Posterior Segment Complications of Cataract Surgery

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ISBN 978-981-15-1017-5 e-ISBN 978-981-15-1019-9
https://doi.org/10.1007/978-981-15-1019-9

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Introduction

This book deals with the recognition and management of all posterior segment complications associated with cataract surgery and will provide a comprehensive coverage of these sight-threatening complications. Written for the benefit of the novice as well as experienced surgeon, each chapter is structured to offer pertinent pearls in identifying patients at risk and will emphasise on surgical strategies to be adopted to minimise the occurrence of this complication as well as management options and long-term post-operative care of these compromised eyes.

The authors who have contributed are experienced surgeons who have a long track record of successful management of these complications and are by themselves sought after teachers in this field.

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M. Chakrabarti, A. Chakrabarti (eds.), *Posterior Segment Complications of Cataract Surgery*
https://doi.org/10.1007/978-981-15-1019-9_1

1. Risk Factors for Posterior Segment Complications of Cataract Surgery

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Keywords Risk factors – Cataract surgery – Posterior segment complications

1.1 Introduction

Cataract surgery has evolved over the past few decades into a very safe and efficient procedure. Advances in intraocular lenses have complimented the technical surgical advances making cataract surgery a refractive procedure with excellent visual outcomes. Despite these advances in technology and techniques for safety, complications occur occasionally, even in the best of hands.

Posterior segment complications of cataract surgery are rare and in a few instances they may be anticipated in view of risk factors that the eye may harbor. Awareness of these risk factors will enable the cataract surgeon to prepare well in advance and modulate a surgical strategy to prevent these complications. In this chapter, we discuss the risk factors for the following posterior segment complications of cataract surgery.

1. **Needle stick injury**
2. **Dropped nucleus**
3. **Rhegmatogenous retinal detachment**
4. **Pseudophakic cystoid macular edema**
5. **Endophthalmitis**
6. **Toxic anterior segment syndrome**
7. **Suprachoroidal hemorrhage**
8. **Dislocated IOL**
9. **Progression of retinal disease after cataract surgery**
10. **Phototoxic retinopathy**

1. **Needle Stick Injury**—This complication can occur if cataract surgery is planned under either peribulbar or retrobulbar anesthesia. As most cataract surgeries are currently being performed under topical anesthesia, the incidence of needle stick injury is negligible. Needle stick injury can lead to globe perforation if the sclera is injured, vascular insufficiency if the central retinal artery is damaged or toxic optic neuropathy and Purtscher's like retinopathy if the optic nerve is injured during anesthesia. Risk for globe perforation is high in the following conditions:

   (a) High myopia: Incidence of scleral perforation is estimated to be 0.13% in eyes with high myopia (axial length > 26 mm) and higher in eyes with posterior staphyloma [1, 2].
   (b) Retrobulbar block poses greater risk compared to peribulbar block [2, 3]
   (c) Deep socket eyes with difficult access to the orbit [2]
   (d) Uncooperative patient, mentally challenged, etc.
   (e) Faulty techniques: Most common site is the inferotemporal quadrant followed by the superonasal quadrant [3].

2. **Dropped Nucleus:** Cataract surgery leading to posterior capsular rupture (PCR) prior to segment removal carries the risk of nuclear fragments sinking into the vitreous cavity. Risk factors for dropped nucleus can be classified as under:

   (a) **Posterior polar cataract**: Posterior polar cataracts are often associated with dehiscence of the central part of the posterior capsule. Forceful hydrodissection can lead to intraoperative "capsular block syndrome" with rupture of the dehiscent posterior capsule leading to drop of the entire nucleus [4, 5].
   (b) **Zonular instability**: Zonular laxity or loss of zonules can be detected as phacodonesis during preoperative evaluation. This is best observed in an undilated pupil under slit lamp magnification by asking the patient to perform rapid horizontal saccades. Coexistent conditions such as pseudoexfoliation [6], blunt trauma or syndromic habitus such as Marfan's and Ehler Danlos [7, 8] should alert the surgeon to look for subtle phacodonesis during preoperative evaluation. Ultrasound biomicroscopy (UBM) can be used to detect zonular integrity preoperatively in doubtful cases though careful clinical evaluation is the best indicator. Similarly, history of zonular problems during cataract surgery of

the other eye should prompt the surgeon to anticipate the same in the eye to be operated.

