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NAME: Radhika Gupta STD.: SEC.: ROLL NO.: SUB.: Glaucoma

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Management algorithm of a glaucoma pt:

↑ IOP
ONH abnormalities
Scotomas
Shallow AC.

↓

Gonioscopy

|

- Open angle
  - Primary
    - POAG
    - Juvenile
    - NTG
    - Ocular HTN
  - Secondary
    - Steroid induced
    - Pseudo exfoliation
    - Pigment dispersion
    - Traumatic
    - Pseudophakic

  → Medications
  Laser Trabeculoplasty
  Trabeculectomy

- Occludable Angle
  - Primary angle closure
    - PACS
    - PAC
    - PAC with OHT
    - PACG
  - Secondary angle closure
    - Neovascular
    - Uveitic
    - Pseudophakic.

  → Laser Iridotomy
  Medication.
  Trabeculectomy

CLASSMATE Date Page

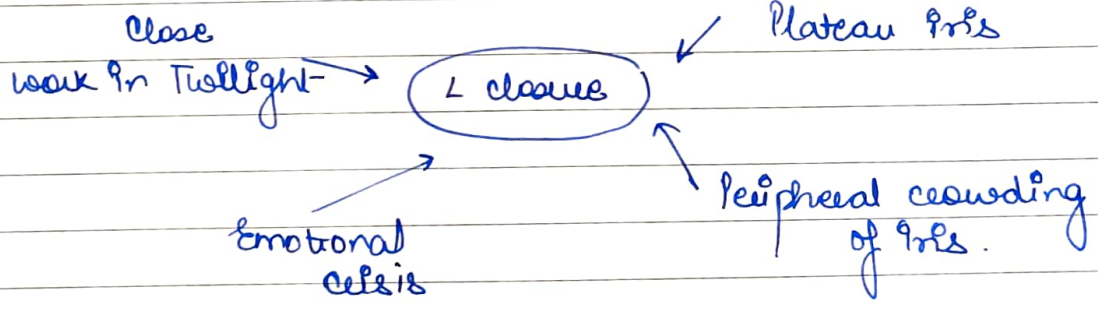
Primary Angle Closure Disease

Def Spectrum of condition in which peripheral iris moves forward to block the opening of trabecular meshwork by an occludable angle causing ↑ IOP.

Epidemiology Asian, Eskimos ♀ »
Asymptomatic variety » ♂
» 1° degree relatives

Predisposing factors Anatomic features
- a short eye
- small corneal diameter
- shallow AC
- Relative anterior positioning of lens-iris diaph

In small eye - Lens is normal sized ∴ growth at its own pace ∴ crowding AC.



Occludable Angle - Inability to see posterior trabecular meshwork over more than 180/270 degrees with patient looking straight ahead.

Gonioscopy

Manipulative
To look into Angle recess
Extent of synechiae
↓
Asking pt to look into mirror

Indentation
Allow visualization of depth of ∠ recess

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Classification.

(a) International society of geographical Ophthalmology

- Primary angle closure suspect (PACS)
  - An eye in which apposition contact b/t peripheral iris & TM is considered possible
- Primary angle closure (PAC)
  - An eye with occludable drainage ∠
  - + features of trabecular obstruction by peripheal iris
    - → Peripheral Ant synechiae
    - → ↑ IOP
    - – iris whorling
    - – glaucomaflecken lens
    - – excessive pigment deposition on TM.
  - × Optic disc changes
- Primary angle closure glaucoma (PACG)
  - PAC
  - + glaucomatous optic atrophy

(b) Clinical classification

- Primary
- Subacute.
- Acute.
- Chronic.

Angle Closure

Primary

Dark room provocative test used as Dx tool.
↑ IOP by 8mm of Hg is Dx

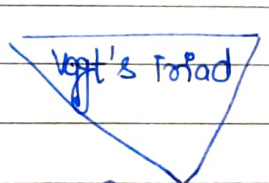
Subacute

Symptoms		Until headache Brow ache Blurring of vision Unbroken coloured haloes └ confirmed by Fincham test
Ant seg	Shallow AC	Shallow AC Occludable angle evidence of Angle closure └ PAS └ Blotches of pigments
Gonio	Occludable angle Angle recess in such eyes $<20^\circ$	
IOP		sharp ↑IOP for short period ↓ followed by spont resolution of pupillary block.
ONH		
Therapy		

e glaucoma.

Acute.	Chronic.
Sudden occlusion of entire ∠ ⊆ acute ↑ of IOP.	**Causes** ↳ Repeated subacute attacks ↳ Acute PACG > few hrs ⇒ Irreversible synechial closure → Permanent damage of TM ↳ Asymptomatic / Creeping ∠ closure Iridotrabecular Synechiae
headache — severe Unilateral Diminution of vision Red eye. Nausea »	
Ciliary / Conj congestion. Corneal edema. shallow AC. Iris bombe ⊆ vertically oval, mid dilated pupil.	
Post resolution of Corneal edema ↓ Extensive IridoCorneal Synechiae.	Synechial closure over atleast 180°
↑	Chronic ↑
Optic disc hyperaemic or. N	↑nt with visual field change

Secondary Iris atrophy



Glaucoma flecken.

Pigment dispersion on Corneal endothelium.

Treatment

i.v Acetazolamide 2 vials
i.v Mannitol.

Strong → No CVD

↓

↓ IOP | relieve ischaemic changes in iris | ↓ Corneal edema

↓

attempt gonioscopy

↓

Pilocarpine 2%

↓

Pupil contracts to be blocked

↓

Pressure applied on central part of cornea ⊆ sclera

↓

displaces Aqueous

↓

Laser Iridotomy

PACG eye.

fellow eye as Px

Laser Iridotomy

Nd:YAG Laser
150÷200 μ

Pilocarpine 30 min prior to keep iris taut

In mid peripheral iris at 1 or 11 O clock

↓

Identify Crypt

↓

Power 3-6 mJ & thickness

Post op → Steroid, Antiglaucoma medication 5-7
check patency on follow up visit

Glaucoma Drainage Devices

History

Horse hair – 1906
Setons – suture, glass, plastic material
Long tube connected to distal end plate

Indications → Medically uncontrolled glaucoma where trabeculoplasty fails

- → NVG
- → Uveitic glaucoma
- → Fibrous downgrowth.
- → ICE.
- → Prior Cataract
- → PK
- → Congenital glaucoma
- → Scleral Ectasia

Structure

Silicon tube – shunts Aq from AC
↓
End plate – Equatorial region of globe
Fibrous Capsule over the plate
Aq → passive diffusion ⇒ Peri-Ocular Capillaries

IOP reduction ∝ Capsule thickness ← Modulated by BSS or Mitomycin
Surface area.

Physiology

Tube (silicon) from AC

↓

disc / plate / Encircling elements beneath Conj & Tenon

Ridge

↓

Ou Ext plate.

thr ⊆ distal end of tube inserts on upper surf of plate.

↓

↓ risk for obstruction of post opening of tube ⊂ surrounding tissue & fibrous Capsule

1) After insertion

↓

fibrous Capsule that forms filtering bleb around Ext portion

↓

Thin collagenous capsule surrounded by granulomatous rxn at thr

↓

resolve in 4m

↓

Capsule thickness stable & remains thin

↓

• diff to ↓ early Postop hypotony.

Implant design

- Valved
  - Open, Unobstructed drainage tube
  - Flow restricted Valve Mech.
    - AGV
      - Polypropylene → Inflammat^n
        - S2 ← 96 mm^2 → FP7
        - S3 ← 184 mm^2 → FP8
        - * B1 ← 364 mm^2 → FX1
      - Silicon
    - Krupin
      - Joseph
      - Optimed
      - Mute
- Non Valved
  - Pressure regulated valve
    - Baerveldt
      - ↓
      - Barium
      - Schocket
      - Tube
      - Shunt
    - Molteno
      - ↓
      - Propylene
        - Single 134 mm^2
        - Double 268 mm^2
        - Paed 74 mm^2.

+ fenestration

Plate.

- Single plate
- Double plate. *

Consist of Silicon Elastomer membr.

Material

- Polypropylene
  - ↓
  - » Inflammation
- Silicon
- Hydroxylapatite.
- Expanded Poly TFE. (PTFE)
  - ↑ Vascularizat^n of fibrous Capsu
  - ↑ efficacy
  - ↓ Capsule size
  - ↑ final lifetime of implant

AGV.

Valve with 2 silicon elastomer membs 8x7mm allows one way regulation of flow ⊆ goal of keeping IOP 8-10 mm

↓

2nd plate → Implanted in 2nd Quad to ↑ SA by 180mm²

to ↑ SA by 180mm²

Inlet Cross section > Outlet

∴ Small pressure differential b/t AC & subcon space

HTN phase → Transient phase of ↓ Capsule permeability 4-8wk

Obstructions

Tube related

Capsule/Valve related

No touch zone — area of implant covering chamber ⊆ silicon leaflets

↓IOP

Double plate Motteno ⊆ Mito > Ahmed ⊆ disc > AGV.

↓ required for Another OX

Krupin.

Concept of 1 way valve open at predetermined IOP values

Schocket.

Si tube from AC to 360° encircling Si band. (at RD repair)

Large SA as c/o Molteno but Molteno better IOP lowering

Baerveldt.

Basium.

Large surface area. Implanted through 1 Quad Cay incision

250 mm² 350 mm²

Plate under rectus mal insertion.

→ Superotemporal Quad

→ fenestration also

allows growth of fibrous tissue | ↓↓ of bleb | ↓ risk of diplopia | Secure implant

Molteno.

Longest experience

Single plate | Thin acrylic < dia - 13mm, Area - 135mm²

Ext dia - 0.6mm. Int dia - 0.30mm

- Connects to upper surface of plate.
- Plate has fenestration - sutures.

Single | Double plate

» IOP control

» hypotony

dual chamber. ←

Single plate

V shape Reservoir

Molteno 3

Bowl shaped

acts as Biological valve.

Malignant Glaucoma

Terms Ciliary block G., Aqueous Misdirection, Direct Lens block ACG

def G occur as complications of various Ocular surgical procedures

- G Sx
- Cataract
- Corneal transplant
- VRSx.

Malignant occs no response to conventional therapy.

c/f

- Classic Malignant G
  - Unil
  - Post incisional Sx
- MG in Aphakia
  - diff dm.
  - Pupillary block.
  - Supraciliary Hmg
- in Pseudophakia

Miotic induced ~~Mode~~ MG
- Crowd of CB.
- forward shift of lens
- AC shallow.

Spontaneously

MG as c Bleb needling.

Other ocular disorders
- after PPV

c Inflammat° & infection.
- Endoph by Nocardia q.

Theories

Post pooling of Aqueous
- Ag behind PVD
- echo free zones in Vitreous

Cilio lenticular or Ciliovitreal block.
- Ant rotation of Ciliary processes

Ant Hyaloid obstruction.
- Break in Hyaloid
- Obst in Ant Vitreous face Aq flows & fluid accumulates

Shortness of Lens
- Zonules
- forward mo
- Lens-iris dia
- laxity of Zon

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AOA

Pupillary block

MG
deep
shallow
✓

PB
Central AC
PI
Deep
shallow
× patent

Choroidal detachment

AC - flat (Secondary)
Hypotonous eye
CSCJ - C.D
Mx - Spont.
Scleral incis in Inf Quad

Management

Suprachoroidal Hmrg

» Pupil dilated
dark red brown elevation

Medical

Mydriatic - Cycloplegics
types - Osmotics

Maintained on.
Atropine Rx to
avoid recurrence.

Surgical

Other eye

Px PI

Laser Tech.

Arg / YAG Photo Coag of Ciliary processes
Transscleral DLCP

Slit lamp
Needle aspiration.

Ant hyaloid face

Post sclerotomy
&
Aftr infection

3mm behind

Ant PPV

Lens extraction

Incision of Ant hyaloid face

Deep incision into fluid pockets.

Post PK Glaucoma

Early | Late (>3mth)

- Phakic 11-38%
- A 42-89%
- Overall - 30%

Late → if Pre-Op IOP ↑

Factors

- Recipient age > 60yrs
- Aphakia — Aphakia > Pseudo > Phakic
- Pre-Existing gl
- Pre-Op Dx of Adherent Leucoma
  - BK
  - Herpetic Keratitis
  - Trauma
  - Keratoconus
- AS reconstruction.
- ass c Vitrectomy
- ↑ after Cataract Sx ICCE >>
- Repeat PKs
- Technic PK ∞ Corneal Endo Scar Pre-Op.

Danger - 90 A.

↑ Incidence of associated graft failures.

Mechanism

Early.

- Uveitis
- Hyphema
- Pupillary block
- Steroid induced

↓

Collapse of TM
Loss of Ant supp.
due to incision in DM
If Aphakia - No Post supp
Loss of loss of zonule

- Through & through sutures
- Superficial

Compression of AC angle.
↓
PAS formation

Late.

due to intact Vitreous face

If graft rej → steroid
Sign of S → c pseudoph.
- Congenital Opaque Cornea

PAS
Long term steroid
Withdrawal in graft c

Mx

Prevention

↳ TM support.

↳ x in KC (↑ Myopia)

↳ Donor graft → Deep AC

Looser & shorter suture bite

(↓ tissue compression)

Smaller trephine size.

Thinner peripheral host Cornea.

Larger Host Corneal diameter.

Rx → Placement of sutures near pupillary portion of flaccid fits to create taut fits.

Rx

↳ Medical

✓ Topical steroid

✓ Mydriatics, β blocker, α_2 Adr, Ag

x CAI, Topical ↳ PG Anal

↳ Cornea decomp

↳ Dx ↳ Loose fit → Traub c Mucus

GDD

Cyclocryotherapy

↳ FS DLCP ⇒ ↓ graft decompensation.

Same size donor → Compression of Corneolimbal L.

↓

Compromising TM.

