Best-selling Books

ILLUSTRATED TEXTBOOK OF PEDIATRICS



Indumathy Santhanam

Four Colour | Soft Cover | 1/e, 2018

8.5" x 11" | 980 Pages | 9789352701025

- A concise book written by the experienced teaching faculty
- Presents the text in simple language with attractive cartoons and in colorful layout
- Tries to bridge the gap between concepts and understanding
- Includes excellent information with a large number of clinical photographs
- An attempt has been made towards making learning pediatrics a passion.

JAYPEE
The Health Sciences Publisher

Please visit our website
www.jaypeebrothers.com or Scan the QR Code

Review of
OPHTHALMOLOGY

Review of
OPHTHALMOLOGY

Quick Text Review & MCQs

Seventh Edition

AK Khurana
MS FAICO CTO (London)
Senior Professor and Ex-Head
Regional Institute of Ophthalmology
Postgraduate Institute of Medical Sciences
Rohtak, Haryana, India

Aruj K Khurana
DNB (Sankara Nethralaya, Chennai) FICO
FVRS, (Narayana Nethralaya, Bengaluru)
Consultant, Vitreo-retinal Services
Nirmal Ashram Eye Institute
Rishikesh, Uttarakhand, India

Bhawna P Khurana
MS DNB FICO FNN
Assistant Professor
Squint, Paediatric Ophthalmology
Orbit Oculoplasty, and Ocular Oncology Unit
Department of Ophthalmology
SGRR Institute of Medical and Health Sciences
Dehradun, Uttarakhand, India

JAYPEE

JAYPEE BROTHERS MEDICAL PUBLISHERS
The Health Sciences Publisher
New Delhi | London | Panama

JAYPEE **Jaypee Brothers Medical Publishers (P) Ltd**

Headquarters

Jaypee Brothers Medical Publishers (P) Ltd
4838/24, Ansari Road, Daryaganj
New Delhi 110 002, India
Phone: +91-11-43574357
Fax: +91-11-43574314
Email: jaypee@jaypeebrothers.com

Overseas Offices

J.P. Medical Ltd
83 Victoria Street, London
SW1H 0HW (UK)
Phone: +44 20 3170 8910
Fax: +44 (0)20 3008 6180
Email: info@jpmedpub.com

Jaypee-Highlights Medical Publishers Inc
City of Knowledge, Bld. 235, 2nd Floor
Clayton, Panama City, Panama
Phone: +1 507-301-0496
Fax: +1 507-301-0499
Email: cservice@jphmedical.com

Jaypee Brothers Medical Publishers (P) Ltd
Bhotahity, Kathmandu, Nepal
Phone: +977-9741283608
Email: kathmandu@jaypeebrothers.com

Website: www.jaypeebrothers.com
Website: www.jaypeedigital.com

Review of Ophthalmology

First Edition: 1996
Seventh Edition: **2019**

ISBN 978-93-5270-686-0

Printed at Replika Press Pvt. Ltd.

Dedicated to

My parents and teachers for their blessings
My students for their encouragement
My children for their patience
&
My wife Professor Indu Khurana
for her understanding

Preface

Review of Ophthalmology is a welcome companion to comprehensive ophthalmology, as it provides appropriate subject matter to prepare for various postgraduate entrance examinations. The seventh edition of the book has been thoroughly revised and updated with recent advances, in each chapter. Further layout of the book has been thoroughly changed to make it user friendly. Now, the book has been reorganised into six sections:

Section I: Anatomy and Physiology of Eye

Section II: Optics and Refraction

Section III: Diseases of Eye and Ocular Adnexa

Section IV: Ocular Therapeutics

Section V: Systemic and Community Ophthalmology

Section VI: Practical Ophthalmology

Chapters layout has also been changed and now each chapter contains 'Quick Text Review' material followed by related Multiple Choice Questions (MCQs).

Salient Features of the Book

- Main feature of this book is that it is based on the *Comprehensive Ophthalmology*, a textbook, which is used by most of the students during their graduation course.
- Provides a means for quick text revision and self-assessment to the medical students preparing for competitive postgraduate entrance examinations.
- Quick review of the text, given in the beginning of each chapter provides an opportunity for preparing for the viva questions commonly asked in clinical/practical examinations and various interviews.
- Though a quick review, the subject matter in this section has been covered in depth and extensively including the recent advances. The important text on which MCQs are based has been highlighted with under rule.
- Community ophthalmology chapter has been extensively updated in view of the objectives under Vision 2020, National Programme for Control of Blindness and Visual Impairment in India, during 12th five-year plan (2012–2017).
- Chapter on Clinical Methods in Ophthalmology also includes uses of recently introduced sophisticated equipment.
- Multiple choice questions are given in the second part of each chapter. Most of the MCQs are single best response type, baring a few extra-edge questions. While framing the thought-provoking MCQs, particular care has been taken to include all those important MCQs which have repeatedly appeared in various postgraduate medical entrance tests held in the last ten years up to 2018. Answers to the MCQs have been given at the bottom of each page to facilitate easy reading.

cknowledgements. It is my great pleasure to convey my gratitude to all those, whose blessings and ontribution has made this venture possible. I shall remain ever indebted to my parents and teachers r their unending blessings. I owe a lot to my students who have been a constant source of inspiration id encouragement. The sincere help rendered in completion of seventh edition by Dr Shweta Goel, r Kamal Garg and Dr Garima Gupta and residents of Regional Institute of Ophthalmology (RIO), Rohtak,

Haryana, India needs to be acknowledged.

I acknowledge with thanks, the respect, affection and cooperation of faculty members of Regional Institute of Ophthalmology (RIO), PGIMS, Rohtak, namely, Dr CS Dhull, Dr SV Singh, Dr JP Chugh, Dr VK Dhull, Dr RS Chauhan, Dr Manisha Rathi, Dr Neebha Anand, Dr Manisha Nada, Dr Urmil Chawla, Dr Ashok Rathi, Dr Sumit Sachdeva, Dr Reena Gupta, Dr Jitender Phogat, Dr Jyoti Deswal, Dr Sunil Kumar, Prof Sanjiv Mittal, AIIMS, Rishikesh, Uttarakhand, and Prof Subhash Tadeya, MAMC, New Delhi.

The contribution made by Dr Aruj K Khurana and Dr Bhawna P Khurana in completion of this edition is duly acknowledged. The love and moral support, in addition to the editorial help, rendered by my daughter Dr Arushi and Son-in-Law Dr Gurukripa, Virginia Commonwealth University, Rechmond, Virginia, USA, and my wife Dr Indu Khurana, Professor of Physiology and Dean-cum Principal, World College of Medical Sciences and Research, Gurawar, Jhajjar, Haryana, India, made my task untiring.

The enthusiastic cooperation received from Shri Jitendar P Vij (Group Chairman), Mr Ankit Vij (Managing Director), Mr MS Mani (Group President), Ms Pooja Bhandari (Production Head), Ms Sunita Katla (Executive Assistant to Group Chairman and Publishing Manager), Ms Seema Dogra (Cover Designer), Mr Rajesh Sharma (Production Coordinator), Mr Vakil Khan (Proof Reader), and Mr Ajeet Rathor (Typesetter) of M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, needs special acknowledgement.

Sincere efforts have been made to verify the correctness of text and the answers to the MCQs. However, in spite of the best efforts, ventures of this kind are not likely to be free from human errors, some inaccuracies, ambiguities and typographic mistakes. Therefore, a feedback from the users will be of utmost help in improving future editions of the book. Endeavour of this kind shall be highly appreciated and duly acknowledged.

AK Khurana

Contents

SECTION—I

Anatomy and Physiology of Eye

CHAPTER

1

Anatomy and Development of Eye

QUICK TEXT REVIEW

ANATOMY OF EYE

EYEBALL

Dimensions of an adult eyeball

- Anteroposterior diameter : 24 mm
- Vertical diameter : 23 mm
- Horizontal diameter : 23.5 mm
- Circumference : 75 mm
- Volume : 6.5 cc
- Weight : 7 g

Segments and chambers of the eyeball

Anterior segment. It includes crystalline lens and structures anterior to it viz. iris, cornea and two aqueous humour filled spaces, the anterior and posterior chamber.

Angle of anterior chamber from anterior to posterior comprises:

- Schwalbe's line
- Trabecular meshwork
- Scleral spur
- Band of ciliary body and
- Root of iris.

Anterior chamber. Its depth in the centre is 2.5–3 mm, it is comparatively shallow in very young children and old people. The chamber shallows by 0.01 mm per year. It is shallower in hypermetropia and deeper in myopes. Usually, males have larger anterior chamber dimensions than female and volume of aqueous humour in it is 0.25 mL. Posterior chamber contains about 0.06 mL of aqueous humour.

Posterior segment. It includes structures posterior to the lens viz. vitreous humour, retina, optic disc, choroid and pars plana (part of ciliary body).

CORNEA

- It is a transparent, dehydrated and avascular structure.
- Forming 1/6th of the outer fibrous coat of eyeball.

Dimensions

- Anterior vertical diameter : 11 mm
- Anterior horizontal diameter : 12 mm
- Posterior diameter : 11.5 mm
- Radius of curvature of central part
  - Anterior : 7.8 mm
  - Posterior : 6.5 mm
- Thickness
  - at the centre : 0.52 mm
  - at the periphery : 1 mm
- Refractive index : 1.33
- Refractive power : 45 D

Note:

- *Pachymetry* 500–600 micron, always central thickness measured because centre is the thinnest part.
- *Specular microscopy* is a detailed microscopic analysis of individual cell morphology and an estimate of cellular density.

Layers of cornea

- *Epithelium*: Stratified squamous type. Corneal epithelium replaces itself about once a week.
- *Bowman's membrane*: Once destroyed does not regenerate.
- *Stroma*: Constitutes 90% of total thickness. Consists of collagen fibres (lamellae arranged in many layers).
- *Pre-Descemet's membrane or Dua's layer* (discovered in 2013) is about 15 micrometer thick

acellular structure which is very strong and impervious to air.
- *Descemet's membrane*: Once destroyed, it regenerates. Its prominent peripheral end forms Schwalbe's line.
- *Endothelium*: Cell density in a young adult is about 6,000 cells/mm^2. Metabolically, it is the most active layer of cornea.

SCLERA

Thickness of sclera

- At posterior pole: 1 mm (thickest)
- At the insertion of extraocular muscles: 0.3 mm (thinnest)
- Equator: 0.5 mm
- Lamina cribrosa is the thinnest sieve like sclera through which pass fibres of the optic nerve.

CRYSTALLINE LENS

Dimensions

Lens is a transparent, biconvex, crystalline structure placed between iris and vitreous in a saucer-shaped depression called patellar fossa.
- *Diameter*: 9–10 mm
- *Thickness* varies with age from 3.5 mm (at birth) to 5 mm (at 60 to 70 years); in an adult average is 4.25 mm
- *Thickness of the lens capsule* at anterior pole is 14 µm
- *Weight* varies with age from about 135 mg (0–9 years), 175 mg (20–30 years) to 255–275 mg (60–80 years)
- *Radius of curvature*
  - Anterior : 11 mm
  - Posterior : 6 mm
- *Refractive index* : 1.39
- *Refractive power* : 15–16 D

Structure

Lens capsule is thinnest at the posterior pole.

Lens epithelium. It is a single layer on the anterior (front) surface. There is no epithelium on posterior surface.

Nucleus: It is the central part of the lens containing oldest lens fibres.
- *Embryonic nucleus*: Corresponding to the lens at 1–3 months of gestation. It consists the oldest primary fibres.
- *Fetal nucleus* (3 months gestation till birth). Its fibres meet around the Y-shaped sutures (anterior Y is erect and, posterior Y is inverted).
- *Infantile nucleus*: From birth to puberty.
- *Adults nucleus*: Lens fibres formed after puberty rest of life.

Cortex: It is the peripheral part containing t youngest fibres.

IRIS AND CILIARY BODY

- *Iris is thinnest* at its root.
- *Anterior limiting membrane* is the anterior mc condensed part of stroma. It is deficient in the ar of crypts. Definitive colour of the iris depends up the amount of pigment in this layer.
- *Anterior pigmented epithelium* of ciliary body forward continuation of the pigment epitheliu of the retina.
- *Posterior non-pigmented epithelium* of ciliary bod is forward continuation of the sensory retina.
- *Ciliary processes* (About 70–80 in number) ar white, finger-like projections from the pars plicat part of the ciliary body.

VITREOUS, RETINA AND VISUAL PATHWAY

Vitreous

- *Volume* of vitreous is approximately 4 cc (abou two-thirds of the volume of the eye).
- *Vitreous consists* of large molecules of hyaluronic acid.
- *Subhyaloid space* refers to the potential space between vitreous and retina.
- *Vitreous base* refers to its strongest attachment to the pars plana and the retina in the region of ora serrata.

Retina

- *Dimensions of retina*
  - Optic disc : 1.5 mm
  - Macula lutea : 5.5 mm (15° visual field)
  - Fovea centralis : 1.5 mm (5° visual field)
  - Foveola : 0.35 mm
  - Thickness of retina : 0.5 mm near optic disc, 0.2 mm at equator, and 0.1 mm most anteriorly
- *Optic disc*, 1.5 mm in size, is responsible for blind spot of Mariotte
- *Rods and cones* are sensory end organs of the visior
- *Rods are absent* in the foveal region. Ganglion cel layer is thickest in the macular region
- *Henle's layer* refers to thickened outer plexiform layer in the foveal region
- *Foveola* is the most sensitive part of retina. I contains only cones and their nuclei covered by a thin internal limiting membrane.

- *Major retinal vessels* are present in the nerve fibre layer
- *Superficial capillary network* of the retina is present at the level of nerve fibre layer
- *Nourishment of macula-lutea* is entirely dependent upon the choroid.

Visual pathway

Visual sensation neurons

- *First order*—bipolar cells
- *Second order*—ganglion cells
- *Third order*—neurons of lateral geniculate body.

Optic nerve

- *Fibres of optic nerve* once cut, do not regenerate, because they are not covered by neurilemma.
- *Length of optic nerve*
  - Total length : 47–50 mm
  - Intraocular part : 1 mm
  - Intraorbital part : 30 mm
  - Intracanalicular part : 6–9 mm
  - Intracranial part : 10 mm
- *Diameter of optic nerve*
  - Intraocular (optic disc) : 1.5 mm
  - Intraorbital part : 3–4 mm
  - Intracranial part : 4–7 mm
- Intraocular part of optic nerve is closely related to ophthalmic artery, which crosses obliquely over it.

EXTRAOCULAR MUSCLES

Origin and insertion

- *Four rectus muscles* (superior, inferior, medial and lateral) arise from the common tendinous ring (annulus of Zinn) at the apex of the orbit, and are inserted on the sclera at following distances from the limbus:
  - Medial rectus : 5.5 mm
  - Inferior rectus : 6.5 mm
  - Lateral rectus : 6.9 mm
  - Superior rectus : 7.7 mm

  Superior rectus and medial rectus have an attachment with the dural sheath of the optic nerve, this accounts for the painful movements in retrobulbar neuritis.

  Lateral rectus muscle arises by two heads.
- *Inferior oblique* (shortest extraocular muscle), is the only muscle arising from the floor of the orbit. It is inserted on the sclera posterior to the equator in the area coinciding with the macular region.
- *Superior oblique* (longest extraocular muscle) arises from the apex of the orbit, turns around the trochlea and is inserted in the upper and outer part of the sclera behind the equator.

Nerve supply

- *3rd cranial nerve*: Superior rectus, medial rectus, inferior rectus and inferior oblique.
- *4th cranial nerve*: Superior oblique.
- *6th cranial nerve*: Lateral rectus. Palsy produces eyeball inward, i.e. esotropia or convergent squint, and homonymous (uncrossed) diplopia.

Actions

Muscle	*Primary action*	*Secondary action*	*Tertiary action*
MR	Adduction	—	—
LR	Abduction	—	—
SR	Elevation	Intorsion	Adduction
IR	Depression	Extorsion	Adduction
SO	Intorsion	Depression	Abduction
IO	Extorsion	Elevation	Abduction

APPENDAGES OF THE EYE AND ORBIT

Conjunctiva

1. *Epithelium*: Stratified squamous non-keratinized
   - Marginal conjunctiva - 5 layered
   - Tarsal conjunctiva - 2 layered
   - Fornix and bulbar conjunctiva - 3 layered
   - Limbal conjunctiva - 5 layered
   - Goblet cells are seen in nasal part of conjunctiva. Maximum density of goblet cell is present infero-nasally and in the fornices.

2. *Adenoid layer:* Consists of fine connective tissue reticulum. It is most developed in the fornices. It is not present since birth but develops after 3–4 months of life (so conjunctival inflammation in infants does not produce follicles). Limbal stem cells are present in the limbal conjunctiva.

3. *Fibrous layer*: It contains all the blood vessels and nerves.

Glands of eyelids

- *Meibomian glands* (Tarsal glands) are modified sebaceous glands; about 20–30 in each lid.
- *Glands of Zeis* are modified sebaceous glands which open into follicles of eye lashes.
- *Glands of Moll* are modified sweat glands which open into hair follicles.
- *Accessory lacrimal glands* of Wolfring are present near the superior border of upper tarsus.

Lacrimal apparatus

- *Accessory lacrimal glands of Krause* are about 42 in the upper fornix and 6–8 in the lower fornix

- *Tears* are produced after one week of life
- *Lacrimal sac* when distended, is about 15 mm in length and 5-6 mm in breadth
- *Angular vein* is situated 8 mm medial to the medial canthus.

Nasolacrimal duct

- *Length* 12-24 mm, diameter 4-5 mm
- *Directed* downward, slightly outwards and backwards
- *Opens in* inferior meatus
- *Narrowest point* is near the upper end
- *Valve of Hasner* is present near its lower end.

ORBIT

- *Volume*—30 cc. The eyeball occupies one-fifth of the volume
- *Thinnest wall*—medial
- *Thickest wall*—lateral
- *Floor* is commonly involved in blow-out fractures
- *Surgical spaces* in orbit—four (subperiosteal space, peripheral space, central space or muscle cone and Tenon's space).

Bones, walls and fissures of orbit

Walls of orbit are formed by following bones:

1. *Medial wall*
- Frontal process of maxilla
- Lacrimal bone
- Orbital cribriform plate of ethmoid and
- Body of sphenoid.

2. *Lateral wall*
- Zygomatic bone
- Greater wing of sphenoid.

3. *Superior wall (roof)*
- Orbital plate of frontal bone
- Lesser wing of sphenoid.

4. *Floor* (commonly involved in blow out fracture)
- Orbital surface of maxillary bone
- Orbital surface of zygomatic bone
- Palatine bone.

Fissures and foramen of orbit are:

- *Inferior orbital fissure*
  - Present between floor and lateral wall
- *Superior orbital fissure*
  - It is at orbital apex, lateral to optic foramen
- *Optic canal/Optic foramen*
  - Formed by two wings of lesser wing of sphenoid at orbital apex.

DEVELOPMENT OF THE EYE

Eyeball and its related structures are derived from three different germ layers, namely—neuroectoderm, surface ectoderm and mesoderm with contribut from the neural crest cells. The following primor are first formed:

- *Optic vesicle* (Neuroectodermal structure)— outgrowth from the prosencephalon
- *Lens placode* specialised area of surface ectode
- *Mesoderm* surrounding the optic vesicle
- *Visceral mesoderm* of maxillary process.

STRUCTURES DERIVED FROM THE EMBRYONIC LAYERS

1. Surface ectoderm

- The crystalline lens
- Epithelium of the cornea
- Epithelium of the conjunctiva
- Lacrimal gland
- Epidermis of eyelids and its derivatives viz., cil tarsal glands and conjunctival glands
- Epithelium lining the lacrimal apparatus.

2. Neural ectoderm

- Retina with its pigment epithelium
- Epithelial layers of ciliary body
- Epithelial layers of iris
- Sphincter and dilator pupillae muscles
- Optic nerve (neuroglia and nervous elements onl
- Definitive or secondary vitreous
- Ciliary zonules.

3. Periocular mesenchyme derived from the neural crest and associated paraxial mesoderm

- Stroma, Descemet's membrane and endotheliu of the cornea
- Angle of anterior chamber
- Stroma of the iris
- Ciliary body and choroid
- Primary vitreous.
- Blood vessels of choroid, iris, ciliary vessels, centr retinal artery and other vessels
- Sclera
- Sheaths of optic nerve
- Extraocular muscles
- Fat, ligaments and other connective tissu structures of the orbit
- Upper and medial walls of the orbit
- Connective tissue of the upper eyelid.

4. Visceral mesoderm of maxillary processes below the eye balls

- Lower and lateral walls of orbit
- Connective tissue of the lower eyelid.

IMPORTANT MILESTONES IN THE DEVELOPMENT OF THE EYE

Embryonic and fetal period

Stage of growth	*Development*
2.6 mm (3 weeks)	Optic pits appear on either side of cephalic end of forebrain
3.5 mm (4 weeks)	Primary optic vesicle invaginates
5.5–6 mm	Development of embryonic fissure
10 mm (6 weeks)	Retinal layers differentiate, lens vesicle formed
20 mm (9 weeks)	Sclera, cornea and extra-ocular muscles differentiate
25 mm (10 weeks)	Lumen of optic nerve obliterated
50 mm (3 months)	Optic tracts completed, pars ciliaris retina grows forwards, pars iridica retina grows forward and lid folds develop
60 mm (4 months)	Hyaloid vessels atrophy, iris sphincter, dilator and ciliary muscles develop
230–265 mm (8th month)	Foetal nucleus of lens is complete, all layers of retina nearly developed and macula starts differentiation.
265–300 mm (9th month)	Except macula, retina is fully developed, infantile nucleus of lens begins to appear, pupillary membrane and hyaloid vessels disappear. Medulation of optic nerve reaches lamina cribrosa.

Eye at birth and postnatal development

- *Anterior posterior diameter* about 16.5 mm (70% of adult size) which is attained by 7–8 years of age.
- *Corneal diameter* is about 10 mm. Adult size (11.7 mm) is attained by 2 years of age.
- *Lens* is spherical and 3.5 mm thick at birth. Lens grow throughout life and become 5 mm thick at 60 years of age.
- *Macula* differentiate 4–6 months after birth.
- *Refractive status.* Newborn in hypermetropic by +2 to +3 D.
- *Fixation status* developing at 1 month and is completed by 6 months.

Embryonic Remnants in the Eye

- *Mittendorf's dot:* It is the remnant of the anterior end of the hyaloid artery and remains attached to the posterior pole of the lens.
- *Bergmeister papilla:* It is the remnant of the posterior end of the hyaloid artery. It remains attached to the optic disc associated with some glial tissue.
- *Persistent hyperplastic primary vitreous (PHPV):* Failure of the foetal vasculature to regress is called PHPV (explained in detail in the chapter on Retina).

Coloboma: Failure of the embryonic fissure to close gives rise to ocular coloboma.

MULTIPLE CHOICE QUESTIONS

1. **Anteroposterior diameter of normal adult eyeball is:**
   A. 25 mm
   B. 24 mm
   C. 23.5 mm
   D. 23 mm

2. **Smallest diameter of the eyeball is:**
   A. Vertical
   B. Horizontal
   C. Anteroposterior
   D. More than 24 mm

3. **Circumference of an adult eyeball is:**
   A. 80 mm
   B. 65 mm
   C. 75 mm
   D. 70 mm

4. **Volume of an adult eyeball is:**
   A. 7.5 mL
   B. 6.5 mL
   C. 5.5 mL
   D. 8 mL

5. **Weight of an adult eyeball is:**
   A. 7 g
   B. 9 g
   C. 11 g
   D. 13 g

6. **Anterior segment of the eyeball includes structures lying in front of the:**
   A. Iris
   B. Crystalline lens
   C. Vitreous body
   D. Cornea

7. **Posterior segment of the eyeball includes structures present posterior to the:**
   A. Posterior surface of the lens and zonules
   B. Iris and pupil
   C. Vitreous body
   D. Anterior surface of the lens and zonules

8. **Diameter of an adult crystalline lens is:**
   A. 5–6 mm
   B. 7–8 mm
   C. 9–10 mm
   D. 11–12 mm

9. **Thickness of the adult crystalline lens is about:**
   A. 2.5 mm
   B. 3.5 mm
   C. 4.25 mm
   D. 5 mm

10. **Radius of curvature of the anterior surface of adult crystalline lens with accommodation at r is:**
    A. 7 mm
    B. 10 mm
    C. 8 mm
    D. 9 mm

11. **Capsule of the crystalline lens is thinnest at:**
    A. Anterior pole
    B. Posterior pole
    C. Equator
    D. None of the above

12. **Infantile nucleus of the crystalline lens refers t the nucleus developed from:**
    A. 3 months of gestation to till birth
    B. Birth to one year of age
    C. Birth to puberty
    D. One year of age to 3 years of age

13. **The lens fibres meet around the Y-shaped sutures in which part of nucleus of the crystalline lens:**
    A. Embryonic nucleus
    B. Fetal nucleus
    C. Infantile nucleus
    D. All of the above

14. **The youngest lens fibres are present in:**
    A. Central core of the lens nucleus
    B. Outer layer of the nucleus
    C. Deeper layer of the cortex
    D. Superficial layer of the cortex

15. **Schwalbe's line forming part of the angle of anterior chamber is the prominent end of:**
    A. Sclera
    B. Descemet's membrane of cornea
    C. Anterior limit of trabecular meshwork
    D. Posterior limit of trabecular meshwork

16. **In a normal adult person, the depth of anterior chamber in the centre is about:**
    A. 2.5 mm
    B. 3 mm
    C. 3.5 mm
    D. 4 mm

17. **Is a sweat gland:**
    A. Gland of Moll
    B. Gland of Zeis
    C. Meibomian gland
    D. All of the above

1:B 2:A 3:C 4:B 5:A 6:C
7:A 8:C 9:D

10:B 11:B 12:C 13:A 14:D 15:B
16:A 17:A

18. The layer of the cornea once destroyed does not regenerate is:
A. Epithelium
B. Bowman's membrane
C. Descemet's membrane
D. All of the above

19. All of the following are true about corneal endothelium *except*:
A. Cell density is about 3000 cells/mm² at birth
B. Corneal decompensation occurs when cell count is decreased by 50%
C. Endothelial cells contain active pump mechanism
D. Endothelium is best examined by specular microscopy

20. Adult size of the cornea is attained by the age of:
A. 2 years
B. 3 years
C. 5 years
D. 9 years

21. Sclera is weakest at the level of:
A. Macula
B. Equator
C. Insertion of extraocular muscles
D. Ora serrata

22. The definitive colour of the iris depends upon the:
A. Anterior limiting layer
B. Stroma
C. Anterior pigmented epithelium
D. Posterior pigmented epithelium

23. Circulus iridis major is formed by the anastomosis of:
A. Long posterior ciliary arteries with short posterior ciliary arteries
B. Anterior ciliary arteries with short posterior ciliary arteries
C. Long posterior ciliary arteries with anterior ciliary arteries
D. Long posterior arteries with anterior conjunctival arteries

24. Layer of non-pigmented epithelium of the ciliary body is the forward continuation of the:
A. Pigment epithelium of the retina
B. Sensory retina
C. Internal limiting membrane of the retina
D. Bruch's membrane of the choroid

25. The number of ciliary processes is about:
A. 20-30
B. 50-60
C. 70-80
D. 90-100

26. All of the following are true about circulus arteriosus minor *except*:
A. It receives contribution from anterior ciliary arteries and long posterior ciliary arteries
B. It is an arterial and venous plexus
C. It lies near the pupillary margin
D. It is the seat of formation of aqueous humour

27. The strongest attachment of the vitreous body to the surrounding structures is at the level of:
A. Vitreous base
B. Optic disc
C. Posterior surface of the lens
D. Foveal region

28. Diameter of the optic disc is:
A. 1.5 mm
B. 2.5 mm
C. 3.5 mm
D. 5 mm

29. Diameter of the macula lutea is:
A. 1.5 mm
B. 3.5 mm
C. 4.5 mm
D. 5.5 mm

30. Diameter of fovea centralis is:
A. 0.5 mm
B. 1.0 mm
C 1.5 mm
D. 2.5 mm

31. Henle's layer refers to the thickened outer plexiform layer in the region of:
A. Foveola
B. Foveal region
C. Parafoveal region
D. Paramacular region

32. Major retinal vessels are present in:
A. Between the vitreous and internal limiting membrane
B. The nerve fibre layer
C. The inner plexiform layer
D. The inner nuclear layer

33. Optic nerve consists of axons of:
A. Ganglion cells
B. Bipolar cells
C. Rods and cones
D. All of the above

34. Optic nerve fibres once cut, do not regenerate because they are not covered by:
A. Myelin sheath
B. Neurilemma
C. Both of the above
D. None of the above

18 : B 19 : B 20 : A 21 : C 22 : A 23 : C
24 : B 25 : C
26 : D 27 : A 28 : A 29 : D 30 : C 31 : B
32 : B 33 : A 34 : B

35. Neurons of first order for visual sensations are:
A. Rods and cones
B. Bipolar cells
C. Ganglion cells
D. None of the above

36. Neurones of third order for visual sensations lie in:
A. Layer of bipolar cells
B. Layer of ganglion cells
C. Lateral geniculate body
D. Visual cortex

37. The longest extraocular muscle is:
A. Superior oblique
B. Inferior oblique
C. Superior rectus
D. Inferior rectus

38. The shortest extraocular muscle is:
A. Superior oblique
B. Inferior oblique
C. Superior rectus
D. Inferior rectus

39. The posterior end of which muscle insertion lies near the macula ?
A. Inferior oblique
B. Superior oblique
C. Superior rectus
D. Inferior rectus

40. The nerve which has the longest intracranial course is:
A. Fourth cranial nerve
B. Third cranial nerve
C. Sixth cranial nerve
D. Fifth cranial nerve

41. Glands of Zeis are:
A. Modified sebaceous glands
B. Modified sweat glands
C. Modified lacrimal glands
D. Modified meibomian glands

42. Ducts of the main lacrimal gland open in:
A. Superior fornix
B. Inferior fornix
C. Both of the above
D. None of the above

43. Accessory lacrimal glands of Krause are present in the:
A. Upper fornix
B. Lower fornix
C. Both of the above
D. None of the above

44. Length of the nasolacrimal duct is about:
A. 8–12 mm
B. 22–34 mm
C. 12–18 mm
D. 18–21 mm

45. Nasolacrimal duct opens into:
A. Superior meatus
B. Middle meatus
C. Inferior meatus
D. Maxillary sinus

46. Nasolacrimal duct is directed:
A. Downwards, slightly outwards and backward
B. Downwards, slightly inwards and backwards
C. Downwards, slightly outwards and forwards
D. Downwards, slightly inwards and forwards

47. In the nasolacrimal duct, valve of Hasner is prese at its:
A. Upper end
B. Lower end
C. Middle
D. None of the above

48. Thinnest wall of the orbit is:
A. Medial wall
B. Floor
C. Roof
D. Lateral wall

49. Thickest wall of the orbit is:
A. Medial wall
B. Lateral wall
C. Roof
D. Floor

50. The volume of the orbit is about:
A. 30 cc
C. 50 cc
B. 40 cc
D. 60 cc

51. All of the following ocular structures are derive from the surface ectoderm *except*:
A. Crystalline lens
B. Substantia propria of the cornea
C. Conjunctival and corneal epithelium
D. Lacrimal glands

52. Crystalline lens is derived embryologically from the:
A. Surface ectoderm
B. Neuroectoderm
C. Surface ectoderm and mesoderm
D. Neuroectoderm and mesoderm

53. Definitive or secondary vitreous is embryologicall derived mostly from:
A. Neuroectoderm
B. Mesoderm
C. Surface ectoderm
D. Surface ectoderm and mesoderm

35 : B 36 : C 37 : A 38 : B 39 : A 40 : A
41 : A 42 : C 43 : C 44 : C

45 : C 46 : A 47 : B 48 : A 49 : B 50 : A
51 : B 52 : A 53 : A

54. Sphincter and dilator pupillae muscles are derived embryologically from the:
A. Surface ectoderm
B. Mesoderm
C. Neuroectoderm
D. All of the above

55. All of the following ocular structures are derived embryologically from the neuroectoderm *except*:
A. Epithelial layers of ciliary body and iris
B. Sphincter and dilator pupillae muscles
C. Optic nerve
D. Optic nerve sheaths

56. Normal A: V ratio of retinal blood vessels is:
A. 1:2
B. 2:3
C. 3:2
D. 3:4

57. 'Safe zone' of the eye ball is:
A. At the limbus
B. 3-4 mm behind the limbus
C. 8-9 mm behind the limbus
D. 12 mm behind the limbus
E. 1 mm behind the limbus

58. Yoke muscle for right superior rectus is:
A. Left superior rectus
B. Left inferior oblique
C. Left inferior rectus
D. Left superior oblique

59. The short posterior ciliary arteries are about in number:
A. 10
B. 20
C. 30
D. 40
E. 45

60. The canal of Schlemm possesses the following anatomic characteristics *except*:
A. Contains red cells
B. Contains aqueous
C. Lined by endothelium
D. Contains partitions resembling the dural venous sinuses

51. Muscle in the lid attached to posterior tarsal margin is:
A. Levator palpebrae superioris
B. Superior oblique
C. Muller's muscle
D. Superior rectus

62. Which of the following extraocular muscle has sympathetic innervation:
A. Levator palpebrae superioris
B. Muller's muscle
C. Superior rectus
D. Inferior rectus

63. Most sensitive part of eye is:
A. Fovea centralis
B. Macula lutea
C. Blind spot
D. Temporal retina

64. Volume of the vitreous is:
A. 2 mL
B. 3 mL
C. 4 mL
D. 7 mL

65. Avascular coat in eye is:
A. Sclera
B. Cornea
C. Retina
D. Choroid

66. Which continues to grow in the lifetime:
A. Cornea
B. Iris
C. Lens
D. Retina

67. Which part of orbicularis oculi is known as Horner's muscle:
A. Orbital
B. Lacrimal
C. Temporal
D. Muller's muscle

68. All visual reflexes are developed by:
A. 1 year
B. 2 years
C. 5 years
D. 10 years

69. Corneal endothelial cell count is done by:
A. Specular microscopy
B. Keratometry
C. Gonioscopy
D. Slit lamp

70. Anterior chamber depth:
A. Increases with age
B. Is lesser in women
C. Is lesser in myopes
D. Has hardly any effect on anterior chamber volume

:C 55:D 56:B 57:C 58:B 59:B 62:B 63:A 64:C 65:B 66:C 67:B
:A 61:C 68:A 69:A 70:B

CHAPTER

2

Physiology of Eye and Vision

QUICK TEXT REVIEW

MAINTENANCE OF CLEAR OCULAR MEDIA

Physiology the structures forming the refractive media of the eye is described briefly.

PHYSIOLOGY OF TEAR FILM

(*See* page 138)

PHYSIOLOGY OF CORNEA

Corneal transparency is the result of:

- *Peculiar arrangement* of corneal lamellae (lattice theory)
- *Avascularity of cornea*
- *Relative dehydration* maintained by epithelial and endothelial barriers and active bicarbonate pump of the endothelium
- *Swelling pressure* of the stroma
- *Corneal crystallines* (water soluble proteins of keratocyte).

Corneal metabolism. Epithelium is metabolically more active than endothelium:

- Glucose and other solutes are derived from aqueous humour and perilimbal capillaries
- Oxygen is derived from the air through tear film
- Respiratory quotient of cornea is 1.

PHYSIOLOGY OF CRYSTALLINE LENS

Lens transparency is the result of:

- Avascularity
- Tightly-packed lens fibres
- Arrangement of lens proteins
- Semipermeable lens capsule
- Active pump mechanism in lens fibres
- Auto-oxidation and high concentration of reduced glutathione
- Aquaporin-O also help in maintaining transparency.

Lens metabolism

- *Metabolic activity* of the lens is largely limited to epithelium and cortex, nucleus is relatively inert
- *About 80% glucose is metabolised* anaerobically by the glycolytic pathway, 15% by HMP shunt, and a small proportion via Kreb's cycle
- *Sorbital pathway* plays role in diabetic cataract
- *Respiratory quotient* of lens is 1
- *Preventive antioxidant mechanism* of lens are enzymatic (glutathione, glutathione peroxidase, superoxide dismutase and catalase) and non-enzymatic (vitamin C, vitamin E and carotenoids).

PHYSIOLOGY OF AQUEOUS HUMOUR AND MAINTENANCE OF INTRAOCULAR PRESSURE

(*See* page 78)

PHYSIOLOGY OF VISION

Initiation, processing and transmission of visual impulse

Initiation of visual impulse

Sensory nerve endings for visual sensation are rods and cones. Each eye contains about 120 million rods and 6 million cones and only 1.5 million ganglion cells.

Phototransduction

Visual pigments (in rods rhodopsin with spectrum of 500 nm and in cones erythrolabe with spectrum 565 nm, chlorolabe with spectrum 535 nm, and cyanolabe with spectrum 440 nm), absorb light and trigger receptor potential which unlike other receptor systems leads to hyperpolarization of the cells and not the depolarization. This phenomenon of conversion of light energy into nerve impulse is called phototransduction.

Processing and transmission of visual impulse

Receptor potential generated in the photo-receptors is transmitted by electronic conduction to other retinal cells up to ganglion cell. Ganglion cells, however, transmit by action potential to the LGB cells.

Parvocellular system of visual pathway consisting of P ganglion cells and other P cells transmit information about colour and fine details of vision.

Magnocellular system consisting of M ganglion cells and other M cells is concerned with contrast and motion.

Visual perceptions

1. *The light sense:* It is the awareness of the light. The minimum brightness required to evoke a sensation of light is called the *light minimum*. The rods are more sensitive to low illumination than the cones. Dark adaptation is the ability of the eye to adapt itself to decreasing illumination. Dark adaptation is delayed in:

- Vitamin A deficiency
- Glaucoma
- Pigmentary retinal dystrophy.

2. *The form sense:* It is the ability to discriminate between the shapes of the objects. Cones play major role in this faculty, therefore form sense is most acute at the fovea where cones are most densely packed and highly differentiated. Visual acuity recorded by Snellen's test chart is the measure of form sense.

3. *Sense of contrast:* It is the ability of the eye to perceive slight changes in the luminance between regions which are not separated by definite borders. Contrast sensitivity is decreased in:

- Glaucoma
- Refractive errors
- Diabetes
- Optic nerve diseases
- Cataractous changes.

Measurement of contrast sensitivity: In clinical practice, the contrast sensitivity can be measured by using any of the following charts with letters or stripes represented in various shades of gray:

- Arden gratings
- Cambridge low-contrast gratings
- Pelli-Robson contrast sensitivity chart which consists of low contrast letters with same size
- The Visitach chart, and
- Functional acuity contrast test (FACT).

4. *Colour sense vision:* It is the ability of the eye to discriminate between different colours. It is a function of the cones. There are three primary colours—red, green and blue. All other colours are produced by mixture of these primary colours (Young Helmholtz's trichromatic theory).

Note: Colour vision involves opponent colour cells and difference between rods and cones is all (intensity, number and colour) except signal transduction.

MULTIPLE CHOICE QUESTIONS

1. Does not form the refractive media of eye:
A. Tear film
B. Corner
C. Crystalline lens
D. Fovea Centralis

2. Phototransduction refers to:
A. Initiation of vision
B. Processing of vision
C. Transmission of visual sensation
D. Visual perception

3. Is not true about rhodopsin:
A. Present in the rods
B. Consists of opsin and 11-cis retinal
C. Maximum absorption spectrum is around 250 nm
D. Is bleached by light

4. Visual cycle refers to:
A. Alternate distance and near fixation
B. Day vision and colour vision
C. Photodecomposition and regeneration of visual pigments
D. Cycle of night vision and colour vision

5. Process of visual adaptation refers to:
A. Dark adaptation
B. Light adaptation
C. Dark and light adaptation
D. Dark, light and colour adaptation

6. The faculty of vision does not includes:
A. Form sense
B. Light sense
C. Contrast sense
D. Colour sense
E. Visual evoked potential

7. Relative state of dehydration of cornea is maintained by:
A. Peculiar arrangement of corneal lamellae
B. Avascularity of cornea
C. Active $Na^+ K^+$ ATPase pump of the corneal endothelium
D. All of the above.

8. Most toxic agent to cause oxidative damage to crystalline lens is:
A. Superoxide anion
B. Hydrogen peroxide
C. Lipid peroxide
D. Lipid hydroperoxides

9. Pathway of glucose metabolism which plays important role in galactosemic cataract is:
A. Glycolytic pathway
B. Pentose, Hexose, Monophosphate shunt
C. Kreb's citric acid cycle
D. Sorbitol pathway

10. Composition of aqueous humour is similar to plasma *except* that it has:
A. High concentration of bicarbonate
B. Low concentration of bicarbonate
C. Low concentration of pyruvate
D. High concentration of glucose

11. Active secretion of substances during aqueous formation is dependent on:
A. Calcium and voltage-gated ion channels
B. Level of blood pressure in the ciliary capillaries
C. Plasma osmotic pressure
D. Level of intraocular pressure

12. Most accepted theory for aqueous transport across the inner wall of Schlemm's canal is:
A. Vacuolation theory
B. Aqueous outflow pump mechanism
C. Leaky pores in endothelial cells forming the inner wall of Schlemm's canal
D. Sondermann's channels

13. True for diurnal variation of intraocular pressure (IOP) is:
A. IOP is usually higher in the morning hours
B. IOP is usually low in the morning hours
C. IOP variation is related to plasma acetylcholine level
D. In normal eye IOP fluctuation is <10 mm of Hg.

14. True about tears *except*:
A. Lacus lacrimalis refers to tear collection at medial canthus
B. 50% of tears is drained by inferior canaliculus
C. Tear drainage is on active process
D. Fibres of orbicularis muscle constitute lacrimal pump mechanism

1:D 2:A 3:C 4:C 5:C 6:E 7:C 8:A 9:D 10:A 11:A 12:B 13:A 14:B

SECTION—II

Optics and Refraction

CHAPTER

3

Elementary and Physiological Optics

QUICK TEXT REVIEW

ELEMENTARY AND PHYSIOLOGICAL OPTICS

LIGHT AND GEOMETRICAL OPTICS

- *Light* is the visible portion (400–700 nm) of the electromagnetic spectrum
- *Cornea absorbs* rays shorter than 295 nm. Lens absorbs rays shorter than 350 nm
- *Critical angle* refers to the angle of incidence in the denser medium, corresponding to which angle of refraction in the rarer medium is 90°
- *Image formed* by a prism is virtual, erect and displaced toward its apex
- *Sturm's conoid* refers to the configuration of rays refracted through a toric surface.

OPTICS OF THE EYE

- *Total dioptric* power is about +58 to +60 D
- *Principal point* lies 1.5 mm behind the anterior surface of cornea
- *Nodal point* is situated 7.2 mm behind the anterior surface of cornea
- *Anterior focal point* is 15.7 mm in front of the anterior surface of cornea
- *Posterior focal point* (on the retina) is 24.4 mm behind the anterior surface of cornea
- *Anterior focal length* is 17.2 mm (15.7 + 1.5)
- *Posterior focal length* is 22.9 mm (24.4 – 1.5).

Axis of the eye

1. *Optic axis*. It is the line that passes through centre of the cornea, centre of the lens and meets the retina on the nasal side of the fovea.

   In practice, it is not possible to measure optic axis. Therefore, it is substituted by pupillary line, which is perpendicular to the cornea at center of pupil.
2. *Visual axis*. It is the line joining the fixation point, nodal point and the fovea.
3. *Fixation axis*. It is the line joining the fixation point and the centre of rotation.

Angles of the eye

1. *Angle alpha*. It is formed between the optic axis and visual axis at the nodal point.
2. *Angle gamma*. It is formed between the optical axis and fixation axis at the centre of rotation of the eyeball.
3. *Angle kappa*. It is formed between the visual axis and central pupillary line. A positive angle kappa results in pseudoexotropia and a negative angle kappa in pseudoesotropia.
4. *Visual angle* is the angle subtended by an object at the nodal point.

Refractive power of the eye

• Total	:	+58 to +60 D
• Cornea	:	+44 D to 45 D
• Lens	:	+15 to+16 D

Refractive indices of the media of the eye

• Cornea	:	1.376
• Aqueous humour	:	1.336
• Crystalline lens	:	1.39
• Vitreous humour	:	1.336

Refractive indices of the other media

• Air	:	1
• Water	:	1.33
• Tear fluid	:	1.338
• HEMA	:	1.43
• PMMA	:	1.496
• Spectacle, crown glass	:	1.52
• Flint glass	:	1.61
• Diamond	:	2.52

SOME SALIENT POINTS

- *Commonest problem associated with aphakic glasses* is pin-cushion distortion.
- The retinal image of the aphakic eye is about a quarter larger than the emmetropic retinal image.
- Visual angle is the angle subtended by the object at the nodal point.
- Basic principle of stenopaeic slit is pin-h[illegible] phenomenon.
- The pigment epithelium on the back of the iris a[illegible] the retinal pigmentary epithelium at the back the eye absorb radiation of all wavelengths.
- The eye is normally myopic for blue and green ra[illegible] and hypermetropic for red rays.
- *Image jump* occurs with the use of bifocal lense[illegible]

MULTIPLE CHOICE QUESTIONS

1. **Crystalline lens absorbs light rays shorter than:**
   A. 295 nm
   B. 350 nm
   C. 390 nm
   D. 490 nm

2. **The prism produces displacement of the objects seen through it towards the:**
   A. Apex
   B. Base
   C. Sideways
   D. None of the above

3. **The critical angle refers to the angle of incidence in the denser medium, corresponding to which angle of refraction in the rarer medium is:**
   A. Less than 90°
   B. 90°
   C. More than 90°
   D. Equal to angle of incidence

4. **The refractive power of an emmetropic eye is about:**
   A. +50D
   B. +55D
   C. +60D
   D. +65D

5. **In the media of the eye, highest refractive index is of the:**
   A. Cornea
   B. Aqueous humour
   C. Lens
   D. Vitreous humour

6. **The anterior focal length of the schematic eye is:**
   A. 15.7 mm
   B. 17.2 mm
   C. 13 mm
   D. None of the above

7. **The posterior focal point of the reduced eye situated on the retina is how many millimetre behind the anterior surface of cornea:**
   A. 22.9 mm
   B. 24.4 mm
   C. 23 mm
   D. 21 mm

8. **The optical axis of the eye meets the retina at a point which:**
   A. Coincides with the fovea centralis
   B. Is nasal to the fovea centralis
   C. Is temporal to the fovea centralis
   D. Is nasal to optic disc

9. **Visual axis of the eye meets the retina at a point which:**
   A. Coincides with the fovea centralis
   B. Is nasal to fovea centralis
   C. Is nasal to optic disc
   D. Is temporal to fovea centralis

10. **Sturm's conoid refers to configuration of the rays refracted through:**
    A. Concave spherical surface
    B. Convex spherical surface
    C. Toric surface
    D. Irregular surface

11. **Unit of light emitted from a surface is:**
    A. Lambert
    B. Candella
    C. Lux
    D. Lumen

12. **The power of reduced eye is:**
    A. 17 D
    B. 45 D
    C. 59 D
    D. 66 D

13. **Image formed by a prism is:**
    A. Virtual, erect and displaced towards its apex
    B. Real, erect and displaced towards its base
    C. Real, inverted and displaced towards its apex
    D. Virtual, inverted and displaced towards its base

14. **Most important factor determining convergence of light rays on the retina is:** ***(DNB 2014)***
    A. Length of the eyeball
    B. Refractive power of the lens
    C. Curvature of the cornea
    D. Physical state of the vitreous

15. **Visual axis is:**
    A. Center of cornea to retina
    B. Object to fovea
    C. Center of lens to cornea
    D. None

1:B 2:A 3:B 4:C 5:C 6:B 7:B 8:B 9:A 10:C 11:D 12:C 13:A 14:B 15:B

CHAPTER

4

Errors of Refraction and Accommodatio

QUICK TEXT REVIEW

ERRORS OF REFRACTION

EMMETROPIA

- An emmetropic (optically normal) eye is slightly hypermetropic for red rays and myopic for green rays
- At birth, eye is hypermetropic by +2 to +3 D and usually becomes emmetropic by the age of 5 to 7 years.

HYPERMETROPIA

Hypermetropia (long sightedness) is of following types:

- *Axial hypermetropia* due to decreased axial length of the eye ball is the most common cause. One mm decrease in axial length causes three dioptres of hypermetropia.
- *Curvatural hypermetropia* occurs due to flattening of the cornea. One mm increase in the radius of curvature of cornea causes six dioptres of hypermetropia.
- *Index hypermetropia* occurs due to increase in the refractive index of the cortex of the crystalline lens as seen in early cortical cataract and in diabetics
- *Positional hypermetropia* results due to backward displacement of the lens.

Components of hypermetropia

- *Latent hypermetropia.* It is corrected by the ciliary tone. It is detected when refraction is carried out after abolishing the ciliary tone with atropine.
- *Manifest hypermetropia.* It consists of two components.
  - Facultative hypermetropia. It can be overcome by an effort of accommodation.
  - Absolute hypermetropia. It cannot be overcome by an effort of accommodation.
- Fundus changes in hypermetropes, in hype metropia pseudopapilloedema may be seen.

Optical changes in aphakia

- Eye becomes highly hypermetropic
- Total power of eye is reduced from +60 D to +44 I
- Anterior focal point becomes 23.2 mm in front c the cornea
- Posterior focal point is 31 mm behind the corne
- Loss of accommodation.

Disadvantages of aphakic glasses

- Produce image magnification by 25 to 30%
- Pincushion distortion due to spherical aberratio is the most frequently noticed problem
- Limited field of vision
- Roving ring scotoma (Jack in the box phenomenon
- Chromatic aberration.

Intraocular lens in aphakia

- Exact power is calculated by biometry usin keratometer and A-scan ultrasound
- Standard power of +20 D of posterior chamber IOI is equivalent to +10 DS spectacles
- All disadvantages of aphakic glasses are eliminate by intraocular lens use
- Average weight of an IOL in air is 15 mg and i aqueous humour is 5 mg
- Power of an IOL in air is more (+60 D) than that i the aqueous humour (+20 D)
- Equivalent power of an anterior chamber IOL i about +3 D less than that of the posterior chambe IOL
- Further details of IOL (*See* page 71).

Surgical treatment of hypermetropia:

- Hyperopic LASIK is effective in correctin hypermetropia up to +4 D

- Other corneal procedures includes hyperopic PRK, Holmium laser thermoplasty and conductive keratoplasty (CK)
- Lens-based procedures include phakic refractive lenses (PRL) or implantable collamer lenses (ICL) for hyperopia of between >4 D to 10 D and refractive lens exchange (RLE) for high hypermetropia especially in the presbyopic age.

MYOPIA

- *Axial myopia.* One mm increase in axial length produces myopia of 3 D.
- *Curvatural myopia.* One mm decrease in radius of curvature of cornea produces myopia of 6 D.
- *Congenital myopia.* Present since birth, usually unilateral, usually the error is of about 8–10 D which mostly remains constant.
- *Simple or developmental myopia.* It is the commonest type of myopia. It does not progress after adolescence and the error usually does not exceed -6 to -8 D.
- *Pathological (degenerative) myopia.* It results from a rapid axial growth of eyeball (posterior to equator) which is strongly linked with heredity since it is familial and more common in certain races (Chinese, Jews, Japanese). Fundus examination may reveal/patches of chorioretinal degeneration, and *Foster-Fuch's spot* (dark circular area due to intrachoroidal haemorrhage at the macula).

Complications of pathological myopia

Complicated cataract
Choroidal haemorrhage
Tears and haemorrhages in the retina
Vitreous haemorrhage
Retinal detachment

Diseases associated with myopia are microphthalmos, congenital glaucoma, microcornea, retrolental fibroplasia, Marfan's syndrome, Turner's syndrome, and Ehlers-Danlos syndrome.

Surgical treatment of myopia

Cornea-based surgeries

Radial keratotomy, abandoned, so not done presently. In it, multiple radial incisions are given in the periphery of cornea (leaving central 4 mm optical zone) in order to flatten the curvature of cornea.

Photorefractive keratectomy (PRK). In it, reshaping of the cornea is done with excimer laser. (preferred in patients with thin corneas).

Laser assisted in situ keratomileusis (LASIK) is presently the preferred surgical technique for correcting myopia of up to -8 D. In it, the midstromal tissue is ablated with excimer laser after raising a 130–160 micron thick flap of anterior corneal tissue.

The eligibility criteria for LASIK are:

- Age > 18 years
- Stability of refraction for at least 6 months
- Minimum corneal thickness of 500 microns
- Residual stromal depth of 250 microns
- Absence of any other corneal pathology like keratoconus
- Absence of other ocular pathologies like glaucoma, retinal degenerations, etc.

Customized (C) LASIK based on the wavefront technology is useful in correcting the aberrations. Epi (E) LASIK is done without stromal flap.

Femto-LASIK, also known as 'All Laser LASIK' or 'No blade LASIK' involves making of corneal flap with the help of femtosecond laser.

Orthokeratology a non-surgical reversible method of molding the cornea with overnight wear unique rigid gas permeable contact lenses, is also being considered for correction of myopia up to -5 D. It can be used even in the patients below 18 years of age.

Refractive Lenticule Extraction (ReLEx) is a technique for myopia correction in which a lenticule of corneal stroma is extracted with the help of femtosecond laser. The technique is now named SMILE (small incision lenticule extraction).

Lens based surgeries

Phakic intraocular lenses (PRL) also knows as implantable collamer lenses (ICL) is being performed in myopia of > -8 D.

The main eligibility criteria would be:

- Age > 18 years with stable refraction for at least 6 months
- Not eligible for cornea-based surgery
- Open angles on gonioscopy
- Minimum anterior chamber depth of 2.8 mm
- No evidence of cataract.

Refractive lens exchange (RLE), i.e. removal of clear crystalline lens by extracapsular cataract extraction (preferably by phacoemulsification) with IOL implantation of appropriate power is being recommended for surgical treatment of myopia of >12 D.

ASTIGMATISM

Depending upon the axis and the angle between the two principal meridia

- *With-the-rule astigmatism,* wherein the vertical meridian is more curved than the horizontal and the two principal meridia are at right angle to each other. Thus, correction of with-the-rule

astigmatism will require a concave cylinder at 180 ± 20° or a convex cylinder at 90 ± 20°.

- *Against-the-rule astigmatism.* It is just reverse of with-the-rule astigmatism, i.e. here in the horizontal meridian is more curved than the vertical.
- *Oblique astigmatism.* Here in the two principal meridia are at right angle to each other, but these are not the horizontal and vertical, e.g. these may be 45° and 135°.
- *Bi-oblique astigmatism.* In this condition, the two principal meridia are not at right angle to each other, e.g. these may be 30° and 100°.

Depending upon the type of refractive error

- *Simple astigmatism.* Here in the rays of light are focused on the retina in one meridian and either in front (simple myopic astigmatism) or behind (simple hypermetropic astigmatism) the retina in the other meridian.
- *Compound astigmatism.* In this type, light rays are focused in both the principal meridia either in front (compound myopic astigmatism) or behind (compound hypermetropic astigmatism) the retina.
- *Mixed astigmatism.* Here, the light rays are focused in front of the retina in one meridian and behind the retina in the other meridian. Thus, eye is myopic in one meridian and hypermetropic in the other. Such patients have comparatively less visual symptoms as circle of least diffusion is formed on the retina.

Irregular astigmatism

- It is seen in patients with irregular corneal scars and keratoconus. In it, there are multiple meridia which admit no geometrical analysis.
- It can be best treated by rigid gas permeable contact lens which replaces the anterior surface of cornea for refraction.
- Penetrating keratoplasty is indicated in extensive corneal scarring.

ANISOMETROPIA

In this refractive condition, degree of error is unequal in two eyes.

- *Simple anisometropia.* One eye is emmetropic and the other either myopic or hypermetropic.
- *Compound anisometropia.* Both eyes are either hypermetropic (compound hypermetropic anisometropia) or myopic (compound myopic anisometropia) but error in one eye is higher than the other.
- *Mixed anisometropia.* One eye is myopic and other hypermetropic.
- *Simple astigmatic anisometropia.* One e emmetropic and the other has either sim myopic or simple hypermetropic astigmatism.

ANISEIKONIA

In this condition, the images projected on to visual cortex from the two retinae are abnorma unequal in size and/or shape.

- *Optical aniseikonia* occurs in high anisometrop
- *Retinal aniseikonia* may develop due to stretch or oedema of the retina in macular area.
- *Cortical aniseikonia* refers to asymmetri simultaneous perception in spite of equal size the images formed on the two retinae.

ACCOMMODATION AND ITS ANOMALIES

ACCOMMODATION

- *Near point or punctum proximum.* It is th nearest point at which small objects can be se clearly. It varies with age, being about 7 cm the age of 10 years, 25 cm at 40 years and 33 c at 45 years.
- *Far point (punctum remotum).* It is the farthe point from where objects can be seen clearl In an emmetropic eye, far point is infinity, in hypermetropic eye it is virtual and lies behind th eye, and in myopia it is real and lies in front of the ey
- *Range of accommodation.* It is the distan between the near point and the far point of an ey
- *Amplitude of accommodation.* It is the differen between the dioptric power needed to focus at ne point and far point. It varies with age, being abo 14 D at 10 years, 4 D at 40 years and 2 D at 50 yea of age.

PRESBYOPIA

It is not an error of accommodation but a condition age-related physiological insufficiency of accomm dation, leading to failing vision for near (usual after the age of 40 years).

Factors responsible for presbyopia

- Decrease in the elasticity and plasticity (hardenin of lens with age.
- Age-related decrease in the tone of ciliary muscl
- Decrease in the tone of the ciliary zonules
- Rigidity of the zonules with age.

Causes of premature presbyopia

- Hypermetropia
- Primary open-angle glaucoma

- General debility, causing presenile weakness of ciliary muscle
- Premature sclerosis of the crystalline Jens
- Excessive close work.

Surgical treatment of presbyopia
The techniques still under trial are:
- Monovision LASIK
- Presbyopic bifocal LASIK (LASIK-PRAM)
- Anterior ciliary sclerotomy (ACL) with tissue barrier
- Bifocal or multifocal or accommodating IOLs
- Conductive keratoplasty (CK).

DETERMINATION AND CORRECTION OF REFRACTIVE ERRORS

Retinoscopy (Skiascopy or shadow test)

When a plane mirror retinoscope is used at a distance of 1 m, depending upon the movement of the red reflex (shadow) the results are interpreted as below:

- No movement : Myopia of 1 D
- With movement : Either emmetropia or hypermetropia or myopia less than 1 D
- Against movement : Myopia more than 1 D

Auto-refractometry

- Auto-refractometry is an objective method of finding out the error of refraction by using computerized autorefractometers
- These are based on the principle of indirect ophthalmoscopy
- Autorefractometer quickly gives information about the refractive error in terms of sphere, cylinder with axis and inter-pupillary distance
- It is a good alternative to retinoscopy for busy practice, mass screening and epidemiological studies
- Subjective refraction is must even after auto-refractometry.

Tests for confirmation of subjective refraction

- *Duochrome test.* It is based on the principle of chromatic aberration. When red letters are more clear than the green it indicates that patient is slightly myopic.
- *Jackson's cross-cylinder test.* It is used to verify the strength and axis of the cylinder prescribed. The cross cylinder is a combination of two cylinders of equal strength but with opposite sign, placed with their axis at right angles to each other. It is formed by a spherical lens (e.g. +0.5 DS) with a cylinder of the opposite sign and double power (e.g. -ID C).
- *Astigmatic fan test.* It is used to confirm the cylindrical correction. In the presence of astigmatism, some lines will be seen more sharply defined.
- *Pin-hole test.* An improvement in the visual acuity while looking through a pin hole indicates that optical correction in the trial frame is incorrect.

Spectacles

- *Crown glass* of refractive index 1.5223 is most commonly used for making spectacles.
- *Resin lenses* are made of 'allyl diglycol carbonate'. These are light weight, unbreakable and scratch resistant.
- *Meniscus lenses* are used to make spectacles of small to moderate power. Periscopic lenses have a concave posterior surface of –1.2 D. Deep meniscus type lenses have a concave posterior surface of –6 D. Spherical correction added to the anterior surface of the meniscus lenses.
- *Lenticular form lenses* are used for high plus and high minus lenses.
- *Aspheric lenses* are also used to make high power (e.g. aphakic) lenses.

Contact lenses

- *Hard contact lenses* are made up of PMMA (Polymethyl methacrylate) which is a light weight and non-toxic but hydrophobic material, durable, cheap and of high optical quality. *Disadvantages*: can cause corneal hypoxia and corneal abrasions (not used).
- *Soft contact lenses* are made up of presently HEMA (hydroxy ethyl methacrylate) which is hydrophilic. *Advantages*: Being soft and oxygen permeable, they are most comfortable and so well tolerated. *Disadvantages*: These include problems of proteinaceous deposits, getting cracked, limited life, inferior optical quality, more chances of corneal infections and cannot correct astigmatism of more than 1 D.
- *Rigid gas permeable (RGP) contact lenses* are classically made up of copolymer of PMMA and silicone containing vinyl monomer and fluoropolymers (which is permeable to O_2). Advantages are O_2 permeability and their ability to correct astigmatism.
  Disadvantages include difficult fitting technique and tolerance problems in early stages.

SOME SALIENT POINTS

- Astigmatism is the most common refractive error.
- Refractive errors are the most common cause of defective visual acuity.
- *Commonest type of astigmatism* encountered in general population is against-the-rule astigmatism.
- *Curvatural* myopia and hypermetropia occur commonly as a factor of astigmatism.
- Pathological curvatural myopia is seen typically in conical cornea.
- All accommodation is lost in aphakia.
- S, G, H, and B are the easiest letters to recogn on the Snellen chart, whereas L, T, U, V and C the five most difficult ones.
- Distant vision is often found to be surprisin good with mixed astigmatism due to circle of le diffusions.
- *Asthenopia* is worse in lower degree of ast matism than the higher degrees of astigmati due to circle of least diffusion.

MULTIPLE CHOICE QUESTIONS

1. **At birth eye is usually:**
   A. Hypermetropic
   B. Myopic
   C. Emmetropic
   D. Aniseikonic

2. **The most common type of refractive error is:**
   A. Hypermetropia
   B. Myopia
   C. Astigmatism
   D. None of the above

3. **One millimeter decrease in axial length of the eyeball leads to hypermetropia of:**
   A. 6 dioptres
   B. 2 dioptres
   C. 3 dioptres
   D. 4 dioptres

4. **One millimeter increase in the radius of curvature of cornea leads to hypermetropia of:**
   A. 3 dioptres
   B. 4 dioptres
   C. 5 dioptres
   D. 6 dioptres

5. **In an aphakic eye the anterior focal point from the anterior surface of cornea is about:**
   A. 15 mm
   B. 21 mm
   C. 23 mm
   D. 31 mm

6. **In an aphakic eye posterior focal point from the back of cornea is about:**
   A. 23 mm
   B. 25 mm
   C. 31 mm
   D. 21 mm

7. **The standard power of an intraocular lens implanted in the posterior chamber is:**
   A. 18 dioptres
   B. 20 dioptres
   C. 23 dioptres
   D. 25 dioptres

8. **An aphake wearing aphakic glasses will most commonly notice:**
   A. Pincushion distortion
   B. Spherical aberration
   C. Barrel distortion
   D. Chromatic aberration

9. **Because of circle of least diffusion, the distant vision is comparatively good in:**
   A. Simple myopic astigmatism
   B. Compound myopic astigmatism
   C. Mixed astigmatism
   D. Compound hypermetropic astigmatism

10. **A difference in the size of two retinal images which can be well tolerated is:**
    A. 2%
    B. 3%
    C. 5%
    D. 10%

11. **In Against-the-rule astigmatism:**
    A. Vertical meridian is more curved than the horizontal
    B. Horizontal meridian is more curved than the vertical
    C. Both meridia are equally curved
    D. None of the above

12. **Radial keratotomy corrects myopia by causing:**
    A. Steepening of cornea
    B. Flattening of cornea
    C. Shortening of cornea
    D. Pin-hole effect

13. **Range of accommodation is the distance between:**
    A. Far point and near point of the eye
    B. The eyes and the near point
    C. The eyes and the far point
    D. The retina and the near point

14. **Causes of premature presbyopia include all of the following *except*:**
    A. General debility
    B. Primary open-angle glaucoma
    C. Uncorrected myopia
    D. Premature sclerosis of the lens

15. **During accommodation, there occurs decrease in the radius of curvature of the:**
    A. Anterior surface of the lens
    B. Posterior surface of the lens
    C. Both surfaces of the lens
    D. None of the above

16. **Near point of the eye varies with:**
    A. The age of the patient
    B. The static refraction of the eye
    C. Both of the above
    D. None of the above

1:A 2:C 3:C 4:D 5:C 6:C 7:B 8:A 9:C 10:C 11:B 12:B 13:A 14:C 15:C 16:C

17. Far point of the eye varies with:
A. The age of the patient
B. The static refraction of the eye
C. Both of the above
D. None of the above

18. Bilateral paralysis of accommodation can occur in patients with:
A. Diabetes
B. Syphilis
C. Diphtheria
D. All of the above
E. None of the above

19. During retinoscopy with a plane mirror from a distance of 1 M, no movement of pupillary red reflex with the movement of the mirror indicates:
A. Emmetropia
B. Myopia of 1 D
C. Hypermetropia of less than 1 D
D. All of the above

20. The end point of streak retinoscopy is:
A. Neutralization of the red reflex
B. Streak disappears and the pupil appears completely light or dark
C. Just reversal of the red reflex
D. All of the above

21. The fastest acting cycloplegic drug is:
A. Atropine
B. Tropicamide
C. Cyclopentolate
D. Homatropine

22. All of the following are true about autorefractometry *except*:
A. Quick procedure
B. Gives information about spherical and cylindrical error
C. Measures interpupillary distance
D. Subjective verification of refraction is not required

23. While performing duochrome test, if the patient reports that he sees red letters more clear than green, it indicates that he is slightly:
A. Myopic
B. Hypermetropic
C. Presbyopic
D. None of the above

24. While performing subjective verification of refraction, the cross cylinder is used to check:
A. Axis of the cylinder to be prescribed
B. Power of the cylinder to be prescribed
C. Both of the above
D. None of the above

25. The principle of the stenopaeic slit test is bas on:
A. Astigmatic fan
B. The circle of least diffusion
C. Pin-hole phenomenon
D. Sturm's conoid

26. Preferably presbyopia should be:
A. Fully corrected
B. Under corrected
C. Over corrected
D. None of the above

27. Soft contact lenses are made of:
A. Polymethyl methacrylate
B. Hydroxymethyl methacrylate
C. Glass
D. Silicone
E. All of the above

28. Consistency of the gas permeable contact lense is:
A. Hard
B. Soft
C. Semisoft
D. None of the above

29. Contact lens is best used in:
A. High myopia
B. Irregular astigmatism
C. Aphakia
D. Regular astigmatism

30. Excessive accommodation causes:
A. Hypermetropia
B. Myopia
C. Pseudomyopia
D. Pseudohypermetropia

31. Haemorrhage at macular spot in high myopia is called:
A. Lacquer's lines
B. Foster-Fuchs flecks
C. Dalen-Fuchs nodules
D. Berlin's oedema

32. Over correction is preferable in:
A. Myopia
B. Presbyopia
C. Hypermetropia
D. Aphakia

33. Kappa angle is the angle between the:
A. Pupillary axis and visual axis
B. Visual axis and optical axis
C. Centre of eyeball rotation and line of fixation
D. None of the above is correct

17:B 18:D 19:B 20:B 21:B 22:D 23:A 24:C 25:C 26:B 27:B 28:A 29:B 30:C 31:B 32:C 33:A

34. Alpha angle is the angle between the:
A. Pupillary axis and optical axis
B. Visual axis and optical axis
C. Centre of eyeball rotation and line of fixation
D. None of the above is correct

35. Astigmatism is considered to be:
A. Spherical aberration
B. Curvatural ametropia
C. Axial ametropia
D. Index ametropia

36. Presbyopia is due to:
A. Loss of elasticity of lens capsule
B. Weakness of ciliary muscle
C. Weakness of suspensory ligament
D. All of the above

37. The term anisometropia indicates:
A. Refractive error
B. Long vision
C. Short vision
D. Ageing process

38. Facultative hypermetropes manage to see because of:
A. Wrinkling of eye
B. Ciliary muscle contraction
C. Accommodation
D. Use of cycloplegics

39. Constantly changing refractive error is seen in:
A. Traumatic cataract
B. Diabetic cataract
C. Morgagnian cataract
D. Intumescent cataract

40. Maximum refractive power is due to the:
A. Anterior surface of lens
B. Posterior surface of lens
C. Anterior surface of cornea
D. Posterior surface of cornea

41. The most accepted method for treatment of a myopic with refractive error of 2D is:
A. Spectacles
B. Contact lens
C. Radial keratotomy
D. Excimer laser

42. Which is the most common complication of high myopia:
A. Glaucoma
B. Cataract
C. Haemorrhage
D. Retinal detachment

43. Lattice degeneration is seen in:
A. Myopia
B. Hypermetropia
C. Aphakia
D. Presbyopia

44. Aniseikonia refers to:
A. Difference in the corneal diameter
B. Difference in the image size (retinal image)
C. Difference in the refractive power
D. Difference in image colour

45. A female patient wants LASIK surgery for her eye. She asks for your opinion. All the following things are suitable for performing LASIK surgery *except*:
A. Myopia of 4 diopters
B. Age of 15 years
C. Stable refraction for 1 year
D. Corneal thickness of 600 microns

46. Accommodation is maximum at the age of:
A. 25 years
B. 5 years
C. 14 years
D. 30 years

47. Presently surgical treatment of choice in a 22-year-old male with –10 D myopia is:
A. Phakic refractive lens
B. Refractive lens exchange
C. Wavefront guided LASIK
D. LASIK with femtosecond laser

48. Foster-Fusch's spots are seen in:
A. Hypermetropiea
B. Myopia
C. Astigmatism
D. None

49. Jack in box scotoma is seen after correction of Aphakia by:
A. IOL
B. Spectacles
C. Contact lens
D. None

50. Accommodation is due to:
A. Relaxation of ciliary muscles
B. Contraction of ciliary muscles
C. Contraction of dilator pupillae
D. None

51. Objective assessment of the refractive state of the eye is termed:
A. Retinoscopy
B. Gonioscopy
C. Ophthalmoscopy
D. Keratoscopy

34 : A 35 : A 36 : D 37 : A 38 : C 39 : D
40 : C 41 : A 42 : D
43 : A 44 : B 45 : B 46 : B 47 : A 48 : B
49 : B 50 : B 51 : A

52. Which component of the eye has maximum refractive index:
A. Anterior surface of the lens
B. Posterior surface of the lens
C. Centre of the lens
D. Cornea

53. A 55-year-old male with a limbal scar presents to the ophthalmology clinic with markedly defective vision for near and far. Clinical examination reveals a wide and deep anterior chamber, iridodonesis and a dark pupillary reflex. A vision of 6/6 is achieved with correcting lens of +11D. Which of the following is the most likely diagnosis:
A. Aphakia
B. Pseudophakia
C. Hypermetropia
D. Posterior dislocation of lens

54. On performing refraction using a plane mirror on a patient who has a refractive error of –3 D sphere with –2 D cylinder at 90° from a distance of 1 metre under no cyclopegia, the reflex would be seen to move:
A. With the movement in the horizontal axis and against the movement in the vertical axis
B. With the movement in both the axes
C. Against the movement in both the axes
D. With the movement in the vertical axis and against the movement in horizontal axis.