(c) **Poor mydriasis**: Inadequate pupillary dilatation increases the risk of PCR and nucleus drop [9, 10]. A small pupil hampers adequate visualization leading to a small capsulorhexis and difficulty in nuclear disassembly. Traumatic maneuvers during phacoemulsification can lead to either zonular loss or posterior capsular rupture and resultant nucleus drop. Pupillary diameter can be assessed preoperatively using the slit lamp beam length and should be documented in the case files to alert the surgeon of this possibility. Cause of poor mydriasis such as pseudoexfoliation, floppy iris secondary to tamsulosin, age-related sclerosis of the sphincter, chronic pilocarpine use, etc. should also be determined.

(d) **Cataract density**: Very dense brunescent/ black cataracts and mature/hypermature cataracts significantly increase the risk for nucleus drop due to myriad reasons [5, 9]. Peripheral capsulorhexis extension, poor visualization of the posterior capsule, poor red glow, and inadvertent posterior capsular trauma due to the chopper and/or phaco probe all increase the likelihood of nucleus drop in dense/mature cataracts. Additionally, black cataracts and hypermature cataracts have preexisting zonular laxity in view of the sheer cataract mass being supported by the zonules.

(e) **Capsulorhexis tear:** Capsulorhexis tear due to any cause increases chances of PCR and nucleus drop [9, 10]. Capsulorhexis tear and peripheral extension is commonly seen with hypermature cataracts, eyes with angle closure glaucoma and when the intralenticular pressure is high. Surgeons in training also experience peripheral extension of the rhexis margin without any predisposing risk factors. Irrespective of the underlying cause, capsulorhexis tear and extension must alert the surgeon to possible extension to the posterior capsule and potentially high risk of PCR and nucleus drop during phacoemulsification maneuvers.

(f) **Post PPV eyes**: Eyes that have undergone previous vitreous surgery are always at a slightly greater risk of PCR and nucleus drop [5, 9]. A documented history of prior posterior capsular touch by vitreoretinal instruments almost always leads to posterior capsular instability and warrants careful surgical maneuvers. Post silicone oil removal, the posterior epinucleus becomes abnormally leathery and is difficult to crack or chop. Additionally, lack of vitreous support leads to unusual deepening of the anterior chamber during cataract surgery. The red fundal glow may also be altered due to previous retinal surgical maneuvers making surgery difficult and leading to PCR and nucleus drop.

(g) **High myopia:** Eyes with very high myopia have very deep anterior chamber and weak zonules making it difficult to reach the cataract surface and chop/emulsify it. Such eyes are prone to surge, alterations in intraocular pressure intraoperatively and are at an increased risk of PCR and nucleus drop [5, 9].

(h) **Positive pressure:** Excessive amount of anesthetic injected into the retrobulbar space causes positive pressure and raised intraocular pressure. This leads to repeated shallowing of anterior chamber and thus increases chances of PCR and nucleus drop.

(i) **Poor patient cooperation:** Especially while performing surgery under topical anesthesia can predispose to PCR and dislocation of nucleus.

3. **Rhegmatogenous Retinal Detachment**: Cataract surgery especially complicated by PCR and vitreous loss increases the risk of retinal detachment [11]. The following risk factors should be kept in mind and the risk of retinal detachment assessed periodically after cataract surgery:

   (a) **Posterior vitreous detachment**: It is presumed that alterations in intraocular pressure during cataract surgery induce posterior vitreous detachment (PVD) [12–14]. As PVD progresses, regions of strong vitreoretinal adhesions are prone to develop retinal tears and subsequent retinal detachment. History of retinal detachment in the other eye should prompt the surgeon to examine the retinal periphery well and periodically monitor for retinal tears in the postoperative period as PVD progresses.

   (b) **PCR with vitreous loss:** Disruption of the anterior vitreous face and performance of anterior vitrectomy increases stress on the vitreous base, thus increasing traction and risk of retinal tears, giant retinal tears, and retinal detachment [12–14]. Use of automated vitrector with proper settings (high cut rate and low vacuum), bimanual vitrectomy (separating infusion and aspiration), and anterior vitrectomy in a closed chamber reduce the risk of retinal detachment.

   (c) **Preexistent retinal degenerations:** Preexistent lattice degeneration also increases the risk of retinal detachment, especially in eyes that are yet to develop a PVD [15].

   (d) **Posterior capsulotomy during and after cataract surgery:** Especially in pediatric population, leads to vitreous disturbance and traction at the vitreous base and increases the risk of retinal detachment [16, 17].

   (e) **Traumatic maneuvers:** Surgical maneuvers such as fishing the nucleus out from the mid-vitreous cavity increase the risk of giant retinal tears [18]. Posterior levitation via the pars plana has been described as an effective way to avoid sinking of the nucleus [19]. In this technique, a microvitreoretinal blade is inserted via the pars plana, and the nucleus is levitated into the anterior chamber and removed via a limbal approach. Such maneuvers also increase the risk of retinal detachment and are better avoided [20].

