Management of Cataract Complications

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Cataract Extraction

- One of the most commonly performed procedures in the United States
- Personal experience
- Co-management

Statistics

- Number of Americans > 40 who are affected by cataracts: 20.5 million
- Percentage of Americans >80 who have cataracts: 50%
- Number of surgeries performed worldwide by 2010: Approximately 20 million
- Number of surgeries performed worldwide by 2010: Approximately 32 million
- Annual amount spent through Medicare to treat cataracts: $3.4 billion
- Number of Americans who have cataract surgery each year: 3,000,000
- Success rate of cataract surgery: 98%
- Percentage of patients without severe post-op complications: 99.5%

Complications

- Time
  - Pre-Operative
  - Intra-operative
  - Early post-operative (first few days)
  - Late post-operative (weeks to months)

- Location
  - Anterior (cornea, anterior chamber, IOL, capsule)
  - Posterior (vitreous, retina)

Pre-Operative Care
Pre-Operative Care

Pre-existing Ocular Conditions
- High Myopia
- High Hyperopia
- Binocular vision abnormalities
- Blepharitis
- Dry Eye Disease
- Fuch's Dystrophy
- Pseudoptosis
- Glaucoma
- LRM
- Macular Degeneration
- Diabetic Retinopathy
- Retinitis Pigmentosa
- High Myopia
- Planning combined procedure

Pre-existing Medical Conditions
- Age
- Sex
- Race
- Diabetes Mellitus
- Atherosclerotic Vascular disease
- Hypertension
- Allergies/reactions to sedatives/anesthetics
- Blending tendencies
- BPM
- Marfan Syndrome
- Breathing problems
- Systemic medications
  - Systemic
  - OAG
  - Diuretics
  - NSAIDS
  - Saw palmetto
  - Ginkgo biloba

Age
- Older >60 assoc w increased postsurgical complications
- Oldest patients at increase risk for endophthalmitis

Race
- Several studies vary on whether whites or African Americans have higher complication rates.
- Higher endophthalmitis rates among African Americans

Sex
- Several studies report inc risk among Men
  - 44% higher odds of endophthalmitis
- Behavioral difference key
  - Compliance
  - Differences in bacterial flora between sexes
  - Use of a-agonists

Diabetes
- Those with ophthalmic manifestations of DM had 33% inc risk for complications
- Complication risk increased with level of DR severity
  - Altered immunity
  - Poor pupil dilation
  - Bleeding tendencies

Same day combined Surgery
- Common to stage two procedures together to help address multiple issues at once
- Stein et al found 151% inc risk for severe adverse events in combined procedures
  - Longer time in operating room
  - Exposure to addtl instruments
  - More incisions

Surgeon Factor
- Surgeon Volume
  - AE 70% lower in surgeons who performed 501-1000 surgeries / yr
  - 86% lower among surgeons >1000 sx
- Highest risk in surgeons performing 50-250 cases / yr

Intra-Operative Care

Flomax (Tamsulosin)
- Most widely prescribed treatment worldwide for BPH
  - $1.9 billion 2009
- Systemic Alpha1 antagonist
  - Highly selective for A1a receptor
- Relaxes smooth muscles
  - bladder neck and prostate
  - permitting more complete emptying
  - iris dilator smooth muscle
**Flomax (Tamsulosin)**

- **Strong Association with IFIS**
  - first reported in 2005
  - Iris billowing and floppiness
  - Iris prolapse to main and side incisions
  - Progressive miosis
- **Classified:**
  - Mild (17%)
  - Moderate (30%)
  - Severe (43%)
- **Canadian study**
  - Doubling rate of serious postoperative complications following Cat Sx
  - RD, retained fragments, severe inflamn, endophthalmitis

- **IFIS can occur more than 1 year after tamsulosin has been discontinued**
  - Eventually produce a permanent atrophic change in the iris dilator muscle that is not reversed by discontinuation
  - IFIS has occurred within 3 – 7 days of initiating tx
  - Stopping pre-operatively is of unpredictable and questionable value
- **Important to make surgeon and patient aware**
- **Pregnancy Category B**