55. A lady want LASIK surgery for her daughter. She asks for your opinion. All the following things are suitable for performing LASIK surgery *except*:
A Myopia of 4 Diopters
B. Age of 15 years
C. Stable refraction for 1 year
D. Corneal thickness of 600 microns

56. Best corrected Visual Acuity is 6/18 of a patient with a corneal scar which improves with pin hole to 6/9. Best explanation is:
A. Spherical aberration
B. Myopic astigmatism
C. Irregular astigmatism
D. Cataract

57. Maximum refraction takes place between:
A. Air tear film
B. Tear film and cornea
C. Cornea and aqueous
D. Aqueous lens

58. Most common type of refractive error in old children: *(COMEDK 201*
A. Hypermetropia
B. Myopia
C. Presbyopia
D. Astigmatism

59. The most common cause of myopia is: *(DPG 201*
A. Increase in axial length of the eyeball
B. Increase in thickness of the lens
C. Increase in viscosity of aqueous humour
D. Increase in viscosity of vitreous humour

60. Pseudopapillitis is seen in: *(DPG 2008*
A. Hypermetropia
B. Myopia
C. Squint
D. Presbyopia

61. Silk retina is seen in: *(DNB 2015)*
A. Myopia
B. Hypermetropia
C. Astigmatism
D. Presbyopia

62. Laser used in the treatment of myopia: *(DNB 2015)*
A. Nd:YAG
B. Excimer
C. Argon
D. Krypton

63. In retinoscopy, for a distance of 1 m the correction factor is –1D. What is the correction factor for retinoscopy done at 66 cm? *(Kerala PG)*
A. –2
B. –1
C. –0.5
D. –1.5

64. Cross cylinder is: *(PGI)*
A. One plus cylinder and one minus cylinder o equal strength
B. One plus and one minus cylinder of unequa strength
C. Two plus cylinders
D. Both minus cylinders
E. One spherical and one cylindrical lens

65. A 35-year-old man has normal distance vision but complains of difficulty in near vision. His retinoscopy shows +2D sphere. The probable diagnosis is: *(AIIMS/ AIPG 2002)*
A. Hypermetropia
B. Presbyopia
C. Myopia
D. Accommodative inertia

66. Lensometer detects:
A. Correct power of glasses
B. IOL power
C. Corneal topography
D. Biochemical constitution of lens

52:C 53:A 54:C 55:B 56:C 57:A 58:B 59:A 60:A 61:B 62:B 63:D 64:A,E 65:A 66:A

SECTION—III

Diseases of Eye and Ocular Adnexa

CHAPTER

5

Diseases of Conjunctiva

QUICK TEXT REVIEW

CONJUNCTIVITIS

***Normal flora** of the conjunctiva* include coagulase-negative *Staphylococcus* and diphtheroids.

***Common causative organisms** for different types of conjunctivitis are:*

• Purulent (hyperacute conjunctivitis)	:	*Gonococci, Neisseria meningitides*
• Angular conjunctivitis	:	Moraxella-Axenfeld (*Haemophilus laciniatum*)
• Swimming pool conjunctivitis (inclusion conjunctivitis)	:	*Chlamydia trachomatis* serotypes D to K
• Epidemic kerato-conjunctivitis	:	Adenovirus type 8,19
• Acute haemorrhagic conjunctivitis (Apollo conjunctivitis)	:	Enterovirus type 70
• Beal's conjunctivitis (Pharyngoconjunctival fever)	:	Adenovirus type 3 and 7
• Egyptian ophthalmia (Trachoma)	:	*Chlamydia trachomatis serotype* A, B, Ba, C
• Acute membranous conjunctivitis	:	*Corynebacterium diphtheriae* and *Streptococcus haemolyticus*
• Ophthalmia neonatorum	:	Gonococci, *Chlamydia trachomatis* (D to K), staphylococci, herpes simplex
• Acute follicular conjunctivitis	:	Adenovirus, Chlamydia oculogenital, herpes simplex
• Ophthalmia nodosa	:	Caterpillar hair.

BACTERIAL CONJUNCTIVITIS

- *Staphylococcus aureus* is the most common cause of bacterial conjunctivitis and blepharo-conjunctivitis.
- *Pneumococcal conjunctivitis* is usually associated with petechial subconjunctival haemorrhages.
- *Streptococcus pyogenes* usually produces pseudo-membranous conjunctivitis.
- *Haemophilus influenzae* (*H. aegyptius* or *Koch*-Weeks bacillus) classically causes epidemics of mucopurulent conjunctivitis (red-eye).
- *Moraxella-Axenfeld* bacillus is most common cause of blepharoconjunctivitis.
- *Neisseria gonorrhoeae* produce acute purulent conjunctivitis.
- *Corynebacterium diphtheriae* causes acute membranous conjunctivitis.

Acute mucopurulent conjunctivitis

- *Most common* type of acute bacterial conjunctivitis.
- *Common causative organisms*: *Staphylococcus aureus* (commonest), *H. aegyptius* (Koch-Weeks bacillus), *Pneumococcus* and *Streptococcus*.

Acute purulent conjunctivitis

- Commonest causative organism is *Gonococcus*, rarely it may be *Staphylococcus aureus* or *Pneumo-coccus*.
- May be associated with urethritis and arthritis.
- In gonococcal conjunctivitis, when cornea is not involved, a single IM injection of ceftriaxone 1 gm is effective.
- When cornea is involved a 5 days course of ceftriaxone 1–2 gm daily is needed.

Acute membranous conjunctivitis

- A rare disease, typically caused by *corynebacterium diphtheriae* and occasionally by virulent type of *Streptococcus haemolyticus*.

- *Corneal ulceration* is frequent complication. The bacteria may even invade the intact corneal epithelium.
- *Other Complications are*: Symblepharon, trichiasis, entropion, and conjunctival xerosis.

Treatment: Topical penicillin and antidiphtheria serum (ADS) and I/M injections of penicillin and ADS.

Pseudomembranous conjunctivitis

Acute conjunctivitis with pseudomembrane formation, does not bleed on peeling.

Cause: *Severe Adenoviral infection, Ligneous conjunctivitis,* Gonococcal conjunctivitis, *Autoimmune conjunctivitis, Streptococcus haemolyticus,* Staphylococci, *and low virulent diphtheria infection.*

Treatment: *Topical antibiotics and anti-inflammatory drugs.*

Angular conjunctivitis

Caused by Moraxella-Axenfeld (MA) diplococci, so also called as diplobacillary conjunctivitis.

- Source of infection is usually nasal cavity.
- MA bacillus produces proteolytic enzyme which macerates epithelium of the conjunctiva, lid margin and the skin surrounding angles of the eye.

CHLAMYDIAL CONJUNCTIVITIS

Chlamydia, previously thought to lie midway between bacteria and viruses is now classified as a bacterium with following features:

- They are obligate intracellular and filterable,
- They contain both DNA and RNA,
- Divide by binary fission and are sensitive to antibiotics.

Trachoma

- Also called *Egyptian ophthalmia* is caused by *Chlamydia trachomatis*. Serotypes, A,B, Ba and C are associated with hyperendemic (blinding) trachoma.
- *Chlamydia trachomatis* is epitheliotropic and produces intracytoplasmic inclusion bodies called *HP (Halberstaedter Prowazek) bodies.*
- Most common mode of trachoma spread is through fomites and flies. Reservoir of infection are children with active disease.
- Prevalence of trachoma is worldwide (affecting about 500 million people), but is highly prevalent in North-Africa, Middle-East and certain regions of South-East Asia.
- It is responsible for 15–20% of the world's blindne Leading cause of preventable blindness in t world.
- Incubation period varies from 5 to 21 days.
- *Conjunctival reaction in trachoma* is both follicul (conjunctival follicles) and papillary (papilla hyperplasia).
- Herbert follicles refer to typical trachoma follicl present in the limbal area (pathognomic).
- Pathognomic features of trachoma follicles a presence of Leber's cells and areas of necrosis.
- Trachomatous pannus initially is seen in the upp part. In progressive pannus infiltration is ahead vascularization while in regressive pannus it sto short of limbus.

Herbert's pits: *Cicatrized follicles at the superi limbus.*

Note: ***Arlt's line:*** *It is a thick band of scar tissue in t palpebral conjunctiva of the eye, near the lid marg seen in cicatrizing trachoma.*

McCallan classification of trachoma

- Stage I (Incipient trachoma)—Hyperaemia upper palpebral conjunctiva with immatur follicles
- Stage II (Established trachoma)—Mature follicle papillae and progressive pannus
- Stage III (Cicatrizing trachoma)—Conjunctiv scarring, Herbert's pit
- Stage IV—Stage of sequelae.

WHO classification (FISTO)

- *Trachomatous inflammation follicular* (TF): Fi or more follicles (each bigger than 0.5 mm) on t upper tarsal conjunctiva.
- *Trachomatous inflammation intense (TI* Inflammatory thickening of the upper tars conjunctiva obscures more than half of the norm deep tarsal vessels.
- *Trachomatous scarring (TS):* Scarring on the tars conjunctiva.
- *Trachomatous trichiasis (TT):* When at least o eye lash rubs the eye.
- *Trachomatous corneal opacity (CO):* Easily visib corneal opacity present over the pupil.

Sequelae of trachoma

- *Lids:* Trichiasis, entropion, tylosis, ptosi madarosis, ankyloblepharon.
- *Conjunctiva:* Concretions, pseudocyst, xeros symblepharon.
- *Cornea:* Opacity, xerosis, total corneal pannus.

Complication: The only complication of trachoma is corneal ulceration leading to corneal opacity.

Treatment: Topical tetracycline or systemic azithromycin, constitute treatment of choice.

- *Other drugs*: Topical erythromycin eye ointment or topical sulphonamides eye drops or ointment. Systemic tetracycline or erythromycin can also be given if needed.

SAFE Strategy for prevention:

S: Surgery for trichiasis/entropion/corneal opacity
A: Antibiotics for active infection (**Azithromycin 500 mg single dose**)
F: Facial cleanliness
E: Environmental hygiene.

WHO criteria for trachoma elimination

- TF prevalence 5% in 1–9 years children
- TI prevalence 1% per 1000 in total population.

Adult inclusion conjunctivitis

- Caused by serotypes D to K of *Chlamydia trachomatis*
- Source of infection is urethritis in males and cervicitis in females
- Mode of infection is through contaminated fingers or more commonly through contaminated water of swimming pool (hence the name swimming pool conjunctivitis).

VIRAL CONJUNCTIVITIS

Acute haemorrhagic conjunctivitis

- Caused by picorna viruses (enterovirus type 70)
- Also known as 'Apollo conjunctivitis' or 'epidemic haemorrhagic conjunctivitis (EHC).

Epidemic keratoconjunctivitis (EKC)

- Caused by adenovirus 8 and sometimes by 19
- Acute follicular conjunctivitis associated with preauricular lymphadenopathy
- Superficial punctate keratitis which appears after one week of onset is a distinctive feature of EKC.

Pharyngoconjunctival fever (Beat's conjunctivitis)

- Caused by adenovirus 3 and 7
- Primarily affects children and appears as epidemics
- Acute follicular conjunctivits associated with pharyngitis, fever and pre-auricular lymphadenopathy.

OPHTHALMIA NEONATORUM

- Bilateral inflammation of conjunctiva occuring during first 30 days of life
- Any discharge or watering from the eyes in the first week of life should arouse its suspicion since tears are not formed till then.

Etiology

- *Gonococcal infection* is most common cause in developing countries
- *Neonatal inclusion conjunctivitis* caused by serotypes D to K of chlamydia trachomatis is emerging as the most important cause
- *Staphylococcal*/streptococcal infection
- *Chemical conjunctivitis* induced by silver nitrate or antibiotics used as prophylaxis
- *Herpes simplex infection* by type II virus is a rare cause.

Incubation period

Causative agent	*Incubation period*
• Chemicals	4–6 hours
• *Gonococcus*	2–4 days
• Other bacterial	4–5 days
• Neonatal inclusion conjunctivitis	5–14 days
• Herpes simplex	5–7 days

Drug prophylaxis

Drug prophylaxis for ophthalmia neonatorum includes use of Povidone-iodine 2.5% solution, tetracycline eye ointment, erythromycin eye ointment or that is 1% silver nitrate eye drops Crede's method (not used now).

ALLERGIC CONJUNCTIVITIS

Spring catarrh (Vernal keratoconjunctivitis)

- A hypersensitivity reaction to exogenous allergens
- It is a **Type I hypersensitivity** reaction mediated by **IgE and mast cells**
- It is thought to be an atopic allergic disorder in many cases, in which there occurs Th2 lymphocyte alteration and secondarily the IgE mediated mechanisms play important role.
- More common in boys than girls between 5 and 15 years of age
- Intense itching and ropy discharge are characteristic symptoms
- Cobblestone arrangement of papillae on the upper tarsal conjunctiva, Homer Tranta's spots and ropy discharge are pathognomic.
- Palpebral form is more common than bulbar and mixed types.
- Vernal keratopathy occurs in following forms:
  - Punctate epithelial keratitis involving upper cornea

- Ulcerative vernal keratitis (shield ulcer)
- Vernal corneal plaques
- Subepithelial scarring
- Pseudogerontoxon (Cupids bow)

- Keratoconus may be associated with spring catarrh.

Atopic keratoconjunctivitis (AKC)

- It can be thought of as an adult equivalent of vernal keratoconjunctivitis
- Often associated with atopic dermatitis
- Associations may be keratoconus and atopic cataract (posterior subcapsular).

Giant papillary conjunctivitis (GPC)

- A localised allergic response to a physically rough or deposited surface such as contact lens, prosthesis, left out nylon sutures
- Papillae are 1 mm or more in diameter.

Phlyctenular keratoconjunctivitis

- Phlycten is a pinkish white nodule (1 to 3 mm in size), surrounded by hyperaemia on the bulbar conjunctiva, usually near the limbus.
- A delayed hypersenstivity (type IV-cell mediated) response to endogenous microbial proteins such as: tubercular, staphylococcal (most common), moraxella bacillus, and parasites (worm infestation).
- Gender. More common in girls than boys between 3 and 15 years of age.
- Corneal involvement (phlyctenular keratitis) may be in the form of scrofulous ulcer, fascicular ulcer and miliary ulcer.

Contact dermoconjunctivitis

A delayed hypersensitivity (type IV) response to prolonged contact with chemicals and drugs, such as, atropine, penicillin, neomycin, soframycin, and gentamicin.

MISCELLANEOUS CONJUNCTIVITIS

Acute follicular conjunctivitis is a feature of:
- Adult inclusion conjunctivitis
- Epidemic keratoconjunctivitis (EKC)
- Pharyngoconjunctival fever (PCF)
- New-castle conjunctivitis
- Acute herpetic conjunctivitis.

Pseudomembranous conjunctivitis is a feature of:
- Severe adenoviral infection
- Ligneous conjunctivitis
- Gonococcal conjunctivitis
- Autoimmune conjunctivitis.

Conjunctivitis associated with skin diseases su as acne rosacea, Stevens-Johnson syndro epidermolysis bullosa, and pemphigoid. Ligne conjunctivitis is a cicatrizing conjunctivitis in whi membrane is cast off and recurs again and again.

Ophthalmia nodosa is a granulomatous inflamm tion of the conjunctiva in response to irritati caused by the retained hair of caterpillar.

Parinaud's oculoglandular syndrome is a gro of conditions characterised by unilateral granul matous conjunctivitis, pre-auricular lymph denopathy, and fever. Its common causes are c scratch disease, tuberculosis, syphilis, lymphc granuloma venereum, sarcoidosis and tularemia.

DEGENERATIONS AND XEROSIS

DEGENERATIVE CONDITIONS

Pterygium

- It is a combined elastotic degeneration wit hyperplasia of the subconjunctival tissue in th form of vascularised granulation tissue.
- A degenerated fold of conjunctiva grows on th surface of the cornea to **involve the superficia corneal layers up to the stroma.**
- Exposure to ultraviolet rays of sunlight is implicate in the etiology.
- Fully developed pterygium has three parts—head neck and body. More common on nasal side.
- Deposition of iron seen sometimes in cornea epithelium anterior to advancing head is calle *stocker's line.*

Symptoms
- Visual disturbance when it encroaches th pupillary axis and due to induced astigmatism (Usually with the rule)
- Diplopia due to restriction of ocular movements
- Disturbance of tear film
- Cosmetic blemish

Treatment is surgical excision.
- Recurrence after surgical removal is 30–50%.
- Measures to reduce recurrence include: trans plantation in lower fornix (McReynolds' operation old technique not used now), postoperative bet irradiation, postoperative use of antimitoti drops (mitomycin-C or thiotepa), and mucou membrane grafts. Conjunctival limbal autograf (CLAU) is the best and preferred method.
- Lamellar keratectomy and lamellar keratoplasty i indicated in recurrent recalcitrant cases.

Concretions

- These are formed due to accumulation of inspissated mucus and dead epithelial cell debris into the conjunctival depressions called *loops of Henle.*
- These are not calcareous deposits.
- Causes are trachoma, age-related degeneration and idiopathic.

CONJUNCTIVAL XEROSIS

Parenchymatous xerosis occurs following cicatricial disorganization of the conjunctiva due to local causes, such as:

- Trachoma
- Diphtheric membranous conjunctivitis
- Stevens-Johnson syndrome
- Pemphigus
- Pemphigoid
- Thermal, chemical or radiational burns of conjunctiva
- Prolonged exposure due to lagophthalmos.

Epithelial xerosis occurs due to hypovitaminosis-A. It typically occurs in children and is characterised by varying degree of conjunctival thickening, wrinkling and pigmentation.

CYSTS AND TUMOURS

Commonest cysts of the conjunctiva are lymphatic cysts and implantation cysts

Commonest congenital tumour of the conjunctiva is epibulbar dermoid

In *Goldenhar's syndrome,* epibulbar dermoid is associated with preauricular skin tag, hemifacial hypoplasia and vertebral anomalies.

- *Epithelioma* (epidermoid squamous cell carcinoma) of the conjunctiva usually occurs at limbus.
- *Premalignant conditions* of conjunctiva are intraepithelial epithelioma (Bowen's disease), superficial spreading melanoma, lentigo maligna (Hutchinson's freckle).
- *Naevus of Ota* refers to oculodermal melanosis.

SOME SALIENT POINTS

- *Bandage* should not be *applied* in acute catarrhal or mucopurulent conjunctivitis
- *Topical steroids* are contraindicated in acute bacterial conjunctivitis
- *Hyperaemia* is the most conspicuous clinical sign of acute conjunctivitis
- *Unilateral chronic conjunctivitis* should suggest the presence of a foreign body retained in the fornix, trichiasis or inflammation of the lacrimal sac.
- *Trachoma and other conjunctival inflammation in the newborn* cannot produce a follicular reaction; because the adenoid layer is devoid of lymphoid tissue until 2–3 months postnatally.
- *Preauricular lymphadenopathy* is a feature of viral and chlamydial conjunctivitis which is rarely present in bacterial conjunctivitis, but seldom in allergic conjunctivitis.
- *Conjunctival ulceration* should always suggest either the presence of an embedded foreign body or a tuberculous or syphilitic lesion.
- *Epidemic keratoconjunctivitis* is the only serious eye disease known to be transmissible by tonometry.

MULTIPLE CHOICE QUESTIONS

1. **Epidemics of conjunctivitis are known to occur with:**
   A. Bacterial infections
   B. Viral infections
   C. None of the above
   D. Both of the above

2. **Most common bacteria associated with conjunctivitis is:**
   A. Staphylococcus aureus
   B. Streptococcus pneumoniae
   C. Haemophilus influenzae
   D. Neisseria gonorrhoea

3. **Preauricular lymph nodes may be enlarged in all *except*:**
   A. Bacterial conjunctivitis
   B. Viral conjunctivitis
   C. Allergic conjunctivitis
   D. Chlamydial conjunctivitis

4. **Commonest causative organism for angular conjunctivitis is:**
   A. Moraxella axenfeld
   B. Klebsiella pneumoniae
   C. Haemophilus influenzae
   D. None of the above

5. **Form the normal bacterial flora of the conjunctiva:**
   A. Corynebacterium xerosis
   B. E. coli
   C. Streptococci
   D. All of the above

6. **Pathognomic features of trachoma follicle are:**
   A. Presence of Leber's cells
   B. Areas of necrosis
   C. Both of the above
   D. None of the above

7. **Trachoma inclusion bodies in conjunctival smear are detected by:**
   A. Giemsa stain
   B. Iodine stain
   C. Immunofluorescent staining
   D. All of the above

8. **Swimming pool conjunctivitis is caused by:**
   A. Chlamydia trachomatis
   B. Adenovirus type 8
   C. Picorna virus
   D. Gonococcus

9. **Acute haemorrhagic conjunctivitis is caused by**
   A. Enterovirus
   B. Adenovirus
   C. Pseudomonas
   D. Streptococcus haemolyticus

10. **Occur in epidemics:**
    A. Enterovirus conjunctivitis
    B. Staphylococcal conjunctivitis
    C. Adenovirus conjunctivitis
    D. All of the above
    E. None of the above

11. **Ophthalmia neonatorum is:**
    A. Inflammation of the conjunctiva occurring in an infant less than 30 days old
    B. Any discharge/watering from the eye in first week of life
    C. Always caused by gonococci
    D. All of the above

12. **Incubation period of gonococcal ophthalmia neonatorum is:**
    A. 24 hours
    B. 5–7 days
    C. 7–10 days
    D. None of the above

13. **Intense itching is pathognomic feature of:**
    A. Spring catarrh
    B. Trachoma
    C. Follicular conjunctivitis
    D. Angular conjunctivitis
    E. All of the above

14. **Spring catarrh may be associated with:**
    A. Anterior subcapsular cataract
    B. Keratoconus
    C. Interstitial keratitis
    D. All of the above

15. **Associations of atopic keratoconjunctivitis include *all except*:**
    A. Keratoconus
    B. Atopic cataract
    C. Atopic dermatitis
    D. Interstitial keratitis

16. **Giant papillary conjunctivitis occurs as an allergic response to *all except*:**
    A. Contact lens
    B. Intraocular lens
    C. Prosthesis
    D. Nylon sutures

1:D 2:A 3:C 4:A 5:A 6:C 7:D 8:A 9:A 10:D 11:A 12:D 13:E 14:D 15:D 16:B

17. All are true about phlyctenular conjunctivitis *except*:
A. It is type-IV cell mediated hypersensitivity
B. Allergens are endogenous as well as exogenous
C. Incidence is higher in girls than boys
D. Nodular lesion usually occurs near the limbus

18. Ophthalmia nodosa occurs due to:
A. Leprotic conjunctivitis
B. Syphilitic conjunctivitis
C. Sarcoidosis conjunctivitis
D. Irritation by hair of caterpillar
E. All of the above

19. All are known to cause conjunctival xerosis *except*:
A. Trachoma
B. Membranous conjunctivitis
C. Angular conjunctivitis
D. Ocular pemphigoid

20. All are known to produce parenchymatous conjunctival xerosis *except*:
A. Vitamin A deficiency
B. Diphtheric membranous conjunctivitis
C. Trachoma
D. Stevens-Johnson syndrome

21. Goldenhar syndrome is associated with which prominent ocular manifestation:
A. Microcornea
B. Megalocornea
C. Sclerocornea
D. Epibulbar dermoids

22. Follicle formation may be seen in all of the following *except*:
A. Trachoma
B. Vernal keratoconjunctivitis
C. Inclusion conjunctivitis
D. Epidemic keratoconjunctivitis

23. Pseudomembranous conjunctivitis is caused by:
A. *Gonococcus*
B. *Staphylococcus*
C. *Streptococcus*
D. Keratoconjunctivitis sicca

24. Conjunctivitis in newborn is commonly caused by:
A. *Streptococcus*
B. *Gonococcus*
C. *Pseudomonas*
D. *Chlamydia*

25. Unilateral conjunctivitis is commonly seen in:
A. Blepharitis
B. Vernal conjunctivitis
C. Dacryocystitis
D. Trachoma

26. Ligneous conjunctivitis is caused by:
A. Purulent conjunctivitis
B. Membranous conjunctivitis
C. Angular conjunctivitis
D. Phlyctenular conjunctivitis
E. Any of the above

27. Horner Tranta's spots are seen in:
A. Vernal conjunctivitis
B. Phlyctenular conjunctivitis
C. Angular conjunctivitis
D. Follicular conjunctivitis

28. HP inclusion bodies in trachoma are seen to be:
A. Extracellular
B. Intracytoplasmic
C. Intranuclear
D. None

29. Pathognomonic feature of trachoma is:
A. Bulbar papillae
B. Palpebral papillae
C. Bulbar follicles
D. Palpebral follicles

30. "Safe strategy" has been developed for the control of:
A. Conjunctivitis
B. Trachoma
C. Refractive error
D. Ocular trauma

31. Subconjunctival haemorrhage can occur in all conditions *except*:
A. Passive venous congestion
B. Pertussis
C. Trauma
D. High intraocular tension

32. Unilateral chronic conjunctivitis may be associated with
A. Habit of smoking
B. Use of uniocular microscope
C. Foreign body retained is the fornix
D. Unilateral aphakia

33. Trachoma in a newborn cannot produce follicular reaction because:
A. Antibodies are transferred from mother
B. Adenoid layer is devoid of lymphoid tissue
C. Immunity is not developed
D. Incubation period is one year

34. Conjunctival ulceration may suggest:
A. Embedded foreign body
B. Tuberculosis
C. Syphillis
D. Any of the above.

17:B 18:D 19:C 20:A 21:D 22:B 23:C 24:D 25:C 26:B 27:A 28:B 29:C 30:B 31:D 32:C 33:B 34:D

35. Commonest congenital tumour of conjunctiva is:
A. Epibulbar dermoid
B. Benign melanoma
C. Papilloma
D. Capillary haemangioma

36. Inclusion body conjunctivitis true is *all except*:
A. Self-limiting
B. Present only in infants
C. Occurs while passage from birth canal
D. Caused by chlamydia

37. Pathognomonic of trachoma is:
A. Bulbar papillae
B. Palpebral papillae
C. Bulbar follicles
D. Palpebral follicles

38. All are seen in stage III trachoma *except*:
A. Tarsal epithelial fibrosis
B. Trachomatous pannus
C. Herbert's pits
D. Disappearance of Bowman's membrane

39. Follicles of a diameter of 5 mm are typically seen in:
A. Pharyngoconjunctival fever
B. Trachoma
C. Drug-induced follicular conjunctivitis
D. Ophthalmia neonatorum

40. Tetracycline ointment for mass prophylaxis:
A. 0.1% C. 1%
B. 0.5% D. 5%

41. Spring catarrh is:
A. Type I hypersensitivity reaction
B. Type II
C. Type III
D. Type IV

42. Complication of vernal keratoconjunctivitis:
A. Cataract
B. Keratoconus
C. Retinal detachment
D. Vitreous haemorrhage

43. Treatment of vernal keratoconjunctivitis includes all *except*:
A. Steroids
B. Cromoglycate
C. Olopatadine
D. Antibiotics

44. The histology of pterygium includes:
A. Elastotic degeneration
B. Epithelial inclusion bodies
C. Precancerous changes
D. Squamous metaplasia of the epithelium

45. Subconjunctival cyst is seen in:
A. Toxoplasmosis
B. Cysticercosis
C. Leishmaniasis
D. Chagas disease.

46. In the grading of trachoma, trachomatou inflammation-follicular is defined as the presenc of:
A. 5 or more follicles in the lower tarsal conjunctiv
B. 3 or more follicles in the lower tarsal conjunctiv
C. 5 or more follicles in the upper tarsal conjunctiv
D. 3 or more follicles in the upper tarsal conjunctiv

47. Inclusion conjunctivitis is caused by:
A. Chlamydia trachomatis
B. Chlamydia psittaci
C. Herpes
D. Gonorrhea

48. Features of vernal conjunctivitis are:
A. Shield ulcer
B. Horner-Trantas spots
C. Papillary hypertrophy
D. Herbert pits
E. Pannus

49. Features of vernal keratoconjunctivitis are:
A. Papillary hypertrophy
B. Shield's ulcer
C. Herbert's pits
D. Trantra's spot
E. Ropy discharge

50. Topical sodium cromoglycate is used in treatment of:
A. Phlyctenular conjunctivitis
B. Vernal catarrh
C. Subconjunctival haemorrhage
D. Trachoma

51. A Malnourished child from a poor socioeconomic status, residing in overcrowded and dirty areas present with a nodule around the limbus with hyperemia of surrounding conjunctiva in his left eye. He is also observed to have axillary and cervical lymphadenopathy. Which of the following is the most likely diagnosis:
A. Phlyctenular conjunctivitis
B. Foreign body granuloma
C. Vernal keratoconjunctivitis
D. Episcleritis

52. Follicular conjunctivitis are found in all *except*:
A. Herpes simplex conjunctivitis
B. Drug induced
C. Adult inclusion conjunctivitis
D. Allergic conjunctivitis
E. Molluscus contagiosum

35 : A 36 : B 37 : C 38 : B 39 : B 40 : A
41 : A 42 : B 43 : D 44 : A

45 : B 46 : C 47 : A 48 : A, B and C
49 : A, B, D and E 50 : B 51 : A 52 : None

53. Pterygium all are true *except*:
A. Arise from any part of conjunctiva
B. Can cause astigmatism
C. Surgery is treatment of choice
D. UV exposure is risk factor
E. Stromal defect seen
F. A connective tissue degeneration

54. Stocker's line is seen in:
A. Pinguecula
B. Pterygium
C. Congenital ocular melanosis
D. Conjunctival epithelial melanosis

55. Neonatal conjunctivitis is caused by *all except*:
A. *Gonococcus*
B. *Chlamydia*
C. *Aspergillus*
D. *Pseudomonas*

56. A patient complains of pain in both eyes with congestion. Blurring of vision, photophobia and mucopurulent discharge since one day. Many cases have been reported from the same community. The causative agent is probably:
A. Adenovirus
B. Enterovirus 70
C. Herpes simplex
D. Hemophilus

57. All are features of trachoma McCallen's stage III, *except*:
A. Herbert's pits
B. Pannus
C. Necrosis in scar
D. Scar on tarsal conjunctiva

58. Which of the following is not true of acute viral conjunctivitis? (*AIIMS 2013*)
A. Vision is not affected
B. Corneal infiltration is seen
C. Antibiotics are the mainstay of treatment
D. Pupil remains unaffected

59. Arlt's line is seen in: (*AIPG/DNB 2013*)
A. Vernal keratoconjunctivitis
B. Pterygium
C. Trachoma
D. Ocular pemphigoid

60. Topical sodium cromoglycate is used in the treatment of: (*COMEDK*)
A. Phlyctenular conjunctivitis
B. Vernal keratoconjunctivitis
C. Trachoma
D. Subconjunctival haemorrhage

61. A child of weight 8 kg has Bitot's spots in both eyes. Which is the most appropriate schedule of Vitamin A for the child? (*AIPG*)
A. 2 lakh units IM on days 0, 14
B. 1 lakh units IM on days 0, 14
C. 2 lakh units IM on days 0, 1, 14
D. 1 lakh units IM on days 0, 1, 14

62. Goblet cells are seen in: (*DNB 2016*)
A. Cornea
B. Conjunctiva
C. Retina
D. Vitreous

63. Which of the following may present as a bluish red nodule resembling conjunctival haemorrhage? (*APPG 2013*)
A. Kaposi sarcoma
B. Ciliary staphyloma
C. Lymphoma
D. Limbal dermoid

53 : A 54 : B 55 : C 56 : B 57 : B 58 : C 59 : C 60 : B 61 : D 62 : B 63 : A

CHAPTER

6

Diseases of Cornea

QUICK TEXT REVIEW

CONGENITAL ANOMALIES

Megalocornea

- The horizontal diameter of cornea at birth is 10 mm. The adult size of 11.7 is attained by the age of 2 years.
- Megalocornea is labelled when the horizontal diameter of cornea is of adult size at birth or 13 mm or greater after the age of 2 years. Cornea is clear with normal thickness and normal vision. Megalocornea is often associated with Marfan's syndrome.

Microcornea

- In microcornea, the horizontal diameter is less than 10 mm since birth.
- The condition may occur as an isolated anomaly (rarely) or in association with nanophthalmos (normal small eyeball) or microphthalmos (abnormal small eyeball). Eye is usually hypermetropic.

Congenital cloudy cornea

The conditions responsible can be denoted by the eponym STUMPED as follows:

- Sclerocornea
- Tears in Descemet's membrane
- Ulcer
- Metabolic conditions
- Posterior corneal defect
- Endothelial dystrophy
- Dermoid.

KERATITIS

CORNEAL ULCER (ULCERATIVE KERATITIS)

Bacterial corneal ulcer

Commonest causative organisms are ***Pneumococcus,*** others are ***Staphylococcus, Pseudomonas and Gonococcus.***

Pathogens which can invade the normal intact corneal epithelium are: *Neisseria gonorrhoea, Neisseria meningitidis, Corynebacterium diphtheriae, Listeria* and *Haemophilus.*

Commonest organisms/etiological agents responsible for different corneal ulcers are:

• Hypopyon corneal ulcer	• *Pneumococcus*
• Mycotic corneal ulcer	• *Aspergillus fumigatus*
• Marginal corneal ulcer (Catarrhal corneal ulcer)	• Koch-Weeks bacillus (*Haemophilus aegyptius*)
• Typical dendritic corneal ulcer	• Herpes simplex virus
• Very rapidly progressive sloughing corneal ulcer	• *Pseudomonas*
• Ulcus serpens	• *Pneumococcus*
• Fascicular ulcer	• Phlyctenulosis
• Atheromatous ulcer	• Degenerative change in old leucoma

Hypopyon corneal ulcer

- *Staphylococci, Streptococci, Gonococci* and *Moraxella* may produce hypopyon; but by far the most dangerous are *Pseudomonas pyocyanea* and the *Pneumococcus*
- Characteristic hypopyon ulcer caused by *Pneumococcus* is called *ulcus serpens* which has a tendency to creep over the cornea
- Commonest cause of failure in treatment is secondary glaucoma.

Mycotic corneal ulcer

- *Common causative* fungi are *Aspergillus* (most common), *Candida* and *Fusarium*
- *Common mode of infection* is injury by vegetative material, e.g. thorn, branch of a tree, etc.
- *Injudicious use of antibiotic and steroids* increase the incidence of fungal infections

- *Typical fungal ulcer* is dry looking, greyish white with finger-like extensions into the surrounding stroma under the intact epithelium. A sterile immune ring (Immune ring of Wessely) and multiple satellite lesions are characteristic. Usually, a big hypopyon (pseudohypopyon) which is non-sterile, infective presents even if the ulcer is very small. Corneal vascularization is conspicuously absent.
- *Drug of choice for filamentous infections* is natamycin and for *Candida* is Amphotericin B (0.15%).

Herpes simplex corneal ulcer

Herpes simplex virus (HSV) is a DNA virus. Ocular infection is more common with HSV-1 and rare with HSV type II

Primary ocular herpes occurs in non-immune children. Lesions are vesicles of skin of the lids, acute follicular conjunctivitis. Fine or coarse punctate epithelial keratitis occurs in 50% cases

Recurrent ocular herpes is caused by periodic reactivation of virus (which lies dormant in the trigeminal ganglion) by following precipitating stimuli: Fever such as malaria or flu, general ill health, exposure to ultraviolet rays (sunlight), immunocompromised patients, e.g. in AIDS, and excessive use of topical or systemic steroids

Lesions of recurrent ocular herpes are:

- *Punctate epithelial keratitis* is initial lesion
- *Dendritic ulcer* is pathognomonic lesion
- *Geographical (amoeboid) ulcer* is formed when branches of dendritic ulcer enlarge and coalesce
- *Disciform keratitis* is a delayed hypersensitivity reaction to HSV antigen, characterised by a focal disc-shaped patch of stromal oedema without necrosis
- *Endothelitis*: This is also an immune response to the viral antigen. It presents with stromal oedema, Descemet's folds and endothelial exudates. Keratic precipitates with anterior uveitis may be present.

Metaherpetic ulcer is a sterile trophic ulceration which occurs due to healing defect at the site of previous herpetic ulcer.

Antiviral drugs effective against HSV are:

5-iodo-2 deoxyuridine (IDU)—1% drops 1 hourly during day and 2 hourly at night

Trifluorothymidine (TFT)—1% drops 2 hourly

Acyclovir—3% ointment 5 times a day. It is the only drug effective in stromal keratitis.

Herpes zoster ophthalmicus

- *Varicella-zoster virus* is a neurotropic DNA virus which produces acidophilic intranuclear inclusion bodies
- *Herpes zoster virus* is the most common virus causing the corneal ulcer
- *Lesions* are strictly limited to one side of the midline of the head
- *Frontal nerve* is more frequently affected than the lacrimal and nasociliary
- *Cutaneous lesions* in the area of distribution of the involved nerve appear after 3–4 days of onset of disease
- *Ocular lesions* occur in 50% cases
- *Hutchinson's rule* which implies that ocular involvement is frequent if the side or tip of the nose presents vesicles is useful but not infallible.
- *Superficial punctate epithelial keratitis* is the most common feature
- *Pseudodendritic keratitis*: These are different from the true dendrites seen in Herpes simplex because they are devoid of **terminal bulbs** and are more peripheral in location.
- *Nummular keratitis* may occur as multiple tiny granular deposits surrounded by a halo of stromal haze
- *Iridocyclitis occurs* in 50% cases of Zoster keratitis
- *Neurotrophic keratitis* occurs as a complication of Gasserian ganglion destruction
- *Episcleritis and scleritis* occur in 50% cases
- *Palsy of 3rd, 6th and 7th cranial nerve* may occur in severe infection
- *Optic neuritis* occurs in 1% cases
- *Acute retinal necrosis* and neuroretinitis are also reported.
- *Post-herpetic neuralgia* may persist for months or years

Treatment

Oral acyclovir 800 mg 5 times a day × 10 days is effective

- *Systemic steroids* are indicated in cranial nerve palsies and optic neuritis.

Acanthamoeba keratitis

- *Acanthamoeba*, a fresh-water protozoan, is found in fresh water, well water, sea water, sewage soil, and air.
- *Keratitis* is more common in contact lens wearers using home-made saline, and occurs both in immunocompetent and immunosuppressed

(However, the **most common infectious keratitis in a contact lens user is caused by *Pseudomonas*).**

- *Severe pain*, out of proportion to the degree of inflammation is typical feature.
- *Typical lesions* are central or paracentral ring-shaped stromal infiltrates with overlying epithelial defects with associated radial keratoneuritis.
- *Calcofluor white stain, KOH and lactophenol cotton blue* stained film may demonstrate cysts in corneal scrapings.
- *Culture medium*: Non-nutrient agar with *E. coli* and does not depend on host for completion of life cycle.
- *Treatment* consists of 0.1% propamidine isethionate (Brolene), Polyhexamethylene Biguanide (0.02%), Chlorhexidine (0.02%) and neomycin eye drops. Keratoplasty is required in resistant cases.

Neurotrophic/Neuroparalytic keratitis

***Etiology*:** Occurs due to paralysis of sensory nerve supply of the cornea. Most typically 5th nerve paralysis as a result of radical treatment of trigeminal neuralgia. *Other causes* are diabetes, leprosy, brain tumours, cerebrovascular accidents.

Typical features are absence of pain, lacrimation and complete loss of corneal sensations.

Treatment

- It is an indolent, painless ulcer which does not respond to conventional management
- Treatment is artificial tears and tarsorrhaphy.

Exposure keratitis

***Etiology*:** It occurs in conditions producing lagophthalmos such as extreme proptosis, facial nerve palsy, coma, overcorrection of ptosis, etc.

***Features*:** Initial dessication due to exposure occurs in the interpalpebral area leading to fine punctate epithelial keratitis followed by frank ulceration and vascularization.

Treatment: Artificial tears and tarsorrhaphy.

Rosacea keratitis

- *Rosacea*, a disease of sebaceous glands of the skin, occurs in elderly women as facial eruptions.
- *Ocular lesions* include blepharoconjunctivitis, acne rosacea keratitis, corneal vascularization and iritis in severe cases.
- *Treatment* consists of topical steroids and systemic tetracycline.

Peripheral Ulcerative Keratitis (PUK)

- This is an immunological ulcer associated wit disorders like **rheumatoid arthritis, SLE, PA Wegener's granulomatosis, etc.**
- Ulcer involves the periphery of the cornea extending up to the limbus. It may lead to thinnin and perforation. Healed ulcer gives rise to irregula astigmatism.
- Treatment is **topical steroids. Corneal patch graftin** may be done in cases of severe thinning.

Mooren's ulcer (Chronic serpiginous or rodent ulcer)

Exact etiology is not known, probably it is a autoimmune disease. Thus, Mooren's ulcer is, b definition, an idiopathic PUK, where no systemic association can be identified.

Typical ulcer is a shallow furrow with whitish over-hanging edge, vascularized base accompanied b severe pain.

Treatment

- *Immunosuppression* with cyclosporin is useful.
- *Conjunctival resection and cautery:* It is assumed that the antibodies responsible for corneal destruction and ulceration are brought by the conjunctival vessels. Hence, conjunctival resection is done.
- *Corneal patch graft*, is required for a deep ulcer.

Non-healing corneal ulcer

Local causes

- Raised intraocular pressure
- Misdirected cilia
- Large concretions
- Chronic dacryocystitis
- Impacted foreign body
- Lagophthalmos
- Inadequate therapy
- Wrong therapy.

General causes

- Diabetes mellitus
- Severe anaemia
- Malnutrition
- Vitamin-A deficiency
- Immunocompromised patients.

SUPERFICIAL PUNCTATE KERATITIS

Characterised by multiple spotty lesions i superficial layers of cornea associated with acut pain, photophobia and lacrimation.

Etiology of SPK includes: Viral infections, chlamydial infections, toxic due to *Staphylococcal* toxins, exposure keratitis and neuroparalytic keratitis, allergic lesions, keratoconjunctivitis sicca, Thygeson's SPK, and photophthalmia.

Treatment: Topical weak steroids have suppressive effect.

Photophthalmia

Etiology. Superficial punctate keratitis which occurs due to effect of ultraviolet rays (especially 290–311 nm) associated with exposure to:

- Naked arc light, as in industrial welding and cinema operators
- Bright light of short circuiting
- Reflected ultraviolet rays from snow surface (snow blindness)

Characteristic features are severe burning pain, lacrimation, marked photophobia and blepharospasm occurring 4–5 hours after exposure to the ultraviolet rays.

Superior limbic keratoconjunctivitis

- Occurs with greater frequency in female patients with hyperthyroidism.
- Conjunctiva in region of superior limbus and adjoining parts of bulbar and tarsal conjunctiva are congested. Cornea shows superficial punctate keratitis which stains both with fluorescein and rose bengal.

Thygeson's superficial punctate keratitis

- It is a chronic, recurrent, bilateral, superficial keratitis characterised by coarse punctate epithelial lesions (snow flake)
- Each lesion is a cluster of heterogeneous granular grey dots.

Filamentary keratitis

- *Superficial punctate keratitis associated with formation of epithelial filaments* which are freely movable over the cornea, firmly attached at the base and stain both with fluorescein and rose bengal.
- *Common causes* are: Keratoconjunctivitis sicca, superior limbic keratoconjunctivitis, prolonged patching, following epithelial erosions as in herpes simplex, Thygeson's keratitis, recurrent corneal erosion syndrome and trachoma.

INTERSTITIAL KERATITIS

Common causes are syphilis, tuberculosis, Cogan's syndrome, trypanosomiasis, malaria, leprosy, and sarcoidosis.

Basis of the disease is essentially an immune reaction to the foreign antigen.

Clinical features. An inflammation of the corneal stroma without primary involvement of the epithelium or endothelium. It is a dense keratitis associated with deep corneal vascularisation.

Treatment is topical steroids. Therapy for the associated systemic disease has to be initiated.

Syphilitic (luetic) interstitial keratitis

- Ninety% cases are associated with congenital syphilis
- In congenital syphilis, manifestations are usually bilateral and develop between 5 and 15 years of age
- In acquired syphilis, manifestations are usually unilateral
- Interstitial keratitis may occur alone or as a part of *Hutchinson's triad* which also includes: Hutchinson's teeth and vestibular deafness
- Disease is a result of antigen-antibody reaction
- Ground glass appearance of cornea and 'Salmon patches' are typical features
- After healing, corneal opacities and ghost vessels are left behind.

Tubercular interstitial keratitis

- It is more frequently unilateral and sectorial.

Cogan's syndrome

It comprises interstitial keratitis of unknown etiology, acute tinnitus, vertigo and deafness typically occurring in middle-aged adults. It is often bilateral.

DEGENERATIONS, DYSTROPHIES AND ECTATIC CONDITIONS

CORNEAL DEGENERATIONS

Arcus senilis

- Annular lipid infiltration of corneal periphery is seen in elderly people. The ring of opacity is separated from the limbus by a clear zone (*lucid interval of Vogt*)
- Lipid is first deposited in anterior part of the Descemet's membrane and the stroma
- Most commonly encountered peripheral corneal opacity.

Arcus juvenilis

- Condition similar to arcus senilis occurring in young persons (below 40 years of age).

Calcific degeneration (Band keratopathy)

Characterised by deposition of calcium salts in Bowman's membrane and most superficial part of stroma.

Etiology:
Local causes. It is associated with chronic uveitis in adults, children with Still's disease, phthisis bulbi, chronic glaucoma, chronic keratitis, and ocular trauma.
Systemic causes. Hyperparathyroidism, hypervitaminosis D, multiple myeloma.
Clinical Features. Presents as band-shaped opacity in the inter-palpebral area surface of the opaque band is stippled due to holes in the calcium plaques in the area of nerve canals of Bowman's membrane.

Treatment consists of chemical removal of calcium salts with 0.01 molar solution of EDTA. Phototherapeutic keratectomy (PTK) with excimer laser is very effective in clearing the cornea.

Salzmann's nodular degeneration

- *Occurs* in eyes with recurrent attacks of phlyctenular keratitis, rosacea keratitis or trachoma
- *Cornea shows* one to ten bluish white nodules arranged in a circular fashion, due to deposition of hyaline plaques between epithelium and Bowman's membrane.

Spheroidal degeneration (climatic droplet keratopathy)

- *Occurs* in men who work outdoors, especially in hostile climates. Its occurrence has been related to exposure to ultraviolet rays and/or ageing.
- *Cornea shows* amber-coloured spheroidal granules accumulated at the level of bowman's membrane and anterior stroma in the interpalpebral area.

CORNEAL DYSTROPHIES

Classification

1. ***Anterior dystrophies*** (superficial dystrophies), primarily affecting epithelium and Bowman's layer:
- Epithelial basement membrane dystrophy
- Reis-Bücklers dystrophy
- Meesman's dystrophy
- Recurrent corneal erosion syndrome
- Stocker-Halt dystrophy.

2. ***Stromal dystrophies***
- Granular (Groenouw's type I) dystrophy
- Lattice dystrophy
- Macular (Groenouw's type II) dystrophy
- Crystalline (Schnyder's dystrophy).

3. ***Posterior dystrophies,*** affecting primarily the corneal endothelium and Descemet's membrane:
- Cornea guttata
- Fuchs' epithelial endothelial dystrophy (late hereditary endothelial dystrophy)
- Posterior polymorphous dystrophy of Schlichting
- Congenital hereditary endothelial dystrophy (CHED).

4. ***Ectatic dystrophies***
- Keratoconus (anterior)
- Posterior keratoconus
- Keratoglobus.

Autosomal dominant dystrophies

- Lattice dystrophy is the most common stromal corneal dystrophy (lattice type 1)
- Granular dystrophy
- Fleck dystrophy
- Meesmann dystrophy
- Reis-Bückler dystrophy
- Avellino dystrophy.

Autosomal recessive dystrophies

- Macular dystrophy: Least common stromal dystrophy
- Lattice type 3.

Stromal Dystrophies

In these dystrophies, there is deposition of a foreign substance within the corneal stroma. The different types are:

Type of dystrophy	*Substance deposited*	*Test*
Lattice dystrophy	Amyloid	Congo-red
Granular dystrophy	Hyaline	Masson's trichrome
Avellino (Combination of Lattice and Granular dystrophy)	Amyloid and Hyaline	Congo-red and Masson's trichrome
Macular dystrophy	Muco-polysaccharides	Alcian blue
Schnyder's crystalline dystrophy	Phospholipids	Oil-red O
Gelatinous drop-like dystrophy	Amyloid	Congo-red

- Stromal dystrophies usually present with **diminution of vision.**
- Treatment is **keratoplasty.**

Salient points: Corneal dystrophies—

- *Cogan's microcystic dystrophy* is the *most common* of all corneal dystrophies seen in working-age adults.
- *Reis-Bückler's dystrophy* primarily involves Bowman's membrane.
- In *macular dystrophy,* acid mucopolysaccharides are deposited in the cornea.

- *Cornea guttata* may occur independently or as a part of early stage of Fuchs' dystrophy.
- Primary open-angle glaucoma is a common association of *Fuchs' dystrophy*.
- *Epithelial basement membrane* dystrophy is the most common anterior corneal dystrophy
- *Fuchs endothelial dystrophy* is the most common posterior endothelial dystrophy.
- *Posterior polymorphous dystrophy*. It is dominantly inherited and is associated with corectopia (abnormal location of pupil).

ECTATIC CONDITIONS OF CORNEA

Keratoconus

Non-inflammatory ectatic condition of cornea giving it a conical shape with resultant irregular myopic astigmatism. It is usually bilateral (85%). It is more common in girls after puberty.

Classification: Morphologically divided into:
- Nipple cone (5 mm)
- Oval cone (5–6 mm) displaced inferotemporally
- Globus cone (>6 mm) may involve over 75% of cornea.

Signs and symptoms are:
- *Impaired vision* due to progressing myopia and irregular astigmatism.
- *Munson's sign*, i.e. localised bulging of lower lid when patient looks down, is positive in late stages.
- *Vogt's Striae*: Stress lines parallel to sleep axis of cornea
- *Increased visibility of nerves*: It is due to thinning of the cornea and not due to thickening of nerves
- *Reduced corneal sensation*
- *Hurricane keratopathy*: Whorl pattern of SPK due to effect of contact lens
- *Fleischer's ring* seen at the base of cone is perhaps due to hemosiderin deposition in epithelium
- *Applanation tonometry*: Pulsation of mires is visible due to thin cornea
- *An annular dark* shadow is seen on distant direct ophthalmoscopy
- *Scissors reflex* on retinoscopy
- *Irregular astigmatism* on keratometry
- *Irregularity of circles* on placido disc examination
- *Acute hydrops*: Sudden hydration of corneal stroma due to rupture of Descemet's membrane.
- *Corneal topography makes* early diagnosis.

Keratoglobus

- It is a familial and hereditary (autosomal recessive) bilateral congenital disorder characterised by thinning and hemispherical protrusion of the entire cornea.
- It should be differentiated from buphthalmos where increased corneal size is associated with raised intraocular pressure, angle anomaly and cupping of the disc.

MISCELLANEOUS AND SYMPTOMATIC CONDITIONS OF CORNEA

MISCELLANEOUS KERATOPATHIES

Vortex keratopathy

- Also called *cornea verticillata*
- *Characterised by* bilateral, symmetrical, grayish or golden corneal epithelial deposits
- *Occurs* in patients taking chloroquine, amiodarone, amodiaquine, meperidine, indomethacin, chlorpromazine and tamoxifen. Also seen in patients with Fabry's disease (glycolipidosis).

Crystalline keratopathy

This is a typical entity where refractile crystals are seen in the epithelium and **anterior stroma** of the cornea. It may be infectious or non-infectious

Infectious crystalline keratopathy (ICK) is usually seen after corneal graft and refractive surgeries. The most common causative organism is *Streptococcus viridans*. Other organisms may be *Staphylococcus epidermidis*, *Pneumococcus*, *Haemophilus* and *Candida*.

Non-infectious crystalline kerotopathy include:

Chrysiasis refers to deposition of gold in corneal stroma following prolonged administration in patients with rheumatoid arthritis.

Cystinosis refers to widespread deposition of cysteine crystals in conjunctiva, cornea, iris, lens and retina. A hereditary disorder (autosomal recessive) leading to defect in its lysosomal transport.

Monoclonal gammopathy refer to deposition of crystal in corneal epithelium and stroma seen in patients with:
- Multiple myeloma
- Waldenstrom's macroglobulinemia
- Lymphoma.

16. Radial keratoneuritis is a feature of:
A. Acanthamoeba keratitis
B. Herpes zoster keratitis
C. Neuroparalytic keratitis
D. All of the above

17. Exposure keratitis is not associated with:
A. 7th nerve paralysis
B. 5th nerve paralysis
C. Symblepharon
D. Ectropion

18. All are features of rosacea keratitis *except*:
A. Corneal vascularisation
B. Associated blepharoconjunctivitis
C. Central superficial ulcer
D. Progresses to involve the whole cornea

19. All are true for Mooren's ulcer *except*:
A. Peripheral ulcerative keratitis
B. Advancing edge is undermined
C. Perforation is common
D. Floor of ulcer is quickly vascularised

20. Photo-ophthalmia results from exposure to:
A. Ultraviolet rays
B. Infrared rays
C. Beta-irradiation
D. All of the above

21. In photophthalmia site of lesions is:
A. Cornea
B. Retina
C. Optic nerve
D. All of the above

22. Filamentary keratitis may occur:
A. In trachoma
B. In keratoconjunctivitis sicca
C. Following cataract surgery
D. All of the above

23. Hutchinson's triad includes *all except*:
A. Interstitial keratitis
B. Hutchinson's teeth
C. Vestibular deafness
D. Flat nose bridge

24. Interstitial keratitis may be associated with:
A. Congenital syphilis
B. Malaria
C. Sarcoidosis
D. All of the above

25. Commonest causative organism of corneal ulcer is:
A. *Pneumococcus*
B. *Staphylococcus*
C. *Streptococcus*
D. Fungi

26. Metabolically active corneal layer is:
A. Epithelium
B. Stroma
C. Descemet's membrane
D. None of the above

27. Fascicular ulcer is seen in:
A. Phlyctenular keratitis
B. Rosacea keratitis
C. Riboflavin deficiency
D. All of the above

28. Corneal dystrophy associated with acu mucopolysaccharidosis is:
A. Lattice
B. Granular
C. Macular
D. Peripheral

29. All of the following result in loss of corne sensations *except*:
A. Acute congestive glaucoma
B. Dendritic ulcer
C. Absolute glaucoma
D. Exposure keratitis

30. The earliest symptom to occur in corneal ulcer i
A. Pain
B. Photophobia
C. Loss of sensation
D. Diminished vision

31. Corneal reflex is lost in the disease of:
A. Ophthalmic nerve
B. Ciliary ganglion
C. Supraorbital nerve
D. Motor nucleus of 5th cranial nerve

32. The commonest cause of hypopyon is:
A. *Moraxella*
B. *Gonococcus*
C. *Pneumococcus*
D. *Staphylococcus*
E. *C. diphtheriae*

33. Keratomalacia includes the following *except*:
A. Night blindness
B. Severe pain in the eye
C. Xerosis of the cornea
D. Perforation of cornea

34. Kayser Fleischer ring is found in which layer cornea?
A. Bowman's membrane
B. Substantia propria
C. Descemet's membrane
D. Endothelium

16 : A 17 : B 18 : C 19 : C 20 : A 21 : A
22 : D 23 : D 24 : D 25 : A
26 : A 27 : A 28 : C 29 : D 30 : A 31 :
32 : C 33 : B 34 : C

35. Corneal transparency is due to *all except*:
A. Normal IOP
B. $Na^+ K^+$ pump
C. Hypercellular stroma
D. Peculiar arrangement of stromal lamella

36. Condition which is always bilateral:
A. Infantile glaucoma
B. Megalocornea
C. Acute congestive glaucoma
D. All of the above
E. None of the above

37. Commonest causative organism of corneal ulcer is:
A. Pneumococci
B. Streptococci
C. Staphylococci
D. Fungal

38. Corneal ulceration may be caused by injury to which cranial nerve:
A. Third
B. Fifth
C. Sixth
D. All of the above

39. What type of corneal dystrophy is associated with acid mucopolysaccharidosis:
A. Granular
B. Lattice
C. Macular
D. Peripheral

40. The colour of fluorescein staining in corneal ulcer is:
A. Yellow
B. Blue
C. Royal blue
D. Green

41. Metabolically most active layer of cornea is:
A. Endothelium
B. Stroma
C. Descemet's membrane
D. Epithelium

42. Earliest symptom in corneal ulcer is:
A. Loss of sensation
B. Diminished vision
C. Photophobia
D. Pain

43. Munson's sign is seen in:
A. Keratoconus
B. Keratoglobus
C. Microcornea
D. All

44. "Orange skin" cornea results due to:
A. Chalcosis
B. Siderosis
C. Ammonia burn
D. Mustard gas

45. Anterior lenticonus is seen in:
A. Marfan's syndrome
B. Ehler-Danlos syndrome
C. Weill-Marchesani syndrome
D. Homocystinuria

46. For transplantation, cornea is preserved in:
A. Modified MK medium
B. Glycerine medium
C. Wet medium
D. All of the above

47. Microscopy of corneal ulcer showed branching septate hyphae. The probable diagnosis is:
A. Candida
B. Mucormycosis
C. Aspergillus
D. Histoplasma

48. Corneal epithelium is composed of:
A. Stratified keratinized epithelium
B. Stratified non-keratinized epithelium
C. Columnar epithelium
D. Pseudostratified epithelium
E. Transitional epithelium

49. Keratomalacia is associated with:
A. Measles
B. Mumps
C. Rubella
D. Chicken pox

50. Herpes zoster ophthalmicus is a predicator of:
A. Leukemia
B. Lymphoma
C. HIV
D. All of the above

51. All are true about keratoconus *except*:
A. Increased curvature of cornea
B. Astigmatism
C. KF ring cornea
D. Thick cornea

52. Thinning of cornea occurs in:
A. Megalocornea
B. Bullous keratopathy
C. Endothelial dystrophy
D. Keratoconus

53. Treatment of choice for photophthalmia is:
A. Irrigation with antibiotics
B. Irrigation with local anaesthesia
C. Irrigation with saline
D. Patching the eye

35 : C 36 : B 37 : C 38 : B 39 : C 40 : D 41 : D 42 : D 43 : A 44 : D 45 : A 46 : A 47 : C 48 : B 49 : A 50 : D 51 : D 52 : D 53 : D

54. Deep anterior lamellar keratoplasty is indicated in:
A. Disease of deeper cornea, e.g. endothelial damage
B. Full thickness corneal opacities
C. Bullous keratopathy
D. Superficial corneal opacities

55. Recurrent corneal erosion seen in:
A. Corneal dystrophy
B. Keratoglobus
C. Keratoconus
D. Peutz-anomalies

56. Posterior polymorphous dystrophy
A. Causes corectopia
B. Is inherited in an autosomal recessive fashion
C. Causes blindness in over 90% of sufferers
D. Can be treated with lamellar corneal grafts

57. To prevent keratoconus what is used:
A. Antibiotics
B. Cycloplegics
C. Glasses
D. None

58. Interstitial keratitis is seen in *all except*:
A. Syphilis
B. Acanthamoeba
C. Chlamydia trachomatis
D. HSV
E. HZV

59. Band-shaped keratopathy seen in:
A. JRA
B. RA
C. SLE
D. DLE

60. Following corneal transplantation, most common infection occur due to:
A. *Staphylococcus epidermidis*
B. *Streptococcus*
C. *Klebsiella*
D. *Pseudomonas*

61. Enlarged corneal nerves may be seen in all of the following *except*:
A. Keratoconus
B. Herpes simplex keratitis
C. Leprosy
D. Neurofibromatosis

62. A 28-year-old male complains of glare in both eyes. The cornea shows whorl like opacities of the epithelium. He also gave a history of long term treatment with amiodarone. The most like diagnosis is:
A. Terrain's marginal degeneration
B. Cornea verticillata
C. Band-shaped keratopathy
D. Arcus juvenilis

63. Dellen is:
A. Localized thinning of peripheral cornea
B. Raised lesions in corneo-limbal junction
C. Age-related macular degeneration
d. Marginal keratitis

64. True about anatomy of adult cornea:
A. Horizontal diameter is 12 mm
B. Horizontal diameter is 10 mm
C. In megalocornea diameter is >12 mm
D. In microcornea diameter <10 mm
E. Vertical diameter > Horizontal diameter

65. True about cornea:
A. Power is 43 D
B. Majority of refraction occur at air-tear interfac
C. With the rule astigmatism is present becaus vertical meridian more sleep than horizont meridian
D. Spherical structure
E. Refractive index 1.334.

66. Corneal transparency is maintained by *all excep*
A. Relative dehydration
B. Increased mitotic figures in centre of cornea
C. Unmyelinated nerve fibers
D. Uniform spacing of collagen fibrils

67. Ionic pump in corneal endothelium is necessar for maintaining deturgescence of the cornea an thus transparency. It can be blocked by:
A. Inhibition of anaerobic glycolysis
B. Activation of anaerobic glycolysis
C. Inhibition of Kreb's cycle
D. Inhibition of HMP pathway

68. A young man aged 30 years, presents with difficulty in vision in the left eye for the last 10 days. He i a rural community and gives history of trauma to his left eye with vegetative matter 10–15 days back. On examination, there is an ulcerative lesion in the cornea, whose base has raised soft creamy infiltrate. Ulcer margin is feathery and hyphate There are a few satellite lesions also. The most probable etiological agent is:
A. *Acanthamoeba*
B. *Corynebacterium diphtheria*
C. *Fusarium*
D. *Streptococcus pneumonia*

54 : D 55: A 56 : A 57 : D 58 : B 59 : A 63 : A 64 : A and D 65 : A, B and C 66 : F
60 : A 61: B 62 : B 67 : A 68 : C

69. Kallu, a 25-year-old male patient presented with a red eye and complains of pain, photophobia, watering and blurred vision. He gives a history of trauma to his eye with a vegetable matter. Corneal examination shows a dendritic ulcer. A corneal scraping was taken and examined. Microscopy showed macrophages like cells on culturing the corneal scrapings over a non-nutrient agar enriched with *E. coli*, there were plaque formations. Which organism is most likely:
A. Herpes simplex
B. Acanthamoeba
C. Candida
D. Adenovirus

70. Corneal dystrophies are usually:
A. Primarily unilateral
B. Primarily bilateral
C. Primarily unilateral without systemic disease
D. Primarily bilateral with systemic disease

71. Corneal dystrophies are:
A. Macular
B. Granular
C. Lattice
D. Moorens
E. Fuchs

72. Which of the following is the least common corneal dystrophy:
A. Macular dystrophy
B. Lattice type I
C. Lattice type III
D. Granular corneal dystrophy

73. Which one of the following stromal dystrophy is a recessive condition?
A. Lattice dystrophy
B. Granular dystrophy
C. Macular dystrophy
D. Fleck dystrophy

74. Corneal vascularisation is/are caused by:
A. Graft rejection
B. Chemical burn
C. Contact lens use
D. Vitreous haemorrhage
E. Viral injection

75. The central nebular corneal opacity is easily treated with:
A. Lamellar keratoplasty
B. Penetrating keratoplasty
C. Gas permeable contact lens
D. Soft contact lens

76. Which of the following statements regarding corneal transplantation is true:
A. Whole eye needs to be preserved in tissue culture
B. Donor not accepted if age >60 years
C. Specular microscopy analysis is used to assess endothelial cell count
D. HLA matching is mandatory

77. Pigment deposition on cornea seen in:
A. Chloroquine
B. Digoxin
C. Ranitidine
D. Amiodarone.

78. Corneal transplantation:
A. Donor >60 years not allowed
B. Whole eye preserved in culture
C. Specular microscopy done for corneal endothelial count
D. HLA matching required

79. Corneal tattooing is done by:
A. Iron
B. Silver
C. Copper
D. Platinum

80. Neuroparalytic keratitis is due to which cranial nerve:
A. 3rd nerve
B. 5th nerve
C. 6th nerve
D. 7th nerve

81. Where are stem cells present in the cornea? *(DNB 2016)*
A. Limbus
B. Epithelium
C. Stroma
D. Descemet's membrane

82. In hypoxic injury, the cornea becomes oedematous due to the accumulation of: *(AIIMS 2014)*
A. Carbon dioxide
B. Lactate
C. Pyruvate
D. Glycogen

83. Contact lens wear has been shown to have deleterious effects on the corneal physiology. Which of the following statements is incorrect? *(AIPG)*
A. The level of glucose availability in the corneal epithelium is reduced
B. There is reduction in the density of hemi-desmosomes
C. There is increased production of CO_2 in the epithelium
D. There is reduction in the glucose utilization by the corneal epithelium

69 : B 70 : B 71 : A, B, C and E 72 : A 73 : C 74 : A, B and C 75 : A 76 : C 77 : A and D 78 : C 79 : D 80 : B 81 : A 82 : B 83 : D

84. Corneal thickness is best measured by: *(APPG 2013)*
A. Ophthalmometer
B. Lensometer
C. Pachymeter
D. Focimeter

85. Which of the following can cause corneal perforation in just 48 hours? *(AIIMS)*
A. *Staphylococcus*
B. *Pseudomonas*
C. Diphtheria
D. Aspergillus

86. Steroids are contraindicated in: *(AIPG)*
A. Phlyctenular conjunctivitis
B. Mooren's ulcer
C. Vernal keratoconjunctivitis
D. Dendritic ulcer

87. Corneal ulcer resembling fungal ulcer is seen due to infection with: *(May AIIMS 2016)*
A. *Nocardia asteroids*
B. *Mycobacterium*
C. *Chlamydia trachomatis*
D. *Klebsiella pneumoniae*

88. Recurrent corneal erosions are seen in: *(PGI 2007)*
A. Keratoglobus
B. Keratoconus
C. Glaucoma
D. Corneal dystrophy

89. In Keratoconus, all are seen *except*: *(PGI 2000)*
A. Munson's sign
B. Thinning of cornea at the centre
C. Distortion of the corneal reflex
D. Hypermetropic refractive error

90. Keratoconus is associated with all *except*: *(Manipal 2009)*
A. Down's syndrome
B. Marfan's syndrome
C. Ehlers-Danlos syndrome
D. Usher syndrome

91. True about Keratoconus is/are: *(PGI 2014)*
A. Increased curvature of the cornea
B. Astigmatism is seen
C. Kayser-Fleischer ring is seen
D. Cornea is thick
E. Soft contact lenses are used

92. Early keratoconus may be diagnosed by: *(APPG 2014)*
A. Corneal topography
B. Keratometry
C. Pachymetry
D. Ophthalmoscopy

93. Corneal dystrophies are: *(AIIMS 2012)*
A. Primarily unilateral
B. Primarily bilateral
C. Primarily unilateral with systemic disease
D. Primarily bilateral with systemic disease

94. Which of the following is the least common corneal dystrophy? *(AIPG 2010)*
A. Macular dystrophy
B. Lattice type I dystrophy
C. Lattice type II dystrophy
D. Granular dystrophy

95. Which of the following does not result in amorphous whorl-like deposits in the cornea? *(AIIMS 2015)*
A. Chloroquine
B. Amiodarone
C. Indomethacin
D. Chlorpromazine

96. Which of the following is not an absolute contra indication for corneal transplantation? *(AIIMS 2014*
A. TB meningitis
B. Rabies
C. Death due to unknown cause
D. SSPE

97. Signs of graft rejection are all *except*: *(PGI*
A. Krachmer's spots
B. Khodadoust line
C. Graft oedema
D. Epithelial rejection line
E. Foster's spots

98. Khodadoust line indicates: *(DNB 201*
A. Sympathetic ophthalmia
B. Rejection in corneal graft
C. Acute congestive glaucoma
D. Lesion in optic chiasma

99. Universal marker for limbal stem cells is:
A. Elastin
B. Keratin
C. Collagen
D. ABCG2

84 : C 85 : B 86: D 87 : A 88 : D 89 : D 90 : D 91 : A, B

92 : A 93 : B 94 : A 95 : D 96 : A 97 : E 98 : B 99 : D

CHAPTER

7

Diseases of Sclera

QUICK TEXT REVIEW

INFLAMMATORY DISORDERS

EPISCLERITIS

- Typically affects young adults, being twice as common in women than men
- *Etiology* in most cases is not known. Occurs in association with gout, rosacea, psoriasis and as hypersensitivity reaction to endogenous tubercular or streptococcal proteins
- *Types:* Diffuse episcleritis, nodular episcleritis
- In nodular episcleritis, a pink or purple flat nodule surrounded by congestion is usually situated 2–3 mm away from the limbus
- *Episcleritis periodica* refers to a fleeting type of disease
- *Treatment* in severe cases is with topical steroids and systemic indomethacin 50 mg twice daily.

SCLERITIS

- Usually occurs in elderly patients (40–70 years), involving females more than the males. More rare than episcleritis.
- About 50% cases are associated with some systemic disease including connective tissue disease like Rheumatoid arthritis, Wegener granulomatosis, Polyarteritis nodosa and SLE.
- About 0.5% of patients with seropositive rheumatoid arthritis develop scleritis.
- Causes of non-pyogenic scleritis are syphilis, tuberculosis, and leprosy.
- In scleritis pain is moderate to severe, deep and boring in character.

Classification

I. ***Anterior scleritis***
   - Non-necrotizing: Diffused or nodular
   - Necrotizing: With or without inflammation

II. ***Posterior scleritis***

Salient features

- Non-necrotizing anterior diffuse scleritis is the most common clinical variety
- Patients of particularly necrotizing scleritis may have one of the following systemic diseases: Rheumatoid arthritis, connective tissue vascular disorders like polyarteritis nodosa, SLE, Wegener's granulomatosis and miscellaneous diseases like relapsing polychondritis, herpes zoster and surgically-induced scleritis.
- *Scleromalacia perforans* refers to anterior necrotizing scleritis without inflammation. It is common in women with long-standing seropositive rheumatoid arthritis. There is no effective treatment for this condition
- *Posterior scleritis* is frequently misdiagnosed. Its features are proptosis, limitation of ocular movements, exudative retinal detachment, macular oedema
- *Cornea and uveal tract are frequently involved* in scleritis and not in episcleritis.

MISCELLANEOUS CONDITIONS AND SALIENT POINTS

BLUE SCLERA

- *A typical association* of blue sclera is osteogenesis imperfecta
- *Other associations* are Marfan's syndrome, Ehlers-Danlos syndrome, pseudoxanthoma elasticum, congenital glaucomas, healed scleritis and Werner's syndrome, staphyloma, Paget's disease.

STAPHYLOMA

- *Staphyloma* refers to bulging of the ecstatic cicatricial outer coat of the eyeball lined by uveal tissue

- *Anterior staphyloma* results after total sloughing of the cornea
- *Intercalary staphyloma* refers to ectasia of sclera with incarceration of root of iris within 3 mm of limbus). It may occur after scleritis, perforating injury, peripheral corneal ulceration
- *Ciliary staphyloma* refers to scleral ectasia 3 mm posterior to limbus. It may occur following scleritis, perforating injury or absolute glaucoma
- *Equatorial staphyloma* commonly occurs at the regions of sclera which are perforated by vortex veins. It is seen in high myopia and healed scleritis
- *Posterior staphyloma occurs* posterior to the equator. It may occur due to pathological myopia (most common cause), posterior scleritis, an posterior perforating injury.

CAUSES OF SCLERAL THINNING

- Uveitis
- Scleritis
- Tuberculoma
- Congenital glaucoma.

SOME SALIENT POINTS

- *Diseases of the sclera are chronic* because of relativ avascularity of sclera.
- *Sclera is thickest* at the posterior pole and thinnes at the lamina cribrosa.

