Ophthalmology Lecture 3: Cataract

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Cataract

ELWA Family Medicine Residency Program
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OUTLINE

• INTRODUCTION
• EPIDEMIOLOGY AND CAUSES OF CATARACT
• TYPES OF CATARACT
• CLINICAL FEATURES OF CATARACT
• TREATMENT AND COMPLICATIONS OF CATARACT
An opacity in the lens is called a ‘cataract’ (Greek: waterfall), because vision is similar to looking through a waterfall.
INTRODUCTION

- It is the leading cause of blindness worldwide
- Cataract is the second leading cause of visual impairment after refractive error
- The burden of visual impairment is not borne equally.
- Visual impairment ranks behind arthritis and heart disease as the third most common chronic cause of impaired function in persons older than 70 years.
- Patients with vision impairment are more likely to fall, make medication errors, have depression, or report social isolation.
- With rehabilitation, many patients with impaired vision can attain independence, retain their jobs, and lessen their reliance on social services and institutions.
Vision impairment that could have been prevented or has yet to be addressed

- Unaddressed presbyopia (826 million)
- Unaddressed refractive error (123.7 million)
- Cataract (65.2 million)
- Glaucoma (6.9 million)
- Corneal opacities (4.2 million)
- Diabetic Retinopathy (3 million)
- Trachoma (2 million)
• Greater burden amongst
  • Low- and middle-income countries
  • Under-served populations such as
    • Women
    • Migrants
  • Persons with certain kinds of disability,
  • Rural communities.
• Blindness prevalence varies between 0.4% (in developed regions) and 1.5% (in poor underserved regions) in different population.

• Cataract is responsible for between 40%-55% of all blindness worldwide.

• Research has shown that the prevalence of blindness in Liberia is estimated at 1 percent, with an estimated total of 35,000 blind people. Cataract is the major cause of blindness in Liberia, with an estimated backlog of 17,500 people or 50 percent of the total blind population.
Ageing and the lens

• Various degenerative and ageing changes occur in the lens, probably because of its unusual structure.
• These changes occur to some degree in everyone, as they grow older.
  1. Increase in hardness and loss of accommodation
  2. Increase in density
  3. Increase in size
  4. Increase in opacity
RISK FACTORS

