Corneal Emergencies Associated with Other Intraocular Surgeries

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18.1 Introduction

Ophthalmic surgeries have become increasingly safe over the decades with advancing technology, evolving surgical techniques, and advances in surgical training. Cornea-related complications may be observed in association with any intraocular surgery, including phacoemulsification, glaucoma surgeries, strabismus surgeries, lid and oculoplasty surgeries, and vitreoretinal surgeries. Majority of the corneal complications are minor and self-resolving in nature, including superficial abrasions and epithelial defects. Corneal emergencies after other intraocular surgeries are rare; however, timely diagnosis and management is imperative to prevent irreversible sequelae including corneal decompensation and scarring. We herein describe the corneal emergencies that may be observed after other intraocular surgeries, associated risk factors, their diagnosis, management, and preventive measures.

18.2 Corneal Emergencies in Cataract Surgery

Cataract surgery is one of the most commonly performed ophthalmic surgeries. Minor complications such as postoperative corneal edema, corneal abrasions, and epithelial defects are commonly observed especially with inexperienced surgeons. Rarely, corneal emergencies that require urgent management may occur, including acute corneal clouding, Descemet membrane detachment, toxic anterior segment syndrome with corneal endothelial toxicity, and clear corneal incision-related complications. It is imperative to recognize these complications and institute

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appropriate treatment at the earliest to prevent sight-threatening visual and anatomical sequelae.

18.2.1 Descemet Membrane Tears and Detachment

Descemet membrane detachment (DMD) and tears may occur after any intraocular surgery but are most commonly associated with phacoemulsification (Fig. 18.1a). Incision-site DMD has been reported in 25–82% of cases undergoing phacoemulsification [1–3].

18.2.1.1 Predisposing Factors

Various instrument-related factors, surgeon factors, ocular and systemic co-morbidities predispose to the formation of wound-site DMD [4, 5]. Use of blunt keratomes to make the corneal incisions results in a ragged morphology of the incision and predisposes to DMD. Excessive surgical manipulations, prolonged phacoemulsification time, increased ultrasound energy, repeated entry into the anterior chamber with instruments or phacoemulsification probe, and surgeon inexperience increase the likelihood of developing DMD. Ocular pathologies including Fuchs' endothelial dystrophy, corneal scars, corneal injuries, and healed keratitis can lead to the formation of DMD during an otherwise uneventful cataract surgery. Old age and deep-set eyes with narrow palpebral fissures are risk factors for development of wound-site DMD.

Fig. 18.1 Descemet Membrane Detachment (DMD) observed after phacoemulsification. (**a**) Slit-lamp examination showing Descemet membrane detachment involving the visual axis. (**b**) Anterior segment OCT can be used to assess the height and extent of DMD
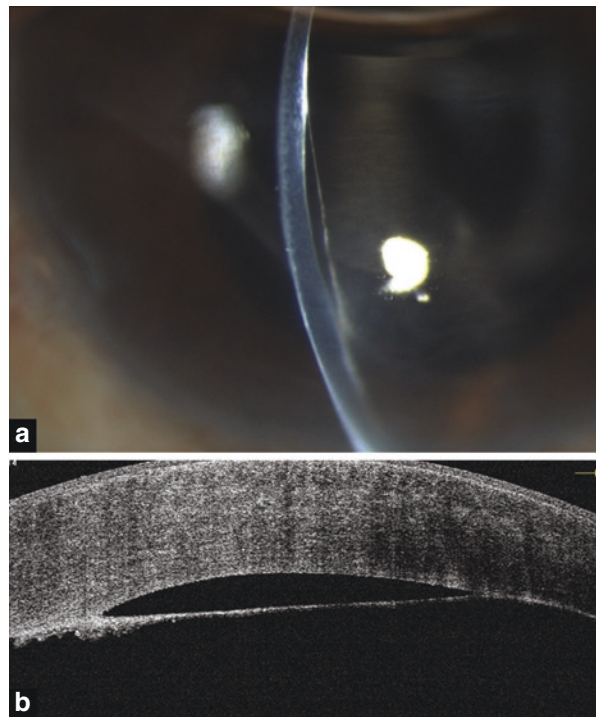
18.2.1.2   Diagnosis

Intraoperatively, DMD may be directly visualized under the operating microscope. Intraoperative optical coherence tomography (iOCT) helps in the diagnosis and management of on-table DMD by providing a real-time visualization of the corneal ultrastructure even in the presence of overlying stromal edema.