4. **Pseudophakic Cystoid Macular Edema (PCME):** Usually, acute PCME occurs at about 3 months after cataract and can occur even after uncomplicated cataract surgery. However, the following situations increase the risk of PCME:

   (a) **PCR with vitreous loss:** This is also termed Irvine–Gass syndrome and is thought to be due to traction on the macula as a result of prior incomplete anterior vitrectomy [21, 22].

   (b) **Diabetes**: Individuals with diabetes, especially those with underlying diabetic retinopathy, are at an increased risk of PCME due to the compromised blood retinal barrier [22].

   (c) **Intraocular lens (IOL) positioning**: Placement of the IOL other than “in the bag” increases the risk of PCME. IOL in sulcus, anterior chamber lens, papillary capture of IOL optic, iris claw lens, or sclera-fixated IOL all increase the risk of PCME. Non-UV blocking IOLs are also known to increase the risk of PCME [22].

   (d) **Preexisting uveitis**: Eyes with preexisting uveitis, especially anterior uveitis, are known to have a flare up after cataract surgery with resultant CME [22].

   (e) **Excessive tissue handling during surgery**: Surgery performed by training ophthalmologists and involving maneuvers

such as sphincterectomy and synechiae release lead to excessive postoperative inflammation and increase the risk of PCME [22].

(f) **Others**: Retinitis pigmentosa, retained cortical matter in the vitreous cavity, PCME in fellow eye, and the presence of epiretinal membrane also increase the risk of PCME [22].

Use of preoperative non-steroidal anti-inflammatory drugs has not been found to be effective in PCME prophylaxis by the American Board of Ophthalmology [20]. However, in the presence of the above risk factors, perioperative topical anti-inflammatory drugs might be useful in PCME prophylaxis.

5. **Endophthalmitis**: Infective endophthalmitis is the most dreaded and visually threatening complication following cataract surgery. The incidence is low and ranges from 0.05 to 0.15%. Though endophthalmitis can occur after uneventful cataract surgery, its risk increases many-fold in the presence of the following risk factors:

   (a) **PCR with/without vitreous loss:** Increases the risk of endophthalmitis by breaching anatomical barriers and allowing organisms entry into the nutrient rich vitreous [23].
   (b) **Surgical tunnel complications**: A leaking corneal tunnel with resultant hypotony increases the likelihood of organisms entering the eye [23, 24]. Wound burns after phacoemulsification, improper tunnel location, and depth are factors that predispose to wound leak and subsequent complications such as endophthalmitis.
   (c) **Chronic dacryocystitis**: Untreated chronic dacryocystitis is a source of continuous infection and increases the risk of endophthalmitis [24]. Preoperative syringing should be performed preferably in all patients and especially in those with history of persistent watering.
   (d) **Poor lid hygiene, personal hygiene**: These lead to alteration in the local flora in the conjunctiva and predispose to infections. It is recommended that blepharitis and other conditions of the lids be well controlled before taking up the patient for cataract surgery [24]. Additionally, proper draping keeping the eye lashes away from the surgical field also reduces the risk of infection.
   (e) **Diabetes**, chronic alcoholism, long-term use of systemic steroids, and other debilitating systemic diseases reduce immunity and predispose to endophthalmitis.
   (f) **Contaminated eye drops**: Contaminated Natamycin eye drops causing superimposed pseudomonas keratitis has been reported in the past [25]. Contaminated eye drops, irrigating solution, and viscoelastics can also potentially increase the risk of endophthalmitis.
   (g) **Nocardia endophthalmitis**: Very old and frail patients are at an increased risk for Nocardia endophthalmitis [26]. This infection is indolent, starts from the surgical tunnel, and gradually involves the vitreous cavity over weeks.
   (h) Chronic endophthalmitis caused by *Propiniobacterium* acne: Risk increases after Nd:YAG capsulotomy [27].

6. **Toxic Anterior Segment Syndrome (TASS)**: Though TASS mainly involves the anterior segment, anterior vitreous involvement may occur in severe cases. TASS leads to severe anterior segment inflammation typically within 24 h of surgery. Risk factors for TASS include:

   (a) Alterations in pH, osmolality, and elevated endotoxin levels in ocular viscoelastic devices, balanced salt solution, IOLs, and ocular medications [28].
   (b) Instruments with residual detergents and antiseptics lead to TASS outbreaks [29].