1. The biggest risk factor for cataract is age.
2. Life in tropical countries and poor countries increases the risk of developing cataract.
   • Episodes of severe dehydration in early life
   • Solar radiation
   • Diet
   • Heat
3. Some diseases cause or are associated with cataract.
   • Eye diseases and cataract
     • Uveitis
     • Glaucoma
     • Trauma
<table>
<thead>
<tr>
<th>Systemic disease/risk factor</th>
<th>Comment/examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endocrine disease</strong></td>
<td></td>
</tr>
<tr>
<td>Diabetes*</td>
<td>Diabetics develop cataracts more frequently and at a younger age than non-diabetics</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td></td>
</tr>
<tr>
<td>Other rare endocrine conditions</td>
<td>e.g. Galactosaemia, hypocalcaemia, hyperparathyroidism</td>
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<tr>
<td><strong>Genetic metabolic conditions</strong></td>
<td></td>
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<tr>
<td>Wilson’s disease</td>
<td>Disorder of copper metabolism, causing sunflower cataract</td>
</tr>
<tr>
<td>Myotonic dystrophy</td>
<td>Disease causing muscle wasting and causes anterior and posterior polar cataracts</td>
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<tr>
<td>Other rare metabolic conditions</td>
<td></td>
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<tr>
<td><strong>Drugs and medications</strong></td>
<td></td>
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<tr>
<td>Steroid medication*</td>
<td>Long term steroid use, both ocular and systemic causes cataract formation</td>
</tr>
<tr>
<td>Alcohol*</td>
<td>Thought to be related to rapidly maturing subcapsular cataracts</td>
</tr>
<tr>
<td>Anticholinesterase miotics, e.g. pilocarpine</td>
<td></td>
</tr>
<tr>
<td>Phenothiazines</td>
<td>Anterior subcapsular granular opacities</td>
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<tr>
<td>Systemic infections</td>
<td></td>
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<td>-------------------------------------</td>
<td>---------------------------------------------------</td>
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<tr>
<td>Congenital viral infections*</td>
<td>e.g. Fetal cataracts caused by rubella and chicken pox (varicella zoster) during pregnancy</td>
</tr>
<tr>
<td>Congenital syphilis</td>
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<tr>
<td>Congenital toxoplasmosis</td>
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<table>
<thead>
<tr>
<th>Skin Diseases</th>
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<tbody>
<tr>
<td>Atopic dermatitis</td>
<td>Cataracts in 10% of patients with chronic disease. Typically anterior and posterior cataracts. Cataracts also occur with some other very rare skin diseases</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chromosomal disorders</th>
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<tbody>
<tr>
<td>Down's syndrome*</td>
<td>Cataracts in 50% of patients.</td>
</tr>
<tr>
<td>Turner syndrome</td>
<td></td>
</tr>
<tr>
<td>Other rare diseases</td>
<td>e.g. Patau syndrome, Edward syndrome</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Skeletal diseases</th>
<th></th>
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<tbody>
<tr>
<td>e.g. Conradi syndrome, osteogenesis imperfecta, Pierre Robin syndrome, Rubinstein-Taybi syndrome</td>
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<table>
<thead>
<tr>
<th>Syndromes that cause lens displacement</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Marfan syndrome</td>
<td>Autosomal dominant genetic condition</td>
</tr>
<tr>
<td>Homocystinuria</td>
<td>Inborn error of metabolism</td>
</tr>
<tr>
<td>Ehlers–Danlos syndrome</td>
<td>Inherited defect of collagen production</td>
</tr>
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<table>
<thead>
<tr>
<th>Syndromes that also cause pigmentary, retinal degeneration</th>
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<tbody>
<tr>
<td>e.g. Laurence–Moon–Biedl syndrome, Usher syndrome, Cockayne syndrome</td>
<td></td>
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</table>
ANATOMY OF THE LENS

CORTEX
- It is the peripheral part which compromises the youngest lens fibres.

NUCLEUS
- It is the central part containing the oldest fibres. It consists of different zones, which are laid down successively as the development proceeds.
- Different zones:
  1. Embryonic nucleus
  2. Fetal nucleus
  3. Infantile nucleus
  4. Adult nucleus
CATARACTS
Its transparency is due to the arrangement of its fibres, internal structure and the biochemistry of the lens cells and fibres.

A cataractous lens is when the lens become opaque.
• The lens is avascular
• It lies behind the iris
• It is attached to the ciliary muscle by the zonules
• It is made up of fibres derived from the anterior lens capsule
• The nucleus is the oldest part of the lens
• Fibres are continuously added around the nucleus throughout life, forming the cortex
Incidence of Lens opacities in the “normal” population with aging.
(Cinotti & Patti, 1968)

<table>
<thead>
<tr>
<th>AGE GROUP (YEARS)</th>
<th>LENS OPACITY (%)</th>
</tr>
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<tbody>
<tr>
<td>50 – 59</td>
<td>65</td>
</tr>
<tr>
<td>60 – 69</td>
<td>83</td>
</tr>
<tr>
<td>70 – 79</td>
<td>91</td>
</tr>
<tr>
<td>&gt; 80</td>
<td>100</td>
</tr>
</tbody>
</table>
CAUSES

CONGENITAL
- Familial
- Intrauterine infections
- Maternal drug ingestions

AGE
- Elderly

METABOLIC
- Diabetes
- Hypocalcaemia
- Wilson’s Disease
- Galactosemia
CAUSES

**DRUG-INDUCED**
- Corticosteroids
- Miotics
- Amiodarone
- Phenothiazines

**TRAUMATIC AND INFLAMMATORY**
- Post intra-ocular surgery
- Uveitis

**DISEASE ASSOCIATED**
- Down’s Syndrome
- Dystrophia Myotonica
- Lowe’s Syndrome
- Atopic dermatitis
CLASSIFICATION

MORPHOLOGICAL CLASSIFICATION

1. Subcapsular cataract
   - Anterior subcapsular cataract
   - Posterior subcapsular cataract

2. Nuclear cataract
   - Involves the nucleus of lens. Yellow to brown coloration

3. Cortical cataract
   - Wedge shaped or radial spoke-like opacities.

4. Polar cataract
   - Central posterior part of the lens
CLASSIFICATION
BASED ON DEGREE OF MATURITY

MATURE
Cataract is one in which the lens is completely opaque.