Instead of ↑ IOP → Tight Sutures

Longer bites.

Larger trephine size.

Small total recipient CD.

↑ Peripheral Corneal thickness

Nesco.

Additional Rx procedures

Post op.

PAS

Epithelial outgrowths

Steroid induced

Thinning of Corneal Stroma → Epithelial Edema

Instruments – OBF pneumotonometer
Tonopen.
Dynamic Contour Tonometer.

Plateau Iris

One of Mechanism of ACG.

- Relative Pupillary Block
- Plateau Iris Configuration
- Phacomorphic
- Malignant

If PI for presumed PB has failed → think of Plateau Iris.

- (A) Plateau Iris Configuration.
- (B) Plateau Iris Syndrome.
- (C) Pseudoplateau Iris.

(A) Plateau Iris Configuration

- Closed angles c flat iris & normal central ACD
- Also described in association c long anterior zonules
- Swelling of ciliary body or forward rotation of CB = Plateau like configuration of Iris
- Sulpha based Compounds
- Use of TCZ, Oral Diamox, Topiramate.
- Supraciliary effusions + CB thickening produce ACG by
  - Ant Iris rotation.
  - Induced PB.

Plateau Iris Syndrome

Peripheral iris — Ant displaced

UBM based Mech — Ant positioning of ciliary processes

↓

Post PI, peripheral iris prevented from falling back

↓

Progressive anterior dislocation of CB & bolstering of peripheral iris & formation of PAS.

Clinically

↓

Patent PI yet

- Shallow PACD
- ACG attack
- Gonio high plateau iris

Think of Plateau Iris Syndrome

Additional Confirmatory Test — UBM / provocative AC with 2.5-5% phenylephrine.

Rx

- dilute pilocarpine at bedtime.
- PI.

Pseudoplateau Iris

Cysts of Iris or CB.

- Plateau Iris
- Pseudoplateau Iris
  - ⇒ TM pigmentation.
  - ↓ clock hrs of gonio angle closure
  - ⇒ OR
  - Bumpy peripheral Iris configuration

→ UBM

↓

Confirm Dx

- P° Cyst
- S° Cyst
  - Traumatic implantation of epithelia
  - Metastatic
  - Parasitic lesions
  - Miotics use.

Rx

if Angle closure

- significant
  - Puncture Cyst.
  - Laser Iridoplasty
- Not significant
  - ↓
  - good prognosis

Complications Post Trabeculectomy

Intra Op

- Button holing of conj flap
- Haemorrhage
- Choroidal effusion
- Vitreous loss
- Lens injury
- Stripping of DM
- Tearing of scleral flap

Post Op

Early

- Uveitis & Hyphaema
- Bullen
- Loss of Central vision
- Ocular decompression retinopathy

Late

- Late failure of filtration
- Leaking filtering bleb
- Bleb related infections
  - → Blebitis
  - → Endophthal
- Cataracts
- Overhanging filtering bleb
- Spontaneous Hyphaema

- Sympathetic Ophthalmia
- → Corneal changes
- → Eyelid changes
- Hypotony & CD

IOP	↓	↓	↑	↑
AC	flat	deep	flat	deep
	• Conj defect • Excessive filtration • Serous Choroidal detachments	⇓ Hypotony Maculopathy	• Aq Misdirection Syndrome • Incomplete iridectomy with pupillary block • delayed suprachoroidal Hging	• Flat scleral bleb • Obstruction of fistula • Bleb fail

Mx

Complication

a) Buttonholing of conj flap → gentle handling
close tenon by 10-0 Nylon sutures
figure of 8
Tissue adhesive / Cautery
BCL.

b) Haemorrhage
Episcleral bleeding → Irrigation, Cautery
Cutting of CB → Cautery, Pressure & Sponge
Large bubble in AC
- CD, Explosive thing
Large choroidal Leak → Immediate closure of fistula
» ↑ PreOp IOP. - Incision in inferotemporal quadrant to allow blood to drain
generalized atherosclerosis
↑ IntraOp pulse

c) Choroidal effusion.
↑ episcleral vessels
Sturge Weber Syndrome
Nanophthalmos
↓ protein
identified → Sudden shallowing of AC
→ Retention of iridectomy through surgical fistula.
- Scleral incision 3-5mm post to limbus
- Placement of post sclerotomies before & after Trabeculectomy

d) Vitreous loss
rupture of Zonules & HM
Sponges, Scissors, Vitrectomy instruments

e) Torn scleral flap
Replaced & donor Sclera
Pericardial graft (Tutoplast)

f) Uveitis & Hyphaema.

U → Topical cs
Mydriatic - cycloplegics

» Inflamm → ↑. cs dose

Hyphaema → elevation of head & limited activity

└ Prevention - sclerotomy anterior to scleral spur ∴ " SL

g) Sellers.

Tear replacements
BCL.

h) Loss of Central Vision.

Snuff Out Syndrome

Rf → Old age, hypotony & pre-op macular splitting in VF.

Minimize post-op extremes of IOP.

i) Ocular Decompression Retinopathy

↑ Pre Op IOP ⊆ sudden decompression → RVO.

↓ IOP & flat AC

Shallowest D2, D3.

flat	shallow
Cornea lens touch	iridoCorneal touch
Cornea swollen flattened	Cornea clear
	Iris stroma not flattened by gentle touch

Assc ↓ Endothelial Cell Count
PAS formation

early — Mx — Wait & watch. >> 2 wk then reform

Mx

- Careful closure of scleral flap
- Meticulous Conj closure
- Injection of Visco in AC
- Use of Combination of long acting gas & visco-elastic material
-

Causes

- Conjunctival defect
  - Pressure patch
  - fusiform shaped cotton ball
    - straight ahead
    - Morn – Evening
  - Large diameter CL
  - Cyanoacrylate tissue
  - Topical CS → ↑ fibrosis
  - Injection of autologous fibrinogen conc

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Excessive filtrations

- Loose scleral flap closure
- Large filtering bleb

Prevention – Multiple nylon sutures
Releasable sutures

Mx

- BCL.
- Tissue patching
- Air
- Gases 15% PFP 50% SF_6
- Visco in AC

Serous Choroidal Detachments – Hypotonous eyes + Inflammation + Venous Congestion

↑ in protein.

↓ Aq prod | ↑ Uveo & scleral outflow

resolve if 7-9 mm Hg IOP

drain by: Inferior sclerotomy & deepen AC by Visco

↓IOP & deep AC

× Worry

✓ If Wound Leak
↑ Inflammation
Post pole abnormalities

Hypotony Maculopathy

Findings — fine macular striae radiating from fovea
Myope extensive choroidal folds
Tortuous retinal vessels.
Disc swelling
↓ VA.

Risk factors — Young, Myope.
Pre-Op CA Inh use.
filtering Sx ± MMC use.

Prevention — Minimize antifibrinolytic use
• Tight sutures

Treatment — Pressure patching
TCA application
Cryo to bleb
Oversized BCL
Inj of autologous serum
Cony | Compression sutures
Resuturing | scleral flap
Patch grafting
Transcony sutures through scleral flap
) Excise bleb → Undermine adj Cony
↓
Create new filtering bleb ← pull it down to limbus

↑IOP & flat AC

- Ag Iridectomy syn
- Incomplete Iridectomy with pupillary block
- Delayed Supra choroidal Hmrg.

Delayed Supracharoidal Hmrg → ↓ IOP → ass ⊆ RD & 360°
SC haemorrhage

- Rx for surgical Intervention
- Kissing choroidal detachments
- Vitreous incarceration.
- VR adhesions

Even after Visco-Canalostomy — Risk is there.

↑IOP & Deep AC

Right flap → Laser suture lysis

Obstruction of fistula by Iris, CP, lens, Bld, Vitreous
L Evaluate by gonioscopy
- Ag Laser therapy & Nd YAG LASER
- Revise the filter.

⇓

If no obste found

Failing Bleb. | Encapsulated Bleb.

~~Filtering Bleb~~ – ~~Low to flat, heavily vascular~~

Failing Bleb.

- Low to flat
- Heavily vascularized & no microcysts

- Cs (PA) 1% fully
- Remove scleral flap sutures
- TPA Injected Sub Conj
- 5FU
- Digital Rescue.
- Anesthetic moistened applicators beside edge of scleral flap
- Suture Lysis.
- Blood clot obstructing
  - ↳ Intracameral TPA 6-12.5µg
  - ↳ Subconj " "

⇓

Fail

⇓

Anti gl drugs
& repeat Sx & MMC
or
Drainage device.

Encapsulated Bleb.

Tenon Capsule cysts
High Bleb phase
⇒ Highly elevated, smooth domed blebs & large vessels but intervening avascular spaces & no microcysts

Dx gonio – Patent sclerotomy & stationery set of vessels beneath Conj.
» 2 mths of Sx

RF Long term glaucoma Rx
Congenital & JOAG

Tx Resume drugs till it works
Digital Rescue.
± steroids.
± Early Needling

Late Complications

Late bleb failure – Mech – closure of fistula

Histo – ↑ fibroblasts, new collagen
hypocellular capsule of fibrous tissue lined by thick layer of fibrin

Mx – incise the membrane
Arg laser Rx – Pigmented
No yag – Non "
Rest.

Leaking filtering bleb – Too thin. – Rupture – Endoph.
If → Large avascular areas, small, focal, cystic blebs
severe coughing
oozing – » 5FU. Point Leak – Large Avasc area
Use Seidel test. Rx – Soft SCL
Bandage Coverage
Cyanoacry glue, Autologous fibrinous glue

Sx revision → Resection of bleb.
Creation of new conj flap post to defect
Rotational conj flap
Conj – x sufficient – Autologous conj grafts

Histo – epithelial tract running from surf of bleb to episclera.

Exc draining fistula & – Autologous tenon & ½ thickness scleral patch grafts.

Bleb related Inf.

	Blebitis	Endoph.
	White bleb ± Intense Conj injection. Variable degree of AC rxn. Vitreous – clear.	Milky white ± Out ± Cat opt defects., hypopyon int ✓✓
	Limited foam.	Virulent. ↓ vision, redness, pain. diffuse Conj congestion
Incid	1.1 – 1.3 %.	» Inferior » ± NVC
Org		Staph E, Strep Sanguis, Haemophilus Influenzae.
Rf	Early, Chronic, Intermittent bleb leak. ↑ AL, Conjunctivitis, URI, Winter season, Intra Op MMC, AB use after Post op period.	Thin walled, filtering bleb Early – Staph epididermidis Late ± Strep
		Rf – Inferior, Blepharitis, DM, Ao Bug CL use
		(CF) focal granulomatous uveitis
Rx	Topical Antibiotics FQ – Topical fortified Cefall Steroid — depending on Surgeon	Rx as Endoph ✓ Vitrectomy
Prog	» than Endoph.	

	✓	✗
fornix based 	Easier to create Good Sx exposure Easier to identify Sx landmarks Avoid Post Conj Scaring	Harder to excise Tenon's Short Aq leak at limbus less (↓ IOP post op)
limbal based 	Easier to excise Tenon. Argon laser lysis of sutures SubConj 5FU inj. digital pressure ↓ post op IOP lower.	- Ant dissection of Conj flap is difficult as inadvertent post in fornix - Post Sx exposure » Conj Manipulation

Small Dose Bleb — Sweating Bleb

Overhanging Bleb / Bleb dysthesia

Small Procedures

- Revision of Bleb →
  Incision made through peripheral cornea 90-180° from fistula.
  ↓
- Viscoelastic injected to maintain deep AC
  ↓
  Cyclodialysis spatula passed through incision & into fistula to elevate scleral flap
  ↓
  Break adhesions along the margins & a sweeping action of spatula.

Digital Pressure - Apply steady pressure & index fingers to superior sclera through lower lid for 15s
↓
Apply pressure & index fingers & tip through UL behind bleb

Laser Suture Lysis - Argon USED 50µ. 0.1s. 250-1000 mW.
→ krypton or diode.
1st three weeks

through cay → Compressed & Cornea of 4 mirror goniolens
Hoskin lens
Ritch lens.

Remove 1 suture. — Re-assess status of eye

↓ * (Bleb formed, IOP ↓) → Next day

↓ X

the later other suture.

Needling 25-30 G needle is passed beneath Conjunctiva.

last 5-10 min from bleb.

↓

Balloon up Conj

↓

Passes into bleb to puncture & incise fibrous episcleral tissue

↓

(Modification) ⇒ inject 5mg of 5FU. (10mg/ml — 0.5cc
50mg/ml = 0.1cc

⇒ dissect Conjunctiva from fibrous tissue

↓

Completely excise it

↓

resuture it.

Pigmentary glaucoma

Typical finding & glaucoma.

\+ → Pigmentary glaucoma

\− → Pigment Dispersion Syndrome.

general features — Male, myopic

Males have ↑ AOD.

Exs induced. — ↓ by pilocarpine

Phenylephrine induced mydriasis.

Of

Krueck Window Sign

Cornea

Krukenberg spindle

↓

Accumulation of pigment on post surf of cornea in a perfect spindle shape manner

⇓

Aq. Convection currents

⇓

Phagocytosed by adjacent end

⇓

♀ → Removal

Pleomorphism & Polymegathism | cells

Iris

Transillumination defect

↓

Mid periphery

↓

If not seen then by infrared Videographic tech

↓

Anisocoria. Jn. Horner's

Heterochromia

Look for pig

- Post lens capsule
- Zonules
- Ant of filtering bleb

Gonio

↓

Pig along TM

+

Schwalbe line

⇓

Sampolesi Line.

Fundus

RD

Egger's line

↓

Pigment deposit on Ant hyaloid face

Scheie's stripe.

Cantmayer line

Theories of Apch

a) Developmental abnormality of iris pigment epithelium
   - focal atrophy, hypopigmentation
   - apparent delay in melanogenesis
   - hyperplasia of dilator muscle
   - hypovasc of iris.

b) Background bowing of peripheral iris ⇒ Mechanical rubbing of lens zonules against iris pigment epithelium!

