Cataract Surgery Complications - The Retinal Perspective

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Modern cataract surgery is safe in majority of patients. Cataract surgery with phacoemulsification is one of the most successful procedures performed, and its popularity has decreased operating times and given patients a shorter postoperative healing period. However pseudophakia changes the physiology of the eye and immediate change involves the release of cytokines. Deformation of the globe and intraoperative fluctuation of intraocular pressure may induce microlesions and alteration of ocular perfusion. The barrier function between the anterior and posterior segment is compromised after surgery and the geometry of the intraocular chamber changes and vitreous body is subject to increased destruction during the years after surgery. All these changes along with surgical problems are the main reasons for posterior segment complications of cataract surgery.

Acute posterior segment complications include globe perforation, dislocated lens fragments, hemorrhagic choroidal detachment, and endophthalmitis. Late retinal complications include, malpositioned intraocular lens, retinal detachment, cystoid macular edema, exacerbation of diabetic retinopathy, choroidal detachment, phototoxic injuries, etc. The occurrence of these complications after cataract surgery are low, but it is important to recognise them early and treat appropriately. In this article each of these complications are reviewed.

1. Needle stick induced globe perforation

It is a grave complication of peribulbar and or retrobulbar anesthesia. With the practice of topical cataract surgery the incidence have decreased in the recent years. The incidence and prevention of needlestick injury by peribulbar or retrobulbar injections have generated considerable debate since the introduction of these techniques. Reported peribulbar perforation rates range from 0 in 2684 to 5 in 666 (0.75%) consecutive blocks. Intermediate rates of 0.006% and 0.024% were found in 2 larger series of 16 224 and 4000 patients, respectively. Studies of retrobulbar injections report 3 perforations in 4000 cases (0.075%) and 1 perforation in 5235 cases (0.019%), respectively. Predisposing eyes are the ones with increased axial length, posterior staphyloma, previous ophthalmic surgery, faulty techniques and poor patient cooperation.

Signs

Sudden hypotony, acute raise in intraocular pressure in cases where the anaesthetic is injected directly into the vitreous cavity, loss of red reflex following anaesthesia should give one a suspicion of inadvertent globe perforation.

Management

A good assessment of the fundus is the first step in management. Look for the site of perforation (Figure 1), presence of retinal haemorrhage, vitreous haemorrhage, retinal detachment, supra chorioidal haemorrhage, optic nerve perfusion, retinal infarction in the form of pale oedematous retina etc. In cases where fundus visualization is hampered due to media haze; ultrasonography should be performed. If the site of perforation is seen, cryopexy or laser photoocoagulation may be performed to the site or sites of perforation and can proceed with cataract surgery in the absence of hypotony. If there is marked hypotony subsequent cataract surgery can be done at a later date. In cases of vitreous haemorrhage, retinal detachment, supra chorioidal haemorrhage etc planned vitreoretinal surgery is the treatment of choice.

How to avoid perforation

Learn good technique, identify susceptible eyes especially look for posterior staphyloma preoperatively. Before injecting the drug check for free ocular movements denoting that the needle has not engaged ocular coats.

2. Operating microscope induced phototoxic retinopathy

Focal retinal pathology and dysfunction as a sequela to operating microscope illumination is well recognised. Retinal phototoxicity in humans was first reported in 1983 by McDonald and Irvine in eyes subjected to extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens implantation. In two subsequent studies, phototoxicity was reported to occur in 7% and in as many as 28% of eyes undergoing cataract surgery. The occurrence of phototoxic injuries has been correlated with exposure to light of certain wavelengths, particularly blue light, and most significantly, the duration of surgery. However studies have also shown that this can happen with shorter operating time also. Other factors thought to predispose eyes to phototoxic injury include lightly pigmented ocular fundi, emmetropic eyes, retinal vascular disease, the use of hydrochlorothiazide, hypothermia, hypoxia, deficiency of ascorbic acid, vitamin A deficiency, strong illumination from the operating microscope and diabetic patients; especially those with retinopathy. During the last decade, phacoemulsification has gained popularity as a cataract extraction technique and the operating time has decreased accordingly. However,
Risk factors for vitreous loss and subsequent dislocation of lens material during cataract surgery include small pupillary size, hard nucleus, deep-set eyes and patient’s eye movement during surgery. Other risk factors are previous trauma or surgery, pseudoexfoliation and hereditary disorders such as Marfan’s syndrome. In these disorders the weakened zonules increase the probability of zonular dehiscence, capsular break and lens dislocation.11,17

There are many complications associated with retained lens fragments which include:

**Intraocular Inflammation:**

The lens protein is an immunologically protected protein and cause severe reaction once exposed to the intraocular environment. This inflammation can develop within hours of the dislocation. The intensity seems to be proportionate to the volume of the lens material present in the vitreous cavity. It also depends on the degree of manipulation and individual inflammatory activity.14 Lens-induced inflammation may be quite severe. In patients with vitreous opacification an echography may demonstrate intravitreal fragments and may help differentiate from an endophthalmitis. However, a distinction is not always possible and sometimes the two may coexist.18