IMMATURE
Cataract is one in which the lens is partially opaque.

HYPERMATURE
Cataract is shrunken and wrinkled anterior capsule due to leakage of water out of the lens

MORGAGNIAN
Cataract is a hypermature cataract in which liquefaction of the cortex has allowed the nucleus to sink inferiorly
## HOW TO DIFFERENTIATE MATURE AND IMMATURE CATARACT?

<table>
<thead>
<tr>
<th>IMMATURE CATARACT</th>
<th>MATURE CATARACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual acuity is reduced to counting fingers</td>
<td>Visual acuity is reduced to hand movement or perception of light</td>
</tr>
<tr>
<td>Lens is partially opaque</td>
<td>Lens in totally opaque</td>
</tr>
<tr>
<td>Iris shadow is present</td>
<td>No iris shadow is present</td>
</tr>
<tr>
<td>Fundus may be visible</td>
<td>No fundus details</td>
</tr>
</tbody>
</table>

![IMMATURE CATARACT](image1.png)

![Mature Cataract](image2.png)
MORGAGNIAN CATARACT
- The lens is made mostly of water and protein fibers.
- Opacity occurs when the lens protein (crystallins) clump together.
- Ability for lens to refract lights reduce which cause reduction in visual acuity.
- Chemical modification of the lens cause it to be thicken and harden.
It is not fully understood.

There are three metabolic pathways which convert glucose in energy (ATP) and other relevant metabolic molecules. These are:

1. Glycolysis
2. The Pentose Phosphate Shunt
3. The Polyol Route
CLINICAL PRESENTATION

PRESENTING COMPLAINTS AND HISTORY

- **Decreased visual acuity** is the commonest complaint.
  - Progressive and painless
  - Worse in bright light

- There may be complaint of **glare** and **monocular diplopia** if the cataract splits the visual axis

- A myopic shift in the refraction with progression of cataract may also be noted

- Some complain of a **white reflex** in the pupil
PAST MEDICAL HISTORY

- May reveal **risk factors** such as
  - Trauma
  - Intrauterine infections
  - Diabetes or other metabolic disorders

FAMILY HISTORY

- Cataract may have occurred in other members of the family in the hereditary variants.
- Visual acuity is impaired for both distance and near and patient may even be blind.

- **Opacity** in the lens

- Ocular adnexia and intraocular structures when examined may reveal lesions that may point at
  - The cause, type and eventual visual prognosis

- If RAPD positive, this indicates an optic nerve disease or extensive macular lesions
  - Visual prognosis guarded in such cases
Blurred vision due to scattering of light on the retina
VISUAL ACUITY

Normal vision

Vision through early cataract

Vision through advanced cataract
The treatment of cataracts is:

1. Glasses
2. Better lighting
3. Surgery
   a. Phacoemulsification
   b. ECCE
   c. ICCE (not performed now)

Sometimes a cataract should be removed even if it doesn't cause major problems with vision, if it is preventing the treatment of another eye problem, such as age-related macular degeneration, diabetic retinopathy or retinal detachment.
The aim of treatment is:

1. Improve vision
2. Increase mobility and independence
3. Relief from the fear of going blind
INDICATIONS

1. Work or lifestyle is affected by vision problems caused by the cataract.
2. Glare caused by bright lights is a problem.
3. Cannot pass a vision test
4. Have double vision.
5. Notice a big difference in vision when you compare one eye to the other.
6. Have another vision-threatening eye disease, such as diabetic retinopathy or macular degeneration.
Cataract Surgery

- The patient will be given eye drops, which must be used, as directed, to prevent infection.
- If the patient has cataracts in both eyes, one will be operated and the second a few weeks or months later.
- Some people may need spectacles after the operation.