Postoperatively, slit-lamp biomicroscopy can help visualize the detached Descemet membrane. Anterior segment optical coherence tomography (ASOCT) is a useful adjunct to monitor the location and extent of DMD and the effect of treatment (Fig. 18.1b). Ultrasound biomicroscopy (UBM) helps in the visualization of DMD in hazy corneas and guides surgical management; however, it is technician-dependent and time consuming as compared with ASOCT.

18.2.1.3   Management

Various classification systems have been proposed to differentiate different types of DMD and help in decision-making regarding management [5]. Mackool et al. classified DMD as planar or non-planar, based on the height of separation of the DM from stroma [6]. Kumar et al. developed the HELP algorithm for classification and management of DMD based on ASOCT, wherein DMD was classified based on the height, extend, chord length, and relation to pupil [7].

The management of DMD may be conservative or surgical based on the morphological characteristics of DMD and involvement of the visual axis (Fig. 18.2).
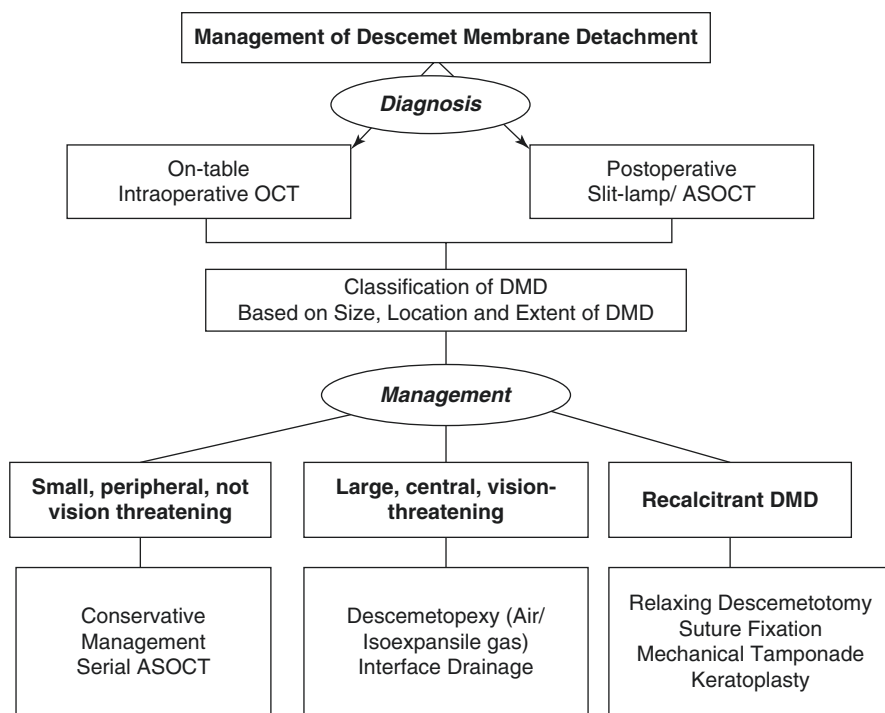
Fig. 18.2   Management algorithm for Descemet membrane detachment

Conservative management is advocated for small peripheral DMD localized to the incision-site, with <1 mm separation of the DM from the stroma. Descemetopexy is the gold standard for management of large DMDs involving the visual axis or cases not responding to conservative management [5]. Descemetopexy refers to the intracameral injection of air or isoexpansile gases (SF6 or C3F8) to tamponade the detached DM and promote its re-attachment. Gas or air is injected via a cannula through an anterior chamber paracentesis incision or directly using a 26/30 G needle while ensuring that the site of entry is located opposite to the area of DMD. A single continuous bubble is injected intracamerally after decompressing the anterior chamber by releasing some aqueous. The aim of descemtopexy is to fill at least 2/3rds of the AC with the gas or air bubble, approximately 8 mm in diameter and providing adequate tamponade to the involved area with DMD. Postoperatively, a supine position is advocated to facilitate the appropriate positioning and tamponade effect of the air/gas bubble [5]. Interface drainage of fluid may be required in large DMDs. A relaxing descemetotomy may be performed in taut DMDs to release the traction. In cases with bullous DMD refractory to pneumatic descemetopexy, performing an adjunctive relaxing descemetotomy can promote DM re-attachment by facilitating the drainage of the supra-descemetic fluid. A keratome may be used to incise the Descemet membrane while performing a descemetotomy. Rarely, persistent cases may require mechanical tamponade using OVDs or suture-fixation of DM. Suture fixation of DMD is performed by passing a full-thickness transcorneal 10-0 nylon suture which hitches the Descemet to the cornea [5]. Patients undergoing mechanical tamponade with OVDs are at a risk for postoperative intraocular pressure (IOP) spikes and should be prescribed prophylactic anti-glaucoma medications. Endothelial keratoplasty is reserved for cases of recalcitrant DMD with significant endothelial cell loss, whereas a full-thickness keratoplasty may be required in cases of long-standing DMD with stromal scarring.