MULTIPLE CHOICE QUESTIONS

1. All of the following are features of episcleritis *except*:
A. Redness
B. Marked pain
C. Photophobia
D. Lacrimation

2. Scleritis is most commonly associated with:
A. Polyarteritis nodosa
B. Tuberculosis
C. Rheumatoid arthritis
D. Sarcoidosis

3. The most common variety of scleritis is:
A. Non-necrotizing anterior diffuse
B. Non-necrotizing anterior nodular
C. Anterior necrotizing with inflammation
D. Anterior necrotizing without inflammation

4. The clinical variety of scleritis associated with collagen diseases is:
A. Necrotizing nodular scleritis
B. Non-necrotizing nodular scleritis
C. Scleromalacia perforans
D. All of the above

5. Ciliary staphyloma occurs due to all of the following *except*:
A. Scleritis
B. Perforating injury
C. Absolute glaucoma
D. Episcleritis

6. Blue sclera is seen in:
A. Alkaptonuria
B. Osteogenesis imperfecta
C. Lowe's syndrome
D. All of the above

7. Sclera is thinnest at:
A. Posterior pole
B. Equator
C. Corneoscleral junction
D. Points of muscular attachments

8. Commonest cause of posterior staphyloma is:
A. Glaucoma
B. Retinal detachment
C. Iridocyclitis
D. High myopia

9. Episcleritis periodica refers to:
A. Fleeting type of episclerities
B. Complicated episclertis
C. Intermediate stage between episcleritis and scleritis
D. None of the above

10. Scleritis is associated with some systemic disease including connective tissue disorder in:
A. 35% of cases
B. 50% of cases
C 66% of cases
D. 85% of cases

11. Staphyloma involvement:
A. Iris with conjunctiva
B. Conjunctiva with cornea
C. Choroid with retina
D. Iris with cornea

12. Most common cause of posterior staphyloma:
A. Trauma
B. Glaucoma
C. Myopia
D. Scleritis

13. In scleritis all are true *except*:
A. Scleromalacia perforans are more commonly associated with systemic diseases than posterior scleritis
B. Pain is not a prominent feature
C. Retinal detachment is a known complication
D. Glaucoma is a known complication

14. The most common systemic association of scleritis is:
A. Ehlers-Danlos syndrome
B. Disseminated systemic sclerosis
C. Rheumatoid arthritis
D. Giant cell arteritis

15. Most common cause of anterior staphyloma is: ***(DNB 2013)***
A. Corneal ulcer
B. Myopia
C. Hypermetropia
D. Herpetic keratitis

16. In scleritis, all are true *except*: ***(Manipal 2009)***
A. Scleromalacia perforans is commonly associated with systemic disease
B. Pain is not a prominent feature
C. Retinal detachment is a known complication
D. Glaucoma may occur

1:B 2:C 3:A 4:D 5:D 6:B 7:D 8:D 9:A 10:B 11:D 12:C 13:B 14:C 15:A 16:B

CHAPTER

8

Diseases of Uveal Trac

QUICK TEXT REVIEW

UVEITIS (INFLAMMATIONS OF UVEA)

CLASSIFICATION

Anatomical Classification

Depending upon the anatomical part of the uveal tract which is involved, uveitis can be classified into:

- *Anterior uveitis:* It involves the iris and pars plicata of the ciliary body, hence known as **iridocyclitis**.
- *Intermediate uveitis:* It involves the pars plana of the ciliary body and the surrounding vitreous, hence known as **pars planitis**.
- *Posterior uveitis:* It involves mainly the choroid with associated inflammation of the overlying retina and vitreous, hence called **chorioretinitis**.

Pathological Classification

Non-granulomatous: Common systemic disorders associated with acute non-granulomatous anterior uveitis are: sacroiliitis, ankylosing spondylitis, Reiter's syndrome, psoriasis, ulcerative colitis and Crohn's disease.

Granulomatous: Important causes of granulomatous uveitis are: Tuberculosis, Leprosy, Syphilis, Herpetic uveitis, Brucellosis, Histoplasmosis, cryptococcosis, Sarcoidosis, Vogt-Koyanagi, Harada's disease, Sympathetic ophthalmitis, Lens induced uveitis, and Foreign body uveitis.

Clinical Classification

- *Acute uveitis*: Sudden onset uveitis with limited duration.
- *Recurrent uveitis*: Repeated episodes of uveitis separated by periods of inactivity lasting at least 3 months.
- *Chronic uveitis*: Persistent inflammation which promptly recurs within 3 months when treatment is stopped.

ETIOLOGY

A. Infectious uveitis

i. *Bacterial uveitis.* It may be granulomatous, e.g tubercular, leprotic, syphilitic and other spirochetal uveitis, Brucellosis, Lyme disease, Leptospiral uveitis, Ocular nocardiasis, Ocular bartonellosis Uveitis in whipple disease, or pyogenic such as streptococci, staphylococci, pneumococci and gonococcus.

ii. *Viral uveitis* may be associated with herpes simplex, herpes zoster and cytomegalovirus (CMV) AIDS, Chikungunya, Dengue, West Nile disease and Rubella infections.

iii. *Fungal uveitis* is rare and may accompany systemic aspergillosis, candidiasis, cryptococcosis and blastomycosis. It also includes presumed ocular histoplasmosis syndrome.

iv. *Parasitic uveitis* is known in toxoplasmosis toxocariasis, onchocerciasis, cysticercosis, diffuse unilateral subacute neuroretinitis and amoebiasis.

v. *Rickettsial uveitis* may occur in scrub typhus and epidemic typhus.

B. Non-infectious uveitis

1. *Autoimmune uveitis*

i. *HLA-associated systemic diseases with uveitis* include: Ankylosing spondylitis (HLA-B27), Reiter's syndrome (HLA-B27), Behcet's disease (HLA-B51), Birdshot retinochoroidopathy (HLA-A29), VKH syndrome (HLA-DR4, HLA-DR1), Sympathetic ophthalmitis (HLA-DR4), Sarcoidosis (HLA-B8, HLA-B1), Persumed ocular histoplasmosis (HLA-B7, HLA-DR2), Retinal vasculitis (HLA-B44), Multiple sclerosis (HLA-B7, HLA-DR2), Intermediate uveitis (HLA-B8, -B51, -DR2, -R15) and Juvenile rheumatoid arthritis (HLA-A2, -DR5, DR8, -DR11, -DR2.1)

ii. ***Other systemic diseases*** associated with non-infectious uveitis are:

- *Collagen related diseases* such as polyarteritis nodosa (PAN), Disseminated lupus erythematosus (DLE), physiology of rheumatoid arthritis
- *Diseases of skin* such as psoriasis, lichen planus, erythema nodosum, pemphigus
- *Metabolic diseases* like diabetes mellitus and gout.
- **Anaphylactic uveitis.** It is said to accompany the systemic anaphylactic reactions, like serum sickness and angioneurotic oedema and local anaphylactic reaction such as phacoanaphylactic uveitis.

2. *Atopic uveitis.* It occurs due to airborne allergens and inhalants, e.g. seasonal iritis due to pollens. A similar reaction to such material as danders of cats, chicken feathers, house dust, egg albumin and beef proteins has been noted.

3. *Traumatic uveitis* is known to occur following blunt or penetrating ocular trauma and surgical trauma from intraocular procedures.

4. *Idiopathic uveitis* It may be specific or nonspecific.

i. *Idiopathic specific uveitis entities* include the conditions which have certain special characteristics, e.g. pars planitis, sympathetic ophthalmitis and Fuchs' heterochromic iridocyclitis.

ii. *Nonspecific idiopathic uveitis entities* include the condition which do not belong to any of the known etiological groups. About more than 25% cases of uveitis fall in this group.

C. Masquerade Syndrome

Masquerade syndrome refers to clinical presentation of uveal inflammation which are not due to immune-mediated uveitis entities.

i. ***Non-neoplastic masquerade syndromes,*** classically may occur in conditions like: retinitis pigmentosa, ocular ischaemic syndrome, retinal detachment, intraocular foreign body and pigmented dispersion syndrome.

ii. ***Neoplastic masquerade syndromes.*** Some intraocular neoplasms which can present with features of uveitis include:

Lymphoid malignancies such as primary central nervous system lymphomas, secondary to systemic lymphomas, secondary to leukaemias and secondary to uveal lymphoid proliferation.

Non-lymphoid malignancies include uveal melanomas, retinoblastoma, juvenile xanthogranuloma and metastatic tumours.

IRIDOCYCLITIS

Clinical features

Endothelial bedewing of the cornea is the earliest sign of iritis.

Keratic precipitates (KPs), i.e. proteinaceous cellular deposits at the back of the cornea are an important feature of cyclitis. They may be the only sign in insidious cases of cyclitis. KPs are seldom present in simple iritis

- *Mutton fat KPs* are pathognomonic of granulomatous iridocyclitis
- *Small and medium KPs* are seen in nongranulomatous iridocyclitis
- *Very fine KPs* occur in Fuchs heterochromic cyclitis
- KPs are arranged in a triangular fashion due to convection current.

Aqueous flare is the earliest sign of iridocyclitis. It is best seen with slit lamp examination. Occurs due to leakage of proteins and leucocytes into the anterior chamber as a result of breakdown of blood-aqueous barrier.

Aqueous cells are sign of active inflammation.

Iris nodules are a feature of granulomatous iridocyclitis. Koeppe's nodules are situated at the pupillary border. Bussaca's nodules are situated near the collarette.

Small and irregular pupil in iridocyclitis results from sphincter irritation due to toxins and engorgement of the radial blood vessels of the iris.

Iris bombe results from annular posterior synechiae. In it, anterior chamber becomes funnel shaped.

Complications of uveitis

Acute anterior uveitis: Complicated cataract, secondary glaucoma and CME.

Chronic anterior uveitis: Rhegmatogenous retinal detachment, phthisis bulbi (end result of chronic uveitis, in which intraocular tension is reduced due to decreased aqueous formation). Histopathology shows marked scleral thickening and intraocular ossification.

Granulomatous versus non-granulomatous uveitis

Feature	*Granulomatous*	*Non-granulomatous*
Onset	Insidious	Acute
Keratic precipitates (KPs)	Mutton fat	Small
Iris nodules	Usually present	Absent
Posterior synechiae	Thick and broad based	Thin and tenuous
Fundus	Nodular lesions	Diffuse involvement

Treatment

- *Atropine* is the most important topical drug (of choice) for the management of a case of acute iridocyclitis. This relieves the ciliary spasm and prevents the formation of posterior synechiae.
- *Steroids*, topical (drug of choice) as well as systemic are effective in most cases.
- *Immunosuppressive drugs* are especially useful in severe cases of Behcet's disease, sympathetic ophthalmitis, pars planitis, and Vogt-Koyanagi-Harada syndrome.

INTERMEDIATE UVEITIS

Sarcoidosis, toxocariasis, candidiasis, multiple sclerosis, toxoplasmosis, herpes simplex associated acute retinal necrosis, Behcet's disease, HIV associated uveitis, CMV retinitis, White dot syndromes.

- Patient mainly complains of floaters
- *Anterior segment*: May be quiet or associated with mild inflammation
- *Posterior segment*: Whitish vitreous exudates are seen surrounding the pars plana, more prominent inferiorly. These exudates are known are **snow-ball opacities**. They coalesce to form an inflammatory plaque around the pars plana which is referred to as **snow-banking**.

Treatment: periocular and systemic steroids.

CHOROIDITIS (POSTERIOR UVEITIS)

Posterior Uveitis

Symptoms

Decrease in vision is the common complaint. Pain, photophobia and redness are generally absent

Signs

- Anterior chamber is generally quiet
- Posterior chamber: It shows the following features:
  - Vitritis
  - Choroiditis: It may be unifocal or multifocal
  - Periphlebitis
  - Neuroretinitis.

Clinical types include:

- *Diffuse choroiditis* refers to a large spreading lesion involving most of the choroidal tissue. It is usually tubercular or syphilitic in origin
- *Disseminated choroiditis* is characterised by multiple small areas of inflammation scattered over the greater part of choroid, usually tubercular or syphilitic in origin
- *Central choroiditis* involves macular area, common causes are: Toxoplasmosis, histoplasmosis, tuberculosis, syphilis, visceral larva migrans (onchocerca) and rubella.
- *Juxtacaecal choroiditis* involves the area adjoining optic disc, typical example is Jensen's choroiditis
- *Anterior peripheral choroiditis* is usually syphilitic in origin
- *In late stages of choroiditis*-negative scotoma occurs in field of vision.

Treatment: Drug of choice—Systemic steroids.

WHITE DOT SYNDROMES

This is a broad term which encompasses different entities which are associated with posterior uveitis giving rise to multiple white dots in the chorioretina. These are actually microgranulomas composed of lymphocytes and macrophages.

Important causes of white dot syndromes are:

- Acute posterior multifocal placoid pigment epitheliopathy
- Serpiginous choroidopathy
- Birdshot retinochoroidopathy
- Punctuate inner choroidopathy
- Progressive subretinal fibrosis and uveitis
- Presumed ocular histoplasmosis syndrome (POHS)
- Multiple evanescent white dot syndrome (MEWDS).

ENDOPHTHALMITIS

Etiology

- *Exogenous infection* is the most common mode for purulent endophthalmitis. Most common cause is intraocular surgery.
- *Most common organisms causing endophthalmitis* are divided into two groups:
  1. *Surgeon fault*: *Staphylococcus epidermidis*, *Staphylococcus aureus* and *Pseudomaonas*.
  2. *Patient fault*: *Propionbacterium acnes*.

Features

- *Inflammation of inner structure* of the eyeball (which include; uveal tissue, retina, vitreous and sclera is spared) with pouring of exudates into the anterior and posterior chamber of the eye.
- *On examination*—Amaurotic cat's eye reflex.
- *Puff ball opacities* in the vitreous are pathognomonic of fungal endophthalmitis

Treatment

- *Intravitreal antibiotic injection* is treatment of choice. *Vitreous samples collected* in emergency should be stored at 4°C.
- *Antibiotics* should be given by all the routes viz. topical, subconjunctival, intravitreal (treatment of choice) and intravenously in bacterial endophthalmitis

- *Steroids* should be started after 12–24 hours of intensive antibiotic therapy
- *Vitrectomy* is the treatment of choice for fungal endophthalmitis. In bacterial endophthalmitis, it should be performed when the condition does not improve with intensive conservative therapy for 48 hours.

SPECIFIC CLINICOETIOLOGICAL VARITIES OF NON-SUPPURATIVE UVEITIS

I. Uveitis in chronic systemic bacterial infections

Tubercular uveitis

- Accounts for 1% of uveitis patients in developed countries. However, it is a very common cause of uveitis in developing countries
- Most frequent feature is chronic granulomatous uveitis
- Isoniazid test (300 mg/day for 3 weeks) for suspected ocular involvement is a useful diagnostic test
- Systemic treatment consists of a course of isoniazid, pyridoxine and rifampicin for 12 months.

Acquired syphilitic uveitis

- *Acute plastic iritis,* typically occurs in secondary syphilis
- *Gummatous anterior uveitis* occurs in late secondary syphilis and is characterised by yellowish red highly vascularized nodules arranged near the pupillary or ciliary border of iris
- *Chorioretinitis* may be peripheral, disseminated or diffuse
- *Neuroretinitis* may cause optic atrophy.

Leprotic uveitis

- Uveitis (predominantly anterior) occurs more commonly in lepromatous than the tuberculoid form of leprosy
- *Chronic granulomatous iritis* is characterised by presence of small glistening '*iris pearls*' near the pupillary margin in necklace form.

II. Uveitis in non-infectious systemic diseases

Sarcoid uveitis

Sarcoid uveitis accounts for 2% cases of uveitis and may occur as:

- *Acute unilateral non-granulomatous* anterior uveitis occurs in young patients with acute sarcoidosis
- *Chronic bilateral granulomatous* iridocyclitis occurs in older patients with chronic lung disease
- *Uveoparotid fever* (Heerfordt's syndrome): Bilateral granulomatous panuveitis, painful enlargement of parotid glands, cranial nerve palsies, skin rashes, fever and malaise
- *Fundus changes* include:
  - Periphlebitis-advanced stage of vascular sheathing leads to Candle-wax drippings.
  - Retinal granulomata
  - Pre-retinal nodules *(Lander's sign)*
  - Retinal haemorrhages (in acute sarcoid retinopathy)
  - Choroidal granulomata
  - Optic disc may show granuloma, neovascularization, papilloedema or optic atrophy.

Behcet's disease

- *Typically affects* young men who are positive for HLA-B5
- *Ocular features* are bilateral, recurrent, acute non-granulomatous iridocyclitis associated with transient hypopyon.

Vogt-Koyanagi-Harada (VKH) syndrome

It is more common in Japanese who are usually positive for HLA-DR4. Clinical features include:

- *Cutaneous lesions*—alopecia, poliosis, and vitiligo
- *Neurological lesions* are meningism, encephalopathy, tinnitus, vertigo, and deafness
- *Ocular features* are chronic granulomatous anterior uveitis, posterior uveitis, and exudative retinal detachment.

III. Uveitis with arthritis

Uveitis with ankylosing spondylitis

- Ankylosing spondylitis is a common, chronic, sero-negative inflammatory arthritis which usually involves sacroiliac and posterior intervertebral joints
- Typically affects HLA-B27 positive young males
- About 30% cases develop a recurrent, unilateral, non-granulomatous, acute anterior uveitis.

Reiter's syndrome

- *Characterised by a triad* of urethritis, arthritis and conjunctivitis
- Acute non-granulomatous iridocyclitis occurs in 20–30% cases
- Typically affects young males, 70% of whom are positive for HLA-B27.

Juvenile chronic arthritis (JCA)

- *Anterior uveitis* associated with JCA is chronic bilateral non-granulomatous with insidious onset
- Bilateral in 70% cases (white uveitis)
- Uveitis is much more common in pauciarticular JCA than polyarticular JCA
- About half of the cases are positive for HLA- DW5 and 75% are positive for antinuclear antibodies (ANA)

- *Complications* include posterior synechiae, complicated cataract and *band-shaped keratopathy* (commonest).

IV. Parasitic uveitis

Toxoplasmosis

Congenital toxoplasmosis

- Fetus gets infestation from the involved mother through transplacental route.
- *Characteristic triad* includes convulsions, calcification (intracranial), and chorioretinitis.
- Chorioretinitis at birth may be: (1) Inactive (more common)—bilateral punched out heavily pigmented scar at macula, or (2) Active (rare) - necrotic granulomatous retinochoroiditis.

Acquired toxoplasmosis

- Very rare
- Most of the cases are subclinical (asymptomatic).

Recurrent toxoplasmic retinochoroiditis

- Most common cause of a focal retinochoroiditis
- Characterised by a whitish-yellow, slightly raised area near the margin of old punched out scar of healed chorioretinitis
- There may be associated non-granulomatous type of mild anterior uveitis.

Antitoxoplasmic drugs

- Clindamycin
- Spiramycin
- Pyrimethamine
- Sulphadiazine.

Toxocariasis

Infestation occurs in childhood by accidental ingestion of ova of toxocara canis shed in faeces of cats.

Visceral larva migrans produces following ocular lesions (usually unilateral):

- *Toxocara chronic endophthalmitis* which presents between 2 and 10 years of age as leukocoria
- *Posterior pole granuloma*—between 5 and 15 years of age
- *Peripheral granuloma*—between 6 and 40 years of age.

V. Fungal uveitis

Presumed ocular histoplasmosis syndrome (POHS)

- Presumed to be caused by histoplasma capsulatum
- Lesions (usually bilateral) include:
  - *Histo spots:* Atrophic spots scattered in the midretinal periphery
  - *Neovascular maculopathy* ending in disciform scarring.

Candidiasis

An opportunistic infection occuring in:

- Immunocompromised patients (e.g. tho suffering from AIDS or malignancies)
- Patients with long-term indwelling catheter
- Drug addicts using infected needles.

Ocular lesions

- Anterior uveitis associated with hypopyon
- Multifocal chorioretinitis with Roth's spots
- Endophthalmitis—characterised by 'puff ball' 'cotton ball' colonies, which joined by exudati strands form a 'string of pearls'.

VI. Viral uveitis

Herpes zoster uveitis

- Unilateral non-granulomatous acute anteri uveitis occurs in about 50% cases with herp zoster ophthalmicus
- Complications include:
  - Large segmental iris atrophy in 20%
  - Secondary glaucoma due to trabeculitis in 10
  - Complicated cataract may occur in late stage

Acquired cytomegalovirus (CMV) retinitis

- Occurs in immunocompromised patients (e.g patients with AIDS and those on cytotoxic therap for malignancies, etc.)
- *Ocular lesions* includes: Cotton-wool spots, area of retinal necrosis, and areas of vasculitis an haemorrhage (sauce and cheese retinopathy)
- *Complications* are exudative retinal detachmen retinal atrophy and optic atrophy.

VII. Idiopathic specific uveitis syndromes

Fuch's uveitis syndrome (Heterochromic iridocyclitis)

Unilateral mild grade, non-granulomatous, anterio uveitis occurring between 20 and 40 years of age characterised by:

- Heterochromia of iris due to diffuse stroma atrophy
- Fine KPs
- Paint aqueous flare
- No posterior synechiae
- Neovascularization of the angle
- Early development of the complicated cataract (usually the presenting sign)
- Secondary glaucoma (uncommon).

Intermediate uveitis (pars planitis)

- Patients presents with floaters or defective visio
- Eye usually looks quiet
- 'Snow ball' vitreous opacities in the inferior quad rant, which may coalesce to form 'snow banking

Glaucomatocyclitis crisis (Posner Schlossman syndrome)

Etiology

Typically affects young adults, 40% of whom are positive for HLA-BW 54.

Clinical features

- *White eye* (no or minimal congestion)
- *Cornea* usually clear/mild epithelial oedema
- *Fine KPs* but no synechiae
- *Dilated pupil.*
- *IOP*: Recurrent attacks of acute rise of the intra-ocular pressure (40–50 mm Hg) without shallowing of anterior chamber.
- *Gonioscopy*: open-angle glaucoma
- *Fundus* shows no optic nerve cupping
- *Visual field* is normal.

Treatment

- Anti-glaucoma drugs
- NSAIDs and rarely
- Steroids.

HETEROCHROMIA

Congenital causes

- Waardenburg's syndrome
- Horner's syndrome
- Naevus of ota
- Congenital ocular melanocytosis.

Acquired causes

- Chronic iritis
- Fuchs heterochromic cyclitis
- Iris naevus or melanoma
- Siderosis
- Rubeosis
- Topical latanoprost.

WHITE-DOT SYNDROME

Characterized by multiple white dots in fundus.

Inflammatory causes

- Presumed ocular histoplasmosis syndrome (POHS)
- Multiple evanescent white dot syndrome (MEWDS)
- Bird-shot retinochoroidopathy
- Multifocal choroiditis
- VKH syndrome
- Sympathetic ophthalmitis
- Serpiginous choroidopathy
- HIV retinopathy
- Acute posterior multifocal placoid pigment epitheliopathy (APMPPE).

Degenerative/dystrophic causes

- Stargardt's disease
- Retinitis punctata albescens
- Cystinosis
- Drusen.

Neoplastic causes

- Leukemic retinopathy
- Metastatic tumours
- Large-cell lymphoma (Non-Hodgkin's lymphoma).

Traumatic causes

- Purtscher's retinopathy.

Miscellaneous causes

- Chloroquine or tamoxifen toxicity
- Photocoagulation spots.

MALIGNANT MELANOMA OF CHOROID

- Of the tumours of uveal tract, the malignant melanoma is the most common primary intraocular tumour of the adults
- Extremely rare in Negroes
- Commonly seen between 6th and 9th decade of life
- It arises from the pigment cells derived from the neural crest (neuroectodermal)
- May arise from the pre-existing naevus or de-novo from the mature melanocytes present in the stroma
- Earliest pathognomic sign is appearance of orange patch due to accumulation of lipofuscin in the retinal pigment epithelium
- Associated are intraretinal or vitreous haemorrhage.

Glaucoma may develop with or without uveitis due to any of the following causes:

- Obstruction of vortex veins
- Angle blockage by forward displacement of the lens iris diaphragm
- Neovascularization of the angle
- Infiltration of the angle by tumour cells.

MISCELLANEOUS POINTS

- *Patients with aniridia* have a higher prevalence of Wilms' tumour
- *Coloboma of the uveal tract* is the commonest congenital anomaly of the eye
- *Typical iris coloboma* occurs in the inferonasal quadrant. It results from failure of closure of the embryonic fissure
- Albinism results from tyrosinase deficiency
- *Blue iris* occurs due to the absence of pigment in the iris stroma
- *Sarcoidosis and Behcet's syndrome* show increased IgA levels

- *Persistent pupillary membrane* is a remnant of anterior vascular sheath of the lens. It is characterised by the stellate-shaped shreds of the pigmented tissue attached at the collarette
- *Lesions in the choroid* are restricted to isolated areas because of segmental blood supply to choroid
- *Anterior uveitis*: Drug of choice is topical steroid and second drug of choice is mydriatic and cycloplegic
- *Intermediate and posterior uveitis*: Drug of choice is systemic steroids
- *Management of uveitic glaucoma includes*: Topical steroids, mydriatics and cycloplegics
  - Topical beta blockers (first drugs of choice), epinephrine or dipivefrine, apraclonidine (alpha 2 agonist),carbonic anhydrase, inhibitors, hyperosmotic agents
  - Laser iridotomy when medical therapy fails.

  Note: Prostaglandin analogues (latanoprost) should not be used as they may increase cystoids macular oedema
- *Juvenile Rheumatoid arthritis* (pauciarticular) is associated with uveitis, cataract, ANA positive, rheumatoid factor negative. After cataract operations IOLs is contraindicated in JRA because it act as a foreign body. In other type of uveitis, w put heparin coated IOLs which retard the pigmen from iris.
- *Choroidal neovascularisation* is associated wit angioid streaks, choroidal rupture (trauma) an pathological myopia.
- *Choroidal effusion syndrome* (ciliochoroida effusion) is characterized by:
  - Thick sclera (main feature), ciliochoroida detachment (abnormal accumulation of serous fluid in outer layer of ciliary body and choroid
  - Absence of inflammation and neoplastic disease
  - Eyes may be nanophthalmic or hypermetropic
  - Leopards spots, i.e mottling of pigment epithelium.
- Polypoidal choroidal vasculopathy: It is a peculiar hemorrhagic disorder invalving macula. It is characterized by recurrent sub-retinal and sub-retinal pigment epithelium bleeding in middle aged black women. Indocyanine green angiography and subsequently optical coherent tomography is used for diagnosis.
- Choroideremia: Degenerative disease, involving choriocapillaris, retinal pigment epithelium and photoreceptors. X linked recessive, so, only males are affected. First symptoms is night blindness.

MULTIPLE CHOICE QUESTIONS

1. Most common etiological variety of uveitis is:
A. Infective
B. Allergic
C. Toxic
D. Metabolic

2. All of the following HLA-phenotypes are associated with uveitis *except*:
A. HLA-B27
B. HLA-B5
C. HLA-BW54
D. HLA-10

3. All of the following are features of granulomatous iridocyclitis *except*:
A. Minimal ciliary congestion
B. Mutton fat KPs
C. Marked aqueous flare
D. Nodules on the iris

4. All of the following are features of acute non-granulomatous iridocyclitis *except*:
A. Marked ciliary congestion
B. Numerous small keratic precipitates
C. Minimal aqueous flare
D. No iris nodules

5. Aqueous flare seen in anterior chamber is due to:
A. Leakage of protein particles into the aqueous humour following breakdown of blood aqueous barrier
B. Leakage of leukocytes into anterior chamber
C. Both of the above
D. None of the above

6. Koeppe's nodules:
A. Are a feature of nongranulomatous iridocyclitis
B. Are situated at the pupillary border
C. Consist of polymorphonuclear cells
D. Do not initiate posterior synechiae formation

7. Busacca's nodules:
A. Are a feature of nongranulomatous uveitis
B. Are situated at the pupillary border
C. Usually initiate posterior synechiae formation
D. Consists of lymphocytes, plasma cells, epithelioid and giant cells

8. Festooned pupil results from:
A. Irregular dilatation of pupil with atropine in the presence of segmental posterior synechiae
B. Annular synechiae
C. Occlusion pupillae
D. All of the above

9. Role of atropine in iridocyclitis includes all of the following *except*:
A. It dilates the pupil, prevents the formation of synechiae and may break the already formed synechiae
B. Gives comfort and rest to the eye by relieving ciliary muscle spasm
C. It reduces exudation by decreasing hyperaemia
D. It lowers the intraocular pressure increasing aqueous outflow facility

10. Granulomatous uveitis is seen in all of the following *except*:
A. Uveitis with ankylosing spondylitis
B. Sympathetic ophthalmitis
C. Tubercular uveitis
D. Uveitis in sarcoidosis

11. Dalen Fuchs nodules are pathognomic of:
A. Pathological myopia
B. Sympathetic ophthalmitis
C. Fuchs uveitis syndrome
D. Sarcoidosis

12. A healed patch of chorioretinitis gives rise to:
A. Negative scotoma
B. Positive scotoma
C. Both of the above
D. None of the above

13. 'Snow ball' opacities near the ora serrata are pathognomonic of:
A. Fungal endophthalmitis
B. Pars planitis
C. Diabetic retinopathy
D. Anterior choroiditis

14. Sign of activity in chronic iridocyclitis is:
A. Aqueous cells
B. Aqueous flare
C. Pigmented KPs
D. All of the above

15. The pathognomonic sign of acute iridocyclitis is:
A. Small pupil
B. Aqueous flare
C. Keratic precipitates
D. All of the above

16. 'Puff-balls' opacities in the vitreous are pathognomonic of:
A. Fungal endophthalmitis
B. Pars planitis
C. Exudative retinopathy of Coats
D. Sympathetic ophthalmitis

17. In bacterial endophthalmitis systemic steroids should be:
A. Started immediately
B. Started after 12–24 hours of intensive antibiotic therapy
C. Deferred
D. Given after 7 days of intensive antibiotic therapy

1:B 2:D 3:C 4:C 5:A 6:B 7:D 8:A 9:D 10:A 11:B 12:A 13:B 14:A 15:C 16:A 17:B

18. The cell type most typically seen in the keratic precipitates of non-granulomatous uveitis is:
A. Polymorphonuclear cells
B. Lymphocytes
C. Plasma cells
D. Epithelioid cells

19. Iritis roseata is seen in:
A. Leprosy
B. Syphilis
C. Tuberculosis
D. Sarcoidosis

20. Heterochromia iridis is a feature of:
A. Malignant melanoma of iris
B. Sympathetic paralysis
C. Glaucomatocyclitis crisis
D. Siderosis bulbi
E. All of the above

21. The following features of panophthalmitis differentiate it from endophthalmitis *except*:
A. Presence of pus in the anterior chamber
B. Proptosis
C. Limited and painful ocular movements
D. Complete loss of vision

22. In a patient with suspected tubercular anterior uveitis the diagnosis is confirmed by:
A. Positive Mantoux test
B. Associated findings suggestive of old systemic tuberculosis
C. A positive response to isoniazid test
D. All of the above

23. 'Iris-pearls' are seen in:
A. Syphilis
B. Leprosy
C. Sarcoidosis
D. Tuberculosis

24. Heerfordt's disease is characterised by all of the following *except*:
A. Unilateral non-granulomatous panuveitis
B. Painful enlargement of parotid glands
C. Cranial nerve palsies
D. Skin rashes, fever and malaise

25. Behcet's disease is characterised by all of the following *except*:
A. Unilateral granulomatous uveitis
B. Recurrent hypopyon
C. Aphthous ulceration
D. Genital ulcerations

26. All of the following are true for Vogt-Koyanagi-Harada syndrome *except*:
A. More common in Japanese people, who are usually positive for HLA-B27
B. Ocular features are; chronic granulomatous anterior uveitis, posterior uveitis and exudative retinal detachment
C. Cutaneous lesions are alopecia, poliosis ar vitiligo
D. Neurological lesions include, meningisn encephalopathy, tinnitus, vertigo and deafnes

27. Reiter's syndrome is typically characterised by:
A. Urethritis, conjunctivitis and iridocyclitis
B. Arthritis, conjunctivitis and iridocyclitis
C. Urethritis, arthritis and conjunctivitis with o without iridocyclitis
D. All of the above

28. Recurrent toxoplasmic retinochoroiditis, all ar true *except*:
A. Manifests at an average age of 25 years
B. The infestation is acquired by eating the under cooked meat of intermediate host containing cyst of the parasite
C. Typical lesion is a patch of focal necrotizing retinochoroiditis adjacent to a pigmented scar
D. There may be associated iritis

29. All of the following are true for the acquired cytomegalo inclusion disease *except*:
A. It occurs only in immunosuppressed patients
B. The infection is acquired from the infected cervix of the partner during sexual intercourse
C. Typical lesion is acute necrotizing retinitis
D. Exudative retinal detachment may occur

30. Granulomatous uveitis with involvement of parotid gland is seen in:
A. Tuberculosis
B. Syphilis
C. Mumps
D. Sarcoidosis

31. All of the following are true for colloid bodies (drusens) *except*:
A. Are hyaline excrescences of Bruch's membrane
B. Are secreted by pigment epithelial cells
C. Are usually associated with marked loss of vision
D. Are a precursor of disciform maci degeneration in some eyes

32. In clinical aniridia all of the following are true *except*:
A. Iris is completely absent
B. Usually familial condition
C. May be associated with congenital glaucoma
D. Ciliary processes may be visible

33. Typical coloboma of iris occurs:
A. Inferonasally
B. Superonasally
C. Inferotemporally
D. Superotemporally

18 : B 19 : B 20 : E 21 : A 22 : C 23 : B
24 : A 25 : A 26 : A
27 : C 28 : B 29 : B 30 : D 31 : C 32 : A
33 : A

34. Malignant melanoma of conjunctiva is usually of:
A. Spindle A type
B. Spindle B type
C. Mixed cell type
D. Epithelioid cell type
E. All of the above

35. Malignant change in a choroidal nevus is evidenced by:
A. Increased pigmentation or height of the nevus
B. Appearance of orange patches of lipofuscin over the surface
C. Appearance of serous detachment in the area of nevus
D. All of the above
E. None of the above

36. Malignant melanoma of the choroid of following histological features has got the best prognosis:
A. Epithelioid cell melanoma
B. Spindi - A melanoma
C. Spindle - B melanoma
D. Mixed cell melanoma

37. Malignant melanoma of the choroid with following histopathological features has got the worst prognosis:
A. Epithelioid cell melanoma
B. Spindle - A melanoma
C. Spindle - B melanoma
D. Mixed cell melanoma

38. The most common histopathological type of malignant melanoma of choroid is:
A. Spindle - A cell
B. Spindle-B cell
C. Epithelioid cell
D. Mixed cell

39. Essential atrophy of the choroid is due to inborn error of metabolism of which amino acid?
A. Cystine
B. Cysteine
C. Arginine
D. Ornithine
E. Lysine

40. The earliest symptom of sympathetic ophthalmitis is:
A. Pain
B. Decreased distant vision
C. Photophobia
D. Diplopia

41. The most earliest sign of anterior uveitis is:
A. Aqueous flare
B. Keratic precipitates
C. Constriction of pupil
D. Raised intraocular pressure

42. Separation of rods and cones due to exudative choroiditis causes:
A. Photopsia
B. Micropsia
C. Macropsia
D. Metamorphopsia

43. Commonest cause of endogenous uveitis in India is:
A. Tuberculosis
B. Leprosy
C. Syphilis
D. Diabetes mellitus

44. The most frequent bacterial agent causing non-granulomatous uveitis is:
A. *Staphylococcus*
B. *Streptococcus*
C. *Pneumococcus*
D. Influenza bacillus
E. None of the above

45. Peripheral anterior synechiae after an attack of acute congestive glaucoma occur earliest in the:
A. Lower part
B. Upper part
C. Lower and inner part
D. Lower and outer part
E. Medial part

46. In complete albinism the colour of iris is:
A. White
B. Black
C. Pink
D. Blue
E. Green

47. Iris bombe occurs is:
A. Ring synechiae
B. Anterior synechiae
C. Posteriorsynechiae
D. All

48. Drug of choice for acute iridocyclitis is:
A. Steroids
B. Acetazolamide
C. Atropine
D. Antibiotics

49. The correct statement regarding the duration after which sympathetic ophthalmitis develops is:
A. 3–12 weeks after trauma
B. Within 1 week of trauma
C. After 2 months of trauma
D. Typically at 10 days after trauma

50. One of the most common complication of iridocyclitis is:
A. Scleritis
B. Secondary glaucoma
C. Band-shaped keratopathy
D. Corneal ulcer

51. First sign of sympathetic ophthalmitis is:
A. Keratic precipitates
B. Miosis
C. Aqueous flare
D. Retrolental flare

34 : E 35 : D 36 : B 37 : A 38 : D 39 : D 40 : C 41 : A

42 : B 43 : A 44 : B 45 : B 46 : C 47 : A 48 : C 49 : A 50 : B 51 : D

52. The investigations of anterior uveitis for a 25 years old boy are all *except*:
A. HLA-B27
B. X-ray sacroiliac joint
C. TORCH agent test
D. USG abdomen
E. ELISA for HIV

53. Uveitis is caused by all *except*:
A. TB
B. *Staphylococcus*
C. *Streptococcus*
D. *Klebsiella*

54. Photopsia occurs in:
A. Iritis
B. Choroiditis
C. Cyclitis
D. Scleritis

55. 'Snow banking' is typically seen in:
A. Pars planitis
B. Endophthalmitis
C. Coat's disease
D. Eales disease

56. May masquerade as uveitis:
A. Choroidal detachment
B. Retinal detachment
C. Age-related macular degeneration
D. Central retinal artery occlusion

57. Commonest cause of fungal uveitis is:
A. Candida
B. Aspergillus
C. Fusarium
D. Mucormycosis

58. All are causes of white-dot syndrome *except*:
A. Fuchs heterochromic uveitis
B. VKH syndrome
C. HIV retinopathy
D. Sympathetic ophthalmitis

59. Most common cause of anterior uveitis associated with arthritis:
A. Ankylosing spondylitis
B. Rheumatoid arthritis
C. Syphilis
D. Tuberculosis

60. 1st sign of anterior uveitis:
A. Keratic precipitate
B. Aqueous flare
C. Hypopyon
D. Miosis

61. Keratic precipitates are on which layer of cornea:
A. Epithelium
B. Endothelium
C. Stroma
D. Bowman's membrane

62. Which of the following indicates activity anterior uveitis:
A. Cells in anterior chamber
B. Circumcorneal congestion
C. Keratic precipitate
D. Corneal oedema

63. True about heterochromic uveitis:
A. Involves posterior surface of iris
B. Involves anterior part of iris
C. Involves posterior chamber
D. Posterior synechiae

64. Vogt-Koyanagi-Harada (VKH) syndrome is:
A. Chronic granulomatous uveitis
B. Chronic non-granulomatous uveitis
C. Acute purulent uveitis
D. None

65. Histological changes in lens induced uveiti include:
A. Ghost cells
B. Giant cell reaction
C. Amyloid in the cornea
D. Vasculitis

66. Drug used in LUMINATE program for non-infectious uveitis is:
A. Cyclosporine
B. Voclosporin
C. Methotrexate
D. Infliximab

67. Granulomatous uveitis is seen in:
A. Vogt-Koyanagi-Harada disease
B. Fuch's disease
C. Bechet's syndrome
D. Sarcoidosis
E. Psoariasis

68. A 10-year-boy present with b/l chronic uveitis Which investigation should be ordered:
A. Hemogram
B. X-ray of sacroiliac joint
C. HIV rest
D. Mantoux test

69. The investigation of anterior uveitis of a young boy are:
A. HLA B 27
B. X-ray of sacroiliac joint
C. TORCH agents
D. ELISA for HIV
E. USG abdomen

70. Signs of uveitis:
A. Generalized conjunctival congestion
B. Circumciliary congestion
C. Cells and flare in aqueous
D. Keratic precipitate

52 : D 53 : D 54 : B 55 : A 56 : B 57 : A 58 : D 59 : A 60 : B 61 : B

62 : A 63 : B 64 : A 65 : B 66 : B 67 : A and D 68 : D 69 : A and B 70 : B, C and D

71. A 25-year-old lady presents with severe sudden onset of pain, corneal congestion, photophobia and deep anterior chamber in the right eye. The left eye is normal. X-ray pelvis shows sacroiliitis. The diagnosis is:
A. Anterior uveitis
B. Posterior uveitis
C. Intermediate uveitis
D. Scleritis

72. In patients with anterior uveitis, decrease in vision due to posterior segment involvement can occur because of:
A. Visual floaters
B. Inflammatory disc oedema
C. Exudative retinal detachment
D. CME

73. Mutton for keratic precipitate and Busacca's nodules is seen in:
A. Granulomatous uveitis
B. Non-granulomatous uveitis
C. Posterior uveitis
D. Choroiditis

74. Uveal effusion syndrome may be associated with all of the following *except*:
A. Myopia
B. Ciliochoroidal detachment
C. Structural defect in sclera
D. Nanophthalmos

75. In heterochromic cyclitis:
A. 60% of patients develop glaucoma
B. Show a good response when treated with steroids
C. Lens implantation following cataract surgery is contraindicated
D. Hyphaema during cataract surgery is due to iris neovascularization

76. A young patient presents to the ophthalmic outpatient department with gradual blurring of vision in the left eye. Slit lamp examination reveals fine stellate keratic precipitates and aqueous flare and a typical complicated posterior subcapsular cataract. No posterior synechiae were observed. The most likely diagnosis is:
A. Intermediate uveitis (Pars plants)
B. Heerfordt's disease
C. Heterochromic iridocyclitis of Fuchs
D. Subacute iridocyclitis

77. Which of the following drug is currently used for the prophylaxis of noninfectious uveitis in LUMINATE program:
A. Cyclosporine
B. Voclosporin
C. Methotrexate
D. Infliximib

78. Amsler sign is seen in:
A. Posner-Schlossman syndrome
B. Pars planitis
C. Macular degeneration
D. Fuchs uveitis

79. The use of highly active anti-retroviral therapy (HAART) is associated with the development of:
A. Keratitis
B. Uveitis
C. Retinitis
D. Optic neuritis

80. True about ciliary body is: *(PGI 2013)*
A. Located about 10 mm from the corneoscleral junction
B. Consists of pars plana and pars plicata
C. Contraction of the ciliary body helps in accommodation
D. Secretes aqueous humour
E. Derives its blood supply from the short posterior ciliary arteries

81. The type of synechiae in iris bombe is: *(AIPG)*
A. Ring
b. Total
c. Filiform
d. Goniform

82. Primary objective of use of atropine in anterior uveitis is: *(AIIMS 2000)*
A. Relaxation of ciliary muscle
B. Increase blood flow
C. Prevent posterior synechiae formation
D. Increase supply of antibodies

83. Snow banking is seen in: *(PGI/ DNB 2014)*
A. Pars planitis
B. Endophthalmitis
C. Coat's disease
D. Eales disease

84. HLA B5 is associated with: *(APPG 2014)*
A. Vogt-Koyanagi Harada's disease
B. Posner-Schlossman syndrome
C. Behcet's disease
D. Reiter's syndrome

85. Most common ocular lesion in HIV: *(DNB 2015)*
A. CMV retinitis
B. Cotton wool spots
C. Kaposi sarcoma
D. Choroiditis

86. Headlight in fog appearance is characteristic of: *(DNB 2013)*
A. CMV retinitis
B. Tuberculosis
C. Toxoplasmosis
D. Sarcoidosis

71 : A 72 : C 73 : A 74 : A 75 : D 76 : C 77 : B
78 : D 79 : D 80 : B,C,D 81 : A 82 : A 83 : A 84 : C 85 : E 86 : C

CHAPTER

9

Diseases of Lens

QUICK TEXT REVIEW

CATARACT

CONGENITAL AND DEVELOPMENTAL CATARACT

1. Cataracta centralis pulverulenta

- It is also known as embryonic nuclear cataract
- Bilateral small rounded opacity with powdery appearance lying in the centre (embryonic nucleus)
- Hereditary with dominant genetic trait.

2. Lamellar (Zonular) cataract

- Commonest type, accounting for 50% of visually significant cases
- Usually bilateral, opacity involves a zone of foetal nucleus around the embryonic nucleus with peripheral riders (spokes of a wheel).
- May be genetic or due to vitamin-D deficiency or maternal rubella between 7 weeks and 8 weeks of gestation. Hypoparathyroidism or hypocalcaemia during pregnancy may also cause this type of cataract.

3. Sutural cataract

Usually static, bilateral, punctate opacities scattered around the Y-shaped sutures, of different patterns, (floriform, coralliform, spear shaped and anterior axial embryonic cataract).

4. Anterior polar cataract

- It is also known as *pyramidal cataract*
- Occurs due to delayed formation of anterior chamber or acquired following corneal perforation in childhood or ophthalmia neonatorum.
- Morphological types are: Thickened white plaque, anterior pyramidal cataract and reduplicated cataract or double cataract (the buried opacity is called 'Imprint').

5. Posterior polar cataract

Occurs due to persistence of posterior vascula capsule of the lens.

6. Coronary cataract

- Occurs at puberty and thus involves the adolescer nucleus or deeper cortex
- Characterised by club-shaped radiating opacitie involving the periphery (so vision is usually ur affected).

7. Blue-dot cataract (Cataracta-punctata cerulea)

Stationary, rounded, bluish, punctate opacitie involving adult nucleus or deep cortex. In minu degrees, it is almost universal in occurrenc Develops in second decade of life. It does n involve vision.

8. Total cataract

It may be hereditary or associated with rubell either unilateral or bilateral.

9. Congenital membranous cataract

Occurs due to partial or total absorption of le matter.

Management of Congenital cataract

Surgical treatment in the form of lens aspiratio or lensectomy with posterior capsulotomy a anterior vitrectomy is the procedure of choice.

Timing of surgery

- Bilateral cataract, in dense early surgery by 4- weeks of age and in partial, it may not be require until later if at all.
- Unilateral cataract. In dense cataract, urge surgery within days is required. Partial catara can be observed and treated nonsurgically by pa time occlusion to prevent amblyopia.

Visual prognosis is very poor in unilateral advanced cataract because of dense stimulus deprivation amblyopia.

Correction of paediatric aphakia above two years with posterior chamber intraocular lens implantation, and below two years with extended wear contact lens, or spectacles in bilateral cases.

ACQUIRED CATARACTS

I. Senile cataract (Age-related cataract)

It is the most common form of cataract.

Etiology: *Senile cataract is an age change.* Factors affecting its onset and maturation include: Heredity, exposure to ultraviolet radiations from sunlight, diet, and dehydrational crisis in childhood.

- *Main biochemical features* of cortical senile cataract are decreased levels of total proteins, amino acids and potassium associated with increased concentration of sodium and marked hydration of the lens. While nuclear cataract is accompanied by a significant increase in water insoluble proteins which give brown colour to nucleus. Intensification of age-related nuclear sclerosis associated with dehydration and compaction of nucleus resulting in hard cataract.
- *In a fully developed* cataract, glutathione, ascorbic acid and riboflavin are deficient or absent. These are the principal agents mediating the auto-oxidative system of the lens.

Morphological types

Cortical cataract: Cuneiform cataract accounts for 70% cases, cupuliform cataract for 5% cases and nuclear cataract for 25% cases of senile cataract.

- *Cupuliform* (posterior subcapsular) cataract lies right in the pathway of axial rays, and thus, causes an early loss of vision. It causes difficulty in vision in bright light and for near work. Glare is common.
- *Cuneiform cataract*, there are wedge shaped cortical opacities in the peripheral portion of the lens. Hence, it leads to visual difficulty in dim light when the pupil is dilated. Monocular diplopia or polyopia (incipient stage) occurs in cuneiform cataract.

Mature cataract. Becomes pearly white in appearance with absence of iris shadow.

Hypermature cataract: It has two varieties:

- *Sclerotic cataract:* The lens becomes shrunken and small with calcification on the anterior capsule. There is wrinkling of the lens capsule. It predisposes to *subluxation of lens.*
- *Morgagnian cataract:* There is total liquefaction of the cortex as a result of which the nucleus sinks inferiorly. The liquefied cortex leaks through the intact capsule and blocks the trabecular meshwork. This leads to *phacolytic glaucoma* or lens protein glaucoma. It also causes *phacoanaphylactic uveitis.*

Intumescent cataract: This means a swollen cataract due to excessive hydration. The swollen lens pushes the iris forward leading to closure of the angle and producing the so called *phacomorphic glaucoma.*

Nuclear cataract: This is an age-related increase in the refractive index of the lens nucleus. It causes a myopic shift in refraction known as *index myopia.* As a result of this myopic shift, the near vision improves. So, the need for presbyopic glasses decreases. This is called *second sight of old age.* The main mechanism of formation of nuclear cataract is *conversion of the soluble crystallins to insoluble crystalloids.*

Presenile cataract

The different conditions associated with presenile cataract are:

- *Myotonic dystrophy:* The typical cataract is Christmas Tree Cataract.
- *Syndermatotic cataract:* It is associated with skin disorders like atopic dermatitis, ichthyosis and psoriasis
- *Down's syndrome*
- *Werner's syndrome*
- *Neurofibromatosis.*

II. Metabolic cataracts

1. ***Diabetic cataract:*** The true diabetic cataract, usually occurring in young adults is characterised by acute onset, often bilateral, 'snow-flake opacities.' Accumulation of 'Sorbitol' due to NADPH+ dependent aldose reductase pathway is primarily responsible for development of true diabetic cataract. Fluctuating refractive error is a feature of diabetic cataract.

2. ***Galactosaemic cataract (oil droplet cataract)*** is associated with inborn error of galactose metabolism due to deficiency of galactose-1-phosphate uridyltransferase (GPUT). A related disorder occurs due to deficiency of galactokinase causing lamellar cataract. Accumulation of 'dulcitol' is primarily responsible for development of galactosaemic cataract. Accumulation of galactose leads to *oil droplet cataract.* It is, however, a reversible cataract and disappears when galactose is removed from the diet. Development of cataract may be prevented by early diagnosis and elimination of milk from the diet.

3. ***Hypocalcaemic cataract*** may be associated with parathyroid tetany.

4. ***Sunflower cataract*** may be associated with inborn error of copper metabolism (Wilson's disease).

- *Wilson's disease:* It is a deficiency of α-2 globulin ceruloplasmin leading to inadequate. Cu binding and deposition of Cu in tissues. The ocular features are **Kayser–Fleischer ring (KF)** and **Sunflower Cataract.** It is also known as **pseudo-cataract** because it does not cause visual impairment.

5. ***Cataract in Lowe's (oculocerebral-renal) syndrome;*** an inborn error of amino acid metabolism. Other ocular features are microphakia, posterior lentiglobus and glaucoma.

III. Complicated cataract

This name is given to cataract arising due to inflammatory or degenerative diseases of the eye. It is usually **posterior subcapsular cataract.** It has a typical **bread crumb appearance** with **polychromatic lustre.** The causes are:

- Anterior, intermediate or posterior uveitis
- Retinitis pigmentosa
- High myopia
- Angle closure glaucoma: This is typically **anterior subcapsular cataract** and is known as **glaucomflecken**
- Intraocular tumours.

IV. Toxic cataracts

1. *Corticosteroid-induced cataract*: Posterior subcapsular opacities may be associated typically with the use of systemic steroids.
2. *Miotics-induced cataract*: Anterior subcapsular granular cataract may be associated with the use of long acting miotics such as echothiophate and demecarium bromide.
3. *Other causes* of toxic cataracts are chlorpromazine (star shaped or stellate cataract), amiodarone (anterior subcapsular cataract), gold (used for treatment of rheumatoid arthritis, and busulphan (used for treatment of chronic myeloid leucaemia).

V. Radiational cataract

1. *Infra-red (heat) cataract.* It typically occurs as discoid posterior subcapsular opacities in workers of glass industry, hence the name 'glass-blower's cataract.'
2. *Irradiation cataract:* It may follow exposure to X-rays, γ-rays or neutron.
3. *Ultraviolet radiation* has been linked with se cataract.

- Most common type of radiational catarac posterior subcapsular cataract (PSC).

VI. Electric cataract

It may occur following passage of powerful elec current through the body. Punctate subcapsu opacities which mature rapidly.

VII. Syndermatotic cataract

It is associated with skin disorders like ato dermatitis, scleroderma and keratosis.

VIII. Traumatic cataract

Traumatic cataract in blunt/concussion trauma typically is rosette-shaped cataract.

In penetrating injury, it is usually anteri subcapsular.

IX. Miscellaneous cataract

- Christmas tree cataract is seen in myoton dystrophy
- Shield cataract occurs in atopic keratoconjunctiviti
- Neurofibromatosis (NF2) is associated wit posterior subcapsular cataract.

Management of cataract in adults

Extracapsular techniques with posterior chambe IOL *are* the treatment of choice,

- *Incidence of post-operative complications* suc as endophthalmitis, cystoid macular oedem and retinal detachment is comparatively lo with extracapsular cataract extraction (ECCE as compared to intracapsular cataract extractio (ICCE).

Extracapsular techniques of cataract removal

Conventional extracapsular cataract extraction

In this technique, the lens nucleus is removed i toto by making an opening in the anterior capsule As a result, a large limbal incision of 8–9 mm i needed. The capsular bag with an opening in th anterior capsule is left after removal of the lens. Th IOL is placed in the capsular bag.

Small incision cataract surgery (SICS): Th technique is almost similar to ECCE but corneoscleral tunnel of 6–7 mm instead of a limb incision.

- It is a low-cost alternative to phacoemulsificatio which offers the advantages of sutureles cataract surgery with the added advantages o having wider applicability and an easier learnin curve.

Phacoemulsification is a technique of ECCE. *Surgical steps* include a 3.2 mm clear corneal volvular incision, continuous curvilinear capsulorrhexis, hydrodissection, emulsification and aspiration of nucleous using ultrasonic phacoprobe. The phaco-needle vibrates longitudinally at an ultrasonic speed of 40,000 times per second.

Femtosecond laser assisted cataract surgery (FLACS) is the most advanced technique of MICS. Femtosecond laser is an ultra short pulse laser (10–15 seconds) which has a variety of application in ophthalmic practice. In cataract surgery, Femtosecond laser is used to create the corneal incision, capsulorrhexis and fragmentation of lens nucleus. It may also be used to correct astigmatism by astigmatic keratotomy.

Intraocular lens implantation

It is the best method for correction of aphakia. Types of IOLs include:

Anterior chamber Intraocular lens (IOLs): These lie entirely in front of the iris and are supported in the angle. These are not much popular due to comparatively higher incidence of bullous keratopathy. Commonly used IOL is Kelman multiflex lens.

Iris supported lenses: These are fixed on the iris with the help of sutures, loops or claws. These are also not popular due to higher rate of complications.

Posterior chamber lenses: These lie behind the iris and may be supported by ciliary sulcus or capsular bag. These are very popular and are available in modified C-loop and other designs.

Types of PClOLs available are:

Rigid IOLs are made of PMMA

Foldable lenses: These are made up of Acrylic (hydrophobic or hydrophilic) and hydrogels. They are all posterior chamber IOLs (PCIOLs) which are placed in the capsular bag. The different types are:

- *Monofocal IOLs:* These provide good distance vision but glasses have to be used for near (since accommodation is lost after pseudophakia).
- *Multifocal IOLs:* These IOLs have separate zones which focus for distance and near. So, they provide good vision both for distance and near without glasses. The main disadvantage is glare and haloes.
- *Accommodative IOLs:* These lenses can move in the capsular bag during accommodation to provide good vision for both distance and near without glasses.
- *Toric IOLs:* These lenses have a cylindrical power incorporated in them and hence help to correct any associated **corneal astigmatism**. They may be multifocal or monofocal.

Primary versus secondary IOL implantation. *Primary IOL implantation* refers to the use of IOL during surgery for cataract, while *secondary IOL* is implanted to correct aphakia in previously operated eye.

OL Power Calculation Formulae

SRK-II formula: This is used for emmetropic eyes (axial length 22–25 mm). The formula states P = A-2.5L-0.9K (A = constant, L = axial length, K = keratometry)

Hoffer formula: This is used for hypermetropic eyes (Axial length < 22 mm)

SRK-T formula: This is used for myopic eyes (axial length > 25 mm)

Haigis/Holladay II formula: These are used in post-refractive surgery cases.

DISPLACEMENTS OF LENS

- *On distant direct ophthalmoscopy*, edge of the clear subluxated lens is seen dark due to total internal reflection of the light.
- *Anterior dislocation* (in anterior chamber): Clear lens is seen as an oil drop in the aqueous.
- *Posterior dislocation* (in vitreous humor): Lens may be floating in the vitreous (lens nutans) or fixed to the retina (*lens fixata*).
- *Simple ectopia lentis*: Displacement is bilaterally symmetrical and usually upwards. Autosomal dominant inheritance.
- *Ectopia lentis et pupillae*: Displacement of lens is associated with slit-shaped pupil. Other associations may be cataract, glaucoma and retinal detachment.

Congenital ectopia lentis with systemic anomalies include:

- *Marfan's syndrome*: Lens is subluxated upward and temporally in both eyes.
- *Homocystinuria*: Lens is subluxated downward.
- *Well-Marchesani syndrome*: Characterised by spherophakia and anterior subluxation of lens.
- *Ehlers-Danlos syndrome*. Subluxated lens may be associated with blue sclera, keratoconus and angioid streakes.

Acquired, consecutive or spontaneous displacements are seen in hypermature cataract, buphthalmos, high myopia, intraocular tumours, and chronic cyclitis.

CONGENITAL ANOMALIES OF LENS

- *Coloboma of the lens*: A notch usually seen in the inferior quadrant of the equator. Occurs due to defective development of the suspensory ligament in that part.

- *Anterior lenticonus*: Cone-shaped anterior axial bulge. May occur in Alport's syndrome.
- *Posterior lenticonus*: Posterior axial bulge may occur in Lowe's syndrome.
- *Micro-spherophakia*: A small spherical lens may occur as an isolated finding or as a feature of Well Marchesani's or Marfan's syndrome.
- *Microphakia* is a small lens which occur in Lowe's syndrome.
- *Lentiglobus:* Generalized hemispherical deformity.

SOME SALIENT POINTS

- *Lens is incapable of becoming inflamed* due to the capsule.
- *Most common manifestation of developmental cataract* is punctate cataract (blue dot cataract).
- *Presenile cataract* occurs in patients with atopic dermatitis (stellate opacities mostly posterior), dsytrophica myotonia (christmas tree cataract and GPUT and GK enzyme deficiency.
- *Zonular or lamellar cataract* is the most commo congenital cataract causing visual impairmer (otherwise blue dot cataract is the most commo congenital cataract).
- *Most common postoperative complication* of extra capsular cataract extraction is posterior capsul thickening.
- *Best method to decide about the immaturit* and maturity of senile cataract is distant direc ophthalmoscopy.
- *Visual loss in posterior polar cataract* is muc more than the anterior polar cataract, because th former is close to the nodal point of the eye.
- *Cupuliform or posterior cortical cataract* seldo matures.
- *Down syndrome*: Ocular features include: Kerato conus, brushfield spot, and blue dot cataract.

MULTIPLE CHOICE QUESTIONS

1. Is the most common type of congenital cataract:
A. Lamellar cataract
B. Cataracta centralis pulverulenta
C. Coronary cataract
D. Coralliform cataract

2. Visual prognosis is poor in:
A. Bilateral congenital cataract
B. Unilateral congenital cataract
C. Zonular cataract
D. Cataract pulverulenta

3. The most common type of senile cataract is:
A. Cuneiform cataract
B. Cupuliform cataract
C. Nuclear cataract
D. None of the above

4. Complete unilateral congenital cataract should preferably be operated:
A. Within a few weeks of birth
B. At the age of 6 months
C. At the age of 2 years
D. At the age of 5 years

5. Immature senile cataract can be best differentiated from mature senile cataract by:
A. Iris shadow test
B. Oblique illumination examination
C. Visual acuity testing
D. Distant direct ophthalmoscopy
E. Pin-hole test

6. A true diabetic cataract is also known as:
A. Sunflower cataract
B. Rosette-shaped cataract
C. Snow-storm cataract
D. Coronary cataract

7. The early changes in corticosteroid-induced cataract are in the form of:
A. Central posterior subcapsular lens changes
B. Anterior cortical lens changes
C. Nuclear changes
D. Diffuse lens changes
E. None of the above

8. The type of cataract seen in Wilson's disease is:
A. Sunflower cataract
B. Snowflake cataract
C. Posterior subcapsular cataract
D. Coronary cataract

9. All are the causes of complicated cataract *except*:
A. Pars planitis
B. Retinitis pigmentosa
C. Retinal detachment
D. Posterior vitreous detachment

10. In a patient with senile cataract the macular functions can be tested by all *except*:
A. Two-light discrimination test
B. Swinging flash light test
C. Maddox rod test
D. Laser interferometry

11. Elschnig's pearls are a sign of:
A. Chronic uveitis
B. Secondary cataract
C. Cystoid macular oedema
D. All of the above

12. Lens subluxation occurs in all *except*:
A. Homocystinuria
B. Ehlers-Danlos syndrome
C. Congenital syphilis
D. Congenital rubella

13. All are true *except*:
A. The infantile nucleus is completely formed by one year of age
B. The embryonic nucleus is situated between the two Y sutures
C. Congenital blue dot cataracts are associated with development of senile cataract at an early stage
D. Zonular cataracts typically affect the outer part of the fetal or the inner part of the adult nucleus

14. Anterior lenticonus may be associated with:
A. Alport's syndrome
B. Lowe's syndrome
C. Marfan's syndrome
D. Homocystinuria

15. During IOL implantation, corneal endothelial damage can be prevented by use of:
A. Methyl cellulose
B. Sodium hyaluronate
C. Chondroitin sulfate
D. All of the above

16. Is responsible for presenile cataract:
A. Atopic dermatitis
B. Blue dot congenital cataract
C. Dystrophica myotonica
D. None of the above
E. All of the above

17. Hyperlysinemia may be associated with:
A. Subluxation of the lens
B. Spherophakia
C. Strabismus
D. All of the above

1:A 2:B 3:A 4:A 5:D 6 : C 7:A 8:A 9:D 10:B 11:B 12:D 13:A 14:A 15 :D 16:E 17:D

18. Most common complication following extracapsular cataract extraction is:
A. After cataract
B. Corneal endothelial decompensation
C. Secondary glaucoma
D. Cystoid macular oedema

19. Expulsive choroidal haemorrhage is caused by rupture of:
A. Retinal vessels
B. Short posterior ciliary arteries
C. The choriocapillaris
D. Long posterior ciliary arteries

20. Cataract in newborn is:
A. Zonular
B. Coronary
C. Snowflake
D. Cortical

21. During cataractogenesis lens stria appear at first in:
A. Upper nasal quadrant
B. Lower nasal quadrant
C. Upper temporal quadrant
D. Lower temporal quadrant

22. A mature uniocular cataract in a 3-year-old child:
A. Will require refraction
B. May be absorbed
C. Should be removed
D. Should be left as such

23. Lens capsule is thinnest at the:
A. Central anteriorly
B. Laterally
C. Superior pole of the lens
D. Posterior pole of the lens

24. Cataract brunescens result due to deposition of:
A. Melanin
B. Copper
C. Iron
D. Silver
E. Gold

25. Polyopia is a symptom of:
A. Cortical cataract
B. Cupuliform cataract
C. Radiational cataract
D. Electrical cataract

26. All of the following are features of Ehler-Danlos syndrome *except*:
A. Blue sclera
B. Long stature
C. Subluxation of lens
D. Epicanthal folds
E. Keratoconus

27. Ideal site for intraocular lens implantation is:
A. Anterior to the pupil
B. Behind the cornea
C. In the lens capsule
D. Behind the lens capsule

28. Developmental cataract is seen in:
A. Rubella
B. Galactosemia
C. Mongolian idiocy
D. Cretinism
E. All of the above

29. Rosette cataract is seen due to:
A. Trauma
B. Copper foreign body
C. Diabetes
D. Hyperparathyroidism

30. True about zonular cataract is:
A. Bilateral
B. Stationary
C. Autosomal dominant
D. Association with hypocalcemia
E. All of the above

31. The commonest type of cataract in adults is:
A. Nuclear cataract
B. Cortical cataract
C. Morgagnian cataract
D. None of the above

32. The commonest side effect of lens implant surge is:
A. Vitreous haemorrhage
B. Glaucoma
C. Iridocyclitis
D. Panophthalmitis

33. Most common type of cataract following radiatio is:
A. Posterior subcapsular
B. Anterior subcapsular
C. Tear-drop cataract
D. Diffuse cataract

34. Crystalline lens has a respiratory quotient of:
A. 1
B. 0.6
C. 0.7
D. 0.9

35. Causes of early onset of cataract are all *except*:
A. Diabetes mellitus
B. Smoking
C. Trauma
D. Recurrent episodes of diarrhoea

18:A 19:B 20:A 21:B 22:C 23:D 24:A 25:A 26:B 27:C 28:E 29:A 30:E 31:B 32:C 33:A 34:A 35:B

36. Cataract is responsible for what percentage of blindness in India:
A. 62%
B. 55%
C. 80%
D. 75%

37. Most common complication of extracapsular cataract surgery is:
A. Retinal detachment
B. Opacification of posterior capsule
C. Vitreous haemorrhage
D. Bullous keratopathy

38. Dislocation of lens is seen in:
A. Retinoblastoma
B. Medulloblastoma
C. Neuroblastoma
D. None of the above

39. In a patient, highest visual morbidity is seen in:
A. Nuclear cataract
B. Intumescent cataract
C. Posterior subcapsular cataract
D. Anterior subcapsular cataract

40. Commonest type of cataract is:
A. Blue dot
B. Zonular
C. Cupuliform
D. Cuneiform

41. Christmas tree cataract is seen in:
A. Down's syndrome
B. Rubella
C. Myotonic dystrophy
D. Diabetes

42. All are the advantages of leaving the capsule behind in cataract surgery *except*:
A. Prevents cystoid macular oedema
B. Decreases endothelial damage
C. Progressively improves vision
D. Decreases chance of retinal detachment
E. Decreases chance of endophthalmitis

43. Cataract is caused by all *except*:
A. Ultraviolet radiation
B. MRI
C. Infrared radiation
D. Microwave radiation
E. Ionizing radiation

44. In preoperative assessment of cataract patient following is to be done:
A. Axial length of cornea
B. Corneal thickness
C. Thickness of the lens
D. Corneal curvature

45. Modern IQL is not made up of:
A. Acrylic acid
B. PMMA
C. Silicon
D. Glass

46. Second sight phenomenon is seen in:
A. Nuclear cataract
B. Cortical cataract
C. Senile cataract
D. Iridocyclitis

47. A child has got a congenital cataract involving the visual axis which was detected by the parents right at birth. This child should be operated:
A. Immediately
B. At 2 months of age
C. At 1 year of age when the globe becomes normal sized
D. After 4 years when entire ocular and orbital growth becomes normal

48. Best site for IOL implant is:
A. Endocapsular
B. Scleral fixation
C. Anterior chamber
D. Iris claw implant

49. Congenital morgagnian cataract is a feature of:
A. Rubella cataract
B. Lowe's syndrome
C. Hereditory cataract
D. Galactosemic cataract

50. IOL preferred in children is:
A. Foldable acrylic lens
B. Foldable silicon lens
C. Three piece PMMA lens
D. Single piece PMMA lens

51. Capsule of the crystalline lens is thinnest at:
A. Anterior pole
B. Posterior pole
C. Equator
D. None

52. The crystalline lens derives its nourishment from:
A. Blood vessels
B. Connective tissue
C. Aqueous and vitreous
D. Zonules

53. The major function of major intrinsic protein-26 (MIP-26) is:
A. Glucose transport in lens
B. Transport of water in lens
C. Diffusion barrier
D. Capsule of lens

36: A 37: B 38: A 39: C 40: A 41: C 42: C 43: B 44: D 45: D 46: A 47: A 48: A 49: A 50: A 51: B 52: C 53: B

18. Most common complication following extracapsular cataract extraction is:
A. After cataract
B. Corneal endothelial decompensation
C. Secondary glaucoma
D. Cystoid macular oedema

19. Expulsive choroidal haemorrhage is caused by rupture of:
A. Retinal vessels
B. Short posterior ciliary arteries
C. The choriocapillaris
D. Long posterior ciliary arteries

20. Cataract in newborn is:
A. Zonular
B. Coronary
C. Snowflake
D. Cortical

21. During cataractogenesis lens stria appear at first in:
A. Upper nasal quadrant
B. Lower nasal quadrant
C. Upper temporal quadrant
D. Lower temporal quadrant

22. A mature uniocular cataract in a 3-year-old child:
A. Will require refraction
B. May be absorbed
C. Should be removed
D. Should be left as such

23. Lens capsule is thinnest at the:
A. Central anteriorly
B. Laterally
C. Superior pole of the lens
D. Posterior pole of the lens

24. Cataract brunescens result due to deposition of:
A. Melanin
B. Copper
C. Iron
D. Silver
E. Gold

25. Polyopia is a symptom of:
A. Cortical cataract
B. Cupuliform cataract
C. Radiational cataract
D. Electrical cataract

26. All of the following are features of Ehler-Danlos syndrome *except*:
A. Blue sclera
B. Long stature
C. Subluxation of lens
D. Epicanthal folds
E. Keratoconus

27. Ideal site for intraocular lens implantation is:
A. Anterior to the pupil
B. Behind the cornea
C. In the lens capsule
D. Behind the lens capsule

28. Developmental cataract is seen in:
A. Rubella
B. Galactosemia
C. Mongolian idiocy
D. Cretinism
E. All of the above

29. Rosette cataract is seen due to:
A. Trauma
B. Copper foreign body
C. Diabetes
D. Hyperparathyroidism

30. True about zonular cataract is:
A. Bilateral
B. Stationary
C. Autosomal dominant
D. Association with hypocalcemia
E. All of the above

31. The commonest type of cataract in adults is:
A. Nuclear cataract
B. Cortical cataract
C. Morgagnian cataract
D. None of the above

32. The commonest side effect of lens implant surger is:
A. Vitreous haemorrhage
B. Glaucoma
C. Iridocyclitis
D. Panophthalmitis

33. Most common type of cataract following radiatio is:
A. Posterior subcapsular
B. Anterior subcapsular
C. Tear-drop cataract
D. Diffuse cataract

34. Crystalline lens has a respiratory quotient of:
A. 1
B. 0.6
C. 0.7
D. 0.9

35. Causes of early onset of cataract are all *except*:
A. Diabetes mellitus
B. Smoking
C. Trauma
D. Recurrent episodes of diarrhoea

18 : A 19 : B 20 : A 21 : B 22 : C 23 : D 24 : A 25 : A 26 : B 27 : C 28 : E 29 : A 30 : E 31 : B 32 : C 33 : A 34 : A 35 : B

36. Cataract is responsible for what percentage of blindness in India:
A. 62%
B. 55%
C. 80%
D. 75%

37. Most common complication of extracapsular cataract surgery is:
A. Retinal detachment
B. Opacification of posterior capsule
C. Vitreous haemorrhage
D. Bullous keratopathy

38. Dislocation of lens is seen in:
A. Retinoblastoma
B. Medulloblastoma
C. Neuroblastoma
D. None of the above

39. In a patient, highest visual morbidity is seen in:
A. Nuclear cataract
B. Intumescent cataract
C. Posterior subcapsular cataract
D. Anterior subcapsular cataract

40. Commonest type of cataract is:
A. Blue dot
B. Zonular
C. Cupuliform
D. Cuneiform

41. Christmas tree cataract is seen in:
A. Down's syndrome
B. Rubella
C. Myotonic dystrophy
D. Diabetes

42. All are the advantages of leaving the capsule behind in cataract surgery *except*:
A. Prevents cystoid macular oedema
B. Decreases endothelial damage
C. Progressively improves vision
D. Decreases chance of retinal detachment
E. Decreases chance of endophthalmitis

43. Cataract is caused by all *except*:
A. Ultraviolet radiation
B. MRI
C. Infrared radiation
D. Microwave radiation
E. Ionizing radiation

44. In preoperative assessment of cataract patient following is to be done:
A. Axial length of cornea
B. Corneal thickness
C. Thickness of the lens
D. Corneal curvature

45. Modern IQL is not made up of:
A. Acrylic acid
B. PMMA
C. Silicon
D. Glass

46. Second sight phenomenon is seen in:
A. Nuclear cataract
B. Cortical cataract
C. Senile cataract
D. Iridocyclitis

47. A child has got a congenital cataract involving the visual axis which was detected by the parents right at birth. This child should be operated:
A. Immediately
B. At 2 months of age
C. At 1 year of age when the globe becomes normal sized
D. After 4 years when entire ocular and orbital growth becomes normal

48. Best site for IOL implant is:
A. Endocapsular
B. Scleral fixation
C. Anterior chamber
D. Iris claw implant

49. Congenital morgagnian cataract is a feature of:
A. Rubella cataract
B. Lowe's syndrome
C. Hereditory cataract
D. Galactosemic cataract

50. IOL preferred in children is:
A. Foldable acrylic lens
B. Foldable silicon lens
C. Three piece PMMA lens
D. Single piece PMMA lens

51. Capsule of the crystalline lens is thinnest at:
A. Anterior pole
B. Posterior pole
C. Equator
D. None

52. The crystalline lens derives its nourishment from:
A. Blood vessels
B. Connective tissue
C. Aqueous and vitreous
D. Zonules

53. The major function of major intrinsic protein-26 (MIP-26) is:
A. Glucose transport in lens
B. Transport of water in lens
C. Diffusion barrier
D. Capsule of lens

36: A 37: B 38: A 39: C 40: A 41: C 42: C 43: B 44: D 45: D 46: A 47: A 48: A 49: A 50: A 51: B 52: C 53: B

54. Most common type of congenital cataract is:
A. Capsular
B. Zonular
C. Coralliform
D. Blue dot

55. In cataract, spectacles are advised for following number of weeks after operation:
A. 6 weeks
B. 10 weeks
C. 12 weeks
D. 14 weeks

56. Which laser is used in the management of after cataracts:
A. Argon
B. Krypton
C. Nd-YAG
D. Excimer

57. An infant present with bilateral white pupillary reflex. On slit lamp examination a zone of opacity is observed around the fetal nucleus with spoke like radial opacities. The most likely diagnosis is:
A. Cataracto centralis pulverulenta
B. Lamellar cataract
C. Coronary cataract
D. Posterior polar cataract

58. Which of the following is the most important factor in the prevention of the endophthalmitis in cataract surgery?
A. Preoperative preparation with povidone iodine
B. One week antibiotic therapy prior to surgery
C. Trimming of eyelashes
D. Use of intravitreal antibiotics

59. A patient presents to the emergency department with uniocular diplopia. Examination with oblique illumination shows golden crescent while examination with co-axil illumination show a dark crescent line. Which of the following is the most likely diagnosis:
A. Lenticonus
B. Coloboma
C. Microspherophakia
D. Ectopia lentis

60. In Mafan's syndrome lens dislocation is commonly seen:
A. Upwards
B. Downwards
C. Supero-temporally
D. Nasally

61. Which of the following is the only reversible cataract:
A. Senile cataract
B. Cataract in galactosemia
C. Congenital cataract
D. None

62. Minimum vision loss is seen with which cataract:
A. Blue dot cataract
B. Zonular cataract
C. Anterior polar cataract
D. Posterior polar cataract

63. In preoperative assessment for cataract operation following is to be done *except*:
A. Axial length of eyeball
B. Keratometry
C. Posterior segment evaluation
D. Stereopsis examination

64. Modern IOL is all *except*:
A. Acrylic
B. PMMA
C. Silicon
D. Glass

65. Complications of cataract surgery are:
A. Endophthalmitis
B. Optic neuropathy
C. Retinal detachment
D. Vitreous loss

66. Dislocation of lens is seen in all the following conditions *except*:
A. Congenital rubella
B. Marchesani's syndrome
C. Marfan syndrome
D. Homocystinuria

67. Ectopia lentis is seen in all *except*:
A. Marfan's syndrome
B. Congenital rubella
C. Homocystinuria
D. Sulfite oxidase deficiency

68. Which ocular structures is the most radiosensitive?
A. Lens
B. Cornea
C. Retina
D. Optic nerve

69. Branching posterior spoke like cataracts (Propeller) are seen in:
A. Down's syndrome
B. Fabry's disease
C. Neurofibromatosis
D. Atopic keratoconjunctivitis

54 : D 55 : A 56 : C 57 : B 58 : A 59 : D 60 : C
61 : B 62 : A 63 : D 64 : D 65 : A, C and D 66 : A 67 : B 68 : A 69 : B

70. Crystalline lens contains which antigen?
A. Sequestered antigens
B. Cross antigens
C. Heterophile antigens
D. Isoantigens

71. Ascorbate and Alpha Tocopherol are maintained in the lens in reduced state by: (AIIMS 2014)
A. Glucose
B. Glycoprotein
C. Glutathione
D. Fatty acids

72. Which of the following does not handle free radicals in the lens? (AIPG)
A. Vitamin A
B. Vitamin C
C. Vitamin E
D. Catalase

73. Typical bilateral inferonasal subluxation of lens is seen in: (DNB)
A. Marfan's syndrome
B. Homocystinuria
C. Hyperlysinemia
D. Trauma

74. Spontaneous absorption of lens material is seen in: (COMEDK)
A. Marfan's syndrome
B. Hallerman Streiff syndrome
C. Aniridia
D. Persistent hyperplastic primary vit-reous (PHPV)

75. Gene commonly indicated in congenital cataract: (AIIMS 2014)
A. PAX-6
B. CRYGS- 3
C. LMX-1B
D. PITX-3

76. Which of the following is true regarding concentration of proteins in senile cataract? (AIIMS 2013)
A. More insoluble protein, less soluble protein
B. More soluble protein, less insoluble protein
C. Equal concentration of soluble and insoluble protein
D. None of the above

77. True about posterior subcapsular cataract is: (DNB 2015)
A. Visual loss is late
B. It is a type of mature senile cataract
C. Difficulty in bright light is a symp-tom
D. Glare is uncommon

78. Which of the following does not cause complicated cataract? (WBPG)
A. Pathological myopia
B. Diabetes mellitus
C. Retinitis pigmentosa
D. Iridocyclitis

79. Select the correct match: (PGI 2013)
A. Wilson's disease-Sunflower cataract
B. Alport's syndrome-posterior lenticonus
C. Amiodarone-anterior subcapsular cataract
D. Myotonic dystrophy-Christmas tree cataract
E. Down's syndrome- Cortical cataract

80. The investigation to predict postoperative visual outcome after cataract surgery is: (DNB 2016)
A. Pachymetry
B. Topography
C. Potential acuity meter
D. Lensometry

81. Power for nuclear fragmentation in cataract surgery is: (DNB 2016)
A. Ultrasonic
B. Thermal
C. Electrical
D. Magnetic

82. In which of the following conditions is IOL implantation after cataract surgery contra-indicated? (AIPG)
A. Fuch's heterochromic iridocyclitis
B. Juvenile rheumatoid arthritis
C. Psoriatic arthritis
D. Reiter's syndrome

83. Late onset endophthalmitis after cataract surgery is caused by: (AIPG)
A. *Staphylococcus epidermidis*
B. *Pseudomonas*
C. *Streptococcus pyogenes*
D. *Propionibacterium acne*

84. Most common late complication of cataract surgery: (DNB)
A. Cystoid macular oedema
B. Glaucoma
C. Posterior capsule opacification
D. Uveitis.