Post bowing goes ⊆ ↑ age ∞ ↑ AL

↑ ⇒ Exercise

↓ = PI done, Miotics, prevention of blink

block goes

Concept of reverse pupillary block.

c) RPB – One way valve effect

d) Elongated Ant granules that may be pigmented — zonule free zone of 6.9mm

Mech of IOP elevation

No. of Ag. Melanin granules ⇓ debris.

Changes in Trabecular endothelial cells & collagen beams.

Variant of COAG.

Trabecular cells engulf melanin → Cell injury & death from phagocytic overload → ½ digested Melanoprotein ⇓ Retained in Intracellular storage vacuole → generate free radical

Md migrate to Necrotic Trabecular cell ← debris thr Schlemm Canal ← Circulation

These cut dc Sac ↓ Pu PDS ∴ ↓ Aq. Outflow

DoD

- Pseudo Exfoliation Syndrome — Peripupillary area
  - L Old age, typical lens appearance

BIL
- Uveitis
- Trauma
- Ocular Melanosis
- CB. Melanocytoma
- IO Sx
- COAG ≤ Excessive Pigment dispersion

Unil
- PCRA displacement
- Unil Angle recession.

Mx

- Medical Rx
- LASER.
- Incisional Sx
- Physical activity
  - 0.5% pilo

Medical Rx

Miotics

- Pilocarpine — ↓ Mech of PDS
  ↓ IOP by direct effect
  bt young — Induces Myopia
  Risk of RD.
- Thymoxamine — × Cycloplegia
- Dapiprazole. → ↓ effective
  ∴ No longer used

- Analogues
- β adrenergic Antag
- CA Inh

LASER

PI done.

- Dilute Pilo.
- Consensual reflex for Constriction

Argon or SLT.

Classification of glaucoma

Staging of glaucoma

a) Initial events — Events leading to stage 2-5.
- Pressure related - Acq.
- P. indep - genetic, toxic susceptible to apoptosis

b) Early structural alterations — Tissue changes
- P. sel - Alteration in Acq. outflow system
- P. unsel - GC & ONH

c) Final alterations — Physiologic change
- Psel - ↑ IOP
- Punsel - ↓ Axonal Conduction, Vascular perfusion, lamina deformity

d) ONH. damage - RGC & Axonal loss — GON, Visual field loss

e) Visual loss - Progressive loss of visual field. — " "

Classification Based on Initial Events

- Open ∠
  - without other known ocular & systemic disorder
    - COAG
    - NTG
- ∠ Closure
  - Pupillary block
  - Combined Mech. glaucoma
- Developmental
  - Congenital
  - JOAG
  - Axenfeld Rieger Peter Anomaly
  - Aniridia
  - Others
- Gl. ass ⊆ with ocular & systemic disorders

- Disorders of Corneal endothelium
  - ICE
  - PPD
  - FECD
- Iris & CB
  - Pigmentary gla
  - Iridoschisis
  - Plateau Iris
  - Iris & CB cyst
- Lens
  - Exfoliation
  - ⊆ Cataracts
  - ⊆ lens dislocat°
- Retina, Choroid & V
  - NVG
  - ⊆ RD

- IO Tumour
  - Malignant melanoma
  - Rb
  - Metastatic Ca
  - Leukemia
- ⊆ Inflammation
  - Uveitis
  - Keratitis, episcleritis, Scleritis
- IOS$_N$
  - Malignant
  - Pseudophak.
  - C. SX
  - VRSX
  - Epithelial, fibrous, endothelial proliferat°
- Steroid induced
- O. Trauma
- Hmeg
- ↑ Episcleral venous Pressure

Classification based on Mech of Outflow obstruction

Open

- Pretrabecular (Membrane Overgrowth)
  - NVG
  - Endothelial layer
    - ICE
    - PPS
    - Penetrating & Non " trauma
  - Epithelial downgrowth
  - Abnormal Ingrowth
  - Inflammatory Membs
    - Such HI
    - Luetic IK.
- Trabecular
- Post Trabecular

(b) Trabecular (Occlusion of Intertrabecular Spaces)

- Idiopathic
  - COAG
  - Steroid induced
- Obstruction of TM.
  - Visco
  - α chymo Induced
  - Vitreous
- Alterations of TM
  - Edema
    - Uveitis
    - Sclerotis
    - Alkali burns
  - Angle recession
  - IOFB

- RBC
  - Hemorrhagic
  - Ghost cell
- MΦ
  - Hemolytic
  - Phacolytic
  - Melanomalytic
- Neoplastic
  - Malignant Tx
  - NF
  - Naevus of OTA
  - Juvenile Xantho granuloma
- Pigment particle
  - Pigmentary
  - Exfoliation
  - Uveitis
  - MM
- Protein
  - Uveitic
  - Lens Induced

Post trabecular

- Obstruction of Schlemm Canal
  - Collapse of S. Canal
  - Obsta (Sickled RBC)
- ↑ EVP
  - CST
  - CCF
  - Retrobulbar Tx.
  - Thyroteopic Exophthalmos
  - SVC obstruction
  - Mediastinal Tx.
  - Sturge Weber Syndrome
  - ↑ EVP

Angle Closure

- Ant (Pulling)
  - Contracture of Memb.
    - NVG
    - ICE
    - PPS
    - Trauma
  - Contracture of Inflammatory ppt
- Post (Pushing)
  - (+)
    - PBL
    - Lens induced
      - Intumescent
      - Sublux of lens
      - Malale lens syndrome
    - Post Synechiae
      - Iris/IOL block in Pseudophakia
      - Uveitis & Post Synechiae
      - Iris-Vitreous block in aphakia
  - Papillary Block
  - (-)
    - B

Plateau iris syndrome — CB glaucoma — After lens extraction (forward vitreous shift)

→ B

- 2° to scleral buckling Sx
- 2° to PRP
- CRVO
- Cysts of Bbs & CB

→

- Lens induced
  - Intumescent
  - Subluxation.
  - Phacle lens syndrome
- IOT x
  - MM
  - Rb.
- Pseudoexfoliative tissue contracture
  - ROP
  - PHPV.

Developmental anomalies of AC

- High insertion of anterior Uvea
  - Congenital
  - Juvenile
- Incomplete development of TM/SC.
  - Axenfeld R.
  - Peters.
- Iridocorneal adhesions
  - Broad ~~Sheard~~ steands
  - fine steands that contract to close ∠ (Aniridia)

Epidemiology of glaucoma

Refer studies & recent data.

Natural H/O — fig 9.2 / 153.

Latency → Detectable preclinical phase → Clinical phase

- Latency: Normal; Glaucoma suspect
- Detectable preclinical phase: Early, Moderate] Gfl
- Clinical phase: Advanced gl

Clinical risk factors for COAG

- General
  - Age
  - Race
  - Family H/O
- Ocular
  - IOP
  - ONH & Peripapillary features → Disc Hrhg, PPA
  - Myopia
- Systemic
  - DM
  - BP — Diastolic → Nocturnal arterial hypoTN & NTG
  - Migraine
  - CSF pressure

Prognosis for Blindness from COAG

a) Risk for blindness
b) Risk factors -:
- Advanced stage
- Young age
- Inadequate IOP control
- ↑ rate of progression despite Rx

Prognosis for Blindness for ACG & 2° glaucoma

- Undx. gl
- Missed Opportunities for Dx & Under Rx
- Non adherence &

Strategies for improving blindness →

- Improved early detection
- Improving coverage of case finding
- " " accuracy " " "
- Screening for COAG
- Cost effectiveness of "

Glaucoma Suspect

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Definition

Gonio — Open Angle + Any 1

- GAT > 21 mm of Hg
- OD, RNFL appearance s/o G
- Disc Rim — diffuse / focal narrowing / sloping
- NFL — diffuse / focal abn] at sup & inf poles
- Disc Hmeg
- Asymmetric appearance of disc b/t fellow eyes (>0.2)
- VF s/o Early G damage.

Prevalence & development of COAG -:

G suspect — COAG 1% over 5-15 yrs

Ocular HTN → COAG over 5yrs

Medicat^{n} 1%

Observat^{n} gp 2%

High risk gp → GONO 3-5%

High risk / suspects

- IOP > 30
- Thin CCT
- Vertical CDR > 0.7
- Old age
- Abn VF (↑ PSD)
- + Exfoliation / PDS
- Disc Hmeg
- family H/O
- fellow eye ⊆ Adv G
- Additional

Ocular

- Suspicious disc
- Myopia.
- ↓ ONH perfusion
- Steroid responders

Systemic

- African ancestry
- Sleep Apnea.
- DM
- CVD
- HTN
- HypoT
- Myopia
- Migraine
- Vasospasm.

Screening / Early detection.

IOP → ONH → VF
- Manual
- SAP
- SWAP
- FDT

IOP

↑ CCT, adjust for CCT
2.5-3.5 mm / 50µ.
GAT is calibrated for 520µ

Slit lamp → ACD
Angle recession
PDS
Inflamm.
Exfoliation

Fundus → Red free.
Additional tools to document NFL

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Explain new methods – HRT, RTA, GLO

- Ocular Bld flow – ↓ OT (16%) → Cup (55%) ↑ IT (22%)

Risk factors

When to Rx

Categorize

- High → Rx
- Moderate → Can Rx or Close observe
- Low → IOP, ONH monitor → Rx if progression

Also Consider –: Greater age & life expectancy
Psychological factors
Comorbidities
Social environment
Availability for follow up
Pseg.

Guidelines for follow up.

Rx	Target IOP achieved	↑ risk	Follow up Interval: Exam.	Follow up Interval: ONH/VF Eval
X	N/A	X	6-24	6-24
X	N/A	✓	3-12	6-18
✓	✓	✓	3-12	6-18
✓	X	✓	<4	3-12.

gonio if pt to be started on Miotics.

Normal Tension Glaucoma

Variant of COAG.

CNTGS

1/3
↓
confirmed localized visual field progression at 3yr

1/2
↓
further deterioration at 7yr

EMGT

76% progression on ONH & VF after 4yr.

* Sf. diurnal IOP normal but progressive changes consider night time IOP peak.

Clinical features

	NTG	POAG
IOP	High normal range Wider diurnal variation.	>21 mm Hg – risk factor
CCT	Prognostic info >>	Normal Thin CCT = Actual IOP >> but risk +/-
AC gonio		Open >> iris processes High insertion of iris root >> TM pigmentat^n >> ° segmentat^n in Pigment^n
ONH	>> Thinning RNFL → >> localized defects closer to Macula, >> diffuse defects.	RNFL . ↑ Cup , PPA Saucerizat^n of NRR, Disc thing
Visual abnormalities		Central retained Contrast, Colour may ↓.
Visual fields	Deeper. >> Localized scotomas ↑ depth & Area constant	Initially ↑ area Later depth.

NTG Theories

(a) **Ocular Vascular Abnormality** –:

- **Non Progressive** ↓ → ass ⊆ transient episode of vascular shock
- **Progressive form** ↓ → Chronic Vascular insufficiency of ONH

Associated findings –: Hemodynamic Causes

- ↓ Dia. Ophth dynamometry levels
- ↓ O. pulse amplitude
- Bil complete Occlusion of ICA ⊆ reversed OA flow
- focal arteriolar narrowing around ON
- ↑ Vascular resistance of OA by colour Doppler.
-

Systemic Vascular Abn

» Nocturnal BP deep
↑↑ Diastolic BP
» lack of autoregulation of ONH circulation

∴ 24 hr BP monitoring
↑ freq of headache & ∝ ⊆ out migraine

(b) Impaired Ach induced peripheral endothelium mediated Vasodilation

↓

Polymorphism of Endothelin Receptor Type A.

Vasospastic events involved.

(c) ↑ Bld viscosity, Hyper Coagulability
(d) ↑ cholesterolaemia
(e) Diffuse cerebral ischaemia (In MRI)
(f) Immune Mech :- ↑ Paraproteinemia., Auto Ab

Auto Ab

Anti rhodopsin. Anti glutathione S transferase

Histo IgG, IgA deposits in ganglion cells, INL, ONL

Evidence of apoptotic cell death in GC & INL.

DD

- Wide diurnal IOP variations
- Once had ↑IOP & now (N)
  - Pigmentary glaucoma
  - Steroid induced
- Advanced OA

Cong.
- ON abn — Coloboma, pits
- AD. OA — Kjer type.

Acq
- H/O — steroid used, Trauma
- Hemodynamic Causes
- CH_3OH poison
- ON
- AION, NAION
- Compressive lesions
- Wide variation

Ix.

- Tonometry
- Provocative Test.
  - Potential occludable AC
- Adjunctive Test
  - steroid responsiveness

POAG or Chronic Open L glaucoma

Definition Multifactorial ON in which there is characteristic atrophy of ON. where ↑IOP is risk factor

Epidemiology IOP = >21 mm of Hg Considering gaussian curve skewed to right.
1-2% >40 yrs.

Proposed Mech of COAG

- Mech of Obstruction & Aq. outflow.
  - Histo observations
  - Influence of Aq. Hum
  - Alterations of TM
  - Stress Response Markers
  - Collapse of Schlemm Canal
  - Alterations of intracellular channels
- CS Sensitivity
  - HPA theory
  - CAMP theory
  - GAG Theory
  - Phagocytosis ↑.
- CSF Pressure. Mech of Optic Neuropathy
  - Histo obs
  - Immunological studies
  - Bld flow
  - Apoptic Susceptibl of ganglion cells
  - Possible Infectious

2 Subsets of COAG

- Vasospastic finger Bld flow IOP & VF loss
- distured Coagulat" s/o VF loss ×

Mech. of Obstruction of Aq. Outflow

a) Histo

(b) Influence of Aq Humour → >> TGF β2
TGF β → Inhibition of Epithelial cell proliferation
→ Induction of ECM protein synthesis
→ Stimulation of Mesenchymal cell growth
⇓
Subsequent ↑ resistance to Aq Outflow.

