6 Intraoperative and Postoperative Complications

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Cataract surgery in children is more difficult and the rate of complications is higher when compared to adult surgery. The rate of intraoperative and postoperative complications is inversely proportional to the age at surgery. In addition to age, surgical technique can influence the rate of complications (e.g., primary intraocular lens implantation vs. aphakia). Higher intraoperative complications in children may be attributed to the common occurrence of an immature iris that results in poor pupil dilation. In addition, the eyes of young children are small and soft. Even small and well-constructed surgical wounds leak when not sutured securely. The anterior capsule in children is highly elastic and difficult to predictably tear into a circular and centered capsulorhexis. Scleral collapse and a formed, non-liquified, vitreous body create the upthrust commonly referred to as posterior vitreous pressure. Postoperative complications are also higher due to an intense inflammatory response and poor compliance to postoperative topical anti-inflammatory drops. The detection of postoperative complications can be challenging because of the difficulties encountered in performing detailed postoperative examinations in children, who may be uncooperative.

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6.1 Intraoperative Complications

Innovations in surgical technique (e.g., closed chamber techniques using bimanual irrigation/aspiration) and technology (e.g., high viscosity viscosurgical devices, improvement in intraocular lens materials and designs, advances in vitrectomy instruments, etc.) have helped us to minimize surgical trauma such as iris manipulation and improve the overall intraoperative performance. The rate of intraoperative complications is higher in eyes receiving primary intraocular lens (IOL) implantation as compared to aphakia. In the Infant Aphakia Treatment Study (IATS), intraoperative complications were observed in 11% (6/57) of eyes in the *no IOL group* versus 28% (16/57) of eyes in the *IOL group* [1].

Iris prolapse is more frequently observed during pediatric cataract surgery as compared to adult surgery as a result of poorly developed iris tissue and the nearly universal finding of a floppy iris. Over-filling of the anterior segment with ophthalmic viscosurgical device (OVD), to counteract the collapsibility of the soft eyes, may contribute to the frequency of iris prolapse. Incisions should be constructed to provide a snug

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fit for the instruments that pass into the anterior chamber. This concept of a tight-fit, closed chamber, is much more important in pediatric surgery than it is when operating on adults. In IATS, iris prolapse during surgery was observed in 4% (2/57) of eyes in the *no IOL* group and 21% (12/57) of eyes in the *IOL group* ($P = 0.008$) [1]. The authors attributed this fivefold increase in the IOL group to a larger wound size and the greater intraocular manipulation required to implant an IOL in a small, soft and often microphthalmic infant eye [1].

A pupil may fail to dilate preoperatively if the iris is immature and lacking the smooth muscle development needed for an active dilation response to mydriatic drugs. The iris may also be fibrotic and adherent to the lens capsule. During surgery, a well-dilated pupil may constrict due to surgical iris manipulation or touch. Miosis from iris manipulation occurs in a more robust fashion in children as compared to adults. Use of 0.5 mL of 1:1000 non-preserved, bisulfite-free adrenaline (epinephrine) in 500 mL of irrigating fluid has been in standard use for pediatric cataract surgery for decades. Intracameral epinephrine helps to maintain pupillary dilation throughout the surgery. The use of OVD can also help to improve or maintain pupil dilation in children. As described in adult eyes, the intraoperative floppy-iris syndrome (IFIS) includes a triad of intraoperative signs: *iris billowing and floppiness, iris prolapse, and progressive miosis* [2, 3]. We reported pediatric IFIS in a 4-month old child when epinephrine was inadvertently omitted during cataract surgery [2]. Intracameral phenylephrine and ketorolac (1%/0.3%), known as Omidria (Omeros, Seattle, WA) is now FDA approved in the USA for adults and children to help maintain pupil diameter during cataract surgery and reduce postoperative pain. A direct comparison study of non-preserved epinephrine and Omidria in pediatric eyes has not, to our knowledge, been conducted.

Fluctuation of anterior chamber depth (anterior chamber "bounce") occurs frequently in soft pediatric eyes and can result in more inflammation via the iris stimulation that the bounce induces. Bimanual irrigation/aspiration through tight-fit wounds with minimal leaking helps to maintain a consistent deep anterior chamber throughout the lens aspiration, thus avoiding anterior chamber fluctuation. Some surgeons prefer to use an anterior chamber maintainer rather than holding both instruments as in bimanual surgery. An unstable anterior chamber usually results from too much leak around the instruments that are placed in the anterior chamber. Venturi-pump machines often have a fluid pump that can be increased to offset the leak. Gravity-fed irrigation systems are not as effective. The surgeon must also learn to balance the aspiration with the irrigation in a way that does not repeatedly shallow the anterior chamber during surgery.