**Posterior Capsule Rupture**

- **Most common intraoperative complication (1.9-3.5%)**
  - Vitreous Loss
  - Need for vitrectomy
  - Placement of intraocular lens in ciliary sulcus or AC
  - Additional surgical interventions
- **Risk factors for Post Cap Rupture**
  - Increasing age
  - Male sex
  - Comorbid glaucoma
  - Diabetic retinopathy
  - Brunescent /white cataract
  - Poor views of the fundus
  - Exfoliation syndrome / phacodonesis
  - Small pupil
  - Axial length >26mm
  - α-antagonist use
  - Inability to lay flat
  - Trainee surgeon

**Post-Operative Care**

- Critical evaluation of the operated eye during the immediate post-operative and peri-operative period is extremely important
  - 1 day
  - 1 week
  - 1 month
- Thorough DFE is mandatory in any patient who does not meet or exceed expected VA

**Areas of Decreased Vision**

In evaluating reduced post-operative acuity, one should know both the timing and severity of the visual complaint in order to determine an etiology.

- **Early Visual Impairment**
  - Severe (20/200 or worse)
  - Moderate (20/100 or better)
- **Delayed Visual Recovery**
Early Visual Impairment

- Vascular Occlusion
- Retinal Detachment
- Infectious Endophthalmitis
- Toxic Anterior Segment Syndrome
- Delayed Suprachoroidal Hemorrhage
- Optic Nerve Damage
- Globe Rupture or Perforation
- Intraocular aminoglycoside toxicity

These injuries often occur through vascular insult, direct mechanical injury, or retinal toxicity.

Early Visual Impairment

- Epithelial Irregularity
- Irregular or Marked Corneal Astigmatism
- Corneal Edema
- Dislocated / subluxated IOL
- Operative / Post-operative bleeding
- Retained Cortex or Nuclear fragments
- Hypotony
- Photoretinal Toxicity
- Extraocular Muscle paresis

These complications predominantly affect optical clarity, macular function or refractive state.

Early Visual Impairment

- Vascular Occlusion
  - CRVO, CRAO
  - Choroidal Infarction
- May occur in Sx if complicated by:
  - retrobulbar hemorrhage
  - nerve sheath injection
  - elevated IOP

Retinal Detachment

- CRVO, CRAO
- Choroidal Infarction
- May occur in Sx if complicated by:
  - retrobulbar hemorrhage
  - nerve sheath injection
  - elevated IOP

Higher risk if high myopia, prior scleral buckle, staphyloma, enophthalmos

Early Visual Impairment

- Retinal Detachment
  - CRVO, CRAO
  - Choroidal Infarction
- May occur in Sx if complicated by:
  - retrobulbar hemorrhage
  - nerve sheath injection
  - elevated IOP

Acute Bacterial Endophthalmitis

- Usually manifests 2-7 days after surgery, most within 6 weeks
- Pain, injection, significant decrease in VA, purulent discharge
- Incidence 1:1000
- Most acute cases due to Staphylococci (aureus and epidermidis)
- Act as soon as possible
- Key to Dx is culturing aqueous and vitreous.
**Early Visual Impairment**

- Acute Endophthalmitis
- Clinical Appearance
  - Ant chamber cell
  - Hypopyon
  - Fibrin
  - Focal Corneal edema
  - Eyelid edema
  - Chemosis
  - Hyperemia
  - Vitreal Involvement
  - Pt has Pain
- 21% with underlying DM

**Early Visual Impairment**

- Endophthalmitis Vitrectomy Study (EVS)
  - Multicenter randomized trial carried out at 24 centers in U.S. (1990-1994)
  - Looked at 420 patients with clinical evidence
  - To determine the role of IV and systemic antibiotics
  - To determine role of immediate PP Vitrectomy
  - Results
    - No difference in final visual acuity or media clarity with or without use of systemic / IV antibiotics
    - Therefore recommend intravitreal injection of AB


Results of the Endophthalmitis Vitrectomy Study. A randomized trial of immediate vitrectomy and of intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis.