(c) Alterations of TM → site of resistance = Juxto Canalicular tissue & inner Wall of Schlemm Canal
↑ ECM & accumulat" of plaque material.
Plaque material derived from thickened sheaths of elastic fibres.

(d) Stress Response Markers → Myocilin — Mutated in COAG
>> Stress, Dexa Rx, Oxi stress, Rx of TGF-β

Myocilin
HSP
αβ Crystallin

» active Endothelial cells
↓ freq of actin filaments in TM
Intertrabecular spaces are narrowed
Hyaluronic Acid ↓ in TM, ↑ CSO_4
segmental Outflow obstruction.
↓ Giant Vacuole or pores

(e) Collapse of Schlemm Canal → Bulge of TM into Canal

(f) Alteration in Intrascleral channels → Attenuation of channel due to swelling of GAG in adj sclera

CS Insensitivity

Betamethasone 0.1%
Dexa 0.1%

TDS - QID x 3 - 6 wk

↓

Trimodal response

2/3 (Non Responder)	1/3 (Moderate)	4-5% (Marked)
↓	↓	↓
Low response	Intermediate response	↑ >> 15 mm Hg
↑ IOP < 5 mm of Hg	↓	>30
↓	6-15 mm Hg (20-30)	↓
65%	↓	5-6%
AR Inheritance (Homozygous)	32% (Heterozygous)	(Homo)

- HPA axis T.
- CAMP theory
  - CS ⊕ → β adrenergic stimulat" of Adenyl cyclase Enz
- GAG theory
  - CS ⊕ hydrated GAG polymerized
  - ↓
  - Obstruct
  - ⊖ CS stabilize
  - ⊖ lysozyme in Trab cell
- Phagocytosis theory
  - CS ⊖
  - ↓
  - Phagocytes
  - ↓
  - Debris accumula

Mech of ONeuropathy.

Histo — ↑ CT in septa
↑ amt of type IV & VI collagen
↓ capillaries ⊆ loss of axons

Immunological studies → ↑ AntiCardiolipin Ab ass ⊆ progressive

Blood flow — diff in Red cell aggregability
↑ plasma viscosity
Altered autoreg of Bld flow

Apoptotic susceptibility of ganglion cells
Excitotic cell death from accumulation of glutamate & imbalance of proteases that modulate ECM in retina.

Possible Infectious Susceptibility — COAG & Exfoliation & H. Pylori infection.

CSF Pressure

Translaminar pressure = Intraocular space - Subarachnoid space
↓CSF ⇒ ↑IOP
L >> NTG.

Mx of POAG → In detail.

COAG >> ↑IOP ⊆ strong Cycloplegics if undergoing long term miotic therapy
↓
Inhibition of Muscarinic effect
Direct Inhibitory action on CM.

Angle Closure Glaucoma

1° — 2°

- Pupillary Block
- Plateau iris
- Combined Mech

2° — as discussed earlier

Pupillary Block

Most common form of ACG

axs ⊆ Mid dilatation of pupil

4 form PB

Acute. Subacute Cheonic. Combined Mech

Acute	Subacute	Cheonic	Combined Mech
Sudden Marked Pain. Blurred vision Red eye Nausea, Vomitting Brady, Sweat^{n} Trigeminal region.	Repeated attacks	PPS ↑nt IOP ↑↑ Creeping ∠CG shortening of L. Look for Exfoliation	∠ → Normal ↓ PI ↓ IOP ↓↓↑↑.
Cong Hyperemia Ciliary flush Peripheral Cong Congest^{n} Blurred vision due to Edema	Dull ache behind eye, blurring Coloured haloes around light YR. BG Night » Morning ↓ — Mucus of deep		

Epidemiology ↓ than COAG in Canadian — AACG > COAG.

Indian studies -:

dd

gonioscopy — Occludable angles

a) **Risk factors** → Age depth & vol ∝ $\frac{1}{age}$

% of narrow ∠ >> in old age.

Race ACG → ↓ American Indian, blacks

Sex ♀> bcos of shallow AC

Refractive Error >> Hyperopia

Family H/O — x

Systemic disorders IGT & DM II ∝ $\frac{1}{Age}$

(*) If narrow ∠ then pigmentation » in superior Quadrant

b) Exam a) IOP → Larger than Normal amplitude in diurnal IOP curve.

(b) PACS

- Penlight #
- Slit lamp Exam → Van Herick's #
- Gonioscopy → Lens & mirrors → Explain detail → Classificat°
  - Schaic
  - Spaeth
  - Shaffer
  - Becker
- Newer Tech
  - UBM
  - OCT
  - LT / AL = Prognosticating factors.

(c) Provocative tests
- Prone test
- Darkroom test
- Pharmacologic dilatation of pupil

(d) Precipitating factors

Mydriasis
- Dim illumination → Dark room at theatre, Winter
- Emotional stress → ↑ Sympathetic tone → Mydriasis → RPB.
- Drugs → Mydriatics
  - Anticholin
  - TCA
  - Botulinum → ↓ Ach
  - Adrenergic agents – Topical Epinephrine PE.

Miosis → Reading in Bright light → forward shift of lens-iris diaphragm

Symptoms → As earlier

Clinical findings during Acute attack.

- ↑ IOP 40-60 mm Hg
- Blurred vision
- Digital palpation — firm eye.

Slit lamp Exam →
- Conj hyperaemia.
- Cloudy Cornea → Topical glycerine clears
- Vertically oval, mid dilated fixed pupil

Paralysis of Sphincter ← degeneration of Ciliary ganglion.

↓ Circulation

↑ IOP

- Specular Microscope → Endothelial loss
- PPCD. shallow

Aq flare, Pigments

Sector atrophy of Iris

Posterior Synechiae

Glaukomflecken — Irregular white opacities in Anterior Capsule of lens → due to lens epithelial ischaemia or Necrosis

Gonioscopy — Indentation G. | Compressive G

Fundus Exam. Hyperaemic, Edematous

Pallor x Cupping

↓ Acute

+

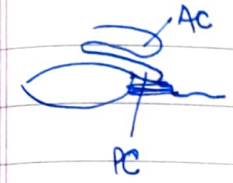
↓ Chronic

Visual field — Non specific constriction
↳ Upper field.

Theories of ACG

RPB | CACG | Plateau Iris

Relative Pupillary Block



Iris mal exerts backward pressure in Post chamber

↓

↑ Pressure in Post chamber

↓

Thin Peripheral iris to bulge in AC

Gonio

Iridocorneal Contact → Ant to TM

Apposition of Iris to Meshwork

Anatomical factors predisposing → Thick, Ant placed lens
Small diameter & short posterior curvature of Cornea
Short AL of globe

(*) Shallow AC = Survival advantage – (Alaska, Canada).
Iris's Vasculature near Cornea generate heat ∴ ↓ deg of freeze of Cornea

- Relatives have predisposition
- forward displacement to lens due to loose zonules which is worsened by miotic therapy & relieved by cycloplegics.

Significance – Mid dilated pupil 3.5 - 6mm – critical degree of dilatation

Chronic Angle closure glaucoma → PAS >> superior Quad as Angle disease & progresses inferiorly

↓

Lo Creeping L closure.

Plateau Iris As earlier

DoD

How to diff b/t Open & closed L glaucoma

gonio

↓

Thymoxamine test 0.5%. opens closed L & ↓ IOP by relax of dilator ms

whereas Anti Ch (Nodics)

↓IOP ↓ resistance to trabecular outflow.

Open L

↓

PI

open puee Lcy.

DoD

POAG.

Open L ≤ associated Abn.

↓

as previous table.

Management → ↓IOP

Relief of ∠ closure

Medical | Surgical

Medical:

↓IOP

↓

x Miotics until ↑IOP (Paralysis of mol)

↓

∴ ↓IOP by i.v CAI
topical β block
α_2 Ag.
PG Analogue

↓

But ↑↑↑ IOP then use Hyperosmotic agents.

x Topical CAIs as exacerbate Corneal edema.

δ (what to use)

↓

αδx α gonio finding – PAS
α Duration of ACG
α Permanent damage to ACG

ACG → filtering δx chances of ciliary block ↓
∴ Careful δs use

↓

Lensectomy ≤ bypass of PAS imp.

Relief of ∠ closure.

↓

↓IOP

↓

1 drop of Pilocarpine (1-2%) (Miottes)
(x Copious use)

Thymoxamine alone
Not so useful

Surgical:

when to operate | δ to use

when to operate

↑↑ IOP

↓

a) Indentation of Cornea x30s using cotton tipped applicator

b) Topical glycerine drops – Clears Corneap

Clear → PI

Cornea x → Peripheral Iridoplasty
L. pupilloplasty

c) Paracentesis 27G-30G

⇓

x to wait
Just do PI.

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CGRN

Childhood — Us <18yrs — UK, UNICEF <16yr.

Diameter of Cornea

Newborn	11
1–12 mth	12
>1yr	13.

Childhood glaucoma Research Network

- 1°
  - 1° Congenital → IV
  - JOAG → V
- 2°
  - I → Gl ass ⊆ Non Acq
    - a → Ocular Anomalies
    - b → Systemic disease
  - II → Gl ass ⊆ Acq
  - III → Gl foll Congenital Cataract Sx.

IOP >21
ON Cupping ↑CDR — Asym 0.2 / Focal Thinning
K — ↑dia or Haab steae
↑AL or myopic shift.
VF defect
≥2 of abv

(−) → Glaucoma Suspect

(+) → Cong Eye Anomalies / Systemic Syndrome

(+) → Systemic Involvement

(−) → H/o Trauma / Uveitis

(+) → II

(−) → Buphthalmos

(+) → IV

(−) → V

(−) → Gl dx after Cataract Sx

(+) → Other Ocular Anomalies beside Cataract

(+) → III

(−) → Ia

(+) → Ib

Childhood

Primary

- Congenital OAG
  - Newborn (Irido Trabeculodysgenesis)
  - Infantile (Trabeculodysgenesis)
  - Late Recognised.
- JOAG
- Ass ⊆ Ocular abn
  - Ant seg dys
    - Iridodysgenesis
      - Aniridia
      - Congenital Iris Ectropion ↓.
      - Irido trabecular dys (Iris hypoplasia)
    - Corneodysgenesis
      - Axenfeld Rieger
      - Peters
      - Sclerocornea
      - Cong Microcornea ⊆ Myopia
      - CHED
      - PPD
      - Megalocornea
- Ass ⊆ Systemic Abn

Ass ⊆ systemic Abn

- Chromosomal disorders
  - Trisomy 13-15
  - 18
  - 21
  - Turner (XO)
- CT abn
  - Marfan
  - Stickler
- Metabolic disease
  - Lowe (Oculo Cerebro Renal)
  - NPS (Hurler)
- Phacomatoses
  - Sturge Weber
    - Isolated
    - ⊆ CNS
  - NF I
  - Nevus of OTA
- Others
  - Rieger
  - Axenfeld
  - Oculodental digital
  - Knicst
  - Rubinstein Taybi Syndrome
  - Hallermann Streiff
  - Irodo Nilli
  - Michel
  - Waardenburg
  - Nail patella

Glaucomas

Secondary

Traumatic

- Acute
  - Concussion
  - Hyphaema
  - Ghost Cell Ca.
- Late Onset ≤ Recession
- AV Fistula.

2° to Neoplasm

- Rb.
- Juvenile Xanthogranuloma
- Leukemia
- Melanoma
- Melanocytoma.
- Iris Rhabdomyosarcoma
- Aggressive Neoplasm of Iris.

2° to Uveitis

- Open ∠
- ACG
  - Synechial
  - Iris bombe ≤ pupillary block
  - Trabecular endothelialization

Lens induced

- Subluxation - dis pupillary block
  - Marfan
  - Homo
  - Weill Marchesani
- Spherophakia
- Phacolytic G.

Steroid induced

After Sx for Congenital Cataract

- Pupillary block
- Lens tissue Trabecular Obstruction
- COAG ≤ ∠ abn

Malignant G

2° to Maternal Rubella

2° to 10 Infection

- Acute Recurrent Toxo
- Acute Herpetic Intio
- Endogenous Endoph.
- Iris Stromal cyst

2° to Rubeosis

- Rb
- Coat's Disease
- Medullocpithelioma
- FEVR
- Chronic RD

≤ ↑ EVP

- Sturge Weber
- CCF
- Orbital disease

2° to ACG

- ROP
- μ Ophthalmos
- Nano "
- Rb
- Persistent fetal Vasculature
- CB cyst

Signs & Symptoms

Epiphora.

Abn. Behaviors

Corneal enlargement or Opacification

Buphthalmos

Photophobia. Blepharospasm (Corneal edema ↖ Haab's striae)

LDOD.

Vogt's — forceps delivery → Vertical.

Deep AC.

ONH Cupping

Old child — ↓ vision ↗ C. Edema, ONH damage

↗ Amblyopia, Astigmatism

Progressive Myopia

>> Old — ACG symptoms

DOD

- Red eye + Epiphora.
  - CNLDO
  - Conjunctivitis
  - C. Epithelial defect
  - Keratitis
  - Inflamed Ant Seg
- Corneal Enlargement.
  - Axial Myopia
  - Megalocornea
  - Megalophthalmos
- Actual/Pseudo ONH Cupping
  - Physio large Cup
  - Coloboma/pit
  - Atrophic ON
  - Hypoplastic
  - Malformation

Corneal Edema

- forceps related birth Trauma
- Congenital Mal
  - Sclerocornea
  - Peter's
  - Choristoma
- Cong dystrophy
  - CHED
  - PPD
- Keratitis
  - Herpetic
  - Rubella
  - Phlyctenular
- Metabolic dis
  - MPS
  - Cystinosis
  - Lowe

Evaluation

a) Confirming dx of g
b) Determining Cause
c) gathering information

EUA → gonio, Corneal dia, CCT, AL.

a) Vision Testing → Acc to age group.
If → Frequency double perimetry.

b) External Exam → NF, Hemangioma.
Bulph (Asymmetry b/t eyes)
Photophobia.
NLDO
facial features

c) Cornea Exam → Enlargement
Edema
Scarring

Age	Normal	Suspicion
0-6m	9.5-11.5	> 12
1-2yr	10-12	> 12.5
>2yr	<12.	>13.