18.2.1.4 Prevention

DMD may be prevented by using sharp non-reusable surgical keratomes and proper incision construction. Femtosecond laser assisted cataract surgery (FLACS) is associated with superior wound construction and decreased incision-site DMD as compared with conventional phacoemulsification. Increasing surgeon experience and skills helps to minimize the incidence of postoperative DMD.

18.2.2 Acute Corneal Clouding

Acute corneal clouding during phacoemulsification precludes intraoperative visualization and requires urgent management in order to allow the surgery to progress and prevent complications.

18.2.2.1 Predisposing Factors

Intracameral injection of the wrong concentration of drug, contaminated or wrong solution may result in acute toxicity to the corneal endothelium with immediate

clouding. Acute clouding of the cornea has been reported after injection of an inappropriate mixture of Miochol as well as after accidental substitution of BSS by distilled water. Inadvertent intrastromal injection of trypan blue dye can lead to corneal staining and clouding [8].

18.2.2.2   Diagnosis
Acute clouding or staining of the cornea may be visualized directly under the operating microscope with an impairment of visualization of the anterior segment structures. Anterior segment optical coherence tomography (ASOCT) can help to monitor the corneal thickness and rule out any Descemet membrane detachment postoperatively [9].

18.2.2.3   Management
Immediate intracameral lavage with BSS is indicated in cases of acute corneal clouding due to the instillation of wrong solutions or drugs. Surgery should be abandoned in cases with persistent clouding and impaired visualization. Inadvertent trypan blue staining of the corneal stroma may spontaneously resolve over time with conservative management alone [8, 9].

18.2.2.4   Prevention
Proper labeling of all intraocular medications and solutions and good communication between the members of the surgical team can help minimize wrong intracameral injections. Good depth perception, surgical training, and use of sharp keratomes to make corneal incisions can help prevent inadvertent intrastromal injections of dye or BSS [8, 9].

18.2.3 Corneal Endothelial Toxicity and Toxic Anterior Segment Syndrome

Toxic anterior segment syndrome (TASS) refers to acute-onset postoperative sterile anterior segment inflammation that often results in corneal endothelial toxicity and decompensation. It is a rare complication with an incidence of 0.22% reported in large case series and is most commonly observed after phacoemulsification (Fig. 18.3) [10].

18.2.3.1   Predisposing Factors
TASS results from a toxic insult to the anterior segment structures and may be associated with inappropriate pH, osmolality, concentration and chemical composition of intraocular solutions, preservatives, intraocular medications, intraocular lenses, and ophthalmic viscosurgical devices (OVDs) [11]. Improper cleaning of ophthalmic instruments is most commonly implicated in TASS, which may lead to the introduction of bacterial endotoxins, detergents, denatured OVDs, and other impurities into the eye [10–12].

Fig. 18.3 Post-surgical toxic anterior segment syndrome (TASS) with limbus to limbus microcystic edema, Descemet membrane folds, iris pigments on endothelium, and iris chafing
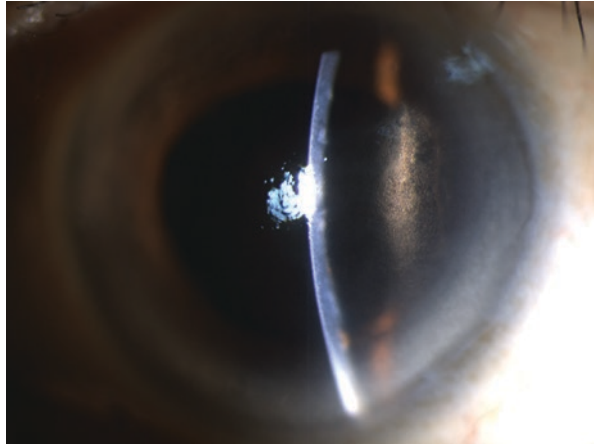
18.2.3.2 Diagnosis

The diagnosis of TASS is established clinically based on the classical presentation of limbus to limbus corneal edema with severe anterior segment inflammation, presenting within 12–48 h of an uneventful cataract surgery. Severe fibrinous reaction may be observed in the anterior chamber with extensive pigment dispersion [11]. A hypopyon may be seen in severe cases.

Infectious endophthalmitis is the most important differential diagnosis and should be ruled out before starting treatment. In contrast to TASS, endophthalmitis usually presents 2–7 days after surgery, often associated with pain, significant vitritis is present and culture of vitreous may be positive. TASS has a more acute presentation with absence of vitritis and is always culture negative.