It is no longer a secret that anterior capsulotomy is notoriously difficult in infants and young children because of the extreme elasticity of the anterior capsule. The capsulotomy is made even more challenging when there is poor dilation of the pupil and positive vitreous pressure. Rarely, an anterior capsule tear may be observed as soon as the anterior chamber is opened, caused by the sharp tip of the entrance knife, especially when the anterior chamber is very shallow. The availability of better operating microscopes, microsurgical instruments, higher-viscosity OVDs and the use of trypan blue are helpful. However, a "runaway rhexis" or a tear extending out toward the equator is still frequently encountered. For manual continuous curvilinear capsulorhexis (CCC)—it occurs mainly during the formation of the anterior capsulotomy. Once a manual CCC is achieved, the edge is very strong and will withstand intraocular gymnastics very efficiently. When a tear occurs during manual CCC, the surgeon should stop tearing, place more OVD, regrab close to the tear edge, and pull toward the center of the pupil. If this does not recover the capsulotomy easily, conversion to a vitrectorhexis or to a Kloti diathermy capsulotomy has been successful for us. For vitrectorhexis and Kloti diathermy—a tear is more likely to occur during IOL implantation or irrigation/aspiration or after OVD removal. Care should be taken to avoid right-angled edges, which is a weak point and likely to tear during intraoperative maneuvering. If a right-angled edge is seen during the capsulotomy, it should be rounded out manually or by using the vitrector before completion of the capsulotomy. The sudden flat anterior chamber that can occur after the OVD is removed but before the wounds are sutured can cause the IOL to move anteriorly and place stress on the capsulotomy edge. We compared the rate of inadvertent anterior lens capsular tears with CCC or vitrectorhexis in pediatric cataract and IOL implantation surgery [4]. Of the 339 eyes, 19 eyes (5.6%) were noted to develop an anterior capsule tear (vitrectorhexis, 12 of 226 eyes, 5.3%; CCC, 7 of 113, 6.2%). These tears occurred during anterior capsulotomy in seven eyes, hydrodissection in one, cataract removal in three, and IOL insertion/manipulation in eight. In eyes operated for cataract at or before 72 months of age, the manual CCC technique was more likely to develop a tear (relative risk, 3.09) compared with eyes of older children (>72 months of age), where the vitrectorhexis technique was more likely to develop a tear (relative risk, 3.14).

Inappropriate size and shape are also complications of the anterior capsulotomy that are seen more often with children than with adults. Surgeons are urged to go slow and pay particular attention to size, shape, and centration each time the capsulotomy edge is released. If the capsulotomy opening is too small, it can be enlarged after the IOL is inserted. If it is too large or poorly shaped, take care to get the haptics of the IOL under the capsulorhexis edge and place the haptics where the capsulotomy edges can be most easily seen.

A high intraoperative vitreous pressure is produced as a result of scleral collapse due to low scleral rigidity, which results in forward movements of the iris lens diaphragm. In pediatric eyes, the posterior capsule is often convex rather than concave from the surgeon's viewpoint. We often remove the peripheral lens cortex first, leaving the central nucleus of the lens until last since it holds the posterior capsule back in a more flat or concave configuration. Use of a high viscosity OVD (e.g., Healon-GV) helps to maintain a deep anterior chamber and keep the iris lens diaphragm back.

An inadvertent posterior capsule tear may not be as devastating to the pediatric cataract surgeon as it is to adult cataract surgeon, because pediatric cataract removal often includes posterior capsulotomy/capsulectomy with or without a vitrectomy. However, an uncontrolled posterior capsule tear may still compromise the ability of the surgeon to safely place an IOL into the capsular bag. Posterior capsule tears may occur in children due to preexisting posterior capsule abnormalities that are common in posterior polar cataracts and posterior lentiglobus. The surgeon can recognize a *torn posterior capsule* during lens aspiration by signs such as a sudden deepening of the anterior chamber. This occurs instantaneously as a rent appears in the capsule. As this occurs, the pupil will dilate in response to the deepening anterior chamber. Finally, during aspiration, lenticular particles/residual cortical matter falls away from, and will not come toward, the tip of the aspirator. This occurs because the tear in the posterior capsule alters the flow dynamics in the anterior chamber. Sometimes the presence of vitreous in the anterior chamber may also indicate a torn posterior capsule. The posterior capsule can tear during hydrodissection, irrigation and aspiration, capsular polishing, lens insertion, and OVD removal. Posterior capsule tear can also occur during incision enlargement with the sharp tip of the keratome.

In all cases, if the posterior capsular tear is entirely within view, a posterior capsulorhexis can be attempted. If the vitreous face is intact, this is done by placing OVD above and below the tear, pushing the vitreous face back, and allowing room to grasp the torn capsule. If the vitreous face is already broken, OVD is necessary only to stabilize the anterior chamber and make room for the forceps. Using a capsulorhexis forceps, the capsule is then gently torn to create a 360° posterior capsulorhexis. Failed attempts may result in extension of the tear and, if not already present, vitreous loss.

Alternatively, the vitrector handpiece can be used to round out the posterior capsule tear, remove residual cortex, and remove prolapsed vitreous. Pediatric surgeons are more likely to use this approach since the use of the vitrector is often more familiar than the use of a capsulorhexis forceps on the posterior capsule. Care should be taken to begin with a low flow so that the anterior chamber dynamics are not changed drastically when the instruments are placed in the eye. This could lead to an extension of the posterior capsule tear. Once rounded out, the posterior vitrectorhexis can be quite stable and resistant to further tearing. The advantage of the vitrector handpiece is that it can safely remove cortex when it is mixed with vitreous. It can also cut the capsule and vitreous simultaneously without undue traction on the vitreous base or the retina. A Venturi-pump-driven vitrector handpiece works best when used in this way.