(d) Tonometry → Jerkins Applanation.
Tonopen (Handheld Mackay Marg type)
Icare Tonometer – Awake, x LA.
Pneumatonometer – » Opaque & Scarring C.

BUA effects

↓ Chloral hydrate
Methohexital
Midaz.
Sevoflurane

↓↓ O_2.
NO.
Halothane

↑ Ketamine

↑↑↑ Succinylcholine
Laryngospasm
Bell reflex
ET. intubat°

Slit lamp Exam

Haab's stria
Scarring
Post embryotoxon (AFA)
Corneal adhesion to Iris/Lens (Petei)
Deep AC
Stretched/thinned out limbus.

Gonioscopy

OPD → Zeiss Sussmann

OT. → Koeppe's

ON & fundus Exam

ONH.

Additional — Stalk in PFV
foveal hypoplasia - Aniridia
Choroidal Hemangioma - Sturge Weber

Cupping is reversible in kids.

Other Dx. Test

a) **Refraction** — Myopia → Astig → Amblyopia

b) **USG** → AL. ∝∝ gDD candidates
Confirms retinal status & Opaque media
Confirm patency of gDD

c) **OCT** → USG Pachymeter
Thinned in children & congenital ly
Eyes & Aniridia have thicker than Avg Cornea

d) **Others** → fundus photo → OCT.

Primary Congenital Glaucoma

Primary Type.

- Isolated Ag, outflow abn
  - 1st 3yrs → Congenital (PCG)
    - At birth → ~~Congenital~~ Newborn. (ITD)
    - c in 3yr → Infantile.
  - >3yr till adulthood → JOAG
    - Developmental g (as eye x expand. beyond 3yr in response to ↑IOP) (10-35yrs)
- Those c associated

✱ Buphthalmos
Hydro-Ophthalmia. (Dcas by other cause of g)

PCG
- Trabeculodysgenesis
- Goniodysgenesis

General features

Demography – Roma population of Slovakia (Consanguinity)

Heredity – 3 loci, 2 gene identified.

GLC 3A – CYP1B1 – Cyto P450 Enz.
3B
3C – LTBP2. TGFB2 → Null mutat" in Pakistan Iran
MYOC – race. – TGR – CB, TM.

Clinical features → Bil 65-80% cases
Stretching limited to Cornea, AC structure, sclera, ON, scleral canal, lamina cribrosa.

History △

External Exam
a) C. diameter
b) C. Edema
c) Refractive error — Myopic shift
d) Tonometry
e) Slit lamp Exam — Haab's striae, deep AC
f) Gonioscopy — Koeppe's — Iris ⊙

- In PCG, iris has an insertion more anteriorly to ⊆ altered transluency of ∠ face rendering rather indistinct CSB, TM, scleral spur. ⇒ Barkan Membs
- Scalloped borders of iris pigment epithelium & TM in PCG may appear through translucent peripheral iris stroma as Morning mist.
- ∠ is avascular, loops of vessels from major arterial circle seen abv. Iris root — Loch Ness Monster Phenomenon

f) Fundoscopy
g) Visual field
i) Visual acuity
j) USG. ↓ AL 0.8mm after Sx ↓ of IOP.

⊙ Iris — stromal hypoplasia ⊆ loss of crypts.

Mgt

Haab's striae

Tears in DM

Single/multiple – characteristically oriented horizontally or concentric to limbus

Associated c Corneal edema in early phases of ↓.

At birth	At 6mth Dx
↓	↓
25%.	60%.

Testament to early onset of IOP elevation

IOP normalize, Tear separated by endothelial overgrowth

Corneal edema clear, linear opacities persist.

Specular uscopy → ↓ Endothelial count.

DD

a) forceps injury during birth – Vertical/Oblique

b) Band like str in PPD & post corneal Vesicles

Haab's	PPD.
Thin, smooth areas b/t. thickened, curled edges	Corneal thickening

Etiology of PCG

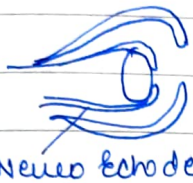
Eye development



→ Lens vesicle at 3wk of gestation

8mm stage – adhesion b/t Lens vesicle & Corneal epithelium

12.5 mm – Clear Zone.



Neural Ectoderm – reach periphery of lens & undiff mass overrides rim of cup.

Cornea | Iris | AC structures

patron

Earlier Mesodermal origin

Now Neural Crest Cells. (NCC)

Dev of Cornea & Iris

NCC

↓

3 waves of tissue b/t Lens & Surf Ectoderm

I | II | III

I → 8th wk → Primodial Corneal Endothelium → DM

II → Stroma

III → b/t Cornea & Lens → Pupillary Membs. Stroma of Iris.

Pig epithelial layer of iris fm. Neural Ectoderm

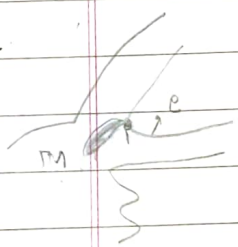
Development of AC angle

- Atrophy or Resorption → Progressive disappearance of portions of fetal tissue.
- Cleavage → Separation of 2 pre-existing tissue layers due to differential growth rates.
- Rarefaction → Mesh distention due to growth of Ant Ocular segment

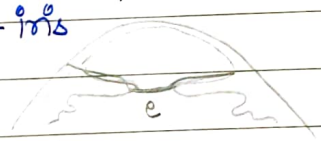
5th Mth – Ant surf of iris inserts at edge of C. Endothelium.

AC ∠ ←]] fetal pectinate ligament → Corneoscleral Meshwork primordium

(a)

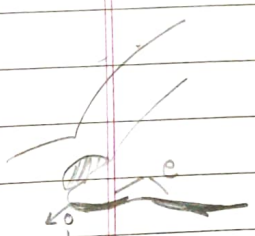


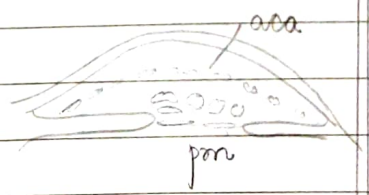
c) – endothelium
i) – iris



5mth of gestation → Continous layer of endothelium creates a closed cavity of AC & ant surf of iris inserts in front of TM.

3rd. Trimester





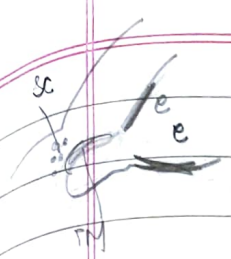
Endothelial layer disappear frm pupillary membrane & iris

↓

Covers over Ant Chamber ∠

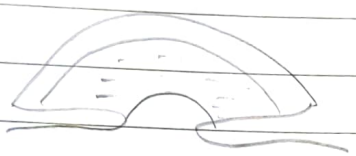
↓

Peripheral uveal tissue slide post into ∠ chamber structures









Development of trabecular lamellae & intertrabecular spaces begins in inner, posterior aspect of primodial tissue & progresses toward SC & SL.

~~Development~~ Normal AC forms by 1yr.

Theories of abnormal development

- Mann — Incomplete atrophy of AC mesoderm
- Barkan — Barkan Membrane → ✓ gonio & dissect" iscope
- Worst — ✓ Atrophy & resorption × cleavage
- Maumenee — Abn. ant insertion of ciliary mol into TM
- Anderson — High insertion of anterior veka into TM
- M — Absence of Schlemm canal
- Kupfer — Defective NCC development

Management

Definitive ℞ is ⊗x.

Medical — To clear edema.
Control IOP.

Many obstacles also — Inadequate IOP control
difficult long term adherence.

⊗x — effective time 2-8 mths

- Angle ⊗x
  - Incisional
    - Internal → goniotomy
    - External → Trabeculotomy → Trabeculectomy Augmented → goals
- filteration ⊗x

(×) ↓ success bcos of scarring, fibrosis
Risk of endophthalmitis

Goniotomy

Sharp knife (Abnormal tissue) incised under direct visualization ⊆ goniolens

↓

Incision through inner portion of TM

↓

releases compressive traction of Ant uvea.

×

Trabeculotomy

Identify Schlemm canal by ext dissection ↓

TM incised by passing probe into SC., rotate Ant

↓

SC canulated ⊆ suture or illuminated endoscopic probe

↓

Pull suture → 360° Trabeculotomy

Cloudy Cornea ✓✓

Ex - Multiple goniotomies failed

Spares conj tissue for future Sx.

GSS

↓

Cyclodestructive procedures → ↓ rate of Aq

L Refractive cases

↓

PK → for corneal cloudiness

L Post op complication ↑IOP graft failure

↓

Post op. — Target IOP — <20mm. if ONH healthy

↓

Visual rehab of Amblyopia.

Developmental Glaucomas

Primary glaucoma with associated abnormalities.

⇓

also called Neurocristopathies

- Trabeculodysgenesis
- Iridodysgenesis
- Corneodysgenesis

Axenfeld Rieger syndrome	Neural Crest Origin ✓
Peter's Anomaly	
Sclerocornea.	
Megalcornea	
CHED	
Aniridia	X

Axenfeld - Rieger Syndrome (ARS)

- Axenfeld anomaly → Peripheral anterior segment defects
- Rieger Anomaly → Peripheral abn ⊆ additional changes in iris
- Rieger Syndrome → Ocular anomalies + Systemic developmental defects

General features

Bil

a) Ocular features

- Cornea.
- AC angle
- Iris
- Additional ocular abn
- Glaucoma

Cornea – • Posterior Embryotoxon – Prominent anteriorly displaced schwalbe line.. On slit lamp → white line on posterior cornea near limbus #
» Temporally or 360° around
Isolated – 8-15%. May be some feats to ARS
• Megalcornea • Cong Opacities
Histol → dense collagen & ground substance covered by monolayer of spindle shaped cells ⊆ BM.

AC angle – Gonio – Prominent SL.
- Tissue strands bridge AC ∠ from peripheral iris to prominent ridge
- Thickike to broad bands • SS obscured

Iris Mild stromal thinning to marked atrophy ⊆ hole formation, Corectopia, ectopion uvea.

Atrophy & hole formation — occurs away from direction of Coloboma.
× progress after birth

Additional Ocular Abn strabismus, limbal dermoid, Corneal pannus, Cataract, Congenital Ectropion Uvea, Transillumination defects, Coloboma, hypoplasia of ONH.

Glaucoma high incidence of peripheral iris into TM

Systemic features – defect of teeth & facial bones

Dental	Facial
• Microdontia	• Maxillary hypo
• Oligodontia	• Flattening of Midface
• Ant Maxillary	• Hypertelorism
• Permanent dental incisors	• Telecanthus
• ↑° empty sellae syndrome, ↓↑def, short stature	
hypospadias, OCA, Mental def	

Genetic Linkage basis of NCC contribution.

AD

4q25 – PITX2
6p25 – FOXC1
] duplication more severe than mutat°

Type I – PITX2 (OMIM 601542)
II – RIEG2 & 601499
III – 3 602482 – Mutat° FOXC1 gene

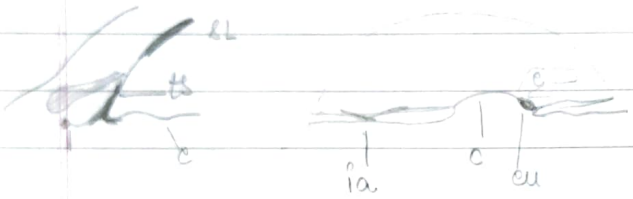
Theories of Mech

a) 

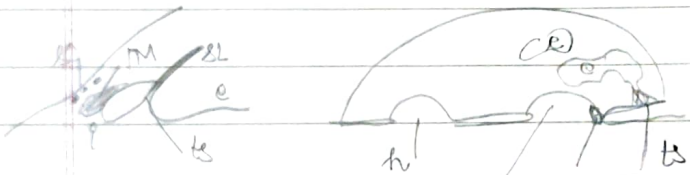
½ retention of primodial cells (c) on Iris & ACA, incomplete post recession of peripheral uvea 4m TM obs. diff b/t cornea & AC Endothelium & prominent SL.

b) 

development of tissue steands 4m retained endothelium across ACA

c) 

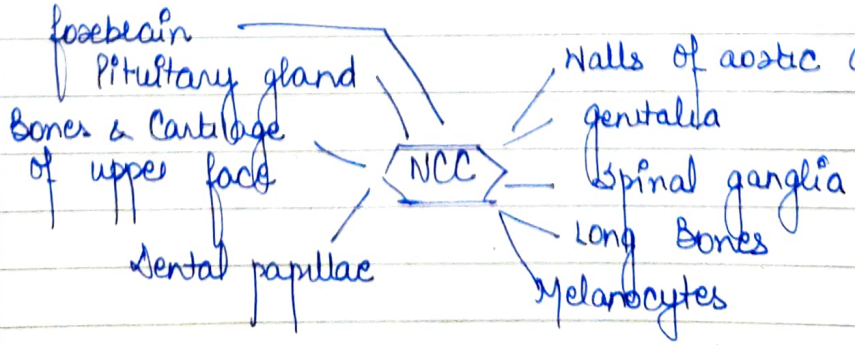
Contraction of retained endoth. & Iris changes of Corectopia, Ectropion Uvea, Iris atrophy

d) 

Incomplete development of TM & SC – Continued traction on Iris & possible 2° ischaemia leads to hole formation

⇓

Incomplete maturation of TM & SC ⇒ Responsible for associated glaucoma.



