DISEASES OF THE LENS

Dr RK Bansal MS, FRCSEd
Consultant Ophthalmology
GMCH-32
Chandigarh
EMBRYOLOGY
ANATOMY OF LENS
ANATOMY OF LENS

Dia:9-10mm,
Th:3.5-5mm,
Ant R:10mm,
Post R:6mm
Power 14-16D,
RI: 1.39
Ant capsule 14µ
Post capsule 3µ
ANATOMY

Embryonic: 1Mo to 3Mo
Fetal: 3Mo to birth
Infantile: birth to puberty
Adult: adult life
ANATOMY: Y SUTURES
Zonules

• Also called suspensory ligament
• Fibers from ciliary body to lens
• 3 group of fibers; 1\text{st} from pars plana to anterior capsule, 2\text{nd} from anterior part of CB to posterior capasule and 3\text{rd} group from processes to equator
• Role in accommodation
Lens avascular. Metabolism occurs in cortex.
85% Glucose metabolised by anaerobically by glycolytic pathway.
15% by hexose monophosphate pathway.
Sorbitol pathway used in diabetes and galacosemia
CATARACT CLASSIFICATION

• Cataract: any opacity in lens called cataract

CLASSIFICATION

• Etiological
• Morphological
ETIOLOGICAL CLASSIFICATION

• 1. Congenital and Developmental

• 2. Acquired
  a. Senile/age related
  b. Traumatic
  c. Complicated
  d. Metabolic
  e. Radiation
  f. Toxic: steroid, Cu, iron, miotics
  g. Systemic diseases: skin, osseous, syndromes
MORPHOLOGICAL CLASSIFICATION

CAPSULAR:
ANT/POST

POLAR:
ANT/POST

SUB-CAPSULAR:
ANT/POST

CORTICAL

NUCLEAR
CONGENITAL AND DEVELOPMENTAL CATARACT

- Cong. if insult during pregnancy
- Developmental after birth up to adolescent age
- Particular area of lens affected, other areas remain clear
- Small punctate opacities are common; do not affect vision
Congenital/Developmental Cataract

• Common cause of childhood blindness
• Responsible for 10% of visual loss in children
• 1:250 births have some cataract
• Isolated anomaly
• Associated with other systemic conditions
CONGENITAL/DEVELOPMENTAL CATARACT
Cataracta centralis pulverulenta

✗ Embryonic nuclear cataract
✗ Autosomal dominant
✗ Bilateral
✗ Small round opacities; powdery appearance
✗ Does not affect vision
Lamellar/Zonular cataract

- Most common (50%)
- Foetal nucleus involved
- Linear opacities like riders in cortex
- Genetic or environmental
- Bilateral
- Affects vision, need for surgery
SUTURAL CATARACT

• Punctate opacities along sutures
• Static and bilateral
• Do not affect vision
• Opacities could be floriform, coralliform or spear shaped
POLAR CATARACT

- Anterior or posterior
- Anterior due to delayed formation of AC
- Adjoining cortex involved
- Pyramidal or reduplicate
- Congenital or acquired
- Posterior due to persistent vasculosa lentis
CORONARY CATARACT

- Common variety-occurs during puberty
- Adolescent nucleus and cortex affected
- Club shaped opacities 360 D, radial orientation
- Vision unaffected
PUNCTATE OR BLUE DOT CATARACT

- Round bluish dots in adolescent nucleus
- Stationary and vision not affected
- Occurs during first two decades
TOTAL CONG. CATARACT

- Common
- Unilateral or bilateral
- May be hereditary
- Rubella can cause such cataract
- Progressive; needs early surgery
- May become membranous
ETIOLOGY OF CATARACT

• Hereditary; autosomal dominant
• Maternal infections; rubella, toxoplasma, CMV
• Drug induced; steroids, thalidomide
• Radiation exposure
• Metabolic disorders; galactosemia
• Birth trauma
• Malnutrition; Vit D
• Idiopathic
MATERNAL INFECTIONS