Anterior vitreous face (AVF) disturbance during posterior capsule rupture is well recognized in adult cataract surgery. However, in children, this is less of a problem because anterior vitrectomy has become an integral part of the surgical strategy. However, some surgeons prefer to err on the conservative side and avoid anterior vitrectomy in children 2–8 years of age. When performing a PCCC without vitrectomy, surgeons should watch for signs of AVF disturbance, and if seen, a vitrectomy should be performed. The subtle signs are a vitreous strand in the anterior chamber, vitreous strands attached to the capsule flap, and distortion of the anterior and posterior capsulorhexis [5]. Intracameral Triamcinolone can be used in suspected cases of AVF disturbance to detect AVF disturbance. Some surgeons choose to use miotics to look for peaking of the pupil.

Intraoperative hyphema may occur and may or may not need to be cleared before wound closure [6]. A small hyphema will clear spontaneously. Hyphema was noted in approximately 5% of eyes in the IATS study [1]. Vascularized plaques or patent hyaloid artery remnants may lead to intraoperative vitreous hemorrhage. Another less commonly encountered complication is bleeding into the vitreous cavity. When exiting the pars plana, the vitrector cutter must be turned off before the handpiece is withdrawn. If not, the cutter may engage the tip on a ciliary process during handpiece withdrawal, causing profuse bleeding. If this occurs, intraocular cautery will likely not be needed but a full core vitrectomy may be needed to clear the blood. A retinal specialist will need to be consulted unless the surgeon is experienced in core vitrectomy techniques.

The most common intraoperative complication related to the IOL is malplacement or malpositioning of the implant on entry into the eye. When polymethylmethacrylate (PMMA) IOLs were used, asymmetrical fixation was common, especially in infants—the leading haptic could be placed easily into the capsular bag, but often there was unintended placement of the trailing haptic into the ciliary sulcus. Placing an oversized rigid IOL into a small soft eye was a real challenge. After the leading haptic entered the capsular bag, the OVD often exited the eye through the large wound, the pupil became miotic, and the surgeon was pleased just to get the trailing haptic somewhere posterior to the iris. Posterior vitreous upthrust made dialing the lens into the capsular bag more difficult. The modern-day use of foldable IOLs has made this complication less frequent. The trailing haptic of commonly used single-piece acrylic IOLs can now be manually placed under the capsulotomy edge using a push–pull instrument with great certainty. A second hook can be used to pull the iris edge back for better visualization if needed. Care should be taken to place the haptics into the capsular bag before they have unfolded completely. Once the haptics have unfolded outside the capsular bag, they are more difficult to place into proper position manually. This is especially true when a multi-piece acrylic IOL is used. If this happens, the IOL optic should be displaced eccentrically within the capsular bag as much as possible before an attempt is made to pull the haptic out of the ciliary sulcus. These lenses do not dial as easily in children as they do in adults.

Some pediatric surgeons choose to perform a primary posterior capsulotomy and an anterior vitrectomy prior to, rather than after, implantation of an IOL. An OVD is then used to inflate the remaining capsular "tire." The IOL must be carefully aimed at entry so that it enters the capsular bag. Fearing the deep entry, some surgeons aim too anteriorly and the IOL enters the ciliary sulcus. Unlike the situation mentioned earlier, where IOLs dial up into the ciliary sulcus due to vitreous upthrust, IOLs often dial through the posterior capsulotomy when a vitrectomy has already been performed. Even gentle dialing and gentle posterior force on the optic may send a soft foldable IOL through an even modestly sized posterior capsulotomy. In this situation, the IOL is best lifted entirely into the anterior chamber and then reinserted, rather than dialed. To avoid this complication and make IOL insertion easier, we recommend IOL insertion into an intact capsular bag prior to the posterior capsulotomy. The IOL haptics should be oriented 90° away from the wound. This allows the vitrector to be placed under the IOL optic more easily for OVD removal or for primary posterior capsulotomy and anterior vitrectomy. To avoid the possibility of dragging a strand of vitreous back to the wound, we recommend removing the OVD after the IOL is in place but performing the primary posterior capsulotomy and anterior vitrectomy through the pars plana, leaving the irrigation cannula in the anterior chamber.

Other less common complications include loss or disruption of a portion of the zonule, cloudy cornea, iris sphincterotomy, retained cortex, and lens fragments in the vitreous. Each of these was reported as an intraoperative complication in the IATS study cohort.

6.2 Postoperative Complications

Postoperative complications may be seen during the early postoperative period (e.g., wound leak, intraocular pressure (IOP) spike, corneal edema, anterior uveitis), after a few months but within a few years (posterior capsule opacification, glaucoma), or several years after cataract surgery (glaucoma, retinal detachment, high myopia).