**Glaucoma:**

Blodi et al9 found elevated intraocular pressure (IOP) in 50 percent of patients undergoing pars plana vitrectomy for removal of retained lens fragments. Chronic glaucoma was seen on long-term follow-up in patients in whom the vitrectomy was performed after 3 weeks. The presumed mechanism for elevated IOP is the liberation of lens proteins which along with the macrophages and other inflammatory cells in the aqueous humor may compromise the outflow facility. Chronic inflammation may eventually lead to peripheral anterior synechiae and chronic angle closure glaucoma.19

**Corneal Edema:**

Some degree of corneal edema is seen in almost 33 to 85 percent of patients with retained lens material.19,17,18 Increased manipulation at the time of initial complicated cataract surgery as well as increased postoperative inflammation contribute to the corneal edema. But it usually clears in a few days rarely necessitating keratoplasty.

**Retinal Tear And Detachment:**

Retinal tears or detachment may develop intraoperatively at the time of cataract surgery, in the early postoperative period or after removal of intravitreal fragments by pars plana vitrectomy. Isolated retinal breaks are seen more commonly than retinal detachment which has been reported in 0 to 11 percent cases before pars plana vitrectomy.9,10,12,17,20,21
where attempts were made by the cataract surgeon to retrieve the dislocated fragments using lens loop or vitreous irrigation. Hence minimal manipulation is recommended to avoid trauma to the retina.

Vitreous Haemorrhage:

It is uncommon but has been reported with the use of posterior vitreous irrigation in order to lift up the dislocated fragments. This manoeuvre could lead to trauma to the iris, ciliary body or retina and cause vitreous hemorrhage.

Cystoid Macular Edema:

Inadequate treatment or unrecognized lens fragments can cause a chronic inflammation which would eventually cause cystoid macular edema and compromise visual outcome. Blodi et al. reported it in 9% and Gilliland et al in about 7% of patients.

Role of the Primary Surgeon

It is very important to stay calm and assess the situation. If recognised early, judicious management can minimize embarrassment to the surgeon. Although it can occur in any stage of phacoemulsification, most commonly is seen to occur during nucleus emulsification and cortical clean up. If posterior capsule tear is recognized early, further complication can be prevented by preventing collapse of the anterior chamber (AC) and extension of the tear. If there is no vitreous disturbance, viscoelastic should be injected into the AC to tamponade the posterior capsular (PC) tear and the fragments should be removed by careful phacoemulsification or by converting to the conventional ECCE. A second instrument can be placed behind the fragments to prevent posterior migration. The cortex can be removed carefully and an intraocular lens can be implanted in the bag if the posterior capsular tear is small. If the posterior capsular support is inadequate with intact anterior capsule a sulcus supported posterior chamber IOL can be inserted. When vitreous is present in the AC, continued phacoemulsification causes vitreous traction and increases the risk of retinal detachment. The vitreous should be removed by an anterior vitrectomy first followed by removal of the residual lens matter.

Once the nuclear fragments have sunk into the vitreous, the dilemma arises. The first decision to be made by the primary surgeon is whether intervention is required. If the whole lens along with the intact capsule has dislocated, it poses little danger in terms of immediate inflammation, glaucoma or damage to the retina. Also, if the dislocated matter is less than 5 percent of the total lens volume, it rarely causes any problems. It would usually get absorbed slowly and does not warrant surgical removal.

Various techniques have been described in literature for removal of retained lens particles. Surgical approach has evolved significantly since Verhoff suggested irrigation of the vitreous cavity with normal saline to lift up the fragments. Intravitreal injection of viscoelastic material to retrieve the fragments followed by anterior vitrectomy has been suggested. Another technique is to use a lens loop to remove fragments from the AC followed by anterior vitrectomy. Single port pars plana vitrectomy at the time of cataract surgery has been advocated by some. Chang et al. described their technique of posterior assisted levitation in which pars plana injection of Viscoat (sodium hyaluronate 3%–chondroitin sulfate 4%) was used to stabilize and elevate a descending nucleus in 8 patients with posterior capsule rupture. The nucleus or nuclear remnants were successfully removed in all 8 patients.

Tova Lifshitz in his study found posterior levitation to be safe in 8 cases for a follow up of 14 to 28 months. Soon-Phai Chee described a technique of Anterior-assisted levitation to manage a subluxed crystalline lens that tilts severely into the anterior or mid vitreous cavity. In the absence of intervening vitreous presentation, a 27-gauge needle is inserted via a snugly fitting paracentesis incision to reach the anterior capsule of the posteriorly dislocated cataract or the capsular bag. The needle is introduced at an oblique angle and used to gently puncture the anterior capsule of the subluxated lens. The needle tip is brought forward and the anterior capsule grasped by microforceps introduced via another paracentesis wound. An ophthalmic viscosurgical device is then injected into the anterior chamber and the lens stabilized. Although such manoeuvres can be successful, the chances of developing serious complications may be high and therefore should be avoided. It is, therefore, advisable to minimize attempts at retrieval of the dislocated lens fragments by the primary surgeon.