ΔoΔ

- ICE syndrome
  - Onset - young adult
  - x family H/O
  - Unilateral
  - Corneal endothelial abn
- PPCD
  - C. Endothelial abn.
- Peter's Anomaly
  - Distinct Hech
  - Central portion of Cornea

- Aniridia
  - PITX2
- Congenital Hypoplasia of iris
  - ↓
  - If non Ocular features - Iridogonodysgenesis Type II
  - PITX2.
- Oculodentodigital Dysplasia

- Ectopia lentis et pupillae.
  - Corectopia
- Congenital Ectopion Uvea
- Congenital Microcoria & Myopia.

Mx. Detection & control of associated glaucoma

drugs ↓ Aq production
- β blocker
- CAI
- α_2 Ag

Trabeculectomy ✓

Peter's Anomaly

Buphthalmos ⊆ Bil Corneal opacities (Central)

General features – At birth, Bilateral
Sporadic, AR.
PAX6, PITX2, CYP1B1 gene. Morphological finding.

Clinicopathological features Central Corneal abnormality –
defect in DM, Corneal endothelium ⊆ Thinning & opacification of Central area of C. Stroma

Fibronectin defect
of. – Interstitial Inflamm. → Von Hippel Internal Corneal Ulcer

Keratolenticular ← Peter → C ⊆ peripheral defects as ARS
Contact
E A
F B

Fig 16.14

Lens N develop, 2° pushed forward

Ass glaucoma – PAS
– changes in TM & aging
& ARS.

DDs

Other Causes of Central Corneal abnormalities

Post Keratoconus
x-y
Thinning of Central Area
Excessive Curvature Post
haze

Congenital Corneal Leukomas & Staphylomas

Histo – Multilaminar DMC abn Ant banding & localized excrescences

classmate
Date
Page

Mx. Sx → Prab → ppd → cyclo

Pk »
Sector Prodectomy

Pseudo Exfoliation Syndrome & Exfoliation Sy

classmate
Date 57
Page

MoC Cause of Open ∠ glaucoma

True Exfoliation / Capsular delamination.

superficial layers of lens capsule seperates from deeper capsular layers to form scroll like margins & occassionally to float in AC as thin, clear membs.

↓

glass blowers — Extended exposure to infrared radiations

May be due to trauma or intra-ocular inflammation.

Epidemiology

↑ c age

Uni / Bil

Diff c Altitude & Light exposure.

40% ⟶ Sy

Clinical features

a) **Cornea** → flakes of exfoliative material & pig accumulation ⇒ vertical spindle ⇒ Krukenberg of Pig
Specular → ↓ cell density, changes size & shape
Even in Normal Eye of Uvit ⇒ Early Sign of disease

Guttae formation → Fuchs, PBK, ABK

Ex vs. fuchs → Ex → ↓ diffusely distributed gutta like structure. ass ⊆ Melanin deposit in AC.
Peripupillary iris atrophy.

b) Lens, Zonule, CB changes — Target Sign

deposit on AC surface – 3 zones.
- Translucent → Consistent finding
- Central disc ⊆ occasional curled edges
- Clear zone – contact b/t moving lens & peripheral granular zone. — radial striations

Precapsular film. ⇒ ground glass appearance
fibrillar layer similar to exfoliative material
Because of

» Cataracts » Nuclear Opacities

Cycloscopy – Exfoliative material on ciliary processes in PI

Zonular involvement → Lens Subluxation. Phacodonesis
deposits at Insertion of Zonules
Proteolytic Enz → ↓ disintegration

c) Iris changes → white flecks on pupillary margin of iris
c loss of pigment at pupillary ruff
↓
Iris transillumination – moth eaten appearance
diffuse mid peripheral transillumination defects

Krocks → ○ deposit at pupil border

FA – hypoperfusion, peripupillary leakage, NVE.

TIA Pt Eye » Transill + Exfolial scos of hypoperfusion
↓
Iris hypoxia → atrophy of m&l
↓
Melanin dispersion
wheel like pattern of pigment particles
Pigment deposition on Pcil Iris
↓
Poor Mydriasis

d) gonioscopic findings → Excessive pigment dispersion
pig → Uneven distribution c flecks of exfoliative material. Sampaolesi line
» ↓ in Pigmented eye

e) Other slit lamp findings → In Aphake – deposit on Ant hyaloid
Pseudo » → PCIOL
» Aq. flare.

f) UBM finding – ↓ x mydriasis – UBM – deposit on zonule seen.

Clinical Classification

Preclinical stage

↓

Suspected exfoliation Syndrome
Precapsular layer

↓

Mini Exfoliation Syndrome - focal defects start SN

↓

Classical exfoliation Syndrome

Complications

	Clinical	Surgical
Lens, CS, Zonules	Cataract, Phacodonesis Lens Subluxation ACG	Zonular Rupture Vitreous loss Rupture of PC Decentration of lens imp PC fibrosis 2° Cataract.
Iris	Melanin dispersion Poor Mydriasis, Asym Pupil size Iris Rigidity, Capillary Hmeg BIB Aq barrier defects, Pseudo Poectis PC hypoxia, Post Synechiae	Miosis Intra/Post op hyphaema Inflammation Post Synechiae Pupil Block
IOP	IOD HTN, OAG	↑IOP post op
Cornea	Endothelial decompensation	
Post Seg	RVO.	

Cause of glaucoma

Acc to EMGT → >> risk factor 2* R.f of progression in established ↓

- POAG
  - Aq. outflow obstruction in COAG
  - Bt
    - Exf ✓ COAG
    - ✗ steroid response
    - LOX1 valve ✗
    - difficult IOP control
    - ↑↑ GON
    - >> diffuse NRR damage
    - Sectoral preference
- acute ↑ in IOP.
- Pupillary block ACG
  - Zonular weak
  - ↓ Lens moves forward.
  - ↓ Lens thickening
  - ↓ SM deg, pnis ↑gacity
  - Relative Ant Micro-ophthalmos
    - Normal AL.
    - Smaller Ant seg (CD<11mm)

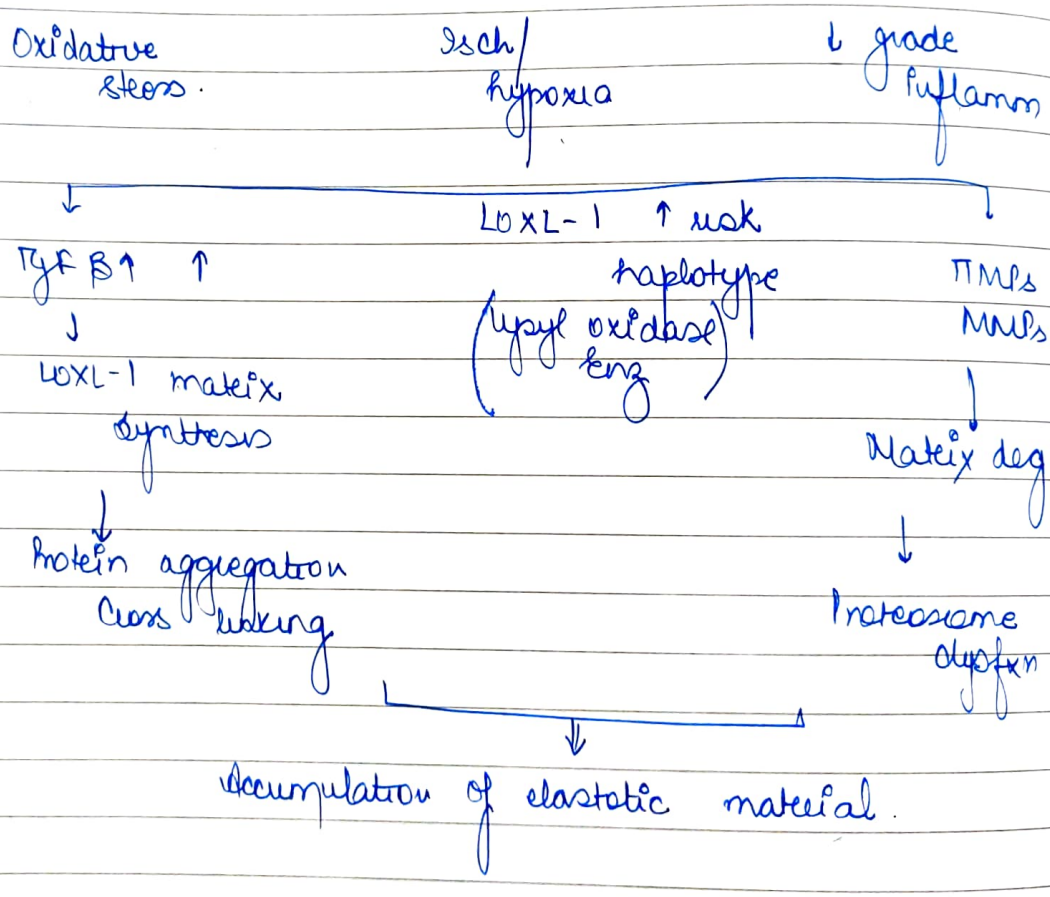
XFS

- Capsular delamination
  - Nature of Material
    - Thin.
    - Clear membr like material separating 4m AC
    - Curling at Margins.
    - Defect ↓
- 1° Amyloidosis
  - ↓ >> in AD Familial Amyloidotic Polyneuropathy
- Pigment dispersion

Etiopathogenesis / Theories.

Micro fibullopathy
Polymorphism in LOX1 gene — elastin fibres gene.
Tropo-elastin

Source of Exfoliative material → Many cells in Ant Seg.
Lens Capsule Epithelium, Vasc Endo, Corneal Endo.
& C Endo
Extrabulbar sites — Conj, EOM, Orbital septa,
Ciliary retrobul vessels passing thro ON sheath.



Mx

lot of IOP fluctuation

good response to Pg analogues
Laser Trabeculoplasty

Cataract Sx → may ↓ IOP.

ECCE - » risk of Zonular dehiscence
Poor pupillary dilation
Synechiae
In Cataract Sx look for → Zonular dialysis
Asymmetric AC depth
Corneal endothelium.
UBM

Tip - Large Capsulorrhexis → Enable Nucleus to prolapse in AC ∴ ↓ Stretch on Zonules
- Prevent Capsular phimosis

Hydrodissection - Tap on Nucleus to decompress.

If weak Zonules - CTR.
↓ steps while manipulating Nucleus

Small pupil size - Iris hook
Malyugin ring

PCIOL → » risk of fibrinoid rxn.

Associated c disorders of Corneal Endothelium

- Disorders of Cornea
  - Developmental
    - Peter's Anomaly
    - Sclerocornea
    - Aniridia
    - Axenfeld Rieger syndrome
  - Acquired
    - Uveitis
    - Trauma
    - full thickness (ex.)
  - 1° disorders of Corneal endothelium
    - ICE
    - PPCD
    - FED
- Secondary abnormality of cornea
  - Pressure Induced Corneal Changes
    - Epithelial & stromal edema
    - Endothelial changes
    - Haab Striae
  - Exfoliation Induced Corneal endothelial changes
  - Drug induced
    - Endothelial decompensation c topical CA I
    - Toxic effect to C. epithelium
      - BAC
      - β blockers

Iridocorneal Endothelial Syndrome

Common clinical features → ♀>

3 variants

- Progressive iris atrophy → ♀>>.
- Chandler Syndrome → MoC
- Cogan Reese Syndrome

Pathologic features →

Cornea → Endothelial abn → fine hammered silver appearance of post cornea

Specular — pathognomic findings → Light central spot & light peripheral zone with various degree of pleiomorphism in size & shape.

If asymptomatic by 1 eye — other eye tell's.

Metaplasia occurs ∴ +ve Immuno Histo Stain for Cytokeratins normally expressed by epithelium rather than Endo.

Multilayered collagenous memb. post to normal prenatal & natal layers of collagenous ste of DM.

Iris — Hallmark is hole formation with corectopia & ectropion uvea = in direction of PAS

2 Types of hole

- Stretch hole
- Melting holes.

Sketch holes → Iris is markedly thin in Quad away fm. pupillary distortion
↓
Holes develop ⊆ in area of sketch

Melting holes → develop ⊆ out associated Corectopia or thinning of Iris

Light μ → Cellular Hemb over iris — Feteo Corneal Hemb

Chandler
x Iris changes
Minimal atrophy.
Corectopia

Cogan
Pigmented pedunculated Nodules.

Lens Feteo Corneal Hemb — confused for Ant Lens Capsule
∴ Confusion during Cataract Sx.

Ocular findings

Theories of Mech

Memb. Theory
↓
C. Endothelium responsible
↓
+ve family H/O
↓
Presence of Post natal layer of DM

Virus mediated Mech
↓
DNA polymerase gene products for HSV
↓
Proliferative Memb over Ant Chamber
↓
Obstruct TM ⟶ PAS formation

POAG

↓

Endothelial disorders

- PPMD → Specular
- Fuch's – x iris & AC features

Dissolution of Iris
↓
Axenfield
L Congenital
L Bil

Aniridia.
L Bil

Iridoschisis
L Old Adults

#

Nodular lesions of Iris

- Melanoma of iris
- Iris Melanosis
- Lisch Nodules in NF1
- Diffuse Iris Nodular naevi
- Sarcoidosis

Mx.

Rx of Corneal edema & associated glaucoma

Medically by → Aq production ↓

eventually Sx ↗ Reg Sx

↗ chance of Perm theory

↓

Sx ↙ Aug.
Cyclo.

Edema — ↓ IOP

Hypertonic Saline

PK indicated

keeping viral theory in mind — Immunotoxin.

PAS extends beyond limbus line

Posterior Polymorphous Corneal Dystrophy

Gen features — Rare, Bilateral, AD

3 gene identified
- COL8A2
- ZEB1
- VSX1

Symptoms in young adulthood.