70 : A 71 : C 72 : A 73 : B 74 : B 75 : B 76 : A 77 : C 78 : B 79 : A, C, and D 80 : C 81 : A 82 : B 83 : D 84 : C

18. Most common complication following extracapsular cataract extraction is:
A. After cataract
B. Corneal endothelial decompensation
C. Secondary glaucoma
D. Cystoid macular oedema

19. Expulsive choroidal haemorrhage is caused by rupture of:
A. Retinal vessels
B. Short posterior ciliary arteries
C. The choriocapillaris
D. Long posterior ciliary arteries

20. Cataract in newborn is:
A. Zonular
B. Coronary
C. Snowflake
D. Cortical

21. During cataractogenesis lens stria appear at first in:
A. Upper nasal quadrant
B. Lower nasal quadrant
C. Upper temporal quadrant
D. Lower temporal quadrant

22. A mature uniocular cataract in a 3-year-old child:
A. Will require refraction
B. May be absorbed
C. Should be removed
D. Should be left as such

23. Lens capsule is thinnest at the:
A. Central anteriorly
B. Laterally
C. Superior pole of the lens
D. Posterior pole of the lens

24. Cataract brunescens result due to deposition of:
A. Melanin
B. Copper
C. Iron
D. Silver
E. Gold

25. Polyopia is a symptom of:
A. Cortical cataract
B. Cupuliform cataract
C. Radiational cataract
D. Electrical cataract

26. All of the following are features of Ehler-Danlos syndrome *except*:
A. Blue sclera
B. Long stature
C. Subluxation of lens
D. Epicanthal folds
E. Keratoconus

27. Ideal site for intraocular lens implantation is:
A. Anterior to the pupil
B. Behind the cornea
C. In the lens capsule
D. Behind the lens capsule

28. Developmental cataract is seen in:
A. Rubella
B. Galactosemia
C. Mongolian idiocy
D. Cretinism
E. All of the above

29. Rosette cataract is seen due to:
A. Trauma
B. Copper foreign body
C. Diabetes
D. Hyperparathyroidism

30. True about zonular cataract is:
A. Bilateral
B. Stationary
C. Autosomal dominant
D. Association with hypocalcemia
E. All of the above

31. The commonest type of cataract in adults is:
A. Nuclear cataract
B. Cortical cataract
C. Morgagnian cataract
D. None of the above

32. The commonest side effect of lens implant surgery is:
A. Vitreous haemorrhage
B. Glaucoma
C. Iridocyclitis
D. Panophthalmitis

33. Most common type of cataract following radiation is:
A. Posterior subcapsular
B. Anterior subcapsular
C. Tear-drop cataract
D. Diffuse cataract

34. Crystalline lens has a respiratory quotient of:
A. 1
B. 0.6
C. 0.7
D. 0.9

35. Causes of early onset of cataract are all *except*:
A. Diabetes mellitus
B. Smoking
C. Trauma
D. Recurrent episodes of diarrhoea

18 : A 19 : B 20 : A 21 : B 22 : C 23 : D 24 : A 25 : A 26 : B 27 : C 28 : E 29 : A 30 : E 31 : B 32 : C 33 : A 34 : A 35 : B

36. Cataract is responsible for what percentage of blindness in India:
A. 62%
B. 55%
C. 80%
D. 75%

37. Most common complication of extracapsular cataract surgery is:
A. Retinal detachment
B. Opacification of posterior capsule
C. Vitreous haemorrhage
D. Bullous keratopathy

38. Dislocation of lens is seen in:
A. Retinoblastoma
B. Medulloblastoma
C. Neuroblastoma
D. None of the above

39. In a patient, highest visual morbidity is seen in:
A. Nuclear cataract
B. Intumescent cataract
C. Posterior subcapsular cataract
D. Anterior subcapsular cataract

40. Commonest type of cataract is:
A. Blue dot
B. Zonular
C. Cupuliform
D. Cuneiform

41. Christmas tree cataract is seen in:
A. Down's syndrome
B. Rubella
C. Myotonic dystrophy
D. Diabetes

42. All are the advantages of leaving the capsule behind in cataract surgery *except*:
A. Prevents cystoid macular oedema
B. Decreases endothelial damage
C. Progressively improves vision
D. Decreases chance of retinal detachment
E. Decreases chance of endophthalmitis

43. Cataract is caused by all *except*:
A. Ultraviolet radiation
B. MRI
C. Infrared radiation
D. Microwave radiation
E. Ionizing radiation

44. In preoperative assessment of cataract patient following is to be done:
A. Axial length of cornea
B. Corneal thickness
C. Thickness of the lens
D. Corneal curvature

45. Modern IQL is not made up of:
A. Acrylic acid
B. PMMA
C. Silicon
D. Glass

46. Second sight phenomenon is seen in:
A. Nuclear cataract
B. Cortical cataract
C. Senile cataract
D. Iridocyclitis

47. A child has got a congenital cataract involving the visual axis which was detected by the parents right at birth. This child should be operated:
A. Immediately
B. At 2 months of age
C. At 1 year of age when the globe becomes normal sized
D. After 4 years when entire ocular and orbital growth becomes normal

48. Best site for IOL implant is:
A. Endocapsular
B. Scleral fixation
C. Anterior chamber
D. Iris claw implant

49. Congenital morgagnian cataract is a feature of:
A. Rubella cataract
B. Lowe's syndrome
C. Hereditory cataract
D. Galactosemic cataract

50. IOL preferred in children is:
A. Foldable acrylic lens
B. Foldable silicon lens
C. Three piece PMMA lens
D. Single piece PMMA lens

51. Capsule of the crystalline lens is thinnest at:
A. Anterior pole
B. Posterior pole
C. Equator
D. None

52. The crystalline lens derives its nourishment from:
A. Blood vessels
B. Connective tissue
C. Aqueous and vitreous
D. Zonules

53. The major function of major intrinsic protein-26 (MIP-26) is:
A. Glucose transport in lens
B. Transport of water in lens
C. Diffusion barrier
D. Capsule of lens

36: A 37: B 38: A 39: C 40: A 41: C 42: C 43: B 44: D 45: D 46: A 47: A 48: A 49: A 50: A 51: B 52: C 53: B

CHAPTER

10

Glaucoma

QUICK TEXT REVIEW

AQUEOUS HUMOUR

- Normal range of intraocular pressure is 10–21 mm Hg (mean 16 ± 2.5 mm Hg).
- Normal amount of aqueous humour present in the anterior chamber is 0.25 mL and in posterior chamber is 0.06 mL (total 0.31mL).
- Normal aqueous production rate is about 2.3 µL/minute.
- Aqueous humour is secreted by non-pigmented epithelium of pars plicata region of the ciliary body.
- *Composition of aqueous* is similar to plasma except that it has high concentration of ascorbate, pyruvate, and lactate; and *low concentration of protein*, urea and glucose. Concentration of ascorbate and bicarbonate is high and that of chloride is low in posterior chamber aqueous as compared to that in anterior chamber.
- *Site of aqueous production is ciliary processes.* Aqueous humour is primarily derived from the plasma.
- *Mechanisms concerned* with aqueous production are diffusion (10%), ultrafiltration (20%), and active secretion (70%).
- *Trabecular (conventional) outflow* of aqueous humour accounts for 90% and uveoscleral outflow for 10%.

PRIMARY GLAUCOMAS

CONGENITAL/DEVELOPMENTAL GLAUCOMA

It may occur in three forms:

Primary congenital glaucoma occurs due to trabeculodysgenesis and is not associated with any other anomaly.

Congenital glaucoma with other associated ocular anomalies, such as posterior embryotoxon, Axenfeld–Rieger syndrome, aniridia, congenita microcornea, occurs due to iridocorneal dysgenesis

Congenital glaucoma with associated systemi syndromes, e.g. Sturge–Weber syndrome, Vo Recklinghausen's neurofibromatosis, and Lowe syndrome.

Primary congenital glaucoma

- In about 40% cases, it presents since birth (Ne born glaucoma or *True congenital glaucoma)*
- In about 50% cases, it manifests prior to the age o 2 years *(Infantile glaucoma)*
- In 10% cases, it presents between 2 and 10 years o the age *(Juvenile glaucoma)*.
- When it occurs before 3 years of age, eyeball usuall enlarges, and so the term *buphthalmos* is used.

Prevalence and genetics

- Autosomal recessive inheritance with incomplet penetrance
- Affects 1 in 10,000 live births
- Male : female ratio– 3 : 2
- Bilateral in 75% cases.

Clinical features

- Lacrimation (first symptom), photophobia blepharospasm and eye rubbing.
- Buphthalmos (occurs with onset before the age o 3 years), characterised by enlarged eyeball, cornea diameter more than 13 mm, corneal oedema (firs sign), Haab's striae (healed splits in Descemet membrane), deep anterior chamber, raised IOP and variable optic disc cupping. Eye become myopic.
- *Gonioscopic examination* may reveal: Mesoderma membrane (Barkan's membrane), thickening o trabecular sheets, hypoplastic iris stroma an insertion of iris above scleral spur.

Treatment

- *Goniotomy* is the surgery of choice (80% success rate).
- *Trabeculotomy* is required when corneal clouding prevents visualization of angle for goniotomy.
- *Combined trabeculotomy and trabeculectomy* (with antifibrotic treatment) is nowadays the preferred surgery with better results.

PRIMARY OPEN-ANGLE GLAUCOMA (POAG)

Predisposing and risk factors

1. ***Heredity:*** POAG has a polygenic inheritance. The approximate risk of getting disease in siblings is 10% and in offspring is about 4%.

2. ***Age:*** Affects 1 in 100 of population over 40 years of age. Risk increases in 50–70 years of age.

3. ***High myopes*** are more predisposed than the emmetropes.

4. ***Other risk factors*** include thyrotoxicosis, diabetes mellitus, and cigarette smoking.

Signs

1. ***IOP changes:*** Initially there is exaggeration of the normal diurnal variation. A difference of more than 6 mmHg is suspicious and over 8 is diagnostic (normal below 5). In later stages IOP is permanently raised and ranges between 30 and 45 mmHg.

2. ***Optic disc changes:*** Normal cup/disc ratio is 0.3. Asymmetry of more than 0.2 between two eyes and/or notching of the neural rim is suspicious. Marked cupping (0.7 to 0.9) may occur in advanced cases.

- Nasal shift of blood vessels at the disc with appearance of being broken at the margin (Bayoneting sign)
- NRR thinning/notching
- Laminar dot sign
- Increased pallor (area of disc lacking small vessels)
- Haemorrhages on the disc or disc margin
- Glaucomatous optic atrophy (white and deeply excavated disc) is the end result.

3. ***Visual field defects:*** These run parallel to the optic disc changes and progress in the following sequence:

- Baring of blind spot (earliest field defect)
- Paracentral scotoma between 10 and 20° of visual field (Bjerrum's area). It is the earliest clinical significant field defect.
- Seidel's sign (sickle-shaped extension of blind spot)
- Arcuate or Bjerrum's scotoma
- Ring or double arcuate scotoma
- Roenne's central nasal step
- Peripheral nasal step of Roenne's
- Tubular vision with a temporal island of vision
- Advanced field loss with a temporal island of vision only
- Complete loss of vision.

Ocular associations

High myopia, Fuchs' endothelial dystrophy, retinitis pigmentosa, central retinal vein occlusion and primary retinal detachment.

Diagnosis

1. ***Established POAG:*** IOP more than 21 mmHg associated with definite disc cupping and visual field defects.

2. ***Glaucoma suspect or ocular hypertension:*** IOP more than 21 mmHg with no disc changes or visual field defects. These cases should be treated as cases of POAG under following circumstances:

- Significant diurnal variation (more than 8 mmHg)
- Significantly positive water drinking provocative test (more than 8 mmHg)
- More than 0.2 asymmetry of cup-disc ratio in two eyes
- Splinter haemorrhages over or near the disc
- Family history of glaucoma
- IOP constantly more than 30 mmHg
- Diabetic and highly myopic patients.

3. ***Low tension glaucoma (LTG)*** or normal tension glaucoma: IOP less than 21 mmHg with typical disc and/or visual field defects.

Treatment

I. *Medical therapy*

a. ***Topical antiglaucoma drugs form*** is the treatment of choice for POAG in both eyes

- *Topical prostaglandin analogues* are the first drugs of choice (increase uveoscleral aqueous outflow) (latanoprost, bimatoprost, travoprost)
- *Topical beta-blockers* decrease aqueous secretion from ciliary epithelium and are of second choice.
- *Alpha agonists*, non-selective, e.g. epinephrine and ***dipivefrine***, increase uveoscleral aqueous outflow. Selective alpha 2 agonists, e.g. apraclonidine and brimonidine decrease aqueous outflow.
- *Carbonic anhydrase inhibitors*, e.g. dorzolamide, acetazolamide and brinzolamide decrease aqueous secretion due to lack of HCO_3.

- *Cholinomimetics,* e.g. pilocarpine, physostigmine, carbachol, echothiophate increase aqueous outflow by opening of trabecular meshwork due to ciliary muscle contraction.

b. ***Systemic therapy consists*** of carbonic anhydrase inhibitors (acetazolamide, dichlorphenamide, methazolamide), and hyperosmotic agents, e.g. mannitol and glycerol which reduce the vitreous volume.

II. *Argon or diode laser trabeculoplasty*

When treatment with antiglaucoma medications fails, laser trabeculoplasty is indicated.

III. *Surgery (filtration surgery)*

Most common surgery is trabeculectomy.

Note: POAG is a bilateral condition. Treatment of fellow eye is the same.

PRIMARY ANGLE-CLOSURE GLAUCOMA (PACG)

Prevalence

There is a great ethnic variability in the prevalence of PACG. The ratio of POAG versus PACG reported for different ethnic groups is as below:

Ethnic group	*POAG : PACG*
• European, African and Hispanics	5 : 1
• Urban Chinese	1 : 2
• Mongolians	1 : 3
• Indians	1 : 1

Clinical features

A. *Symptoms*

- Severe pain
- Associated with nausea and vomiting and
- Coloured halos seen.

B. *Signs*

- Pupil semidilated, vertically oval, fixed and nonreactive to bright light and
- IOP increased.

Etiology

Predisposing factors

- Hypermetropic eyes with shallow anterior chamber
- Eyes in which iris-lens diaphragm is placed anteriorly
- Eyes with narrow angle of anterior chamber due to small eyeball, relative large crystalline lens or bigger size of the ciliary body
- Plateau iris configuration
- Sex: Male : Female is 1 : 3
- Nervous personality with unstable vasomot system
- Positive family history
- Usually fifth or sixth decade of life.

Precipitating factors for acute PAC

- Dim illumination
- Emotional stress
- Use of mydriatics (atropine).

Clinical stages/classifications

New classification (2006) of PAC disease is below:

1. ***Primary angle closure suspect*** (PACS) diagnosed when gonioscopy reveals iridotrabecul contact in >270° angle and no peripheral anteri synechia with normal IOP, optic disc and visu fields. Impression: the angle is at risk.

2. ***Primary angle closure*** (PAC) is characterized b

- > 270° iridotrabecular contact on gonioscopy
- IOP elevated and/or PAS present
- Optic disc and visual fields normal.

Impression: Angle is abnormal either in functi (elevated IOP) and/or in structure (PAS +ve)

Acute primary angle closure: Sudden rise in IO occurs due to total angle closure.

Surgical treatment is required after medical contr of IOP

- Peripheral iridectomy/laser iridotomy—whe peripheral anterior synechiae (PAS) are formed less than 50% of the angle of anterior chamber
- Filtration surgery (e.g. trabeculectomy)—whe PAS are formed in more than 50% of the angle
- Peripheral iridectomy/laser iridotomy should als be considered for the fellow eye.

3. ***Primary angle closure glaucoma*** (PACG) labeled when:

- *Iridotrabecular contact* is seen in >270° angle o gonioscopy
- *PAS* are formed
- *IOP* is elevated
- *Optic disc and visual fields* show typical glauco matous damage.

PACG may develop as a sequelae to subacut or acute PAC or due to gradual and progressiv (creeping) synechial angle closure.

Absolute glaucoma: In this end stage, the eye i painful, completely blind, and IOP is very high.

SECONDARY GLAUCOMAS

1. Lens-induced glaucomas

- *Phacomorphic*: IOP is raised due to secondary angle closure and/or pupil block by lens intumescence or, anterior subluxation or dislocation of lens or spherophakia.
- *Phacolytic*: An acute secondary open-angle glaucoma due to clogging of trabecular meshwork by macrophages laden with lens proteins in a patient with hypermature cataract.
- *Lens particle glaucoma*: It occurs due to trabecular blockage by the lens particles.
- *Phacoanaphylactic*: It occurs due to sensitisation of eye or its fellow to lens proteins. IOP is raised due to clogging of trabeculae by inflammatory material.

2. Glaucomas due to uveitis

- *Non-specific hypertensive uveitis*: IOP is raised due to clogging by inflammatory material and associated trabeculitis.
- *Specific hypertensive uveitis syndromes*: These include: Fuchs' uveitis syndrome and glaucomatocyclitic crisis.
- *Post-inflammatory glaucoma*: It may result from annular synechiae, occlusiopupillae, angle closure following iris bombe formation or angle closure due to organisation of the inflammatory debris.

3. Pigmentary glaucoma

- About 35% of patients with pigment dispersion syndrome develop pigmentary glaucoma.
- Bilateral condition, typically affecting young myopic males.
- Glaucomatous features are similar to POAG with associated pigment deposition on corneal endothelium (Krukenberg's spindle), trabecular meshwork, iris, lens and zonules.

4. Neovascular glaucoma

- Rubeosis iridis
- It results due to formation of a neovascular membrane involving angle of the anterior chamber.
- Usually, stimulus to new vessel formation is retinal ischaemia as seen in diabetic retinopathy, CRVO, Eales' disease. Other rare causes are chronic uveitis, intraocular tumours, old retinal detachment, "CRAO" (known as 100 day glaucoma) and retinopathy of prematurity
- Neovascularisation begins at pupil and spreads centrifugally

Management includes: Panretinal photocoagulation to prevent stimulus to new vessel formation

- *Glaucoma implant* (e.g. Molteno tube) operation
- *Cyclocryotherapy*.

5. Glaucoma associated with intraocular tumours

Intraocular tumours such as retinoblastoma and malignant melanoma may raise IOP by one or more of the following mechanisms:

- Trabecular block by tumour cells
- Neovascularization of the angle
- Venous stasis following obstruction to vortex veins.

6. Pseudoexfoliative glaucoma (Glaucoma capsulare)

- Pseudoexfoliative syndrome (PES) refers to amyloid like deposits on pupillary border, anterior lens surface, posterior surface of iris, zonules and ciliary processes.
- 70% cases of PES are associated with raised IOP (secondary open-angle glaucoma).
- Other features and treatment are similar to POAG.

7. Glaucoma in aphakia

It implies association of glaucoma with aphakia.

Causes

- Raised IOP due to postoperative hyphaema, inflammation, vitreous filling the anterior chamber
- Angle closure due to flat anterior chamber
- Pupil block with or without angle closure
- Undiagnosed pre-existing POAG
- Steroid-induced glaucoma
- Epithelial ingrowth
- Aphakic malignant glaucoma.

8. Steroid-induced glaucoma

- Roughly, 5% of general population is high steroid responder (develop marked rise of IOP after about 6 weeks of steroid therapy), 35% are moderate and 60% are non-responders
- Pathogenesis: Probably mucopolysaccharides are deposited in the trabecular meshwork
- Features are similar to POAG.

Management

- Can be prevented by judicious use of steroids
- IOP may normalise in 98% of cases within 10 days to 4 weeks of discontinuation of steroids
- Medical therapy with 0.5% timolol maleate is effective during normalization period
- Filtration surgery is required in intractable cases.

9. Ciliary block glaucoma (Malignant glaucoma)

Also known as ciliovitreal block or aqueous misdirection syndrome.

- It can occur as a complication of any intraocular operation.
- Classically, it occurs following peripheral iridectomy or filtration operation for primary narrow-angle glaucoma.
- Pathogenesis involves ciliolenticular or ciliovitreal block.

Clinical Features

- Persistent flat anterior chamber with negative Seidel's test
- Markedly raised IOP
- May be phakic, aphakic or pseudophakic
- Vortex veins seen in malignant melanoma.

Management

1. Medical therapy (is useful in about 50% cases):
   a. Atropine eye drops
   b. Acetazolamide 250 mg TDS
   c. 0.5% Timolol maleate eye drops BD
2. Surgical therapy: Anterior vitrectomy and injection of air in the anterior chamber.

Note: YAG laser hyaloidotomy is also used as a treatment modalities.

10. Glaucoma associated with intraocular haemorrhage

- *Haemolytic glaucoma*: Acute open-angle glaucoma which occurs due to obstruction of the trabecular meshwork by macrophages laden with lysed RBC debris after hyphaema.
- *Ghost cell glaucoma*: It occurs in aphakic eyes with vitreous haemorrhage. RBCs converted into Khaki coloured ghost cells block the trabecular meshwork.
- *Red cell glaucoma*: Caused by blockage of trabecular meshwork by RBCs following massive hyphaema.
- *Haemosiderotic glaucoma*: It occurs due to sclerotic changes in trabecular meshwork induced by iron from the haemoglobin.

11. Glaucoma associated with iridocorneal endothelial (ICE) syndromes

- ICE syndromes include progressive iris atrophy, corneal oedema, Chandler's syndrome and Cogan-Reese syndrome.
- IOP is raised due to endothelial membrane lining the trabecular meshwork.

Histopathology: Collagen deposit on posteri surface of Descemet's membrane.

MISCELLANEOUS POINTS

- *Commonest hazard following surgery* of narro angle glaucoma is *malignant glaucoma.*
- *Congenital anomaly most commonly associate with buphthalmos* is facial haemangiomas.
- *Sampaolesi's line* refers to heavy pigme deposition in a line above Schwalbe's line in th angle of anterior chamber (a feature of exfoliati glaucoma).
- *Vogt's triad* includes glaukomflecken (anteric subcapsular lenticular opacity), patches of ir atrophy and slightly dilated nonreacting pup (due to sphincter atrophy); seen in the ey which has suffered an attack of acute congestiv glaucoma.
- *Pilocarpine* and other *miotics are contraindicate* in inflammatory glaucoma, malignant glaucom and glaucoma due to spherophakia.
- *Most preferred site for filtering operation* is superio nasal quadrant.
- *Pilocarpine in angle closure glaucoma* should b used after control of IOP by aqueous suppressan and hyperosmotic agents.
- *Argon laser trabeculoplasty* is only the adjuvant t medical therapy of primary open-angle glaucoma
- *Miotics are not useful* in a buphthalmos, aphaki glaucoma, glaucomatocyclitic crisis, glaucom inversus and in epidemic dropsy glaucoma.
- *Secondary glaucoma after perforation of the corne* is due to blockage of the drainage angle by anterio synechiae.
- *In acute-congestive glaucoma*, the choice of surger between peripheral iridectomy and filterin operation is decided by gonioscopic examinatio
- *Single most important test in diagnosing POAG* an response to treatment is visual field testing.
- *Earliest and most constant symptom in infanti glaucoma* is lacrimation.
- *Latanoprost*: PGF2 alpha.
  - Mechanism of action: Increases uveoscler aqueous outflow
  - Drug of choice for open angle glaucoma.
  - Most potent antiglaucoma drug.
  - Drug of choice for low tension glaucoma.
- Safest antiglaucoma/drug of choice in children dorzolamide.

- Antiglaucoma drugs causing blepharoconjunctivitis are:
  - Latanoprost (clinically significant and most common)
  - Timolol
  - Dipiverfrine
- Increased IOP in glaucoma damages retinal ganglion cells (RGC).
- Nasal field first to be damaged and temporal last.
- Diffused iris melanoma causes intractable secondary glaucoma.
- In epidemic dropsy, wide angle glaucoma is associated with raised levels of histamine, prostaglandin and proteins (hypersecretary glaucoma)
- Fincham's test is used to differentiate the halos of PACG and immature cataract, in this stenopaeic slit is passed across the pupil, glaucomatous halos remains intact while halos due to cataract are broken into segments.
- Inverse glaucoma: Pilocarpine causes paradoxical rise in IOP, in spherophakia

Weill-Marchesani syndrome is associated with spherophakia

Mnemonic (5S)

Short

Stubby finger

Stupid

Spherophakia

Subluxation.

Applanation tonometer: It is based on *Imbert Fick* law.

- *Goldmann Applanation tonometer* is the *gold standard tonometer.*
- *Mackay-Marg tonometer*: It is used in *irregular corneas*
- *Maklakov tonometer*: This is an applanation tonometer with *variable applanation area (A) and fixed force (F)*

Pascal's Dynamic Contour Tonometer: It is the most accurate tonometer.

MULTIPLE CHOICE QUESTIONS

1. **Normal aqueous production rate is about:**
   A. 2 l/min
   B. 2.3 µL/min
   C. 2.6 µL/min
   D. 2.9 µL/min

2. **Trabecular (conventional) outflow of aqueous humour accounts for:**
   A. 90%
   B. 80%
   C. 70%
   D. 60%

3. **Incidence of congenital glaucoma is:**
   A. 1 in 1000 births
   B. 1 in 5000 births
   C. 1 in 10,000 births
   D. 1 in 34,000 births

4. **In normal diurnal variation, intraocular pressure is:**
   A. Highest on awakening and lowest during evening
   B. Lowest during morning and highest during evening
   C. Highest in the morning and evening
   D. Lowest in the morning and evening

5. **Normal diurnal variation of intraocular pressure is:**
   A. 0-2 mm of Hg
   B. 2-3 mm of Hg
   C. 3-6 mm of Hg
   D. 6-8 mm of Hg

6. **In indentation tonometry:**
   A. Plunger indents a hard eye more than a soft eye
   B. Lower scale readings are obtained in high intraocular pressure
   C. Low scleral rigidity gives high reading of intraocular pressure
   D. All of the above

7. **Retinal nerve fibres most sensitive to glaucomatous damage are:**
   A. Superior and inferior arcuate fibres
   B. Macular fibres
   C. Superior radiating fibres
   D. Inferior radiating fibres

8. **Incidence of primary open-angle glaucoma in population over 40 years of age is about:**
   A. 1 in 100
   B. 1 in 200
   C. 1 in 500
   D. 1 in 1000

9. **Sickle-shaped extension of blind spot is kno as:**
   A. Bjerrum's sign
   B. Seidel's sign
   C. Down's sign
   D. Baring of blind spot

10. **Ocular associations of primary open-ang glaucoma include all *except*:**
    A. Central retinal vein occlusion
    B. Central retinal artery occlusion
    C. Retinal detachment
    D. Retinitis pigmentosa

11. **Vogt's triad is indicative of:**
    A. Past attack of herpes zoster ophthalmicus
    B. Past attack of acute-angle closure glaucoma
    C. Vogt-Koyanagi-Harada syndrome
    D. Past attack of acute iridocyclitis

12. **Glaukomflecken is a feature of:**
    A. Acute narrow-angle glaucoma
    B. Pseudoexfoliative glaucoma
    C. Juvenile glaucoma
    D. Phacolytic glaucoma

13. **In the incidence of primary angle closu glaucoma, male to female ratio is:**
    A. 1:1
    B. 1:2
    C. 1:3
    D. 1:4

14. **The earliest clinically significant field defect primary open-angle glaucoma is:**
    A. Paracentral scotoma
    B. Baring of blind spot
    C. Seidel's scotoma
    D. Isopter contraction

15. **All are the causes of neovascular glaucoma excep**
    A. Intraocular tumour
    B. Central retinal vein occlusion
    C. Diabetic retinopathy
    D. Central serous retinopathy

16. **Krukenberg's spindle seen in patients wi pigmentary glaucoma refers to deposition pigment on:**
    A. Trabecular meshwork (gonioscopic sign)
    B. Back of cornea
    C. Anterior surface of the lens
    D. All of the above

1:B 2:A 3:C 4:A 5:C 6:B 7:A 8:A 9:B 10:B 11:B 12:A 13:D 14: 15:D 16:B

17. In Fincham's test:
A. Glaucomatous halo remains intact
B. Halo due to immature cataract does not break into segments
C. Halo due to mucopurulent conjunctivitis is broken into segments
D. All of the above

18. All are the features of an acute attack of primary narrow-angle glaucoma *except*:
A. Intraocular pressure is raised up to 940-70 mm Hg
B. Eye is red, painful and tender
C. Disc shows glaucomatous cupping
D. Fellow eye also shows shallow anterior chamber

19. In Indian population ratio of POAG : PACG is:
A. 4:1
B. 2:1
C. 1:1
D. 1:2

20. All of the following can precipitate the attack of narrow angle *except*:
A. Prolonged prone position
B. Mydriatics
C. Prolonged work in bright light
D. Emotional upsets

21. The most characteristic visual field change in primary open-angle glaucoma is:
A. Nerve fibre bundle defect
B. Enlargement of blind spot
C. Generalised constriction of field
D. Sector-shaped defects

22. All of the following are true about pigmentary glaucoma *except*:
A. It occurs more often in young myopic men
B. Iris transillumination defects are noted
C. It is associated with Krukenberg's spindle
D. The intensity of pigment deposit in the angle is related to iris colour

23. Epinephrine:
A. Reduces aqueous production
B. Reduces outflow facility
C. Reduces aqueous production and increases outflow facility
D. Increases aqueous production and reduces outflow facility

24. Treatment of malignant glaucoma is:
A. Pilocarpine
B. Cyclocryotherapy
C. Vitreous aspiration
D. Trabeculectomy

25. Neovascular glaucoma may be associated with all of the following *except*:
A. Diabetes
B. Hypertension
C. Central retinal vein occlusion
D. Intraocular tumours

26. Primary open-angle glaucoma is associated with all of the following *except*:
A. Diabetes mellitus
B. Myopia
C. Hyperthyroidism
D. Pars planitis

27. Cupping of the disc is not a feature of:
A. Buphthalmos
B. Chronic simple glaucoma
C. Acute congestive glaucoma
D. Megalocornea

28. Inverse glaucoma occurs in:
A. Spherophakia
B. Lenticonus
C. Subluxated lens
D. All of the above

29. Lowe's syndrome is characterized by all *except*:
A. Glaucoma
B. Albuminuria
C. Glycosuria
D. Oligoammonuria
E. Retinal detachment

30. All the following can be seen in Axenfeld's anomaly, *except*:
A. Posterior embryotoxon
B. Iris synechiae to Schwalbe's line
C. Ectopia of the lens
D. Glaucoma

31. All the following are true concerning Rieger syndrome *except*:
A. Autosomal recessive inheritance
B. Glaucoma
C. The possible presence of facial, dental and osseous defects
D. The spectrum of Axenfeld's anomaly and marked abnormal development of the iris mesoderm

32. In chronic simple glaucoma the most common field defect is:
A. Arcuate field defect
B. Baring of blind spot
C. Bjerrum scotoma
D. Siedel's sign

17 : A **18 : C** **19 : C** **20 : C** **21 : A** **22 : D** **23 : C** **24 : C** **25 : B** **26 : D** **27 : D** **28 : A** **29 : E** **30 : C** **31 : A** **32 : B**

33. Treatment of malignant glaucoma includes all *except*:
A. Topical atropine
B. Topical pilocarpine
C. IV mannitol
D. Vitreous aspiration

34. The earliest change in glaucoma is:
A. Papilloedema
B. Hazy cornea
C. Baring of the blind spot
D. Sickle scotoma

35. Neovascular glaucoma can occur in all *except*:
A. Diabetes mellitus
B. Hypertension
C. CRAO
D. CRVO

36. Coloured haloes are found in all *except*:
A. Pigmentary glaucoma
B. Acute-angle-closure glaucoma
C. Cataract
D. Uveitis

37. Secondary glaucoma following corneal perforation is due to:
A. Central anterior synechiae formation
B. Peripheral anterior synechiae
C. Intraocular haemorrhage
D. Angle recession

38. In haemolytic glaucoma the mechanisms are all *except*:
A. Siderosis of trabeculae
B. Deposition of haemosiderin
C. RBC clogging the trabeculae
D. Inflammation

39. The most reliable provocative test for angle-closure glaucoma is:
A. Homatropine mydriatic test
B. Mydriatic-miotic test
C. Water drinking test
D. Dark room test

40. Which of the following types of senile cataract is the most notorious to produce glaucoma:
A. Incipient cataract
B. Lamellar cataract
C. Hypermature Morgagnian cataract
D. Intumescent cataract

41. All of the following anatomical changes will predispose to primary-angle-closure glaucoma *except*:
A. Small cornea
B. Flat cornea
C. Anterior chamber shallow
D. Short axial length of eyeball

42. Argon laser trabeculoplasty is used in:
A. Closed-angle glaucoma
B. Primary open-angle glaucoma
C. Neovascular glaucoma
D. Aphakic glaucoma

43. In buphthalmos, lens is:
A. Anteroposterior flat
B. Small
C. Large
D. None of the ab

44. First sign seen in open-angle glaucoma is:
A. Arcuate scotoma
B. Extension above blind spot
C. Roene's nasal step
D. Siedel's scotoma

45. Congenital glaucoma presents as:
A. Microphthalmos
B. Photophobia
C. Leucocoria (white reflex)
D. Pain

46. In a hypertensive patient with glaucoma which the following is not used:
A. Dipivefrine
B. Alpha blocker
C. Alpha agonist
D. Laser trabeculoplasty

47. Schwalbe's ring corresponds to:
A. Corneal endothelium
B. Descemet's membrane
C. Schlemm's canal
D. Ciliary body

48. A 75-year old patient present with deterioratio of vision. On examination the pupillary refle is observed to be sluggish and the intraocula pressure is normal. Optic disc evaluation show a large and deep cup and primarily show paracentral scotomas. The most likely diagnosis is
A. Primary narrow angle glaucoma
B. Normal tension glaucoma
C. Neovascular glaucoma
D. Absolute glaucoma

49. Treatment of primary open angle glaucoma:
A. Timolol maleate
B. Atropine
C. Acetazolamide
D. Prostaglandin analogue

50. True about primary angle closure glaucom *except*:
A More common in females
B. Shallow anterior chamber
C Shorter diameter of cornea is a predisposin factor
D. Common in myopes

33:B 34:C 35:B 36:D 37:B 38:D 42:B 43:A 44:B 45:B 46:A 47:
39:D 40:D 41:B 48:B 49:A 50:D

51. Intractable secondary glaucoma is seen in:
A. Diffuse iris melanoma
B. Nodular iris melanoma
C. Melanocytic deposits in anterior part of iris
D. Melanocyte proliferation in posterior oveal tissue.

52. Which of the following is not primary glaucoma:
A. Juvenile glaucoma
B. Pigmentary glaucoma
C. Congenital glaucoma
D. Infantile glaucoma

53. In POAG (primary open angle glaucoma) which is not seen:
A. Horizontal cupping
B. Bayonetting sign (crossing of vessels)
C. Positive diurnal variation
D. Dot sign

54. A patient presents with h/o evening halos and occasional headache for some months. His examination shows normal IOP but shallow AC. He is in which stage of glaucoma:
A. Acute
B. Absolute
C. Prodrome
D. Constant instability

55. Not seen in acute angle closure glaucoma:
A. Colored halos
B. Flashes of light
C. Vertically oval pupil
D. Increased IOP

56. Drug used in acute congestive glaucoma are all *except*:
A. Atropine
B. Pilocarpine
C. Acetozolamide
D. Mannitol
E. Timolol

57. Treatment of acute congestive glaucoma includes all exept:
A. Sclerectomy
B. Trabeculectomy
C. Trabeculoplasy
D. Iridotomy

58. Iridocorneal endothelial syndrome is associated with:
A. Progressive atrophy of iris stroma
B. Bilateral stromal oedema of iris and cornea
C. Deposition of collagen in Descemet's membrane
D. Deposition of glycosaminoglycan in Descemet's membrane

59. Treatment option for glaucoma includes all *except*:
A. Trabeculectomy
B. Trabeculotomy
C. Vitrectomy
D. Viscoanulostomy
E. Iridectomy

60. False statement about depth of anterior chamber:
A. Less in women than men
B. Correspondent to volume of anterior chamber
C. More in myopes
D. Less in hypermetropes

61. Glaucomflecken is:
A. Acute uvetis due to glaucoma
B. Lens opacity due to glaucoma
C. Retinal detachment due to glaucoma
D. Flashes of light due to glaucoma

62. Cells affected in glaucomatous optic neuropathy are: *(AIIMS 2014/2013)*
A. Amacrine cells
B. Bipolar cells
C. Ganglion cells
D. Rods and cones

63. In the conversion of CO_2 and H_2O to form carbonic acid during formation of aqueous humour, the enzyme catalyzing the reaction is: *(AIIMS)*
A. Carboxylase
B. Carbamylase
C. Carbonic anhydrase
D. Carbonic dehydrogenase

64. Which of the following is used as self-tonometer? *(AIIMS 2014)*
A. Diaton palpebral tonometer
B. Rebound tonometer
C. Perkin's tonometer
D. Dynamic contour tonometer

65. Tonometer used in irregular cornea: *(AIIMS)*
A. Mackay-Marg tonometer
B. Rebound tonometer
C. Draeger's tonometer
D. Maklakov tonometer

66. Tonometer with variation in applanation surface is: *(AIIMS)*
A. Maklakov tonometer
B. Mackay-Marg tonometer
C. Rebound tonometer
D. Draeger tonometer

67. Which of the following procedures is not done in dilated pupil? *(AIIMS 2014)*
A. Gonioscopy
B. Fundoscopy
C. Laser interferometry
D. Electroretinogram

51: A **52: B** **53: A** **54: C** **55: B** **56: A**
57: C **58: A**
59: C **60: B** **61: B** **62: C** **63: C** **64: B**
65: A **66: A** **67: A**

68. Schwalbe's line is: *(DNB 2015)*
A. The posterior limit of the Descemet's membrane
B. The posterior limit of the Bowman's membrane
C. The anterior limit of the Descemet's membrane
D. The anterior limit of the Bowman's membrane

69. Which of the following is not true regarding primary congenital glaucoma? *(DNB 2015)*
A. Photophobia is the most common symptom
B. Haab's striae may be seen
C. Thin and blue sclera may be seen
D. Anterior chamber is shallow

70. Shallow anterior chamber is seen in all *except*: *(TNPG 2013)*
A. Old age
B. Hypermetropia
C. Steroid induced glaucoma
D. Angle closure glaucoma

71. First drug to be given in acute angle closure glaucoma: *(AIIMS)*
A. Acetazolamide
B. Atropine
C. Pilocarpine
D. Timolol

72. Treatment of choice for acute angle closure glaucoma: *(AIPG 2000)*
A. Pilocarpine
B. Laser iridotomy
C. Timolol
D. Trabeculoplasty

73. Open angle glaucoma causes: *(COMEDK 2009)*
A. Sudden loss of vision
B. Difficulty in dark adaptation
C. Amaurosis fugax
D. Uniocular diplopia

74. Malignant glaucoma is seen in: *(PGI)*
A. After intraocular surgery
B. Intraocular malignancy
C. Trauma
D. Thrombosis

75. Krukenberg spindle is seen in: *(DNB 2013)*
A. Pigmentary glaucoma
B. Sympathetic ophthalmitis
C. Retinitis pigmentosa
D. Chalazion

76. Krukenberg spindle is seen in: *(APPG 2014)*
A. Corneal endothelium
B. Retina
C. Lens
D. Conjunctiva

77. Which of the following anti-glaucoma medicatio can cause drowsiness? *(AIP*
A. Latanoprost
B. Brimonidine
C. Timolol
D. Dorzolamide

78. Which anti-glaucoma medication is unsafe infants? *(DPG 20*
A. Timolol
B. Brimonidine
C. Dorzolamide
D. Latanoprost

79. Which of the following topical drugs cau heterochromia iridis? *(AIIMS 20*
A. Latanoprost
B. Prednisolone
C. Olopatadine
D. Timolol

80. Which anti-glaucoma drug causes pigmentati of eyelids? *(DNB 20*
A. Brimonidine
B. Timolol
C. Latanoprost
D. Dorzolamide

81. Which of these drug combinations is not genera used in glaucoma? *(DNB 20*
A. Timolol + Latanoprost
B. Timolol+ Brimonidine
C. Timolol+ Pilocarpine
D. Pilocarpine + Latanoprost

82. Express shunt in glaucoma is made up of: *(AIIMS 20*
A. Silicon
B. Titanium
C. Gold
D. Stainless steel

83. Triple procedure in glaucoma includes all following *except*: *(DNB 20*
A. Trabeculectomy
B. PCIOL implantation
C. Extracapsular cataract extraction
D. Insertion of glaucoma drainage device

84. Hypersecretory glaucoma is seen in: *(AI*
A. Epidemic dropsy
B. Marfan's syndrome
C. Hypertension
D. Diabetes

68: C 69: D 70: C 71: A 72: B 73: B 74: A 75: A 76: A 77: A 78: B 79: A 80: C 81: D 82 83: D 84: A

CHAPTER

11

Diseases of Vitreous

QUICK TEXT REVIEW

DISORDERS OF VITREOUS

VITREOUS LIQUEFACTION (SYNCHYSIS)

- Most common degenerative change
- *Causes:* Senile, myopic degeneration, post-inflammatory, post-traumatic.

POSTERIOR VITREOUS DETACHMENT (PVD)

- PVD with vitreous liquefaction (synchysis) and collapse (syneresis) is of common occurrence in majority of the normal subjects above the age of 65 years.
- Flashes of light and floaters may be associated
- A ring like opacity (Weiss reflex) representing a ring of vitreous attachment at the optic disc margin is pathognomic.
- May be complicated by retinal break, retinal and/or vitreous haemorrhage and cystoid maculopathy.

VITREOUS HAEMORRHAGE

- *Causes* are diabetic retinopathy, hypertensive retinopathy, Coats disease, Eales' disease, trauma, retinal breaks and/or posterior vitreous detachment, anaemia, leukaemia and sickle cell retinopathy, central retinal vein occlusion, and bleeding disorders—haemophilia, purpura.
- *Clinical features*: Sudden onset of floaters (black spots in front of the eye) when the haemorrhage is small; and sudden painless loss of vision if the haemorrhage is large.
- *Examination reveals* normal anterior segment, no red glow and non-visualization of fundus in a large haemorrhage.
- *B-scan USG* is particularly helpful in diagnosing vitreous haemorrhage.
- *Complications* include retinitis proliferans, vitreous liquefaction and degeneration, and ghost cell glaucoma in aphakia.
- *Vitrectomy* is indicated if vitreous haemorrhage does not absorb in 3 months.

PERSISTENT HYPERPLASTIC PRIMARY VITREOUS

- *Usually unilateral,* bilateral cases are rare and may be associated with Trisomy13 (patau syndrome)
- *Typically presents as a white reflex* (congenital leukocoria) in pupil, it must be differentiated from other causes of leukocoria, particularly *retinoblastoma.*
- *Differentiating features from retinoblastoma* are:
  - Lack of calcification on CT (calcification is an important feature of retinoblastoma)
  - Development of cataract (cataract is rare in retinoblastoma)
  - Unilaterality (retinoblastoma is bilateral in about one-fourth of cases).
- *Associations* are: Long ciliary processes, microphthalmos, cataract, glaucoma, and vitreous detachment. Seen in Patau syndrome.
- *Visual prognosis* is poor despite early intervention.

MISCELLANEOUS POINTS

- *Synchysis (liquefaction) and syneresis (collapse)* are the two most common degenerative changes in the vitreous gel.
- Optimum time for vitrectomy in a patient of bacterial endophthalmitis not responding to conservative treatment is 24 hours after the intravitreal injection of antibiotics.
- Vitreous gel never regenerates
- Strongest attachment of the vitreous is to the ora serrata (vitreous base attachment)
- Most common cause of vitreous haemorrhage is trauma
- *Most common cause of spontaneous vitreous haemorrhage* is proliferative diabetic retinopathy.

VITRECTOMY

Indications of vitreous surgery

- Vitreous loss during cataract surgery
- Along with lensectomy
- Endophthalmitis
- Vitreous haemorrhage not getting absorbed in 3 months
- Proliferative retinopathies
- Dropped nucleus and intraocular lens
- Intraocular foreign bodies
- Vitreous amyloidosis
- Aphakic keratoplasty.

Types of vitrectomy

- *Anterior vitrectomy*, i.e. removal of anterior vitreous.
- *Core vitrectomy*, i.e. removal of central bulk of vitreous.
- *Subtotal and total vitrectomy*, i.e. removal of almost total vitreous.

Techniques of Vitrectomy

I. ***Open-sky vitrectomy.*** It is performed through the primary wound to manage disturbed vitreous in cataract surgery, aphakic keratoplasty, and globe rupture.

II. ***Pars-plana vitrectomy (PPV)*** can be:

1. *One-port vitrectomy*, not a preferred techniqu now-a-days, can be performed with the help a multifunction vitrectomy probe comprisi vitreous infusion, suction, and cutter (VSC).
2. *Three-port-vitrectomy*, the preferred techniqu comprises three different ports one each fo illumination probe, infusion cannula, and cutte and suction probe. It includes:
   - 20 gauge PPV,
   - 23 gauge PPV, and
   - 25 gauge PPV.

Vitreous Substitutes

Vitreous substitutes are used in vitreo-retina surgery to:

- Restore intraocular pressure, and
- Provide intraocular tamponade.

Commonly used vitreous substitutes include:

1. *Expanding gases,* e.g:
   - Sulphur hexafluoride (SF6),
   - Perfluoropropane (C3F8)
2. *Perfluoro carbon liquids* (PFCLS), e.g:
   - Perfluoro-n-octane
   - Perfluro-tributylamine,
   - perfluro-decalin, and
   - perfluro-phenanthrene.
3. *Silicone oil.* It allows more controlled retina manipulation during VR surgery.

MULTIPLE CHOICE QUESTIONS

1. Synchysis refers to:
A. Liquefaction of the vitreous
B. Black spots in front of the eyes
C. Collapse of the vitreous
D. Detachment of the vitreous

2. Syneresis refers to:
A. Liquefaction of the vitreous
B. Black spots in front of the eye
C. Collapse of the vitreous
D. Detachment of the vitreous

3. In vitreous base detachment, vitreous body is detached from its attachment with the:
A. Optic disc
B. Ora-Serrata
C. Posterior surface of the lens
D. Fovea centralis

4. All of the following are features of asteroid hyalosis *except*:
A. Usually bilateral
B. Solid vitreous
C. Spherical calcium bodies
D. Usually asymptomatic

5. All of the following are features of synchysis scintillans *except*:
A. Fluid vitreous
B. Spherical calcium bodies
C. Shower of gold rain
D. Secondary to trauma or inflammations of the eye

6. Vitrectomy should be considered if the vitreous haemorrhage is not absorbed within:
A. 1 month
B. 3 months
C. 6 months
D. 2 months

7. Presistent hyperplastic primary vitreous may be associated with:
A. Long ciliary processes
B. Microphthalmos
C. Cataract
D. All of the above

8. Commonest cause of vitreous haemorrhage is:
A. Diabetes
B. Hypertension
C. Trauma
D. Lens extraction

9. Vitreous haemorrhage is seen in all *except*:
A. Coat's disease
B. Eales' disease
C. CRVO
D. CRAO

10. Vitreous haemorrhage is not seen in:
A. Hypertension
B. Eales' disease
C. Trauma
D. Diabetes mellitus
E. Vitreous degeneration

11. A vitreous aspirate has been collected in an emergency at 9 pm. What advice would you like to give to the staff on duty regarding the overnight storage of the sample:
A. The sample should be kept at 4°C
B. The sample should be incubated at 37°C
C. The sample should be refrigerated in deep freezer
D. The sample should be refrigerated for the initial 3 hours and then kept at 37°C

12. Eales disease is:
A. Recurrent optic neuritis
B. Recurrent pappilloedema
C. Recurrent periphelbitis retinae
D. None

13. Eale's disease is:
A. Retinal haemorrhage
B. Vitreous haemorrhage
C. Conjunctival haemorrhage
D. Choroidal haemorrhage

14. A 25-year-old male presents with painless sudden loss of vision. Ocular and systemic examination is not contributory. What is probable diagnosis.
A. Retinal detachment
B. Eale's disease
C. Glaucoma
D. Cataract

15. Persistent primary hyperplastic vitreous (PHPV) is associated with:
A. Patau syndrome
B. Edward syndrome
C. Trisomy 14
D. Downs syndrome

16. When compared to blood, vitreous humour has higher concentration of: *(AIIMS 2015)*
A. Glucose
B. Sodium
C. Potassium
D. Ascorbate

17. Most common age-related change seen in the vitreous: *(DNB 2013)*
A. Anterior vitreous detachment
B. Posterior vitreous detachment
C. Vitreous haemorrhage
D. Vitritis

1:A 2:C 3:B 4:A 5:B 6:B 7:D 8:C 9:D 10:E 11:A 12:C 13:B 14:B 15:A 16:D 17:B

CHAPTER

12

Diseases of Retin

QUICK TEXT REVIEW

CONGENITAL AND DEVELOPMENTAL DISORDERS

Coloboma of the optic disc

- Results from failure of the embryonic fissure closure.
- Minor defect manifests as inferior crescent, usually associated with hypermetropia or astigmatism.

Drusen of the optic disc

- Lies deep beneath the surface of the disc tissue in childhood (presents as pseudopapilloedema) and emerges out by the early teens presenting as waxy pea-like irregular refractile bodies.

Hypoplasia of the optic disc

- An important cause of blindness at birth in developed countries (rare in developing countries).
- Associated with maternal alcohol use, diabetes and use of certain drugs in pregnancy.
- Bilateral in 60% cases.
- Small disc with 'double ring sign' is pathognomonic.

Medullated nerve fibres/Opaque nerve fibres

- Represent myelination of nerve fibres of the retina (normally myelination stops at lamina cribrosa).
- Appear as whitish patch with feathery margins, usually present around the disc and may cause enlargement of the blind spot.
- Disappear in patients with optic atrophy.

Congenital remnants of the hyaloid arterial system

- *Bergmester's papilla*—a flake of glial tissue projecting from the disc (commonest anomaly of the hyaloid system).
- *Mittendorf dot*—remnant of anterior end of hyaloid artery attached to the posterior lens capsule, usually associated with a posterior polar cataract.

INFLAMMATIONS OF RETINA

Retinitis

- *Subacute retinitis of Roth* typically occurs patients with subacute bacterial endocard (SABE) and is characterised by Roth's sp (superficial haemorrhages with a white spot in centre).
- *Cytomegalovirus (CMV) retinitis* and herp zoster retinitis are more common in patie with AIDS. CMV retinitis is most comm cause of chorioretinitis in AIDS, typical func changes are labeled as crumbled chee and ketchup appearance (souse and che appearance), pizza pie appearance and bru fire appearance.

Periphlebitis retinae

Primary periphlebitis retinae (Eales' disea an idiopathic inflammatory venous occlusion considered a hypersensitive reaction to tuberc proteins.

Eales' disease is a bilateral condition, affec peripheral retina in young adult males. I characterised by recurrent primary vitre haemorrhages. This is the *most common caus spontaneous vitreous haemorrhage in young adu* ***Complications*** *of* Eales' diseases includ rubeosis iridis, neovascular glaucoma, prolifera retinopathy and tractional retinal detachment.

Treatment: Retinal photocoagulation is the tr ment. Anti VEGF injection, Pars plana vitrecto are other options.

Secondary periphlebitis occurs in patients v uveitis.

VASCULAR DISORDERS OF RETINA

RETINAL ARTERY OCCLUSIONS

Central retinal artery occlusion (CRAO)

Etiology. It occurs due to obstruction at the level of lamina cribrosa. *Emboli* are the most common causes of CRAO. *Other causes* are gaint cell arteritis, SLE, Wegner's granulomatosis, scleroderma, and occasionally raised IOP.

Clinical features. Causes *sudden painless loss of vision* (central vision not affected in patients with cilioretinal artery). Retina becomes white due to oedema and a *'Cherry-red-spot'* is seen at the fovea.

- Arterioles become narrow and blood column within the retinal vessels is segmented (*Cattle-track* appearance).

Treatment. CRAO is an **ocular emergency** whose window period of treatment is **3 hours.** Ocular massage for 15 min that leads to lowering of IOP which in turn increases the blood flow and may dislodge the thrombus, IV Mannitol, Inhalation of 5% CO_2 + 95% O_2 and Paracentesis.

Branch retinal artery occlusion (BRAO)

- Occurs following lodgement of embolus at a bifurcation.
- Retina distal to the occlusion becomes oedematous with narrowing of arterioles.
- Later on involved area is atrophied leading to permanent sectorial field defect.

Retinal vein occlusion

Predisposing factors are hypertension, diabetes mellitus, open-angle glaucoma, polycythemia, and periphlebitis.

Non-ischaemic central retinal vein occlusion (CRVO) is most common variety (75%), characterised by mild to moderate visual loss. About 15% cases of nonischaemic CRVO are converted to ischaemic CRVO in 4 months and about 30% in 3 years.

Ischaemic central retinal vein occlusion is characterised by much more marked signs and symptoms than non-ischaemic CRVO.

Fundus changes include tortuous and engorged veins, scattered retinal haemorrhages, cotton wool spots, and unilateral disc changes (Blood and thunder fundus appearance).

Complications. Rubeosis iridis and neovascular glaucoma (NVG) occurs in more than 50% cases within 3 months, vitreous haemorrhage, and proliferative retinopathy.

Differential diagnosis of CRVO, most important, is ocular ischemic syndrome. Veins are dilated in both, but veins are tortuous in CRVO.

Branch retinal vein occlusion: The superotemporal branch is the most commonly affected (33%).

HYPERTENSIVE RETINOPATHY

Chronic hypertensive retinopathy

Generalized narrowing of arterioles which may be mild or moderate.

Focal arteriolar narrowing is seen as area of localized vasoconstriction on the disc or within.

Arteriovenous nicking (crossing changes, hallmark of chronic hypertensive retinopathy) include:

- *Salu's sign*, i.e. deflection of veins at crossing
- *Bonnet sign*, i.e. banking of veins distal to crossing
- *Gunn sign*, i.e. tapering of veins on either side of crossing.

Arterial reflex changes. Changes in normal reflex, which is sharp and thin due to blood column under the transparent wall, include:

- *Diffuse and loss bright reflex* is seen due to thickening of vessel wall.
- *Copper wiring*, i.e. reddish brown reflex occurs due to progressive sclerosis and hyalinization.
- *Silver wiring*, i.e. opaque white reflex, occurs ultimately due to continued sclerosis.

Superficial retinal haemorrhages, flame shaped, occur scattered, more around posterior pole.

Hard exudates, i.e. yellow waxy spots occur due to lipid deposits. They are more seen on posterior pole and may be arranged as macular fan or star.

Cotton wool spots, fluffy lesions, represent areas of infract in nerve fiber layer.

Acute changes of hypertension

Acute hypertensive retinopathy changes includes

- *Marked arteriolar narrowing* due to spasm
- *Superficial retinal haemorrhages*, flame shaped, arranged in clusters.

Keith Wegner grading of hypertensive retinopathy

Grade I: Mild generalized narrowing of arterioles.

Grade II: Marked generalized narrowing plus focal constriction of arterioles with deflection of the vein at arteriovenous crossing (Salu's sign).

Grade III: Grade II changes plus copper wiring of arterioles, Bonnet sign, Gunn sign, Salu's sign along

with haemorrhages, cotton wool spots and hard exudates.

Grade IV: Grade III changes plus silver wiring and papilloedema.

Retinopathy in toxaemia of pregnancy

- Earliest changes consist of narrowing of nasal arterioles followed by generalised narrowing.
- Advent of hypoxic changes (cotton wool spots, haemorrhages and retinal oedema) should be considered an indication for termination of pregnancy.

DIABETIC RETINOPATHY

Risk factors

- *Duration of diabetes* is most important risk factors. Incidence is about:
  - After 10 years of diabetes 20% of Type I and 25% of Type II.
  - After 20 years of diabetes 90% of Type I and 60% of Type II.
  - After 30 years of diabetes 95% of both Type I and Type II.
- *Poor Glycemic Control*
- *Heredity:* Effect is more on proliferative DR, transmission is recessive
- *Sex:* Male: Female: 3: 4
- *Pregnancy:* Accentuates the changes of DR
- *Hypertension:* Accentuates the changes of DR.

Other ocular manifestations of DM

- Cataract (Snowflake/snow strom)
- Myopia (when there is sudden increase in blood sugar level)
- Rarely hypermetropia
- Cranial nerve palsy: 3rd (most common), 4th, 6th and 7th.

Pathophysiology

- The hallmark of diabetic retinopathy is the alteration in the structure and cellular composition of the microvasculature.
- *Hyperglycaemia* leads to the formation of advanced glycation end products (AGE) which are deposited in the walls of the retinal blood vessels. AGE cause **loss of pericytes** and damage to the endothelial cells. This in turn leads to **microaneurysm** formation due to weakening of the vessel walls.
- Endothelial cells are responsible for maintenance of the blood retinal barrier. Hence, *endothelial cell damage* leads to abnormal capillary permeability and leakage.
- *Retinal leucostasis* is another important factor in the development of diabetic retinopathy. Increase in inflammatory cytokines causes influx of leucocyte which adhere to the vascular endothelium an cause a decrease in capillary perfusion.
- *Retinal hypoperfusion* leads to increase i angiogenic mediators like **Vascular Endothelia Growth Factor (VEGF),** which stimulate **neo vascularization.**

Classification of DR

1. *Non-proliferative diabetic retinopathy (NPDR)*

Signs

- *Microaneurysms:* They are the *first detectabl lesions of DR.* They are dilated capillaries presen at level of *Inner Nuclear Layer* of the retina due t *loss of pericytes* in the capillary walls.
- *Intraretinal haemorrhages:* Rupture of the weakened capillaries leads to intraretina haemorrhages. They are of two types:
  - *Flame-shaped haemorrhages* which are locate in the nerve fibre layer, and
  - *Dot blot haemorrhages* which are located in the inner nuclear layer
- *Hard exudates.* These are lipoproteins leaking fro the damaged retinal blood vessels. They are mainl located in the outer plexiform layer
- *Retinal thickening* due to diffuse oedema
- *Venous abnormalities* beading, looping an dilatation
- *Cotton-wool spots:* Areas of nerve fibre laye infants.
- *Intraretinal microvascular abnormalities* (IRMA)

***Treatment** is not required, management includes:*

- Adequate control of diabetes
- Annual fundus examination.

2. *Proliferative diabetic retinopathy*

Signs of PDR: In chronological order, over an above the signs of NPDR are as follows:

- *Neovascularization* on the disc (NVD) o elsewhere (NVE). Widespread retinal ischaemi leads to increase in a mediator called *Vascula Endothelial Growth Factor (VEGF)* which cause neovascularization
- Incomplete posterior vitreous detachment
- Elevation of new vessels and vitreous haemorrhag
- Fibrovascular epiretinal membrane
- Tractional retinal detachment.

Treatment includes:

- *Panretinal argon photocoagulation* (PRP). Th mechanism of action of laser is described a *conversion of hypoxia to anoxia.*
- *Intravitreal injection of anti-VEGF* before PR protects the macula and reduces risk of vitreou haemorrhage.

- *Intravitreous triamcinolone* may be considered as an adjunct to PRP.
- *Pars plana vitrectomy.* Indications for surgery are:
  - Tractional retinal detachment
  - Non-resolving vitreous haemorrhage
  - Patients not responding to laser therapy.

3. Diabetic maculopathy

Focal exudative maculopathy

- Characterized by changes of NPDR and hard exudates arranged in a circinate pattern in macular area.
- Fluorescein angiography reveals focal leakage with adequate macular perfusion.
- *Treatment* of focal DME not involving centre of fovea consists of focal argon laser to micro-aneurysms and centre of the hard exudates ring.

Diffuse exudative maculopathy

- Changes of NPDR with very few hard exudates in the macular area
- *Diffuse retinal oedema* and thickening throughout the posterior pole
- *Cystoid macular oedema* and lamellar hole in long standing cases
- *Fluorescein angiography* shows diffuse leakage but good macular perfusion.
- *Treatment* consists of intravitreal anti-VEGFs and argon laser photocoagulation should be reserved for recalcitrant cases not responding to anti-VEGFs and intravitreal triamcelone.

Ischaemic maculopathy

- Marked visual loss
- Microaneurysms, haemorrhages, mild or no oedema and only a few hard exudates if any
- Fluorescein angiography shows poor macular perfusion.

Mixed maculopathy

- Features of combined ischaemic and exudative maculopathy are present.

4. Advanced diabetic eye disease

- Persistent vitreous haemorrhage
- Tractional retinal detachment
- Neovascular glaucoma
- Treatment is pars plana vitrectomy with endo-photocogulation and management of RD.

SICKLE-CELL RETINOPATHY

Retinal changes are caused by hypoxia resulting from blockage of small blood vessels by the abnormal shaped rigid red blood cells.

Clinical features

- Stage I: Peripheral arteriolar occlusion
- Stage II: Peripheral arteriovenous anastomosis
- Stage III: Neovascularization
- Stage IV: Vitreous haemorrhage
- Stage V: Vitreoretinal traction bands and tractional retinal detachment.

Treatment

- *Pan retinal photocoagulation (PRP)* is effective in regressing the neovascularization.
- *Pars plana vitrectomy* for stage IV and V.

ANAEMIC RETINOPATHY

- Changes appear when haemoglobin falls below 5 g%
- Pale background and pale arterioles
- Dilated veins
- Superficial haemorrhages and subhyaloid haemorrhage
- A few Roth's spots and cotton wool spots.

LEUCAEMIC RETINOPATHY

- Pale and orange fundus background
- Dilated and tortuous veins
- Superficial haemorrhages, Roth's spots and subhyaloid haemorrhage.
- Perivascular leucaemic infiltration.

RETINOPATHY OF PREMATURITY (RETROLENTAL FIBROPLASIA)

Occurs in premature infants (weighing less than 1300 gm) exposed to high concentration of oxygen. Ii is an important cause of leukocoria in children.

Clinical features

Zones of Location

- Zone I : Circle with optic nerve at centre and a radius of twice the distance from optic nerve to macula
- Zone II : From edge of Zone I to the nasal ora serrata nasally and equator temporally
- Zone III : Lateral most crescent shaped area from Zone II to ora-serrata temporally

Severity of ROP

- *Stage 1* : Formation of demarcation line.
- *Stage 2* : Formation of retinal ridge.
- *Stage 3* : Ridge with extraretinal fibrovascular proliferation.
- *Stage 4* : Subtotal tractional retinal detachment.
- *Stage 5* : Total retinal detachment.

Plus disease: Presence of dilatation and tortuosity of posterior retinal vessels.

Management

Oxygen concentration in incubator should be kept less than 30%.

Regular screening by indirect ophthalmoscopy is most important

- Neonates born **at ≤32 week of gestation or birth weight <1500 gm must be screened for ROP**
- Neonates born at **≥32 weeks or weighing between 1500–2000 g** who have been exposed to oxygen are also screened
- *Screening is done at 4 weeks* from birth or 32 weeks of gestation whichever is later

Treatment. Based on results of ETROP (Early Treatment of Retinopathy of Prematurity) study, the treatment of ROP is described as:

Type of ROP	*Treatment*
Type 1 ROP or Threshold ROP: • Zone I, any stage ROP with plus disease • Zone I, stage 3 ROP with or without plus disease • Zone II, stage 2 or 3 ROP with plus disease	Peripheral retinal ablation should be carried out
Type II ROP: ROP not meeting the criteria for threshold ROP	Follow-up

- *Pars plana vitrectomy* for tractional retinal detachment.

COAT'S DISEASE (EXUDATIVE RETINITIS OR EXUDATIVE RETINOPATHY OR RETINAL TELANGIECTASIS)

- It is an idiopathic condition with massive subretinal exudates and associated with telengiectatic retinal vessels and aneurysms.
- Males are more commonly affected in their first decade of life.
- No genetic predisposition.
- In this condition, abnormal telengiectatic and leaky blood vessels are seen most commonly in the *infero-temporal quadrant* of the retina. These blood vessels cause severe intraretinal and subretinal exudation leading to *exudative retinal detachment.*
- Presentation is with *leukocoria* and *strabismus* associated with *vision loss.*
- On examination, exudation with retinal detachment is seen.
- A variant of Coat's disease is called *Idiopathic Juxtafoveal Telangiectasia*

Treatment is laser photocoagulation of t telangiectatic vessels.

DYSTROPHIES AND DEGENERATIONS OF TH RETINA

RETINITIS PIGMENTOSA (PIGMENTARY RETINAL DYSTROPHY)

Retinitis Pigmentosa (RP) is a type of retin dystrophy predominantly affecting the rod phot receptor cells of the retina with subsequent degen ration of the cones.