- The patient is awake.
- The eye is not removed.
- The operation takes about 20 minutes.
- The patient will be administered anesthesia: topical or local or, in rare cases, general anesthesia.
- After the operation, there is a patch covering the eye.
- The patient must be seen, at the clinic, the day following surgery.
- The patient may go home the day of surgery, or may stay in the hospital, depending on their general health and how far they live from the clinic.
- The patch is removed the next day and the patient can immediately see.
**SURGERY: ICCE**

- **Intracapsular cataract extraction**
- Involves extraction of the *entire lens*, including the posterior capsule and zonules
- Weak and degenerated zonules are a pre-requisite for this method
- This is the surgery of choice if there is *markedly subluxated or dislocated lens*
- This technique of surgery has largely been replaced by ECCE
**SURGERY: ECCE**

- **Extracapsular cataract extraction**
  - An 5 mm to 6 mm incision is made in the eye where the clear front covering of the eye (cornea) meets the white of the eye (sclera).
  - Another small incision is made into the front portion of the lens capsule. The lens is removed, along with any remaining lens material.
  - **An IOL may then be placed inside the lens capsule.** And the incision is closed.

*it is usually done if the cataract is too large to be destroyed by ultrasound*
SURGERY: ECCE

Extracapsular cataract extraction
COMPLICATIONS

1. Infection in the eye (endophthalmitis).

1. Swelling and fluid in the center of the nerve layer (cystoid macular edema).

1. Swelling of the clear covering of the eye (corneal edema).

1. Bleeding in the front of the eye (hyphema).

1. Detachment of the nerve layer at the back of the eye (retinal detachment).
<table>
<thead>
<tr>
<th>ECCE</th>
<th>ICCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small incision 5-6mm</td>
<td>Large incision 10-12mm</td>
</tr>
<tr>
<td>Posterior lens conserved</td>
<td>Removal entire lens</td>
</tr>
<tr>
<td>No stiches required, self healing</td>
<td>Required stiches, long rehabilitation time</td>
</tr>
<tr>
<td>IOL implant</td>
<td>Aphakic eye</td>
</tr>
<tr>
<td>Post operative complication minimal</td>
<td>Added risk for retinal detachment, corneal edema and vitreous loss</td>
</tr>
</tbody>
</table>
PHACOEMULSIFICATION

- Two small incisions are made in the eye where the clear front covering (cornea) meets the white of the eye (sclera).

- A circular opening is created on the lens surface (capsule)

- A small surgical instrument (phaco probe) is inserted into the eye.

- Sound waves (ultrasound) are used to break the cataract into small pieces. Sometimes a laser is used too. The cataract and lens pieces are removed from the eye using suction.

- An intraocular lens implant (IOL) may then be placed inside the lens capsule.

- Usually, the incisions seal themselves without stitches.
PHACOEMULSIFICATION
<table>
<thead>
<tr>
<th>Method</th>
<th>Indications</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICCE</td>
<td>Weak zonules</td>
<td>No risk of secondary cataract</td>
<td>High risk of vitreous loss (20%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Little equipment needed</td>
<td>Astigmatism</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delayed visual rehabilitation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AC or sutured IOL</td>
</tr>
<tr>
<td>ECCE</td>
<td>Very hard lens</td>
<td>Least equipment needed</td>
<td>Astigmatism</td>
</tr>
<tr>
<td></td>
<td>Poor corneal endothelium</td>
<td>Easy on corneal endothelium</td>
<td>Delayed visual rehabilitation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posterior chamber IOL</td>
<td></td>
</tr>
<tr>
<td>Phaco</td>
<td>Most cataracts</td>
<td>Fast visual rehabilitation</td>
<td>Expensive instrumentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ultrasound can be hard on cornea endothelium</td>
</tr>
</tbody>
</table>
Cataract surgery with intraocular lens implantation is one of the miracles of modern medicine. These happy patients were all operated on the previous day by one surgeon.
THANK YOU
REFERENCES

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- AMERICAN ACADEMY OF OPHTHALMOLOGY, LENS AND CATARACT, BCSC 11, 2019
- CATARACT LECTURE BY AUDI ADIBAH et.al