The word complication comes from the Latin complicare (to fold together), suggesting a combination of problems leading to complexity and puzzlement. When complications occur during cataract surgery, they can serve as a platform to identify useful improvements to a procedure, to select management options, and to compare the postoperative results of the complicated case with those of uncomplicated procedures. This article reviews management strategies for three specific cataract complications—posterior capsular rupture (PCR), sinking nuclei, and dangling IOLs (Figure 1).

POSTERIOR CAPSULAR RUPTURE

Early recognition and management of PCR is key to preventing further complications that can adversely affect visual quality.

Early recognition. Watch for the signals of PCR:
- Sudden deepening of the anterior chamber with momentary pupil dilation;
- Sudden transitory appearance of red reflex;
- Difficulty rotating a previously mobile nucleus; and
- Undue tilting of one nuclear pole.

Upon recognizing PCR, the surgeon’s reflex is to withdraw the phacoemulsification probe immediately from the eye, but this is the wrong course of action. Instead, a dispersive ophthalmic viscosurgical device (OVD) should be administered from the sideport incision to plug the posterior capsular defect and stabilize the anterior chamber. Afterward, safe withdrawal of the phacoemulsification probe can be initiated.

Management. When the PCR is small, it is safe to convert the rupture into a posterior rhexis and implant a one-piece foldable acrylic IOL in the capsular bag. When the capsular opening is large, however, a sulcus-fixated IOL is preferable. The haptics are placed in the sulcus, and optic capture is achieved in the anterior capsular opening to stabilize the IOL. In eyes with inadequate anterior capsular support, the glued IOL technique can provide stable intrascleral fixation.

Figure 1. Algorithm for cataract complications.
VITREOUS LOSS

Side effects. Poor visual outcomes following vitreous loss are caused by vitreous incarceration into the surgical wound, long-standing intraocular inflammation, and high astigmatism. Incarcerated vitreous strands within the surgical wound may predispose the wound to epithelial and fibrous ingrowth and the introduction of microorganisms into the eye. Furthermore, retinal traction caused by vitreous strands increases the risk of cystoid macular edema and retinal detachment, and contact between vitreous strands and the corneal endothelium may lead to corneal decompensation.

Management. The principles of management include preventing lens material from descending into the vitreous, preventing vitreous prolapse into the anterior chamber, and securely fixing the IOL. Use of a dispersive OVD helps to plug the PCR and prevent further prolapse into the anterior chamber. Removal of cortical material can be done with low parameters set on I/A mode. With a large PCR, thorough vitrectomy must be performed to clear up the vitreous in the pupillary plane and the anterior chamber. Triamcinolone acetonide can be used to stain the vitreous to ensure thorough vitrectomy.

Various methods have been employed to achieve compartmentalization of the anterior and posterior chambers, thereby preventing vitreous prolapse and facilitating nuclear fragment removal from the anterior chamber. A Sheets glide and HEMA contact lens can provide this seclusion, or a three-piece foldable IOL can be used in the IOL scaffold technique, which is described below.

IOL FIXATION TECHNIQUES IN PCR

Glued IOL. This technique is universally applicable in the event of PCR, regardless of the size of the capsular break. Two partial-thickness scleral flaps are created 180° opposite each other (Figure 2A), followed by sclerotomy beneath the flaps with a 20-gauge needle, approximately 1 mm from the limbus. A three-piece foldable IOL is then loaded into an injector, with the tip of one haptic slightly protruding from the cartridge, resembling the number 7 (Figure 2B). The IOL is injected, and the tip of the leading haptic is grasped with Glued IOL forceps (Epsilon Eyecare or MicroSurgical Technology). The injector is then slightly withdrawn so that the trailing haptic lies at the corneal incision (Figure 2C) and, after the IOL unfolds, the tip of the leading haptic is externalized from the left sclerotomy site with the Glued IOL forceps. The handshake technique is used to externalize the trailing haptic from the right sclerotomy site.