- *Sporadic: Most common*

Inheritance

- *Autosomal recessive*—most common and relative severe
- *Autosomal dominant*—common and relative benign
- *X-linked*—least common, most severe.

Incidence

- 1 person per 5000 of the world population
- Male: female ratio is 3 : 2
- Bilateral equal involvement.

Clinico-investigative features

- *Night blindness*—may occur before the retina changes, appear.

Fundus changes

- Retinal pigmentary changes occur in the form perivascular deposition (jet black spots) of bon corpuscle pigments in the equatorial region; whic later spread both anteriorly and posteriorly
- Retinal arterioles are attenuated
- Optic disc becomes pale waxy ending in consecutiv optic atrophy.

Visual field changes

- Annular or ring scotoma
- Tubular vision in advanced cases.

Electrophysiological changes

- Appear even before the subjective symptoms an signs
- *Scotopic flash ERG:* Decrease in the amplitude the 'a' wave
- EOG is extinguished.

Ocular associations

- Myopia (common)
- Primary open-angle glaucoma in 30%
- Microphthalmos
- Keratoconus (rare)
- Subcapsular cataract.

Systemic associations

Laurence-Moon-Biedl syndrome (most common)
- Retinitis pigmentosa
- Obesity
- Hypogenitalism
- Polydactyly
- Mental deficiency.

Cockayne's syndrome
- Retinitis pigmentosa
- Nystagmus
- Progressive infantile deafness
- Dwarfism
- Mental retardation
- Ataxia.

Refsum's syndrome
- Retinitis pigmentosa
- Peripheral neuropathy
- Cerebellar ataxia.

Usher's syndrome
- Retinit's pigmentosa
- Labyrinthine deafness.

Hallgren's syndrome
- Retinitis pigmentosa
- Vestibulocerebellar ataxia
- Congenital deafness
- Mental deficiency.

ATYPICAL FORMS OF RETINITIS PIGMENTOSA

- *Retinitis pigmentosa sine pigmento:* All features of retinitis pigmentosa, except no or minimal visible pigmentary changes.
- *Sectorial retinitis pigmentosa:* Only one quadrant (usually nasal) or one half (usually inferior) is involved.
- *Pericentric retinitis pigmentosa:* Pigmentary changes are confined to an area immediately around the macula.
- *Retinitis punctata albescens:* Autosomal dominant, innumerable discrete white dots are scattered over the fundus.

MACULAR DISORDERS

PHOTORETINITIS

- Damage of the foveolar region caused by ultraviolet ray and infra-red rays of bright sun-light, commonly occurring during solar eclipse (Eclipse burn).
- Typical lesion appears as a bean or kidney shaped pigmented spot with yellowish white centre in the foveal region.

CENTRAL SEROUS CHORIO-RETINOPATHY (CSC-R)

It refers to spontaneous detachment of neurosensory retina in the macular region
- Risk Factors: *Stress, smoking and steroids*
- Seen in *Type A personalities.*

Clinical features:
- Typically affects males between 20 and 40 years causing sudden painless mild loss of vision (6/9-6/12), micropsia, metamorphopsia and relative positive scotoma
- *Fluorescein angiography* may show 'ink-blot' or 'smoke-stack' sign (Mushroom or umbrella configuration).

Treatment. Wait and watch, as *self-limiting* (in 90% cases in about 12 weeks) *but recurrent* (about 40%)
- *Laser photocoagulation* is indicated in:
  - Long standing cases (more than 4 months)
  - Patients showing multiple leaks
  - Impaired visual acuity in the fellow eye from CSCR.

CYSTOID MACULAR OEDEMA

Collection of fluid in the outer plexiform (Henle's layer) and inner nuclear layer of the retina, centred around fovea due to break down of the inner blood-retinal barrier.

Causes are:
- *Postoperative complication* of cataract and keratoplasty operations.
- *Inflammations* such as pars planitis, and posterior uveitis
- *Retinal vascular disorders,* diabetic retinopathy, and retinal vein occlusion.
- *Retinal dystrophy*–Retinitis pigmentosa
- *Side effect* of topical 2% adrenaline in aphakic patients.
- *Secondary* to other maculopathies
- *Complication of peripheral retinal photocoagulation.*

Clinical features include:
- Minimal to moderate loss of vision which may be permanent in persistent cases
- Typical fundus picture in advanced cases is of 'Honey-comb appearance' of macula
- Fluorescein angiography in well established cases presents a 'flower-petal appearance'
- Long standing CME may end in macular hole.
- ***Treatment*** is *steroids,* nonsteroidal anti-inflammatory drugs, anti-VEGF.

AGE-RELATED (SENILE) MACULAR DEGENERATION (AMD)

Non-exudative AMD

- Also called as *dry* or *geographical AMD*
- Comparatively common (90% cases) and causes gradually progressive mild to moderate loss of vision.
- Fundus shows: Colloid bodies, pale areas of retinal pigment epithelium (RPE) atrophy, and irregular or clustered pigmentation.

Exudative AMD

- Also called as wet or neovascular AMD
- Comparatively rare (10% cases) but causes progressive and marked loss of vision.

Clinical course rapidly passes through following stages:

- Stages of drusen formation
- Stage of detachment of RPE.
- Stage of subretinal neovascular membrane (SRNVM)
- Stage of haemorrhagic detachment of RPE.
- Stage of haemorrhagic detachment of neurosensory retina
- Terminal stage of disciform macular scarring (degeneration).

Treatment includes

- *Intravitreal injections of anti-VEGF* (e.g. avastin) are recommended
- *Photodynamic therapy (PDT)* is the treatment of choice after anti-VEGF
- *Laser photocoagulation* (double frequency YAG 532) may be considered for an extrafoveal SRNVM situated 200 μ or more from the centre of fovea.
- *Low Vision Aids* — for advanced burnt out disease.

HEREDOMACULAR DEGENERATIONS

Best's disease

- Autosomal dominant (AD).
- Dystrophy of *RPE layer* at the macula
- *Deposition of lipofuscin pigment at the macula.*

Clinical picture. More commonly it occurs upto 6 years of age. In it loss of vision is not profound. Five stages are:

- *Pre-vitelliform stage:* Normal fundus but EOG is abnormal.
- *Vitelliform stage:* Egg yolk lesion at macula.
- *Pseudohypopyon stage:* Partially absorbed egg yolk lesion.
- *Vitelliruptive stage:* A scrambled egg appearance at macula
- *Stage of scarring:* Hypertrophic, atrophic vascularized scar at macula.

Note: ERG is normal but EOG is abnormal.

Stargardt's disease

- Autosomal recessive (AR) disease
- No family history present
- Stargardt's disease is a retinal dystrophy wit predominant macular involvement, hence als called *Juvenile Macular Dystrophy.*
- Presents with central decreased vision in first o second decade of life (more commonly less tha 21 years).
- Typical fundus picture is 'beaten-bronze' or 'snail slime reflex' in the macular area.
- Adult variant is Fundus Flavimaculatus wher involvement is predominantly in the peripher retina. Hence patients may be asymptomatic
- In this, flash ERG and EOG both are normal patter ERS is affected
- On fluorescein angiography dark choroid stars are seen.

Congenital Stationary Night Blindness

Group of retinal disorders characterized by infantile onset nyctalopia which is non-progressive.
Inheritance: May have Autosomal Dominant, Autosomal Recessive or X-linked Recessive inheri tance.
Fundus may be normal or abnormal in appearance. Two characteristic types are:

- *Fundus albipunctatus.*
- *Oguchi's disease:* The fundus has an unusua golden-yellow colour in light adapted conditio which becomes normal after prolonged dar adaptation. This is called *Mizuo phenomenon.*

Leber's Congenital Amaurosis

- This condition is associated with very poor visio since birth or very early childhood
- Fundus shows *salt and pepper retinopathy*

Characteristic feature is *oculodigital syndrom* where constant rubbing of the eyes by the child du to poor vision leads to *enophthalmos.*

RETINAL DETACHMENT

Retinal detachment (RD) refers to separatio of neuroensory retina from the retinal pigmen epithelium (RPE).

I. RHEGMATOGENOUS RD

This is the commonest type of retinal detachment.

Predisposing factors

- Age—Most common 40-60 years (no bar)
- Sex—Male: Female: 3:2
- Myopia—40% cases
- Aphakia or pseudophakia (previous cataract surgery)
- Retinal degenerations such as:
  - Lattice degeneration (most common)
  - Snail track degeneration
  - White-with-pressure and white-without pressure lesions
  - Diffuse chorioretinal degenerations
  - Acquired (senile) retinoschisis.
- Trauma
- Senile posterior vitreous detachment (PVD).
- *Retinoschisis.* This is a condition where there is splitting of the neurosensory retina and vitreous degeneration. It is of two types:
  - Typical Retinoschisis: Split at the level of *Outer Plexiform Layer*
  - Reticular Retinoschisis: Split at the level of *Nerve Fibre Layer*. Seen more com-monly in hypermetropes in the inferotemporal periphery of retina.

Clinical features

Prevalence

Affects 1 in 1000 population each year.

Prodromal symptoms

- *Photopsia* (flashes of light) due to vitreoretinal traction
- *Dark spots (floaters)* in front of the eyes (muscae volitantes).

Symptoms of detached retina

- *Localized relative loss in the field of vision* of detachment retina, which is described by the patient as **a black curtain or veil** in front of the eye.
- *Loss of vision* in detachments involving macular area.

Signs

- *Hypotony:* The liquefied vitreous in the subretinal space is absorbed through the RPE leading to hypotony.
- *Shafer's sign:* Pigments in anterior vitreous (tobacco dusting) is a feature of *fresh RD.*
- *Detached retina gives grey reflex,* is raised, thrown into folds which oscillate with the movements of the eye.
- *Retinal breaks holes* (round, horse-shoe-shape or slit like) look reddish and are most frequently found in the periphery (commonest in the upper temporal quadrant).
- *Signs of old RD are*:
  - Thinning of the detached retina
  - Secondary intraretinal cysts
  - Subretinal demarcation lines (high water marks).

Management

Indications of prophylactic treatment

- Symptomatic retinal breaks associated with PVD
- Large asymptomatic retinal tears (Horseshoe tear)
- Asymptomatic retinal break and/or lattice degeneration in the presence of: aphakia, high myopia, only eye, RD in fellow eye, strong family history of RD, and Marfan's syndrome, Stickler's syndrome and Ehlers-Danlos syndrome.

Basic principles of treatment

1. *Sealing of retinal breaks:* It can be performed with cryopexy or photocoagulation.

2. *Bringing the sclera, choroid and detached retina with each other.* It is carried out by the procedure of:

- *External tamponade* (scleral buckling or encirclage) or
- *Internal tamponade* PPV with intravitreal silicone oil.
  - *Pneumatic retinopexy:* In this procedure, the neurosensory retina is pushed towards the RPE by injecting an expansile gas in the vitreous cavity. The break is then sealed with laser. The gases commonly used are *Sulphur Hexafluoride (SF6) and Perfluoropropane (C3F8).*

Indications for drainage of subretinal fluid (SRF)

- Difficulty in localizing retinal breaks in bullous RD.
- Long-standing (old) RD
- RD with inferior breaks
- RD with immobile retina
- RD with advanced glaucoma, thin sclera and recent cataract extraction.

II. TRACTIONAL RETINAL DETACHMENT

It occurs due to retina being mechanically pulled away from its bed by the progressive contraction of fibrous or fibrovascular membrane over large areas of vitreo-retinal adhesions (vitreo-retinal traction bands).

Causes include:

- Post-traumatic retraction of scar tissue
- Proliferative diabetic retinopathy
- Sickle-cell retinopathy
- Retinopathy of prematurity

- Eales' disease
- Plastic cyclitis
- Post-vitreous haemorrhage retinitis proliferans.

Clinical features

- *Presence of vitreoretinal traction bands* with lesions of the causative disease
- *Configuration of the detached retina* is concave
- *Absent*—photopsia, floaters, retinal breaks, shifting fluid sign, mobility of detached retina.

Treatment: Pars Plana Vitrectomy and *endophotocoagulation.*

III. EXUDATIVE OR SOLID RETINAL DETACHMENT

Retina is elevated due to accumulation of fluid beneath it, associated with RPE damage:

Causes

1. *Systemic diseases*

- Toxaemia of pregnancy
- Renal hypertension
- Blood dyscrasias
- Polyarteritis nodosa.

2. *Ocular diseases*

- *Inflammations*
  - Harada's disease
  - Sympathetic ophthalmitis
  - Posterior scleritis
  - Orbital cellulitis
- *Vascular diseases*
  - Exudative retinopathy of coats
  - Central serous retinopathy
- *Neoplasms*
  - Retinoblastoma (exophytic)
  - Malignant melanoma of choroid
- *Sudden hypotony following*:
  - Globe perforation
  - Intraocular operation
- *Other causes*: Choroidal neovascularisation, haemangioma and metastatic tumour of choroid.

Clinical features

Exudative RD can be differentiated from rhegmatogenous RD by following characteristics:

- Absence of photopsia
- *Absence of retinal breaks*, folds and undulations
- *Configuration* of the RD is convex
- *Shifting fluid sign* is pathognomic of exudative RD
- On transillumination, rhegmatogenous RD is transparent while exudative RD is opaque.

Treatment

- Systemic steroids
- Treatment of the cause.

RETINOSCHISIS

- Characterized by the abnormal splitting of t retina's neurosensory layer, usually in the ou plexiform layer, resulting in a loss of vision in t corresponding visual field in some rarer forms.
- Usually asymptomatic
- It is classified into degenerative (typical a reticular), hereditary (X-linked juvenile retin schisis, familial foveal retinoschisis), and traction and exudative (secondary to optic disc pit).

TUMOURS OF RETINA

RETINOBLASTOMA

Incidence

- Most common intraocular tumour of childhood
- Occurs in 1 in 15000–20000 live births and accoun for 3% of all childhood cancers.
- Age—Usually presents at 18 months (1–2 years)
- Rare in Negroes
- 25–30% cases are bilateral.

Heredity

- *Retinoblastoma (RB) gene* is a cancer-suppress gene located on long arm of chromosome 1 (13q 14).
- *Deletion or inactivation of RB gene by tu mutations* (Knudson's two-hit hypothesis) resul in occurrence of retinoblastoma.
- Of all cases *10% are familial* (inherited by autosom dominant mode) and *90% are sporadic.*
- *Of sporadic cases,* about two-thirds (60% of a cases) occur by somatic mutation and one-thir (30% of all cases) occur by germline mutation.
- *Heritable or germline cases* (10% familial + 30 sporadic = 40%) occur by first mutation in R gene on germ cells (gametes) before fertilizatio and second mutation in RB gene on retinal cell These cases have multifocal, usually bilateral (85% tumours and can transmit to 50% of offspring.
- *Non-heritable or somatic cases* (60%) occu sporadically by both hits (mutations) in RB gene retinal cells in embryo. These cases have unifoca unilateral tumours which cannot be passed on t the off spring.

Pathology

- *Arises from* the immature retinal neural cells
- *Histologically,* cells may present as highl undifferentiated or well differentiated tumour.
- *Features of well-differentiated tumour* include:
  - Flexner-Wintersteiner rosettes (highly specifi for retinoblastoma)

- Homer-Wright rosettes (also seen in neuroblastoma and medulloepithelioma)
- Pseudorosettes
- Fleurettes

Other histological features of retinoblastoma are:

- Areas of necrosis
- Calcification.

Clinical features

Presenting Symptoms

- Leukocoria (61%)
- Squint (22%)
- Nystagmus in bilateral cases
- Secondary glaucoma and buphthalmos (rare)
- Pseudohypopyon (rare)
- Anterior chamber inflammation which may mimic anterior uveitis (rare)
- Hyphaema (rare)
- Proptosis which may mimic orbital cellulitis (rare).

Fundus examination in early stage (before leukocoria) may show:

Endophytic retinoblastoma which grows inwards and is white or pearly pink in colour. Fine blood vessels may be present on its surface. In the presence of calcification, it gives the typical 'cottage-cheese' appearance.

Exophytic retinoblastoma which grows outwards and causes exudative retinal detachment.

Associated Tumours

Osteosarcoma (most common), Malignant melanoma, testicular carcinoma, Ewing's tumour, Wilm's tumour.

Trilateral Retinoblastoma: Bilateral retinoblastoma plus pinealoblastoma.

Investigations

Plain X-rays, orbit— may show calcification in 75% cases.

Ultrasonography CT scan and MRI scan are quite useful.

Lactic dehydrogenase (LDH) levels are raised in aqueous humour (Aqueous: Plasma LDH >1).

Differential diagnosis

Differential diagnosis of leukocoria

Congenital cataract
Retinopathy of prematurity
Persistent hyperplastic primary vitreous
Toxocara endophthalmitis
Coats' disease
Coloboma of choroid
Retinal dysplasia.

Differential diagnosis of endophytic retinoblastoma discovered on fundus examination:

- Patch of exudative choroiditis
- Astrocytoma.

Differential diagnosis of exophytic retinoblastoma causing exudative retinal detachment:

- From other causes of exudative RD, e.g. Coat's disease.

International classification of retinoblastoma (ICRB)

Group A: (very low risk) includes all small tumours ≤3 mm in greatest dimension, confined to retina, located >3 mm from fovea and >1.5 mm from the optic disc.

Group B: (low risk) includes large tumours >3 mm in dimension, and any size tumours located <3 mm from fovea, and <1.5 mm from the optic disc margin.

Group C: (***moderate risk***) includes *retinoblastoma with focal seeds* characterized by subretinal and/or vitreous seeds ≤3 mm from the retinoblastoma

Group D: (***high risk***) includes *retinoblastoma with diffuse seeds* characterized by subretinal and/or vitreous >3 mm seeds from the retinoblastoma.

Group E: (***very high risk***) includes *extensive retinoblastoma* characterised by any of the following: tumour touching the lens, neovascular glaucoma, tumour anterior to anterior vitreous face involving ciliary body and anterior segment, diffuse infiltrating tumour, opaque media with hemorrhage, tumour necrosis with aseptic orbital cellulitis, invasion of postlaminar optic nerve, choroid, sclera, orbit, and anterior chamber, or phthisis bulbi.

Treatment

Enucleation

- It is treatment of choice for intraocular tumour of more than 10 mm in size or when optic nerve is involved.
- The eyeball should be enucleated with maximum length of the optic nerve (>10 mm) and taking care not to perforate it.

Conservative (tumour destructive) therapy

It is indicated when tumour is less than 10 mm in size and optic nerve is not involved.

Tumour destructive therapy consists of *chemoreductions* with systemic carboplatin, vincristine and etoposide followed by focal therapy with any of following modalities:

- *Cobalt plaques (brachytherapy)*: For small peripheral tumour.
- *Cryotherapy*: For small peripheral tumour.

- *Argon, diode or xenon arc photocoagulation*: For small posterior tumours not invading either the macula or the optic nerve.

Surgical debulking of the orbit with radiotherapy (external beam therapy) and chemotherapy (etoposide, carboplatin, vincristine) are used as palliative measures. In patients with either orbital extension, or intracranial extension or distant metastasis.

Prognosis

Fair (survival rate 70–85%) if eyeball is enucleated, before the extraocular extension.

Poor prognostic factors are:
- Optic nerve involvement beyond the transection (65% mortality).
- Undifferentiated tumour cells (40% mortality)
- Massive choroidal invasion.

PHAKOMATOSES

1. Angiomatosis retinae (von Hippel-Lindau's disease)
- Angiomatosis involves retina, brain, spinal cord, kidneys and adrenals
- Retinal lesions comprise vascular dilatation, tortuosity and formation of aneurysms which vary from small miliary to balloon-like angiomas, followed by appearance of haemorrhages and exudates, resembling exudative retinopathy of Coats'. Massive exudation is frequently complicated by retinal detachment.

2. Tuberous sclerosis (Bourneville disease)

Classic diagnostic triad includes:
- Adenoma sebaceum
- Mental retardation
- Epilepsy associated with potato-like hamartomas of the brain, retina and viscera.

3. Neurofibromatosis (Von-Recklinghausen's disease)
- *Multiple tumours* of skin, nervous system and other organs
- *Cutaneous manifestations* vary from cafe-au-lait spots to neurofibromata
- *Ocular manifestations include*: Neurofibromas of lids and orbit, glioma of optic nerve and congenital glaucoma.

Characterstic features of neurofibromatosis (NF-1) and neurofibromatosis (NF-2) are as follows:
- *NF-1* has bare orbit/orphan Anne sign.
- *NF-2* is associated with bilateral acoustic neuroma, posterior subcapsular cataract and multiple schawnoma, meningioma a ependymoma.

4. Encephalofacial angiomatosis

(Sturge-Weber syndrome) Characterised angiomatosis in the form of port wine stain (Naev flammeus) involving one side of the face which m be associated with choroidal haemangiomas, lep meningeal angioma and congenital glaucoma on t affected side.

To remember Mnemonic (**STURGE**) stands for:
S : Port wine **S**tain, **S**ezuires
T : **T**ram track appearance on X-ray skull
U : **U**nilateral cortical atrophy
R : **R**etardation (mental)
G : **G**laucoma (congenital)
E : **E**ncephalofacial angiomatosis.

MISCELLANEOUS POINTS
- *Superficial retinal haemorrhages* are mo commonly associated with hypertension.
- *Pseudoxanthoma elasticum* is the most commo systemic disorder associated with angioid streak other causes are: macular degeneration, Paget disease, Gronblad-strandberg syndrome, seni elastosis.
- *Angioid streaks*:
  - May be mistaken for blood vessels
  - Are usually situated near the disc
  - Are situated at a deeper level than retinal vesse
  - Result due to defects in Bruch's membrane.
- *Rods are primarily affected in* retinitis pigmentos
- *Lattice degeneration* most commonly occurs in th superotemporal quadrant.
- *Salt and pepper fundus* is characteristic congenital syphilitic retinal affection. It is al seen in Leber's amaurosis and congenital rubell
- *Bull's eye macular lesions* are seen in chloroqui retinopathy and progressive cone dystrophy.
- *Reversal of diabetic retinopathy* can be seen in woman with Sheehan's syndrome (due to lack growth hormone).
- *Colour vision* is not significantly impaired in ey with early macular disease, in contrast to eyes wi early lesions of optic nerve.
- *Macular star* may occur in hypertensive retin pathy, papilloedema and Eales' disease.
- *Flame-shaped superficial* haemorrhages occur the nerve fibre layer of the retina.
- *Retinoblastoma is the most common* retin malignancy.
- *Retinoblastoma is the most common prima malignant intraocular tumour of childhood a*

the second most common primary intraocular malignancy of all age groups (Choroidal melanoma is more common).

- *Most common mode of metastasis* of retinoblastoma is by direct extension, by continuity to the optic nerve.
- *Most common site of metastasis* of retinoblastoma is brain.
- *Snow ball opacities in vitreous* are seen in pars planitits, candidiasis and sarcoidosis.
- *Causes of ring scotoma* include retinitis pigmentosa, high myopia, primary open angle glaucoma, aphakic spectacles correction and after pan retinal photocoagulation (PRP).
- *Causes of tubular vision* include retinitis pigmentosa, high myopia, primary open angle glaucoma, and CRAO with sparing cilioretinal artery.
- *Juxta foveal telangiectasia* is a variant of Coat's disease. It is macular telangiectasia which in structural abnormalities are seen in the vessels.

MULTIPLE CHOICE QUESTIONS

1. **Congenital anomalies of the optic disc include all *except*:**
   A. Coloboma
   B. Drusen
   C. Hypoplasia
   D. Medullated nerve fibres

2. **Normally retinal fibres are:**
   A. Medullated
   B. Non-medullated
   C. Medullated in childhood and become non-medullated in old age
   D. Non-medullated in childhood but become medullated in old age

3. **All of the following are true for medullated nerve fibres of the retina *except*:**
   A. Appear as a whitish patch usually present around the disc
   B. Are commonly seen at birth in premature children
   C. Disappear in patients with optic atrophy
   D. May cause enlargement of blind spot

4. **All of the following are features of central retinal artery occlusion *except*:**
   A. Marked narrowing of retinal arterioles
   B. 'Cherry red spot' at macula
   C. Retinal oedema
   D. Multiple superficial haemorrhages

5. **The most common site of obstruction in central retinal artery is:**
   A. In front of the lamina cribrosa
   B. At the lamina cribrosa
   C. Behind the lamina cribrosa
   D. The point where the artery enters the optic nerve

6. **Dot and blot (round) retinal haemorrhages are situated at the level of:**
   A. Ganglion cell layer
   B. Nerve fibre layer
   C. Inner nuclear layer
   D. Outer plexiform layer

7. **Risk factors for development of diabetic retinopathy include:**
   A. Duration of diabetes
   B. Heredity
   C. Pregnancy
   D. All of the above

8. **Diabetic retinopathy is essentially an angiopathy affecting retinal:**
   A. Precapillary arterioles
   B. Capillaries
   C. Venules
   D. All of the above

9. **All of the following are true for anaemi retinopathy *except*:**
   A. Occurs when haemoglobin level falls below gm%
   B. Arterioles become pale
   C. Veins are pale and narrow
   D. Superficial retinal haemorrhages and subhyaloi haemorrhage are seen invariably

10. **Is not true about soft exudates (cotton woo patches on retina):**
    A. Are a sign of retinal hypoxia
    B. Formed due to swelling of nerve fibre layer
    C. Frequently change their shape
    D. In late stages are converted into hard exudates

11. **Hard exudates are seen in the following *except*:**
    A. Hypertensive retinopathy
    B. Diabetic retinopathy
    C. Leukemic retinopathy
    D. Exudative retinopathy of Coat's

12. **All of the following are true for retinopathy prematurity *except*:**
    A. Occurs in premature infants due to late crying
    B. Due to hypoxia there occurs neovascularizatio followed by fibroproliferation
    C. End result is bilateral blindness
    D. Blindness can be prevented by early diagnos and ablation of vascular premature retina wi cryotherapy or photocoagulation

13. **Most common mode of inheritance for retini pigmentosa is:**
    A. Autosomal recessive
    B. Autosomal dominant
    C. Sex linked
    D. None of the above

14. **Following are the ocular association of retini pigmentosa *except*:**
    A. Myopia
    B. Primary angle closure glaucoma
    C. Microphthalmos
    D. Conical cornea

1:D 2:B 3:B 4:D 5:B 6:D 7:D 8:D 9:C 10:D 11:C 12:A 13 14:B

15. Retinitis pigmentosa forms a constituent of all the following syndromes *except*:
A. Lowe's syndrome
B. Refsum's syndrome
C. Usher's syndrome
D. Hallgren's syndrome

16. All of the following are causes of night blindness *except*:
A. Retinitis punctate albescens
B. Choroideremia
C. Retinitis pigmentosa
D. Retinitis of Roth

17. 'Bull's eye' lesion in macular region is seen in:
A. Progressive cone dystrophy
B. Choroquine maculopathy
C. Both of the above
D. None of the above

18. Cherry red spot at macula is seen in all of the following *except*:
A. Tay-Sach's disease
B. Letterer-Siwe disease
C. Niemann-Pick disease
D. Commotio retinae

19. Photoretinitis results from:
A. Infra-red rays of sunlight
B. Ultraviolet rays of sunlight
C. Both of the above
D. None of the above

20. Spontaneous regression of proliferative retinopathy may occur in:
A. Diabetic retinopathy
B. Proliferative sickle retinopathy
C. Retinopathy of prematurity
D. All of the above
E. None of the above

21. In central serous retinopathy, in the macular region, there occurs:
A. Spontaneous detachment of neurosensory retina
B. Macular oedema
C. Detachment of pigment epithelium
D. Detachment of choroid

22. Macular scar is formed in which of the following diseases:
A. Papillitis
B. Hypertension
C. Neuroretinitis
D. Papilloedema
E. All of the above

23. In cystoid macular oedema fluid collects in the macular region at the level of:
A. Outer nuclear layer
B. Outer plexiform layer
C. Inner plexiform layer
D. Between pigment epithelium and neurosensory retina

24. In cystoid macular oedema, basic defect is:
A. Breakdown of inner blood retinal barrier
B. Breakdown of outer blood retinal barrier
C. Increased permeability of the choriocapillaris
D. All of the above

25. Retinal degenerations predisposed to retinal detachment include all of the following *except*:
A. Lattice degeneration
B. Snail track degeneration
C. Focal pigment clumps
D. Pavingstone degeneration

26. All of the following are the causes of exudative retinal detachment *except*:
A. Retinopathy of toxaemia of pregnancy
B. Retinopathy of prematurity
C. Exudative retinopathy of Coats
D. Sympathetic ophthalmia

27. Shifting fluid is pathognomonic of:
A. Solid retinal detachment
B. Rhegmatogenous retinal detachment
C. Tractional retinal detachment
D. Choroidal detachment

28. All of the following are true about incidence of retinoblastoma *except*:
A. Is the most common intraocular tumour of childhood
B. Occurs in 1 in 14000–34000 live births
C. No sex predisposition
D. More common in negroes than whites

29. Retinoblastoma arises from:
A. Layer of rods and cones
B. Layer of bipolar cells
C. Ganglion cells layers
D. Any nucleated retinal layer

30. In a child with phthisical eye of unknown etiology following possibility should be kept in mind:
A. Birth trauma
B. Still's disease
C. Retinoblastoma
D. Untreated congenital glaucoma

15:A 16:D 17:C 18:B 19:A 20:D 21:A 22:E 23:B 24:A 25:D 26:B 27:A 28:D 29:D 30:C 31:B 32:D

31. All of the following are causes of leukocoria *except*:
A. Coloboma of choroid
B. Coloboma of optic disc
C. Retinopathy of prematurity
D. Retinoblastoma

32. Poor prognostic factor in retinoblastoma is:
A. Optic nerve involvement
B. Massive choroidal invasion
C. Undifferentiated tumour cells
D. All of the above

33. Which is not seen in retinitis pigmentosa:
A. Pale waxy optic disc
B. Attenuated vessels
C. Retinal haemorrhages
D. Bone corpuscles

34. Best diagnostic test for Best's disease is:
A. Dark adaptation
B. ERG
C. EOG
D. Gonioscopy

35. All are true about angioid streaks *except*:
A. They are mistaken for blood vessels
B. Are situated near the disc
C. Situated at a superficial level than the retinal vessels
D. Result due to defects in Bruch's membrane
E. Are associated with pseudoxanthoma elasticum

36. Eales' disease is best treated with:
A. Antitubercular drugs
B. Steroids
C. Antibiotic drops
D. Antibiotics systemically

37. The commonest cause of rubeosis iridis is
A. Diabetes mellitus
B. Central retinal vein occlusion
C. Central retinal artery occlusion
D. Carotid stenosis

38. The retinal capillaries are distinguished by having all, *except*:
A. Widening of the capillary calibre in the periphery
B. Capillary free zone around the veins
C. Superficial network
D. Deep denser network
E. Capillary-free-zone around the arteries

39. The true pulse in the retinal arteries is seen in:
A. Aortic aneurysm
B. Aortic regurgitation
C. Exophthalmic goitre
D. All of the above
E. None of the above

40. Commonest eye tumour is:
A. Melanoma
B. Retinoblastoma
C. Carcinoma of eyelid
D. Carcinoma of lacrimal sac

41. Visual loss in diabetic retinopathy is due to ... *except*:
A. Cataract formation
B. Background diabetic retinopathy
C. Ischaemic maculopathy
D. Vitreous haemorrhage

42. The earliest change noticed in hypertensi... retinopathy is:
A. Soft exudate
B. Arteriolar spasm
C. Venospasm
D. Hard exudate

43. Primary retinal detachment is seen in:
A. Diabetes
B. High myopia
C. Malignant melanoma
D. All of the above

44. Premature babies can have the following:
A. Buphthalmos
B. Retinopathy of prematurity
C. Increased incidence of myopia
D. Persistent hyaloid artery
E. All of the above

45. Earliest change in diabetic retinopathy is:
A. Hard exudate
B. Soft exudate
C. Dot haemorrhage
D. Microaneurysm

46. Ring scotoma is seen in:
A. Glaucoma
B. Retinitis pigmentosa
C. Sympathetic ophthalmia
D. Vitreous haemorrhage

47. Retinal detachment is preceeded by:
A. Floaters and flashes
B. Eales' disease
C. Trauma
D. All of the above

48. Resuscitation time of the human retina followi... ischaemia is:
A. 30 minutes
B. 45 minutes
C. 1 to 2 hours
D. 15 to 20 minutes
E. 8 minutes

33 : C 34 : C 35 : C 36 : B 37 : A 38 : B 39 : D 40 : B 41 : B 42 : B 43 : B 44 : B 45 46 : B 47 : D 48 : C

49. Purtscher's retinopathy results from:
A. Head injuries
B. Chest injuries
C. Trichiasis
D. All of the above

50. In recently recognised IDDM patient examination of fundus is done at:
A. Immediately
B. At 1 year
C. At 5 years
D. None of the above

51. For prevention of retrolental fibroplasia O_2 should be:
A. 30–40%
B. 50–60%
C. 20–30%
D. 70–80%

52. Commonest cause of loss of vision in non-proliferative diabetic retinopathy is:
A. Vitreous haemorrhage
B. Macular oedema
C. Detachment of retina
D. Subretinal haemorrhage

53. All of the following are differential diagnosis for cotton wool spots in fundus *except*:
A. AIDS
B. Diabetic retinopathy
C. Hypertension
D. Eales' disease

54. Sudden loss of vision in patient with diabetic retinopathy is due to:
A. Cataract
B. Glaucoma
C. Vitreous haemorrhage
D. Papilloedema

55. Enlarging dot sign in fundus fluorescein scanning is seen in:
A. Cystoid macular oedema
B. Central serous retinopathy
C. Significant macular oedema
D. Coat's disease

56. In a young patient presenting with recurrent vitreous haemorrhage diagnosis is:
A. Eales' disease
B. CRVO
C. Proliferative retinopathy
D. Coat's disease
E. Episcleritis

57. The superficial retinal haemorrhages are situated in:
A. Nerve fibre layer
B. Outer nuclear layer
C. Inner nuclear layer
D. Inner plexiform layer

58. Large haemangioma of lid and cheek along with glaucoma is seen in:
A. von Recklinghausen's disease
B. Sturge Weber's syndrome
C. von Hippel's disease
D. Lindau's disease

59. The following about retinoblastoma is true *except*:
A. Autosomal dominant
B. Treatment is enucleation
C. Radiotherapy is also given
D. Evisceration is the treatment

60. Retinoblastoma is bilateral in:
A. 1% of cases
B. 50% of cases
C. 100% of cases
D. 30% of cases

61. Familial retinoblastoma:
A. Has autosomal recessive inheritance
B. More commonly bilateral
C. Due to mutation
D. More common than sporadic retinoblastoma

62. Ideal treatment of B/L retinoblastoma:
A. Enucleation
B. Radiotherapy
C. Chemotherapy
D. Phototherapy
E. Cyclophotocoagulation

63. Most common second malignancy in patients with familial retinoblastoma is:
A. Teratoma
B. Medullary carcinoma
C. Osteosarcoma
D. Malignant melanoma

64. In photocoagulation of retina, which quadrant is first coagulated:
A. Temporal
B. Nasal
C. Superior
D. Inferior

65. Pseudo-rosettes are seen in:
A. Retinoblastoma
B. Ophthalmic nodosa
C. Phakolytic glaucoma
D. Trachoma

66. Knudson's hypothesis is applied for:
A. Glaucoma
B. Retinoblastoma
C. Cataract
D. Melanoma

49 : B 50 : C 51 : A 52 : B 53 : D 54 : C 55 : B 56 : A 57 : A

58 : B 59 : D 60 : D 61 : B 62 : C 63 : C 64 : A 65 : A 66 : B

67. True about fovea centralis:
A. Cones present
B. Visual acquity lowest
C. Optic nerve passes
D. Rods present
E. Visual acquity highest

68. Broadest neuroretinal rim is seen in:
A. Superior pole
B. Inferior pole
C. Nasal pole
D. Temporal lobe

69. Cherry red spot is seen in:
A. Eales' disease
B. Retinitis pigmentosa
C. Central retinal artery thrombosis
D. Central retinal vein occlusion

70. All of the following take part in the pathogenesis of macular oedema in diabetic retinopathy *except*:
A. Retinal pigment epithelium dysfunction
B. Oxidative stress
C. VEGF
D. Increased protein kinase-C

71. Vitreous haemorrhage in diabetic retinopathy
A. Non-proliferative diabetic retinopathy
B. Prolifertive diabetic retinopathy
C. Both
D. None

72. Grid laser photocoagulation is indicated in:
A. Ischaemic maculopathy
B. Clinical significant macular oedema
C. Macular hole
D. Proliferative diabetes retinopathy

73. Panretinal photocoagulation is indicated in:
A. Macular oedema
B. Retinal breaks
C. Proliferative diabetic retinopathy
D. Tractional retinal detachment

74. In retinal detachment:
A. Effusion of fluid into the suprachoroidal space
B. Retinoschisis
C. Separation of sensory retina from pigment epithelium
D. None of the above

75. Soft exudates are found in:
A. DM
B. HTN
C. Toxaemia
D. Coat's disease
E. All

76. Hard exudates not seen in:
A. Hypertension
B. DM
C. Toxaemia of pregnancy
D. SLE
E. Coat's disease

77. Hard exudates are seen in all *except*:
A. Diabetic retinopathy
B. Retinitis pigmentosa
C. Eales' disease
D. Retinal artery macroaneurysm
E. Choroidal neovascularisation

78. Cherry red spot found in:
A. Gangliosidosis
B. Retinopathy of prematurity
C. Tay-Sach's disease
D. Gaucher's disease
E. Retinal detachment

79. Features of non-proliferative DR is all *except*:
A. Neovascularisation
B. Soft exudate
C. Hard exudate
D. Vitreous detachment
E. Cotton-wool spot

80. Diabetic retinopathy is characterized by:
A. Hard exudates
B. Neovascularisation
C. Glaucoma
D. Cataract
E. Retinal detachment

81. Treatment of diabetic retinopathy
A. Phocoemulsification
B. Retina laser photocoagulation
C. LASIK
D. Pars plana vitrectomy

82. Treatment of diabetic retinopathy neovascularisation is/are:
A. Retinal laser photocoagulation
B. Pars plana vitrectomy
C. Phacoemulsion
D. Anti VEGE ab
E. LASIK

83. Which of the following agents is not used in the treatment of diabetic macular oedema retinopathy:
A. Ruboxistaurin
B. Pyridazinones
C. Benfotiamine
D. Tamoxifen

67 : A and E 68 : B 69 : C 70 : A 71 : B
72 : B 73 : C 74 : C 75 : A, B and C
76 : C 77 : B 78 : A, C and D 79 : A and D
80 : A, B, C, D and E 81 : B and D 82 : A and D 83

84. All of the following may be used to differentiate central retinal venous occlusion (CRVO) from ocular ischaemic syndrome due to carotid artery stenosis, *except*:
A. Dilated retinal vein
B. Tortuous retinal vein
C. Retinal artery pressure
D. Ophthalmodynamometry

85. Commonest type of retinal detachment:
A. Rhegmatogenous
B. Choroidal haemorrhage
C. Exudative
D. Tractional

86. Retinal detachment is not seen in:
A. Myopia
B. Eales' disease
C. Cataract extraction
D. Panretinal photocoagulation

87. Is not the cause of exudative retinal detachment:
A. Scleritis
B. Toxaemia of pregnancy
C. Dysthyroid eye disease
D. Central serous retinopathy

88. Exudative retinal detachment is not seen in:
A. Central retinal artery occlusion
B. Scleritis
C. Harada's syndrome
D. Coat's disease

89. Retinal detachment is not diagnosed by:
A. Ultrasound biomicroscopy
B. Hurby lens
C. 3 mirror contact lens
D. Direct ophthalmoscopy
E. Indirect ophthalmoscopy

90. A patient presented with sudden onset of floater and perception of falling of a curtain (veil) in front of the eye which one of the following is the most appropriate diagnosis:
A. Retinal detachment
B. Eales' disease
C. Vitreous haemorrhage
D. Glaucoma

91. A young adults presents with night blindness and tubular vision. On examination, intraocular pressure was observed to be 18 mm and the anterior segment was unremarkable. Fundoscopy showed attenuation of arterioles and waxy pallor of the optic disc with bony corpuscles like spicules of pigmentation in mid peripheral retina. Ring scotomas were observed on perimetry. Which of the following is the most likely diagnosis:
A. Pigmentary retinal dystrophy
B. Primary open angle glaucoma
C. Lattice degeneration of retina
D. Diabetic retinopathy.

92. A 70-year-old man presents with deterioration of vision 3 weeks after cataract extraction and IOL implantation. Slit lamp examination shows honeycomb maculopathy and fluorescin angiography (FA) shows 'flower petal' hyperfluorescence. The most likely diagnosis is:
A. Age-related macular degeneration (ARMD)
B. Central serous retinopathy (CSR)
C. Macular dystrophy
D. Cystoid macular oedema

93. Bull's eye lesion seen with:
A. Chloroquine
B. Dapsone
C. Rifampicin
D. Ethambutol
E. Gold

94. A patient with clinically significant diabetic macular oedema with non progressive diabetic retinopathy was treated with non-progressive diabetic retinopathy was treated with macular grid photocoagulation. The patient still has vitreo macular traction. What is the preferred treatment?
A. Intravitreal bevacizumab
B. Pars plana vitrectomy
C. Repeat macular grid photocoagulation
D. Augmented macular photocoagulation

95. Mizuo-phenomenon is seen in:
A. Fundus albipathicus
B. Fundus flavimaculatus
C. Oguchi's disease
D. Choroideremia

96. Which retinal layer is most radioresistant:
A. RPE
B. Layer of rods and cones
C. Bipolar cell layer
D. Ganglion cell layer

97. 'Sea-Fan' retina is seen in:
A. CRAO
B. Hypertensive retinopathy
C. Sickle cell disease
D. Gaucher's disease.

84 : A 85 : A 86 : D 87 : C 88 : A 89 : A 90 : A 91 : A 92 : D 93 : A 94 : B 95 : C 96 : B 97 : C

98. Central retinal artery occlusion is known to be associated with:
A. Panophthalmitis
B. Diabetic retinopathy
C. CMV retinitis
D. Orbital mucormycosis.

99. Lamina cribrosa is absent in:
A. Morning glory syndrome
B. Nanophthalmia
C. Colobama of retina
D. Optic nerve agenesis

100. A young patient presents to the ophthalmology clinic with loss of central vision. There is no obvious family history. ERG and EOG were observed to be normal which of the following is the most likely diagnosis:
A. Stargardt's disease
B. Best's vitelliform dystrophy
C. Retinitis pigmentosa
D. Cone-rod dystrophy

101. A young patient presents to the ophthalmology clinic with loss of central vision. ERG is normal but EOG is abnormal. Which of the following is the most likely diagnosis:
A. Stargardt's disease
B. Best's vitelliform dystrophy
C. Retinitis pigmentosa
D. Cone-rod dystrophy

102. A young patient present with significant loss of central vision and a normal ERG. There is no obvious family history of similar presentation. The most likely diagnosis:
A. Best's disease
B. Stargardt's disease
C. Retinitis pigmentosa
D. Cone-rod dystrophy

103. Von Recklinghausen disease is associated with:
A. Glaucoma
B. Optic nerve glioma
C. Neurofibroma of the lids
D. All of them

104. Von Recklinghausen disease is associated with:
A. Glaucoma
B. Choroidal hemangioma
C. Sub-retinal neovascularization
D. Retinal detachment

105. Vortex vein invasion is commonly seen in:
A. Retinoblastoma
B. Malignant melanoma
C. Optic nerve glioma
D. Medullo-epithelioma

106. All of them are true *except*:
A. Retiniblastomas are hereditry 40%, non-hereditary 60%
B. Retiniblastomas are B/L 30%, U/L 70%
C. Retiniblastomas are familial 6%, non-familial 94%
D. All are true.

107. Which is the only phacomatosis to be inherited on an autosomal recessive basis:
A. Ataxia-telangiectasia
B. Sturge-Weber syndrome
C. von Hippel lindau syndrome
D. Neurofibromatosis

108. Which of these features is a classic radiologic feature of optic nerve glioma:
A. Tram-track appearance of optic nerve
B. Kingking of optic nerve
C. Multiple cystic spaces in optic nerve
D. Adjacent bony erosion

109. Retinitis pigmentosa is a feature of all *except*:
A. Refsum's disease
B. Hallervorden Spatz Syndrome
C. NARP
D. Abetalipoprofeinemia

110. Bergmeister papilla are present on the:
A. Anterior corneal surface
B. Near the optic disc
C. Anterior lens surface
D. Posterior lens surface

111. Which of the following is not an ophthalmi emergency:
A. Macular hole
B. Retinal Detachment
C. CRAO
D. Acute primary angle closure glaucoma

112. Marfan's syndrome is not associated with:
A. Retinal detachment
B. Vitreous hemorrhage
C. Ectopic lentis
D. Roth spots

113. Shafer's sign is seen in: *(DNB 201*
A. Retinal detachment
B. Congenital glaucoma
C. Stargardt's disease
D. Retinopathy of prematurity

114. Subretinal demarcation line or watershed line seen in: *(AIIMS 201*
A. Fresh rhegmatogenous retinal detachment
B. Old Rhegmatogenous retinal detachment
C. Retinopathy of prematurity
D. Retinitis pigmentosa

98:D 99:A 100:A 101:B 102:B 103:D
104:A 105:B

106:D 107:A 108:B 109:B 110:B 111
112:D 113:A 114:B

5. Pneumatic retinopexy is an outpatient procedure where retinal detachment is sealed with air insufflation. Which is the gas used in the process? *(AIIMS 2014)*
A. Carbon dioxide
B. Sulphur hexafluoride
C. Nitrous oxide
D. Oxygen

16. Microaneurysms are the earliest feature of diabetic retinopathy. In which layer of retina are they seen? *(AIIMS 2014)*
a. Outer plexiform layer
b. Inner nuclear layer
c. Layer of rods and cones
d. Retinal pigment epithelium

17. Splashed tomato appearance of retina is seen in: *(DNB 2016)*
A. CRAO
B. CRVO
C. Eales' disease
D. Sickle cell retinopathy

18. Retinopathy of prematurity: True statement is: *(DNB 2015)*
A. It is classified into 4 stages depend-ing on severity
B. It resolves spontaneously without any treatment
C. Zone III involves the nasal retina
D. Polyhydramnios is a risk factor

119. Which of the following is not a feature of vitreous haemorrhage? *(Jipmer 2015)*
A. Sudden loss of vision
B. Floaters
C. Metamorphopsia
D. Absence of fundal glow

120. Investigation of choice in vitreous haemorrhage is: *(DNB 2016)*
A. Ultrasound biomicroscopy
B. USG A-Scan
C. USG B-Scan
D. Optical coherence tomography

121. Confirmatory investigation in Retinitis pigmentosa is: *(DNB 2015)*
A. Optical coherence tomography
B. Pachymetry
C. Electroretinogram
D. Visual acuity assessment

122. Which of the following is not used in the treatment of neovascular ARMD? *(COMEDK 2015)*
A. Alemtuzumab
B. Bevacizumab
C. Ranibizumab
D. Aflibercept

123. Hereditary retinoblastoma is associated with which chromosomal segment? *(AIPG)*
A. 13q14
B. 13p14
C. 14q13
D. 14p13

124. Knudson's two hit hypothesis describes the occurrence of: *(PGI 2000)*
A. Glaucoma
B. Retinoblastoma
C. Optic nerve glioma
D. Meningioma

125. Most common route of spread of retinoblastoma: *(AIIMS 2015)*
A. Lymphatics
B. Optic nerve
C. Direct spread
D. Vascular

126. Evisceration is contraindicated in: *(AIIMS 2015)*
A. Malignancy
B. Panophthalmitis
C. Severe ocular trauma
D. Expulsive choroidal haemorrhage

127. Which of the following does not show calcification? *(AIIMS 2014)*
A. Persistent hyperplastic primary vit-reous
B. Choroidal osteoma
C. Optic nerve head drusen
D. Retinoblastoma

128. Acute loss of vision in a case of alcoholic pancreatitis: *(AIPG 2010)*
A. Purtscher's retinopathy
B. Acute congestive glaucoma
C. Central retinal artery obstruction
D. Optic neuritis

115:B 116:B 117:B 118:D 119:C 120:C 121:C 122:A 123:A 124:B 125:B 126:A 127:A 128:A

CHAPTER

13

Neuro-ophthalmology

QUICK TEXT REVIEW

LESIONS OF VISUAL PATHWAY

Lesions of visual pathway are summarized in Table 12.1.

ABNORMAL PUPILLARY REFLEXES

1. ***Amaurotic (pupil) light reflex (Total afferent conduction defect):*** It refers to absence of direct light reflex on the affected side and absence of consensual reflex on the normal side. It indicates blindness due to lesions of the optic nerve or retina Near reflex is normal and pupils are equal in size in both eyes.

2. ***Marcus Gumt pupil (Relative afferen conduction defect):*** *See* Page 189

3. ***Efferent pathway defect:*** In this situation both direct and consensual light reflexes are absent on the affected side and present on the normal side Causes of efferent pathway defect include: effec

Table 12.1: Lesions of visual pathway

Site of lesion	*Salient features*	*Common causes*
Optic nerve	• Ipsilateral blindness, • Absent ipsilateral direct light reflex • Absent contralateral consensual light reflex	• Optic atrophy, • Traumatic avulsion of optic nerve • Acute optic neuritis
Sagittal (central) lesions of the chiasma	Bitemporal hemianopia	• Supra-sellar aneurysms • Pituitary tumours • Craniopharyngioma • Glioma of third ventricle
Lateral chiasmal lesions	Binasal hemianopia	• Distention of third ventricle • Atheroma of posterior communicating arteries
Optic tract	• Homonymous hemianopia • Wernick's hemianopic pupillary response	• Syphilitic meningitis • Tuberculosis and tumours of optic thalamus • Aneurysms of superior cerebellar or posterior cerebral arteries
Lateral geniculate body	Homonymous hemianopia with sparing of pupillary reflexes	• Syphilitic meningitis • Tuberculosis and tumours of optic thalamus
Optic radiations • Total fibres • Lower fibres only • Upper fibres only	• Homonymous hemianopia (sometimes sparing the macula) • Homonymous upper • Quadrantanopia (pie-in the sky) • Homonymous lower quadrantinopia (Pie-in the floor)	• Vascular occlusion • Primary and secondary tumours, and • Trauma • Temporal lobe lesions • Anterior parietal lobe lesion
Visual cortex	Homonymous hemianopia (usually sparing the macula)	• Vascular occlusion • Primary and secondary tumour • Trauma

parasympatholytic drugs like atropine and matropine, internal ophthalmoplegia and third rve paralysis.

Wernicke's hemianopic pupil: It is seen in lesions one optic tract. In this condition ipsilateral direct d contralateral consensual light reflexes are sent when light is thrown on the temporal half of e retina on the affected side and nasal half of the posite side.

Argyll Robertson pupil(ARP)

Near reflex and accommodation present (Mnemonic ARP: Accommodation Reflex Present)

Light reflex absent

Pupil: Bilateral symmetric, small and irregular (Iris damage).

Poor dilation to mydriatics and in darkroom.

Causes: Neurosyphilis, diabetes mellitus and multiple sclerosis.

Pseudo Argyll Robertson pupil seen in aberrant degeneration of 3rd nerve.

Adies tonic pupil (Holmes-Adies pupil)

Reaction to light absent

Near reflex very slow and tonic

Pupil usually unilateral, affected pupil is slightly larger (anisocoria) (NO MIOSIS)

It constricts with weak pilocarpine (0.125%), while normal pupil does not, (denervated iris sphincter is suprasensitive to topical parasympathomimetics).

It may be associated with absent knee jerk and occur more often in young women.

Causes: Post-ganglionic parasympathetic pupillomotor damage.

orner's syndrome

is due to disturbance of the sympathetic erve supply to the dilator pupillae muscle. The mpathetic pathway starts from the *posterior ypothalamus*. The descending fibres reach the *ilio-spinal Centre of Budge* in the spinal cord. rom here, the fibres travel to the *superior cervical anglion* in the neck. The post ganglionic fibres in the *ophthalmic branch of trigeminal nerve* and ach the dilator pupillae via *the long ciliary nerves*. long with the dilator pupillae, these nerves also pply the *Muller's muscle* of the lids and the *sweat and*.

inical Features

Mild ptosis due to paralysis of Muller's muscle

Apparent enophthalmos

Miosis

- Diminished sweating or anhydrosis: This is seen in pre-ganglionic cases (Lesion in the pathway prior to the superior cervical ganglion)
- Heterochromia iridis in long standing and pediatric cases.

Pharmacological Tests

- *Cocaine test: Confirms Horner's syndrome.* On instillation of the drug, normal pupil dilates but Horner's pupil does not.
- *Hydroxyamphetamine test: Confirms pre-ganglionic Horner's syndrome.* On instillation of the drug, the pupil dilates in preganglionic Horner's syndrome but it does not dilate in post-ganglionic cases.
- *Adrenaline test: Confirms postganglionic Horner's syndrome.* On instillation of adrenaline, the dilatation is very prominent and quick in postganglionic cases due to denervation hypersensitivity.

DISEASES OF OPTIC NERVE

OPTIC NEURITIS

Optic neuritis includes papillitis and retrobulbar neuritis.

Etiology

- The most common cause is multiple sclerosis, vitamin B12 deficiency, vitamin B2 deficiency and diabetes.
- Viral infections like measles, mumps, chickenpox in children
- Granulomatous inflammation like sarcoidosis, tuberculosis, syphilis
- Infection of adjacent structures like meninges, sinuses, orbit.

Anatomically it is classified into:

- *Papillitis*: Inflammation of the optic disc
- *Neuroretinitis*: Inflammation of the optic disc and surrounding retina
- *Retrobulbar neuritis*: Inflammation of the optic nerve behind the globe.

Clinical features

- The condition is usually unilateral, there is monocular sudden, progressive and profound vision loss.
- Occasionally patients may observe an altered perception of moving objects (Pulfrich phenomenon) or a worsening of symptoms with exercise or increase in body temperature (Uhthoff sign)

- There is pain behind the eyeball, particularly in retrobulbar neuritis in which there is pain on eye movement.
- Visual evoked response (VEP) shows reduced amplitude and delayed transmission time.

Signs

- Reduced visual acuity and the most common field defect in optic neuritis is a relative central or centrocaecal scotoma.
- Earliest sign of optic neuritis is relative afferent pupillary defect (RAPD).
- Ophthalmoscopic findings are seen in papillitis, while fundus is normal in retrobulbar neuritis as the part involved is behind the visible part of the optic disc.

Investigations

- *Visual field*: **Centrocecal scotoma**
- *VEP*: Increase in the latency of response is seen
- *MRI brain and orbit*: It helps to rule out multiple sclerosis and decide the further course of management.

Treatment

- Treatment of optic neuritis as per the Optic Neuritis Treatment Trial (ONTT) includes:
- *High dose IV Methyl Prednisolone* (1 gm daily in two divided doses) for 3 days followed by *oral prednisolone* (1 mg/kg/day) for 11 days. Total duration of therapy is 14 days
  Note: The role of steroids is to make the visual recovery faster but there is no significant difference in the final visual outcome with spontaneous recovery and steroids oral steroids alone increase the rate of recurrence.
- The visual acuity may return to normal but permanent residual defects may remain in colour vision and contrast sensitivity.

LEBER'S HEREDITARY OPTIC NEUROPATHY(LHON)

- Maternally inherited mitochondrial DNA mutation
- Seen in males between 15-35 years of age
- *Presentation is just like a unilateral case of papillitis* but the other eye becomes affected in a few weeks
- *Disc is hyperemic and oedematous* with blurred margins. Dilated vessels extend from the disc to the surrounding retina. This is called telangiectatic microangiopathy and is a distinctive feature of LHON.

Treatment: Vitamin B12 injections along with steroids is given. Minimal response to steroids is seen with subsequent development of optic atrophy. Prognosis is very poor.

TOXIC AMBLYOPIAS

- *Tobacco-alcohol-amblyopia* occurring in heavy smokers and drinkers is characterized by foggy vision associated with bilateral centrocaecal scotomas.
- *Methyl alcohol amblyopia* results from degeneration of ganglion cells of the retina, due to effect of formic acid and formaldehyde which are metabolic products of methyl alcohol.
- *Quinine amblyopia* may occur even with small doses in susceptible individuals. Visual loss may be associated with deafness and tinnitus.
- *Ethambutol amblyopia* may recover completely in most of the cases after immediate cessation of the drug.

ANTERIOR ISCHAEMIC OPTIC NEUROPATHY (AION)

- Results from the occlusion of short posterior ciliary arteries
- Occurs in two forms arteretic and nonarteretic
- *Arteretic AION* caused by giant cell arteritis accounts for 10% cases
- Associated systemic features of GCA like temporal headache, jaw claudication and polymyalgia rheumatica may be present.
- *Nonarteretic AION* (90% cases)—exact etiology not known. Risk factors include: structural crowing of disc with small cup, cataract surgery, hypertension, diabetes mellitus, smoking, hyperlipidemia and drugs such as sildenafil (viagra). Atherosclerosis, SLE, PAN, migraine.
- *Characterized* by inferior altitudinal hemianopic field defects.
- *Fundus shows* severe pallor of the disc with disc oedema. Splinter haemorrhages in peripapillary region are seen.

Treatment

No effective treatment for NAAION. Arteritic AION is treated by:
IV methyl prednisolone (1 gm daily for 3 days) followed by:

- *Oral prednisolone* (60-80 mg/day). It is tapered by 10 mg weekly
- *Maintenance dose* of 5-10 mg may be required indefinitely.

AUTOIMMUNE OPTIC NEUROPATHY

- Denotes optic nerve involvement in patients with systemic lupus erythematosis (SLE) and other systemic collagen vascular disorders.
- *Pathogenesis* and features are similar to AION.

APILLOEDEMA (CHOKED DISC)

Papilloedema is non-inflammatory oedema of optic disc

Raised intracranial pressure is the commonest cause of bilateral papilloedema (optic nerve oedema).

Tumour of cerebellum, midbrain and parieto-occipital region produce papilloedema more rapidly.

Tumour of medulla rarely produce papilloedema.

Foster kennedy syndrome characterized by pressure optic atrophy on the side of lesion and papilloedema on the otherside is a feature of olfactory groove meningioma and frontal lobe tumours.

Pathogenesis of papilloedema involves

Due to disturbance of pressure gradient across the lamina cribosa
↓
Stasis of axoplamic in prelaminar area
↓
Axonal swelling
↓
Venous congestion
↓
Extra-cellular oedema

inical features

Vision is normal initially

Typically, there is recurring brief episodes (transient) of visual obscuration (Amaurosis fugax)

Initially there is enlargement of blind spot and progressive contraction of the visual field.

Thus, characteristically there is gradually progressive painless loss of vision.

phthalmoscopic findings

Blurring of optic disc margin in papilloedema first of all involves nasal margins, followed by superior and inferior margin and lastly temporal margin.

Venous engorgement and venous congestion

Loss of venous pulsations

There is filling of physiological cup with gradual obliteration of physiological cup

Paton's lines: Radial retinal lines cascading from the optic disc.

iopathic Intracranial Hypertension

It is defined as a condition where raised ICT is seen in the **absence of intracranial space occupying lesion.** Normal sized ventricles and normal CSF composition is seen.

Seen commonly due to steroid withdrawal, oral contraceptive pills, vitamin A toxicity, amiodarone and outdated tetracyclines.

- *May also be seen in certain endocrine disorders* like hypothyroidism, hypoparathy roidism, Addison's disease, etc.
- *Ophthalmic presentation* is with papilloedema.

OPTIC ATROPHY

1. *Primary optic atrophy:* It results from lesions proximal to the optic disc without antecedent papilloedema. Its common causes are multiple sclerosis, idiopathic retrobulbar neuritis, Leber's and other hereditary optic atrophy, pituitary tumours, toxic amblyopia, tabes dorsalis and trauma to the optic nerve.

Ophthalmoscopically, disc is chalky white in colour, margins are well defined, lamina cribrosa is visible, retinal vessels and surrounding retina are normal.

2. *Consecutive optic atrophy:* It occurs following destruction of the ganglion cells secondary to degenerative or inflammatory lesions of the choroid and retina. Its common causes are retinitis pigmentosa, diffuse chorioretinitis, pathological myopia and occlusion of central retinal artery. Its ophthalmoscopic features include: yellow waxy colour, not so sharply defined margins and attenuation of vessels.

3. *Postneuritic optic atrophy:* It develops as a sequel to long-standing papilloedema or papillitis.

The disc looks dirty white in colour, its edges are blurred, physiological cup is obliterated, lamina cribrosa is not visible, vessels are attenuated and perivascular sheathing is often present.

4. *Glaucomatous optic atrophy:* It results due to the effect of raised intraocular pressure. It is characterised by deep and wide cupping of the optic disc and nasal shift of the vessels.

5. *Vascular (ischaemic) optic atrophy:* It results from the conditions producing disc ischaemia (other than glaucoma) such as: central retinal artery occlusion, giant cell arteritis, severe haemorrhage, severe anaemia and quinine poisoning. Its ophthalmoscopic features are pallor associated with marked vascular attenuation.

Note:

- Pallor of the disc in optic atrophy is not due to atrophy of the nerve fibres but due to loss of vascularity.
- Pallor of the disc cannot be correlated with the amount of visual loss.

SYMPTOMATIC DISTURBANCES OF THE VISION

Night blindness (Nyctalopia)

Its common causes are: vitamin A deficiency, tapeto-retinal degenerations (e.g. retinitis pigmentosa), congenital high myopia, and Oguchi's disease.

Day blindness (Hamarlopia)

Its causes are central corneal and central lenticular opacities and congenital deficiency of cones.

Colour blindness

a. *Congenital colour blindness*

It is an inherited condition affecting males more (3-4%) than females (0.4%). It may be of following types:

i. ***Anomalous trichromatic colour vision:*** In this one of the primary colour, i.e. red, green or blue is defective and the condition is called protano malous, deuteranomalous or tritanomalous, respectively.

ii. ***Dichromatic colour vision:*** Here faculty to percieve one of the three primary colours viz. red, green or blue is completely absent and the condition is called protanopia, deuteranopia or tritanopia respectively.

iii. ***Blue cone monochromatism (BCM):*** Here only hues of blue colour can be appreciated. It is very rare condition.

iv. ***Achromatopsia:*** It refers to total colour blindness. It is an extremely rare condition occurring due to congenital absence of the cones. Therefore, it is associated with day blindness and nystagmus.

b. *Acquired colour blindness*

It may follow damage to macula or optic nerve, where red, green discrimination is particularly affected. Acquired blue colour defect may occur in old age due to increased sclerosis of the crystalline lens.

Tests for colour vision

- Pseudoisochromatic charts
  - Ishihara plates mainly to screen congenital protan and deuterons (i.e. red and green defects)
  - Hardy- Rand- Rittler plates.
- Edridge-Green lantern test
- City university test.
- Fansworth Munsell 100 hue test (most sensitive)
- Fansworth D 15 hue discrimination test
- Nagel's anomaloscope
- Holmgren's wool test

Note: Currently, there is no treatment for colo blindness.

Amaurosis

A complete loss of sight in one or both eyes, i the absence of ophthalmoscopic or other marke objective signs.

Amaurosis fugax

A sudden, temporary (lasting 2-5 minutes) an painless monocular visual loss occurring due to transient failure of retinal circulation.

Common causes

- Carotid transient ischaemic attacks (TIA)
- Embolization of retinal circulation
- Papilloedema
- Giant cell arteritis
- Raynaud's disease
- Migraine
- Prodromal symptom of central retinal artery c carotid artery occlusion
- Hypertensive retinopathy
- Venous stasis retinopathy.

MISCELLANEOUS POINTS

- *Supragenicular lesions* of visual pathway usuall produce visual field defects with macular sparin
- *Optic nerve lesions* produce negative scotoma whereas macular lesions cause positive scotom
- *Chromophobe adenoma* is the most commo primary intracranial tumour producing neuro ophthalmological features.
- *Gaze evoked amaurosis* is seen in optic nerv sheath meningioma.
- *Horner's syndrome* (lack of sympathetic inne vation) is characterized by miosis, mild ptosi mild enophthalmos, anhydrosis of the face o the affected side. Loss of cilio-spinal reflex ar heterochromia (ipsilateral iris is of light colou Tests to confirm diagnosis of Horner's syndron are: dilation lag, and cocaine test (normal pup dilates while Horner's pupil does not dilate wi topical cocaine).
- The swelling of the optic disc in papillitis rare exceeds 2-3D.
- *Scintilating scotoma* is a feature of migraine.
- Unilateral central scotoma is the earliest sympto of compression of optic nerve.
- *Hippus* (alternate rhythmatic dilation and constri tion of pupils) is a feature of multiple sclerosis.
- *Erythropsia* (red coloured vision) may b experienced by some patients after catara extraction.

- *Pupil sparing, third nerve paralysis* suggests a medical cause (diabetes or hypertension). While in surgical causes (aneurysm, tumour) pupil is also invovled.
- The two most common ocular signs of *myasthenia gravis* are ptosis and extraocular muscle weakness (paralytic squint).
- *Neuromyelitis optica* (Devic's disease) may be associated with sudden bilateral blindness.
- *Papillitis and retrobulbar neuritis* : Painful ocular movement is more common in retrobulbar neuritis than papillitis and fundus is normal in retrobulbar neuritis while papillitis has characteristic fundus abnormalities.

MULTIPLE CHOICE QUESTIONS

1. **Process of dark adaptation involves:**
   A. Rods of retina
   B. Cones of retina
   C. Pigment epithelium of retina
   D. Both rods and cones

2. **Visual acuity is a measure of:**
   A. Light sense
   B. Form sense
   C. Contrast sense
   D. All of the above

3. **Bitemporal hemianopia is associated with lesions of the:**
   A. Optic tract
   B. Central chiasma
   C. Lateral parts of chiasma
   D. Optic radiations

4. **Homonymous hemianopia with sparing of pupillary reflexes is a feature of lesions of:**
   A. Optic radiations
   B. Visual cortex
   C. Geniculate body
   D. All of the above

5. **Homonymous hemianopia with usually sparing of the macula is seen in lesions of:**
   A. Geniculate body
   B. Optic radiations
   C. Visual cortex
   D. All of the above

6. **Wernicke's hemianopic pupillary reaction indicates lesions at the level of:**
   A. Optic tract
   B. Distal part of optic nerve
   C. Optic chiasma
   D. Optic radiations

7. **Marcus Gunn pupil is a feature of:**
   A. Optic neuritis
   B. Papilloedema
   C. Ciliary ganglion lesions
   D. Lesion of Edinger-Westphal nucleus

8. **Argyll Robertson pupil results from the lesion of:**
   A. Accessory ganglion
   B. Ciliary ganglion
   C. Tectum region
   D. Lateral geniculate body

9. **All of the following are true for the Adie's tonic pupil *except*:**
   A. Light reflex is present
   B. Near reflex is very slow and tonic
   C. It is usually unilateral
   D. The affected pupil is larger

10. **Pupil is small in all of the following *except*:**
    A. During sleep
    B. Adie's pupil
    C. Argyll Robertson pupil
    D. Pontine haemorrhage

11. **Pupil is spared in:**
    A. Riley-Day syndrome
    B. Disseminated sclerosis
    C. Myasthenia gravis
    D. Horner's syndrome

12. **The most common field defect in papillitis is:**
    A. A relative central or centrocaecal scotoma
    B. Enlargement of the blind spot
    C. Tubular vision
    D. Multiple small peripheral scotomas

13. **Bilateral centrocaecal scotoma more marked wit red than white colour is a feature of:**
    A. Tobacco amblyopia
    B. Leber's disease
    C. Papilloedema
    D. Quinine amblyopia

14. **Basic lesion in tobacco amblyopia is:**
    A. Degeneration of ganglion cells especially c macular region
    B. Degeneration of foveal cones
    C. Ischaemia of optic nerve fibres
    D. All of the above

15. **Typical field defect observed in anterior ischaem optic neuropathy is:**
    A. Altitudinal hemianopia
    B. Paracentral scotoma
    C. Homonymous hemianopia
    D. Baring of the blind spot

16. **Tumours most common to cause early papill edema arise from:**
    A. Cerebellum
    B. Mid brain
    C. Parieto-occipital region
    D. All of the above

17. **Occlusion of short posterior ciliary arteries ma cause:**
    A. Ischaemic optic neuropathy
    B. Posterior segment ischaemia
    C. Anterior segment ischaemia
    D. All of the above

18. **Pseudo-Foster-Kennedy syndrome is characteris by all *except*:**
    A. It is associated with raised intracranial pressu
    B. The culprit tumour causes optic atrophy on o side and papilloedema on the other side
    C. It may be associated with pseudotumour cereb
    D. It needs to be differentiated from tumours arisi from the orbital surface of frontal lobe

1:D 2:B 3:B 4:D 5:C 6:A
7:A 8:C 9:A 10:B

11:C 12:A 13:A 14:A 15:A 16:
17:A 18:B

19. All of the following signs may be appreciated in a patient with early papilloedema *except*:
A. Obscuration of superior, inferior and nasal disc margins
B. Absence of spontaneous venous pulsation
C. Mild hyperaemia of the disc
D. Obliteration of physiological cup of the optic disc

20. The most important factor on which development of papilloedema depends in intracranial tumours is:
A. Site of tumour
B. Size of tumour
C. Nature of tumour
D. Rate of growth of tumour

21. Tumours arising from all of the following structures can induce papilloedema *except*:
A. Medulla oblongata
B. Cerebrum
C. Olfactory groove
D. Orbital surface of frontal lobe

22. In optic atrophy pallor of the disc is an index of:
A. Degeneration of optic nerve fibres
B. Loss of vascularty of the disc
C. Demyelination of the optic nerve fibres
D. All of the above

23. Congenital colour blindness is transmitted as:
A. Recessive disorder
B. Autosomal dominant
C. Sex-linked disorder
D. All of the above

24. Acquired blue blindness is a feature of:
A. Increased sclerosis of the crystalline lens
B. Disease of optic nerve
C. Disease of macula
D. All of the above

25. Amaurosis fugax may occur in all of the following conditions *except*:
A. Papilloedema
B. Papillitis
C. Giant cell arteritis
D. Raynaud's disease

26. Spiral field defect is a feature of:
A. Amblyopia exanopsia
B. Hysterical amblyopia
C. Malingering
D. Toxic amblyopia

27. In uraemic amaurosis the pupils are:
A. Constricted
B. Dilated and do not react to light
C. Normal
D. Dilated but react to light

28. In optic neuritis the best investigation to be done includes:
A. Goldmann perimetry
B. Keratoscopy
C. Ophthalmoscopy
D. Ophthalmodynamometry

29. Normal visual acuity of 6/6 is achieved by the age of:
A. 2 years
B. 3 years
C. 5 years
D. 7 years

30. In fundus, first sign of raised intracranial pressure is:
A. Filling of physiological cup
B. Blurring of nasal disc
C. Dilatation of vessels
D. None of the above

31. Monocular diplopia with homonymous hemianopia originates in the:
A. Geniculate body
B. Calcarine cortex
C. Parietal lobe
D. Temporal lobe
E. Tip of occipital lobe

32. Pupillary reflex is lost in:
A. Optic neuritis
B. Glaucoma
C. Iridocyclitis
D. Adie's pupil

33. Features of papilloedema include all *except*:
A. May be due to intracranial haemorrhage
B. Disc becomes elevated
C. Cotton wool spots may be seen
D. Vision is impaired

34. Which is incorrect of papilloedema:
A. Disc oedema
B. Transient blurring of vision
C. Sudden painless loss of vision
D. Vascular engorgement

35. Functional assessment of optic nerve is by:
A. Angiography
B. Fundoscopy
C. Perimetry
D. CT Scan

36. Defect in amblyopia lies in:
A. Lateral geniculate body
B. Afferent pupillary reflex
C. Rods and cones
D. Retina

37. Pupil that responds to convergence but light reflex is absent:
A. Adies pupil
B. Argyl Robertson pupil
C. Hutchinson pupil
D. Wernicke's pupil

38. Macula is:
A. Optic nerve
B. Optic tract
C. Periodic bluring of vision
D. Constant blinking

9 : D 20 : A 21 : A 22 : B 23 : C 24 : A
5 : B 26 : B 27 : D 28 : A
29 : A 30 : C 31 : B 32 : D 33 : D 34 : C
35 : C 36 : A 37 : B 38 : D

39. An optic nerve injury may result in all of the following *except*:
A. Loss of vision in that eye
B. Dilatation of pupil
C. Ptosis
D. Loss of light reflex

40. Bitemporal hemianopia can be due to:
A. Third ventricle tumour
B. Meningioma of sella diaphragmatica
C. Calcarine cortex infarction
D. Aneurysm of basilar artery

41. Homonymous hemianopia is seen in:
A. Pituitary adenoma
B. Optic nerve damage
C. Post-chiasmic damage
D. All of the above

42. Pituitary tumour causes:
A. Binasal hemianopia
B. Homonymous hemianopia
C. Monocular blindness
D. Bitemporal hemianopia

43. Psychogenic complaints are all *except*:
A. Haloes around light
B. Tired eyes
C. Periodic bluring of vision
D. Constant blinking

44. Most common type of colour blindness is:
A. Protanopes
B. Deuteranopes
C. Tritanopes
D. None

45. In pupillary reflex nerve tested is:
A. 2nd
B. 3rd
C. Both 2nd and 3rd
D. 4th

46. In optic atrophy, the optic disc appears to pale is index of:
A. Atrophy of the nerve fibre
B. Loss of vasculature
C. Gliosis
D. All of the above

47. In case of anisocoria when 1% pilocarpine is instilled into the eye with abnormally dilated pupil, pupil remains dilated. Cause of anisocoria may be:
A. Adies pupil
B. Pharmacological blockage
C. Uncal herniation
D. Diabetic III cranial nerve palsy

48. Headache with bitemporal hemianopia with 6/ vision is seen in:
A. Optic neuritis
B. Trauma
C. Chiasmal lesion
D. Bilateral cavernous lesion

49. All statements are true about papilloedem *except*:
A. Collection of extra-cellular fluid
B. Disruption of neurofilament
C. Stasis of axoplasmic transport
D. Swelling of the axon

50. A young man with blurring of vision in right eye followed by left eye after 3 months, showing dis hyperemia, oedema, circumpapillary telangiectasia with normal pupillary response with centroceca scotoma on perimetry, the cause is:
A. Typical optic neuritis
B. Acute papilloedema
C. Toxic optic neuropathy
D. Leber's hereditary optic neuropathy

51. Which of the following is not a part of the pupillary reflex pathway? *(DNB 2015)*
A. Edinger Westphal nucleus
B. Medial geniculate body
C. Pretectal nucleus
D. Ganglion cells in the retina

52. Optic neuritis is characterised by all of th following *except*: *(APPG 2014)*
A. Strongly associated with demyelinating disease
B. Subacute unilateral vision loss
C. Pain in exacerbated by ocular movements
D. Optic disc is always abnormal in the acute stag

53. Wolfram syndrome is characterised by all *except*
A. Optic atrophy
B. Diabetes mellitus
C. Diabetes insipidus
D. Parathyroid hyperplasia

54. Ophthalmoplegic migraine means: *(AIPG/AIIMS 2003)*
A. Headache with irreversible loss of optic nerv function
B. Recurrent third nerve palsy associated wit headache
C. Headache associated with third, fourth and sixt nerve palsy
D. Headache associated with optic neuritis

55. CHARGE syndrome includes all *except*: *(DNB 201*
A. Coloboma
B. Heart defects
C. Urogenital anomalie
D. Esophageal atresia

39: C 40: B 41: C 42: D 43: A 44: A
45: C 46: B 47: B

48: C 49: B 50: D 51: B 52: D 53:
54: C 55: D

CHAPTER

14

Disorders of Ocular Motility

QUICK TEXT REVIEW

ANATOMY AND PHYSIOLOGY OF OCULAR MOTILITY SYSTEM

RINCIPLE MUSCLES OF ROTATION

xtraocular muscles are:

Four recti: Superior rectus (SR), medial rectus (MR), inferior rectus (IR) and lateral rectus (LR)

Two obliques: Superior oblique (SO) and inferior oblique (IO).

rigin of muscles

All the recti and SO arise from *the apex of the orbit.*

The four recti arise from the *Annulus of Zinn* (common tendinous ring at orbital apex, encircling optic foramina and medial part of superior orbital fissure).