18.2.3.3 Management

TASS is a corneal emergency as a delay in diagnosis and timely institution of appropriate management may result in irreversible endothelial toxicity, corneal decompensation, and stromal scarring. Topical steroids are the mainstay of management and frequent round the clock instillation is recommended in the initial period. A potent steroid such as 1% prednisolone acetate or dexamethasone 0.1% may be used. The steroids are gradually tapered once the inflammation subsides. Fluctuations in IOP may occur and anti-glaucoma therapy is required to manage IOP spikes.

Endothelial or full-thickness keratoplasty may be required in cases with significant endothelial cell loss and corneal decompensation.

18.2.3.4 Prevention

Preservative free medications and intraocular irrigating solutions should be used. Training of the surgical staff and promoting awareness can help to prevent outbreaks of TASS. The most important preventive measure is proper cleaning and sterilization of the surgical instruments. Various guidelines have been formulated for instrument cleaning and sterilization by international ophthalmological societies which may be followed to minimize the incidence of intraocular contamination and TASS [13].

18.2.4 Clear-Corneal Incision Related Complications

Clear corneal incisions made during phacoemulsification may be associated with various complications that require emergent management to maintain the integrity of the wound and intraocular stability. Wound burns with contraction of the incision may be observed, making it difficult to adequately seal the incision at the end of surgery. Pre-existing corneal scars or radial keratotomy incisions may dehisce during phacoemulsification. In addition, clear-corneal incision-related infections have been reported [14, 15].

18.2.4.1   Predisposing Factors

Wound burn and incision contracture are observed due to thermal damage of the cornea and shrinkage of collagen fibers, which results from use of excessive ultrasound energy, prolonged phacoemulsification times, inadequate flow of fluid through the sleeve, tight incisions and kinking of the sleeve [16].

Improper incision construction and excessive intraocular manipulations leading to wound distortion can complicate effective wound-sealing after phacoemulsification. Multiple deep RK incisions are prone to rupture or dehiscence during phacoemulsification.

Incision-related infections are rare after cataract surgery, and predisposing factors include ocular co-morbidities such as an obstructed nasolacrimal duct, systemic co-morbidities including diabetes mellitus and immunosuppression, environmental contamination by fungal spores, and iatrogenic factors including inadequate instrument sterilization [15].

18.2.4.2   Diagnosis

Wound burn with incision contracture is diagnosed by the presence of a white coagulated wound with fish-mouthing, wound leak, and an unstable anterior chamber.

Dehiscence or rupture of RK incisions can be directly visualized under the operating microscope with irrigating fluids and/or aqueous leaking from the involved site.

Leaky wound can be diagnosed by the inability to form the anterior chamber after hydrating the wound. Aqueous may be seen leaking from the clear corneal incision, and a fluorescein stain may be applied on the surface of the wound to confirm the diagnosis.

Corneal infiltrates at the wound-site with anterior chamber reaction is observed in incision-related infections. Corneal scraping is performed to obtain infective material for definitive microbiological diagnosis.

18.2.4.3   Management

Wound burns, leaky wounds, and ruptured RK incisions need to be sutured to restore the anatomical integrity of the eye. Multiple interrupted 10-0 MFN sutures are required in cases with incision contracture due to wound burns. Use of tissue adhesives to seal the wound and bandage contact lens in the postoperative period are useful adjuncts in difficult cases. Ruptured RK incision should be repaired by placing 10-0 MFN interrupted sutures oriented perpendicular to the RK incision before proceeding with the cataract surgery.

Wound-site infection should be managed along the lines of infective keratitis with intensive broad-spectrum fortified topical antibiotics and cycloplegics. The antibiotic therapy should be tailored to the specific micro-organism based on the culture and sensitivity reports.

18.2.4.4 Prevention

Proper incision construction with sharp keratomes and avoiding instrument-incision mismatch helps prevent wound-related complications and wound leak. Adequate flow of irrigating solutions via the phacoemulsification sleeves to cool the ultrasound probe helps minimize heat build-up and protects against thermal burns.

Ocular and systemic co-morbidities must be adequately managed in the preoperative period to prevent wound-site infections. Proper incision construction and well-sealed wounds help to prevent ingress of contaminated material in the postoperative period and protect against localized infection. Instrument sterilization protocols must be adhered to strictly. A clear corneal incision should be avoided in challenging cases such as cataract with prior RK, iridofundal colobomas, and limbal stem cell deficiency and a posterior limbal or scleral incision may be preferred in these cases.