7. **Suprachoroidal Hemorrhage:** Expulsive choroidal hemorrhage is a sudden catastrophic complication during cataract surgery. Torrential bleeding occurs in the suprachoroidal space leading to the development of hemorrhagic choroidal detachment and poor visual outcome. Risk factors for suprachoroidal hemorrhage are:

   (a) **Uncontrolled blood pressure** during surgery: Very high blood pressure leads to a high intravascular pressure in the choroidal circulation along with atherosclerotic changes [30, 31]. Sudden ocular hypotony leads to imbalance in the pressure gradient across the choroidal circulation and sudden explosive bleeding in the suprachoroidal space.
   (b) **PCR with vitreous loss and excess vitrectomy**: Vitreous loss followed by anterior vitrectomy leads to loss of the tamponading effect of the vitreous on the retinal and choroidal circulation [32, 33]. This can lead to sudden choroidal bleeding and progress to expulsive hemorrhage.
   (c) **Sudden hypotony during surgery**: Even without increased intravascular pressure, sudden severe hypotony during surgery can lead to pressure imbalances and expulsive choroidal hemorrhage [32, 33].
   (d) **Very high myopia**: Eyes with degenerative myopia have choroidal sclerosis as a consequence of the myopia [34]. Even minimal hypotony during cataract surgery can cause choroidal bleeding in such eyes. Pressure fluctuations should be strictly avoided or minimized while operating on eyes with degenerative myopia.
   (e) **Uncontrolled glaucoma**: Very high intraocular pressure at the time of cataract surgery predisposes to expulsive choroidal hemorrhage [32].
   (f) **Others**: Advanced age, nanophthalmic eyes, Valsalva maneuver, use of systemic anticoagulants, and previous ocular trauma predispose to suprachoroidal hemorrhage [32].

8. **Dislocated IOL:** Risk factors for posterior dislocation of an IOL are similar to those for a dropped nucleus. The most common setting for a dislocated IOL is PCR with inadequate capsular support and zonular damage.

   (a) **Surgical complication**: Surgical complication such as PCR with vitreous loss leading to inadequate capsular support can lead to dislocation of the IOL into the vitreous cavity during surgery [35]. Improper placement of IOL in the ciliary sulcus or on an intact anterior vitreous face can lead to dislocation of the IOL in the early postoperative period. Use of single piece foldable IOL in eyes with PCR can also lead to instability and subluxation or dislocation of the IOL.
   (b) **Zonular problems** related to Marfan's syndrome and pseudoexfoliation lead to subluxation and dislocation of the IOL in the early postoperative period as well as many years after cataract surgery [36, 37]. Zonular damage due to traumatic surgery, even if stabilized with capsular tension rings/segments, are at a greater risk of IOL dislocation in the early or late postoperative period.
   (c) **High myopia:** Eyes with degenerative myopia are more prone for "in-the-bag" IOL dislocation many years after

uneventful cataract surgery [36].

9. **Progression of Retinal Disease After Cataract Surgery:** Certain diseases progress rapidly after cataract surgery and can lead to vision-threatening consequences if not monitored.

   (a) **Diabetic retinopathy:** It is well known that diabetic retinopathy can progress much faster in pseudophakic eyes. PCR and vitreous loss are known risk factors for rapid progression of non-proliferative to proliferative retinopathy and early neovascular glaucoma [38, 39]. Similarly, poor glycemic control, very rapid preoperative control [38], coexistent hypertension, and long duration of diabetes also increase the risk of rapid progression in diabetic retinopathy status [40, 41].

   (b) **Glaucoma:** Cataract surgery can cause spikes in intraocular pressure leading to progression of glaucomatous damage if IOP is not monitored closely and maintained under acceptable limits [42, 43]. Progression is seen in both open angle and angle closure glaucoma.

   (c) **Phototoxic retinopathy**: The occurrence of phototoxic injuries has been correlated with exposure to light of certain wavelengths, particularly blue light, and most significantly, the duration of surgery [44, 45]. Symptoms are decreased vision, metamorphopsia and scotoma. Retinal phototoxic lesions first appear a few days after exposure as a relatively normal looking macula to well-circumscribed outer retinal whitening with mild disturbances of the retinal pigment epithelium.

Risk factors include

1. Emmetropic eyes
2. Patients with diabetic retinopathy
3. Strong illumination from operating microscope

1.2 Conclusion

Posterior segment complications of cataract surgery are relatively rare. However, many of the complications described in this chapter have well-defined risk factors and can be predicted in most of the cases. Thorough preoperative assessment to identify these risk factors coupled with meticulous surgical planning to avoid complications can enhance surgical success and yield excellent results.

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