Indications, risk factors and the rate of an unanticipated return to the operating room within 3 months of pediatric cataract-related intraocular surgery has been reported recently [7]. The overall reoperation rate was 3.3% within 90 days after cataract surgery. Reasons for reoperation included visual axis opacification (VAO), elevated IOP, vitreous wick to the cataract surgery wound, synechaie, uveitis unresponsive to topical anti-inflammatory medications, retained lens cortex, traumatic iris prolapse and foreign body in the anterior chamber. Factors that increased the risk for reoperation were a history of a traumatic cataract (relative risk 2.55) or age <1 year at the time of first surgery (relative risk 3.02). In the absence of these risk factors, the rate of reoperation during the first 90 days postoperative period was 1.1% [7]. The Toddler Aphakia & Pseudophakia Study (TAPS) recently reported outcomes of unilateral cataracts in infants and toddlers 7 to 24 months of age [8]. The Study authors concluded that the incidence of complications, reoperations, and glaucoma was low when surgery was performed between 7 to 24 months of age and compared favorably with same-site IATS data for infants undergoing surgery before 7 months of age. IOL implantation is relatively safe in children older than 6 months.

Posterior capsule opacification is inevitable in the very young child after cataract surgery if the posterior capsule is left intact. To prevent opacification and visual deprivation, posterior capsulectomy and anterior vitrectomy are performed (Fig. 6.1) [9]. Even after primary posterior capsulectomy and vitrectomy, eyes operated on during the first year of life are predisposed to develop VAO in the form of lens

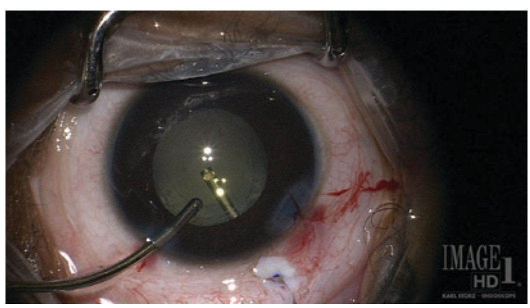

Fig. 6.1 To reduce the incidence of PCO or VAO, a pars plana posterior capsulotomy is being done after IOL insertion in this 12-month-old child

proliferation into the visual axis (defined as lens regrowth extending into the pupillary space and interfering with vision) or pupillary membrane (Figs. 6.2 and 6.3) [10]. Five-year results of the Infant Aphakia Treatment Study (IATS) reported 2 (4%) eyes with lens proliferation obscuring the visual axis in the contact lens group and 23 (40%) in the primary IOL group [10]. Pupillary membranes were observed in 2 (4%) eyes in the contact lens group versus 16 (28%) in the IOL group. TAPS investigators also reported that VAO was more common in pseudophakic (32%) than aphakic (8%) eyes (P = 0.009) in infants operated for bilateral cataract surgery [11]. In addition to age at surgery, the type of IOL used may also be a risk factor for developing a secondary opacification after cataract surgery. Different types of IOLs may have different lengths of time until opacification. For example, secondary opacification formed more quickly when PMMA lenses were implanted compared to acrylic lenses [12]. Eyes with traumatic cataract are more likely to develop PCO as compared to eyes without traumatic cataract [13]. If PCO does develop, YAG laser capsulectomy or surgical membranectomy can be performed [9].

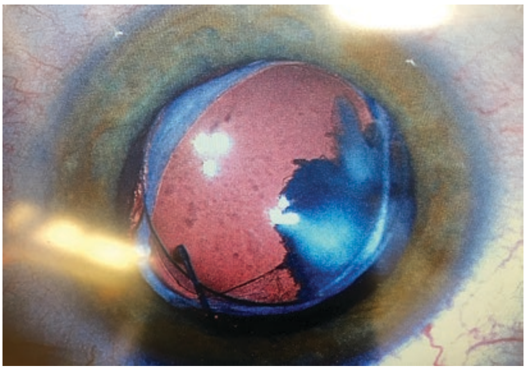

Fig. 6.2 Visual axis opacification despite the use of optic capture of a multi-piece IOL in a young child

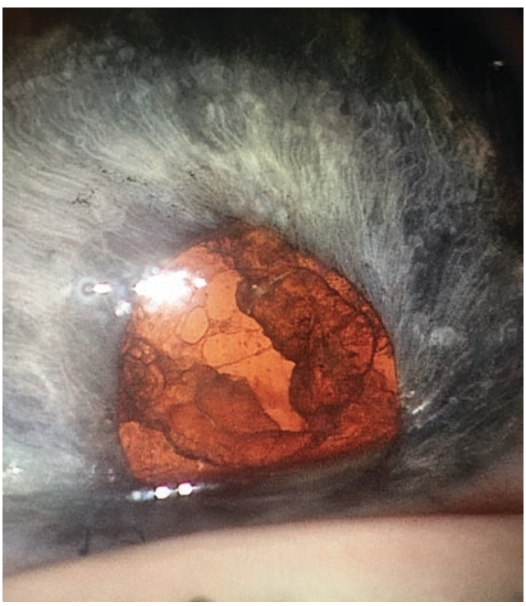

Fig. 6.3 Visual axis opacification in an eye with an immature iris and synechia

Glaucoma after pediatric cataract surgery may develop during early postoperative period or decades after cataract surgery. Late-onset glaucoma is typically open-angle and can often be diagnosed while patients are still asymptomatic. There have been numerous studies aimed at detecting factors in patients that predispose them to developing glaucoma. There is much disagreement, but age at surgery and age at diagnosis are the two most widely agreed upon factors. Previous studies have found the risk of glaucoma decreases with increasing months of age at the time of cataract extraction [14]. The highest risk is in infants who underwent cataract surgery at age 4 weeks or younger [15]. The multivariate analysis of infants enrolled in IATS showed that only younger age at surgery increased the risk of developing glaucoma (3.2 times) [15]. Some studies reported that the risk for developing postoperative glaucoma is decreased with primary IOL implantation [16–18]. We reported that this appearance of protection may be merely a selection bias, with older and more developed eyes receiving the IOLs and younger, less developed eyes being left aphakic [19]. Recently published randomized clinical trial results of IATS at five-years of age concur with our observations. Glaucoma was reported in 9 (16%) eyes with contact lens and 11 (19%) eyes with primary IOL implantation [15]. The IATS found that eyes with smaller corneal diameter (≤10 mm) at cataract removal were not at higher risk for glaucoma within the