Following removal of the nucleus anterior vitrectomy should be further performed and the residual cortex removed to the extent possible. An IOL can be inserted if feasible. Without adequate stabilization and support, an IOL should not be placed. An IOL should be deferred if the dislocated nucleus chunk is large or hard which may have to be removed via limbal route. Silicone lenses should be avoided as these patients are at an increased risk for retinal detachment requiring fluid gas exchange and silicone oil. Tight closure of the wound is necessary to prevent leakage during vitrectomy. Conservative treatment is to be started in order to control the intraocular inflammation, raised IOP and corneal edema which includes topical corticosteroids, cycloplegic agents and antiglaucoma medication. Systemic corticosteroids are rarely necessary.
Timing of Pars Plana Vitrectomy

The cases in which the volume of the dislocated material is 5 to 10 percent can be safely kept under observation. In other patients a three port pars plana vitrectomy is the ideal way of retrieving the dislocated fragments. The exact timing of vitrectomy is controversial. Early vitrectomy is advocated by some to reduce inflammation and expedite visual recovery. A delayed vitrectomy can result in chronic glaucoma and corneal edema. Blodi et al reported chronic glaucoma on long-term follow-up in 60 percent of patients in whom vitrectomy was performed after 3 weeks. Margherio et al17 found a trend of increased incidence of retinal detachment associated with delayed vitrectomy as a result of persistent vitreoretinal traction from prolonged inflammation. Monsinizadeh et al27 observed rapid progression of diabetic retinopathy in a few cases of delayed vitrectomy. Early vitrectomy was reported to have visual outcome of 20/40 or better in 75-78 percent patients. There is little evidence that pars plana vitrectomy done on the day of cataract surgery is associated with improved visual outcome. A brief period of observation may be necessary to allow resolution of corneal edema and improve visualization during vitrectomy. Early intervention within the first two weeks is generally recommended.

Technique of Pars Plana Vitrectomy

The preoperative evaluation should include a dilated fundus examination to identify the number and location of the fragments and to rule out any retinal tears. In patients with media opacities an ultrasonographic examination is indicated. The cataract wound is inspected for leakage and reinforced if required. A standard three port pars plana vitrectomy is performed. The infusion cannula is placed in the inferotemporal quadrant and the other two sclerotomies are made. The vitreous cutter is then used to perform a complete vitrectomy with induction of posterior vitreous detachment if it is not present preoperatively along with removal of any soft cortical matter. Make sure to remove vitreous from around the lens fragments to minimize traction on the retina during the emulsification process. The nuclear fragments are then aspirated with fragmatome or cutter and lifted into the midvitreous cavity where they are emulsified (Figure 2a,b,c). Fragmatome or the vitreous cutter may be chosen based on the nucleus hardness. For grade 1 nuclear sclerosis vitreous cutter is adequate. For grades 2 and 3 nuclear sclerosis, the fragmatome is required. If the nucleus is harder than this, it poses a challenging job as even the fragmatome would be unable to emulsify it. Such nuclear fragments are best delivered through the limbal section (Figure 2d,e,f). Low levels of ultrasound energy are recommended to prevent damage to the retina. The tip of the endoilluminator can be used to support and crush the lens remnants.

Perfluorocarbon Liquids

Perfluorocarbon liquids (PFCls) have been advocated as an adjunct in vitreous surgery for removal of lens fragments. It has been suggested that PFCls protect the retinal surface from injury and facilitate removal of lens fragments. It is especially useful if there is concurrent retinal detachment. The PFCl stabilizes the posterior retina while the lens fragments are being emulsified. Its use is also recommended in cases with hard dislocated nuclei which would require higher ultrasound energy. These are exchanged with either gas or silicone oil at the end of the surgery. The problems with the use of PFCls include a tendency for the fragments to gather at the peripheral PFCl-saline interface and foaming of PFCl during phacoemulsification. Some surgeons routinely employ their use in removing dislocated nucleus, while others reserve their application for specific situations such as extremely hard nucleus or concurrent retinal detachment.

Once the vitrectomy is over, the IOL should be inspected. It may need to be repositioned or exchanged. If an IOL has not been placed at the time of cataract surgery, it can be done now. Based on the adequacy of the capsular support, a PC IOL or an AC IOL may be placed. Scleral fixation of a PC IOL is also possible.