18.3   Corneal Emergencies in Glaucoma Surgeries

All glaucoma surgeries including canaloplasty, trabeculectomy, and glaucoma drainage devices may adversely affect the cornea. Corneal complications after glaucoma surgeries range from mild epithelial abrasions and transient postoperative edema to sight-threatening complications including corneal-tube touch, endothelial decompensation, and Descemet membrane detachment. Glaucoma drainage devices are associated with the highest incidence of post-surgical corneal complications. An urgent management is often required to prevent permanent visual loss and restore anatomical integrity.

18.3.1 Descemet Membrane Detachment

DMD is a relatively rare but sight-threatening complication that may be observed after various glaucoma surgeries, including canaloplasty, trabeculectomy, and implantation of glaucoma drainage devices [17–21]. It is more commonly reported after canaloplasty as compared with trabeculectomy. A meta-analysis of 28 studies reported DMD in 3.1% cases undergoing canaloplasty, with no report of DMD in cases undergoing trabeculectomy [18]. Jaramillo et al. observed DMD in7.4% of cases after canaloplasty; of these, 58% were hemorrhagic DMDs, majority were located in inferior quadrant and 83% were <3 mm in size sparing the visual axis [17].

18.3.1.1   Predisposing Factors

Predisposing factors for the development of DMD after glaucoma surgeries include anatomical factors such as a shallow anterior chamber or weak adhesions between the DM and stroma due to genetic predisposition. Iatrogenic factors for DMD include the use of blunt microkeratomes, shelved incisions, inadvertent intrastromal injection of saline or OVDs leading to a separation of the DM from the stroma or accidental insertion of surgical instruments in the potential space between the stroma and the DM [6, 21].

During canaloplasty, excessive OVD injection may gain access to the pre-descemetic space due to a weakness in the canal wall in the inferior quadrant, leading to characteristic inferior DMDs [17]. Intracorneal hemorrhage during visco-dilation of the Schlemm's canal may lead to the development of hemorrhagic DMD [17].

18.3.1.2   Diagnosis

It may be difficult to establish a timely diagnosis of DMD as corneal edema is frequently observed in the postoperative period after glaucoma surgeries, and there is a low index of suspicion.

Anterior segment optical coherence tomography (ASOCT) is an excellent non-invasive investigative modality that can help to establish the diagnosis of DMD after glaucoma surgeries even in the presence of significant corneal edema. Confocal microscopy is a useful adjunct to assess the corneal ultrastructural changes due to DMD and loss of endothelial cells [21]. Ultrasound biomicroscopy (UBM) may also be used to establish the diagnosis of DMD [21].

18.3.1.3   Management

Timely diagnosis and management of DMD is an emergency as untreated or mismanaged cases may progress to corneal scarring, endothelial decompensation, and loss of vision. The management is based on the size, location, and extent of DMD. Small planar DMDs of <3 mm size located peripherally may be managed conservatively by observation alone. Surgical management including descemetopexy or suture-fixation is often required for large DMDs in the visual axis.

The management of DMD after glaucoma surgeries is challenging as achieving adequate tamponade of the Descemet's membrane may be difficult in the presence of a filtering bleb or tube. Multiple injections of air, gas, and OVD may be required for successful re-attachment of DMD post-trabeculectomy [21]. Drainage of interface fluid along with suture-fixation of the DM and viscoelastic tamponade has been reported [22]. Co-existent choroidal effusion and shallow AC may require transconjunctival suturing of the scleral flap to close the functional bleb in conjunction with choroidal tap and DM tamponade with 20% SF6 [20].

Long-standing DMD may induce significant corneal scarring and keratoplasty may be required for visual rehabilitation. Endothelial or penetrating keratoplasty is also required in cases with corneal decompensation following DMD.

18.3.1.4 Prevention

Post-surgical DMD may be minimized by avoiding the use of blunt surgical instruments and performing careful surgical manipulations. Excessive and forceful OVD injection during visco-dilation may be avoided.

18.3.2 Tube Migration with Tube-Corneal Touch

Glaucoma drainage devices typically consist of one or more plates to anchor the device to the globe, and a tube inserted in the anterior chamber to provide a conduit for aqueous outflow. The tube may migrate into the AC due to the anterior movement of the anchoring plate and has been reported in 35% cases, with up to 20% cases with an Ahmed glaucoma device developing a tube-corneal touch [23–26].

18.3.2.1 Predisposing Factors

Large buphthalmic eyes are predisposed to develop tube migration with tube-corneal touch [25]. Continued elongation of the globe in pediatric eyes combined with a low scleral rigidity lead to a relative anterior migration of the anchoring plate with increased likelihood of tube-corneal touch. Anterior migration of tube may also result from vigorous eye-rubbing.