1 to <7 month age group [15]. TAPS investigators reported that younger age at surgery and smaller (<9.5 mm) corneal diameter at surgery conferred an increased risk for glaucoma or glaucoma-suspect designation [11].

Central corneal thickness should be measured during follow-up visits of children operated for cataract during infancy [20, 21]. Glaucoma is especially difficult to diagnose in children because it is harder to do detailed examination. It is particularly important to attempt regular IOP measurements in children after cataract surgery to stop disease progression before significant damage occurs. It is equally important to continue monitoring for many years, as there may be a lifelong risk of developing secondary glaucoma. If reliable IOP measurements cannot be obtained in the clinic, examinations under anesthesia (EUA) should be conducted at a yearly interval [22]. Different anesthetics will variably affect IOP, but AL will not be affected by anesthetics and should be included in the standard evaluation for glaucoma. The rebound tonometer (Icare USA, Raleigh, NC) may be used as a clinical tool for children who cannot withstand the traditional exam for measuring IOP. When using this tonometer, it is not necessary to administer a topical anesthetic, which leads to increased compliance in children. This instrument facilitates more frequent clinical IOP measurements and thus fewer EUAs. Any elevated IOP reading from the icare must be verified with a second device, such as a Tonopen. Treatment for glaucoma should ideally be early and effective to prevent ongoing damage to the eye. Treatment is typically topical medical management or surgical procedures. Open-angle glaucoma treatment for pediatric aphakic patients is different than pediatric congenital glaucoma. While initial treatment is usually surgical in congenital cases, the first line of treatment for glaucoma in aphakic and pseudophakic eyes is medical. Timolol 0.25% topical therapy is often the first-line medication. It should be avoided in children with asthma or heart conditions. Topical carbonic anhydrase inhibitors such as Drozolamide 2%/Trusopt 1%/Azopt also reduce aqueous humor production. Topical agents are not as efficacious as oral agents, but have fewer side effects. Phospholine iodide/echothiophate iodide 0.125% is also very effective in glaucoma after pediatric cataract surgery. This older and more difficult to get medication is rarely used in phakic patients because it may be associated with cataract formation. However, this is not a concern in aphakic or pseudophakic children, and it works well for managing pediatric secondary glaucoma [23]. Prostaglandin analogs such as Latanoprost 0.005%, Travoprost 0.004%, and Bimatoprost 0.03% are used as a secondary or tertiary option in secondary glaucoma. Prostaglandins increase outflow of aqueous humor, but are less efficacious in aphakic or pseudophakic children compared to adults. Aphakic patients refractory to medical management may need a surgical procedure such as a tube shunt implantation, trabeculectomy with mitomycin C (TMMC), trabeculotomy, goniotomy, or one of the cyclodestructive procedures, such as endoscopic cyclophotocoagulation. Though rare, children who are pseudophakic are more likely to develop closed-angle or pupillary block glaucoma. Surgical or laser iridectomy is the standard of care in these patients, both of which are followed by medical therapy in most cases.

A frequent complication of pediatric cataract surgery is early postoperative increased IOP. A study conducted by the Childhood Cataract Program of the Chinese Ministry of Health found IOP typically peaks at 1 week after surgery and remains elevated for an average of 30 days [24]. A possible explanation for an early postoperative spike in IOP is retained cohesive OVD, particularly in patients with marginally controlled glaucoma who are undergoing secondary IOL implantation [25]. Other explanations include damage to the iris during surgery [26]. Postoperative topical steroids can also cause an increase in IOP but this so-called “steroid response” type of ocular hypertension usually subsides soon after discontinuation of topical steroids. Ultimately, increased IOP that is untreated or does not return to baseline can result in pain, corneal edema, and optic nerve damage. Increased IOP is seen more frequently in patients who already have glaucoma and are undergoing secondary IOL implantation. The IOP spike can be treated with topical or systemic glaucoma medications. As in adults, retained viscous OVD can cause a marked postoperative IOP elevation after surgery for childhood cataracts. Englert and Wilson [25] have suggested the need for more meticulous removal of the OVD. We reported a high incidence of symptomatic early IOP spikes in patients with aphakic glaucoma undergoing secondary IOL implantation and we recommended the use of prophylactic topical and/or systemic glaucoma medications to help prevent or minimize the IOP spike. Monitoring during the early postoperative period was also suggested in these higher risk cases [27].