Pathologic features

Changes in Cornea → Blisters or vesicles at level of DM in post cornea
- gray haze
- vesicle
- Band like thickening at level of DM

» haze of DM as ± Irido Corneal adhesion & Gl

Ultra structure → Thin DM covered by multiple layers of collagen lined aby abnormal cells

Endothelial transformation — +ve Anticytokeratin AE1/AE3

Changes in Iris — few PAS beyond SL.
- Sout an Associated Mems
- Irido trabecular & Irido Corneal apposition
- Bridging over TM

↓
Abnormal Mems

Systemic association in Alports → Hereditary Nephritis
- PPMD
- SNHL
- Retinal flecks
- Ant Lenticonus

Theories of Mechanism

Morris theory — Metaplastic Endothelium
↓
Loses Contact inhibition
BM like material

Molecular Mech → COL4A3 → PPCD3 family
also alpat syndrome

Loss of → ZEB1 → Promotes site
↑ COL4A3
↓
Molec Mech.

DoD

Fuch's
CHED
Post Amorphous Corneal dystrophy
Iridocorneal adhesion
↓
AFA

Band like thickening
L like Haab's Streak
Thinned area & thickened edges.

Mx

Ag ↓ drugs

Cortical edema — Rx. contradictory

ALT ↑ so useful

Dx associated c/ Iris & CB.

- Developmental defects
  - AFS
  - Peter's Anomaly
  - Aniridia
- Iris atrophy c/ Corneal dis
  - ICE
  - PPCD
- Pigmentary glaucoma
  - Iridoschisis
- Plateau Iris
- Exfoliation
- NVG
- Iris Tumours
- Ant Uveitis
- Trauma

Iridoschisis

67th decade

Bil separation of layers of Iris stroma, typically in inferior Quadrants.
» C. Edema.

Other conditions seen → ACG, Angle recession & Syphilitic Interstitial keratitis

Gonio — Strands of Iris obscure visualization of AC ∠.

Histo — Atrophy of Iris c/ scant Collagen.

Specular — Marked ↓ in cell density & ↑° of polymegathism.

Histo — Deg & focal loss of endothelial cells patchy post banding of DM

Mech

Pupillary Block Mechanism

↓

Intermittent & acute IOP elevation.

D.D

Other causes of Iris stromal dissolution

↙ ↓ ↘

ICE AFS Trauma

Mx

↙ ↘

Rx ⊆ Iris Iridotomy Iridectomy

If Edema ↑nt

Glaucoma filteration Sx.

Glaucoma associated with disorders of lens.

- Associated with dislocation of lens.
  - Ectopia Lentis
- associated with Cataract formation.

Ectopia Lentis

- Traumatic dislocation
- Exfoliation Syndrome
- Simple ectopia lentis.
  - Congenital
  - Spontaneous
    - Bil
    - Symmetrical
    - Lens dislocation
      - Up & Out in AC.
    - Ass ⊆ RD & Gl
- Ectopia lentis et pupillae.
  - AR
    - small, subluxated lens
    - Oval slit shaped pupil
    - Axial Myopia
      - Lack of def of ciliary processes except to Quad where pupil is displaced

Ectopia Lentis et pupillae — Localized abn of 2° vitreous with persistence of marginal bundle of Svualt. ⟶ Mech tethering of iris or pupil margin to vitreous base

⇓

Neuro-Ectodermal defect — Resulting in hypoplasia or absence of post pig epithelial layer & md layer

Marfan.

AD.

ectopia → 4-5 decade

Upward.

Lens dislocation

Surgical aphakia

AC anomaly

Homocystinuria.

AR.

Mental retardation.

» subject to Thrombo-embolic events

- earlier than Marfan
- Downward dislocation

ED »

Weill Marchesani syndrome.

Small CB

↓

Elongated zonules

↓

PBG

Spontaneous dislocation

Other Condition

Exam

Lenticular Subluxation.

Weak zonules

Phacodonesis

Mech

Pupillary Block

» Weil

Worsened by Miotic

- Therapy
- Herniation of vitreous into pupil
- PAS + nt.

Phacolytic g.

- Lens dislocate into vitreous
- Retinal perivasculitis

Concomitant Trauma

Trauma to AC L.

Dilate the pupil

↓

Reposit

↓

Can use miotic to keep lens behind
bt keep RPB in mind which will worsen further

↓

If Lens completely in AC

↓

Then constrict the pupil & remove

↓

do PI to prevent RPB later

Phacolytic ↓

↓

Cataract Extraction
is procedure of choice

↓

PP approach

Mechanic ↓

↓

PPS → Medical Rx

Glaucoma associated with Cataract formation.

Phacolytic (Lens Protein G) — OAG & hypermature Cataract

Phacogenic G. — Lens Induced Uveitis

mΦ response to lens material

↓

HMW protein —— ∝. Responsible for obstruction to Aq Outflow.

Clf — Acute, Onset monocular pain & redness

↓VA. ↑IOP, Cay hyperaemia, diffuse Corneal edema

AC → Open, heavy flare. Ca Oxalate & Cholesterol particles Chunks of white material on Aq., ACapsule Specular —— mΦ

Theories of Mech → mΦ laden ⊆ phagocytosed lens material block TM

HMW soluble protein —— directly obstruct outflow of Aq.

L ↓ in Pacd Lenses ∴ ↓ phacolytic G.

Differential diagnosis → OAG ⊆ uveitis → give therapeutical of topical steroids → temporary remission

others :- NVG, Trauma, Occult post segment tumour

So always do B Scan.

Mx → Emergency, Removal of lens. Else do AC tap

Phaco + PCIOL + Irrigation of AC.

↓

If symptoms persist → Trab

Lens particle g.

Cataractous lens material → Phacotoxic Uveitis

- disruption of Lens capsule by c/f. cataract extraction & PK,
- IOP ↑ fluffed up lens cortical matter

Phacolytic ↑ in toxic –:
» Inflam, PAS ».
inflam. pupillary memb +

free particulate lens material significantly ↓ outflow.
↓
a) TM obstruction
b) Inflammation.

Phaco. Anaphylaxis

Terminology
HSR to lens proteins → rupture of Lens Capsule → IO Inflammation Endophthalmitis Phaco-anaphylactica

Latent period during which sensitization to lens protein occurs
↓
Nucleus retained in uveal Chronic, relentless, granulomatous Inflammation that centres on. lens material

Theories of Mech.

Autologous lens protein – Ag
Capsule was barrier
Capsule violates → m/x

∴

Phaco - Anaphylaxis
Pg., Uveitic Conditions
mφ, WBC + Lens material ↑Toxic

Sympathetic Ophthalmia
Phacolytic., toxic g
↓

Mx

dilate pupil, topical steroids

Steroid ↓

Medical ↓
Surgical Irrigation.

Phacomorphic glaucoma → swollen lens → ACG
intumescent lens



RPB.

forward displacement
of lens-iris diaphragm.

Look at lens
ACD

↓ IOP — Hyperosmotics, CAI., Topical β blockers,
α_2 Ag.
PI

Gonio-synechiolysis & Cataract extraction.

Neovascular Glaucoma

Terminology — Rubeosis Iridis

- Congestive G → Acute nature
- Hmagic G → Hyphaema
- Thrombotic G → Vascular thrombotic cause.

Factors predisposing

» hypoxic disease.

- Retinal Ischaemic disc.
  - DR.
  - CRVO
  - CRAO
  - BRVO, BRAO.
  - RD
  - Coats, Eale's
  - LCA, ROP, PHPV.
- Irradiation
  - Photoradiation
- Tumours
  - Choroidal Melanoma
  - Iris "
  - Rb.
  - Large cell lymphom

- Inflammatory disease
  - Uveitis
  - Chronic Iridocyclitis
  - VKH syndrome
  - Sympathetic Ophthalmia.
- Surgical
  - PPV
  - ND YAG Capsulotomy
  - cataract extraction
- Extraocular Vascular disorder
  - CA OD
  - OCF.

DR → » If also before vitrectomy
Unrepaired RD.
+ of Peripheral TRD

Successful Rx → Regression in Rubric.
- Intraocular SOL
- Glycaemic Control
- Post Capsule intact.

Theories of NVG

- Retinal Hypoxia.
  - PDR.
  - CRVO
  - ⊆ significant CNP areas
- Angiogenesis factors.
  - Tumour
    - ↓
    - T. angiogenesis factors
  - ↓
  - VEGF
  - mainly by Muller cells
  - 4 Isoforms 121, 165, 189, 206
  - VEGF 165
- Vaso-inhibitory factors
  - ↓
  - released by lens & vitreous
  - ∴
  - Vitrectomy
  - Lensectomy
  - ↑ chances

Stages of NVG

- Pre-Rubeosis Stage
- Pre glaucoma stage.
- Open Angle glaucoma stage
- Angle Closure glaucoma stage

Pre-Rubeosis Stage

DR.

Look in pupillary margins — 1st to appear

↓

gonioscopy → NVA earlier than NVI

CRVO

↳ extent of CNP.

FFA — direct method.

RAPD.

Infrared pupillometry

ERG — B wave implicit time delay

↓ B/A wave ratio.

		6m	18 m
NI ↓ I.	45-64yr	13%	18%
	>65yrs	6%	8%

Neovascular Stage: Rubeosis Iridis

Cf.

(N) IOP

dilated tufts of pre-existing capillaries. FFA — leakage of f

FFA → Peripupillary Iris

gonio → NVA → Single vascular trunks crossing ciliary body band & scleral spur & arborizing on TM.

Histopath

Begin Intrasteamally → surface of Iris

NV arise 4m Normal Iris & CB veins ↓

connect with Peripheral NeoVascular Network on Iris

SiOil → » tighter & evenly distributed NVI

RVO → Open Interendothelial cell jxns, attenuated Endothelial cytoplasm.

Pericyte formation

c/f

DR — NVG = 13-41%

CRVO »

90 days glaucoma

Open Angle stage

Histopath

fibrovascular stems covering Ant chamber ∠, ant surf of iris & post iris

fluid fibrosis, inflammatory cells in Aq. Hyphaema

chronic inflammatory changes

Gonio — Open AC, Intense NV.

Angle Closure glaucoma

stroma of iris flattened.

∴ smooth glistening appearance

- ectropion uvea +nt
- iris dilated & pulled ant on lens

Overlying the new vessels is superficial layer of myofibroblasts

↓

responsible for tissue contraction.

Gonio — Contracture — PAS.

severe ∠.

A layer of endothelium, continuous ∴ corneal endothelium at pseudo ∠ is seen.

ACG → POAG stage

Ant uveitis

D.D

Fuch's. — NVA

↓ ACG stage as ↓ NV

↓

simulate ICE.

Management

- PRP
- Anti VEGF.
- Panretinal Cryotherapy

PRP – Pan Retinal photo Coagulation → Ag lases
↓ Ant Seg NV

Mech → ↓ retinal O_2 demand ← RPE – 2/3 O_2 demand
↓
↓ stimulus for release.
of Angiogenesis factor.

Prophylactic Rx
Prompt reply in unRx eyes
CRVO ».
After Rx → NVA, NVI persists.

DR → Post PPV + Lensectomy
↓
FFA → Peripapillary
F. leakage
Prophylatic Rx ←

At Begl stage – Rx for all DR.
CRAO.
CI.

Treatment of Rx.
In Early stages
↓
↓ IOP if ∠ closure
x > 270°

Pan Retinal Cryo. ↓ If cloudy media → PRP x possible

↓

Transscleral PR cryo +

Cyclocryotherapy.

Anti VEGF. ↓ IOP.

Bevacizumab 1.25 mg

Significant regression of Ant Seg NV

Medical Mx of Gl & Inflammation.

↓ Aq. Production

(X) → PG → ↓ Uveoscleral route compromised

↑ inflammation

Miotics — ↑ inflammation

Advanced stage —. Atropine helpful for relief of pain

Surgical procedure

Cyclodestructive → PRP ↴ Cyclo

↳ diode laser CycloPC. » Nd yag Cyclo.

Surgical procedure of choice

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Filtering Sx — Rarely successful.

↑ risk of Intra Op bleed.

Post op progression of fibrovasc Memb.

Aug Trab tied
good tied

Other — Endocyclophotocoag ✓
Si Oil injection during revision of V
IVTA → ↓
100% O_2 under hyperbaric conditions

~~Glaucoma & RD~~ IOP changes in RD

↓ IOP & RD → ↓IOP → Inflammation. Reduced Aq. Production

Prolonged hypotony → Post flow of Aq through retinal hole

Glaucoma & RD.

Gl & RD — α RD. — after Rx of RD

Corg & RD → Theories → Multifactorial inheritance.

Mx — May mask each other.

In DR → NVI ↓.

Pigmentary G & RD →

Schwat Syndrome → ↑IOP in RD patient with unilateral ↑IOP & open angles. & Aqueous cells & flare.

↳ Theories — Photorecep outer segments with few Inflamm cells.

- Ocular Trauma & concomitant damage to TM
- Ant uveitis from RD
- Obstruction of TM by pigments frm RPE.

Rx → Rx Octatchrgent

Angle Closure glaucoma associated c disorder of R.V, Choroid

CRVO

↓

Angle closure glaucoma.

RPB.

↓

Occludable ∠ in fellow eye

NVG

↓

Fibrosis Iridis

Choroidal detachment

Idiopathic Hmrgic detachment/lesion

↓

forward displacement of lens-iris diaphragm.

Ciliochoroidal effusion

Nanophthalmos → small eye c small cornea, shallow AC

Hyperopic eye < 20 mm

Modified gag metab → ↑ packing of collagen → sclera thickening

Uveal effusion

Thickened sclera.

↓

↓ scleral permeability

Dense collagen around vortex veins

↓

compression of drainage channels

Mx

↓ Medical

Surgical — Laser »

decompress Vortex veins by making large scleral flaps

over the veins & draining choroidal, subretinal fluid

↓

& air injection into Vitreous Cavity

Uveal effusion Syndrome → ♂> pt.

dilated episcleral vessels, thickened chor

Mx – subscleral sclerotomy.