• Rubella cataract: 50% transmission during first 8 weeks and later around 33%
• Features: cataract, deafness, heart defects- PDA, microcephaly, MR, Hypotonia, hepatosplenomegaly, thrombocytopenic purpura, pneumonitis
• Ocular: cataract, microcornea, microphthalmia, retinopathy, glaucoma, nystagmus, OA, strabismus
Rubella syndrome

- Microcephaly
- PDA
- Cataracts
INVESTIGATIONS

- Rubella serology; IgM
- Urine for reducing substances; galactosemia
- Urine for amino acids; Lowe’s syn.
- Blood glucose, calcium, phosphorus
- CT, MRI for basal ganglia calcification
TREATMENT OF CONG. CATARACT

- Observation: stationary opacities, vision not affected
- Iridectomy: optical; for central nuclear cat.
- Surgery: Phacoaspiration, ECCE, lensectomy
  - Unilateral
  - Total B/L
  - VA < 6/18
- IOL > 2 yrs of age
- Contact lens
- Glasses
- Amblyopia treatment
ADULT CATARACTS

• Age related cataract: most common
• Most common cause of blindness; 50%
• Bilateral; asymmetry common
• Nuclear/ cortical/PSC/Polar
• Factors for early onset; hereditary, U/V radiation, diet
STAGES OF MATURATION

- Lamellar separation
- Incipient cataract
- Immature cataract
- Mature cataract
- Hypermature cataract; morgagnian, sclerotic
- Lens induced glaucoma; phacolytic, phacomorphic, phacoanaphylactic
METABOLIC CATARACTS
DIABETIC

- Senile cataract matures early
- True diabetic; snow flake and PSC type
- Occurs at younger age
- Osmotic hydration of lens, sorbitol pathway
GALACTOSAEMIC CATARACT

- Inborn error of metabolism
- Galactose-1-phosphate uridyl transferase deficiency; classical galactosaemia
- Galatokinase deficiency; classical oil droplet cataract
- Galactose- dulcitol-more osmotic pressure
- Early changes reversible with elimination of milk products in diet
If a galactosemic infant is given milk, unmetabolized milk sugars build up and damage the liver, eyes, kidneys and brain.
HYPOCALCAEMIC CATARACT

- Parathyroid tetany can lead to cataract
- Could be post surgical; thyroidectomy
- White or multicolored crystals in cortex
- Maturity uncommon
WILSON’S DISEASE

- Inborn error of copper metabolism
- Deficiency of ceruloplasmin
- KF ring
- Green sunflower cataract
- Retinal degeneration
- Jaundice, hepatosplenomegaly and cirrhosis
- Neurological signs; dysarthria, dysphasia
- D-penicillamine drug for treatment
Urine is tested for copper levels.
LOWE’S SYNDROME

• Oculo-cerebro-renal disease
• Inborn error of metabolism, boys affected
• Congenital cataract (100%) and glaucoma (50%)
• Microspherophakia
• Mother may show punctate opacities
• Mental retardation, dwarfism, osteomalacia, muscular hypotony, frontal prominence
FABRY’S DISEASE

- Alfa-galactosidase A deficiency
- Angiokeratomas- telangiectasia of skin
- Cardiovascular and renal impairment
- Cornea verticillata and spoke like lens opacities
- Vision not affected
COMPLICATED CATARACT

- Anterior uveitis; posterior sub capsular cataract with polychromatic luster
- Occlusio or seclusio can develop
- Can remain stationary if inflammation controlled
- Occurs due to disturbance of lens metabolism
COMPLICATED CATARACT

• Retinal detachment and retinitis pigmentosa cause posterior sub capsular cataract
• High myopia; nuclear sclerosis
• Acute glaucoma; glaukomfleckens
• Tumors; retinoblastoma, melanoma
TOXIC CATARACTS

• Steroid induced: Topical and oral steroids can cause posterior sub capsular cataract
• Dose relationship with oral steroids, children more susceptible >10mg for 1yr
• Miotics: Long term use with long acting miotics like ecothiophate.
• Other drugs: Amiodarone, chlorpromazine, busulphan, and gold (ant. Sub capsular)
RADIATION CATARACT