Toxic anterior segment syndrome (TASS) is a rare inflammatory condition usually observed within the first 2 days after anterior segment surgery [28–31]. The most common finding is a diffuse corneal edema. Fibrin in the anterior chamber and increased anterior chamber inflammation, often resulting in sterile hypopyon, can occur. With intense topical corticosteroid treatment, most cases resolve over a period of weeks to months. Ari and colleagues evaluated 893 eyes of patients undergoing pediatric cataract surgery [32]. TASS was observed in 19 eyes. In all TASS cases, it was noted that ethylene oxide-sterilized vitrectomy packs were used for anterior vitrectomy. After the abolition of use of this material, the authors did not have any new TASS cases [32]. A task force of the American Society of Cataract Refractive Surgery (ASCRS) has made a number of recommendations for cleaning and sterilizing intraocular surgical instruments to prevent TASS [28].

Endophthalmitis is one of the most severe complications that can occur following cataract surgery. Improved surgical conditions and early diagnosis has improved outcomes, but rates vary worldwide. Melo et al. reported an incidence rate between 0.05% and 0.4% worldwide [33]. Wheeler, Stager, and Weakley reported a rate of 0.071% following pediatric intraocular surgery for cataracts and congenital glaucoma [34]. The most common infectious organisms are *Staphylococcus* and *Pseudomonas* [35]. Additionally, the incidence of methicillin resistant *Staphylococcus aureus* (MRSA) infections is increasing [36]. Prophylaxis and treatment for endophthalmitis in pediatric cataract surgery is similar to adult cataract surgery. We strongly recommend the use of intracameral antibiotics at the end of the cataract surgery in children.

Transient corneal edema is a common problem after cataract surgery. Recent studies have asserted it is the most common complication on the first postoperative day [37]. The edema may be localized or diffuse. Localized edema is due to trauma to the corneal endothelium and resulting inflammation, and diffuse edema causes increased IOP. Steroids may be used to treat inflammation and thus decrease pressure inside the eye [38]. The IATS described corneal edema as an adverse postoperative complication only if it persisted for more than 30 days. This was observed in only 1 of 57 eyes in the IOL group [1]. Contact lens associated corneal problems include bacterial keratitis, corneal opacity due to tight contact lenses, corneal vascularization, and corneal abrasion [22]. The IATS study reported a corneal abrasion in only 1 eye of the 57 in the contact lens group. Cataract surgery may also result in increased corneal thickness and corneal endothelial cell loss. Increased corneal thickness is due to surgical manipulation and the corneal incisions. The thickest areas typically correlate with instrument incision points. Endothelial cell loss occurs after cataract surgery and is dependent upon cataract type, AL, anterior chamber depth, and surgical factors. Cell loss is greatest at 3 months after surgery. Endothelial cell loss is best measured with specular microscopy, and children receiving a secondary IOL, Artisan iris-claw IOL, or angle-supported anterior chamber IOL should be routinely measured [22].

A shallow or flattened anterior chamber may be observed during the early postoperative period and a peaked pupil may accompany this finding. This finding is usually from a wound leak caused by the child rubbing eye and forcing fluid out of the sutured wound. The chamber will usually need to be reformed and the wound may need to be re-sutured. Although the chamber will usually deepen on its own, failure to surgically reform the chamber and reposition the iris may lead to a peaked pupil that chronically sticks in place and is not easily repaired later.

Fibrinous uveitis due to increased tissue reactivity is a more common complication during the early postoperative period in eyes undergoing pediatric cataract surgery compared to adults. However, modern surgical techniques that limit iris manipulation and ensure capsular bag fixation of the IOL have resulted in less postoperative inflammation/fibrinous uveitis even in small children. Frequent topical steroids and even systemic steroids may be needed in selected cases to reduce uveitis-related complications.

A new hyphema occurring postoperatively (as opposed to residual hyphema from an intraoperative bleed) is uncommon, but it can occur [6]. Recurrent hyphema in an aphakic child has been reported [39].

Triamcinolone disappears from the anterior chamber in most eye within days after surgery, however, it may persist, especially if it reaches the vitreous cavity (Fig. 6.4). We don't leave triamcinolone in aphakic eyes since it deposits in the vitreous and is too slow to clear. In these aphakic eyes, if it is used to help visualize the vitreous, then it is removed before the end of the surgery. When an IOL is implanted in a young child, triamcinolone can be left in the anterior chamber to control postoperative inflammation. We commonly use 1 or 2 mg of triamcinolone placed anterior to the IOL just prior to intracameral antibiotic injection.

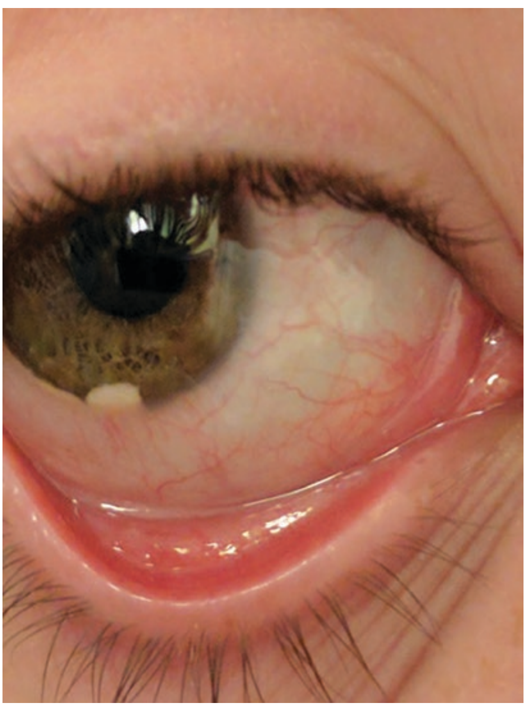

Fig. 6.4 Intracameral triamcinolone persisting in the inferior portion of the anterior chamber at 1 week after surgery