The SO arises from the *body of sphenoid* at the apex of the orbit

The IO arises from the orbital plate of maxilla *at the floor of the orbit.*

sertion of the muscles

ectus muscles are inserted into the sclera at ifferent distances away from the limbus. The istances from limbus are:

MR: 5.5 mm
IR: 6.5 mm
LR: 6.9 mm
SR: 7.7 mm

Spiral of Tillaux is the line joining the points of insertion of the rectus muscles.

Superior oblique after originating from the apex of the orbit first travels super medially, and then turns backward at the trochlea. It then travels posterolaterally to insert in the sclera in the *upper temporal quadrant of the globe.*

Inferior oblique moves backwards and laterally to insert into the *lower temporal quadrant of the globe.*

Few important facts

- Rectus muscle closest to limbus: MR
- Rectus muscle farthest from limbus: SR
- Longest extraocular muscle: SO
- Shortest extraocular muscle: IO.

Actions of extraocular muscles

Muscle	*Primary action*	*Subsidiary action*
Superior rectus (SR)	Elevation	Adduction, Intorsion
Inferior rectus (IR)	Depression	Adduction, Extorsion
Medial rectus (MR)	Adduction	—
Lateral rectus (LR)	Abduction	—
Superior oblique (SO)	Intorsion	Depression, Abduction
Inferior oblique (IO)	Extorsion	Elevation, Abduction

Ductions: These are monocular movements like adduction, abduction, elevation and depression

Movement	*Muscles involved*
• *Adduction*:	Medial rectus; also superior and inferior recti.
• *Abduction*:	Lateral rectus; also superior and inferior obliques.
• *Elevation*:	Superior rectus and inferior oblique
• *Depression*:	Inferior rectus and superior oblique
• *Intorsion*:	Superior oblique and superior rectus.
• *Extorsion*:	Inferior oblique and inferior rectus.

Note: Mnemonic to remember actions of muscles:

- RAD Recti are Adductors except lateral rectus
- SIN Superiors (SR, SO) are intorters
- Inferiors (IR, IO) are extorters

Nerve supply of extraocular muscles

All EOMs are supplied by 3rd nerve, except the lateral rectus by 6th nerve and superior oblique by 4th nerve.

Synergists, antagonists and yoke muscles

1. *Synergists:* These muscles have the similar primary action in the same eye, e.g. superior rectus and inferior oblique of the same eye act as synergistic elevators.

2. *Antagonists:* These have opposite action in the same eye, e.g. medial and lateral recti-muscles.

3. *Yoke muscles (contralateral synergists):* It refers to a pair of muscles (one from each eye) which act simultaneously in conjugate movements of the two eyes. Six pairs of yoke muscles are as follows:

Movement	*Yoke muscles*
Dextroversion	Right lateral rectus and left medial rectus
Levoversion	Left lateral rectus and right medial rectus
Dextroelevation	Right superior rectus and left inferior oblique
Levoelevation	Left superior rectus and right inferior oblique
Dextrodepression	Right inferior rectus and left superior oblique
Levodepression	Left inferior rectus and right superior oblique

TYPE OF FIXATION MOVEMENT

I. Versions: Eye movements in which both eyes move in the same direction (binocular conjugate movements) are called versions. These include:

- Dextroversion (right-sided gaze)
- Levoversion (left-sided gaze)
- Dextroelevation (up and right gaze)
- Levoelevation (up and left gaze)
- Dextrodepression (down and right gaze)
- Levodepression (down and left gaze)

Depending upon specific function, the versions are classified as:

- *Saccades* are rapid conjugate eye movements. These are of two types, voluntary saccades and reflex saccades (involuntary or reflective)
- *Smooth pursuit* (following eye movements): These are voluntary and slow conjugate eye movements.
- *Vestibulocular reflex* (VOR)
- *Optokinetic movement*, these are slow reflexive (involuntary) conjugate movements.

Note: ***Mnemonic to remember:***

For saccades is **FIF**

F—Fast eye movement
I—Involuntary
F—Frontal lobe (opposite)

For pursuit is **SVP**

S—Slow eye movements
V—Voluntary
P—Parito-occipital lobe (same)

II. Vergences: These are slow and disconjugate ey movements in which the eye moves in opposit directions. These includes:

- Convergence
- Divergence

Laws governing ocular movements

1. *Hering's law of equal innervation:* According to it, an equal and simultaneous innervation flow from the brain to a pair of yoke muscles durin conjugate movements. For example, durin dextroversion right lateral rectus and left media rectus receive equal innervation.

2. *Sherrington's law of reciprocal innervation* According to it, during eye movements an increase flow of innervation to the contracting muscle i accompanied by a decreased flow of innervatio to the antagonist muscle. For example, durin dextroversion an increased flow to right LR and th left MR is accompanied by decreased flow to righ MR and left LR.

BINOCULAR SINGLE VISION

It is a conditioned reflex which is not present sinc birth but is acquired during first 6 months and completed during first few years.

Prerequisites for development of binocular single vision

1. *Straight eyes starting* from the neonatal perio with precise co-ordination for all directions of ga (motor mechanism).
2. *Reasonably clear vision* in both eyes so that simil images are presented to each retina (senso mechanism).
3. *Ability of visual cortex* to promote binocular sing vision (mental process).

Grades of binocular single vision

Grade I—Simultaneous perception: It is the pow to see two dissimilar objects simultaneously. F

ample, when a picture of a bird is projected on the right eye and that of a cage on to the left e; an individual with presence of simultaneous rception will see the bird in the cage.

ade II—Fusion: It consists of the power to perimpose two incomplete but similar images to rm one complete image.

ade III—Stereopsis: It consists of the ability to rceive the third dimension (depth perception).

BNORMALITIES OF BINOCULAR VISION

ppression

is a temporary active cortical inhibition of the nage of an object formed at the retina of the uinting eye. This phenomenon occurs only during nocular vision (with both eyes open). This leads to e development of amblyopia.

nblyopia

is a uniocular impairment of vision in the absence any organic disease of ocular media and visual thway. Amblyopia can be of different types:

trabismic amblyopia: The protective mechanism suppression leads to amblyopia. **This type of mblyopia has the best prognosis.**

efractive amblyopia: This is due to uncorrected fractive error. This may be of the following types:

Anisometropic amblyopia: It develops due to difference in refractive error between the two eyes. This leads to amblyopia in the eye with the larger refractive error, if corrective glasses are not worn. Hypermetropes are more prone to develop aniso-metropic amblyopia.

Bilateral ametropic amblyopia can occur if the refractive error is high in both eyes and is not corrected

Meridional amblyopia is the term used when amblyopia affects only one meridian due to high astigmatic error.

timulus deprivation amblyopia: It is seen in ases having media opacity in the form of cataract r corneal opacity from early childhood. These hildren develop amblyopia due to visual form eprivation. This type of amblyopia has the **worst rognosis.**

linical features include:

Unilateral or bilateral *reduced vision*

Crowding phenomenon may be seen: The patient is able to identify a Snellen chart character with the amblyopic eye when the character is presented in isolation. If the character is shown along with other letters, the patient may not be able to recognize it.

- *Neutral density filter test (NDF)*: When the patient is asked to read through a NDF, the amblyopic eye shows no change, while in the normal eye, there is a drop in visual acuity.

Treatment includes:

- *Occlusion:* Occlusion of the good eye forces the child to see with the amblyopic eye and helps in improving vision.
- *Penalization:* If a child is not co-operative to occlusion, penalization by instillation of atropine in the good eye is the next option
- *Pleoptic therapy*
- *CAM stimulator*

Note: Amblyopia treatment should be tried till the child is 12 years old. ***Best results are seen between 5 and 8 years of age.***

Abnormal retinal correspondence (ARC)

If fovea of the normal eye and an extrafoveal point on the retina of the squinting eye acquire a common visual direction (become corresponding points).

SQUINT (STRABISMUS)

Definition and classification

A misalignment of the visual axes of the two eyes is called squint or strabismus. This is not actually a deviation but gives an impression of ocular deviation. Broadly strabismus can be classified as below:

I. Latent squint (Heterophoria)
II. Manifest squint (Heterotropia)
   1. Concomitant squint
   2. Incomitant squint.

Estimation of angle of deviation

- *Hirschberg corneal reflex test.* Roughly, the angle of squint is 15° and 45° when the corneal light reflex falls on the border of pupil and limbus, respectively.
- *The prism and cover test* (Prism bar cover test, i.e. PBCT): This will measure the amount of deviation in prism dioptres. Both heterophoria as well as heterotropia can be measured by this test.
- *Krimsky corneal reflex test:* The power of prism required to centre the light reflex in the squinting eye equals the amount of squint in prism dioptres.
- *Maddox-rod test:* The Maddox rod converts the point light image into a line. Thus, the patient will see a point light with one eye and a red line with the other. Due to disimilar images of the eyes, fusion

is broken and heterophoria becomes manifest. The number on Maddox tangent scale where the red line falls will be the amount of heterophoria in degrees.

- *Maddox wing test:* By it the amount of phoria for near (at a distance of 33 cm) can be measured. It is also based on the basic principle of dissociation of fusion by dissimilar objects.
- *Measurement of deviation with synoptophore:* Both objective and subjective angle of squint can be measured accurately with synoptophore.

PSEUDOSTRABISMUS

1. Pseudoesotropia or apparent convergent squint may be associated with a prominent epicanthal fold and negative angle kappa.

2. Pseudoexotropia or apparent divergent squint may be associated with *hypertelorism,* (a condition of wide separation of the two eyes) and positive angle kappa.

HETEROPHORIA

It is also known as 'latent strabismus'. It is a condition in which the tendency of the eyes to deviate is kept latent by fusion. Therefore, when the influence of fusion is removed, the visual axis of one eye deviates away. Factors predisposing to decompensation: (i) inadequacy of fusional reserve, (ii) general debility and lowered vitality, (iii) psychosis, neurosis, and mental stress, (iv) precision of job; and (v) advancing age.

Types of heterophoria

Esophoria: It is the tendency of the eyes to rotate inwards towards nose.

Exophoria: It is a tendency of the eyes to rotate out towards temple.

Hyperphoria: It is a tendency to deviate upwards, while hypophoria is a tendency to deviate downwards. However, in practice it is customary to use the term right or left hyperphoria depending on the eye which remains up as compared to the other.

Cyclophoria: It is a tendency to rotate around the anteroposterior axis. When the 12 O'clock meridian of cornea rotates nasally, it is called *incyclophoria* and when it rotates temporally it is called *excyclophoria.*

Symptoms

Decompensated heterophoria is associated with multiple symptoms. Cyclophoria is the rarest type of heterophoria but gives greatest discomfort.

HETEROTROPIA

It refers to manifest deviation of the visual a of the eye under binocular conditions. It is of t main types, namely, concomitant and incomita Sensory adaptations in patients with heterotropia

Concomitant squint

It is a type of manifest squint, in which the amou of deviation remains constant (unaltered) in the directions of gaze; and there is no associate limitation of ocular movements.

Concomitant esotropia

1. Infantile esotropia usually presents within t first 6 months of life. It is characterised by fair large angle of squint (>30°), minimum refracti error alternate fixation in primary gaze and crosse fixation in lateral gaze. Binocular vision (both e fixing simultaneously) does not develop. Inferi oblique over action may be present initially develop later and dissociated vertical deviatio develop in 80% by age of 3 years.

Common in children with hydrocephalus an cerebral palsy.

Treatment: Surgery is the treatment of choice. Th usual recommended time is between 6 months 2 years of age (and preferably before 1 year of age)

2. Accommodative esotropia. It is esotropi associated with abnormality in the process accommodation. It usually manifests at the age 2–3 years. It can be:

i. *Refractive accommodative esotropia* (Norm AC/A ratio): It usually develops at the age of 2- years and is associated with high hypermetropia (+ to +7 D). Due to excessive accommodative effort b the patient, there is excessive convergence leadin to esotropia. The angle of deviation is almo equal for both distance and near. Mostly it is ful correctable by use of spectacles.

ii. *Non-refractive accommodative esotropia:* It caused by abnormally high AC/A (accommodati convergence/accommodation) ratio. Esotropi is greater for near than the distance (minimal no deviation for distance). It is fully corrected b adding +3D S for near vision.

iii. *Mixed:* This is a combination of high hype metropia and high AC/A ratio.

3. Sensory deprivation (secondary) esotropi results from monocular lesions (in childhoo which either prevent the development of norm binocular vision or interfere with its maintenanc Examples of such lesions are cataract, seve congenital ptosis, aphakia, anisometropia, opt

trophy, retinoblastoma, central chorioretinitis and so on.

4. **Consecutive esotropia** results from surgical overcorrection of exotropia.

Concomitant exotropia

1. **Congenital exotropia** is rare and almost always present at birth. It is characterised by a fairly large angle of squint, usually alternating with homonymous fixation in lateral gaze, and no amblyopia.
2. **Primary exotropia** usually starts at the age of 2 years as *intermittent exotropia*. It is associated with normal fusion and no amblyopia. If not treated in time, it decompensates to become constant exotropia. It is usually alternating (ADS) with no binocular single vision.
3. **Secondary (sensory deprivation) exotropia** is a constant unilateral deviation which results from long-standing monocular lesions (in adults), associated with low vision in the affected eye.
4. **Consecutive exotropia** is a constant unilateral exotropia which results either due to surgical overcorrection of esotropia, or spontaneous conversion of small degree esotropia with amblyopia into exotropia.

Incomitant squint

It is a type of heterotropia (manifest squint) in which the amount of deviation varies in different directions of gaze.

'A' and 'V' pattern heterotropias

The term 'A' or 'V' pattern squint is labelled when the amount of deviation in squinting eye varies by more than 10° in upward or downward gaze in comparison to that in primary position.

'A' and 'V' esotropia: In 'A' esotropia the amount of deviation increases in upward gaze and decreases in downward gaze. The reverse occurs in 'V' esotropia.

'A' and 'V' exotropia: In 'A' exotropia the amount of deviation decreases in upward gaze and increases in downward gaze. The reverse occurs in 'V' exotropia.

Special ocular motility defects

1. ***Duane's retraction syndrome.*** It is a congenital ocular motility defect occurring due to fibrous tightening of lateral or medial or both rectus muscles. Its features are: limitation of abduction or adduction or both, and retraction of the globe and narrowing of the palpebral fissure on attempted adduction. Eye in the primary position may be orthotropic, esotropic or exotropic.
2. ***Brown's superior oblique tendon sheath syndrome.*** It is a congenital ocular motility defect due to fibrous tightening of the superior oblique tendon. It is characterized by: limitation of elevation of the eye in adduction (normal elevation in abduction), usually straight eyes in primary position and positive forced duction test on attempts to elevate eye in adduction.

Paralytic squint

Paralytic squint is the most common type of squint in adults.

Symptoms

1. *Diplopia* occurs due to formation of image on dissimilar points of the two retinae.
2. *Confusion* occurs due to formation of image of two different objects on the corresponding points of two retinae.
3. *Nausea and vertigo* result from diplopia and confusion.
4. *Ocular deviation* is of sudden onset.

Signs

1. *Primary deviation:* It is deviation of the affected eye and is away from the action of paralysed muscle, e.g. if lateral rectus is paralysed the eye is converged.
2. *Secondary deviation:* It is deviation of the normal eye seen under cover; when the patient is made to fix with the squinting eye. It is greater than the primary deviation.
3. *Restriction of ocular movements:* It occurs in the direction of the action of paralysed muscles.
4. *Compensatory head posture:* It is adopted to avoid diplopia and confusion. Head is turned towards the direction of action of the paralysed muscle.
5. *False projection or orientation:* It can be demonstrated by asking the patient to close the sound eye and then to fix an object placed on the side of paralysed muscle. Patient will locate it to further away in the same direction.
6. There is no amblyopia and visual acuity is normal.

Pathological sequelae of an extraocular muscle palsy

1. Overaction of the contralateral synergistic muscle
2. Contracture of the direct antagonist muscle
3. Secondary inhibitional palsy of the contralateral antagonist muscle.

Clinical varieties of ocular palsies

1. ***Isolated muscle paralysis:*** Lateral rectus and superior oblique are the most common muscles to be paralysed singly, as they have separate

nerve supply. Isolated paralysis of the remaining four muscles is less common, except in congenital lesions.

2. *Paralysis of the third cranial nerve can be congenital or acquired,*
Characteristic features are:

- *Ptosis* due to paralysis of LPS
- *Down and out deviation* of eyeball due to unopposed action of lateral rectus and superior oblique
- *Ocular movements* are restricted in all directions except outward
- *Fixed and dilated pupil* due to paralysis of sphincter pupillae
- *Accommodation lost*, due to paralysis of ciliary muscle.

3. *Total ophthalmoplegia:* In this condition all extraocular muscles including LPS and intraocular muscles are paralysed. It results from combined paralysis of third, fourth and sixth cranial nerves. It is a common feature of orbital apex syndrome and cavernous sinus thrombosis.

4. *External ophthalmoplegia:* In this condition all extraocular muscles are paralysed, sparing the intraocular muscles. It results from lesions at the level of motor nuclei sparing the Edinger-Westphal nucleus.

5. *Internuclear ophthalmoplegia:* In this condition there is lesion of the medial longitudinal bundle. Internuclear ophthalmoplegia (INO) is characterised by defective action of medial rectus on the side of lesion, horizontal nystagmus of the opposite eye and defective convergence.The most common cause of unilateral INO is vascular occlusion associated with diabetes mellitus and that of bilateral INO is multiple sclerosis.

6. *Conjugate paresis* which affects both eye equally is produced by lesions of cerebral cortex and supranuclear pathway. In it though, position and movements of the eyes are abnormal, they maintain their relative coordination and thus produce no diplopia. Vestibulo-ocular refexes are normal Conjugate palsies are common in Niemann-Pick disease.

NYSTAGMUS

It is the repetitive, involuntary to and fro oscillation of the eyes.

Clinical classification

1. *Pendular nystagmus*: Velocity is equal in each direction.
2. *Jerk nystagmus*: Has slow drift and a fast phase.
3. *Mixed nystagmus*: Pendular in primary position and jerk in lateral gaze.

Etiological calcification

I. *Physiological nystagmus:*
Optokinetic nystagmus(OKN). It constitutes o saccadic and pursuit movements. Defect in OKN indicates parietal lobe lesion.
Note: The center of Optokinetic nystagmus i parietal lobe.

II. *Motor imbalance nystagmus:*
1. Congenital nystagmus
2. Spasmus nutans: It is associated with head nodding
3. Latent nystagmus: In infantile esotropia
4. Ataxic nystagmus in internuclear ophthal mology
5. See-saw nystagmus is seen in patients with bitemporal hemianopia.

III. *Ocular nystagmus:* Due to sensory deprivation
Note: Downbeat nystagmus found in lithium toxicity.

MULTIPLE CHOICE QUESTIONS

1. **The muscle which makes an angle of about 51° with the optical axis is:**
   A. Superior rectus
   B. Superior oblique
   C. Inferior rectus
   D. Lateral rectus

2. **The muscle which makes an angle of about 23° with the optical axis is:**
   A. Superior oblique
   B. Superior rectus
   C. Inferior oblique
   D. Medial rectus

3. **Which of the following is not true for binocular single vision ?**
   A. Provides stereoscopic vision
   B. Is present since birth
   C. Is the cause of diplopia in paralytic squint
   D. Fusion is its second grade

4. **Pseudoesotropia is associated with:**
   A. Hypertelorism
   B. Positive angle kappa
   C. Negative angle kappa
   D. None of the above

5. **Pseudoexotropia is associated with:**
   A. Prominent epicanthal fold
   B. Positive angle kappa
   C. Negative angle kappa
   D. None of the above

6. **Asthenopic symptoms are most marked with:**
   A. Cyclophoria
   B. Hyperphoria
   C. Esophoria
   D. Exophoria

7. **All of the following are employed to evaluate a case of heterophoria *except*:**
   A. Maddox-rod test
   B. Alternate cover test
   C. Measurement of fusional reserve
   D. Measurement of near point of convergence

8. **In heterophoria prism is used:**
   A. With apex towards the direction of phoria in glasses for treatment
   B. With apex towards the direction of phoria for exercises only
   C. For exercises mainly in hyperphoria
   D. To detect grade III of binocular vision

9. **Conjugate fixation reflex is established by the age of:**
   A. 3 weeks
   B. 6 weeks
   C. 3 months
   D. 6 months

10. **An object located in the Panum's area stimulates:**
    A. Fusion
    B. Confusion
    C. Diplopia
    D. Stereopsis

11. **Strabismic amblyopia is more common in patients with:**
    A. Intermittent squint
    B. Alternate squint
    C. Constant squint
    D. Latent squint

12. **Which of the following tests helps to differentiate between concomitant squint and paralytic squint?**
    A. Cover-uncover test
    B. Direct cover test
    C. Alternate cover test
    D. None of the above

13. **All of the following lesions causing paralysis of extraocular muscles produce diplopia *except*:**
    A. Nuclear lesions
    B. Lesions of nerve trunks
    C. Lesions of neuromuscular junction
    D. Lesions of supranuclear pathways
    E. None of the above

14. **In paralytic convergent squint diplopia is:**
    A. Homonymous
    B. Heteronymous
    C. Both of the above
    D. None of the above

15. **The commonest cause of unilateral internuclear ophthalmoplegia is:**
    A. Diabetes mellitus
    B. Hypertension
    C. Multiple sclerosis
    D. Lead toxicity

16. **The common cause of bilateral internuclear ophthalmoplegia is:**
    A. Multiple sclerosis
    B. Lead toxicity
    C. Diphtheria
    D. Diabetes mellitus

1:B 2:B 3:B 4:C 5:B 6:A 7:B 8:A 9:B 10:D 11:C 12:C 13:D 14:B 15:A 16:A

17. Onset of stereopsis occurs at the age of:
A. 3 to 5 months
B. 1 to 2 years
C. 5 years
D. 7 years

18. Uniocular diplopia occurs in all of the following *except*:
A. Paralysis of inferior oblique
B. Keratoconus
C. Iridodialysis
D. Incipient cataract

19. A point that falls on horopter excites:
A. Corresponding retinal points
B. Crossed diplopia
C. Confusion
D. Stereopsis

20. Convergence insufficiency is associated with all of the following *except*:
A. Increase in accommodation
B. General debility
C. Refractive errors
D. Wide interpupillary distance

21. All of the following may be present in Duane's retraction syndrome *except*:
A. Limitation of abduction
B. Narrowing of palpebral aperture in abduction
C. Suppression
D. Head turn

22. Brown's syndrome simulates paresis of:
A. Inferior oblique
B. Superior oblique
C. Superior rectus
D. Inferior rectus

23. In 'A'-Esotropia the amount of deviation:
A. Increases in upward gaze and decreases in down gaze
B. Decreases in upward gaze and increases in down gaze
C. Increases in upward as well as downward gaze
D. Decreases in upward as well as downward gaze

24. In 'V'-Exotropia amount of deviation:
A. Increases in upward gaze and decreases in down gaze
B. Decreases in upward gaze and increases in down gaze
C. Increases in upward as well as downward gaze
D. Decreases in upward as well as downward gaze

25. In caloric test left jerk nystagmus occurs when:
A. Cold water is poured in right ear
B. Hot water is poured in right ear
C. Cold water is poured in left ear
D. All of the above

26. Secondary deviation of the eye is based on th following law:
A. Hering's
B. Listing's
C. Donder's
D. Sherrington's

27. Uncrossed diplopia is seen with:
A. Esotropia
B. Exotropia
C. Exophoria
D. Esophoria

28. All are features of paralytic squint *except*:
A. Unequal fixation
B. Vertigo
C. Amblyopia
D. Abnormal head position

29. Amplitude of accommodative convergence is:
A. Altered by weak cycloplegics
B. Altered by lenses and prisms
C. Decreased in older people
D. Altered by orthoptics

30. Large angle Kappa gives rise to:
A. Pseudo-squint
B. Manifest squint
C. Latent squint
D. Periodic squint

31. Most uncommon type of latent strabismus is:
A. Esophoria
B. Exophoria
C. Hyperphoria
D. Cyclophoria

32. In unilateral past pointing nystagmus the site o lesion is:
A. Cerebellar hemisphere
B. Lateral semicircular canal
C. Flocculo-nodular lobe
D. Superior semicircular canal

33. Secondary deviation of the eye is an example o the following law:
A. Herring's
B. Listing's
C. Sherrington's
D. Donder's

34. Action of right superior oblique muscle is:
A. Dextrodepression
B. Dextroelevation
C. Laevoelevation
D. Laevodepression

17: A 18: A 19: A 20: A 21: B 22: A
23: A 24: A 25: A
26: A 27: A 28: C 29: A 30: A 31:
32: A 33: A 34: A

35. The best treatment for correction of 15° non-accommodative esotropia in a 5-year-old child is:
A. Order refraction testing under atropine and full correction
B. Synoptophore exercise
C. Surgical alignment
D. Occlusion patching

36. In right-sided sixth nerve palsy all of the following are seen *except*:
A. Convergent squint
B. Right-sided abduction loss
C. Diplopia on dextroversion
D. Head turned to left

37. For a new born baby with squint surgery should be done at:
A. 3-4 years
B. Immediately
C. 10-12 years
D. 18-21 years

38. Hirschberg test is used to detect:
A. Squint
B. Field defects
C. Glaucoma
D. Optic atrophy

39. Miners nystagmus is of which type:
A. Lateral
B. Vertical
C. Rotatory
D. Can be of any type

40. Down beat nystagmus could be due to:
A. Cerebellar lesion
B. Arnold-Chiari malformation
C. All of the above
D. None of the above

41. Downward and lateral gaze is action of:
A. Inferior oblique
B. Medial rectus
C. Superior oblique
D. Lateral rectus

42. Elevators of eye:
A. SR and IO
B. IO and SO
C. IR and S
D. SO SR

43. Yolk muscle pair is:
A. Rt MR and Rt LR
B. Rt MR and Lt LR
C. Rt SO and Lt IO
D. Rt SR and Lt SR

44. Child with mild squint. Intrauterine, birth history, development history till date all normal. Corneal reflex normal. All other eye parameters normal *except* exaggerated epicanthal fold. Diagnosis:
A. Pseudostrabismus
B. Accommodative squint
C. Exophoria
D. Esophoria

45. Which of the following best defines the "Saccade":
A. Voluntary slow eye movements
B. Involuntary slow eye movement
C. Abrupt, involuntary slow eye movements
D. Abrupt, involuntary rapid eye movements

46. A patient has a right homonymous hemianopia with saccadic pursuit movements and defective optokinetic nystagmus. The lesion is most likely to be in the :
A. Frontial lobe
B. Occipital lobe
C. Parietal lobe
D. Temporal lobe

47. Weakness of both Adduction and Abduction to seen in:
A. Duane's retraction syndrome type 1
B. Duane's retraction syndrome type 2
C. Duane's retraction syndrome type 3
D. All

48. Dilator pupillae is supplied by:
A. Post-ganglionic parasympathetic fibers from Edinger Westphal nucleus
B. Post-ganglionic sympathetic fibers from cervical sympathetic chain
C. IIIrd nerve
D. Sympathetic fibers from fronto-orbital branch of V nerve

49. A 30 years old man came at the outpatient department because he had suddenly developed double vision. On examination it was found that his right eye, when at rest was turned medially. The most likely anatomical structures involved are:
A. Medial rectus and superior division of oculomotor nerve
B. Inferior oblique and inferior division of oculomotor nerve
C. Lateral rectus and abducent nerve
D. Superior rectus and trochlear nerve

50. A patient presented with his head tilted towards left. On examination, he was having left hypertropia which increased on looking towards right or medially. The muscle which is most likely paralyzed is:
A. Left superior oblique
B. Left inferior oblique
C. Right superior oblique
D. Right inferior oblique

51. True about infantile esotropia:
A. Present since birth
B. Small angle of deviation
C. Inferior oblique muscle hyperactivity
D. Variable angle of deviation
E. Associated with refractive error

5 : C 36 : D 37 : A 38 : A 39 : C 40 : C 45 : D 46 : C 47 : C 48 : B 49 : C 50 : A
1 : C 42 : A 43 : B 44 : A 51 : C

52. A patient presents with diplopia with limitation of adduction in the left eye and abducting saccade in the right eye.Convergence is preserved. Most likely etiology is:

A. Partial 3rd nerve palsy
B. Internuclear ophthalmoplegia
C. Duane's reactionary syndrome
D. Absence of medial rectus muscle

53. A 26 years old male with restriction of eye movements in all directions and moderate ptosis but with no diplopia or squint. Diagnosis is:

A. Thyroid ophthalmopathy
B. Chronic progressive external ophthalmoplegia
C. Myasthenia gravis
D. Multiple cranial nerve palsies

54. Final centre for horizontal movement of eye is:

A. Abducent nucleus
B. Trochlear nucleus
C. Oculomotor nucleus
D. Vestibular nucleus

55. Which of the following muscles is an intorter? *(AIIMS 2000)*

A. Inferior rectus
B. Inferior oblique
C. Superior rectus
D. Lateral rectus

56. Which of the following muscles does not have adduction function? *(WBPG 2012)*

A. Medial rectus
B. Superior rectus
C. Inferior oblique
D. Inferior rectus

57. Left superior oblique and left inferior rectus are: *(Kerala PG 2014)*

A. Yoke muscles
B. Agonists
C. Antagonists
D. Synergists

58. Most common type of squint seen in myopes is: *(DNB 2015)*

A. Intermittent exotropia
B. Intermittent esotropia
C. Esotropia hypotropia complex
D. Exotropia hypotropia complex

59. Limitation of both adduction and abduction is seen in: *(AIIMS)*

A. Duane's type I
B. Duane's type II
C. Duane's type III
D. Double elevator palsy

52: B 53: B 54: A 55: C

56: C 57: D 58: A 59: C

CHAPTER

15

Diseases of Eyelids

QUICK TEXT REVIEW

INFLAMMATORY DISORDERS

EPHARITIS

quamous blepharitis

It is usually associated with seborrhoea of scalp (dandruff). In it, glands of Zeis secrete abnormal excessive neutral lipids which are splitted by *Corynebacterium acne* into irritating free fatty acids.

Characterised by accumulation of whitish soft scales along the lid margin.

acterial blepharitis (Ulcerative blepharitis)

Chronic staphylococcal infection of the lid margin. Characterised by yellow crusts at the root of cilia. Small ulcers, which bleed easily are seen on removing the crusts. Anterior lid margin shows dilated blood vessels (rosettes).

Complications and sequelae are:

- Recurrent styes (very common)
- Recurrent conjunctivitis (common)
- Marginal keratitis (common)
- Madarosis, poliosis, tylosis and eversion of punctum.

osterior blepharitis (Meibomitis)

A meibomian gland dysfunction, seen more commonly in patients with acne rosacea and seborrhoeic dermatitis.

Foam in the tears (meibomian seborrhoea) is characteristic feature.

YE (HORDEOLUM EXTERNUM)

Stye is an acute suppurative staphylococcal aureus infection of gland of Zeis or gland of moll and lash follicle.

Patient presents with a painful lid swelling.

- *Recurrent styes* are more common in patients with asthenopia, diabetes mellitus and chronic blepharitis.

Treatment is hot compression, local antibiotics, systemic antibiotics and anti-inflammatory drugs.

CHALAZION (MEIBOMIAN CYST/ TARSAL CYST)

- *Chalazion* is a chronic non-infective, non-suppurative lipo-granulomatous inflammation of the meibomian gland with blockage of duct and collection of sebaceous material.
- *Characterised* by painless tarsal swelling which often may be multiple (most common lid swelling). It is *more common on the upper lid* as the number of Meibomian glands are more on the upper lid.
- *Treatment*: Incision and curettage of chalazion (most common mode of therapy) is done from the conjunctival side by a vertical incision. Intralesional injection of steroid may be effective in soft, small and recurrent chalazion.
- *Recurrence* may occur in *seborrhoeic dermatitis, acne rosacea and malignant changes.*
- *Complications* include secondary malignancy (Meibomian gland adenocarcinoma or sebaceous cell carcinoma).

HORDEOLUM INTERNUM

- An acute primary staphylococcal infection of meibomian gland or secondary infection in a chalazion.
- *Symptoms* are similar to stye except that pain is more intense, due to the swelling being embedded deeply in the dense fibrous tissue.
- *Differential diagnosis* from hordeolum externum is made by the facts that in it, the point of maximum tenderness and swelling is away from the lid margin

and that pus usually points on the conjunctival side and not on the root of cilia.

MOLLUSCUM CONTAGIOSUM

- *A viral infection (large pox virus)* commonly affecting children with small, pale umbilicated lid nodules.
- *Complications*: Ipsilateral chronic follicular conjunctivitis and epithelial keratitis.

DISORDERS OF EYE LASHES AND LID MARGIN

TRICHIASIS

An inward misdirection of eye lashes with normal position of lid margin.

Causes

Trachoma (commonest), ulcerative blepharitis, healed membranous conjunctivitis, hordeolum externum, mechanical injuries, burns and operative scar on the lid margin.

Treatment

- *Epilation* is easy but temporary method, as recurrences occur within 3–6 weeks.
- *Electrolysis*: A current of 2 mA is passed for 10 seconds into the lash root. Recurrences are not rare.
- *Cryoepilation*: The cryoprobe with –20°C is applied for 20–25 seconds. It is the best method for segmental trichiasis. Its main disadvantage is depigmentation of the skin.
- *Argon laser destruction* is effective but may need to be repeated.

ENTROPION

An inward turning of lid margin.

1. Congenital entropion

A rare condition seen since birth. Lower lid retractors not well developed.

2. Cicatricial entropion

Common variety, more frequently involves the upper lid.

Causes include scarring of palpebral conjunctiva in trachoma (most common), membranous conjunctivitis, chemical burns, pemphigus and Stevens-Johnson syndrome.

Surgeries for correction are:

- Wedge resection of tarsoconjunctiva
- Tarsal fracture
- Mucous membrane grafting.

3. Involutional (senile) entropion

Common variety, affects the lower lid in elderly.

Etiological factors

- Weakening or dehiscence of capsulopalpebral fascia (lower lid retractors).
- Degeneration of palpebral connective tissue allowing preseptal fibres to override the pretarsal fibres.
- Horizontal laxity of the lid.

Management

- *Tucking or plication of inferior lid retractors* (Jones-Reech and Wobing operation)
- Modified Wheeler's operation
- Weiss operation
- Bick's procedure.
- *Lester Jones procedure: For severe, recurrent cases.*

4. Spastic entropion

Occurs following spasm of orbicularis due to chronic ocular irritation or following tight bandaging.

More common in elderly and frequently involves lower lid.

5. Mechanical entropion

Occurs due to lack of support provided by the globe to lids as in phthisis bulbi, enophthalmos, after enucleation or evisceration operation.

ECTROPION

- Out rolling or outward turning of the lid margin.
- Epiphora is the main symptom in ectropion.

1. *Congenital ectropion* is very rare, but may be seen in Down's syndrome and blepharophimosis syndrome.

2. *Involutional (senile) ectropion*

- Most common variety, involves the lower lid.
- Occurs due to following age-related changes:
  - Senile laxity of the lid tissues
  - Loss of the tone of orbicularis muscle
  - Weakness of medial and lateral canthal tendons.

Corrective surgeries are:

- *Ziegler's cautery*: For medial ectropion
- *Medial conjunctivoplasty*: For medial ectropion
- *Lazy-T procedure*: For medial ectropion
- *Modified Kuhnt-Szymanowski procedure*: For severe cases involving both medial and lateral side of eyelid.

3. *Cicatricial ectropion.* Occurs due to skin scarring as in thermal burns, chemical burns, lacerating injuries and skin ulcers.

4. *Paralytic ectropion.* Occurs in facial nerve palsy in lower lid.

atment includes:
ubricant eye drops and tarsorrhaphy
ledial canthoplasty.

CHOMEGALY

ers to increase in the length of eyelashes.

uses
Drug induced—Phenytoin, topical prostaglandin nalogues, cyclosporine
Malnutrition
AIDS
Porphyria
Hypothyroidism
Certain rare congenital conditions like Hermansky-Pudlak syndrome, Cornelia de Lange syndrome, Oliver McFarlane syndrome.

MBLEPHARON

dhesions of the lids with the eyeball
Causes: Chemical burns, thermal burns, nembranous conjunctivitis, ocular pemphigus, tevens-Johnson syndrome
Types: Anterior, posterior and total.

KYLOBLEPHARON

Refers to adhesions between upper and lower lid margins.
Usually associated with symblepharon.

GOPHTHALMOS

Inability to voluntarily close the eye-lids
Causes: Orbicularis paralysis, severe ectropion, symblepharon, marked proptosis, overcorrection of ptosis and comatosed patient.

EPHAROSPASM

Essential (spontaneous) blepharospasm is a rare idiopathic condition occurring in elderly patients
Reflex blepharospasm occurs in conditions of chronic ocular irritations
Treatment: Eliminate the cause of reflex blepharospasm
- Botulinum toxin injection into the orbicularis muscle.
- Facial denervation in severe cases.

OSIS

ooping of the upper lid more than the normal mm).

Congenital myogenic ptosis

Congenital weakness of levator palpebrae superioris (LPS) muscle. It is the most common congenital anomaly of the lid. It is characterized by dropping of one or both lids at birth, with diminished or absent lid crease and lid lag on downgaze due to tethering effect of abnormal muscle. It may occur in following forms:

- *Simple congenital ptosis:* Not associated with other anomaly.
- *Congenital ptosis with superior rectus weakness.*
- *Blepharohimosis syndrome:* Congenital ptosis, blepharophimosis, telecanthus and epicanthus inversus.
- *Congenital synkinetic ptosis (Marcus Gunn-winking Ptosis): Retraction of ptotic lid with jaw movement like chewing,* i.e. with stimulation of ipsilateral pterygoid muscle.

Note: Marcus-Gunn Jaw-Winking syndrome occurs due to nuclear or infra-nuclear connection between IIIrd and Vth nerve.

Acquired ptosis

1. ***Neurogenic ptosis.*** Third nerve palsy, ophthalmoplegic migraine, multiple sclerosis. Horner's syndrome occurs in: cervical adenitis, thyroid operation, aortic aneurysm, syringomyelia, Pancoast's syndrome, trauma, cervical cord tumours and multiple sclerosis.

2. ***Myogenic ptosis.*** Myasthenia gravis, dystrophica myotonica, ocular myopathy, oculopharyngeal muscular dystrophy, trauma to LPS muscle, thyrotoxicosis, Lambert-Eaton myasthenia syndrome.

3. ***Aponeurotic ptosis.*** Involutional (senile) ptosis, post-cataract operation, blepharochalasis, traumatic dehiscence or disinsertion of the aponeurosis.

4. ***Mechanical ptosis.*** Lid tumours, multiple chalazia, lid oedema.

Causes of bilateral ptosis

- Myasthenia gravis
- Myotonic dystrophy
- Kearns-sayre syndrome.

Causes of pseudoptosis

- Microphthalmos
- Anophthalmos
- Enophthalmos
- Phthisis bulbi.

Evaluation of ptosis

I. *Degree of ptosis*
- Mild: 2 mm
- Moderate: 3 mm
- Severe: 4 mm or more.

II. *Levator function by Burke's method*
- Normal: 15 mm
- Good: 8 mm or more
- Fair: 5–7 mm
- Poor: 4 mm or less.

III. *MRD 1*
Marginal reflex distance-b/w upper lid margin and light reflex in primary gaze, normal is 4–4.5 mm.

IV. *Vertical fissure height:*
Male-: 7–10 mm
Female-: 8–12 mm

V. *Special tests*
- Tensilon (edrophonium) test for suspected myasthenia
- Phenylepherine test for suspected Horner's syndrome.

Treatment

1. *Fasanella—Servat operation* (Excision of upper border of tarsus together with lower border of muller muscle and overlying conjunctiva)- for mild ptosis with good levator action. It is also indicated in Horner's syndrome.
2. *Levator resection*—for moderate and severe ptosis.
- Blaskovics' operation (conjunctival approach)
- Everbusch's operation (skin approach)

3. *Frontalis sling operation* (Brow suspension)
- For severe ptosis with poor levator function
- Materials used—autogenous fascia lata (best), supramid, prolene, silicone.

TUMOURS OF EYELIDS

A. BENIGN TUMOURS

1. Simple papilloma
- Most common tumour
- Usually occurs at the lid margin.

2. Xanthelasma
- Creamy-yellow plaque like lesion
- Occurs on upper and lower lids near the inner canthus
- More common in middle aged women, diabetics and those with high cholesterol level.

3. Capillary haemangioma
- A childhood tumour, may occur pari-passi or as a part of Sturge-Weber syndrome
- In many cases self-resolution may occur by the ag of 5 years.

4. Neurofibroma
- Lids and orbits commonly affected
- Solitary neurofibroma or as a part of neuro fibromatosis.

B. PRECANCEROUS CONDITIONS
- Solar keratosis
- Carcinoma-in-situ
- Xeroderma pigmentosa.

C. MALIGNANT TUMOURS

1. Basal cell carcinoma
- Commonest malignant tumour of the lids, seen i elderly people (western reports).
- Locally malignant.
- Sites: Lower lid: 50% (most common)
  - Medial can thus: 25%
  - Upper lid: 10–15%
  - Outer canthus: 5%.
- Presentations
  - Noduloulcerative (most common)
  - Nonulcerative nodular
  - Sclerosing type
  - Pigmented basal cell carcinoma.
- Most common histological pattern is solid basa cell carcinoma with characteristic peripher palisaded appearance
- Treatment: of choice is local excision
  - Radiotherapy only in unoperable cases.

2. Squamous cell carcinoma
- Second commonest malignant tumour of the ey lids
- Incidence is much less than the basal cell carcinom
- Common site—lid margin
- *Presentations*
  - An ulcerated growth with elevated an indurated margins (common)
  - Fungating or polypoidal growth (rare)
- *Metastasis*: Preauricular and submandibul lymph nodes
- *Characteristic histological feature* is whorle arrangement forming horn pearls which ma contain laminated keratin in the centre.

3. Sebaceous gland carcinoma
- It is a very rare tumour according to weste reports, but Indian literature reports it as the mo common lid malignancy.
- Arises from meibomian glands (most commor sebaceous glands of eyebrows and caruncle.
- May be mistaken for chalazion.

Malignant melanoma (melanocarcinoma)

May arise from a pre-exiting naevus, but usually arises de-novo from the melanocytes present in the skin.

Metastasis: Locally, lymphatics and blood stream.

Radioresistent, so surgery is treatment of choice.

MISCELLANEOUS POINTS

Blepharophimosis may be associated with Down's syndrome, microphthalmos, Edward's syndrome and Waardenburg's syndrome.

Ptosis associated with lower lid of the affected side being at a higher level than the lower lid of the normal side is seen in Horner's syndrome.

- *Epicanthus* may be associated with Down's syndrome.
- *Blepharitis acaria* is caused by Demodex follicularium.
- *Cutaneous horn of eye lids* is frequently associated with an underlying dysplastic (actinic keratosis) or neoplastic (squamous cell carcinoma) change.
- *Ptosis associated with lid lag* in down gaze is feature of congenital ptosis.
- *Peculiarities of the skin of the eyelids* are loose attachment, extreme thinness, and absence of hair.

MULTIPLE CHOICE QUESTIONS

1. Distichiasis is characterised by all of the following *except*:
A. An extra row of cilia is present
B. Normal row of cilia is present anterior to the openings of the meibomian glands
C. Extra row of cilia occupies a position posterior to the openings of the meibomian glands
D. Cilia of the extra row may rub the cornea

2. Rosettes found at the lid margin are a feature of:
A. Squamous blepharitis
B. Ulcerative blepharitis
C. Both of the above
D. None of the above

3. Stye is an acute suppurative inflammation of:
A. Gland of Zeis
B. Gland of Moll
C. Meibomian gland
D. All of the above

4. Hordeolum internum is a suppurative inflammation of the:
A. Gland of Zeis
B. Gland of Moll
C. Meibomian gland
D. All of the above

5. Of the following conditions most painful is:
A. Stye
B. Hordeolum internum
C. Ulcerative blepharitis
D. Inflammation of gland of Moll

6. In a chalazion with multiple recurrences at the same site the incision and curettage should be:
A. Followed by cauterisation with carbolic acid
B. Preceded by cryotherapy
C. Preceded by intralesional injection of triamcinolone
D. Replaced by excision biopsy

7. Pseudotrichiasis is seen in:
A. Entropion
B. Ectropion
C. Distichiasis
D. Healed membranous conjunctivitis

8. Simple and effective method of treatment for segmental trichiasis is:
A. Epilation
B. Electrolysis
C. Cryolysis
D. Surgical correction

9. All of the following operations are employed to correct senile entropion *except*:
A. Modified Wheeler's operation
B. Modified Ketssey's operation
C. Weiss operation
D. Bick's procedure with Reeh's modification

10. Which of the following types of entropion is no- known:
A. Spastic entropion
B. Paralytic entropion
C. Cicatricial entropion
D. Involutional entropion

11. Senile ptosis is:
A. Neurogenic
B. Myogenic
C. Aponeurotic
D. Mechanical

12. Severe ptosis in a newborn should be operated a the age of:
A. 1 year
B. 3 years
C. 5 years
D. Earliest possiblet

13. All of the following are pre-cancerous conditlon of the lids *except*:
A. Naevi
B. Solar keratosis
C. Xeroderma pigmentosa
D. Carcinoma-in-situ

14. The commonest malignant tumour of the lids is
A. Basal-cell carcinoma
B. Squamous cell carcinoma
C. Adenocarcinoma
D. Melanocarcinoma

15. The most common site of basal cell carcinoma the lids is:
A. Upper lid
B. Lower lid
C. Medial canthus
D. Lateral canthus

16. Sebaceous cell carcinoma of the lids arises fron
A. Meibomian gland
B. Sebaceous gland of eyebrows
C. Caruncle
D. All of the above

17. Epiphora in a patient with seventh nerve palsy most likely due to:
A. Eversion of lower punctum
B. Lateral lower lid ectropion
C. Failure of lacrimal pump system
D. All of the above

1:C 2:B 3:A 4:C 5:B 6:D
7:A 8:C 9:B

10:B 11:C 12:D 13:A 14:A 15:
16:D 17:C

18. Ptosis with lid lag is seen in:
A. Traumatic ptosis
B. Myogenic ptosis
C. Synkinesis
D. Congenital ptosis

19. Tylosis refers to:
A. Hypertrophy and drooping of eyelid
B. Inversion of eyelid
C. Senile eversion of eyelid
D. Distortion of cilia

20. The commonest fungal lesion of the eyelid is:
A. Candida
B. Aspergillosis
C. Sporothrix
D. None

21. Epilation is not indicated in:
A. Ulcerative blepharitis
B. Phthiriasis
C. Trichiasis
D. Madarosis

22. Sling surgery should be avoided in cases of ptosis with:
A. Very poor levator action
B. Poor Bell's phenomenon
C. Weak Muller's muscle
D. Multiple failed surgeries

23. All are complications of chronic staphylococcal blepharoconjunctivitis *except*:
A. Chalazion
B. Marginal conjunctivitis
C. Follicular conjunctivitis
D. Phlyctenular conjunctivitis

24. Fasanella Servat operation is specifically indicated in:
A. Congenital ptosis
B. Steroid-induced ptosis
C. Myasthenia gravis
D. Horner's syndrome

25. The operation of plication of inferior lid retractors is indicated in:
A. Senile ectropion
B. Senile entropion
C. Cicatricial entropion
D. Paralytic entropion

26. A recurrent chalazion should be subjected to histopathologic evaluation to exclude the possibility of:
A. Squamous cell carcinoma
B. Sebaceous cell carcinoma
C. Malignant melanoma
D. Basal cell carcinoma

27. Fusion of palpebral and bulbar conjunctiva is:
A. Symblepharon
B. Trichiasis
C. Ectropion
D. Tylosis

28. Eyelid drooping is seen in:
A. Damage to Edinger-Westphal nucleus
B. Damage to motor part of facial nerve
C. Damage to sympathetic nerve supply
D. Damage to lacrimal nerve

29. A patient with ptosis presents with retraction of ptotic eye lid on chewing. This represents:
A. Marcus gunn Jaw winking syndrome
B. Third nerve misdirection syndrome
C. Abducent palsy
D. Occulomotor palsy

30. S-shaped eyelid is seen in:
A. Plexiform neurofibroma
B. Hemangioma
C. Arterio venious fistula
D. Varix

31. Lipogranulomatous inflammation is seen in: *(AIIMS 2014)*
A. Fungal infection
B. Tuberculosis
C. Chalazion
D. Viral infection

32. A recurrent chalazion should be subjected to histopathological examination to rule out the possibility of: *(AIIMS 2006)*
A. Squamous cell Ca
B. Sebaceous cell Ca
C. Malignant melanoma
D. Basal cell Ca

33. Bilateral ptosis is not seen in: *(AIPG 2001)*
A. Marfan's syndrome
B. Myasthenia gravis
C. Myotonic dystrophy
D. Kearns-Sayre syndrome

34. Telecanthus means: *(AIIMS)*
A. Widened interpupillary distance
B. Widened root of nose with normal interpupillary distance
C. Widely separated medial orbital wall
D. Widely separated canthi

35. Distichiasis means: *(DNB 2016)*
A. Increased number of eyelashes in the lower lid
B. Second row of eyelashes
C. Increased thickness of eyelashes
D. Increased pigmentation of eyelashes

18 : D 19 : A 20 : A 21 : D 22 : B 23 : A 24 : D 25 : B 26 : B
27 : A 28 : C 29 : A 30 : A 31 : C 32 : B 33 : A 34 : B 35 : B

CHAPTER

16

Diseases of Lacrimal Apparatus

QUICK TEXT REVIEW

TEAR FILM AND ITS DISORDERS

TEAR FILM

Structure

1. *Mucus layer.* Innermost and thinnest layer (0.02–0.05 mm) consists of mucin secreted by goblet cells and glands of Manz. Converts hydrophobic corneal surface into hydrophilic.

2. *Aqueous layer.* Thickest layer (6.5–7.5 mm) and consists of tears secreted by main and accessory lacrimal glands alkaline and saltish in taste. Contains antibacterial substances—lysozyme, beta lysin, lactoferrin, immunoglobulin-A.

3. *Lipid or oily layer.* Outermost layer, about 0.1 μm thick consists of secretions of Meibomian, Zeis and Moll glands. Prevents the overflow of tears, retards their evaporation and lubricates the eyelids as they slide over the surface of the globe.

Functions

- Keeps conjunctiva and cornea moist
- Provides oxygen to corneal epithelium
- Washes away debris and noxious irritants
- Antibacterial activity
- Facilitates movements of the lids over the globe.

DRY EYE

Etiology

1. *Aqueous tear deficiency*—Keratoconjunctivitis sicca (KCS)

i. *Sjogren's syndrome*
- Pure KCS: In it only lacrimal gland is damaged by infiltration with mononuclear cells
- Primary Sjogren's syndrome (sicca complex) consists of KCS and a dry mouth (xerostomia)
- Secondary Sjogren's syndrome consists of sicca complex and a connective tissue disease (usually rheumatoid arthritis).

ii. *Non-Sjogren's syndrome. It includes:*
- Congenital alacrima (rare)
- Riley-Day syndrome
- Idiopathic hyposecretion.

2. *Evaporative dry eye.* It is caused by the conditions which decrease tear film stability and thus increase evaporation. It includes:

i. *Mucin deficiency dry eye*
- Hypovitaminosis—A
- Severe conjunctival scarring (trachoma, Stevens-Johnson syndrome, chemical burns, radiations and ocular pemphigoid).

ii. *Lipid deficiency and abnormalities*
- Congenital absence of meibomian glands along with anhydrotic ectodermal dysplasia (rare)
- Chronic blepharitis and meibomitis (common)

iii. *Impaired eyelid functions*
- Bell's palsy
- Dellen
- Symblepharon
- Lagophthalmos
- Ectropion.

iv. *Corneal epitheliopathies.*

Tear film tests

1. *Tear film break-up-time (BUT)*
- It is the interval between a complete blink and appearance of first randomly distributed dry spot on the cornea
- Normal values: 15–35 seconds
- Value less than 10 seconds imply an unstable tear film
- Low values indicate mucin deficiency/disturbance

Schirmer-I-test
t measures total tear secretion (production)
t is performed with 5 × 35 mm strip of Whatman
1 filter paper
Normal value: 15 mm or above/5 minutes
Values between 5 and 10 mm: Mild to moderate
dry eye
Value less than 5 mm: Severe dry eye
Low values are suggestive of aqueous deficiency
dry eye (keratoconjunctivitis sicca).
Rose Bengal staining
Stains devitalized cells
Irritating—so use xylocaine
Three staining patterns are described:
- C-pattern: Fine punctate stain in interpalpebral area (suggests mild dry eye).
- B-pattern: Extensive staining (moderate dry eye)
- A pattern: Confluent staining of conjunctiva and cornea (severe dry eye).

eatment

Tear conservation by decreasing room temperature, use of humidifiers
Tear substitutes: The common tear substitutes are polyvinyl alcohol, carboxymethyl cellulose, hydroxypropyl methyl cellulose, and hyaluronic acid.
Mucolytics like acetylcysteine which disperse mucus filaments and plaque.
Cyclosporine eye drops for keratoconjunctivitis sicca. Systemic steroids, immunosuppressants may also be used in severe cases.
Reduction of tear drainage by punctal occlusion.
Tarsorrhaphy is done in cases of lagophthalmos and proptosis.
Mucous membrane grafting and amniotic membrane grafting are options for parenchymatous conjunctival damage.

IE WATERING EYE

Hyperlacrimation, i.e. more formation of tears of two types:
Primary hyperlacrimation occurs due to direct stimulation of the lacrimal gland as in early stages of lacrimal gland tumours and cysts and due to the effect of strong parasympathomimetic drugs.
Reflex hyperlacrimation results from stimulation of sensory branches of fifth nerve due to irritation of cornea or conjunctiva.

a. *Physiological cause* of epiphora is lacrimal pump failure due to lower lid laxity or weakness of orbicularis muscle.
b. *Mechanical obstruction* in lacrimal passages.

2. *Epiphora refers* to watering due to decreased drainage of tears either due to blockage of lacrimal passage or due to lacrimal pump failure (atonia of sac).
- The commonest cause of epiphora in a newborn is membrane at the lower end of NLD
- The commonest site of obstruction in epiphora occurring in an adult is junction of the sac and the NLD
- For evaluation of functional (physiological) obstruction due to lacrimal pump failure dacryoscintigraphy or radionucleotide dacryocystography is used and it is the most sensitive method for evaluation.

Causes of false negative regurgitation test
- Internal fistula
- Wrong technique of performing regurgitation test
- Encysted mucocele.
- *Crocodile tears* are seen in abnormal VII nerve regeneration.

Tests for lacrimal drainage:
- Syringing and probing
- Jones' dye test
- Fluorescein dye disappearance test
- Dacryocystography (DCG): Confirmatory test for anatomical obstruction
- Radionucleotide testing (Dacryoscintigraphy): Confirmatory test for functional obstruction.

DISORDERS OF LACRIMAL SAC AND LACRIMAL GLAND

DACRYOCYSTITIS

Congenital dacryocystitis

As many as 30% of newborn infants are believed to have closure of nasolacrimal duct at birth; *mostly due to membraneous occlusion at its lower end,* near the valve of Hasner. Watering develops after 7 days of birth followed by mucopurulent discharge. Regurgitation test becomes positive.

Treatment
- *Hydrostatic massage* (Criggler's massage) *over the lacrimal sac area and topical antibiotics* constitute the treatment of congenital NLD block, up to 6 months of age. This conservative treatment cures obstruction in about 90% of the infants.
- *Probing of NLD with Bowman's probe* should be performed, in case the condition is not cured by the age of 6 months (some surgeon wait up to 9 months). In most instances, a single probing will relieve the obstruction. In case of failure, it may be repeated after an interval of 3–4 weeks.

- *Balloon catheter dilation* may be carried out where repeated probing is a failure.
- *Intubation with silicone* tube may be tried when above treatment is a failure.
- *Dacryocystorhinostomy (DCR) operation:* Optimum age is 4 years.

Adult dacryocystitis (Acquired dacrocystitis)

Acute Dacryocystitis

This is an acute suppurative inflammation of the lacrimal sac.

Cause: Obstruction in the NLD leading to stasis of secretion in the sac and secondary infection.

Clinical features: The patient presents with sudden onset pain and swelling in the area of the sac. It may be associated with systemic features like fever.

Complications are: Lacrimal abscess, lacrimal fistula, orbital cellulitis.

Treatment includes:

- Systemic antibiotics and anti-inflammatory drugs
- Topical antibiotics
- *Hot compression* given locally
- *DCR* is done 4–6 weeks after the resolution of the acute episode.

Chronic dacryocystitis

- It is more common than the acute dacryocystitis.
- The disease is predominantly seen in females (80%).
- The patient presents with complains of watering and discharge.
- Regurgitation test is positive.
- Syringing test shows mucoid regurgitation from other punctum suggestive of NLD obstruction.

Complications include: mucocoele, encysted mucocoele, pyocele, acute on chronic dacryocystitis and fibrosed sac.

Dacryocystorhinostomy (DCR) operation is the treatment of choice.

Treatment

- *Dacryocystectomy (DCT)* is indicated when DCR is contraindicated.

SWELLINGS OF THE LACRIMAL GLAND

Mikulicz's syndrome

It is characterised by bilaterally symmetrical enlargement of the lacrimal and salivary glands associated with a variety of systemic diseases. These include: leukaemias, lymphosarcomas, benign lymphoid hyperplasia, Hodgkin's disease, sarcoidosis and tuberculosis.

- *Dacryops.* It is a cystic swelling, which occurs due to retention of lacrimal secretions following blockage of the lacrimal ducts.
- *Lymphoid tumours and inflammatory pseudotumours* constitute approximately 50% of cases.
- *Benign epithelial tumours* include benign mixed tumours which account for 25% cases.
- *Malignant epithelial tumours* constitute 25% of cases and include: Malignant mixed tumour, adenoid cystic carcinoma, mucoepidermoid carcinoma and adenocarcinoma.

Benign mixed tumour

It is also known as *pleomorphic adenoma* and occurs predominantly in young adult males. It is the *commonest tumour* of the lacrimal gland. *Clinically* it presents as a slowly progressive painless swelling in the upper-outer quadrant of the orbit. The eyeball may be proptosed with a down and in displacement. It is locally invasive and may infiltrate its own pseudocapsule to involve the adjacent periosteum. *Histologically*, it is characterised by presence of pleomorphic myxomatous tissue, just like benign mixed tumour of salivary gland. Its *treatment* consists of complete surgical removal with the capsule. Recurrences are very common following incomplete removal.

MULTIPLE CHOICE QUESTIONS

1. **Innermost stratum of tear film is:**
   A. Mucus layer
   B. Aqueous layer
   C. Oily layer
   D. None of the above

2. **Thickest layer of tear film is:**
   A. Mucus layer
   B. Aqueous layer
   C. Oily layer
   D. None of the above

3. **The antibacterial substance present in the tears is:**
   A. Lysozyme
   B. Beta lysin
   C. Lactoferrin
   D. All of the above

4. **Keratoconjunctivitis sicca refers to:**
   A. Aqueous tear deficiency dry eye
   B. Mucin deficiency dry eye
   C. Lipid deficiency dry eye
   D. All types of dry eye

5. **Normal values of tear film break up time range from:**
   A. 5 to 10 seconds
   B. 10 to 15 seconds
   C. 15 to 20 seconds
   D. 15 to 30 seconds

6. **Schirmer-I test measures:**
   A. Total tear secretions
   B. Basal tear secretions
   C. Reflex tear secretions
   D. All of the above

7. **Normal values of Schirmer-I test are:**
   A. 5 mm
   B. 10 mm
   C. 15 mm
   D. 15 mm or above

8. **All of the following are features of Sjogren's syndrome *except*:**
   A. It is an autoimmune chronic inflammatory disease
   B. Typically occurs in women after the menopause
   C. In primary Sjogren's syndrome, keratoconjunctivitis sicca is associated with rheumatoid arthritis
   D. In secondary Sjogren's syndrome, dry eye and/or xerostomia (dry mouth) is associated with rheumatoid arthritis

9. **Tear film break-up-time is the time:**
   A. Between the last blink and the appearance of first dry spot on the cornea
   B. Taken for appearance of dry spot between two blinks
   C. Taken by successive blinks to break the tear film
   D. Taken for disappearance of dry spots on the cornea

10. **Tear lysozyme levels are decreased in:**
    A. Keratoconjunctivitis sicca
    B. Stevens Johnson syndrome
    C. Ocular pemphigoid
    D. All of the above

11. **Positive fluorescein dye disappearance test indicates that watering eye is due to:**
    A. Atonia of the sac
    B. Mechanical obstruction in the lacrimal passages
    C. Both of the above
    D. None of the above

12. **Most common site of congenital blockage in the nasolacrimal duct is:**
    A. At the upper end
    B. In the middle
    C. At the lower end
    D. Whole of the duct

13. **Optimum age for performing dacryocystorhinostomy operation in a child with congenital dacryocystitis is:**
    A. 2 years
    B. 4 years
    C. 6 years
    D. 8 years

14. **In dacryocystorhinostomy operation the communication of the sac is established with:**
    A. Middle meatus
    B. Superior meatus
    C. Inferior meatus
    D. All of the above

15. **Functional efficiency of lacrimal drainage system may be assessed by:**
    A. Lacrimal syringing
    B. Subtraction macrodacryocystography
    C. Radionucleotide dacryocystography
    D. All of the above

16. **Most common site of obstruction in chronic dacryocystitis in adults is:**
    A. At upper end of nasolacrimal duct
    B. At lower end of nasolacrimal duct
    C. In the lacrimal sac
    D. In the common canaliculus

1:A 2:B 3:D 4:A 5:D 6:A 7:D 8:C 9:A 10:A 11:C 12:C 13:B 14:A 15:C 16:A

17. Normal pH of tears is:
A. 5.7
B. 6.7
C. 7.5
D. 7.9

18. Tears are produced in the new born after:
A. 1 Week
B. 2 Weeks
C. 3 Weeks
D. 4 Weeks

19. A 3-month-old infant was brought with complaints of profuse lacrimation. On pressure pus exudes from the puncta. The best line of management is:
A. Dacryocystorhinostomy
B. Syringing
C. Massaging of sac with antibiotics
D. Syringing and probing

20. Crocodile tears are seen in:
A. Frey's syndrome
B. Conjunctivitis
C. Lacrimal tumour
D. Abnormal VIIth nerve regeneration

21. Treatment of nasolacrimal duct obstruction:
A. Syringing
B. Probing
C. DCR
D. Dacryocystectomy
E. Antibiotic

22. Initial treatment of congenital dacryocystitis:
A. Massaging
B. Probing
C. DCR
D. Ointment
E. No treatment required

23. A 60-year-old man presented with watering from his left eye since 1 year. Syringing revealed a patent drainage system. Rest of the ocular examination was normal. A provisional diagnosis of lacrimal pump failure was made. Confirmation of the diagnosis would be by:
A. Dacryoscintigraphy
B. Dacryocystography
C. Pressure syringing
D. Canaliculus irrigation test

24. Unilateral lacrimal gland destruction may be caused by:
A. Inferior orbital fissure fracture
B. Fracture of roof of orbit
C. Fracture of lateral wall
D. Fracture of sphenoid

25. Length of naso lacrimal duct is:
A. 10 mm
B. 11 mm
C. 12 mm
D. 9 mm

17 : C 18 : A 19 : D 20 : D 21 : A, B, C, D and E 22 : A 23 : A 24 : B 25 : C

CHAPTER

17

Diseases of Orbit

QUICK TEXT REVIEW

PROPTOSIS

FINITION

optosis refers to bulging of the eyeball (forward otrusion) beyond the orbital margins. Most urces define exophthalmos/proptosis as protru-on of globe greater than 18 mm.

ophthalmos though synonymous with proptosis the term often used when describing proptosis sociated with Graves's disease.

AUSES

uses of unilateral proptosis

Congenital conditions. Dermoid cysts, congenital cystic eyeball, and orbital teratomas.

Traumatic lesions: Orbital haemorrhage, retained intraorbital foreign body, traumatic aneurysm and emphysema of the orbit.

Inflammatory lesions: Acute inflammations are orbital cellulitis, abscess, thrombophlebitis, panophthalmitis and cavernous sinus thrombosis (proptosis is initially unilateral but ultimately becomes bilateral). Chronic inflammatory lesions include: pseudotumours, tuberculoma, gumma and sarcoidosis.

Circulatory disturbances and vascular lesions: Angioneurotic oedema, orbital varix and aneurysms.

Cysts of orbit: Haematic cysts, implantation cysts and parasitic cysts (hydatid cyst and cysticercus cellulosae).

Tumours of the orbit: These can be primary, secondary or metastatic. (*See* page 81)

uses of bilateral proptosis

Developmental anomalies of the skull: Craniofacial dysostosis, e.g. oxycephaly (tower skull).

- *Osteopathies*: Osteitis deformans, rickets and acromegaly.
- *Inflammatory conditions*: Mikulicz's syndrome and late stage of cavernous sinus thrombosis.
- *Endocrinal exophthalmos*: It may be thyrotoxic or thyrotropic.
- *Tumours*: Symmetrical lymphoma or lymphosarcoma, secondaries from neuroblastoma, nephroblastoma, Ewing's sarcoma and leukaemic infiltration.
- *Systemic diseases*: Histiocytosis, systemic amyloidosis, xanthomatosis and Wegner's granulomatosis.

Causes of specific type of proptosis

Causes of axial proptosis

- Thyroid ophthalmopathy
- Orbital cellulitis
- Carotid-cavernous fistula
- Cavernous sinus thrombosis
- Retinoblastoma
- Optic nerve glioma
- Ophthalmic artery aneurysm
- Optic nerve meningioma
- Cavernous hemangioma
- Pseudotumour.

Causes of non-axial proptosis

- Lacrimal gland tumour
- Frontal mucocoele
- Ethmoidal mucocele
- Carcinoma maxillary sinus
- Encephalocoele
- Meningomyelocele
- Rhabdomyosarcoma
- Metastatic neuroblastoma
- Chloroma
- Orbital varix.

Causes *of acute proptosis* are orbital emphysema following fracture of the medial orbital wall, orbital haemorrhage and rupture of ethmoidal mucocele.

Causes *of intermittent proptosis* (proptosis developing intermittently and rapidly in one when venous stasis is induced by forward bending or lowering the head) are orbital varix (most common), periodic orbital oedema, recurrent orbital haemorrhage and highly vascular tumours.

Causes *of pulsating proptosis* are caroticocavernous fistula (most common), saccular aneurysm of ophthalmic artery, congenital meningocele or meningoencephalocele, neurofibromatosis and traumatic or operative hiatus in the roof of the orbit.

Causes *of proptosis in infants.* Craniostenosis, meningoencephalocele, microphthalmia with teratoma, retinoblastoma, capillary haemangioma, juvenile xanthogranuloma and metastatic neuroblastoma.