18.3.2.2 Diagnosis

Diagnosis of tube migration and tube-corneal touch is usually established on a careful clinical examination using slit-lamp biomicroscopy (Fig. 18.4). Localized corneal decompensation may be present in cases of tube-corneal touch, and an ASOCT or UBM can help to visualize the lumen of the tube and establish its relation to the corneal endothelium in these cases.

Fig. 18.4 Anterior migration of glaucoma drainage device with tube-corneal touch and endothelial decompensation
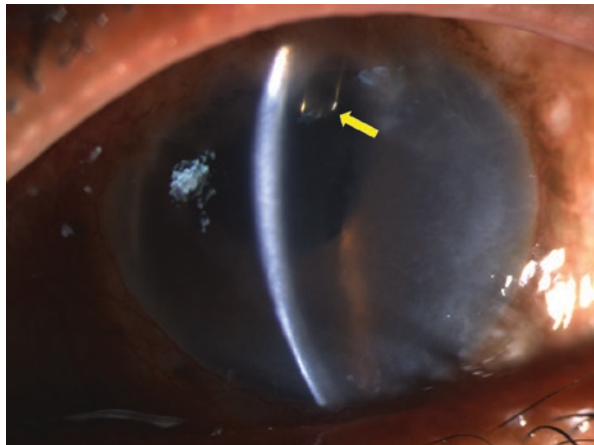
18.3.2.3   Management

Management of a tube-corneal touch is an emergency as it results in progressive endothelial cell loss and corneal decompensation. Surgical trimming of the tube is required in cases with a tube-corneal touch, and the plate may need to be anchored more posteriorly. Pars plana implantation of the tube into the vitreous cavity may be considered in cases with difficult anterior segment anatomy and persistent tube-corneal touch.

18.3.2.4   Prevention

The plate should be anchored securely to the sclera using sutures. The anchoring plate along with the external part of tube should be adequately covered by a patch graft if required. A long scleral tunnel should be made to insert the tube into the anterior chamber in a fashion that the tube is parallel to the iris plane. The tube should be positioned as posteriorly as possible in the anterior chamber to prevent an inadvertent tube-corneal touch [27]. Patients should be taught to avoid eye-rubbing. Postoperative regular follow-up is essential to monitor the position of the tube in the anterior chamber and detect any anterior migration of the tube at its earliest.

18.3.3 Blebitis and Keratitis

Bleb-related infections may be limited to the filtering bleb (blebitis), associated with adjacent keratitis or progress to fulminant bleb-related endophthalmitis [28]. They may occur after glaucoma-filtration surgeries including trabeculectomy and combined trabeculectomy + trabeculectomy with the formation of a bleb. Children are more frequently affected with an incidence ranging from 0% to 17% [29, 30].

18.3.3.1   Pathogens

The pathogenic micro-organisms associated with bleb-related infections are more virulent and include *Streptococcus* species, *Staphylococcus*, *Haemophilus influenzae,* and *Pseudomonas aeruginosa* [31].

18.3.3.2   Predisposing Factors

Bleb morphology is most commonly implicated in bleb-related infections, with avascular, thin-walled cystic blebs predisposing to an increased risk of developing blebitis and endophthalmitis. Excessive use of antimetabolites including mitomycin C (MMC) and 5-Fluorouracil (5-FU) is associated with thin avascular blebs postoperatively with an increased risk of developing bleb-related infections [32–34]. Chronic bleb leak, inferior location of filtering bleb after trabeculectomy, use of releasable sutures, ocular surface disorders, use of contact lens, and bacterial conjunctivitis also predispose to the development of bleb-related infections [32, 33]. Systemic co-morbidities such as diabetes mellitus and immunosuppression also increase the risk of infections. Past history of bleb-related infections is associated with a 12-fold increased risk of developing endophthalmitis.

18.3.3.3 Diagnosis

The diagnosis of bleb-related infections is usually established clinically due to the presence of classical signs and symptoms. The patient is usually symptomatic and presents with foreign body sensation, blurring of vision, redness, photophobia, and purulent discharge. Rapid progression of symptoms points towards a more fulminant course and is suggestive of endophthalmitis, with blebitis having a relatively insidious evolution of symptoms over a few days.

Blebitis is indicated by the presence of intense localized conjunctival inflammation surrounding a white thin cystic avascular bleb, resulting in a characteristic "white on red" appearance. Mucopurulent infiltration of the bleb with a purulent discharge is present in advanced blebitis and bleb leak may be observed. Adjacent keratitis may be observed in cases with corneal involvement. Associated vitritis is present in endophthalmitis which may be confirmed by B-scan ultrasonography.