At the end of the surgery, the fundus is thoroughly inspected using peripheral depression to look for any residual fragments or retinal tears. Cryopexy or laser photocoagulation should be performed if any tears are detected and adequate tamponade should be used.

Complications of Pars Plana Vitrectomy

In general, patients with posteriorly dislocated fragments are at an increased risk of developing retinal detachment. The incidence has been reported to range from 9 to 17 percent in various reports. The visual outcome is influenced by the rate of successful reattachment and recurrent detachment. All possible measures should be taken to avoid this complication during primary as well as secondary surgery. Other major complications include glaucoma, corneal edema, infection etc.

Outcome

The visual outcome has been seen to be 20/40 or better in 60 to 68 percent of the patients. The reasons for improved visual outcome are better management both at the initial as well as the secondary surgery. The development of retinal detachment has the most adverse effect on the visual outcome.

Recommendations

Do minimize attempts at retrieval of the dislocated fragment. Seek the help of a vitreoretinal surgeon. Do adequate anterior vitrectomy and wound closure. Do not follow the fragments.
into the vitreous cavity. One should avoid irrigation of the vitreous cavity. Phacoemulsification should not be performed in the presence of surrounding vitreous but always after clearing it first. Do not use silicone intraocular lenses.

4. Dislocated Posterior Chamber Intraocular Lens

A posterior chamber intraocular lens (PC-IOL) may become dislocated when there is suboptimal posterior capsular support following posterior capsular rupture during cataract extraction. Because it has become widely recognized that PC-IOLs may be implanted even after the posterior capsule is ruptured, this problem has become somewhat more common. The early postoperative dislocation frequently is caused by unknowingly placing part or all of the IOL through a posterior capsular defect onto the anterior hyaloid, or misjudging haptic placement or capsular support. When dislocation occurs more than a few days or weeks after surgery, it may be the result of spontaneous IOL haptic rotation away from the meridians of posterior capsule remnants or zonular dehiscence. Dislocation months or years after placement is even less common and maybe due to traumatic or spontaneous loss of zonal support, particularly in eyes with pseudoxfoliation syndrome.

Preoperative evaluation

Completely dislocated PCIOLs are observed typically first week following surgery. The symptoms of patients depend upon the degree of lens decentration. Decentration may increase with progressive capsular fibrosis and capsular contraction. Decentration usually refers to mild malposition with the optic still covering more than half of the pupillary space. Patients at the milder end of decentration spectrum usually present several weeks following cataract extraction with good visual acuity, normal intraocular pressure and without inflammation. Symptoms include glare from the edge of the optic. Patients with subluxated IOLs are more symptomatic. The presenting visual acuity with correction may be good but frequently unacceptable to the patient. A mobile, luxated PC-IOL may generate unique floater like symptoms, or even induce pupillary block glaucoma.

Pre operative evaluation should include best corrected visual acuity intraocular pressure recording good anterior segment evaluation and a complete fundus assessment. Ultrasound B Scan should be performed in cases where there is no good fundus visualisation and in the presence of choroidal detachment to assess the nature of detachment. It is also important to assess the degree of inflammation inside the eye and manage it accordingly. Pre operative evaluation should also include aphakic refracted visual acuity, assessing the mobility or fixation points of the IOL and evaluating the status of residual lens capsular components. It is important to assess whether there is sufficient capsular support to allow IOL repositioning into the sulcus or whether IOL removal techniques with secondary IOL implantation techniques should be planned. It is important to understand at least six clock hours of peripheral capsule, and half of which is in the inferior quadrants is necessary for ideal PC-IOL support.

Indications For Surgery

IOL with simple decentration are usually managed by observation or use of topical miotics. Surgery may also be deferred, even for luxated PC-IOLs if phakic contact lens correction is visually satisfactory and convenient to the patient, if the other superseding medical or ocular problems prohibit further surgery or if the patient simply elects not to pursue further surgery. Soon-Phaik Chee described a technique of Anterior-assisted levitation to manage a subluxated in-the-bag posterior chamber intraocular lens (PC IOL) that tilts severely into the anterior or midvitreous cavity. In the absence of intervening vitreous presentation, a 27-gauge needle is inserted via a snugly fitting paracentesis incision to reach the anterior capsule of the posteriorly dislocated cataract or the anterior capsulorhexis rim of the PC IOL without disturbing the anterior chamber stability. With the bevel facing forward, the needle is introduced at an oblique angle and used to gently puncture the anterior capsule or insinuate between the fibrosed capsulorhexis rim and the optic of the subluxated PC IOL. The needle tip is brought forward and the anterior capsule grasped by microforceps introduced via another paracentesis wound. An ophthalmic viscosurgical device is then injected into the anterior chamber and the IOL stabilized.

These techniques may be successful but should be avoided as can produce serious complications.