Endophthalmitis Vitrectomy Study Group.

**Early Visual Impairment**

- Toxic Anterior Segment Syndrome
  - Monson et al. first used the term TASS in 1992
  -received greater attention because of a national outbreak in 2005 that affected 112 patients treated at seven sites in six states and was linked to endotoxins in Advanced Medical Optics Endosol Balanced salt solution (BSS).
  - Develop in response to retained lens, toxic intraocular reaction, mechanical irritation, exacerbation of pre-existing uveitis

**Early Visual Impairment - TASS**

- Careful Hx and exam help differentiate between the two and timely intraocular cultures and intravitreal AB must be utilized when interpretation difficult
- Most common clinical symptom is significantly blurred vision
- Corneal Edema is most common clinical finding
  - Limbus to limbus
  - Indicative of widespread endothelial damage

**Early Visual Impairment - TASS**

- Marked ant seg inflammation
  - Hypopyon
  - Fibrin from surface of iris onto surface to IOL, to wound and side ports
  - Can create significant iris damage
  - Permanently dilate
  - Transillumination
  - Damage to TM leading to 2nd Glc
Early Visual Impairment - TASS

- **Treatment**
  - Immediate high dose topical corticosteroid
  - Follow closely
    - Same day
    - Daily
  - IOP monitoring
    - Usual low to start but can rise rapidly
  - Acute trabeculitis
  - PAS development – gonio
  - Specular Microscopy
    - Monitor for permanent endothelial damage
  - No help to wash out the AC

- **Clinical Features**
  - Pain
  - Most patients do not experience
  - Corneal Edema
    - Diffuse “limbus-to-limbus”
  - Anterior Segment Inflammation
    - Increased cell/flare, hypopyon, marked fibrin reaction
  - Iris/pupil
    - Iris atrophy, with dilated, non-reactive pupil
  - Vitreous
    - Usually clear, rare spillover

Early Visual Impairment

- **Intraocular aminoglycoside toxicity**
  - Inadvertent injection of a toxic concentration of aminoglycoside into the eye causes rapid retinal / macular infarction
  - Markedly Elevated IOP
  - Presents as injection, pain, corneal edema, poor pupil response and reduced VA

- **Post-Op pressure elevation**
  - Viscoelastic
  - Inflammation
  - Hyphema
  - Ciliary or pupillary block
  - Mechanical angle closure

Early Visual Impairment - TASS vs Infectious Endophthalmitis

<table>
<thead>
<tr>
<th>CORNEAL FEATURES</th>
<th>TASS</th>
<th>INFECTIOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of symptoms</td>
<td>Relatively immediate (12-48 hours)</td>
<td>Somewhat delayed (2-7 days)</td>
</tr>
<tr>
<td>Pain</td>
<td>Most patients do not experience</td>
<td>&gt;75% of patients have pain</td>
</tr>
<tr>
<td>Corneal Edema</td>
<td>Diffuse “limbus-to-limbus”</td>
<td>Focal corneal edema</td>
</tr>
<tr>
<td>Anterior Segment Inflammation</td>
<td>Increased cell/flare, hypopyon, marked fibrin reaction</td>
<td>Increased cell/flare, hypopyon, moderate to severe fibrin</td>
</tr>
<tr>
<td>Iris/pupil</td>
<td>Iris atrophy, with dilated, non-reactive pupil</td>
<td>Changes relatively uncommon</td>
</tr>
<tr>
<td>Vitreous</td>
<td>Usually clear, rare spillover</td>
<td>Opacified</td>
</tr>
</tbody>
</table>

Early Visual Impairment

- **Corneal Irregularity**
  - Epithelial edema, corneal drying, epithelial toxicity, or direct mechanical injury may contribute to corneal surface irregularity following surgery

- **Corneal edema**
  - Epithelial edema often associated with elevated IOP
  - Stromal edema from endothelial dysfunction
  - Mechanical injury, cell toxicity or pre-existing
  - Cataract surgery accompanied by anterior vitrectomy
    - 3x more likely to be associated with chronic post-operative corneal edema
Common causes of corneal edema
- Dense cataracts
- Shallow anterior chamber
- Pre-existing corneal disease
- High IOP