Drugs – Sulpha related Compounds

Acetazolamide. Topiramate.

ROP

Contracture of ROP mass

↓

Progressive shallowing of AC & LCG

↓

Cicatricial phase of the disease

Angle closure abn → hypopigmentation of Iris root

Translucent material in L.

Prominent SL.

Glaucoma Associated with Elevated Episcleral Venous Pressure.

Normal Episcleral Venous Pressure (EVP) = 8-10mm of Hg

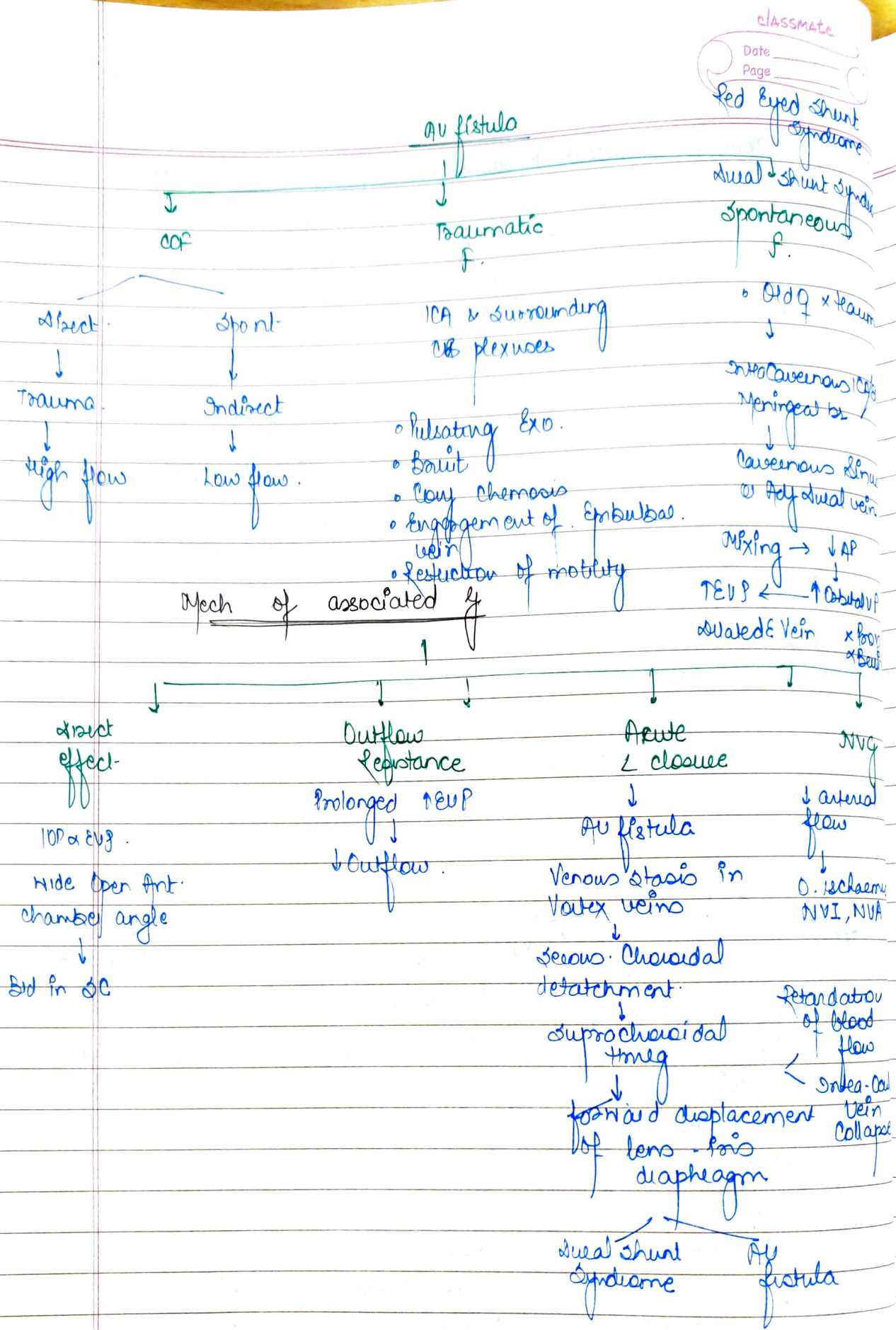
General features

- Ext Exam
  - Variable ° of dilatation & tortuosity
  - Chemosis, Proptosis, Orbital Bruit, pulsation over Orbit
- IOP
- Gonioscopy
  - AC Angle - Open
  - Blood reflux into Schlemm Canal
- Tonography
  - ↑ EVP ∝ ↑ outflow.

Clinical forms of ↑EVP

- Venous obstruction
  - SVC Syndrome
    - Orbital Infiltration EOM
    - Unilat ptosis
    - Marked O. congestion due to obstruction of venous flow thr Orbit
    - AC Inflammation
    - ↑ fibrosis >> IOP in Upgaze
  - Orbital Amyl.
- SVC Syndrome
  - Lesion of Upper thorax
  - Exo, Edema, Cyanosis
- AV fistula.
  - Orbital Varices
    - ↑ EVP
    - Intermittent Exo
    - ↑ Steep on Valsalva
  - Idiopathic
    - ↑ EVP
    - episcleral hemangiomas = AV fistula.
  - Sturge Weber
- Orbital Amyloidosis
  - Perivascular infiltration of Amyloid

GAT >>


AV fistula
CCF
Traumatic F.
Red Eyed Shunt Syndrome
Dural Shunt Syndr
Spontaneous F.
Direct
Spont
Trauma
High flow
Indirect
Low flow.
ICA & surrounding CN plexuses
Pulsating Exo.
Bruit
Conj chemosis
Engorgement of Episcleral vein
Restriction of motility
Mech of associated sx
Direct effect
IOP & EVP.
Wide Open Ant. chamber angle
Bld in SC
Outflow Resistance
Prolonged ↑EVP
↓Outflow.
Acute ↓ closure
AV fistula
Venous stasis in Vortex veins
Serous Choroidal detachment
Supraciliary effusion
Forward displacement of lens - Iris diaphragm
Dural Shunt Syndrome
AV fistula
NVG
↓ arterial flow
O. Ischaemic NVI, NVA
Retardation of blood flow
Intra-Ocular vein Collapse
Bilateral
Spontaneous
Idiopathic
Intracavernous CCF
Meningeal br.
Cavernous Sinus
Adj dural vein
Mixing → ↓ AP
↑EVP
Dilated VP
Dilated Vein
Poor
Bruit

Mx

↑ EVP

Sx lat.
- TAD.
- SVC Syndrome.
- Fibrobullous Tx
- CSF.

Sx later
- CCF
- O. varices
- Medical Mx

Associated with
- ↓ Aq production
- Sx sclerotomies for drainage of SC fluid

Staged Trab → Non penetrat deep sclerotomy
- ⇓
- Gonio puncture.

- ↓
- Transscleral Diode Laser. CP.

- Endo-arterial balloon occlusion
- < Transvenous approach thru Ipsi SOV.

Steroid induced glaucoma

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CF

↳ COAG open AC.

Acute presentation ⊆ ↑↑ pressure rise
- Intensive systemic steroid therapy
- Topical potent steroid
- IVTA in pseudophakic patients.

→ Once steroid stopped they behave like Low tension glaucoma

false ↓ IOP after refractive Sx → OCT, Dewar rigidity changes
Corneal edema., fluid accumulat" below lasik. flap.

Theories of Mech

↓ Aq Outflow.

Nuclear transport of GC receptor.

↓

↑ Nuclear size & DNA content

Dexa ↓ FK506 binding Immunophilin FKBP51

↓

mediate transport of GR beta

Influence on ECM

↓

GAG

- polymer. → upregulated → Biologic edema. ↕ Aq Outflow.
- Depolymer → lysozyme → H. dase ⊖ stabilize.

Influence on Phagocytosis

Endothelial cells

↓

Phagocytic properties

↓

clear Aqueous of debris.

Genetic influences.

↓

Myocilin gene.

Dexa → α1 Anti Chymot.
PEDGF.
CDK6.
PGD_2 Synthase.
Growth Assoc Specific 1
Decorin
IGF.

Outflow obstruction by steroid particles.

↓

IVTA

↓

White crystal in angle of 1 pt.

Prevention

Pt selection

Already having COAG
Long term use »

↑ risk for steroid response

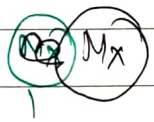
COAG
1st ° relative.
↑ young age
↑ Myopia
Previous steroid response
Type 1 DM
CTD
PK.

Drug selection

a) Topical → » Systemic
b) Periocular — Long acting. Most dangerous.
c) Intravitreal ℞ → ✓
d) Systemic — least likely

Relative Pressure Inducing effects

- CS
  - ↑IOP & Anti Inflamm potency
- Nonadrenal steroids
  - ↓
  - ↳ Progesterone
  - ↓ IOP elevation.
- NSAIDs



- discontinuation of steroid use
  - ↓
  - + Anti glaucoma medicat"
  - ↳ use ↓ potent drug
- Excision of ~~depot~~ steroid.
- Glaucoma therapy.
  - Medical → Laser
  - IVTA.
  - use Sub Teron. inj of Anecortave Acetate.

Pre-Perimetric tests

- Ix
  - GSLO
  - SLP
  - RTA
  - OCT RNFL
- Perimetry
  - SWAP
  - FDT
  - Contrast & Motion Sensitivity

SWAP — target bistratified blue yellow ganglion cell sensitive to blue stimuli

Goldman size V

short λ blue targets on a bright yellow background

× affected by blue blocking acrylic IOL.

SWAP SITA → 12 — 9 min

FDT series of white & black bands flickering at 25 Hz. mediated by subset of large diameter ganglion cells — My ganglion cells that project to Magnocellular visual pathway

sensitive to motion & contrast ↓ >> vulnerable to glaucoma changes

90s

Macula 10-2

N30-F

24-2

30-2

Contrast & Motion Sensitivity

- High Pass Resolution perimetry
- Random Dot Motion AP

ONH Imaging tech

office tech → Direct Ophthalmoscope @ 78D & 90D

graticule

Welch Allyn. Direct O.

Photographic tech

2 dimensional tech

Stereoscopic photo

- 2 photo simultaneously
  - Manual
  - Slide Carriage adapter
- 2 Camera. simultaneously
  - Donaldson. Stereoscopic fundus Camera
    - Better
- Twin prism Separator

→ USG

→ Computed Analysis of ONH & RNFL →

Rodenstock ONH analyzer
Topcon Imagnet
HRA

Confocal Laser Scanning Ophthalmoscopy
Scanning LASER Polarimetry.
OCT
RTA

Tech of Bld flow measurement

Vessel Caliber Assessment
Pulsatile Ocular Bld flow measurement
Scanning LASER
ICG Angio of peripapillary choroid
Laser Doppler flowmetry
Confocal / SL Doppler "
Color Doppler Imaging

10μ = 0.7mm

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Tonometry

Manometry — Live method.

Types

Indentation
↓
Impression
↓
Punctated Cones

- Schiotz
- Hecington
- Giants
- Maurice

(3-4) reading 5.5 / 7.5 / 10 / 15g
→ Errors
→ sterilizatn

Applanation
↓
Simple flattening
↓
Imbert fick's principle

fixed force
Variable area

- Maklakov Kalfa
- Applanometer
- Tonomat
- Barraquer
- Ocular tension Indicator
- Glaucotest

fixed area
Variable force
↓
No effect of Ocular Rigidity

- Mackay Marg
- GAT
  - Slit lamp
  - Hand held
    - Contact
      - Perkin
      - Draeger
    - Non Contact
      - Air puff
      - Pulse Air Tonometer

Mackay Marg types

- Tonopen
- Pneumotonometer

→ Misc advancements in tonometers

- Pascal dynamic contour Tonometer
- Diatom Transpalpebeal "
- Reichert's ORA "
- Icare or Rebound "
- Smartlens
- Proview pressure phosphene "
- Implantable IOP sensors
  - IOP IOL probe
  - CL sensors
  - Choroid IOP sensors

In spl situations

- Irregular Cornea
  - Pneumatic
  - Other — NCT
    - Mackay Marg
    - Tono Pen
- SC Lens
  - Pneumotonometer
  - Tonopen
- IO gases
  - Tonopen
  - Pneumatic tonometer

Shallow AC
- GAT
- Tonopen
- Pneumo-tonometer

In Eyes ≤ KPro
- Digital.

Ocular Rigidity (ε Value)

actually scleral rigidity

Expression of stretchability of eye in response to an ↑IOP.

∝ Inherent elasticity
+
Thickness & time dependent variable ⇒ Visco-elasticity

At

↓ Pressure → ↓ Small ↑ in vol

↑ Pressure → ↓ large ↑ in Vol.

Factors affecting - Friedenwald

- Ref errors → ↑ in Hyper
- ↑IOP → ↓ε value ⇒ H_2O diluting test
- Drugs → ↓ε by miotics
  ↑ by Vasoconstrictors
- Surgery
- Age

OD changes

- Hard sign
- Spaeth's Classification
- Soft sign

- Alteration of Cup & NRR
- Vascular
  - Vessel Calibre
  - Disc Hmrg
  - Collateral over disc
- PP Changes
  - β Zone
  - RNFL wedge defect
  - PP Atrophy

Vascularization
Bayonetting
Overpass
Narrowing
BCLV

- Enlargement of Cup
  - ↑ Cup size
  - ↑ CDR
  - Alteration in Cup shape
  - Asymmetry b/t 2 eyes
  - Changes in position & appearance of lamina C
    - Saving of lamina
    - Backward bowing of lamina
    - Slit like laminar opening
- Loss of NRR
  - Localized
  - diffuse
- ↑ Pallor