A dislocated intraocular lens can produce complications such as substantial intraocular inflammation, retinal detachment, cystoid macular edema and glaucoma, all of which constitute relative indication for surgery. For symptomatically subluxated PC-IOL s surgery may be performed via a limbal or a pars plana approach. Eyes with less extensive IOL subluxation may be managed via a limbal incision with minimal or no anterior vitrectomy if the posterior capsule is largely intact. Vitrectomy using pars plana approach may offer optimal control to achieve the goals of surgery in cases where there is subluxated IOLs with large posterior capsular rent and in dislocated PC-IOL. IOL exchange may be performed if the PC-IOL has been damaged or if PC-IOL designed features make it unsuitable for sulcus or suture fixation. IOL exchange can be done with a scleral fixated intra IOL, anterior chamber IOL, iris claw lenses etc.

Surgical Technique

A standard three port pars plana vitrectomy is performed. It is important to remove the vitreous completely by inducing posterior vitreous detachment if it is not present. It is also important to remove vitreous and capsular remnants from
the vitreous base and from the sclerotomy sites to prevent iatrogenic retinal breaks. After the dislocated IOL is freed from all its attachments, so that it is freely mobile; intraocular forceps is used to grasp the IOL (Figure 3 a,b) and is brought to the anterior chamber (Figure 3c) or IOL is made to float up using perfluoro carbon liquid to the anterior chamber. From this position the intraocular lens is repositioned into the sulcus by grasping the IOL with the forceps and placing one of the haptic into the sulcus and dialing the rest of the IOL into position or IOL is explanted out through a limbal incision. Managing a dislocated PC-IOL in the presence of retinal detachment typically involves standard vitreo retinal surgical techniques22 but per flouro carbon liquids may be used for in selected cases to manipulate the IOL better while avoiding retinal trauma.

Outcomes and Complications

The final visual acuity probably depends not only on preoperative macular function but also complications from the original cataract surgery, such as CME and retinal detachment. Past studies has reported a final visual acuity of atleast 20/40 in 59 - 94 percent of the eyes31,33,34,35,36,37. Post operative complications are difficult to separate from those associated with complicated cataract surgery. Both CME and retinal detachment has been described after IOL repositioning surgery40. Retinal detachment occur in about two percent of the cases33,31,36,34,35 but less frequent than cases of retained lens fragments35. Retinal detachment may be more difficult to repair when scleral fixation has been performed, but this may reflect more, to the complexities of eyes requiring the scleral sutures rather than the technique itself.

Avoiding PC-IOL dislocation depends on accurate assessment of posterior capsular status intraoperatively. Anterior segment surgeon must be suspicious enough to evaluate the integrity of peripheral capsule carefully before implanting a PC-IOL in the presence of posterior capsular rupture. At least six clock hours of peripheral capsule (including the inferior meridians) are necessary to maintain good PC-IOL support. It is also vital that the haptics are placed precisely. Visco elastic substance and iris retraction may facilitate this evaluation and placement. Intraoperatively once IOL has dislocated a good anterior vitrectomy should be performed to prevent vitreous incarceration in the wound. Post operatively topical corticosteroids and, as clinically indicated, intraocular pressure reducing agents should be prescribed. Careful attention to detect other complications such as retinal detachment is necessary. For most cases vitreoretinal referral for definitive management is advisable. Careful assessment of capsular anatomy, detection of co existing complications to formulate a treatment plan in terms of timing and technique options are essential. Generally allowing a week or more for treatment and resolution of acute post operative inflammation is advisable. Accurate IOL power calculation should be done if and IOL exchange is contemplated.

5. Choroidal Detachment

Choroidal detachment is one of the complications associated with any intra ocular surgery. Likewise it can happen in patients undergoing cataract surgery too. The first detachment of choroid was described by Knapp in 1868 following cataract operation. He took it for a tumor and enucleated the eye and then it could be realised that the tumor was a choroidal detachment41. They can be classified as a cilio choroidal detachment which is a mostly a self limiting condition to potentially devastating condition called suprachoroidal hemorrhage.

Serous Choroidal Detachment

The terms choroidal detachment and cilio choroidal detachment are used interchangeably throughout, although the term suprachoroidal or supra ciliary effusion respectively are more descriptive40.

Etiology

Choroidal detachment are more commonly noted following cataract operation where postoperative and or intraoperative hypotony is combined with postoperative inflammation. This can occur in the setting of prolonged operating time and open wound intraoperatively to a leaky wound, chronic inflammation due to malpositioned intraocular lens, retained lens matter and vitreous incarceration into the wound.

Clinical Features

Choroidal detachment can be easily diagnosed by indirect ophthalmoscopy. They usually appear as bullous, solid detachments separated into lobes or quadrants. Shallowing of the anterior chamber is often associated with choroidal detachment due to forward displacement of the ciliary body. Hypotony and inflammatory signs in the anterior chamber are consistently noted.