Causes *of proptosis beginning in childhood:* Dermoid cyst, lymphangioma, cavernous haemangioma, orbital varices, neurofibroma, rhabdomyosarcoma, optic nerve glioma, intraorbital meningioma, orbital cellulitis leukaemic infiltration, granulocytic sarcoma, Burkitt's lymphoma, eosinophillic granuloma, Hand-Schuller Christian disease, sinus histiocytosis, hydatid cyst and fibrous dysplasia.

Causes *of proptosis beginning in adulthood.* Graves' ophthalmopathy (commonest cause), lymphoproliferative disorders, fibrous histocytoma, haemangiopericytoma, cavernous haemangioma, secondary orbital meningioma, osteoma, mucocele, orbital varices, lesions of lacrimal gland, secondary tumours of the orbit.

Causes of pseudoproptosis/pseudoexophthalmos

Causes of pseudoproptosis are buphthalmos, axial high myopia, retraction of upper lid and enophthalmos of the opposite eye.

- ***Most common cause of unilateral proptosis in children:*** Orbital cellulitis
- ***Most common cause of bilateral proptosis in children:*** Chloroma
- ***Most common cause of unilateral proptosis in adults:*** Thyroid ophthalmopathy
- ***Most common cause of bilateral proptosis in adults:*** Thyroid ophthalmopathy.

EVALUATION OF PROPTOSIS

Different views of X-ray orbit

A. Caldwell-Luc view:
- PA view
- Occipitofrontal view
- Structures seen: Superior orbital fissure, greate and lesser wing of sphenoid, ethmoid an frontal sinus and floor of sella.

B. Towne's view
- AP view
- Frontal occipital
- Structures seen: Inferior orbital fissure, dorsu sellae of sphenoid bone.

C. Water's view: Occipitomental
- Structures seen-floor of orbit (blow ou fracture)
- Occipitomental, maxillary sinus and floor o orbital

D. Rhese view: For optic foramen.

Proptosis: Findings in X-ray orbit

Causes of symmetrical enlargement of orbital cavity in X-rays of the orbit
- Optic nerve glioma
- Haemangioma
- Neurofibroma
- Retinoblastoma.

Cause of asymmetrical enlargement of orbit
- Rhabdomyosarcoma
- Dermoid cyst
- Lacrimal gland tumour.

Causes of increased bone density (hyperostosis) i X-rays of orbit
- Sphenoidal ridge meningioma
- Chronic periostitis
- Fibrous dysplasia
- Paget's disease
- Osteoblastic metastasis.

Causes of intraorbital calcification
- Retinoblastoma
- Optic nerve sheath meningioma
- Phlebolith in orbital varix
- Phthisical eye.

Changes in optic canal (optic foramina) in X-rays
- Uniform regular concentric enlargement
  - optic nerve glioma
- Uniform irregular enlargement
  - retinoblastoma
  - optic nerve sheath meningioma
  - orbital neurofibroma

Erosion of the upper margin
- raised intracranial pressure
Erosion of the inferolateral margin
- infraclinoid aneurysm
- infraclinoid meningioma.

OPHTHALMOS

Congenital: Microphthalmos and maxillary hypoplasia
Traumatic: Blow-out fractures of floor of the orbit
Post-inflammatory: Cicatrization of extraocular muscles as in the pseudotumour syndromes
Paralytic enophthalmos: It is seen in Horner's syndrome
Atrophy of orbital contents: Senile atrophy of orbital fat, atrophy due to irradiation of malignant tumour, following cicatrizing metastatic carcinoma and due to scleroderma.

GRAVES' OPHTHALMOPATHY

THOLOGY

e histopathologic reaction of various tissues is minated by a mononuclear cell inflammatory ction. Presence of mucopolysaccharides, predominantly hyaluronic acid, together with erstitial oedema and inflammatory cells accounts the proptosis. Most data presently support e postulate that it is an autoimmune disease th the orbital fibroblast as the primary target of flammatory attack, and extraocular muscle being condarily involved.

NICAL FEATURES

l signs

lrymple's sign—Retraction of the upper lids oducing the characteristic staring and frightened pearance. It is the most common feature.

d lag (von Graefe's sign), i.e. when globe is oved downward, the upper lid lags behind.

roth's sign—Fullness of eyelids due to puffy dematous swelling.

fford's sign—Difficulty in eversion of upper lid.

llwag's sign—Infrequent blinking.

ular motility defects

The most common ocular motility defect is unilateral elevator palsy caused by fibrotic contraction of the inferior rectus muscle followed by failure of abduction due to contracture of medial rectus muscle. Sequence of involvement of muscle s: IR, MR, SR and LR.

- *Enlargement of extraocular muscles* without enlargement of tendons is the hallmark of thyroid ophthalmopathy (seen on CT scan or MRI orbit).

Note: Mnemonic 'I AM So Lucky'
IR-MR-SR-LR

External ophthalmology

Thyroid ophthalmopathy can cause vertical diplopia due to paralysis of vertical acting muscles like inferior oblique.

Exophthalmos is the second most common sign, as a rule both eyes are symmetrically affected; but it is frequent to find one eye being more prominent than the other. Even unilateral proptosis is not uncommon.

Werner classification of ocular changes in Graves disease

Six classes depicted by Mnemonic "NO SPECS"
Class 0: No signs or symptoms
Class 1: Only signs
Class 2: Soft tissue involvement (sign and symptoms)
Class 3: Proptosis
Class 4: Extraocular muscle involvement
Class 5: Corneal involvement
Class 6: Sight loss (optic nerve compression).

ORBITAL CELLULITIS AND INTRAORBITAL ABSCESS

- Suppurative inflammation of the fat and cellular tissues of the orbit.
- It may result from penetrating injury especially when associated with retention of intraorbital foreign body, following operations like evisceration, enucleation, dacryocystectomy and orbitotomy.
- *Extension of infection from neighbouring structures* (most common-ethmoiditis especially in children) is the commonest mode of orbital infections.
- *Characteristic features* are marked swelling of lids conjunctival chemosis, proptosis and limitation of ocular movements. *Important blinding complications* are: central retinal artery occlusion, optic neuritis and corneal ulceration.
- *Orbital apex syndrome* is characterised by a triad of: (i) ophthalmoplegia due to paresis of third, fourth and sixth cranial nerves, (ii) anaesthesia in the region of supply of ophthalmic division of fifth nerve and (iii) amaurosis due to involvement of optic nerve.

CAVERNOUS SINUS THROMBOSIS

- Cavernous sinus thrombosis starts initially as a unilateral condition, which soon becomes bilateral in more than 50% of cases due to intercavernous communication.
- *Paralysis of opposite lateral rectus muscle* is often the first sign of involvement of contralateral cavernous sinus.

Clinical features

- *Generalized*: Abrupt onset of fever with chills and rigor.
- *Localized (ocular) features*: Chemosis of conjunctiva, ipsilateral ophthalmoplegia (3rd-Ptosis, absent direct and consensual pupillary light reflex on ipsilateral side, 4th and 6th nerve palsy), diplopia (lateral gaze is involved earliest) and corneal anaesthesia occurs due to involvement of ophthalmic division of 5th cranial nerve- loss of corneal reflex.
- *Oedema in mastoid region* is a pathognomonic sign.
- Vision loss is not an early feature.
- Magnetic resonance venography (angiography) is the investigation of choice.
- *Rapidly developing, acute inflammatory type of proptosis* seen in cavernous sinus thrombosis needs to be differentiated from orbital cellulitis and panophthalmitis.

CAROTID-CAVERNOUS FISTULA

Carotid-cavernous fistula is an acquired abnormal communication between the carotid arterial system and the venous cavernous sinus. There are two type of carotid-cavernous fistula:

i. High-flow fistula

These are secondary to trauma or iatrogenic and present acutely with pain, proptosis (often pulsatile exophthalmos), chemosis, congestion, bruit, ophthalmoplegia (III-VI nerve palsies), headache, and objective pulsatile tinnitus. The classical triad of presentation is proptosis, chemosis, and bruit. It presents within days or weeks following trauma.

ii. Low-flow fistula

These develop spontaneously in elder women, during pregnancy or in those with hyperplastic tissue. These typically present slowly with less pronounced symptoms.

Investigations

- Selective carotid angiography using digit subtraction technique is the investigation of choic and essential if the treatment is contemplated.
- Magnetic resonance angiography (MRA) are als used commonly.

Treatment

A carotid-cavernous fistula requires a definitiv treatment, which currently involves endovascul technique. The fistula can usually be occluded wit a balloon or a coil without sacrifice of the carotid.

ORBITAL TUMOURS

PRIMARY ORBITAL TUMOURS

- *Dermoids* are common developmental tumour in which the cystic component is lined wit keratinizing epithelium and may contain on or more dermal adnexal structures such as hai follicles and sebaceous glands.
- *Lipodermoids* are solid tumours usually see beneath the conjunctiva.
- *Teratomas* are composed of ectoderm, mesoderm and endoderm. These may be solid, cystic or mixture of both.
- *Capillary haemangioma* is commonly seen at birt or during the first month.
- *Cavernous haemangioma* is the commones benign orbital tumour among adults. The tumou is usually located in the.retrobulbar muscle con and produces unilateral axial proptosis.
- *Rhabdomyosarcoma* is the *most common primar orbital tumour among children*, usually occurrin below the age of 15 years (90%).
- *Lacrimal gland tumours*. Pleomorphic adenom (mixed cell tumour) is the most common benig tumour of lacrimal gland. It causes down an medial displacement of the eyeball. Malignar tumours of lacrimal gland are: adenoid cysti carcinoma, pleomorphic adenocarcinoma, an mucoepidermoid carcinoma.
- *Optic nerve glioma* may present either as a solita tumour or as a part of von Recklinghausen neurofibromatosis (55%). It is characterise by early visual loss associated with a gradua painless,unilateral axial proptosis occurrin in a child usually between 4 and 8 years of ag (female > male). CT scan typically shows fusifor enlargment of optic nerve along with enlargeme of optic canal.

Primary intraorbital meningiomas produce visual loss associated with limitation of ocular movements, optic disc oedema or atrophy, and a slowly progressive unilateral proptosis. The presence of opticociliary shunt is pathognomonic of an optic nerve sheath meningioma.

Lymphomas. Orbits are involved more commonly by non-Hodgkin's lymphomas (Most common malignant orbital tumour in adults).

Hand-Schuller-Christian disease is characterised by a triad of proptosis, diabetes insipidus and bony defects in the skull.

CONDARY ORBITAL TUMOURS

Tumours from eyeball: Retinoblastoma and malignant melanoma.

Tumour from eyelids: Squamous cell carcinoma and basal cell carcinoma

Tumours from nose and paranasal sinuses such as carcinomas, sarcomas and osteomas

Tumours from nasopharynx: Nasopharyngeal carcinoma

Tumours from cranial cavity: Glioma and meningioma.

ETASTATIC ORBITAL TUMOURS

In children: Neuroblastoma (most common), nephroblastoma, Ewing's sarcoma, Leukemic infiltration, testicular embryonal sarcoma and ovarian sarcoma.

In adults: Carcinoma breast (most common in female), lungs (most common in males), prostate, thyroid, rectum, and malignant melanoma from skin.

BLOW-OUT FRACTURE OF THE ORBITAL FLOOR

'Blow-out fractures' mainly involve be orbital floor (especially in the posteromedial floor) and be medial wall.

Three factors responsible for producing enophthalmos in blow-out fracture are: (a) Escape of orbital fats into the maxillary sinus; (b) Backward traction on the globe by entrapped inferior rectus muscle and (c) Enlargement of the orbital cavity from displacement of fragments.

Common roentgen findings are: Fragmentation and irregularity of the orbital floor, depression of bony fragments, proptosis, diplopia (muscle restriction can be confirmed with forced duction test) and hanging drop opacity (tear drop sign) of the superior maxillary antrum from orbital contents herniating through the floor.

Treatment

Fracture involving half or more orbital floor with entrapment of orbital content and persistent diplopia in the primary position should be repaired within 2 weeks by using synthetic material such as silicon, Teflon or supramid.

SOME SALIENT POINTS

- *Most common and most virulent fungal disease involving the orbit* is caused by Mucor (Mucormycosis) and Rhizopus organism of the class Phycomycetes (phycomycosis). Orbital mucormycosis occur most often in patients with diabetic ketoacidosis.
- *Mucoceles of paranasal sinuses affecting the orbit most commonly* occur in frontal sinus. The most common cause of intermittent proptosis is orbital varices.
- *Most common cause of pulsating proptosis* is caroticocavernous fistula.
- *Most common primary tumour of the orbital cavity* presenting as proptosis is cavernous haemangioma.
- *Rhabdomyosarcoma* of the orbit is the commonest primary malignant tumour of childhood.
- *Commonest histological type* of rhabdomyosarcoma of the orbit is embryonal type.
- *Paralysis of opposite lateral rectus muscle* is often the first sign of involvement of contralateral cavernous sinus.
- *Earliest clinical feature of orbital extension of the basal cell carcinoma* of the eyelid is diplopia.
- *Carotid angiography* is the investigation of choice in caroticocavernous fistula. The first sign of cavernous sinus thrombosis is restriction of ocular movements.
- *First sign of cavernous sinus thrombosis* is restriction of ocular movements.
- *Most common cause of unilateral proptosis* in children is orbital cellulitis
- *Most common cause of unilateral proptosis* in adults is thyroid ophthalmopathy.

MULTIPLE CHOICE QUESTIONS

1. Intermittent proptosis is a sign of:
A. Pseudotumour
B. Caroticocavernous fistula
C. Capillary haemangioma
D. Orbital varices

2. Marcus Gunn pupil along with proptosis indicates:
A. Involvement of ciliary ganglion
B. Compression of optic nerve
C Compression of inferior division of 3rd nerve
D. Compression of sympathetic nerves of the eyeball

3. Postural exophthalmometric changes are diagnostic of:
A. Orbital varix
B. Caroticocavernous aneurysm
C. Haemangioma
D. Thyroid ophthalmopathy
E. All of the above

4. Intraorbital calcification in a patient with proptosis is observed in all *except*:
A. Retinoblastoma
B. Orbital varix
C. Hydatid cyst
D. Pseudotumour

5. Dehiscence of bone can be seen as X-rays findings in a patient with proptosis in all *except*:
A. Mucocele
B. Neurofibroma
C. Lacrimal gland tumour
D. Rhabdomyosarcoma

6. Orbital lesions of childhood include all of the following *except*:
A. Lymphangioma
B. Secondary orbital meningioma
C. Cavernous haemangioma
D. Neurofibroma

7. Pseudoproptosis is a feature of:
A. Buphthalmos
B. High axial myopia
C. Upper lid retraction
D. All of the above

8. Opticociliary shunts observed on fundoscopy are a feature of:
A. Meningioma
B. Cavernous haemangioma
C. Orbital varix
D. All of the above

9. Horner's syndrome is characterised by all of the following *except*:
A. Contralateral enophthalmos
B. Ipsilateral miosis
C. Ipsilateral ptosis
D. Anhydrosis of the affected side of face

10. Ocular Graves disease is associated with:
A. Hyperthyroidism
B. Hypothyroidism
C. Euthyroid state
D. All of the above

11. Dalrymple's sign of ocular Graves' disease refe to:
A. Retraction of the upper lid
B. Lid lag
C. Proptosis
D. All of the above combinedly

12. The most common ocular motility defect noted ocular Graves' disease is due to involvement of
A. Inferior rectus
B. Medial rectus
C. Superior oblique
D. Inferior oblique

13. The walls of the orbit which are removed in t two wall decompression for proptosis of thyro ophthalmopathy include part of:
A. Orbital floor and medial wall
B. Orbital floor and lateral wall
C. Orbital roof and medial wall
D. Medial and lateral walls

14. All of the following are the features of orbital ap syndrome *except*:
A. Ophthalmoplegia
B. Enophthalmos
C. Ophthalmic nerve anaesthesia
D. Amaurosis

15. Most often the first sign of involvement opposite side in cavernous sinus thrombosis i
A. Paralysis of opposite lateral rectus muscle
B. Proptosis of the opposite side
C. Paralysis of opposite 3rd nerve
D. Paralysis of opposite 4th nerve
E. All of the above

16. Simultaneous thrombosis of both the cavern sinuses usually occurs in:
A. Diseases of the sphenoid sinuses
B. Septic wounds of the face
C. Pyogenic meningitis
D. Patients with cerebral abscess

1:D 2:B 3:D 4:D 5:D 6:B 9:A 10:D 11:A 12:A 13:A 14
7:D 8:A 15:A 16:A

7. **The most common mucocele of the paranasal sinuses involving the orbit arises from:**
   A. Frontal sinus
   B. Ethmoidal sinus
   C. Maxillary sinus
   D. Sphenoidal sinus

8. **The most commonly seen primary orbital tumour in children is:**
   A. Rhabdomyosarcoma
   B. Glioma of optic nerve
   C. Optic nerve sheath meningioma
   D. Retinoblastoma

9. **Ophthalmoscopic sign pathognomonic of optic nerve sheath meningioma is:**
   A. Papilloedema
   B. Optic atrophy
   C. Opticociliary shunt
   D. All of the above

10. **The diagnostic triad of exophthalmos, diabetes insipidus and bone lesions is characteristic of:**
    A. Hand-Schuller Christian disease
    B. Letterer-Sieve disease
    C. Fibrous dysplasia
    D. Osteoporosis

11. **Cause of lid retraction include:**
    A. Graves' ophthalmopathy
    B. Hypokalaemic periodic paralysis
    C. Cirrhosis of the liver
    D. Hydrocephalus
    E. All of the above

12. **Secondary tumour may spread to the orbit by all of the following *except*:**
    A. Direct spread from the lids
    B. Via blood stream
    C. Via lymphatic channels
    D. Directly from the cranial cavity

13. **The most common tumour that spreads into the orbit from the intracranial cavity is:**
    A. Astrocytoma
    B. Pituitary adenoma
    C. Sphenoid wing-meningioma
    D. Neurofibroma

14. **One of the early symptoms of orbital involvement by basal cell carcinoma of the lid is:**
    A. Diplopia
    B. Defective vision
    C. Proptosis
    D. Severe pain

25. **Intraorbital abscess formation occurs most commonly in which quadrant of the orbit?**
    A. Superotemporal
    B. Superonasal
    C. Inferonasal
    D. Inferotemporal

26. **The most common cause of pulsating exophthalmos is:**
    A. Orbital varices
    B. Neurofibromatosis
    C. Cavernous haemangioma
    D. Caroticocavernous fistula

27. **The most common cause of intermittent exophthalmos is:**
    A. Orbital varices
    B. Cavernous haemangioma
    C. Lymphangioma
    D. Caroticocavernous fistula

28. **The most common benign tumour of the orbit is:**
    A. Optic nerve glioma
    B. Meningioma
    C. Benign-mixed tumour
    D. Haemangioma

29. **Optical media are clear in:**
    A. Cavernous sinus thrombosis
    B. Orbital cellulitis
    C. Both of the above
    D. None of the above

30. **Superior orbital fissure syndrome is frequently caused by:**
    A. Carotid aneurysms
    B. Meningioma
    C. Arachnoiditis
    D. All of the above

31. **All of the following structures are located in the lateral wall of the cavernous sinus *except*:**
    A. Abducent nerve
    B. Oculomotor nerve
    C. Trochlear nerve
    D. Ophthalmic nerve

32. **Contracted socket occurs because of all the following *except*:**
    A. Chronic low grade infection
    B. Chronic mechanical irritation
    C. Irradiation
    D. Loss of fatty tissue during surgery of enucleation

33. **A man presents 6 hours after head injury complaining of mild proptosis and scleral hyperemia:**
    A. Pneumo-orbit
    B. Caroticocavernous fistula
    C. Retro-orbital hematoma
    D. Orbital cellulitis

17:A 18:A 19:C 20:A 21:E 22:C 23:C 24:A 25:B 26:D 27:A 28:D 29:C 30:D 31:A 32:D 33:C

34. Blow-out fracture of orbit is characterized by all *except*:
A. Diplopia
B. 'Tear drop" sign
C. Positive forced duction test
D. Exophthalmos

35. "Blow-out" fracture of orbit involves:
A. Floor
B. Medial wall
C. All of the above
D. None of the above

36. All of the following signs could result from infection within the right cavernous sinus, *except*:
A. Loss of pupillary light reflex
B. Loss of corneal blink reflex
C. Ptosis
D. Right ophthalmoplegia

37. Commonest cause for bilateral proptosis in children is:
A. Cavernous hamangioma
B. Chloroma
C. Fibrous histiocytoma
D. Rhabdomyosarcoma

38. Which of the following tumours present with proptosis:
A. Neuroblastoma
B. Nephroblastoma
C. Germ cell tumour
D. Medulloblastoma
E. Meningioma

39. A patient presented with unilateral proptosis, which was compressible and increases on ending forward. No thrill or bruit was present. MRI shows a retro-orbital mass with enhancement. The likely diagnosis is:
A. AV malformations
B. Orbital encephalocoecle
C. Orbital varix
D. Neurofibromatosis

40. Thyroid ophthalmopathy is associated with all *except*:
A. External ophthalmoplegia
B. Internal ophthalmoplegia
C. Proptosis
D. Large extraocular muscle
E. Lid lag

41. A 19-year old young girl with previous history of repeated pain over medial canthus and chronic use of nasal decongestants, presented with abrupt onset of fever with chills and rigor, diplopia on lateral gaze, moderate proptosis and chemosis. On examination, optic disc is congested. Most likely diagnosis is:
A. Cavernous sinus thrombosis
B. Orbital cellulitis
C. Acute ethmoidal sinusitis
D. Orbital apex syndrome

42. A young man following RTA presented with proptosis and pain in right eye after four days. On examination, there is bruise on forehead and right eye. What is the diagnosis:
A. Cavernous sinus thrombosis
B. Internal carotid artery aneurysm
C. Caroticocavernous fistula
D. Fracture of sphenoid

43. A young adult presents with proptosis and pain in eye after 4 days of trauma to eye. Chemosis, conjunctival congestion and extraocular muscle palsy with inability to move eye are seen. Investigation of choice:
A. MRI
B. Digital subtraction angiography
C. CT
D. MR angiography

44. Blow out fracture of the orbit, most commonly leads to fracture of:
A. Posteromedial floor of orbit
B. Medial wall of orbit
C. Lateral wall of orbit
D. Roof of orbit

45. Most common cause of fracture of roof of orbit:
A. Blow on back of head
B. Blow on parietal bone
C. Blow on the forehead
D. Blow on the upper jaw

46. Which of the following signs is classic for CT scanning in Graves ophthalmopathy:
A. Nodular muscle enlargement
B. Solitary muscle enlargement
C. Fusiform muscle enlargement with sparing of tendoms
D. Kinking of extraocular muscles.

47. Vascular congestion over insertions of the rectus muscles (particularly lateral rectus) is seen in:
A. Lymphoma
B. Hemangioma
C. Graves ophthalmopathy
D. Trauma

34 : D 35 : C 36 : B 37 : B 38 : A, B and E 39 : C 40 : B 41 : A 42 : C 43 : B 44 : A 45 : A 46 : C 47 : C

Commonest cause of bilateral proptosis in children: *(AIPG 2011)*

a. Cavernous hemangioma
b. Chloroma
c. Fibrous histiocytoma
d. Rhabdomyosarcoma

Infection from the dangerous area of the face spreads to the cavernous sinus via which of the following veins? *(COMEDK 2015)*

A. Maxillary veins
B. Retromandibular veins
C. Superficial temporal vein
D. Ophthalmic veins

Paralysis of IIIrd, IVth and VIth cranial nerves with involvement of ophthalmic division of the Vth cranial nerve localizes the lesion to: *(AIPG 2010)*

A. Cavernous sinus
B. Apex of the orbit
C. Brainstem
D. Base of the skull

All of the following could result from infection with right cavernous sinus *except*: *(AIIMS 2003)*

A. Constricted pupil in response to light
B. Engorgement of retinal veins seen on ophthalmological examination
c. Ptosis of right eyelid
d. Right ophthalmoplegia

52. Most common type of optic nerve glioma is: *(AIIMS)*

A. Gemiocytic
B. Fibrous
C. Protoplasmic
D. Pilocytic

53. All of the following types of lymphoma may be seen in the orbit *except*: *(AIIMS 2003)*

A. Non-Hodgkin's lymphoma, mixed lymphocytic and histiocytic
B. Non-Hodgkin's lymphoma, poorly differentiated
C. Burkitt's lymphoma
D. Hodgkin's lymphoma

54. Mucin layer deficiency of tear film is seen in: *(AIIMS 2006)*

A. Keratoconjunctivitis sicca
B. Lacrimal gland removal
C. Canalicular block
D. Herpes zoster

55. Phenol red test for dry eye: True statement is: *(May AIIMS 2016)*

A. It requires topical anaesthesia
B. It measures the volume of tears as it changes colour on contact with tears
C. If colour changes to blue, it depicts mucin deficiency
D. It requires a pH meter

56. Parasitosis of extraocular muscles is seen in: *(DNB 2015)*

A. Trichinosis
B. Amoebiasis
C. Cysticercosis
D. Ascariasis

:B 49:D 50:A 51:A

52:D 53:D 54:A 55:B 56:C

CHAPTER

18

Ocular Injuries

QUICK TEXT REVIEW

MECHANICAL INJURIES

OCULAR TRAUMA TERMINOLOGIES

Birmingham eye trauma terminologies (BETT), as such adapted by 'American Ocular Trauma Society' (AOTS) terminology given below:

Eyewall: Cornea and Sclera

I. *Closed-globe injury:* No full thickness wound in eyewall, but there is intraocular damage

1. *Contusion.* Closed-globe injury with blunt trauma
2. *Lamellar laceration.* Closed-globe injury with partial thickness wound of eyewall cause by a sharp object or blunt trauma.

II. *Open-globe injury.* Full thickness wound of eyewall

1. *Rupture,* caused by blunt trauma
2. *Laceration,* caused by sharp object
   - Penetrating injury. One laceration (entry wound)
   - Perforating injury. Two laceration (one entry and one exit).

Intraocular foreign body. Technically penetrating injury with retained IOFB.

EXTRAOCULAR FOREIGN BODIES

Common sites: On the conjunctiva, it may be lodged in the sulcus subtarsalis, fornices or bulbar conjunctiva. In the cornea, it is usually embedded in the epithelium, or superficial stroma and rarely into the deep stroma.

CLOSED GLOBE TRAUMA

- *Partial corneal tears*
- *Blood staining of corneal* may occur occasionally from the associated hyphaema and raised intraocular pressure. Cornea becomes reddish-brown or greenish in colour, which clears very slowly from periphery toward centre. Blooc staining of cornea simulates dislocation of clea lens in the anterior chamber.
- *Iridodialysis* (detachment of iris from its root at the ciliary body): It results in a D-shaped pupil.
- *Antiflexion of the iris,* i.e. rotation of the detached portion of iris in which its posterior surface face anteriorly.
- *Retroflexion of the iris,* i.e. whole of the iris i doubled back into the ciliary region and become invisible.
- *Vossius's ring* is a circular ring of brown pigmen seen on the anterior capsule. It occurs due t striking of the contracted pupillary margin agains the crystalline lens.
- *Early rosette traumatic cataract* is most typica form of concussion cataract. It appears as feather lines of opacities along the star-shaped sutur lines; usually in the posterior cortex.
- *Late rosette-shaped traumatic cataract:* It develop in the posterior cortex 1–2 years after the injury. I sutural extensions are shorter and more compa than the early rosette cataract.
- *Ruptures of the choroid:* These are concentric to th optic disc and situated temporal to disc and loo like a whitish crescent with fine pigmentation its margins.
- *Commotio retinae (Berlin's oedema):* The traumat macular oedema manifests as milky whi cloudiness involving the posterior pole with 'cherry-red-spot' in the foveal region.
- *Chorio-retinitis sclopeteria,* i.e. chorioretin rupture with retinal haemorrhage.

OPEN GLOBE TRAUMA

Globe rupture

Full thickness wound of eyewall (sclera, corn or both) caused by blunt trauma. It may occur

) ways: direct rupture, at the site of injury and lirect rupture (because of compression force) its weakest part, 3 mm away and concentric the limbus in the neighbourhood of canal of ılemm.

ıetrating and perforating injuries

ıdes of damage include:

Mechanical effects. Uncomplicated/complicated eyewall wound

Intraocular infections. Purulent uveitis/endophthalmitis and panophthalmitis.

Traumatic iridocyclitis

Sympathetic ophthalmitis.

raocular foreign bodies

mmon foreign bodies

ips of iron and steel (90%), particles of glass, stone, d pellets, copper percussion caps, aluminium, stic and wood.

ctions of the foreign body

Inorganic foreign body

No reaction: Inert substances, glass, some plastics, porcelain, gold, silver, platinum, titanium and stone.

Local irritative reaction leading to encapsulation of the foreign body: Occurs with lead and aluminium particles.

Suppurative reaction is excited by pure copper, zinc, nickel and mercury particles.

Specific reactions are produced by iron and copper alloys (most toxic).

derosis bulbi

refers to the degenerative changes produced an iron foreign body. These usually occur after months to 2 years of the injury.

echanism. The iron particle undergoes electrolytic ssociation by the current of rest and its ions are sseminated throughout the eye. These ions mbine with the intracellular proteins and produce egenerative changes. In this process, the epithelial ructures of the eye are most affected.

linical manifestations include:

The anterior epithelium and capsule of the lens are involved first of all. Here, the rusty deposits are arranged radially in a ring. Eventually, the lens becomes cataractous.

Iris: It is first stained greenish and later on turns reddish-brown.

Retina develops pigmentary degeneration which resembles retinitis pigmentosa.

4. *Secondary open-angle type of glaucoma* occurs due to degenerative changes in the trabecular mesh-work.

Chalcosis

It refers to the specific changes produced by the alloy of copper in the eye.

Mechanism: Copper ions from the alloy are dissociated electrolytically and deposited under the membranous structures of the eye. Unlike iron ions these do not enter into a chemical combination with the proteins of the cells and thus produce no degenerative changes.

Clinical manifestations include:

1. *Kayser-Fleischer ring:* It is a golden brown ring which occurs due to deposition of copper under peripheral parts of the Descemet's membrane of the cornea.
2. *Sun-flower cataract:* It is produced by deposition of copper under the posterior capsule of the lens. It is brilliant golden green in colour and arranged like the petals of a sun-flower.
3. *Retina:* It may show deposition of golden plaques at the posterior pole which reflect the light with a metallic sheen.

b. Organic foreign bodies

The organic foreign bodies such as wood and other vegetative materials produce a proliferative reaction characterised by the formation of giant cells. Caterpillar hair produces ophthalmia nodosum which is characterised by a severe granulomatous iridocyclitis with nodule formation.

SYMPATHETIC OPHTHALMITIS

It is a serious bilateral granulomatous panuveitis, which follows a penetrating ocular trauma. The injured eye is called *exciting eye* and the fellow normal eye which also develops uveitis is called *sympathizing eye.*

Predisposing factors

1. It, almost always, follows a perforating wound.
2. Wounds in the ciliary region (the so-called dangerous zone) are more prone to it.
3. Wounds with incarceration of the iris, ciliary body or lens capsule are more vulnerable.
4. It is more common in children than in adults.
5. It does not occur when actual suppuration develops in the injured eye.

Pathology

Dalen-Fuch's nodules are formed due to proliferation of the pigment epithelium (of the iris, ciliary body and choroid) associated with invasion by the lymphocytes and epitheloid cells. Retina shows perivascular cellular infiltration (sympathetic perivasculitis).

Clinical features

Sympathizing (sound) eye: It is usually involved after 4–8 weeks of injury in the other eye. Sympathetic ophthalmitis almost always manifests as acute plastic iritis. Rarely, it may manifest as neuroretinitis or choroiditis.

- Sensitivity to light (photophobia) and transient indistinctness of near objects (due to weakening of accommodation) are the earliest symptoms.

Prophylaxis

Early excision of the injured eye is the best prophylaxis when there is no chance of saving useful vision. Meticulous repair and use of steroids, where eye can be salvaged.

NON-MECHANICAL INJURIES

CHEMICAL INJURIES

Alkali burns

- In general, alkali burns are much more dangerous than acid burns.
- Alkalies dissociate and saponify fatty acids of the cell membrane and, therefore, destroy the structure of cell membrane of the tissues.
- The strong acids cause instant coagulation of all the proteins which then act as barrier and prevent deeper penetration of the acids into the tissues.

RADIATIONAL INJURIES

1. *Ultraviolet radiations* may cause (i) photo-ophthalmia and (ii) may be responsible for senile cataract.
2. *Infrared radiations* may cause solar macular burns
3. *Ionizing radiational injuries* are caused following radiotherapy to the tumours in the vicinity of the eyes. The common ocular lesions include (i) radiation keratoconjunctivitis; (ii) radiation dermatitis of lid and (iii) radiation cataract.

MISCELLANEOUS POINTS

- *Common sites of rupture of the globe* are the limbus, the equator and especially under the rectus muscles, where the sclera in thinnest.
- Indication of early surgical intervention in traumatic cataract is secondary glaucoma.
- *Prolapsed iris* in perforating trauma should preferably be abscissed and not reposited because it will carry intraocular infection.
- *Foreign bodies* are the most common cause of eye injury.
- A piece of glass in the anterior chamber is exceptionally difficult to see because its transparency and refractive index differ little from the surrounding media.
- Intraocular foreign body of iron causes maximum damage to the eye.

MULTIPLE CHOICE QUESTIONS

In a worker engaged in stone breaking with a chisel and hammer, the most common foreign body which can be lodged in his eye is:
A. Stone particle
B. Particle from the chisel
C. Piece from the hammer
D. All of the above

In concussion trauma, damage to ocular structures is caused by:
A. Mechanical tearing of the tissues
B. Disruption of physiological activity by damage to tissue cells
C. Vascular damage leading to ischaemia
D. All of the above

After blood staining the cornea may look as:
A. Reddish brown in colour
B. Greenish in colour
C. Like a clear lens dislocated into the anterior chamber
D. Any of the above

All of the following are true about blood staining of the cornea *except*:
A. Its occurrence is hastened by the raised intraocular pressure
B. It clears from centre towards periphery
C. Its clearance may take 2 years or more
D. Visual prognosis is usually poor in such cases

Traumatic iridodialysis may cause:
A. Antiflexion of the iris
B. Retroflexion of the iris
C. Iridoplegia
D. All of the above

Rosette-shaped cataract most commonly involves:
A. Anterior cortex
B. Posterior cortex
C. Both of the above
D. None of the above

Traumatic cataract occurs as:
A. Rosette-shaped cataract
B. Zonular cataract
C. Total cataract
D. All of the above

Blunt trauma to the eye may produce all of the following changes in the vitreous *except*:
A. Syneresis
B. Asteroid hyalosis
C. Synchysis scintillans
D. Liquefaction

Diameter of the Vossius's ring is:
A. Equal to normal pupil
B. Smaller than the normal pupil
C. Slightly larger than the normal pupil
D. Much larger than the normal pupil

Rupture of sclera in ocular contusion is seen most commonly in:
A. Superonasal quadrant
B. Superotemporal quadrant
C. Inferonasal quadrant
D. Inferotemporal quadrant

Commonest type of concussion cataract is:
A. Punctate cataract
B. Early rosette-shaped cataract
C. Late rosette-shaped cataract
D. Zonular cataract

Prolapsed iris in perforating trauma should preferably be abscised and not reposited to prevent chances of:
A. Infection
B. Post-traumatic iridocyclitis
C. Sympathetic ophthalmitis
D. All of the above

Perforating injuries with retained intraocular foreign body are more serious than those without because of:
A. More chances of infection
B. Deleterious effects of foreign bodies
C. More chances of sympathetic ophthalmitis
D. All of the above

All of the following intraocular foreign bodies produce suppurative reaction *except*:
A. Pure zinc
B. Mercury
C. Copper alloys
D. Nickel

The earliest clinical manifestation of siderosis bulbi is:
A. Rusty deposits in the anterior subcapsular cells of the lens
B. Discolouration of iris
C. Deposits in Descemet's membrane of cornea
D. Pigmentary changes in retina

:B 2:D 3:D 4:B 5:A 6:B 9:B 10:A 11:A 12:A 13:B 14:C
:D 8:B 15:A

16. In siderosis bulbi the electrolytically dissociated iron ions:
A. Are deposited under the membranous structures of the eye
B. Combine with intraocular proteins and produce degenerative changes
C. Produce local irritative reaction at the site where deposited
D. All of the above

17. In chalcosis bulbi the electrolytically dissociated ions of copper are:
A. Deposited under the membraneous structures of the eye
B. Combine with intracellular proteins and produce degenerative changes
C. Produce irritative reaction at the local site
D. All of the above

18. Clinical manifestations of chalcosis include all of the following *except*:
A. Kayser-Fleischer ring
B. Sunflower cataract
C. Greenish discolouration of iris
D. Deposition of golden plaque at the posterior pole of the retina

19. The most toxic intraocular foreign body is a particle of:
A. Copper
B. Iron
C. Tantalum
D. Aluminium

20. All of the following are true about sympathetic ophthalmitis *except*:
A. It is a bilateral disease
B. Pathological features are of non-granulomatous panuveitis
C. Clinically manifests as non-granulomatous iridocyclitis
D. The non-injured eye developing uveitis is called sympathizing eye

21. Regarding occurrence of sympathetic ophthalmitis, all of the following are true *except*:
A. It almost always follows a perforating wound
B. Wounds in the ciliary region are more prone to it
C. More common in adults than in children
D. Less common when actual suppuration develops in the injured eye

22. Clinically in the non-injured eye, sympathetic ophthalmitis may manifest as:
A. Acute plastic iridocyclitis
B. Neuroretinitis
C. Choroiditis
D. All of the above

23. In sympathetic ophthalmitis, Dalen-Fuch's nodules are formed on the:
A. Iris
B. Ciliary body
C. Choroid
D. All of the above

24. The most serious alkali burns of the eye are produced by:
A. Strong liquid ammonia
B. Caustic soda
C. Lime
D. None of the above

25. All of the following are true of chemical burns of the eye *except*:
A. Acid burns are more serious than the alkali burns
B. Alkalies combine with lipids of cells to form soluble compounds, which produce a condition of softening and gelatinisation
C. Acids cause instant coagulation of all the proteins
D. Symblepharon is a distressing sequelae

26. In rosette-shaped cataract the suture act as backbone in:
A. Early-rosette cataract
B. Late-rosette cataract
C. Both of the above
D. None of the above

27. Orange-skin cornea results due to:
A. Chalcosis
B. Siderosis
C. Ammonia burn
D. Mustard gas

28. Most common site for the lodgement of intraocular foreign body is:
A. Vitreous
B. Posterior chamber
C. Lens
D. Anterior chamber

29. Best method of detection of retained glass intraocular foreign body is:
A. CT scan
B. Radiography
C. Ultrasonography
D. Tonography

30. Commotio retinae is seen in:
A. Concussion injury
B. Retinopathy of AIDS
C. Central vein thrombosis
D. Central artery thrombosis

16:B 17:A 18:C 19:A 20:B 21:C 22:D 23:C 24:A 25:A 26:A 27:D 28:A 29:A 30:A

. **Ruptured globe is suspected if there is:**
A. Proptosis
B. Subluxation of lens
C. Blow-out fracture
D. Chemosis, haemorrhage, decreased IOP

. **The incidence of retained intraocular foreign bodies is maximum with injuries due to:**
A. Bow and arrow
B. Chisel and hammer
C. Air-gun pellet
D. Glass

. **All are seen in blunt injury of the eye *except*:**
A. Hyphema
B. Iridocyclitis
C. Double perforation
D. Retinal detachment

. **Traumatic dislocation of lens is best diagnosed by:**
A. Direct ophthalmoscopy
B. Indirect ophthalmoscopy
C. Distant direct ophthalmoscopy
D. Slit-lamp examination

. **A 20-year-old man complains of difficulty in reading the newspaper with his right eye, three weeks after sustaining a gun shot injury to his left eye. The most likely diagnosis is:**
A. Macular oedema
B. Sympathetic ophthalmia
C. Optic nerve avulsion
D. Delayed vitreous haemorrhage

36. **Vossius ring is seen in:**
A. Cornea
B. Lens
C. Vitreous
D. Retina

37. **Dangerous area of eye:**
A. Ciliary body
B. Optic nerve
C. Sclera
D. Choroid

38. **Traumatic eye lesion can causes:**
A. Vitreous haemorrhage
B. Corneal opacity
C. Exudative retinal detachment
D. Glaucoma
E. Cataract

39. **A boy gets hit by a tennis ball in the eye following which he has complaints of decreased vision. Which of the following tells that blunt injury is due to the ball?**
A. Optic neuritis
B. Pars planitis
C. Vitreous base detachment
D. Equatorial oedema

40. **Common feature between sympathetic ophthalmitis and Vogt-Kanayagi-Harada syndrome:**
A. Autoimmune etiology
B. Injury
C. Uveitis
D. Vitiligo

:D 32:B 33:C 34:D 35:B 36:B 37:A 38:A, B, C, D and E 39:C 40:A and C

SECTION–IV

Ocular Therapeutics

CHAPTER

19

Ocular Pharmacology

QUICK TEXT REVIEW

NTRAOCULAR PENETRATION OF DRUGS

raocular penetration of topically instilled drugs

s mainly determined by the corneal epithelium ich is lipophilic and is crossed readily by non-lar drugs. Stroma being hydrophilic allows rapid ssage of the drug through endothelium into the terior chamber. Following features will allow ter penetration of the drug through the cornea:
Solubility both in water and fat
Pro-drug forms are lipophilic and after absorption through epithelium are converted into proper drugs which can easily pass through the stroma.
Wetting agents increase the drug absorption.

e intraocular penetration of systemically adminis-ed drugs

mainly depends upon the blood aqueous barrier. e two characteristics of the drugs which affect their ssage through the blood aqueous barrier are:
Low molecular weight
Lipid solubility (e.g. sulphonamides being lipid soluble are 16 times more permeable than sucrose having almost same molecular weight).

COMMON OCULAR PHARMACOTHERAPEUTICS

NTIVIRAL DRUGS

oxuridine (IDU, 5 Iodo-2 deoxyuridine)

Inhibits the synthesis of DNA by substituting for thymidine and thus prevents replication of virus
Used as 0.1% eye drops one hourly during day and 0.5% eye ointment at night for 10–21 days
Side effects: Follicular conjunctivitis, punctal stenosis.

denine arabinoside

Blocks synthesis of nucleic acids
About 3% ointment is applied 5 times a day for 14–21 days.

Cytosine-Arabinoside

- Not available commercially.

Trifluorothymidine

- DNA inhibitor like IDU
- Advantages over IDU are: higher solubility, greater potency, lack of toxicity and allergic reactions
- Dose: 1% drops 4 hourly for 14 days.

Acyclovir

- Effective in most forms of herpes simplex and herpes zoster
- Penetrates deep and so is very effective in stromal keratitis
- Dose: (i) Topically 3% ointment is used 5 times a day in patients with herpes zoster ophthalmicus and recalcitrant cases of herpes simplex.

Ganciclovir

- Used for CMV retinitis
- Dose: 5 mg/kg body weight every 12 hours for 2–3 weeks followed by maintenance dose of 5 mg/kg once daily.

Foscarnet

- As effective as ganciclovir in treating CMV retinitis with AIDS.

Zidovudine (Azidothymidine, AZT)

- Combined with immunoglobulins in treating HIV infection (AIDS).

ANTIFUNGAL DRUGS

I. Polyene antifungals

- Are isolated from streptomyces
- Act by binding to the sterol group in fungal cell membranes, rendering them permeable

1. *Nystatin*
- Fungistatic
- Effective against candida and aspergillus

- Poor intraocular penetraiton
- 3.5% eye ointment is used 5 times a day.

2. *Amphotericin B (Fungizone)*
- Effective against candida, histoplasma and cryptococcus
- Topically, effective as 0.75% to 0.3% drops in superficial corneal ulcers
- Intravitreal injection for fungal endophthalmitis
- Intravenously, it is used as 0.1 mg/mL in 5% dextrose for systemic infections.

3. *Natamycin (Pimaricin)*
- Broad spectrum antifungal (effective against candida, aspergillus, fusarium and cephalosporium).
- Drugs of choice for fusarium keratitis
- Used as 5% suspension.

II. Imidazole antifungal drugs

1. *Miconazole:* Broad spectrum fungicidal topically used as 1% solution.
2. *Clotrimazole:* Fungistatic, 1% suspension is effective against candida and aspergillus keratitis.
3. *Econazole:* Used as 1% econazole nitrate ointment.
4. *Ketoconazole:* Used in single oral dose of 200–400 mg daily in fungal keratitis and endophthalmitis.
5. *Fluconazole.*

III. Pyrimidine group

- *Flucytosine* used as 1.5% aqueous eye drops one hourly is very effective against candida and yeast infections.

IV. Silver compounds

- *Silver sulfadiazine* eye drops are effective against aspergillus and fusarium keratitis.

ANTIGLAUCOMA DRUGS

I. Miotics

Mechanisms of action

- *In primary open-angle glaucoma,* miotics lower the IOP by enhancing aqueous outflow facility by widening inter-trabecular pores due to a pull exerted on the scleral spur by contraction of the longitudinal fibres of ciliary muscle.
- *In primary angle-closure glaucoma,* the miotics open the angle by pulling the iris away from the trabecular meshwork.
- *Pilocarpine,* once the most commonly used antiglaucoma drugs, is sparingly used presently because of availability of better drugs.

Contraindications

Miotics are not useful in:
- Buphthalmos
- Epidemic dropsy glaucoma
- Glaucoma inversus
- Glaucomatocyclitic crisis
- Aphakic glaucoma
- Inflammatory glaucoma.

II. Sympathomimetic drugs

Mechanisms of action

- Decreased aqueous secretion due to stimulation of alpha receptors in the ciliary body
- Increased aqueous outflow due to stimulation of alpha and beta receptors.

Indications

- POAG—Preferred in the presence of systemic contraindication to beta-blocker
- Secondary glaucomas—Useful in most.

III. Beta adrenergic blockers

Mechanism of action

- Timolol and levobunolol reduce aqueous secretion by blockade of beta-2 receptors in the ciliary processes
- Mechanism of action of betaxolol (cardioselective beta-blocker) is unknown.

Indications

- In POAG and secondary glaucomas, it is the drug of first choice unless contraindicated due to systemic diseases
- In PACG, it is useful as a temporary adjunct.

Commonly used preparations

Timolol
- Non-selective beta-1 and beta-2 blocker
- Available as 0.25 and 0.5% eye drops
- Efficacy is very good; however, the phenomeno of 'short-term escape' (marked initial fal followed by a transient rise with continue moderate fall in IOP) and 'long-term drift' (slo rise in IOP after well controlled with months therapy) are seen.

Betaxolol
- Relative cardioselective beta-1 blocker (10 tim more affinity for beta-1 than beta-2 receptors), can be used in patients with bronchial asthma.
- Available as 0.25% and 0.5% eye drops.

ostaglandin derivatives

tanoprost (0.005%), an ester analogue of prostaglandin F_2-α, which increases uveoscleral outflow.

matoprost (0.03%), a prostamide, which creases ocular outflow resistance.

avoprost (0.004%), a synthetic prostaglandin F2 alogue that increases uveoscleral outflow.

ifluprost (0.0015%) is a newer prostaglandin erivative. Its IOP lowering efficacy is slightly ss, but it causes less disruption of ocular surface.

rbonic anhydrase inhibitors (CAI)

hanism of action

uce aqueous secretion by inhibiting the enzyme onic anhydrase.

cations

emic use (mainly acetazolamide)

lsed as additive therapy for short term in all types f acute glaucomas

ong-term use is reserved for patients with high isk of visual loss, not responding to other modes f therapy.

pical use. CAIs are used as second line of drug d also as adjunct therapy. Preparations include:

Dorzolamide (2%), TDS.

Brinzolamide (1%), BD.

Hyperosmotic agents

chanism of action

crease the osmotic pressure gradient between the od and vitreous and thus draw sufficient water t of the eyeball, thereby lowering IOP.

ications

For rapidly lowering of the acutely raised IOP as in primary acute congestive glaucomas or secondary acute glaucomas.

As a prophylactic measure prior to intraocular surgery.

e effects

Cardiovascular overload

Headache and backache

Urinary retention

Nausea

Mental confusion.

eparations

ycerol

An oral hyperosmotic agent with sweet and sickening taste

- Dose: 1–1.5 g/kg body weight, used as 50% solution, therefore, dose is 50–80 mL mixed with equal amount of lemon juice
- Action peaks in 1 hour and lasts for 4–6 hours
- Metabolised to glucose and so repeated use in diabetes is not recommended.

Mannitol

- Dose: 1–2 g/kg body weight or 5–10 mL/kg body weight of 20% solution in water
- Should be administered intravenously very rapidly over 20–30 minutes
- Action peaks in 30 minutes and lasts for 6 hours.

Antiglaucoma drugs: Mechanism of lowering IOP at a glance

Drugs which increase trabecular outflow

- Miotics (e.g. pilocarpine)
- Epinephrine, dipivefrine
- Bimatoprost.

Drugs which increase uveoscleral outflow

- Prostaglandins (latanoprost)
- Epinephrine, dipivefrine
- Brimonidine
- Apraclonidine.

Drugs which decrease aqueous production

- *Carbonic anhydrase inhibitors* (e.g. acetazolamide, dorzolamide)
- *Alpha receptor stimulators* in ciliary process (e.g. epinephrine, dipivefrine, clonidine, brimonidine, apraclonidine
- *Beta-blockers* (e.g. timolol, betaxolol, levobunolol)
- *Hyperosmotic agents* (e.g. glycerol, mannitol, urea).

ANTI-VASCULAR ENDOTHELIAL GROWTH FACTOR AGENTS (ANTI-VEGF)

The vascular endothelial growth factors (VEGF-A) are the key factors blamed for producing neovascularization disorders, e.g. choroidal neovascularization (wet ARMD), retinal neovascularization (diabetic retinopathy, sickle cell retinopathy, neovascular glaucoma in CRVO, etc.). There are 9 isoforms of VEGF-A of which VEGF-165 is the most abundantly expressed but all isoforms are thought to contribute to ocular angiogenesis.

Preparations of anti-VEGF

Antivascular endothelial growth factor (anti-VEGF) agents, which have revolutionized the treatment of

ocular diseases associated with neovascularization include:

- Ranibizumab (Lucentis),
- Pegaptanib (Macugen), and
- Bevacizumab (Avastin).

Ranibizumab

Ranibizumab (marketed as Lucentis by Genentech, USA) is a humanized monoclonal antibody fragment (fab). Its production is by an *E. coli* expression system in a nutrient medium. Its molecular weight is 48 KD and it has a short half-life of 2 hours.

Mechanism of action. Ranibizumab binds to all isoforms of VEGF-A and inhibits their biological activity.

Dose. It is the only FDA approved non-selective anti-VEGF agent for the treatment of choroidal neovascularization or as multiple intravitreal injection (every 8 weeks) in the dose of 0.5 mg/0.05 mL. Available as 0.23 mL vial containing 10 mg/mL of the drug.

Pegaptanib

Pegaptanib (marketed as Macugen by Eyetech Pharmaceuticals, USA) is a pegylated aptamer (i.e. an oligonucleotide with polyethylene glycol covalently attached). Its molecular weight is 50 KD.

Mechanism of action. It binds with high affinity to VEGF-165 isoform of VEGF-A and inhibits its activity thereby inhibiting angiogenesis.

Intravitreal dose is 0.3 mg in 90 mL (multiple injections every 6 weeks).

Bevacizumab

Bevacizumab (marketed as Avastin by Gentech, USA) is a full length recombinant humanized monoclonal antibody (IgG1) against VEGF-A. Its molecular weight is 149 KD. In contrast to ranibizumab, bevacizumab is a complete antibody originally developed to target the blood vessel growth in metastatic cancer deposits. It is currentl approved for colorectal cancers as an intravenou injection. Its off-label use in ocular neovascula disorders, e.g. wet ARMD have shown its effectivity

Mechanism of action. It binds to all isoforms o VEGF-A and inhibits their activity.

Intravitreal dose. It is available as 4 mL via containing 100 mg of the drug. Its intravitreal dos is 1.25 mg (0.05 mL).

Uses of anti-VEGF agnets

Uses of anti-VEGF agents include neovascular age-related macular degeneration (common indication) diabetic retinopathy, retinal veinocclusion, neovas-cular glaucoma, myopic CNV, inflammatory CNV choroidal osteoma, juxtafoveal telangiectasia, ROP idiopathic polypoidal choroidopathy, pseudophakic cystoid oedema and central serous retinopathy.

Complications of anti-VEGFs

Complications of anti-VEGFs intravitreal injections include cataract, glaucoma, vitreous haemorrhage, endophthalmitis, retinal detachment, etc.

MISCELLANEOUS POINTS

- Tropicamide is the *fastest acting cycloplegic* drug.
- Sulfonamides are most commonly known to cause Stevens-Johnson syndrome.
- Topical steroids are contraindicated in superficial viral keratitis, bacterial corneal ulcer, fungal corneal ulcer.
- Intraocular permeability of the topically instilled drugs is mainly determined by the epithelium o cornea.
- Phenylephrine (10%) drops should not be used in neonates, cardiac patients and patients receiving antidepressants.

MULTIPLE CHOICE QUESTIONS

Intraocular penetration of topically-instilled drugs is mainly determined by the corneal:
A. Epithelium
B. Endothelium
C. Stroma
D. Bowman's and Descemet's membrane

The antiviral drug used for treatment of cytomeglovirus retinitis is:
A. Acyclovir
B. Ganciclovir
C. Trifluorothymidine
D. All of the above

In primary open-angle glaucoma pilocarpine eye drops lowers the intraocular pressure by its direct action on the:
A. Trabecular meshwork
B. Ciliary epithelium
C. Longitudinal fibres of the ciliary muscle
D. All of the above

In primary angle-closure glaucoma pilocarpine lowers the intraocular pressure by its direct action on the:
A. Sphincter pupillae muscle
B. Ciliary epithelium
C. Trabecular meshwork
D. All of the above

Steroid-induced ocular complication is:
A. Glaucoma
B. Papilloedema
C. Central retinal vein occlusion
D. All of the above

The technique of blocking the facial nerve at the neck of mandible is:
A. Van Lint's block
B. O'Brien's block
C. Nadbath block
D. Atkinson's block

Retrobulbar injection of xylocaine blocks all of the following *except*:
A. 3rd cranial nerve
B. 4th cranial nerve
C. 6th cranial nerve
D. Ciliary nerves and ciliary ganglion

Absolute indication of enucleation is:
A. Intraocular retinoblastoma
B. Endophthalmitis
C. Mutilating ocular injury
D. All of the above

9. Pilocarpine is not used in young adults as it causes:
A. Myopia
B. Cystic blebs of iris
C. Fatigue reaction
D. Allergy with circumcorneal congestion

10. Drugs used in treatment of herpes simplex keratitis include all *except*:
A. Idoxuridine 0.1%
B. 5-Fluorouracil
C. Adenosine arabinoside
D. Cytosine arabinoside
E. Pimarcin

11. In atropine instillation, all are seen *except*:
A. Dilated pupil
B. Paralysis of accommodation
C. Increased water content to tear
D. Decreased water content to tear

12. Near vision is not affected with:
A. Atropine
B. Adrenaline
C. Homatropine
D. Pilocarpine

13. In a patient predisposed to glaucoma, the drug contraindicated is:
A. Pilocarpine
B. Ecothiopate
C. Timolol
D. None of the above

14. Main disadvantage of cocaine as local anaesthetic was:
A. Causes dry eyes
B. Follicular conjunctivitis
C. Intraocular penetration
D. Epithelial erosions

15. Combination of pilocarpine and epinephrine use in glaucoma treatment may inhibit:
A. Pigmented pupillary cyst
B. Retinal detachment
C. Vitreous haemorrhage
D. Iridocyclitis

16. Concentration of tropicamide: ***(AIIMS 2013)***
A. 0.01
B. 0.02
C. 0.03
D. 0.05

17. Mydriatic to be used in a 3-year-old child for refraction: ***(Maharashtra PG)***
A. 1% Atropine drops
B. 1% Atropine eye ointment
C. 0.5% Tropicamide eye drops
D. 2% Homatropine eye drops

2:B 3:C 4:A 5:D 6:B 8:A
9:A 10:E 11:D 12:B 13:D 14:D 15:A 16:D 17:B

CHAPTER

20

Lasers and Cryotherapy in Ophthalmology

QUICK TEXT REVIEW

LASERS IN OPHTHALMOLOGY

Types of lasers are summarised in Table 20.1

Table 20.1: Lasers used in ophthalmology

Type of laser	*Wavelength (nanometer)*	*Atomic environment used*	*Effects produced*	*Clinical uses*
Argon	488 (Blue) 514 (Green)	Argon gas	Photocoagulation	Diabetic retinopathy
Krypton	647	Krypton gas	Photocoagulation	Peripheral retinal vascular abnormalities such as Eales' disease, proliferative sickle cell disease, Coat's disease and retinopathy of prematurity
Diode	810	Diode crystal	Photocoagulation	Intraocular tumours such as retinoblastoma, malignant haemangioma
nd-YAG	1064 (near infrared)	A liquid dye, or a solid compound of yttrium aluminium garnet and neodymium	Photodisruption	Capsulotomy, iridotomy
Excimer	193	Helium and florine gas	Photoablation	Refractive corneal surgery (LASIK) Phototherapeutic Keratectomy (PTK)
Helium neon	633 (red)			Used as low power aiming beam for other lasers
Femtosecond	1053	Neodymium-glass	Photodisruption	Femto-LASIK Femto-cataract surgery

CRYOSURGERY IN OPHTHALMOLOGY

Principle

Working of cryoprobes is based on the Joule-Thompson principle of cooling.

Cryounit and probe

The cryounit uses freon, nitrous oxide or carbon-dioxide gas as cooling agent. Temperature produced depends upon the size of the cryoprobe tip, duration of freezing process and the gas used.

- Temperature produced at the tip of cryoprobe
  - For intracapsular cataract extraction is about -40°C
  - For cyclocryopexy is about -80°C
  - For cryoretinopexy in retinal detachment surgery is about -70°C.

Uses

1. *Lids:* (i) Cryolysis for trichiasis, (ii) Cryotherapy fo warts and molluscum contagiosum, (iii) Cryotherap for basal cell carcinoma and haemangioma.
2. *Conjunctiva:* Cryotherapy is used for hypertrophie papillae of vernal catarrh.
3. *Lens:* Cryoextraction of the lens is the best intracapsular technique.
4. *Ciliary body:* Cyclocryopexy for absolute glaucom and neovascular glaucoma.
5. *Retina:* (i) Cryopexy is widely used for sealin retinal holes in retinal detachment, (ii) Prophylacti cryopexy to prevent retinal detachment i certain prone cases, (iii) Retinal cryopexy fo neovascularization, (iv) Cryo-treatment of retino blastoma and angioma.

MULTIPLE CHOICE QUESTIONS

In the laser machines used in ophthalmology, the atomic environment used consists of:
A. Crystal rod
B. Fluid-filled cavity
C. Gas-filled cavity
D. Any of the above

Photo disruption is the basic mechanism of action of:
A. Argon laser
B. Nd: YAG laser
C. Excimer laser
D. All of the above

Photoablation is the basic mechanism of action of:
A. Argon laser
B. Nd:YAG laser
C. Excimer laser
D. All of the above

All of the following are indications of pan retinal photocoagulation *except*:
A. Pre-proliferative diabetic retinopathy
B. Proliferative diabetic retinopathy
C. Ischaemic central retinal vein occlusion
D. Central retinal artery occlusion

Laser photocoagulation is useful in all of the following macular disorders *except*:
A. Exudative age-related macular degeneration
B. Central serous retinopathy
C. Focal type of diabetic maculopathy
D. Aphakic cystoid macular oedema

6. Excimer laser is used in the correction of:
A. Myopia
B. Hypermetropia
C. Astigmatism
D. All of the above

7. Type of laser used for capsulotomy is:
A. CO_2
B. Ruby
C. Nd:YAG
D. Argon

8. YAG laser is used in the treatment of:
A. Retinal detachment
B. Diabetic retinopathy
C. Open-angle glaucoma
D. After cataract

9. Argon laser is used in all *except*:
A. Retinal detachment
B. Retinitis pigmentosa
C. Retinal vein occlusion
D. Eales' disease

10. Excimer laser is used in:
A. Glaucoma
B. Cataract
C. Uveitis
D. Diabetic retinopathy
E. None of the above

11. Wavelength of ND: Yag laser:
A. 1040 nm
B. 1040 mm
C. 1040 cm
D. 1040 m

D 2:B 3:C 4:D 5:D 6:D 7:C 8:D 9:B 10:E 11:A

CHAPTER

20

Lasers and Cryotherapy in Ophthalmology

QUICK TEXT REVIEW

LASERS IN OPHTHALMOLOGY

Types of lasers are summarised in Table 20.1

Table 20.1: Lasers used in ophthalmology

Type of laser	*Wavelength (nanometer)*	*Atomic environment used*	*Effects produced*	*Clinical uses*
Argon	488 (Blue) 514 (Green)	Argon gas	Photocoagulation	Diabetic retinopathy
Krypton	647	Krypton gas	Photocoagulation	Peripheral retinal vascular abnormalities such as Eales' disease, proliferative sickle cell disease, Coat's disease and retinopathy of prematurity
Diode	810	Diode crystal	Photocoagulation	Intraocular tumours such as retinoblastoma, malignant haemangioma
nd-YAG	1064 (near infrared)	A liquid dye, or a solid compound of yttrium aluminium garnet and neodymium	Photodisruption	Capsulotomy, iridotomy
Excimer	193	Helium and florine gas	Photoablation	Refractive corneal surgery (LASIK) Phototherapeutic Keratectomy (PTK)
Helium neon	633 (red)			Used as low power aiming beam for other lasers
Femtosecond	1053	Neodymium-glass	Photodisruption	Femto-LASIK Femto-cataract surgery

CRYOSURGERY IN OPHTHALMOLOGY

Principle

Working of cryoprobes is based on the Joule-Thompson principle of cooling.

Cryounit and probe

The cryounit uses freon, nitrous oxide or carbon-dioxide gas as cooling agent. Temperature produced depends upon the size of the cryoprobe tip, duration of freezing process and the gas used.

- Temperature produced at the tip of cryoprobe
  - For intracapsular cataract extraction is about -40°C
  - For cyclocryopexy is about -80°C
  - For cryoretinopexy in retinal detachment surgery is about -70°C.

Uses

1. *Lids:* (i) Cryolysis for trichiasis, (ii) Cryotherapy fo warts and molluscum contagiosum, (iii) Cryotherap for basal cell carcinoma and haemangioma.
2. *Conjunctiva:* Cryotherapy is used for hypertrophie papillae of vernal catarrh.
3. *Lens:* Cryoextraction of the lens is the best intracapsular technique.
4. *Ciliary body:* Cyclocryopexy for absolute glaucom and neovascular glaucoma.
5. *Retina:* (i) Cryopexy is widely used for sealin retinal holes in retinal detachment, (ii) Prophylacti cryopexy to prevent retinal detachment i certain prone cases, (iii) Retinal cryopexy fo neovascularization, (iv) Cryo-treatment of retino blastoma and angioma.

MULTIPLE CHOICE QUESTIONS

In the laser machines used in ophthalmology, the atomic environment used consists of:
A. Crystal rod
B. Fluid-filled cavity
C. Gas-filled cavity
D. Any of the above

Photo disruption is the basic mechanism of action of:
A. Argon laser
B. Nd: YAG laser
C. Excimer laser
D. All of the above

Photoablation is the basic mechanism of action of:
A. Argon laser
B. Nd:YAG laser
C. Excimer laser
D. All of the above

All of the following are indications of pan retinal photocoagulation *except*:
A. Pre-proliferative diabetic retinopathy
B. Proliferative diabetic retinopathy
C. Ischaemic central retinal vein occlusion
D. Central retinal artery occlusion

Laser photocoagulation is useful in all of the following macular disorders *except*:
A. Exudative age-related macular degeneration
B. Central serous retinopathy
C. Focal type of diabetic maculopathy
D. Aphakic cystoid macular oedema

6. Excimer laser is used in the correction of:
A. Myopia
B. Hypermetropia
C. Astigmatism
D. All of the above

7. Type of laser used for capsulotomy is:
A. CO_2
B. Ruby
C. Nd:YAG
D. Argon

8. YAG laser is used in the treatment of:
A. Retinal detachment
B. Diabetic retinopathy
C. Open-angle glaucoma
D. After cataract

9. Argon laser is used in all *except*:
A. Retinal detachment
B. Retinitis pigmentosa
C. Retinal vein occlusion
D. Eales' disease

10. Excimer laser is used in:
A. Glaucoma
B. Cataract
C. Uveitis
D. Diabetic retinopathy
E. None of the above

11. Wavelength of ND: Yag laser:
A. 1040 nm
B. 1040 mm
C. 1040 cm
D. 1040 m

D 2:B 3:C 4:D 5:D 6:D 7:C 8:D 9:B 10:E 11:A

SECTION—V

Systemic and Community Ophthalmology

CHAPTER

21

Systemic Ophthalmology

QUICK TEXT REVIEW

OCULAR MANIFESTATIONS OF SYSTEMIC DISEASES

OCULAR MANIFESTATIONS OF NUTRITIONAL DEFICIENCIES

Vitamin-A deficiency

Xerophthalmia is the term now reserved to cover all the ocular manifestations of vitamin A deficiency which has been classified by WHO (1982).

Night blindness is the earliest symptom of xerophthalmia in children.

A revised schedule of vitamin 'A' supplements for prophylaxis being followed in India since August 1992 under the programme, named as 'child survival and safe motherhood (CSSM), is as follows:

- First dose (1 lac IU)—at 9 months of age along with measles, vaccination.
- Second dose (2 lac IU)—at 1½ years of age along with booster dose of DPT/OPV.
- Third dose (2 lac IU)—at the age of 2 years.

Deficiency of vitamin B1 (thiamine)

It can cause corneal anaesthesia, conjunctival and corneal dystrophy, acute retrobulbar neuritis and external ophthalmoplegia.

Deficiency of vitamin B2 (Riboflavin)

It can produce photophobia and burning sensation in the eyes due to conjunctival irritation and vascularisation of the cornea.

Deficiency of vitamin C

It may be associated with haemorrhages in the conjunctiva, lids, anterior chamber, retina and orbit. It also delays wound healing.

Deficiency of vitamin D

It may be associated with zonular cataract, papilloedema and increased lacrimation.

OCULAR MANIFESTATIONS OF IMMUNOLOGICAL DISORDER

1. *Rheumatoid arthritis*
   - 'Dry eye' episcleritis
   - Scleritis
   - Iridocyclitis
   - Corneal melting
   - Cataract.
2. *Systemic lupus erythematosus*
   - Episcleritis
   - Iritis
   - Retinopathy.
3. *Giant cell arteritis*
   - Extraocular muscle palsies
   - Anterior ischaemic optic neuropathy.
4. *Sarcoidosis*
   - Enlargement of lacrimal gland
   - Iridocyclitis
   - Retinal periphlebitis.
5. *Reiter syndrome*
   - Conjunctivitis
   - Uveitis
   - Retinal vasculitis.
6. *Periarteritis nodosa*
   - Episcleritis
   - Extraocular muscle palsy
   - Uveitis
   - Retinal haemorrhage
   - Papilloedema.

7. *Vogt-Koyanagi-Harada syndrome*
   - Poliosis
   - Uveitis
   - Choroiditis
   - Exudative retinal detachment.
8. *Multiple endocrine neoplasia* (MENIIb)
   - Mucosal neuromas of the lid and conjunctiva
   - Medullated nerve fibres in the cornea.

OCULAR MANIFESTATIONS OF HAEMATOLOGICAL DISEASES

1. *Lymphocytic leukaemia*
   - Proptosis
   - Iris nodules
   - Retinal oedema
   - Haemorrhages
   - Leukaemic infiltrates
   - Roth spots.
2. *Myeloid leukaemia*
   - Orbital chloroma
   - Haemorrhages
   - Peripheral retinal neovascularisation.
3. *Lymphomas*
   - Lid/orbital deposits
   - Uveitis.
4. *Sickle cell anemia*
   - Dilated conjunctival vessels
   - Retinal capillary occlusion
   - Neovascularisation of retina
   - Chorioretinal scars.

OCULAR MANIFESTATIONS OF INFECTIOUS DISEASES

I. Viral

1. *Herpes simplex*
   - Vesicles on the lids
   - Dendritic keratitis
   - Uveitis
   - Acute retinal necrosis.
2. *Measles:*
   - Catarrhal conjunctivitis
   - Koplik's spots on conjunctiva
   - Corneal ulceration
   - Optic neuritis
   - Retinitis.
3. *Mumps:*
   - Conjunctivitis
   - Acute dacryoadenitis
   - Keratitis
   - Uveitis.
4. *Rubella:*
   - Congenital microphthalmos
   - Congenital cataract
   - Congenital glaucoma
   - Chorioretinitis
   - Optic atrophy.
5. *Whooping cough:*
   - Subconjunctival haemorrhage
   - Rarely orbital haemorrhage leading to proptosis.
6. Acquired immune deficiency syndrome
- *Retinal microvasculopathy:* It is characterised by multiple cotton wool patches, superficial and deep haemorrhages. Micro-aneurysms and telangiectasia occur rarely.
- *Usual ocular infections* which occur with greater frequency and produce more severe infections in patients with AIDS include: herpes zoster ophthalmicus, herpes simplex infections, toxoplasmosis, syphilis and fungal corneal ulcers.
- *Opportunistic infections of the eye:* Cytomegalovirus (CMV) retinitis, candida endophthalmitis, cryptococcal infections and *Pneumocystis carinii* choroiditis.
- *Unusual neoplasms* are Kaposi's sarcoma of the lids or conjunctiva and Burkitt's lymphoma of the orbit.
- *Neuro-ophthalmic lesions* include isolated or multiple cranial nerve palsies.

II. Fungal

1. *Candida and cryptococcus*
   - Conjunctivitis
   - Keratitis
   - Retinitis
   - Endophthalmitis
   - Papilloedema
   - Optic atrophy.

III. Bacterial

1. *Tuberculosis*
   - Phlyctenular conjunctivitis
   - Granulomatous uveitis
   - Juxtapapillary choroiditis
   - Serpiginous choroiditis.
2. *Leprosy*
   - Facial palsy
   - Madarosis
   - Corneal deposits
   - Iris pearls
   - Iritis
   - Secondary glaucoma
   - Cataract.

HACOMATOSIS

'eurofibromatosis I

Plexiform neurofibromas on the eyelids (S-shaped eyelid)
Enlarged corneal nerves
Congenital glaucoma
Congenital ectropion uveae
Lisch nodules
Choroidal naevus
Retinal astrocytoma
Optic nerve glioma
Spheno-orbital encephalocoele.

'eurofibromatosis II

Posterior subcapsular cataract
Hamartomas of retinal pigment epithelium and retina.

turge-Weber syndrome

Episcleral haemangioma
Iris heterochromia
Ipsilateral glaucoma.

uberous sclerosis

Atypical iris coloboma
Iris hypopigmentation
Retinal astrocytoma.

'on Hippel-lindau syndrome

Retinal haemangiomas
Optic nerve haemangioma.

lyasthenia gravis

Bilateral ptosis
Extraocular muscle weakness leading to diplopia
Nystagmoid movements.

lyotonic Dystrophy

Bilateral ptosis
Pupillary light near dissociation
Presenile cataract (Christmas tree cataract)
Pigmentary retinopathy
Low pressure.

lultiple sclerosis

Retrobulbar neuritis
Internuclear ophthalmoplegia
Nystagmus
Extraocular muscle palsies
Intermediate uveitis.

larfan syndrome

High myopia
Megalocornea
Keratoconus
Cornea plana
Angle anomaly and glaucoma
Ectopia lentis
Microspherophakia
Retinal detachment.

