INTRODUCTION
Any breach in the continuity of the posterior capsule is defined as a posterior capsule tear. Intrasurgical posterior capsule tears are the most common and can occur during any stage of cataract surgery. The incidence of posterior capsule complications is related to the type of cataract and conditions of the eye, increases with the grade of difficulty of the case, and furthermore is influenced by the surgeon’s level of experience. Timely recognition and a planned management, depending upon the stage of surgery during which the posterior capsule tear has occurred, is required to ensure an optimal visual outcome.

COMMON RISK FACTORS FOR POSTERIOR CAPSULAR RUPTURE (PCR)

- Intraoperative factors causing variation in anterior chamber depth
- Type of cataract
- Extended rhexis.

INTRAOPERATIVE FACTORS CAUSING VARIATION IN ANTERIOR CHAMBER DEPTH

Intraoperative shallow anterior chamber could be due to various reasons. It may be a tight lid speculum, tight drapes or pull from the recollecting bag. In all the above cases, one needs to remove the precipitating factors (to remove the speculum pressure and the tight drapes and collecting bags). Variation in the amount of space in the anterior and posterior chambers may result from changes in the intraocular pressure (IOP) due to an alteration in the equilibrium between inflow and outflow of fluid. Diminished inflow may be secondary to insufficient bottle height, tube occlusion or compression, bottle emptying, too tight incisions compressing the
irrigation sleeve or the surgeon moving the phaco tip out of the incision, making the irrigation holes come out of the incision. Excessive outflow may be caused by too high vacuum/flow parameters or too large incisions with leakage. Another cause is the postocclusion surge. Use of air pump or gas forced infusion solves most of these problems of intraoperative shallow anterior chamber.  

**TYPE OF CATARACT**

A higher incidence of posterior capsule tear with vitreous loss is associated with cataract with pseudoexfoliation, diabetes mellitus and trauma. Missing the diagnosis in a posterior polar cataract (**Figure 1**) can be catastrophic to the surgeon and the patient. It is frequently associated with a weakened or deficient posterior capsule. Posterior lenticonus, cataracts with persistent primary hyperplastic vitreous, cataracts following vitreoretinal surgery and morgagnian cataracts are some of the other types. In any intraoperative diagnosis of posterior polar cataract, it is to avoid hydrodissection with balanced salt solution (BSS). Hydrodissection may cause hydraulic perforation at the weakened area of the capsule, hence only a careful controlled hydrodissection is preferred. One can also make multiple pockets of viscoelastic injection around the nucleus. If a capsular tear does occur, a closed system should
be maintained by injecting viscoelastic before withdrawing the phaco tip. This helps to tamponade the vitreous backwards where a capsular dehiscence is present.

EXTENDED RHESIS
Extension of anterior capsule can occur as a complication in MICS also. During capsulorhexis, anterior capsular tears can cause posterior capsule tear by extending to the periphery. In a new method of managing this situation, a nick is made from the opposite side of the rhesis using a cystitome or vannas and the capsulorhexis is completed. The viscoelastic in the anterior chamber (AC) is then expressed out to make the globe hypotonous, following which a gentle hydrodissection is done at 90° from the tear, while pressing the posterior lip of the incision to prevent any rise in intraocular pressure (IOP). No attempt is made to press on the center of the nucleus to complete the fluid wave. The fluid is usually sufficient to prolapse one pole of the nucleus out of the capsular bag; else it is removed by embedding the phacoemulsification probe, making sure not to exert any downward pressure and then gently pulling the nucleus anteriorly. The whole nucleus is brought out into the AC and no nuclear division techniques are tried in the bag. The entire nucleus is prolapsed into the anterior chamber and emulsified.

STEPS FOR MANAGEMENT OF PCR
Surgeon should be aware of the signs (Table 1) of posterior capsular tear. Posterior capsule tears can occur during any stage of phacoemulsification surgery. They occurred most frequently during the stage of nuclear emulsification, as reported by Mulhern et al.⁴ (49%) and Osher et al.⁵ and during irrigation–aspiration, as reported by Gimbel et al.⁶ diminishing turbulence inside the eye. If the nucleus is soft, only a small residual amount remains, and there is no vitreous prolapse, the procedure may be continued. If vitreous is already present, special care must be taken for preventing additional vitreous prolapse into the anterior chamber or to the wound. Small residual nucleus or cortex can be emulsified by bringing it out of the capsular bag and can be emulsified in the anterior chamber with viscoelastic underneath the corneal endothelium. In case of a small PCR and minimal residual nucleus (Figure 2), a dispersive viscoelastic is injected to plug the posterior capsule tear. Subsequently, the nuclear material is moved into the anterior chamber with a spatula and emulsified. The recommended parameters are low bottle height (20–40 cm above the patient’s head), low flow rate (10–15 cc/ min), high vacuum (120–200 mm Hg) and low ultrasound (20–40%).
TABLE 1 Signs of posterior capsular rupture