Management of corneal edema
- Time
- Ocular hypotensive agents
- Topical hyperosmotics

Corneal Irregularity
- Irregular or high post-operative astigmatism may substantially reduce visual acuity
- Results from excessive suture tension or wound misalignment
- Thermal injury with resultant collagen shrinkage
- Keratometry or topography will help quantify the problem

Corneal punctate epithelial keratopathy
- Exposure
- Topical drug toxicity
- Irregular tear wetting patterns

Subluxated IOLs can cause reduced acuity, glare, diplopia
Careful refraction of both the pseudophakic and aphakic portions help guide the Tx
Unstable lenses may cause uveitis, corneal injury, GlC, CME

Post-operative Bleeding
- Hyphema
- Vitreous Hemorrhage
- Intracapsular blood
- Minor ant./post. Seg heme usu. clear in days to weeks
- If interfere with fundus exam – ultrasound R/O RD, etc.
- Patients taking anticoagulants do not appear to have significantly increased rates of serious post-op bleeding
**Early Visual Impairment**

- Retained lens fragments
- **Risk factors**
  - Limited pupil dilation
  - Traumatic cataract
  - Patient movement during surgery
  - Disorders that predispose to zonular weakness?
- Causes variable visual symptoms depending on amount and location
  - Nuclear more than cortical incite inflammation, corneal edema, elev. IOP, RD
  - Medical Tx directed toward controlling IOP and inflammation
  - PPV for large particles

**Determining the etiology requires examination of the wound, gonioscopy of the angle, B/O, B-scan, etc.**

**Early Visual Impairment**

- Hypotony
  - Wound leak or globe perforation
  - Serous or hemorrhagic choroidal detachment
  - Cyclodialysis cleft
  - Marked inflammation
  - Retinal detachment

**Early Visual Impairment**

- **Choroidal Detachment**

  Surgical drainage of CD is reserved for patients with mechanical angle closure or choroidal touch centrally

**Early Visual Impairment**

- Phoretential toxicity
  - Phoretential injury from operating microscope
  - Patients complain of scotoma
  - If injury near fovea, VA will be compromised
  - Appears as subtle pale oval lesion, commonly located inferior to fovea
  - Healing results in mottling of RPE – Prognosis excellent if outside fovea

**Early Visual Impairment**

- Temporary diplopia
  - pre-existing sensory strabismus worsening
  - the prismatic effect of a new spectacle correction
  - prolonged anesthetic effect
  - transient myotoxicity
  - low-grade operative trauma to the orbital soft tissues.
  - ? Forcedduction testing

**Delayed Visual Recovery**

- Cornea
- IOL
- Inflammation
- Retina
- Pre-existing condition

*Nayak H, Kersey JP, Oystreck DT, Cline RA, Lyons CJ. Diplopia following cataract surgery: a review of 150 patients.*

Delayed Visual Recovery

- Epithelial Irregularity
- Persistent Corneal Edema
- Irregular or high corneal astigmatism
- IOL subluxation, tilt, or capture
- Ant. Seg. Inflammation
- Post. Seg. Inflammation

By 6 weeks, intraocular inflammation and minor corneal edema should be resolved. IOP should be normal, and the macula should be distinct without edema.

Delayed Visual Recovery

- Hypotony
- Posterior Vitreous Detachment
- Macular Edema
- Photoretninal Toxicity
- UnDx pre-existing conditions
- Incorrect IOL power
- Others

- Anterior Segment Inflammation
- ocular irritation continues beyond normal wound healing:
  - Poorly placed haptics
  - Exposed suture ends
  - Vitreous traction to wound
  - Chronic intraocular infection
  - Exacerbation of underlying uveitis

Delayed Visual Recovery

- Chronic Endophthalmitis
  - manifest as AC cell / vit cells, mod VA red, ocular discomfort, 1-4 months following cataract surgery
  - Propionibacterium Acnes -an anaerobic pleomorphic gram positive bacillus
  - White plaque on PC and granulomatous KP