Once both haptics are externalized (Figure 2D), they are tucked into the scleral tunnels to prevent further haptic movement, reduce pseudophakodonesis, and minimize lens slippage and late redislocation. The flaps are sealed with fibrin glue. With the haptic snugly placed inside an intralamellar scleral tunnel, the IOL remains stable from the early postoperative period; however, com-
Complete scleral wound healing may take up to 3 months. This method avoids the need for additional corneal incisions or multiple sclerotomies, reduces surgical time, and decreases intraocular pressure fluctuation by maintaining a closed system.

**No-assistant technique for glued IOL.** This is a modification for externalization of the haptics in procedures that require a glued IOL. In this technique, the leading haptic remains exteriorized throughout the procedure, eliminating the need for an assistant to hold the haptic, thereby eliminating slippage, kinking, and breaks in the haptic.

**IOL scaffold.** This technique compartmentalizes the anterior and posterior chambers and allows implantation of the IOL in the sulcus following PCO. The nuclear fragments are first elevated above the iris, and vitrectomy is performed to remove vitreous from the anterior chamber and adhesions around the nuclear pieces (Figure 3A). Afterward, a three-piece foldable IOL is injected beneath the nuclear fragments (Figure 3B) so that the leading haptic is guided and placed above the iris while the trailing haptic is left protruding from the corneal incision (Figure 3C). Alternatively, both haptics can be kept above the iris if it is taut, or they can be placed above the rhexis or in the capsular bag, depending on the size of the capsular tear.

The phacoemulsification probe is then introduced into the eye to emulsify nuclear fragments (Figures 3D, 4A, and 4B). Using a dialing instrument in the nondominant hand, the surgeon maneuvers the IOL’s optic-haptic junction on the trailing haptic side, using the IOL to block the pupil. Keeping the trailing haptic outside the incision enables the surgeon to make IOL position adjustments if nuclear rotation occurs, thus reducing the risk of IOL drop. Once the IOL scaffold is established, the surgeon can remove nuclear fragments using the phacoemulsification probe with low flow and vacuum settings and residual cortex using the vitrectomy probe in suction mode with low aspiration. Lastly, the IOL is maneuvered over the capsulorrhexis margin into the ciliary sulcus (Figures 4C and 4D).

The IOL scaffold technique has an advantage that all manipulations are performed in a closed chamber. This is associated with a relatively low incidence of vitreous loss because the small, self-sealing clear corneal wound maintains ocular integrity. Thus, anterior chamber stability and intraocular pressure are maintained, and forward movement of the vitreous that would otherwise occur in an open eye upon conversion to extracapsular cataract extraction is discouraged.

**Glued IOL scaffold.** This procedure combines the advantages of the glued IOL and IOL scaffold techniques and can be helpful when implanting an IOL in eyes with aniridia or absent capsulorrhexis support. After pushing the nuclear fragments anteriorly toward the cornea, the glued IOL technique is performed (Figures 5A through 5C) to compartmentalize the anterior and posterior chambers, followed by phacoemulsification (Figure 5D) as described in the IOL scaffold technique.
SINKING OR DROPPED NUCLEUS

Lens removal. A dropped nucleus is a serious complication that can cause severe morbidity if not handled properly. It can occur at any stage of phacoemulsification, from hydrodissection to nucleus rotation, chopping, or trenching, to irrigation/aspiration. Managing the sinking nucleus in early stages is tricky, as little of the nucleus has been emulsified. The vitreous can often serve as a barrier to prevent the entire nucleus from sinking and resting on the retina; however, this is not as effective in eyes with high myopia and in older patients in whom the vitreous is liquefied. A brisk response from the surgeon instead of panicking is all that is needed at this juncture.

Management. The best management strategy depends on the location of the nuclear chunk within the vitreous. In the anterior vitreous cavity, posterior-assisted levitation (PAL) can be performed by inserting a metal spatula through a pars plana incision and manipulating the fragments into the anterior chamber. Alternatively, the Viscoat PAL technique can be used. Here, Viscoat (Alcon Laboratories, Inc.) is injected behind the partially descended fragment through the pars plana, where it can provide a safety net for the descending nucleus. The nuclear fragment is then levitated into the anterior chamber. A chopstick technique can also be beneficial, wherein the nuclear fragment is trapped between two Sinskey hooks and levitated into the anterior chamber.