- Infrared: Long exposure; posterior sub capsular: glass blower’s cataract
- Irradiation cataract: X-rays, gamma rays, neutrons can cause cataract after 6M to 1 year after exposure.
- Ultraviolet rays: Senile cataract
- Electric cataract: After powerful current, punctate sub capsular cataract
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• Ocular: cataract, microcornea, microphthalmia, retinopathy, glaucoma, nystagmus, OA, strabismus
Rubella syndrome

Microcephaly  PDA  Cataracts
OTHER MATERNAL CAUSES

• Toxoplasmosis and CMV also can cause cataract
• Mother drug intake: thalidomide, steroids
• Exposure to radiation
• Malnutrition during pregnancy
**SYSTEMIC DISEASES**

- **Dystrophia Myotonica:**
  Spastic muscle contractions, hypogonadism, frontal baldness, expressionless face, ptosis, and cardiac anomalies.

Ocular: Polychromatic cataract (Christmas tree cataract, light near dissociation, pigmentary macular deg.)
SYSTEMIC DISEASES

- Atopic cataract: Atopic dermatitis, bilateral posterior sub capsular cataract, keratoconus, keratoconjunctivitis
- Down syndrome: Trisomy 21, MR, mongoloid face, CHD, Cataract, slanted narrow palpebral fissure, keratoconus, strabismus, nystagmus, blephritis, iris spots, myopia
SYSTEMIC DISEASES

• **Werner’s syndrome**: Premature senility, hypogonadism, diabetes, arrested growth, bilateral cataract.

• **Rothmund’s syndrome**: females affected, skin atrophy, pigmentation and telangiectasia, saddle nose, bony defects, hypogonadism, bilateral cataract
CLINICAL FEATURES;

Symptoms

• Visual loss; slow, painless, myopic shift
• Glare and lower contrast sensitivity
• Double or polyopia
• Colored halos
• Blurring of vision, distortion of images
• Pain if glaucoma develops
CLINICAL FEATURES; Examination

• Visual acuity testing
• Refraction
• Distant direct examination
• Iris shadow
• Slit lamp examination and IOP check
• Dilated fundus examination
CLINICAL EXAMINATION

Macular function tests

- Light perception and projection
- Pupillary reaction
- Two point discrimination
- Maddox rod test
- Entoptic images
- Laser interferometry
- Ultrasound, VEP
CATARACT SURGERY

Preop evaluation

• General physical examination and evaluation
• Complete ocular examination; IOP, sac test, conjunctivitis, ocular inflammation.
• IOL power calculation; contact and optical
• IOL calculation formulas
• Plan type of surgery: ICCE, ECCE, Phaco
• Type of anesthesia: topical, local; peri or retrobulbar or general
CATARACT SURGERY
Preop preparation

• Topical antibiotics
• Topical NSAIDS
• Pupil dilatation
• Acetazolamide
• Eye preparation
• Informed consent
CATARACT SURGERY
ICCE

• Cheap and simple,
• Less time consuming; mass surgeries possible
• No posterior capsular opacification, as no capsule
• Easy to learn and master
• No sophisticated equipment required
• Can be done when lens displaced
Methods to do icce

- Cryoextraction
- Tumbling
- Erysiphake
- Alfa chymotrypsin
- Capsular forceps
CATARACT SURGERY
ICCE; disadvantages

• PC lens not possible, scleral fixation, AC or iris fixation can be done
• Not possible in young people; more vitreous loss
• More complications; vitreous incarceration, vitreous touch, pupillary block glaucoma
• RD, endophthalmitis, CME more chances
CATARACT SURGERY

ECCE

• ECCE difficult to learn and more complications with beginners
• Posterior capsule opacification
• Can not be done with lens subluxation or dislocations
• IOL implantation possible
• Less posterior segment complications
SMALL INCISION CATARACT SURGERY

- Type of ECCE
- Incision in the sclera; 5-6mm
- Scleral tunnel is made, which is self sealing
- CCC or capsulotomy done
- Nucleus delivered and cortex aspirated
- IOL implanted
CATARACT SURGERY
PHACOEMULSIFICATION