18.3.3.4 Management

Frequent instillation of broad-spectrum topical antimicrobials should be commenced at initial presentation, which may be later tailored based on the culture reports and sensitivity pattern of the causative micro-organism. Systemic antibiotics are recommended in addition to topical medications especially in pediatric cases, and intravenous antibiotics may be required in concomitant endophthalmitis.

After resolution of active infection, bleb revision with excision of the bleb and advancement of the conjunctiva may be required to correct the underlying cause. Any scleral thinning or a full-thickness sclerostomy evident at the time of the revision should be addressed accordingly. Endophthalmitis, if present, should be adequately managed by a retina specialist with intravitreal injections and/or vitrectomy as required.

18.3.3.5 Prevention

Judicious intraoperative use of antimetabolites may help minimize the incidence of thin cystic blebs and prevent bleb-related infections. It is advisable to bury all releasable sutures and avoid making inferior blebs. Co-existent ocular and systemic co-morbidities should be adequately managed in the preoperative period.

18.4 Corneal Emergencies in Strabismus Surgeries

Complications after strabismus surgeries are uncommon, with corneal complications being extremely rare. Anterior segment ischemia is an extremely rare, sight-threatening complication that may be observed after strabismus surgeries. It involves the entire anterior segment including the cornea.

18.4.1 Anterior Segment Ischemia

The incidence of anterior segment ischemia is 1 in 13,000 cases [35]. It is most commonly associated with strabismus surgeries.

18.4.1.1   Predisposing Factors

The most significant factor associated with the development of anterior segment ischemia is surgery on 3–4 recti muscles in the same sitting compromising the anterior segment circulation. The interruption of anterior ciliary arteries may be accompanied by the interruption of deep episcleral collateral vessels, leading to hypoperfusion of the anterior segment, tissue hypoxia, and inflammation. Other predisposing factors for the development of anterior segment ischemia include advanced age, past history of rectus muscle surgery, and a history of vasculopathy such as diabetes or hypertension [35, 36].

18.4.1.2   Diagnosis

Diagnosis of mild cases of anterior segment ischemia may be established based on iris fluorescein angiography findings of reduced iris perfusion. Severe cases may be diagnosed clinically based on a spectrum of findings including changes in pupil shape and reactivity, postoperative uveitis, cataract, keratopathy, hypotony, loss of vision, and even phthisis bulbi [36].

18.4.1.3   Management

Intensive corticosteroids are the mainstay of management of anterior segment ischemia. Mild manifestations may be managed by topical steroids alone, whereas oral or intravenous corticosteroids are required for severe disease [36]. In addition, cycloplegics are prescribed to prevent synechiae, hypertonic saline to manage corneal edema and anti-glaucoma medications for IOP management, if required.

18.4.1.4   Prevention

The number of rectus muscles operated upon during strabismus surgeries should be limited, and three or four muscle surgeries involving the rectus muscles should be avoided. Techniques to preserve anterior ciliary arteries may be performed to minimize the risk of anterior segment ischemia [36, 37].

18.5   Corneal Emergencies in Ocular Surface, Lid and Orbital Surgeries

Ocular surface, lid and orbital surgeries often result in minor corneal epithelial abrasions and defects, which resolve spontaneously with conservative management. Rarely, corneal perforation may be observed which is an ocular emergency.

18.5.1   Corneal Perforation

Corneal perforation is an extremely rare complication that has been reported after laser blepharoplasty [38]. Excessive corneal thinning with inadvertent full-thickness dissection may be observed during lamellar dissection performed in various ocular surface surgeries, including pterygium surgeries, dermoid excision, or excision of ocular surface squamous neoplasms [39].

18.5.1.1 Predisposing Factors

Corneal perforation has been reported after laser blepharoplasty due to the elevation of cornea superior to the protective corneal shields during laser application [38]. The Bell's phenomenon leads to up-rolling of the eye on closure, which explained the exposure of cornea to the laser beam above the protective shields. Excessive use of laser power and prolonged exposure can lead to inadvertent perforation.

Excessive use of cautery and antimitotic agents and aggressive lamellar dissection can lead to inadvertent limbal perforation during pterygium excision, dermoid excision, or other ocular surface surgeries.

18.5.1.2 Management

The management of corneal perforations is based on the size of perforation. Tissue adhesives with bandage contact lens may be used to manage small perforations. Patch graft may be needed for larger perforations.

18.5.1.3 Prevention

Preoperative investigations including ASOCT and UBM can help to assess the depth of lesions and corneal thickness and aid in proper surgical planning. Intraoperative OCT provides a real-time assessment of the residual stromal bed and helps prevent inadvertent perforation. Laser power and corneal protection should be checked before application.