Nuclear fragments in the midvitreous cavity and beyond should be handled by a vitreoretinal surgeon. In these cases, the fallen vitreous (FAVIT) technique or pars plana lensectomy with vitrectomy is recommended. FAVIT. FAVIT, which stands for “fallen vitreous,” is a method for removing lens fragments that have fallen into the vitreous. In this technique, three pars plana ports are created to achieve complete vitreous removal. A chandelier illumination system, coupled to the infusion cannula to achieve visualization of the posterior segment, is inserted through one port. An endoilluminator is inserted through a second port and a vitrector through a third.

Vitrectomy is performed around the nucleus until it moves freely. The vitrectomy probe is then replaced with a sleeveless phacoemulsification probe with a 700-µm needle. In suction-only mode, the probe is used to lift and hold the lens off the retina and reposition it into the anterior chamber. At this point, phacoemulsification is performed or an enlarged limbal incision is used to remove the lens. If the nucleus is hard, the surgeon can prevent endothelial damage by extending the incision. Alternatively, perfluorocarbon liquid (PFCL) can be injected after vitrectomy to raise the lens off the retina. Later, the PFCL is removed with the phacoemulsification needle.

Pars plana lensectomy with vitrectomy. Any retained lens fragment may be associated with complications including glaucoma, cystoid macular edema, and retinal break or detachment. Pars plana lensectomy with vitrectomy allows excision of vitreous prior to lenticular manipulations, enables lens removal in a closed ocular system, maintains normal anatomic relationships within the eye, and limits vitreous prolapse. It provides excellent intraoperative access to the posterior pole and enables clear visualization of peripheral retina.

Three standard ports are created through the pars plana, and trocars are placed 3 mm posterior to the limbus. If the lens material is very hard, a phacofragmatome can be used; however, care must be taken not to engage vitreous with the instrument. Therefore, once a red reflex is present, vitrectomy should be performed just behind the posterior lens capsule prior to reintroduction of the phacofragmatome. Vitreoretinal traction must be avoided, and all vitreous associated with the lens or lens fragments should be removed prior to emulsifying the lens material. Vitreous staining with triamcinolone acetonide is an excellent way to ensure that all traction is removed.

Whether the vitrector or the phacofragmatome is used, the lens fragments should be gently aspirated into the midvitreous cavity and then cut or fragmented and suctioned out. To protect the macula, a PFCL or an OVD can be injected to elevate large, dense lens fragments. Great care must be taken to remove all PFCL to avoid further complications. Following removal of all apparent lens material, a thorough search for residual lens fragments and retinal breaks should be performed.

DANGLING IOL

Possible complications. In cases of inadequate vitrectomy following a large PCR, IOL tilt and decentration can occur postoperatively and, in severe cases, the IOL can dangle into the anterior vitreous. Despite technical advances, a malpositioned or dislocated IOL caused by PCR or zonular dehiscence remains an infrequen-
quent but serious sight-threatening complication. The key to preventing poor visual outcomes is proper management.

Management. The IOL should be grasped with end-opening forceps, and thorough vitrectomy should be performed around the IOL to relieve it of all vitreous strands and adhesions. If the IOL is lying in the midvitreous cavity or beyond, another effective surgical method is to manipulate the IOL with PFCL and use 25-gauge forceps to lift the IOL from the retinal surface.

Further management depends on the type of IOL. If a three-piece IOL is in the eye, the glued IOL technique can be used to fixate the same IOL; with a one-piece IOL, explantation followed by sulcus fixation of a three-piece IOL in cases of adequate anterior capsular support or a glued IOL procedure in cases of inadequate support is recommended.

SUBLUXATED BAG-IOL COMPLEX, DISLOCATED IOL

Subluxated bag-IOL complex. Subluxation of the capsular bag-IOL complex is often associated with a thick Soemmering ring. Vitrectomy should be completed around the entire bag complex after grasping it with end-opening forceps. It is advisable to explant the bag complex through a scleral tunnel, followed by IOL fixation using the glued IOL technique.

Dislocated IOL. The management of a malpositioned or dislocated IOL is best accomplished with modern pars plana vitrectomy technology. The basic principles of management include initial anterior and posterior vitrectomy to eliminate any vitreous traction, followed by removal or repositioning of the IOL with microforceps, using various techniques to engage the dislocated IOL.

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