- May become apparent after Yag Cap
- responds transiently to topical steroid
- Intravitreal ab therapy gives favorable visual outcome

Delayed Visual Recovery

- Posterior Segment Inflammation
  - Severe vitreous reaction usually presents in early postop assoc. with acute endophthalmitis, retained lens material, uveitis exacerbation
  - Delayed vitreous reaction less likely to be severe and may occur with chronic endophthalmitis, chronic RD, retained lens material, uveitis exacerbation

Delayed Visual Recovery

- Rebound Inflammation
  - Occurs in 5% of patients
  - More common in dark irides
  - More common in patients with DM
  - Occurs when steroids are discontinued to early or tapered too quickly
  - Always look for retained lens material with gonio

- Treatment
  - Resume topical steroids
  - Consider cycloplegia
  - Consider tap and injection to rule out chronic endophthalmitis
Cystoid Macular Edema

Most common cause of decreased vision after cataract surgery
Incidence?
Higher risk patients?

CME Presents 4-12 weeks after uncomplicated Sx with reduced VA modest ocular inflam leakage of FL from optic nerve and macula Results from retinal leakage in perifoveal region and accum. of fluid in the outer plexiform layer of the retina

Major contributing factors intraocular inflammation vitreous traction (wound, iris, or macula) pre-existing microvascular disease biomicroscopy and fundus contact lens exam yellowish spot in fovea ERM, retinal striae & tortuosity of the retinal vessels is assoc. 10-20%

Fluorescein angiography Early to mid arteriovenous phase shows selective leakage of the perifoveal capillaries Late phase shows discrete lobules of hyperfluorescence in petaloid app., usu with assoc. hyperfluorescence of the optic nerve Poor correlation between the degree of leakage seen in FA and VA – Retinal thickness a better indicator of decreased VA, ie Clinical CME vs. Angiographic CME

Optical Coherence Tomography appears as nonreflective cystoid spaces in the outer plexiform and inner nuclear layers
OCT much less-invasive than fluorescein angiography. Also measures retinal thickness, which is invaluable in monitoring the course of therapy

Cystoid Macular Edema
Causes Medication side effects Trauma/injury Diabetes AMD Cataract surgery
**Cystoid Macular Edema**

- Most commonly seen after cataract surgery
- Described in 1953 by Irvine
- Angiographic CME after ICCE: As high as 60%
- Angiographic CME after ECCE: 15% to 30%
- Clinical CME after small incision phaco: 0.1%-2.35%
- OCT evidence of CME after small incision phaco: 4% to 11%
  - also reported to be as high as 41%

**Delayed Visual Recovery**

- Avastin
  - Initially approved to treat colorectal cancer
  - Inhibits VEGF
  - Study in 2008 at University of Wisconsin
  - Macular degeneration
  - Diabetic macular edema
  - ROP
  - Pre-surgical treatment for diabetic vitreous hemorrhage
  - Subconjunctival for corneal neovascularization

**Cystoid Macular Edema**

- Topical NSAIDs all approved for post-operative inflammation
  - But not specifically for CME

- Topical NSAIDs for prophylaxis
  - Wittgen at al (2008)
    - CME in 5 of 278 patients who received perioperative prednisolone, and in 0 of 268 who also received ketorolac
    - 450 patients
    - No cases of CME in patients treated with Nevanac and prednisolone
    - 5 cases of CME in group without Nevanac treatment

**Delayed Visual Recovery**

- Posterior Capsular Opacity
  - “Secondary Cataract”
  - Occurs in 40% of patients
  - Occurs a few weeks to many years after surgery
    - Peak incidence is 2-6 months after surgery
  - Caused by:
    - epithelial cell proliferation and migration
    - epithelial-mesenchymal transition
    - collagen deposition
    - lens fiber generation

**Types of capsular opacification**

- **Elschnig pearls**
  - Proliferation of lens epithelium
  - Occurs after 3-5 years
- **Fibrosis**
  - Usually occurs within 2-6 months
  - May involve remnants of anterior capsule and cause phimosis
Age Dependent
- low incidence in older patients, high in young