• Small incision; 3.2, 2.8, 0.9
• No sutures required
• Less astigmatism
• Early rehabilitation
• Foldable lens material has less PCO
• Complication rate less
• More costly, sophisticated equipment
• Longer learning curve
CATARACT SURGERY

Surgical steps

- Conjunctival incision and cautery; ICCE, ECCE, SICS
- Wound construction; scleral, corneoscleral, corneal. Superior or temporal
- Capsulotomy: CCC, can opener, Envelope
- Hydro dissection and hydrodilination
- Removal of nucleus or emulsification
- Cortical cleanup
- IOL implantation; PMMA, Acrylic, silicone
- Wound closure
Video
ACRILISA
MULTIFOCAL
CATARACT SURGERY

Complications

• Early: Iris prolapse, hyphema, wound leak, pupil block, IOP raised, endophthalmitis, ciliochoroidal detachment
• Late: CME, PCO, RD, Corneal decompensation, epithelial/ fibrous in growth
• Lens malpositions
• Glaucoma
IOL subluxation
Endophthalmitis

• Devastating complication of cataract surgery
• Incidence: 1:10000
• Organisms
  – Staph. epidermis, Staph aureus, pseudomonas, fungal
• Clinical features
  – Pain, visual loss, corneal edema, hypopyon severe reaction
• Rx:
  – Intravitreal injection of Vancomycin 1mg & Ceftazidine 2.25mg
  – PPV
Endophthalmitis
Aphakia

✗ Refractive state
✗ Condition with absent lens in pupillary area
✗ Could be dislocated posteriorly
✗ Capsule could be present if ECCE and no IOL
✗ Iridodonesis, AC deep, jet black pupil or white capsule
✗ No 3rd purkinje image
✗ Require high power glasses
Pseudophakia

• Condition with IOL in the eye
• Normal physiological lens absent
• AC/PCIOL/Iris fixated
• AC deep, iridodonesis, Purkinje images from IOL
ECTOPIA LENTIS

• Lens not fully in its place; partially displaced from ptellar fossa, some zonular attachment present.
• Dislocation: lens totally displaced from its place.
• Could be anterior or posterior dislocation
• Can cause glaucoma, astigmatism, uniocular diplopia
• Isolated anomaly or associated with systemic disease
ETIOLOGY

• Isolated anomaly
• Part of syndrome
• Trauma
• Pseudoexfoliation syndrome
MARFAN’S SYNDROME

- Autosomal dominant
- Cardiac anomalies; aneurysm of aorta and regurgitation
- Skeletal anomalies; Upper limbs long, arachnodactyly, pectus deformity, joint laxity, high arched palate
- Ocular: Lens subluxation upwards, symmetrical, angle anomaly and glaucoma, axial myopia, flat cornea, RD
ECTOPIA LENTIS

- **Weill Marchesani syndrome**: Autosomal recessive.
  - Short stature, short stubby fingers, mental retardation
  - Ocular: Microspherophakia, inferior dislocation, angle anomalies, glaucoma
- **Ehler Danlos syndrome**: Joints lax, skin loose and thin, subluxation
• **Ehler Danlos syndrome**:  
  • Joints lax,  
  • skin loose and thin,  
  • subluxation
Joint and Skin Findings IN EHLER DANLOS
ECTOPIA LENTIS

- **Homocystinuria**: Autosomal recessive, deficiency of enzyme-cystathione synthetase
  - Features like Marfan’s
  - MR, osteoporosis
  - Thromboembolism after GA
  - Hair fine and fair
  - Lens subluxation downwards, glaucoma
OTHER LENS ANOMALIES

• Lens coloboma
• Anterior lenticonus- Alport’s syndrome
• Posterior lenticonus-sporadic unilateral
• Microspherophakia- Lowe’s syndrome, Weill Marchesani syn., Marfan’s syn.
  Hyperlysinemia
Anterior lenticonus  

Posterior lenticonus