18.6   Corneal Emergencies in Vitreoretinal Surgeries

Corneal complications during vitreoretinal surgeries interfere with adequate visualization of the posterior segment and impede the surgical steps. Corneal clouding and epithelial damage are frequently observed during vitreoretinal surgeries. An urgent management is necessary to restore corneal clarity and successfully complete the vitreoretinal procedure. In addition, any corneal wound may dehisce or leak due to the intraocular pressure fluctuations that occur during these surgeries and need to be managed adequately. Anterior segment ischemia may rarely be observed after 360 degrees buckling surgeries, and has been described in detail in the earlier section.

18.6.1 Corneal Clouding

Corneal clouding may be observed during pneumatic retinopexy, buckling surgery or pars plana vitrectomy and impedes posterior segment visualization.

18.6.1.1 Predisposing Factors

Corneal edema may be observed in combined procedures with phacoemulsification and pars plana vitrectomy. Epithelial damage can result from trauma due to the

irrigating lens/wire vectis, low quality irrigating fluids, or excessive scraping of the corneal epithelium during surgery. In addition, frequent IOP fluctuations during surgery with high IOP spikes can cause corneal clouding.

18.6.1.2   Diagnosis
Haziness of the cornea can be directly visualized under the operating microscope. Epithelial defects may be present.

18.6.1.3   Management
Rolling of the cornea with cotton tips or gently scraping off the epithelium can help improve visualization through cloudy corneas.

18.6.1.4   Prevention
Good surgical skills with gentle intraocular manipulations can help minimize corneal clouding. Staged phacoemulsification and pars plana vitrectomy procedures may be preferred rather than combined surgery, especially in complicated cases.

18.6.2 Wound Leak

Wound leak or gape of clear corneal incisions can be observed during retinal surgeries due to the increased pressure on the cornea. A leaky or gaping wound interferes with surgery and needs to be managed immediately.

18.6.2.1   Predisposing Factors
Clear corneal incisions made during combined procedures are more likely to dehisce, especially while inserting the pars plana ports. Excessive pressure exerted by the wide-angle or irrigating lens can lead to wound dehiscence.

18.6.2.2   Diagnosis
Corneal folds with a flat anterior chamber point towards wound leak and hypotony. Aqueous leak can be visualized from the site of dehiscence.

18.6.2.3   Management
Corneal hydration is ineffective in adequately sealing the incision during retinal surgeries, and all corneal incisions should be sutured. Multiple sutures may be required.

18.6.2.4   Prevention
Suture clear corneal incisions if phacoemulsification has been performed recently. Undue pressure on the cornea with the wide-angle lens/irrigating contact lens should be avoided.

18.7 Conclusion

Corneal emergencies may be observed after any intraocular surgery, including phacoemulsification, glaucoma surgeries, strabismus surgeries, oculoplasty procedures, and vitreoretinal surgeries. Emergent management of these complications is essential for two reasons—firstly, corneal involvement precludes adequate visualization of the intraocular structures and hampers the surgical procedure. Secondly, delay in timely diagnosis and management can lead to vision-threatening sequelae including corneal scarring, endothelial decompensation, corneal perforation, and even phthisis bulbi. It is essential for ophthalmic surgeons to be aware of the potential corneal complications that may occur during other intraocular surgeries, take preventive measures to minimize their incidence and adequately manage the corneal emergencies.

Key Points
- Corneal emergencies may be observed after any intraocular surgery, including phacoemulsification, glaucoma surgeries, strabismus surgeries, oculoplasty procedures, and vitreoretinal surgeries.
- Prompt diagnosis and appropriate management is essential to prevent long-term sequelae such as corneal decompensation or scarring.
- Descemet membrane detachment is a commonly encountered corneal emergency in patients undergoing phacoemulsification.
- Management of DMD is based on the size, location, and extent of DMD. Anterior segment optical coherence tomography is a useful adjunct for the timely diagnosis of DMD, classification and formulation of management algorithm.
- Post-surgical TASS often shows a dramatic response to steroid therapy and needs to be differentiated from endophthalmitis.
- Glaucoma drainage devices are associated with a high risk of corneal complications including Descemet membrane detachment, progressive endothelial cell loss, and endothelial decompensation.
- Managing DMD after glaucoma surgeries is more challenging as the presence of a filtering bleb/tube facilitates the escape of air/gas bubble from the anterior chamber.
- Corneal complications after strabismus, oculoplasty, and vitreoretinal surgeries are relatively uncommon and include anterior segment ischemia, accidental corneal perforation, corneal clouding, and wound leak.

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