Postoperative iris and pupil abnormalities are observed after cataract surgery, more commonly after IOL implantation. Corectopia was reported in 2% eyes in the *no IOL* group versus 19% of eyes in the IOL group in the IATS study [1]. Posterior synechia are usually the reason for the observed corectopia although iris damage can also occur at the time of iris prolapse or during surgical manipulation. Younger age at the time of cataract surgery increases the risk for synechiae formation. Trivedi et al. [40] noted that synechiae were seen in 31% of eyes having surgery in the first year of life. Type of IOL also influence rate of synechiae. Wilson et al. [41] noted posterior synechiae in 5 of 110 AcrySof® (Alcon, Fort Worth, TX) lenses (4.5%), compared with 23 of 120 PMMA lenses (19.2%). Evaluating single-piece IOLs in children, we noted synechiae in five eyes (11.9%) [42]. None produced enough corectopia to cause a noticeable cosmetic deformity. Vasavada et al. [43] noted posterior synechiae in 13.6%.

Heterochromia iridis is an asymmetry of iris color in one eye in relation to the other. Summer and Letson reported it in 9% of patients [44]. Cataract surgery stimulates a prostaglandin release resulting the darkening of iris color, which may occur through the same or a similar mechanism by which latanoprost causes darkening of iris color. The darkening effect occurs more often when surgery is done in infancy. Lenart and colleagues evaluated 15 children [45]. Photographs were taken of both eyes. Masked examiners reviewed the photographs and compared, in each patient, the iris color of the eye that was operated and the eye that was not operated. Thirteen of 15 children had darker iris color in the operated eye relative to the non-operated eye.

Early hypotony may indicate a wound leak. Once this is ruled out, sustained hypotony may accompany a postoperative retinal detachment (RD). In glaucoma and uveitis patients, sustained hypotony can be an impending sign of phthisis bulbi. Hypotonous maculopathy may also be present. In patients with nanophthalmos, mild hypotony may be associated with large choroidal effusions. These usually resolve with time.

Excessive anterior capsule fibrosis and shrinkage of the CCC opening can lead to difficulty with retinoscopy and with examining the retinal periphery and, occasionally, decentration of the IOL.

Precipitates composed of pigment, inflammatory cells, fibrin, blood breakdown products, and other elements are often seen during the postoperative period on the surface of an IOL optic implanted in a child (Fig. 6.5). The deposits can be pigmented or nonpigmented but are usually not visually significant. They occur much more commonly in children with a dark iris and when compliance with postoperative medications has been poor. Sulcus-fixated IOL would likely have more deposits compared to bag-fixated IOL. In addition, Vasavada and Trivedi [46] found that the incidence of deposits was higher in eyes with the IOL optic captured through the posterior CCC in comparison with in-the-bag fixated IOLs. The type of IOL also influences IOL deposits. Wilson and colleagues [41] reported that IOL cell deposits were seen in 7 of 110 (6.4%) hydrophobic acrylic lenses, compared with 26 of 120 (21.75%) PMMA lenses. In addition, the incidence of deposits is inversely proportional to age at surgery.

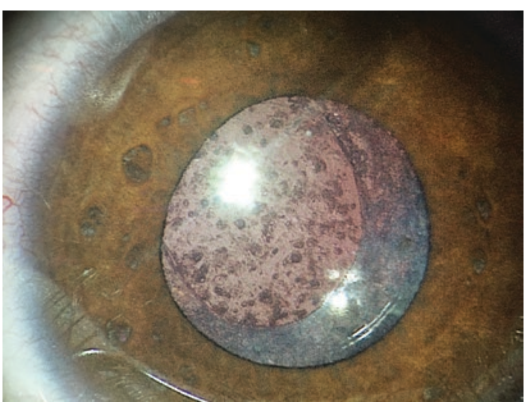

Fig. 6.5 Marked cell deposits on an IOL in a child with poor compliance with postoperative steroid drops

In a recent review from Toronto, IOL repositioning was required in 4/55 eyes [47]. Placing the IOL in the capsular bag with an anterior capsulotomy smaller than the IOL optic helps to prevent pupillary capture, a complication that is much more common in children than in adults. It often occurs in association with posterior synechiae formation and PCO. Pupillary capture occurs most often in children <2 years of age, when an optic size <6 mm is used and the lens is placed in the ciliary sulcus. Pupillary capture can be left untreated if it is not associated with decreased visual acuity or glaucoma. However, surgical repair recreates a more round pupil shape and IOL centration. Fixation of PCIOLs in the capsular bag (whenever possible) is recommended to decrease the incidence of this complication. Also, the anterior capsulotomy should be continuous and smaller than the IOL optic for 360 degrees, if possible. Prolapsing the optic of a secondary sulcus–fixated IOL through the anterior capsulorhexis opening can also prevent pupillary capture.