- Sudden deepening of the chamber, with momentary expansion of the pupil
- Sudden, transitory appearance of a clear red reflex peripherally
- Apparent inability to rotate a previously mobile nucleus
- Excessive lateral mobility or displacement of the nucleus
- Excessive tipping of one pole of the nucleus
- Partial descent of the nucleus into the anterior vitreous space
- ‘Pupil snap sign’ – sudden marked pupil constriction after hydro-dissection

Three possible situations can happen in a posterior capsule rent namely:

- Posterior capsule tear with hyaloid face intact and nuclear material present
- Posterior capsule tear with hyaloid face ruptured without luxation of nuclear material into vitreous
- Posterior capsule tear with hyaloid face ruptured and luxation of nuclear material into vitreous.

Immediate precautions are to be taken not to do further hydrate the vitreous and not to increase the size of the PCR. The conventional management consists of prevention of mixture of cortical matter with vitreous, dry aspiration and anterior vitrectomy, if required. In addition, during phacoemulsification, low flow rate, high vacuum and low ultrasound are advocated if a posterior capsule tear occurs.

REDUCE THE PARAMETERS

Lowering aspiration flow rate and decreasing the vacuum will control surge and will allow the bottle to be lowered, diminishing turbulence inside the eye. If the nucleus is soft, only a small residual amount remains, and there is no vitreous prolapse, the procedure may be continued. If vitreous is already present, special care must be taken for preventing additional vitreous prolapse into the anterior chamber or to the wound. Small residual nucleus or cortex can be emulsified by bringing it out of the capsular bag and can be emulsified in the anterior chamber with viscoelastic underneath the corneal endothelium. In case of a small PCR and minimal residual nucleus (Figure 2), a dispersive viscoelastic is injected to plug the posterior capsule tear. Subsequently, the nuclear material is moved into the anterior chamber with a spatula and emulsified. The recommended parameters are low bottle height (20–40 cm above the patient’s head), low flow rate (10–15 cc/min), high vacuum (120–200 mm Hg) and low ultrasound (20–40%).
DRY CORTICAL ASPIRATION
If there is only a small amount or no vitreous prolapse in the presence of a small capsular rent, a dry cortical aspiration with 23 G cannula can be performed.

FIGURE 2: Posterior capsular rupture. It is to be noted that the IOL sinking into the vitreous cavity. The white reflex indicates nuclear fragments also in the vitreous cavity. This patient was managed by vitrectomy, FAVIT (removal of the nuclear fragments) and the IOL repositioned in the sulcus

VISCOEXPRESSION
It is a method of removal of the residual nucleus by injecting viscoelastic underneath the nucleus to support it and the nucleus is expressed along with the viscoelastic.

CONVERSION TO EXTRACAPSULAR CATARACT EXTRACTION (ECCE)
If there is sizeable amount of residual nucleus, it is advisable to convert to a large incision ECCE to minimize the possibility of a dropped nucleus.

ANTERIOR BIMANUAL VITRECTOMY
Bimanual vitrectomy (Figure 3) is done in eyes with vitreous prolapse. Use 23 G irrigating cannula via side port after extending the side port incision. The irrigation bottle is positioned at the appropriate height to maintain the anterior chamber during vitrectomy. Vitrectomy should be performed with cutting rate (500–800 cuts per minute), an aspiration flow rate of 20 cc/min and a vacuum of 150–200 mm Hg.
**FIGURE 3:** Bimanual vitrectomy is being performed in a posterior capsular tear with vitreous prolapse

**ANTERIOR CHAMBER CLEARED OF VITREOUS**

Vitrectomy is continued in the anterior chamber and the pupillary plane. A rod can be introduced into the anterior chamber to check the presence of any vitreous traction and the same should be released. Complete removal of the vitreous from the anterior chamber can be confirmed if one sees a circular, mobile pupil (Figures 4A and B) and complete air bubble in the anterior chamber. The usage of the fiber of an endoilluminator, dimming the room lights and microscope lights, may be useful in cases of doubt, in

**FIGURES 4A and B:** Clinical photographs showing the change in the anterior chamber after complete removal of the vitreous from the anterior chamber. (A) Before vitrectomy, (B) After vitrectomy.
order to identify vitreous strands. Another useful measure is the use of purified triamcinolone acetate suspension (Kenalog) to identify the vitreous described by Peyman. Kenalog particles remain trapped on and within the vitreous gel, making it clearly visible.