OCULAR ABNORMALITIES IN TRISOMIES

Trisomy 13 (D Trisomy or Patau Syndrome)

- Microphthalmos
- Colobomas (almost 100%)
- Retinal dysplasia
- Cataract
- Corneal opacities
- Optic nerve hypoplasia
- Cyclopia
- Intraocular cartilage.

Trisomy 18 (E trisomy or Edwards syndrome)

- Blepharophimosis
- Ptosis
- Epicanthal fold
- Hypertelorism
- Microphthalmos
- Uveal coloboma
- Congenital glaucoma
- Corneal opacities.

Trisomy 21 (G Trisomy or Down's syndrome)

- Upward slanting palpebral fissure (Mongoloid slant)
- Almond-shaped palpebral fissure
- Epicanthus
- Telecanthus
- Narrowed interpupillary distance
- Esotropia (35% cases)
- High refractive errors
- Cataract
- Iris hypoplasia
- Keratoconus.

Ocular abnormalities in chromosomal deletion syndromes

Cri-du-Chat syndrome (5 p.)

- Hypertelorism
- Epicanthus
- Antimongoloid slant
- Strabisums.

Cri-du-Chat syndrome (11 p.)

- Aniridia
- Glaucoma
- Foveal hypoplasia
- Nystagmus
- Ptosis.

Cri-du-Chat syndrome (13 q.)

- Retinoblastoma
- Hypertelorism
- Microphthalmos
- Epicanthus
- Ptosis

- Coloboma
- Cataract.

De Grouchy syndrome (18 q.)

- Hypertelorism
- Epicanthus
- Ptosis
- Strabismus
- Myopia
- Glaucoma
- Microphthalmos (with or without cyst)
- Coloboma
- Optic atrophy
- Corneal opacity.

Turner syndrome (XO)

- Antimongoloid slant
- Epicanthus
- Ptosis
- Strabismus
- Blue sclera
- Eccentric pupils
- Cataract
- Colour blindness
- Pigmentary disturbances of fundus.

ADVERSE OCULAR EFFECTS OF COMMON SYSTEMIC DRUGS

CVS drugs

- *Digitalis:* Disturbance of colour vision, scotomas
- *Quinidine:* Optic neuritis (rare)
- *Thiazides:* Xanthopsia (yellow vision), Myopia
- *Carbonic anhydrase inhibitors:* Ocular hypotony, Transient myopia
- *Amiodarone:* Corneal deposits
- *Oxprenolol:* Photophobia, Ocular irritation.

GIT drugs

- *Anticholinergic agents:* Risk of angle-closure glaucoma due to mydriasis, blurring of vision due to cycloplegia (Occasional).

CNS drugs

- *Barbiturates:* Extraocular muscle palsies with diplopia, ptosis, cortical blindness
- *Chloral hydrate:* Diplopia, Ptosis, Miosis
- *Phenothiazines:* Deposits of pigment in conjunctiva, cornea, lens and retina, oculogyric crisis
- *Amphetamines:* Widening of palpebral fissure, dilatation of pupil, paralysis of ciliary muscle with loss of accommodation
- *Monoamine oxidase inhibitors:* Nystagmus, extraocular muscle palsies, optic atrophy
- *Tricyclic agents:* Pupillary dilatation (glaucor risk), cycloplegia
- *Phenytoin:* Nystagmus, diplopia, ptosis, sligh blurring of vision (rare)
- *Neostigmine:* Nystagmus, miosis
- *Morphine:* Miosis
- *Haloperidol:* Capsular cataract
- *Lithium carbonate:* exophthalmos, oculogyric cris
- *Diazepam:* Nystagmus.

Hormones

Female sex hormones

- Retinal artery thrombosis
- Retinal vein thrombosis
- Papilloedema
- Ocular palsies with diplopia
- Nystagmus
- Optic neuritis and atrophy
- Retinal vasculitis
- Scotomas
- Migraine
- Mydriasis
- Cyloplegia
- Macular oedema.

Corticosteroids

- Cataract (posterior subcapsular)
- Local immune suppression causing susceptibility to viral (herpes simplex), bacterial and fungal infection
- Steroid-induced glaucoma.

Antibiotics

- *Chloramphenicol:* Optic neuritis and optic atrophy
- *Streptomycin:* Optic neuritis
- *Tetracycline:* Pseudotumour cerebri, transient myopia.

Antimalarial

Chloroquine

- Macular changes (Bull's eye maculopathy)
- Central scotomas
- Pigmentary degeneration of the retina
- Chloroquine keratopathy
- Ocular palsies
- Ptosis
- Electroretinographic depression.

Amoebicides

- *Diiodohydroxyquinoline:* Subacute myelo-optic neuropathy (SMON), optic atrophy.

Chemotherapeutic agents

- *Sulfonamides:* Stevens-Johnson syndrome
- *Ethambutol:* Optic neuritis and atrophy
- *Isoniazid:* Optic neuritis and optic atrophy.

Heavy metals

- *Gold salts:* Deposits in the cornea and conjunctiva
- *Lead:* Optic atrophy, papilloedema, ocular palsies.

Chelating agents

- *Penicillamine:* Ocular pemphigoid, ocular neuritis, ocular myasthenia.

Oral hypoglycaemic agents

- *Chloropropamide:* Transient change in refractive error, diplopia, Stevens-Johnson syndrome.

Vitamins

Vitamin A

- Papilloedema
- Retinal haemorrhages
- Loss of eyebrows and eyelashes
- Nystagmus
- Diplopia and blurring of vision.

Vitamin D

- Band-shaped keratopathy.

Antirheumatic agents

- *Salicylates:* Nystagmus, retinal haemorrhages, cortical blindness (rare)
- *Indomethacin:* Corneal deposits
- *Phenylbutazone:* Retinal haemorrhages.

MISCELLANEOUS POINTS

- Most common ocular involvement in sarcoidosis is iritis.
- The most common ocular finding in AIDS patients is iritis and the most common fundus finding is cotton wool spots.
- The commonest ocular finding in anaemia is pallor of conjunctiva.
- Diabetes is the most common cause of cotton wool spots.
- Toxoplasmosis is the most common cause of posterior uveitis.
- The major cause of blindness in leprosy is iritis
- The most common ocular manifestation of multiple sclerosis is retrobulbar neuritis.
- Ocular signs in SLE are marginal corneal degeneration, episcleritis, scleritis, retinal haemorrhages and cotton-wool retinal exudates.
- Pupillary abnormalities in tabes dorsalis include spinal miosis, anisocoria and Argyll-Robertson pupil.
- Most commonly involved cranial nerve in fracture base of the skull is facial nerve.
- The commonest ocular sign of hypothyroidism is cataract.
- Dalrymple's sign is the commonest lid sign of Graves' ophthalmopathy.
- The commonest feature of Waardenburg's syndrome is lateral displacement of both medial canthi and lacrimal puncta.
- The commonest ocular infection associated with AIDS is CMV retinitis.
- Ocular complications associated with pregnancy are worsening of diabetic retinopathy, ptosis, central serous retinopathy, ophthalmoplegia.

MULTIPLE CHOICE QUESTIONS

1. **Ocular manifestations of vitamin D deficiency include:**
   A. Zonular cataract
   B. Papilloedema
   C. Increased lacrimation
   D. All of the above

2. **As per WHO classification 'X2' stage of xerophthalmia refers to:**
   A. Conjunctival xerosis
   B. Bitot's spots
   C. Corneal xerosis
   D. Corneal ulceration

3. **Earliest feature of xerophthalmia is:**
   A. Night blindness
   B. Conjunctival xerosis
   C. Bitot's spots
   D. Dry eye

4. **Ocular lesions of rubella include all of the following *except*:**
   A. Congenital megalocornea
   B. Congenital cataract
   C. Congenital glaucoma
   D. Optic atrophy

5. **All of the following ocular lesions may occur in patients suffering from AIDS *except*:**
   A. Central toxoplasma chorioretinitis
   B. Central serous retinopathy
   C. CMV retinitis
   D. Candida endophthalmitis

6. **Ocular lesions of gout include all of the following *except*:**
   A. Episcleritis
   B. Scleritis
   C. Keratitis
   D. Uveitis

7. **Atopic dermatitis may be associated with:**
   A. Conjunctivitis
   B. Keratoconus
   C. Cataract
   D. All of the above

8. **Isolated painful third nerve palsy is a feature of aneurysms of:**
   A. Posterior communicating artery
   B. Anterior communicating artery
   C. Vertebrobasilar artery
   D. Ophthalmic artery

9. **Which of the following is ocular false localising sign of raised intracranial pressure?**
   A. Diplopia due to pressure palsy of 6th nerve
   B. Sluggish pupillary reactions and unilateral mydriasis
   C. Homonymous hemianopia
   D. All of the above

10. **Temporal lobe tumours may produce:**
    A. Crossed upper quadrantanopia
    B. Crossed lower quadrantanopia
    C. Uncrossed upper quadrantanopia
    D. Uncrossed lower quadrantanopia

11. **Parietal lobe tumours may be associated with:**
    A. Crossed lower homonymous quadrantanopia
    B. Crossed upper homonymous quadrantanopia
    C. Both of the above
    D. None of the above

12. **Occipital lobe tumours may produce:**
    A. Crossed homonymous quadrantanopia
    B. Crossed homonymous hemianopia
    C. Both of the above
    D. None of the above

13. **The commonest cranial nerve palsy in tabes dorsalis is:**
    A. III nerve
    B. IV nerve
    C. VI nerve
    D. Total ophthalmoplegia

14. **Bilateral retrobulbar neuritis occurs in:**
    A. Multiple sclerosis
    B. Neuromyelitis optica
    C. Both of the above
    D. None of the above

15. **Hutchinson's pupil is characterised by:**
    A. Initial ipsilateral miosis, later followed by dilatation
    B. Initial ipsilateral miosis and contralateral dilatation
    C. Ipsilateral mydriasis and contralateral miosis
    D. None of the above

16. **The commonest ocular infection associated with AIDS is:**
    A. Herpes zoster
    B. Cytomegalovirus
    C. Toxoplasmosis
    D. Tuberculosis

1:D 2:C 3:A 4:A 5:B 6:C 7:D 8:A 9:D 10:A 11:A 12:C 13:A 14:C 15:A 16:B

17. Ocular lesions of leprosy include all of the following *except*:
A. Avascular keratitis
B. Interstitial keratitis
C. Fascicular keratitis
D. Neuroparalytic keratitis

18. Ocular manifestations of Wegener's granulomatosis include all of the following *except*:
A. Proptosis
B. Nasolacrimal duct obstruction
C. Necrotizing scleritis
D. Internal ophthalmoplegia

19. The most common lid sign associated with Grave's ophthalmopathy is:
A. Von Graefe's sign
B. Dalrymple's sign
C. Stellwag's sign
D. Rosenbach's sign

20. Hutchinson's triad of congenital syphilis includes all of the following *except*:
A. Eighth nerve deafness
B. Interstitial keratitis
C. Hutchinson's teeth
D. Saddle nose

21. Most common ophthalmic affection of diphtheria is:
A. Ptosis
B. Isolated ocular palsies
C. Total ophthalmoplegia
D. Ophthalmoplegia externa

22. Most common adverse effect of oral contraceptive is:
A. Colour blindness
B. Optic neuritis
C. Ring scotoma
D. Nystagmus

23. All are seen in albinism *except*:
A. Glaucoma
B. Photophobia
C. Refractive error
D. Nystagmus

24. Night blindness may be caused by all *except*:
A. Vitamin A deficiency
B. Retinitis pigmentosa
C. Syphilis
D. Lattice degeneration

25. Fundus picture in collagen disease is dominated by:
A. Multiple cotton wool spots
B. Multiple superficial haemorrhages
C. Macular oedema
D. None of the above

26. The most characteristic eye lesion in diabetes is:
A. Flame haemorrhages
B. Papilloedema
C. Capillary aneurysm
D. Cataracts

27. Occurrence of diplopia, dysphagia, dysarthria, blurring of vision and muscle weakness could be due to:
A. Diphtheria
B. Botulism
C. Infantile beriberi
D. Myasthenia gravis

28. Internal ophthalmoplegia is seen in:
A. Migraine
B. Diabetes
C. Ethambutol toxicity
D. All of the above

29. Which of the following is most likely to be the cause of painful third nerve palsy of sudden onset in a man of 40?
A. Rupture of an infraclinoid aneurysm
B. Sphenoidal ridge meningioma
C. Diabetes mellitus neuropathy
D. Rupture of a supraclinoid aneurysm

30. Sudden increase in blood sugar in a diabetic causes:
A. Myopia
B. Hypermetropia
C. Presbyopia
D. Anisometropia

31. Basilar insufficiency shows:
A. Ptosis
B. Blurred vision
C. Diplopia
D. VI nerve weakness

32. In uraemic amaurosis the pupils are:
A. Constricted
B. Dilated and do not react to light
C. Dilated but react to light
D. Normal

33. Diabetes mellitus can cause the following in the eye *except*:
A. Cataract
B. Retinopathy
C. Anterior ischemic neuropathy
D. Neuroparalytic keratitis

17: C 18: D 19: B 20: D 21: B 22: B
23: A 24: D 25: A
26: C 27: B 28: A 29: D 30: A 31: A
32: C 33: D

34. The presence of Kayser-Fleischer ring is pathognomonic of:
A. Keratoconus
B. Lowe's syndrome
C. Wilson's disease
D. Albinism

35. Roth's spots in the fundus are seen in:
A. Diabetes
B. Chorioretinitis
C. Bacterial endocarditis
D. Retinoblastoma

36. In Weber's syndrome there is:
A. 3rd nerve palsy
B. 4th nerve palsy
C. 5th nerve
D. 7th nerve

37. Muscle mostly affected in thyroid ophthalmopathy is:
A. Lateral rectus
B. Inferior rectus
C. Superior rectus
D. Medial rectus

38. Dalen Fuch lesion is seen in:
A. Purulent keratitis
B. Epidemic keratoconjunctivitis
C. Retinoblastoma
D. Sympathetic ophthalmitis

39. "Rubeosis Iridis" is most commonly seen in:
A. Diabetes mellitus
B. Central retinal vein occlusion
C. Trauma
D. Central retinal artery occlusion

40. All are seen in albinism *except*:
A. Nystagmus
B. Glaucoma
C. Photophobia
D. Refractive error

41. Bowen's disease is characterized by all *except*:
A. Predilection for the limbus
B. Poikilocytosis
C. Presence of monster cell
D. Being incapable of metastasizing

42. Essential atrophy of choroid is due to inborn error of metabolism of amino acid:
A. Cystine
B. Cysteine
C. Arginine
D. Ornithine E Lysine

43. Which of the following is the most common ocular complication with renal transplantation:
A. Cataract
B. Glaucoma
C. Cytomegalovirus retinitis
D. Candida keratomycosis
E. Candida endophthalmitis

44. Pepper salt fundus is seen in:
A. CMV retinitis
B. Toxoplasmosis
C. Rubella
D. Measles

45. In mumps, the most common eye lesion is:
A. Dacryoadenitis
B. Uveitis
C. Membranous conjunctivitis
D. Chorioretinitis

46. Ptosis with orbicularis oculi palsy is seen in:
A. Eaton Lambert syndrome
B. Myasthenia gravis
C. Polymyositis
D. Motor neuron disease

47. Most common cranial nerve involved in ophthalmoplegic migraine is:
A. II nerve
B. III nerve
C. V nerve
D. VI nerve

48. In a patient with AIDS chorioretinitis is typically caused by:
A. Cytomegalo virus
B. *Toxoplasma gondi*
C. *Cryptococcus neoformans*
D. All of the above

49. The most common condition of inherited blindness due to mitochondrial chromosomal anomaly is:
A. Retinopathy of prematurity
B. Leber's hereditary optic neuropathy
C. Retinitis pigmentosa
D. Retinal detachment

50. Toxic amblyopia is produced by:
A. INH
B. Rifampicin
C. Ethambutol
D. Pyrazinamide

34 : C 35 : C 36 : A 37 : B 38 : D 39 : B 40 : B 41 : B 42 : D 43 : C 44 : C 45 : A 46 : B 47 : B 48 : A 49 : B 50 : B

51. Contraindications of topical steroids are:
A. Dendritic ulcer
B. Disciform keratitis
C. Anterior uveitis
D. Acute angle-closure glaucoma

52. Which drug causes bull's eye macula:
A. Phenytoin
B. Chloroquine
C. Steroids
D. Ethambutal

53. Most common adverse effect on eye in oral contraceptive usage is:
A. Colour blindness
B. Ring scotoma
C. Optic neuritis
D. Nystagmus

54. Drug not deposited in cornea:
A. Gold
B. Chloroquine
C. Amiodarone
D. Antimony

55. In Waardenburg's syndrome, following are seen *except*:
A. Widening of the eyebrow
B. Short palpebral fissure
C. Interstital keratitis
D. Heterochromia iridis

56. Xerophthalmia is caused by:
A. Vitamin C deficiency
B. Small bowel resection
C. Cystic fibrosis
D. Chronic alcoholism
E. Glomerulonephritis

57. Vitamin A deficiency produces:
A. Bitot's spots
B. Trantas spots
C. Keratomalacia
D. Xerophthalmia
E. Colour blindness

58. Ocular manifestation of HIV are all *except*:
A. Predispose to viral, bacterial and fungal function
B. Kaposi sarcoma
C. CMV retinitis
D. Cotton wool spot
E. Intraocular lymphoma

59. Ocular manifestations in AIDS:
A. Kaposi sarcoma
B. Retinitis
C. Lymphoma
D. Tuberculosis
E. Herpes

60. Eye involvement is seen in:
A. Seropositive polyarticular JRA late onset
B. Seronegative pauciarticular JRA late onset
C. Seronegative polyarticular JRA early onset
D. Seronegative pauciarticular JRA early onset

51 : A **52 : B** **53 : C** **54 : D** **55 : C**
56 : B, C and D **57 : A, C and D** **58 : None**
59 : A, B, C, D and E **60 : D**

CHAPTER

22

Community Ophthalmology

QUICK TEXT REVIEW

BLINDNESS

DEFINITION OF BLINDNESS

WHO has defined blindness as *"Visual acuity of less than 3/60 (Snellen) or inability to count fingers in daylight at a distance of 3 meters".*

Categories of visual impairment

Categories of visual impairment as per WHO, 2006 are summarised in Table 22.1.

Categories of visual disability in India

National Program for Control of Blindness and Visual Impairment (NPCB & VI), of India has evolved a new system of categorising visual handicap (Table 22.2).

Table 22.1: Categories of vision impairment (WHO, 2006)

Category of visual impairment	*Level of visual acuity (Snellen)*
Normal vision: 0	6/6 to 6/18
Moderate vision impairment: 1	Less than 6/18 to 6/60
Severe vision impairment: 2	Less than 6/60 to 3/60
Blindness: 3	Less than 3/60 (FC at 3 m) or visual field <10°

Table 22.2: Categories and percentage of visual disability (as per NPCB & VI, 2017)

Better eye best corrected	*Worse eye best corrected*	*Percent impairment*	*Disability category*
6/6 to 6/18	6/6 to 6/18	0%	0
	6/24 to 6/60	10%	0
	Less than 6/60 to 3/60	20%	I
	Less than 3/60 no light perception	30%	II (one eyed person)
6/24 to 6/60 Or Visual field less than 40° up to 20° around centre of fixation or hemianopia involving macula	6/24 to 6/60	40%	III a (low vision)
	Less than 6/60 to 3/60	50%	III b (low vision)
	Less than 3/60 to no light perception	60%	III c (low vision)
Less than 6/60 to 3/60 Or Visual field less than 20 up to 10° around centre of fixation	Less than 6/60 to 3/60	70%	III d (low vision)
	Less than 3/60 to no light perception	80%	III e (low vision)
Less than 3/60 to 1/60 Or Visual field less than 10° around centre of fixation	Less than 3/60 to no light perception	90%	IV a (blindness)
Only HMCF Only light perception, No light perception	Only HMCF Only light perception, No light perception	100%	IV b (blindness)

Note: Vision assessment should be done after best possible correction (medical, surgical or usual/conventional spectacles).

Avoidable blindness includes both preventable blindness (e.g. xerophthalmia blindness) and curable blindness (e.g. cataract blindness).

MAGNITUDE OF BLINDNESS

- The prevalence of blindness in developing countries ranges from 0.5 to 2% or higher, while the representative figures in developed countries are 0.05 to 0.3%.
- The prevalence of blindness reported from India as per old definition of blindness is 1.1% (NPCB, 2001–2002) and 1% (RAAB, 2006–07).

CAUSES OF BLINDNESS

Developed countries versus developing countries. In developed countries, causes include: Accidents, glaucoma, diabetes, vascular diseases, cataract, macular degeneration and hereditary conditions. While in developing countries, the frequent causes are cataract, infectious diseases, xerophthalmia, injuries and glaucoma.

Causes of blindness in India: The major causes of blindness in elderly (70 and above) are senile cataract and age-related macular degeneration (Table 22.3).

Table 22.3: Major causes of blindness in India

RAAB Survey (2006–07)	
Disease condition	***Percent blindness***
Cataract	72.2
Refractive errors (0.7%) + aphakia (5.6%)	6.3
Glaucoma	4.4
Complications of cataract surgery	3.0
Corneal opacity including trachoma	6.5
Posterior segment disorders (DR, 0.1% + ARMD 0.7% + others 2.2%)	3.0
NPCB Survey (2001-02)	
Cataract	62.6
Refractive errors	19.7
Glaucoma	5.8
Posterior segment disorders	4.7
Surgical complications	1.2
Corneal blindness	0.9
Others	5.0

CHILDHOOD BLINDNESS

- Approximately 1.5 million children are blind in the world (WHO, 1992).
- Every year, approximately half a million children become blind, i.e. about one every minute (WHO, 1992).
- Of the children going blind, about 60% die within one year (WHO, 1992).
- In about 70% of new cases (of childhood blindness), blindness is due to vitamin A deficiency (WHO, 1992).

GLOBAL INITIATIVES FOR PREVENTION OF BLINDNESS

VISION 2020: THE RIGHT TO SIGHT

Objective: It is a global initiative to eliminate avoidable blindness by the year 2020.

Partners of vision 2020 initiative are WHO and task force of international NGOs.

Implementation is being done through four phases each of five year plan, commencing in 2000, 2005, 2010 and 2015, respectively.

Basic strategies include:

- Disease prevention and control
- Training of eye health personnel
- Strengthening of existing eye care infrastructures
- Use of appropriate and affordable technology, and
- Mobilization of resources.

Global target diseases include: Cataract, childhood blindness, trachoma, refractive errors, and low vision and onchocerciasis.

VISION FOR THE FUTURE (VFTF)

The International ophthalmology strategic plan to restore and preserve vision, directed and coordinated by the International Council of Ophthalmology has been launched as multi year, flexible and interactive programme.

NATIONAL PROGRAMME FOR CONTROL OF BLINDNESS AND VISUAL IMPAIRMENT IN INDIA

NPCB (renamed as NPCB & VI in 2017) in India was launched in the year 1976 with the objective to reduce prevalence of blindness.

Programme organization: NPCB operates through activities at central level, state level and district level.

District blindness control society (DBCS) with Deputy Commissioner as its chairman who

coordinates the activities at district level and ensures participation of the community and private sector.

***'Vision 2020**: The Right to Sight, in India* has been adopted under NPCB since August 2002 with following strategies:

- Strengthening advocacy,
- Reduction of disease burden,
- Human resource development, and
- Eye care infrastructure development.

Target diseases identified for intervention in India include: Cataract, childhood blindness, refractive errors and low vision, corneal blindness, diabetic retinopathy, glaucoma and trachoma (focal).

NPCB DURING 12TH FIVE YEAR PLAN (2012-2017)

- *NPCB to continue under non-communicable diseases (NCO) flexipool* as part of National Health Mission; to be implemented by District Health Societies.
- *Financial contribution*: Government of India, 75% and state/UT government,25%.
- *Cataract surgery target*: 33 crore operations with above 95% being IOL implantation.
- *Spectacle distribution* target for school-age group children: 44 lakhs.

MULTIPLE CHOICE QUESTIONS

1. **WHO definition of blindness is a visual acuity in the better eye equal to or less than:**
   A. 3/60
   B. 4/60
   C. 5/60
   D. 6/60

2. **In the ninth revision of the international classification of diseases, 'Visual impairment' is a visual acuity in the better eye of:**
   A. 6/18
   B. 6/36
   C. 6/60
   D. 3/60

3. **WHO definition of blindness in addition to visual acuity of less than 3/60 (Snellen's) also includes a visual field in the better eye equal to or less than:**
   A. 5°
   B. 10°
   C. 15°
   D. 3°

4. **As per WHO-NPCB (2001-02) survey, all of the following are true about causes of blindness in India *except*:**
   A. Cataract 62.6%
   B. Refractive errors 7.35%
   C. Glaucoma 5.8%
   D. Surgical complication 2%

5. **All of the following are true about prevention of vitamin A deficiency by supplements *except*:**
   A. Dose in children over 1 year is 2 lac IU orally
   B. Dose in infants less than 6 month (not being breastfed is 50 thousand IV orally)
   C. Dose in first trimester of pregnancy is 1 lac IU
   D. Under CSSM Programme first dose (1 lac IU) is given at 9 months of age along with measles

6. **The school health surveys are quite useful in early detection of mainly:**
   A. Refractive errors
   B. Amblyopia
   C. Colour vision defects
   D. All of the above

7. **Most common cause of blindness (as per WHO-NPCB Survey, 2001-02) in India out of the following is:**
   A. Corneal blindness
   B. Glaucoma
   C. Refractive error
   D. Posterior segment disorder

8. **Commonest cause of blindness in India:**
   A. Vitamin A deficiency
   B. Cataract
   C. Trauma
   D. Trachoma

9. **Lowest incidence of trachoma is seen in:**
   A. Punjab
   B. Rajasthan
   C. Uttar Pradesh
   D. Odisha

10. **Cataract blindness is:**
    A. Preventable
    B. Curable
    C. Avoidable
    D. Curable and avoidable

11. **Blindness in a child is most commonly due to:**
    A. Keratomalacia
    B. Congenital cataract
    C. Glaucoma
    D. Injuries

12. **The commonest cause of vision impairment in India is:**
    A. Uncorrected refractive error
    B. Cataract
    C. Glaucoma
    D. Squint

13. **All of the following are given global prominence in the VISION 2020 goal, *expect*:**
    A. Refractive errors
    B. Cataract
    C. Trachoma
    D. Glaucoma

14. **Most common cause of blindness in children in India *except*:**
    A. Malnutrition
    B. Ophthalmia neonatorum
    C. Glaucoma
    D. Congenital dacryocystitis

15. **All of the following conditions are immediate priorities in the WHO's "vision -2020: The right to sight" *except*:**
    A. Trachoma
    B. Epidemic conjunctivitis
    C. Cataract
    D. Onchocerciasis

1:A 2:C 3:B 4:B 5:C 6:D 7:C 8:B 9:A 10:B 11:A 12:A 13:D 14:D 15:B

16. Under the WHO "Vision 2020' program, the "SAFE" strategy is adopted for which of the following diseases:

A. Trachoma
B. Glaucoma
C. Diabetic retinopathy
D. Onchocerciasis.

17. On SAFE strategy false is:

A. Screening
B. Antibiotics
C. Facial hygiene
D. Environmental modification

18. All of the following are causes of night blindness *except*:

A. Oguchi's disease
B. Gyrate atrophy
C. Choroideremia
D. Devic's disease

19. The visual acuity used as cut off for school screening program is: (*AIIMS*)

A. 6/12
B. 6/9
C. 6/6
D. 6/18

20. Most common cause of ocular morbidity in India: (*AIPG*)

A. Cataract
B. Refractive error
C. Trachoma
D. Vitamin A deficiency

21. NPCB & VI, India criteria for blindness means visual acuity less than:

A. 6/18
B. 6/60
C. 3/60
D. 1/60

16: A 17: A 18: D 19: B 20: B 21: C

SECTION—VI

Practical Ophthalmology

CHAPTER

23

Clinical Methods in Ophthalmology

QUICK TEXT REVIEW

COMMON OCULAR SYMPTOMS AND THEIR CAUSES

Sudden painless loss of vision

Central retinal artery occlusion
Massive vitreous haemorrhage
Retinal detachment involving macular area
Ischaemic central retinal vein occlusion.

Sudden painless defective vision

Central serous chorioretinopathy
Optic neuritis
Methyl alcohol amblyopia
Non-ischaemic central retinal vein occlusion.

Sudden painful loss of vision

- Acute congestive glaucoma
- Acute iridocyclitis
- Chemical injuries to the eyeball
- Mechanical injuries to the eyeball.

Gradual painless loss of vision

- Progressive pterygium involving pupillary area
- Corneal degenerations
- Corneal dystrophies
- Developmental cataract
- Senile cataract
- Optic atrophy
- Chorioretinal degenerations
- Age-related macular degeneration
- Diabetic retinopathy
- Refractive errors.

Gradual painful loss of vision

- Chronic iridocyclitis
- Corneal ulceration

Transient loss of vision (amaurosis fugax)

- Carotid artery disease
- Papilloedema
- Giant cell arteritis
- Migraine
- Raynaud's disease
- Severe hypertension
- Prodromal symptom of CRAO.

Night blindness (Nyctalopia)

- Vitamin A deficiency
- Retinitis pigmentosa and other tapetoretinal degenerations
- Congenital stationary night blindness
- Pathological myopia
- Peripheral cortical cataract
- Advanced case of POAG.

Day blindness (Hemeralopia)

- Central nuclear or polar cataracts
- Central corneal opacity
- Central vitreous opacity
- Congenital deficiency of cones (rarely).

Defective vision for near only

- Presbyopia
- Cycloplegia
- Internal or total ophthalmoplegia
- Insufficiency of accommodation.

Black spots in front of the eyes

- Vitreous haemorrhage
- Vitreous degeneration, e.g. senile, pathological myopia
- Lenticular opacity
- Exudates in vitreous.

Flashes of light in front of the eyes (Photopsia)

- Prodromal symptom of retinal detachment
- Vitreous traction on retina
- Retinitis
- Migraine with aura.

Micropsia (small size of objects), macropsia (large size of objects) and metamorphopsia (distorted shape of objects).

- Central chorioretinitis.

Coloured halos

- Acute congestive glaucoma
- Early stages of cataract
- Mucopurulent conjunctivitis.

Diplopia

a. *Uniocular diplopia*

- Subluxated lens
- Double pupil
- Incipient cataract
- Keratoconus.

b. *Binocular diplopia*

- Paralytic squint (paralysis of third, fourth or sixth cranial nerve)
- Myasthenia gravis
- Diabetes
- Thyroid disorders
- Blow-out fracture of floor of the orbit
- Anisometropic glass (e.g. uniocular aphakic glass)
- After squint correction in the presence of abnormal retinal correspondence (paradoxical diplopia).

COMMON OCULAR SIGNS AND THEIR CAUSES

CONJUNCTIVA

Conjunctival follicles

- Trachoma
- Acute follicular conjunctivitis
- Chronic follicular conjunctivitis
- Benign folliculosis.

Conjunctival papillae

- Trachoma
- Spring catarrh
- Allergic conjunctivitis
- Giant papillary conjunctivitis.

Concretions

- Trachoma
- Degenerative conditions
- Idiopathic.

CORNEA

Decreased corneal sensations

- Herpes simplex keratitis
- Neuroparalytic keratitis
- Leprosy
- Herpes-zoster ophthalmicus
- Absolute glaucoma
- Acoustic neuroma.

Superficial corneal vascularization

- Trachoma
- Phlyctenular keratoconjunctivitis
- Rosacea keratitis
- Superficial corneal ulcers.

Deep corneal vascularization

- Interstitial keratitis
- Deep corneal ulcers
- Chemical burns
- Sclerosing keratitis
- After keratoplasty.

Increased corneal thickness (corneal thickness is best measured by pachymeter)

- Corneal oedema.

Abnormal corneal surface (Placido's disc is used to detect smoothness or irregularities of corneal surface)

- Corneal abrasion
- Corneal ulcer
- Keratoconus.

ANTERIOR CHAMBER

Shallow anterior chamber

- Primary angle closure glaucoma
- Hypermetropia
- Malignant glaucoma
- Postoperative shallow anterior chamber due to
  - Leaking wound
  - Ciliochoroidal detachment
- Corneal perforation
- Intumescent (swollen cataractous) lens
- Iris bombe formation
- Adherent leucoma.

Deep anterior chamber

- Aphakia
- Total posterior synechiae
- Myopia
- Keratoglobus
- Keratoconus
- Anterior dislocation of lens in the anterior chamber

- Posterior perforation of the globe
- Buphthalmos.

Hyphaema

- Ocular injuries
- Postoperative
- Herpes-zoster iritis
- Gonococcal iritis
- Intraocular tumour
- Spontaneous (from rubeosis iridis).

Hypopyon

- Corneal ulcer
- Iridocyclitis
- Retinoblastoma (pseudohypopyon)
- Endophthalmitis
- Panophthalmitis.

IRIS

Nodules on the iris surface

- Granulomatous uveitis (Koeppe's and Busacca's nodules)
- Melanoma of the iris
- Tuberculoma
- Gumma.

Rubeosis iridis (Neovascularization of iris)

- Diabetes mellitus
- Central retinal vein occlusion
- Chronic iridocyclitis
- Sickle-cell retinopathy
- Retinoblastoma.

Iridodonesis

- Dislocation of lens
- Aphakia
- Hypermature shrunken cataract
- Buphthalmos.

PUPIL

Normal pupil

- Diameter 3 to 4 mm
- In infancy pupil is smaller than at birth
- Myopes have larger pupil than hypermetropes.

Miosis

- Effect of miotic drugs (Parasympathomimetic drugs, e.g. pilocarpine)
- Effect of systemic morphine
- Iridocyclitis (narrow, irregular non-reacting pupil)
- Horner's syndrome
- Head injury (pontine haemorrhage)
- Senile rigid miotic pupil
- During sleep
- Argyll-Robertson pupil
- Poisonings
  - Alcohol
  - Barbiturates
  - Organophosphorus compounds
  - Morphine
  - Carbolic acid
- Hyperpyrexia.

Mydriasis

- Topical sympathomimetic drugs such as adrenaline and phenylephrine
- Topical parasympatholytic drugs such as atropine, homatropine, cyclopentolate, tropicamide
- Acute congestive glaucoma (vertically oval, large, immobile pupil)
- Absolute glaucoma
- Optic atrophy
- Retinal detachment
- Internal ophthalmoplegia
- Third nerve paralysis
- Belladonna poisoning
- Coma
- Sympathetic stimulation
  - Aortic aneurysm
  - Cervical rib
  - Irritative lesions in neck
  - Mediastinal sarcoma, lymphosarcoma, Hodgkin's disease and pulmonary carcinoma
  - Emotional excitement
- Severe anaemia
- Adie's tonic pupil is larger than its fellow.

Leukocoria (white reflex in pupillary area)

- Congenital cataract
- Retinoblastoma
- Persistent hyperplastic primary vitreous
- Retrolental fibroplasia
- Toxocara endophthalmitis
- Coat's disease.

Marcus Gunn Pupil

In swinging flash light test, the pupil on the diseased side dilates on transferring light to it causes are:

- Optic neuritis
- Optic atrophy
- Retinal detachment
- Central retinal artery occlusion
- Ischemic central retinal vein occlusion.

LENS

Subluxation of lens

- Trauma
- Marfan's syndrome (superotemporal)
- Homocystinuria (inferonasal)
- Weill-Marchesani syndrome.

RETINA

Cherry red spot

- Central retinal artery occlusion
- Commotio retinae (Berlin's oedema)
- Tay-Sachs disease
- Niemann-Pick disease
- Gaucher's disease
- Sialidosis
- Gangliosidosis
- Metachromatic leukodystrophy
- Multiple sulphates deficiency
- Rarely in Krabbe's disease.

Macular oedema

- Trauma
- Intraocular operations
- Uveitis
- Diabetic maculopathy.

Superficial retinal haemorrhages

- Hypertensive retinopathy
- Diabetic retinopathy
- Central retinal vein occlusion
- Anaemic retinopathy
- Leukaemic retinopathy
- Retinopathy of AIDS.

Soft exudates (Cotton wool spots) on the retina

They are due to disturbance in axoplasmic flow

- Hypertensive retinopathy
- Retinopathy of toxaemia of pregnancy
- Diabetic retinopathy
- Anaemic retinopathy
- DLE, PAN and Scleroderma, SLE
- Leukaemic retinopathy
- Retinopathy of AIDS
- Eales' disease
- Rarely CMV retinitis in AIDS.

Hard exudates on the retina

They are lipid deposits in retina

- Diabetic retinopathy
- Hypertensive retinopathy
- Coat's disease
- Circinate retinopathy.
- Eales' disease
- Old CRVO.

Subretinal neovascular membrane

- Wet ARMD
- Presumed ocular histoplasmosis syndrome (POHS)
- *Angioid streaks*
- Choroidal naevus
- Choroidal rupture
- High myopia
- Inappropriate photocoagulation
- Optic disc drusen.

Bull's eye maculopathy

- Chloroquine toxicity
- Cone dystrophy
- Benign concentric annular macular dystrophy
- Batten's disease
- Bardet-Biedl syndrome
- Occasionally Leber's Amaurosis.

Neovascularization of retina

- Diabetic retinopathy
- Eales' disease
- Sickle-cell retinopathy
- Central retinal vein occlusion.

Proliferative retinopathy

- Proliferative diabetic retinopathy
- Sickle-cell retinopathy
- Eales' disease
- Ocular trauma.

Salt and pepper appearance of fundus

- Prenatal rubella
- Prenatal influenza
- Varicella
- Mumps
- Congenital syphilis.

Arterial pulsations at the disc

- Visible arterial pulsations are always pathological
- True pulse waves are seen in:
  - Aortic regurgitation
  - Aneurysm
  - Exophthalmic goitre
- Pressure pulse is seen in:
  - Glaucoma
  - Orbital tumours.

Venous pulsations at the disc

- Visible in 10–20% of normal people
- Absent in papilloedema.

pillary pulsations

Are seen in aortic regurgitation as a systolic reddening and diastolic paling of the disc.

ISUAL FIELDS

largement of blindspot

Primary open-angle glaucoma.
Papilloedema
Medullated nerve fibres
Drusen of the optic nerve
Juxtapapillary choroiditis.
Progressive myopia with a temporal crescent.

eripheral field contraction

Papillitis
Papilloedema
Optic atrophy
Glaucoma
Peripheral retinochoroiditis
Retinitis pigmentosa
Quinine or salicylate poisoning.

ubular vision

Terminal stage of advanced glaucomatous field defect
Advanced stage of retinitis pigmentosa.

Ring scotoma

- Glaucoma
- Retinitis pigmentosa.

Central scotoma

- Optic neuritis
- Tobacco amblyopia
- Macular hole, cyst, degeneration.

Bitemporal hemianopia

Central lesions of chiasma
Pituitary tumours (common)
Suprasellar aneurysms
Craniopharyngioma
Glioma of third ventricle
Meningiomas at tuberculum sellae.

Homonymous hemianopia

Optic tract lesions
Lateral geniculate body lesions
Lesions involving total fibres of optic radiations
Visual cortex lesions (usually sparing of macula).

Binasal hemianopia

Lateral chiasmal lesions
Distension of third ventricle
Atheroma of posterior communicating arteries.

Altitudinal hemianopia

- Loss of upper or more rarely lower halves of field from pressure upon the chiasma
- Early loss in upper half of field—intra or extrasellar tumours
- Early loss in lower half of field—suprasellar tumours.

Quadrantic hemianopia

- Homonymous upper quadrantanopia (pie in the sky)—temporal lobe lesions involving lower fibres of optic radiations.
- Homonymous lower quadrantinopia (pie on the floor)—anterior parietal lobe lesions involving upper fibres of optic radiations.
- Quadrantic hemianopia also occurs due to lesions in the occipital cortex involving the calcarine fissure.

OCULAR EXAMINATION TECHNIQUES AND DIAGNOSTIC TESTS

Loupe and lens examination

- Power of the corneal loupe is +41 DS
- Magnification of image with corneal loupe is 10 X.

Slit-lamp examination

- Slit-lamp was invented by Gullstrand in 1911
- Aqueous flare and keratic precipitates are best demonstrated by slit-lamp examination.

Testing of visual acuity

- Visual acuity in a child below 2 years of age can be tested by:
  - Optokinetic nystagmus (OKN)
  - Preferential looking test
  - Pattern visual evoked potential (STYCAR: Sight Testing for Young Children and Retard).
- Two distant points can be visible as separate only when they subtend an angle of one minute at the nodal point.
- Each individual letter of Snellen's test type subtends an angle of 5 minutes at the nodal point. Whereas, each component part of the letter subtends an angle of 1 minute.

ETDRS chart

- Testing is done from a distance of 4 metres.
- The main advantage with respect to Snellen's chart is that there are equal number of letters in each line and equal spacing between the letters.
- Visual acuity is expressed in logMAR units.

Tests for Colour Vision

Ishihara's pseudoisochromatic chart: There are **38 plates** which should be read at 75 cm under good illumination.

- *Demonstration plate:* It is the testing plate used to identify **malingerers** since it can be seen by all patients even if they are colour blind.
- *Transformation plates:* A particular number is seen on the plate by a colour normal person whereas a different number is seen by a colour deficient person.
- *Vanishing plates:* A number is seen by a colour normal person but not seen by a colour deficient person
- *Hidden plates:* A number is seen by a colour blind person but not a colour normal person
- *Diagnostic plates:* These plates are used to differentiate protan and deuteron defect.

Note: *The main drawback of this test is that it cannot detect tritan or blue colour defect.*

Other colour vision tests are:

- Hardy-Rand Rittler test
- City University test
- Holmgren's wool test
- Farnsworth Munsell 100 hue test
- Farnsworth Munsell D-15/ Lanthony D-15/ Adams D-15
- Nagel's anomaloscope.

Occupational tests: These tests are used to assess medical fitness in professionals like drivers, pilots, etc. where colour vision is of special importance. The common tests are Edridge Green lantern test, Farnsworth lantern test and Holmes-Wright lantern test.

Tonometry (Intraocular pressure measurement)

- Schiotz tonometer is an indentation tonometer
- Concept of applanation was introduced by Goldmann in 1954. It is based on Imbert-Fick law.
- Applanation tonometers are: Goldmann tonometer, Perkin's tonometer and Pneumatic tonometer.
- Applanation tonometer is more accurate than the Schiotz tonometer because factor of scleral rigidity is not involved in the former.
- Central corneal thickness influences applanation tonometry (false high reading in thick cornea >600 µm and false low reading in thin cornea <550 µm).
- Normal range of intraocular pressure is 10-21 mm Hg.
- Best accuracy with Schiotz tonometer is attaine with that weight with which a scale reading of 3– is achieved.

Gonioscopy

- Angle structures cannot be examined directl since the light emitted from here undergoes tota internal reflection at the anterior surface of th cornea.
- Goldmann and Zeiss gonioscopes are indirec goniolenses and provide a mirror image of th opposite angle.
- Koeppe goniolens provides a direct view of th angle.

Direct ophthalmoscopy

- It was invented by Babbage in 1848 and reinvented and popularized by von Helmholtz in 1850.
- It should be performed from as close to the patient's eye as possible (ideally 15.4 mm).
- Image formed is erect, virtual and 15 times magnified in emmetropes (more in myopes and less in hypermetropes).

Distant direct ophthalmoscopy

- It is performed from a distance of 20–25 cm
- It is useful in detecting opacities in the media o the eye, a hole in the iris, a detached retina and a subluxated lens.
- The black shadow produced by an opacity in the pupillary plane remains stationary, that in front o the pupillary plane moves in the direction of the movement of the eyeball and that behind it wil move in opposite direction.

Indirect ophthalmoscopy

- It was invented by Nagel in 1864
- In it, the examining eye is made myopic by placing a strong convex lens in front of patient's eye.
- It is performed from a distance of an arm's length (60–75 cm).
- Image in indirect ophthalmoscopy is formed in the air between the convex lens and examiner's eye and it is real, inverted and about 3 times magnified with +20 D lens.
- Magnification of the image does not depend upon the refractive error of the observer's eye but depends upon:
  - Power of convex lens used
  - Refractive error of the observed eye and
  - Position of the convex lens in relation to the eye.

Biomicroscopic examination of the fundus

Biomicroscopic examination of the fundus is performed with the help of any of the following:

- −58.6 D Hruby lens
- +78 D or +90 D small diameter lens (Best method for clinical examination of macular lesions)
- Posterior fundus contact lens
- Goldmann's three mirror contact lens.

Amsler grid test

Amsler grid is test for macular degeneration and other visual problems.

Perimetry

- *Normal extent of field of vision* for white colour is:
  - Superior : 60°
  - Nasal : 60°
  - Inferior : 70°
  - Temporal : 90°
- *Field of vision* for blue and yellow colour is roughly 10° less and that for red and green colour is about 20° less than that for white (smallest is with green colour).
- *Red colour perimetry* is particularly useful in the diagnosis of bitemporal hemianopia with chiasmal compression and of central scotoma of retrobulbar neuritis.
- *Kinetic perimetry* can be performed with Lister's perimeter, Goldmann perimeter and tangent screen.
- *Static perimetry* is performed with adapted Goldmann perimeter, Friedmann perimeter and automated perimeter.
- *Campimetry* (scotometry) is performed to evaluate the central and paracentral area (30°) of the visual field on Bjerrum's screen.

Fundus fluorescein angiography

- 5 mL of 10% solution or 10 mL of 5% of sterile sodium fluorescein dye is injected in the antecubital vein.
- In the blood fluorescein is readily bound to the albumin.
- Blue light (420–490 nm) is used for exciting the fluorescein present in the blood vessels.
- Yellow-green filter is used to receive the fluorescent light (510–530 nm) for photography.
- Hyperfluorescence is seen in:
  - Atrophy of retinal pigment epithelium (RPE)
  - Detachment of RPE
  - Central serous retinopathy
  - Cystoid macular oedema
  - Leakage of dye from neovascularization
  - Drusens
  - Papilloedema
- Hypofluorescence is seen in:
  - Retinal haemorrhages
  - Choroideremia
  - Central retinal artery occlusion.

Electroretinography (ERG) and electro-oculography (EOG)

- *Normal ERG* consists of:
  - a-wave is a negative wave possibly arising from the rods and cones.
  - b-wave is a large positive wave which is generated by Muller's cells, but represents the activity of bipolar cells.
  - c-wave is a positive wave representing metabolic activity of pigment epithelium.

  ERG: 3 waves (Pneumonic: RMP)
  R: Rods and cones
  M: Mullers cells (glial cell)
  P: Retinal pigment
- ERG is abnormal in patients with:
  - Retinitis pigmentosa and other tapetoretinal degenerations
  - Central retinal artery *occlusion*
  - Total retinal detachment
- *ERG is normal in diseases* involving ganglion cells and higher visual pathways, such as optic atrophy.
- *EOG is based on* the resting potential of the eye which exists between the cornea (+ve) and back of the eye (-ve).
- *EOG is abnormal* in diseases such as retinitis pigmentosa, vitamin A deficiency, retinal detachment.
- *EOG is more sensitive* than ERG in diagnosis of retinitis pigmentosa.
- The ratio of the voltage (i.e. light peak divided by dark trough) is known as the *Arden ratio*. In practice, the measurement is similar to the eye movement recordings.

Visually evoked response (VER)

- VER refers to electroencephalography (EEG) recorded at the occipital cortex.
- VER assesses the functional state of the visual system beyond the retinal ganglion cells.
- Flash VER is based on light perception while pattern reversal VER is based on form sense and thus gives a rough estimate of the visual acuity.

- Clinically VER is used to:
  - Assess visual acuity in infants and mentally retarded individuals
  - Confirm malingering
  - Confirm optic nerve diseases like retrobulbar neuritis.

Ultrasonography

- Ophthalmic ultrasound is based upon pulse-echo technique employing frequencies in the range of 10 MHz.
- A-Scan (Time amplitude) produces unidimensional image echoes plotted as spikes. The distance between the two echo spikes provides an indirect measurement of tissue such as eyeball length, anterior chamber depth and lens thickness.
- B-scan (intensity modulation) produces two-dimensional dotted section of the eyeball.
- Uses of ultrasound are:
  - Biometric studies using A-scan to calculate power of the intraocular lens to be implanted
  - Assessment of the posterior segment in the presence of opaque media.
  - Study of intraocular and intraorbital tumours
  - Ultrasonographic pachymetry (measurement of corneal thickness).

Optical Coherence Tomography (OCT)

- *OCT gives cross-sectional images* of biological tissues with high axial resolution within 10 µm.
- *Specially useful* in retinal disorders, where it is akin to in vivo histopathology of retina.
- *Based on interferometry* and low-coherence light in near infrared range.
- *Colour coding*: Red yellow colours represent areas of maximal optical reflection and back scattering. Blue-black colours represent area of minimal signals.
- *Clinical applications* include: Posterior segment OCT-macular disorder, optic disc disorders especially glaucomatous damage, anterior segment OCT-angle evaluation, pachymetry, pre- and post-LASIK information, IOL and implant imaging.

MULTIPLE CHOICE QUESTIONS

1. All of the following are causes of sudden painless loss of vision *except*:
A. Central retinal artery occlusion
B. Optic atrophy
C. Optic neuritis
D. Retinal detachment

2. Sudden, transient and painless loss of vision may be complained by the patients with all of the following diseases *except*:
A. Carotid transient ischaemic attacks
B. Papilloedema
C. Papillitis
D. Migraine

3. All of the following may be associated with night-blindness *except*:
A. Pathological myopia
B. Retinitis pigmentosa
C. Retinitis punctata albescens
D. Retinitis proliferans

4. Flashes of light before the eyes (photopsia) is a feature of:
A. Impending retinal detachment
B. Vitreous traction of the retina
C. Retinitis
D. All of the above

5. Snellen's test types are based on the fact that two distant points can be visible as separate only when they subtend at the nodal point of the eye an angle of:
A. 1 minute
B. 3 minute
C. 5 minute
D. 2 minute

6. Assessment of the visual acuity in children below 2 years of age can be made by the following tests, *except*:
A. Landolt's charts
B. Pattern visual evoked potential
C. Preferential looking behaviour
D. Optokinetic nystagmus

7. In microcornea, diameter of cornea is less than:
A. 9 mm
B. 10 mm
C. 11 mm
D. 8 mm

8. Corneal diameter is increased in:
A. Megalocornea
B. Keratoglobus
C. Keratoconus
D. All of the above

9. Diseased and devitalized epithelial cells of the conjunctiva and cornea are stained with:
A. Fluorescein dye
B. Rose Bengal dye
C. Alcian blue dye
D. All of the above

10. Corneal sensations are decreased in all of the following conditions *except*:
A. Recurrent corneal erosion syndrome
B. Herpetic keratitis
C. Neuroparalytic keratitis
D. Leprosy

11. The aqueous flare is best demonstrated by:
A. Biomicroscope
B. Keratoscope
C. Pentoscope
D. Ophthalmoscope

12. Photostress test is positive in:
A. Central serous retinopathy
B. Optic neuritis
C. Ethambutol toxicity
D. Central retinal artery occlusion
E. All of the above

13. Indentation tonometer is based on the fundamental fact that a plunger with indent:
A. More in soft eye
B. More in hard eye
C. Equal in soft and hard eye
D. None of the above

14. All of the following conditions can be diagnosed on distant direct ophthalmoscopy *except*:
A. Opacities in the refractive media
B. A hole in the iris
C. A detached retina
D. A hole in the macula

15. All of the following are characteristics of the image formed on direct ophthalmoscopy, *except* that it is:
A. Erect
B. Real
C. Fifteen times magnified in emmetropes
D. More magnified in myopes than emmetropes

16. In indirect ophthalmoscopy the examining eye is made:
A. Myopic
B. Hypermetropic
C. Emmetropic
D. None of the above

1:B 2:C 3:D 4:D 5:A 6:A 7:B 8:D 9:B 10:A 11:A 12:A 13:A 14:D 15:B 16:A

- Clinically VER is used to:
  - Assess visual acuity in infants and mentally retarded individuals
  - Confirm malingering
  - Confirm optic nerve diseases like retrobulbar neuritis.

Ultrasonography

- Ophthalmic ultrasound is based upon pulse-echo technique employing frequencies in the range of 10 MHz.
- A-Scan (Time amplitude) produces unidimensional image echoes plotted as spikes. The distance between the two echo spikes provides an indirect measurement of tissue such as eyeball length, anterior chamber depth and lens thickness.
- B-scan (intensity modulation) produces two-dimensional dotted section of the eyeball.
- Uses of ultrasound are:
  - Biometric studies using A-scan to calculate power of the intraocular lens to be implanted
  - Assessment of the posterior segment in the presence of opaque media.
  - Study of intraocular and intraorbital tumours
  - Ultrasonographic pachymetry (measurement of corneal thickness).

Optical Coherence Tomography (OCT)

- *OCT gives cross-sectional images* of biological tissues with high axial resolution within 10 µm.
- *Specially useful* in retinal disorders, where it is akin to in vivo histopathology of retina.
- *Based on interferometry* and low-coherence light in near infrared range.
- *Colour coding*: Red yellow colours represent areas of maximal optical reflection and back scattering. Blue-black colours represent area of minimal signals.
- *Clinical applications* include: Posterior segment OCT-macular disorder, optic disc disorders especially glaucomatous damage, anterior segment OCT-angle evaluation, pachymetry, pre- and post-LASIK information, IOL and implant imaging.

MULTIPLE CHOICE QUESTIONS

1. **All of the following are causes of sudden painless loss of vision *except*:**
   A. Central retinal artery occlusion
   B. Optic atrophy
   C. Optic neuritis
   D. Retinal detachment

2. **Sudden, transient and painless loss of vision may be complained by the patients with all of the following diseases *except*:**
   A. Carotid transient ischaemic attacks
   B. Papilloedema
   C. Papillitis
   D. Migraine

3. **All of the following may be associated with night-blindness *except*:**
   A. Pathological myopia
   B. Retinitis pigmentosa
   C. Retinitis punctata albescens
   D. Retinitis proliferans

4. **Flashes of light before the eyes (photopsia) is a feature of:**
   A. Impending retinal detachment
   B. Vitreous traction of the retina
   C. Retinitis
   D. All of the above

5. **Snellen's test types are based on the fact that two distant points can be visible as separate only when they subtend at the nodal point of the eye an angle of:**
   A. 1 minute
   B. 3 minute
   C. 5 minute
   D. 2 minute

6. **Assessment of the visual acuity in children below 2 years of age can be made by the following tests, *except*:**
   A. Landolt's charts
   B. Pattern visual evoked potential
   C. Preferential looking behaviour
   D. Optokinetic nystagmus

7. **In microcornea, diameter of cornea is less than:**
   A. 9 mm
   B. 10 mm
   C. 11 mm
   D. 8 mm

8. **Corneal diameter is increased in:**
   A. Megalocornea
   B. Keratoglobus
   C. Keratoconus
   D. All of the above

9. **Diseased and devitalized epithelial cells of the conjunctiva and cornea are stained with:**
   A. Fluorescein dye
   B. Rose Bengal dye
   C. Alcian blue dye
   D. All of the above

10. **Corneal sensations are decreased in all of the following conditions *except*:**
    A. Recurrent corneal erosion syndrome
    B. Herpetic keratitis
    C. Neuroparalytic keratitis
    D. Leprosy

11. **The aqueous flare is best demonstrated by:**
    A. Biomicroscope
    B. Keratoscope
    C. Pentoscope
    D. Ophthalmoscope

12. **Photostress test is positive in:**
    A. Central serous retinopathy
    B. Optic neuritis
    C. Ethambutol toxicity
    D. Central retinal artery occlusion
    E. All of the above

13. **Indentation tonometer is based on the fundamental fact that a plunger with indent:**
    A. More in soft eye
    B. More in hard eye
    C. Equal in soft and hard eye
    D. None of the above

14. **All of the following conditions can be diagnosed on distant direct ophthalmoscopy *except*:**
    A. Opacities in the refractive media
    B. A hole in the iris
    C. A detached retina
    D. A hole in the macula

15. **All of the following are characteristics of the image formed on direct ophthalmoscopy, *except* that it is:**
    A. Erect
    B. Real
    C. Fifteen times magnified in emmetropes
    D. More magnified in myopes than emmetropes

16. **In indirect ophthalmoscopy the examining eye is made:**
    A. Myopic
    B. Hypermetropic
    C. Emmetropic
    D. None of the above

1:B 2:C 3:D 4:D 5:A 6:A 7:B 8:D 9:B 10:A 11:A 12:A 13:A 14:D 15:B 16:A

17. All of the following are characteristics of the image formed on indirect ophthalmoscopy *except* that it is:
A. Virtual
B. Inverted
C. Magnified
D. Formed between the convex lens and the observer

18. Biomicroscopic examination of the fundus is performed with the help of:
A. -58.6 D Hruby lens
B. +78 D small diameter lens
C. Both of the above
D. None of the above

19. Small opacities in the media of the eye are best detected by:
A. Distant direct ophthalmoscopy
B. Direct ophthalmoscopy
C. Indirect ophthalmoscopy
D. All of the above

20. Diameter of the optic disc is:
A. 1.5 mm
B. 5.5 mm
C. 2.5 mm
D. 3.5 mm

21. The normal extent of temporal field of vision for white colour is about:
A. 60°
B. 80°
C. 90°
D. 110°

22. In colour perimetry the smallest field of vision is with:
A. Green object
B. Blue object
C. Yellow object
D. Red object

23. Campimetry (Scotometry) is performed in the visual field area of:
A. 50°
B. 30°
C. 60°
D. 90°

24. Dark adaptation is delayed in all of the following conditions *except*:
A. Pigmentary retinal dystrophy
B. Vitamin A deficiency
C. Primary open-angle glaucoma
D. Heredomacular degeneration

25. In electroretinogram (ERG) the b-wave represents the activity of:
A. Rods and cones
B. Bipolar cells
C. Ganglion cells
D. All of the above

26. In diagnosis of retinitis pigmentosa ERG is:
A. More sensitive than the EOG
B. Less sensitive than the EOG
C. Equally sensitive as EOG
D. None of the above

27. Visually-evoked response (VER) is useful in the diagnosis of all of the following *except*:
A. Retinitis pigmentosa
B. Retrobulbar neuritis
C. Visual potential in eyes with opaque media
D. Optic atrophy

28. For biometric studies of the eyeball best pulse echo technique on ultrasonography is:
A. A Scan
B. B Scan
C. C Scan
D. All of the above

29. Kayser-Fleischer ring is pathognomonic of:
A. Keratoconus
B. Wilson's disease
C. Lowe's syndrome
D. All of the above

30. Roth's spots are seen in:
A. Diabetic retinopathy
B Chorioretinitis
C. Subacute bacterial endocarditis
D. Retinoblastoma

31. Amaurotic cat's eye reflex is seen in:
A. Papilloedema
B. Papillitis
C. Retinoblastoma
D. Retinitis pigmentosa

32. Thickness of cornea is best measured by:
A. Keratometer
B. Pachymeter
C. Optometer
D. Pentoscope

33. Landolt's broken ring test is used for testing:
A. Form sense
B. Contrast sense
C. Central field
D. Scotopic vision

17 : A 18 : C 19 : A 20 : A 21 : C 22 : A
23 : B 24 : D
25 : B 26 : B 27 : A 28 : A 29 : B 30 : C
31 : C 32 : B 33 : A

34. White pupillary reflex is seen in:
A. Retinoblastoma
B. Complete retinal detachment
C. Endophthalmitis
D. All of the above

35. The image in indirect ophthalmoscopy is:
A. Erect, virtual, magnified
B. Erect, real, magnified
C. Inverted, real, magnified
D. Inverted, virtual, normal

36. Examination of vitreous is best done by:
A. Direct ophthalmoscope
B. Indirect ophthalmoscope
C. Slit-lamp with contact lens
D. Oblique illumination

37. In retinal artery angiogram, the dye is injected through the:
A. Peripheral veins
B. Aorta
C. Retinal artery
D. Retinal vein

38. The distance used in distant direct ophthalmoscopy is:
A. 10 cm
B. 15 cm
C. 25 cm
D. 100 cm

39. Amaurotic cat's eye is not seen in:
A. Cataract
B. Cyclitic membrane
C. Glaucoma
D. Retrolental fibroplasia

40. Angiography is the investigation of choice in:
A. Posterior vitreous detachment
B. Rhegmatogenous retinal detachment
C. Retinoschisis
D. Central serous retinopathy

41. Periphery of retina is best visualised with:
A. Retinoscopy
B. USG
C. Direct ophthalmoscopy
D. Indirect ophthalmoscopy

42. Campimetry is used to measure:
A. Squint
B. Angle of deviation
C. Pattern of retina
D. Field charting

43. The electroretinogram may assist in the diagnosis of all of the following, *except*:
A. Bilateral disease
B. Progression of retinal disease
C. Clinically unsuspected disease in familial degenerations
D. Complications of glaucoma
E. Differentiation between peripheral and central retinal disease

44. Anomaloscope is used to detect:
A. Squint
B. Retinopathy
C. Congenital glaucoma
D. Colour blindness

45. Best diagnostic test for Best disease is:
A. Dark adaptation
B. ERG
C. EOG
D. Gonioscopy

46. Snellen's chart is used to test:
A. Vision
B. Refraction
C. Presbyopia
D. Colour blindness

47. Retinoscopy is used for visualising the:
A. Whole retina
B. Only the peripheral part of the retina
C. Detecting errors of refraction
D. None

48. Magnification of direct ophthalmoscopy is:
A. Five
B. Ten
C. Fifteen
D. Thirty

49. Amsler's grid is used in:
A. Detecting colour vision
B. Retinal function test
C. Maculopathy
D. Refractive errors

50. Not true about macular function test is:
A. Two-point discrimination
B. Maddox rod
C. Laser interferometry
D. Retinogram

51. All are seen in increased intracranial tension *except*:
A. Macular oedema
B. Papilloedema
C. Normal vision
D. Afferent pupillary defect

34 : D **35 : C** **36 : B** **37 : A** **38 : C** **39 : C** **40 : D** **41 : D** **42 : D** **43 : D** **44 : D** **45 : C** **46 : A** **47 : C** **48 : C** **49 : C** **50 : D** **51 : D**

52. Which of the following is used for treatment of myopia:
A. Nd: YAG laser
B. Excimer laser
C. Argon laser
D. Holmium laser

53. Visual acuity test is a test of:
A. Light sense
B. Colour sense
C. Contrast sense
D. Form sense

54. Hutchinson's pupils:
A. Seen in syphilis
B. Unilateral constricted pupil
C. Irregular pupil
D. None of the above

55. In retinoscopy for refractive error at 1m we add −1D. If done at a distance of 66 cm, the addition factor will be:
A. −2D
B. −1.5 D
C. −0.5 D
D. −5 D

56. Shallow anterior chamber is seen in all *except*:
A. Old age
B. Steroid-induced cataract
C. Hypermetropia
D. Angle-closure glaucoma

57. Optical coherence tomography is akin to in vivo:
A. Histopathology
B. Ultrasonic biomicroscopy
C. Confocal microscopy
D. Roentgen examination

58. Axial resolution in optical coherence tomography is about:
A. 10 μ
B. 30 μ
C. 100 μ
D. 300 μ

59. Optical coherence tomography is most useful in disorders of:
A. Macula
B. Crystalline lens
C. Refractive errors
D. Intraocular tumours

60. Area of fundus seen with direct ophthalmoscope is:
A. 1 DD
B. 2 DD
C. 3 DD
D. 4 DD

61. Indocyanine green angiography (ICG Angiography) is most useful in detecting:
A. Occult choroidal neovascularization (Occult CNV)
B. Classic choroidal neovascularization (Classic CNV)
C. Angioid streaks with choroidal neovascularization (CNV)
D. Polypoidal choroidal vasculopathy

62. A wave in ERG is due to activity of:
A. Pigmented epithelium
B. Rods and cones
C. Ganglion cell
D. Bipolar cell

63. Arden index is related to:
A. ERG (Electroretinogram)
B. EOG (Electroculogram)
C. VER (Visual evoked response)
D. Perimetry

64. Perimetry is a test to assess the:
A. Visual acuity
B. Intraocular pressure
C. Visual field
D. Depth of the anterior chamber

65. Sudden painful loss of vision is seen in:
A. Angle closure glaucoma
B. Central retinal artery occlusion
C. Acute uveitis
D. Endopthalmitis
E. Retinal detachment

66. Colour vision is checked by which one of the following? ***(Kerala PG 2015)***
A. Snellen's chart
B. Goldman's three mirror lens
C. Slit-lamp
D. Ishihara's isochromatic charts

67. Holmgren's wool matching is used for assessment of: ***(Bihar PG 2014)***
A. Visual field
B. Visual acuity
C. Colour vision
D. Refraction

52 : B 53 : D 54 : D 55 : B 56 : B 57 : A
58 : A 59 : A
60. B 61 : A 62 : B 63 : B 64 : C
65 : A, C and D 66 : D 67 : C

Index

B

C

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

W

X

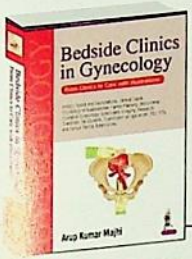
Y

Z

Other Best-selling Books

715.

BEDSIDE CLINICS IN GYNECOLOGY

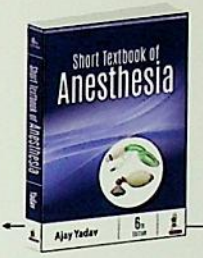


Arup Kumar Majhi

Full Colour | Soft Cover | 1/e, 2018
75[illegible] | 798 Pages | 9789352703210

- This book is written, realising the basic needs of a student appearing for the oral, practical and theory examinations.
- Though this book is primarily meant for the M.B.B.S. students, it would be of immense help for the postgraduates too.
- Most attractive part of this book is a huge number of illustrations of various disease entities, operative findings and procedures, both original and diagrammatic.
- Including research methodology have been covered in details.

SHORT TEXTBOOK OF ANESTHESIA

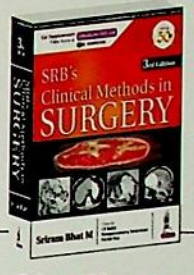


Ajay Yadav

Two Colour | Soft Cover | 6/e, 2018
6.75" x 9.5" | 344 Pages | 9789352704644

- Focuses on the topics asked more frequently in pre-PG examinations
- Most suitable for undergraduate and postgraduate aspirants
- A quick reference for practicing anesthetists
- Text is divided into nine sections to increase the comfort of reading
- Key points are given at the end of each chapter
- The most recent advances in drugs, equipment and techniques have been incorporated
- Cardiopulmonary resuscitation (CPR) guidelines are based on the American Heart Association (AHA), 2015, update.

SRB's CLINICAL METHODS IN SURGERY

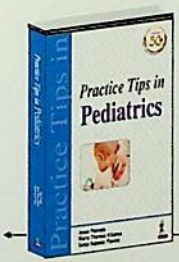


Sriram Bhat M

Full Colour | Soft Cover | 3/e, 2019
8.5" x 11" | 826 Pages | 9789352705450

- Thoroughly revised and updated
- It covers in detail clinical examination in various surgical areas a
- All chapters are thoroughly edited and proper photographs and diagrams are added.
- New chapters on Instruments, X-rays and Specimens added
- Added videos showing clinically is shown with a voice background which will be very useful to students while examining the particular patient.
- Useful to undergraduates, postgraduates of MBBS and MS as well as useful to Ayurveda and allied medical fields; and also useful for practicing clinicians

PRACTICE TIPS IN PEDIATRICS



Jesus Peinado, *et al.*

Single Colour | Soft Cover | 1/e, 2019
6.25" x 9.5" | 242 Pages | 9789386056719

- Quick reference for commonly seen in patient pediatric issues
- Organized by topic and subspecialty
- Addresses wide differential diagnoses concerns
- Assists in diagnostic workup and initial management of pediatric patients.

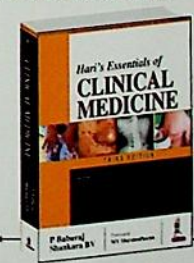
BEDSIDE CLINICS IN SURGERY

Makhan Lal Saha

Full Colour | Soft Cover | 3/e, 2018
6.75" x 9.5" | 1286 Pages | 9789352703142

- All the sections of the book have been thoroughly revised and updated.
- Mainly covers the oral and practical part of the examination.
- Special emphasis is given for elicitation of different physical signs.
- Surgical Problems (emergency and non-emergency) are discussed in detail.
- Surgical pathology section covers important specimens suitable for both undergraduate and postgraduate students.
- The book contains approximately 1,100 figures.

HARI'S ESSENTIALS OF CLINICAL MEDICINE



P Baburaj, *et al.*

Full Colour | Soft Cover | 3/e, 2019
340 Pages | 8.5" x 11" | 9789352705344

- Fully colored new edition
- Appropriate diagrams, tables and photographs are given to make the reading easy
- The book is useful for both undergraduates and postgraduates for proper clinical assessment of the patient
- The book can be a clinical guide for the teachers for conducting clinical classes.

JAYPEE
The Health Sciences Publisher

Please visit our website
www.jaypeebrothers.com or Scan the QR Code

Review of
OPHTHALMOLOGY

Review of Ophthalmology, a free companion to the book *Comprehensive Ophthalmology,* comprises Q
Test Review and Multiple Choice Questions (MCQs) which offers an in-depth revision at a glance an
opportunity for self-assessment. The thoroughly revised seventh edition has been organized into
sections:

Section I: Anatomy and Physiology of Eye

Section II: Optics and Refraction

Section III: Diseases of Eye and Ocular Adnexa

Section IV: Ocular Therapeutics

Section V: Systemic and Community Ophthalmology

Section VI: Practical Ophthalmology

Chapter layout has also been changed in the seventh edition. Now each chapter contains 'Quick Text Rev
material followed by related Multiple Choice Questions (MCQs).

Text is complete in itself to cater to the needs of the students appearing for various PG entra
examinations, namely All India PG, AIIMS, PGI, JIPMER, Delhi PG, and other state PG entra
examinations.

Aims to alleviate the need of time-consuming exhaustive textbooks during preparation for such compet
examinations.

AK Khurana MS, FAICO, CTO (London), Senior Professor and Ex-Head, Regional Institute of Ophthalmol
Postgraduate Institute of Medical Sciences (PGIMS), University of Health Sciences, Rohtak, Haryana, In
He has been teaching ophthalmology for the last about four decades. In addition to this book, he has wr
many popular books. His other books, namely *Practical Ophthalmology, Anatomy and Physiology of
Theory and Practice of Squint and Orthoptics, Ophthalmic Nursing* and *Modern System of Ophthalmo
(MSO) series,* have been well received by the medical students.

Dr Khurana has published about 200 scientific papers in national and international journals of rep
He has also contributed several chapters for postgraduate reference books published in India and abr
He has also been Editor of Haryana Journal of Ophthalmology, and Indian Journal of Strabismus
Pediatric Ophthalmology (IJSPO) and North Zone Journal of Ophthalmology. He was awarded W
Fellowship for higher studies at Moorfields Eye Hospital, London. He was also selected for a course
awarded certificate in Tropical Ophthalmology at International Centre for Eye Health, Institute
Ophthalmology, University of London, UK. He has been honored with Distinguished Author Award by
Federation of Educational Publishers of India, HOS Award for Excellence in Ophthalmology, Excelle
Award by Strabismological Society of India, Gold Medal by Intraocular Implant, Refractive Society of In
Lifetime Achievement Award by HOS and National Lifetime Achievement Award by Uttarakhand S
Ophthalmological Society (UKSOS), and Fellowship of All India Collegium of Ophthalmology (FAICO).

JAYPEE BROTHERS
Medical Publishers (P) Ltd.
www.jaypeebrothers.com
Join us on facebook.com/JaypeeMedicalPublishers

Shelving Recommend
OPHTHALMOLOGY
ISBN 978-93-5270-