Excessive capsular fibrosis and asymmetric IOL fixation are the most common causes of a decentered IOL. Decentration of an IOL can also occur because of traumatic loss of a portion of the zonule and/or inadequate capsular support. Capsular bag placement of the IOL is the most successful way to reduce this complication. Posterior capture of the IOL optic also resulted in better centration of the implanted IOL [46]. Explantation or repositioning of the IOL may be necessary in some cases presenting with significant decentration/dislocation.

Late postoperative opacification of some specific IOL models in adults has been reported widely in the literature. Kleinmann and associates [48] reported the clinicopathological and ultrastructural features of three hydrophilic acrylic IOLs, manufactured from two different biomaterials, explanted from children who had visual disturbances caused by progressive postoperative opacification of the lenses' optic component. These lenses were explanted at 20, 22, and 25 months postoperatively, from children aged 10, 36, and 20 months, respectively, at lens implantation. Pehere and colleagues [49] reported that the deposits were found to be composed of calcium, phosphate, and silicone.

Mullner-Eidenbock et al. [50] noted glistening in both eyes of one patient 1 week postoperatively. The glistening increased during the first 2 postoperative years to a degree of 3+ and then remained stable until the last follow-up at 40 months. Glistenings are commonly observed on postoperative slit lamp examination when a single-piece AcrySof IOL (Alcon, Fort Worth, TX) has been implanted. They appear to be visually insignificant but some surgeons argue that they may have some yet unproven deleterious effect on visual performance.

Retinal detachment is a well-known late complication of pediatric cataract surgery, historically reported to occur 20 years or more after cataract surgery, with only a third of cases occurring in the first 10 years after surgery [51]. The incidence of RD following pediatric cataract surgery appears to have decreased markedly as surgical techniques have advanced and evolved. The use of a modern high-speed vitreous cutter and more frequent use of pars plana approach reduces vitreoretinal traction. During surgery, wound sweeping and scissors cutting ("Weck-cell vitrectomy") should be avoided. This technique can remove vitreous from the wound but it invariably induces acute vitreoretinal traction. Similarly, if a vitreous wick is seen attached to one of the anterior cataract wounds (corneal tunnel or paracentesis) during a postoperative examination, it should be removed as soon as possible to relieve any traction on the retina at the vitreous base. In children without associated ocular anomalies, the incidence of RD is reported as 3.2% after a mean follow-up of 6.8 years [52], 0.8% at 5 years [53], and 2.5% at 5 years [54]. The median interval between pediatric cataract surgery and RD is reported as 6.8, 9.1, and 5.8 years after pediatric cataract surgery [52–54]. High myopia (long axial length) has been reported as significant risk factor for postoperative RD [52, 54]. Intellectual disability has also been reported to greatly increase the risk of RD [53, 54]. Long-term follow-up is critical in children, as RD can occur many years after cataract surgery. A detailed retinal examination is recommended after cataract surgery at least yearly. This is especially important for those eyes at higher risk for RD by virtue of a long axial length for age, persistent fetal vasculature, Stickler syndrome, traumatic cataract, ectopia lentis, or intellectual disability associated with self-injurious behavior.

Cystoid macular edema (CME) is a rare complication following pediatric cataract surgery, probably because of the healthy retinal vasculature and formed vitreous in children. Ahmadieh et al. evaluated 45 eyes of 31 children undergoing cataract surgery and IOL implantation, using intravenous fluorescein and fundus fluorescein angiography, and did not detect CME in any eye at 6 weeks after surgery [55]. Rao et al. [56] performed a similar evaluation 4 to 6 weeks after surgery, using oral fluorescein and angioscopy, in 25 eyes of children and did not detect CME in any of them. CME occurs with unknown frequency after pediatric cataract extraction, in part due to the difficulty in detecting CME in the pediatric patient because of the challenges of performing macular examination, inability to visualize CME with the indirect ophthalmoscope or RetCam, the sedation issues associated with fluorescein angiography, and the inability of young children to position for ocular coherence tomography (OCT). If detected and visually significant, the treatment should parallel guidelines for adult pseudophakic CME, including topical corticosteroids and nonsteroidal anti-inflammatory medications.

To increase safety during wound healing, pediatric cataract surgeons typically place sutures. Since children rub their eyes after surgery and the wounds are prone to leaking, the sutures are placed and tied tight. This can induce large amounts of surgically induced astigmatism in the immediate postoperative period. However, relaxation of a large amount of this suture-induced astigmatism occurs in children having cataract surgery when the wound heals and the Vicryl suture dissolves [57–65].

High postoperative myopia can occur with axial eye growth after early IOL implantation. Optical rehabilitation with contact lens, spectacles, or IOL exchange will be necessary. Alternatively, secondary implantation of a piggyback lens in the ciliary sulcus or corneal refractive surgery can be performed. Secondary Artisan phakic IOL for correction of progressive high myopia in a pseudophakic child has also been reported [66]. IATS study reported phthisis bulbi in 1 eye of the 57 who did not receive an IOL [1]. Other rare complication included ptosis [67].

In summary, intraoperative complications are uncommon but occur in pediatric cataract surgery more commonly than in adult surgery. Also, postoperative complications may develop in the early postoperative period or after many years. Therefore, it is crucial to follow children closely on a long-term basis after pediatric cataract surgery.

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