Ways To Decrease Incidence
- Attempted removal of lens epithelial cells
- Aspiration of the anterior capsule
- Pharmacological dispersion
- Manual polishing of the anterior and posterior capsule
- IOL material and design
  - Sharpe-edge optic IOLs and those made of acrylic and silicone have lower rates of PCD

Treatment of capsular opacification
- Nd:YAG laser capsulotomy
  - Accurate focusing is vital
  - Apply series of punctures in cruciate pattern (a-c)
  - 3 mm opening is adequate (d)

Potential complications
- Damage to implant
- Cystoid macular oedema
- Retinal detachment
- Rare except in high myopes

Delayed Visual Impairment
- Diplopia persistent for 6 mo after Sx
  - Incidence 0.17%
  - 34% - Decompensation of pre-existing asymptomatic strabismus
  - 25% - Extraocular muscle restriction or paresis
  - 8.5% - Refractive
  - 5% - Concurrent onset of systemic disease (including sixth nerve palsies)
  - 5% - Central fusion disruption (acquired loss of fusion)
  - 2.5% - Monocular double vision
  - 20% - Undetermined etiology

Femtosecond Laser-Assisted Surgery
- First human LCS performed 2008 Budapest, Hungary
- Creation of precise anterior capsulotomies
- Liquefaction of Nuclear (N1)
- Fragmentation of N2 and N3 lenses
- Creation of corneal wounds in any position and size
- Treatment of preoperative astigmatism

- Complications reported
  - All complications occurred in first 100 eye
  - Suction Break
  - Conjunctival Redness or Hemorrhage
  - Capsule Tags and Bridges
  - Anterior Capsule Tear
  - Endothelial Damage
  - Capsular Blockage Syndrome and Posterior Capsule Rupture
  - Miosis
  - Vitrectomy
Capsule Tags and Bridges
- Anterior Capsule Tear
- Endothelial Damage
  - Endothelial cut is a serious complication of femto tx
  - High hyperopes at higher risk due to shallow AC
  - Less common with systems that have integrated OCT
- Capsular Blockage Syndrome with consecutive Posterior Capsule Rupture
  - Serious complication
  - Intralenticular gas bubbles form due to excessive energy dissipation in the lens material
  - After capsulotomy the gas bubbles tend to move toward the anterior chamber
  - Can be avoided with Rock N Roll technique which allows air bubbles to leave the crystalline lens

Miosis
- Femtosecond creates shockwave that can affect the surrounding tissue in a 1.0mm area.
  - Therefore with a 5.0mm dia capsulotomy, width of pupil should be 6.5mm
  - Larger the pupil the less chance of shockwave hitting the margin
- Hitting the pupil margin further increases the miosis
- Creates inflammatory debris and fibrin
- Highly myopic eyes and pseudoxfoliation are prone to miotic reaction after femtosecond
- Vitrectomy

Additional Considerations
- Injurious falls between first and Second eyes
- Hospitalization for falls Doubled between 1st and 2nd eye sx
- Expeditied 2nd eye cat sx
- Mental health visits
  - Decrease of 18.80% (p ≤ 0.001) in number of mental health contacts for depression and/or anxiety the year after cataract surgery
  - 28% reduction in health care costs
- Driving Risk
  - Risk for driving-related difficulties was reduced by 88% after sx

Case Study
- 81 year old AA female
- Medical history: HTN
- Ocular history: unremarkable
- Uncomplicated cataract surgery
- Uncorrected VA @ 3 months: 20/20 OD, OS
- Returned two months later
  - BCVA 20/30 OD, 20/60 OS
Evidence has shown a steady decline in rates of serious adverse events over the past few decades.

- Cataract Surgery is a relatively safe procedure in experienced hands.
- Patients who are at risk include older age, male sex, comorbid DR, combined procedures, those taking a-antagonists.
- Complications are less likely to lead to visual loss if handled promptly and properly.
- Newer technologies have ability to decrease future complications.

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