SUTURE THE WOUND

In cases with vitreous loss with PCR, it is recommended to suture the corneal wound as a prophylaxis to prevent infection. One should remove any residual vitreous in the incision site in the main and side port with vitrector or manually with Vannas scissors. If necessary, one needs to insert a rod via the side port and pass it over the surface of the iris, to release them.

IOL IMPLANTATION

Depending upon the state of the capsular bag and rhesis, IOL is implanted (Table 2).

TABLE 53.2 - IOL implantation in PCR

- Insertion and rotation of IOL should always be away from the area of capsule tear
- The long axis of the IOL should cross the meridian of the posterior capsule tear
- Eyes with (< 6 mm) PCR with no vitreous loss, IOL can be placed in the capsular bag
- In the presence of a posterior capsule tear(>6 mm) with adequate anterior capsule rim, an IOL can be placed in the sulcus In deficient capsules, Glued IOL is a promising technique without complications of sutured scleral fixated or anterior chamber IOL

IN THE BAG

In the presence of a posterior capsule tear with good capsular bag, the IOL can be placed in the bag. Small PCR with no vitreous loss and good capsular bag, foldable IOL can be placed.

IN THE SULCUS
If the rent is large, if the capsular rim is available, then the IOL can be placed in the sulcus. The rigid IOL can be placed in the sulcus in large PCR over the residual anterior capsular rim with Mc Person forceps holding the optic. The “chopstick technique” is another method of placing IOL in sulcus. In this new chopstick forceps namely, ‘Agarwal- Katena forceps’ (Figures 5A and B) is used for IOL implantation.

This chopstick technique refers to the IOL being held between two flangs of the forceps. The advantage is the smooth placement of the IOL in the sulcus without excess manipulation. Moreover, the IOL implantation is more controlled (Figures 6A to D) with the forceps as compared to other methods. Small PCR with no vitreous loss and good capsular bag, foldable IOL can be placed (Figures 7A and B). In eyes with intraoperative miosis with PCR, IOL can be implanted with the pupil expansion with “Agarwal’s modified Malyugin ring” method (Figures 8A and B). In this method, a 6-0 polyglactin suture is placed in the leading scroll of the Malyugin ring and injected into the pupillary plane (Figures 9A and B). The end of the suture stays at the main port incision. Once in place, the ring produced a stable mydriasis of about 6.0 mm. Hereby, IOL can be implanted easily in the sulcus with visualization and this prevents the inadvertent dropping of the iris expander into the vitreous during intraoperative manipulation.
FIGURES 6A TO D: (A) The 6.5 mm PMMA rigid IOL being held between two flangs of the forceps. (B) IOL is being introduced through the limbal incision. (C) IOL is positioned in the sulcus. (D) IOL is well centered

DEFICIENT POSTERIOR CAPSULE

Now recently Glued IOL $^{11-13}$ is easily performed in such cases with deficient posterior capsules. Scleral fixated posterior chamber lenses and anterior chamber IOLs $^{14,15}$ can also be implanted when the posterior capsule tear is large.
FIGURES 7 A AND B: (A) Foldable IOL is placed with ‘Agarwal-Katena’ forceps into the sulcus, (B) IOL well centered on the capsular rim

FIGURES 8A AND B: (A) Intraoperative miosis with posterior capsular tear. (B) Agarwal’s modification of the Malyugin ring iris expansion: A 6-0 polyglactic vicryl suture passed in the leading scroll of the ring and injected. The end of the suture stays at the main port incision

SQUELAE AFTER POSTERIOR CAPSULAR RUPTURE

Vitreous Traction
Incomplete vitrectomy can produce dynamic traction on the retina leading to retinal breaks.
FIGURES 9 A AND B: Illustration depicting the Agarwal modification of the Malyugin ring for cases with small pupil with a posterior capsular rupture. (A) 6/0 suture tied to the ring. (B) Malyugin ring in place in the pupil. The suture can be pulled at if the ring begins to fall into the vitreous.

Retinal Detachment
Undetected long standing vitreous traction progresses to retinal break and detachment.

Macular Edema
Manipulation of vitreous will increase not only the traction transmitted to the retina but also the inflammation in the posterior segment and the risk of macular edema.

Vitritis
Over-enthusiastic use of viscoelastic into the vitreous can lead to sterile inflammation. Dropped minimal residual cortex can also present with postoperative vitritis.

IOL RELATED COMPLICATIONS
Improperly placed IOL in the sulcus can lead to lens induced astigmatism and tilt.

CONCLUSION
The occurrence of a posterior capsule tear during cataract surgery is one of the most serious complications. It is important for a surgeon to diagnose the
occurrence of a posterior capsule tear at an early stage, to avoid further enlargement of the tear and associated vitreous complications. The primary goal of all the maneuvers is to remove the remaining nucleus, epinucleus, and as much as cortex possible without causing vitreoretinal traction.

REFERENCES