Investigations

B-scan ultrasonography shows topographically smooth, dome or flat retinochoroidal layer elevation which inserts at ora or ciliary body. The supra choroidal space is echo free or with minimal echoes denoting serous nature of the choroidal detachment. Quantitative assessment shows a steeply rising thick double peak spike with hundred percent amplitude (Figure 4) Kinetic ultrasonography characteristically shows no after movements.

Ultrasound biomicroscopy (UBM) is useful in detecting very small effusion over a ciliary body without clinically detectable choroidal detachment. UBM can demonstrate ciliary body that is detached at the scleral spur.
Treatment
No specific non invasive treatment exists for choroidal detachments. Rational treatment, however must be directed at the cause of detachment. Ocular inflammation can be treated with topical or systemic steroids. Cycloplegic agents are helpful in this condition as they decrease the pull of the ciliary muscles. In cases of leaky wounds; measures must be instituted for water tight closure. In presence of chronic inflammation; pathology such as vitreous wick, malpositioned intra ocular lens etc should be tackled. Massive choroidal detachment with kissing choroidalas which is nonresponsive to medical management should be drained surgically without delay.

Suprachoroidal Hemorrhage
Suprachoroidal haemorrhage (SCH) is a potentially devastating complication of cataract surgery. Epidemiological data are limited to a few retrospective personal and institutional series, some over 15 years old. The estimated incidence of suprachoroidal haemorrhage was 0.04% in a study conducted by R Ling et al. Another study reported .1% incidence in the national cataract surgery survey. The incidence following phacoemulsification surgery was reported between 0.03% (Eriksson et al) to 0.06% (Davison et al). Studies established a lower incidence of suprachoroidal haemorrhage in phacoemulsification compared with ECCE.

Pathogenesis and Risk Factors
Most authors consider ocular hypotony to be essential in the development of Suprachoroidal haemorrhage. Suprachoroidal haemorrhage occurred most frequently after removal of the nucleus. In phacoemulsification, this necessitates a change of instruments when the relative stability of the closed system is at risk of being temporarily disrupted. In ECCE nuclear expression causes maximal distortion of the globe, and ocular hypotony is inevitable. Eyes with glaucoma, systemic hypertension, old age, sudden hypotony, high myopia, previous vitrectomy etc are more predisposed in developing this condition.

Limited Suprachoroidal Hemorrhage
The diagnosis of limited supra choroidal haemorrhage is subjective; there is no consensus on its definition. However R Ling et al in their study described it as suprachoroidal haemorrhage involving one to two quadrants. Patients with limited suprachoroidal haemorrhage may have only one quadrant involved or multiple quadrants with low lying choroidal elevation. These patients characteristically will not have vitreous in the anterior segment. It is important to identify a limited haemorrhage because these patients require no intervention. The choroidal haemorrhage resolves spontaneously over period of weeks to months. While these patients are being observed, it should be noted that although gradual resolution is the rule, they may progress to massive suprachoroidal haemorrhage too.

Massive Suprachoroidal Haemorrhage
The diagnosis of massive supra choroidal haemorrhage is also subjective; there is no consensus on its definition too. However R Ling et al in their study described it as suprachoroidal haemorrhage involving three to four quadrants. In these cases typically retinal apposition is present. The term may also be used in cases without retinal apposition but with other condition that mandate surgical intervention such as ocular pain and secondary glaucoma. Although massive suprachoroidal hemorrhage may resolve spontaneously in some patients, surgical intervention is generally required.

Massive Suprachoroidal Hemorrhage Without Vitreous In The Anterior Segment
Careful preoperative evaluation should determine if there is vitreous in the anterior segment. Gonioscopy helps to confirm the absence of vitreous in the angle or in the surgical wound in patients. Care must be taken to identify any vitreous that enters the anterior chamber through dehisced zonules in patients who are pseudophakic with a posterior chamber intraocular lens (PC-IOL). The vitreous also should be visualised in patients with an anterior chamber intraocular lens (AC-IOL). See if the vitreous penetrates the pupil and extends anterior to the AC-IOL. If vitreous is not visible in the anterior segment of aphakic patients, the following management techniques may be applied. Preoperative medical management of intraocular pressure (IOP) may decrease the risk of rebleeding during surgery. Systemic steroids given preoperatively may stabilize the choroidal vasculature. A 10 to 14 days interval before surgical intervention will allow the greatest egress of suprachoroidal blood because clot lysis would have occurred. There are case reports on successful removal of clot in the early post operative period using recombinant tissue plasminogen activator.

Surgery may be performed under general or local anaesthesia. The conjunctiva is opened 360 degree and the muscles are tagged using 4-0 silk suture. A 23 gauge butterfly needle is prepared by bending it to a 45 degree angle and introduced into the anterior chamber; the needle is connected to the infusion solution and the bottle is raised to a level that allows a steady stream of infusion fluid or an anterior chamber maintainer can be used which may free the assistant to help with other steps of the surgery. The tubing is then clamped. Alternatively, the infusion fluid can be connected to a continuous pressure air pump so that the pressure remains between 20 and 25 mm Hg.

A 15 degree blade is used to make a paracentesis at the
limbus. The sclerotomy should be placed in the quadrant with the greatest suprachoroidal hemorrhage. Using a blade, a radial sclerotomy is made in the middle of the quadrant and sclerotomy should be 3-4 mm in length and extend posteriorly starting 4 mm behind the limbus. Before the sclerotomy is made, cautery should be applied to the sclera and episclera. When the sclerotomy is almost full thickness, the 23-gauge needle with the infusion is turned on. The infusion is initially left off to avoid elevating the IOP excessively before entering the suprachoroidal space. The surgeon cuts through the remaining sclera and suprachoroidal blood is allowed to egress. If the blood stops flowing, the edges of the sclerotomy can be grasped with 0.3-mm forceps and elevated away from the choroid. If this manoeuvre does not permit resumed flow of the suprachoroidal blood, a cyclodialysis spatula is placed in the suprachoroidal space through the sclerotomy and swept back and forth on both sides of the sclerotomy for approximately 5 mm. If the blood has stopped flowing, cotton tipped applicators are rolled over the sclera in an attempt to bring residual suprachoroidal blood to the existing sclerotomy. If this manoeuvre also does not work, additional sclerotomies are made in other quadrants. Indirect ophthalmoscope is used to evaluate the status of the choroidals while the butterfly needle is maintained in the anterior segment. If the choroidals are significantly reduced, the surgery can be terminated. Once the choroidals are adequately drained, the butterfly needle is removed from the anterior chamber. The sclerotomy may be left open or closed with 6-0 or 7-0 Vicryl interrupted sutures. Muscle sutures are removed and the conjunctiva is closed using interrupted 7-0 vicryl sutures.

**Significant Choroidal Hemorrhage With Vitreous In Anterior Segment**

When vitreous protrudes into the anterior segment, there is a risk that it is adherent to anterior segment structures, such as the iris or cornea. Very high suspicion of adherence should be given to cases that have vitreous going to the surgical wound. Adherent vitreous may cause tearing of the retina where it is attached at the vitreous base if the adherent vitreous is not relieved before the choroidal blood is drained. The vitreous must be removed from its anterior connections before significant drainage of the choroidal hemorrhage to prevent tearing of the retina. The fullness of the anterior chamber determines whether to first drain suprachoroidal blood or remove anterior segment vitreous. If the anterior chamber is moderately deep and retina is not present in the anterior chamber, vitrectomy in the anterior chamber before drainage of the suprachoroidal blood is best. Two paracentesis sites are made at the limbus with a 15-degree blade. The incisions are made slightly closer to the horizontal meridians at the 9:30 and 2:30 clock positions. This lateral displacement will allow access to any vitreous located at the

12 o clock position. The 23-gauge bent butterfly needle is placed in one of the paracentesis sites and the vitrectomy instrument is placed in the other. The butterfly needle is initially used to sweep vitreous from surgical wound; excessive force that could be transmitted to the vitreous base must be avoided. In case of tightly adherent vitreous, vitrector is used to separate the connections to the anterior segment. Once the vitreous is separated from the cornea and the corneoscleral angle, attention is addressed to the pupillary margin. Vitreous that is attached to the pupil may be swept gently by the 23-gauge needle in an attempt to free any connections. The vitrector, set on aspiration mode, may also be used to aspirate the vitreous gently and free it from connection to the pupil. The released vitreous then is removed using the cutting and aspiration mode on the vitrector. The process of sweeping the vitreous free of any iris connection and removing the vitreous with the vitrector may be carried out under the iris but excessive excursions should be avoided because the retina may be in close proximity to the posterior iris.

Once the anterior segment-vitreous connections are severed, drainage of suprachoroidal blood is carried out as described in the previous section. During drainage, the posterior segment should be examined frequently with the indirect ophthalmoscope to ensure that vitreous traction does not appear between the vitreous base and the posterior iris. If traction is not present and the retina is attached, choroidal blood drainage can continue until adequate amounts of blood are removed.

If traction is present, retinal tearing may result as the choroidal drainage continues. Vitreous connections must be severed between the vitreous base and the posterior iris to prevent tearing. The vitrector must be introduced into the posterior chamber. A microvitrectoretinal (MVR) blade is used to enter through the pars plana 3 mm posterior to limbus. The opening is made in the superior quadrant on the side of the dominant hand and located to allow access to the site of vitreous traction. Vitrector is used to remove vitreous behind the iris; the more peripheral vitreous should be removed. Once all apparent vitreous traction has been relieved, additional suprachoroidal hemorrhage is removed. As more blood is removed the indirect ophthalmoscope is used to detect any additional areas of traction. These steps are repeated if traction remains and are continued until all residual traction is relieved and adequate amounts of choroidal hemorrhage are removed. The sclerotomy site for the vitrector is closed with 7-0 vicryl suture and the drainage sclerotomy is either left open or closed with 6-0 or 7-0 Vicryl suture. Conjunctiva is reaposed with interrupted 7-0 vicryl sutures. The paracentesis sites should be self-sealing; if not, they are closed with 9-0 or 10-0 non absorbable sutures.
Management Of Suprachoroidal Hemorrhage Associated With Retinal Detachment

Patients who develop a retinal detachment in association with a massive suprachoroidal hemorrhage have been shown to be at risk for a poor visual outcome from the formation of proliferative vitreoretinopathy as well as the formation of large or irregular retinal breaks.

Pars plana vitrectomy is generally indicated in retinal detachment. Drainage of suprachoroidal blood is begun with concomitant vitreous replacement with infusion fluid. Initial drainage will allow some space to develop in the anterior portion of the eye. Vitreous attachments in the anterior segment can be relieved with the vitrector through the limbus or pars plana. After relief of anterior traction, additional suprachoroidal hemorrhage is drained. A 6mm infusion cannula is placed after adequate hemorrhage has been cleared. During the process of draining all mobile suprachoroidal hemorrhage, the retina should be evaluated repeatedly to ensure that no additional vitreous traction remains. If traction is seen additional vitrectomy is completed. Any preretinal and subretinal membranes are removed after vitreous traction is revealed. A mobile retina should remain; in most cases the retina is completely detached. Retinal breaks are marked with diathermy. A posterior drainage retinotomy is made and a fluid – air exchange allows flattening of the retina. Laser photo coagulation is applied surrounding all vitreous traction and in the quadrants that appear to harbour the most suprachoroidal blood. Additional sclerotomies are made radially extending from the level of the muscle insertion to 3-4mm posteriorly. As blood extrudes from the sclerotomies, pressure is released from the wound allowing closure with interrupted sutures. Once the wound is closed the sclerotomies are closed with 7-0 Vicryl suture, to tamponade the bleeding vessels.

6. Pseudophakic Retinal Detachment

Introduction

Retinal detachment remains one of the most serious complications of cataract surgery. It has been estimated that up to 40% of patients referred to vitreo-retinal surgeons for retinal reattachment surgery have had prior cataract extraction. In the past few years, there has been a continuous improvement in surgical techniques for cataract extraction. This has led to an increase in the success rate of the procedure and in the popularity of this surgery; increasing numbers of cataract operations have been performed and with the parallel increased in life expectancy, it is possible that pseudophakic retinal detachment (PRD) will encompass an increasing proportion of rhegmatogenous RD in coming years.

Incidence

The incidence of RD after cataract surgery has been estimated to range between 0.6 and 1.7% during the first postoperative year. In comparison, the overall incidence of rhegmatogenous RD in the general population has been estimated to be between 0.0061% and 0.0179% per year. Rowe and associates calculated that at 10 years, the risk of RD was 5.5 times higher in patients who had undergone cataract surgery than in those who did not have this surgical procedure.

After Intracapsular Cataract Extraction

The incidence of RD after intracapsular cataract
Extracapsular Cataract Extraction and Phacoemulsification

The incidence of RD after extracapsular cataract extraction by nuclear expression (ECCE) or by phacoemulsification appears to be similar, and somewhat lower than that reported after ICCE. The incidence of RD after ECCE has been estimated to be between 0% and 7.5% after a range of follow-up between 4 months and 18 years. However, in most series, the reported incidence or RD after ECCE was approximately 1% (range of follow-up between 9 months and 8 years). Few studies in the literature have reported on the incidence of RD after phacoemulsification. In these series, the incidence of RD ranged between 0% and 3.6%, for a range of follow-up between 4 months and 10 years. One of the largest series on phacoemulsification was reported in 1985 by Chambless, who retrospectively reviewed the surgical complications of 3,047 cases. Retinal detachment was observed in 0.3% of cases in which IOL was not implanted, in 10% of cases with AC-IOLs, in 0.7% of cases with iris-supported IOLs, and in 0.1% of those with PC-IOLs. Javitt and associates, evaluated the probability of RD repair by standard life-table analysis. A total of 57,103 patients were identified. The probability of RD within 3 years after cataract surgery was 0.81%. Rowe et al., using Kalpan-Meir analysis, estimated the cumulative probability of RD at 2.5, and 10 years after cataract surgery (ECCE or phacoemulsification) to be 0.36%, 0.77%, and 1.29%, respectively. In the tenth year after phacoemulsification and ECCE, the cumulative probability of RD was 5.5 times higher than that expected in the reference group not undergoing cataract surgery.

Nd: YAG Posterior Capsulotomy

Opacification of the posterior lens capsule occurs in 15-50% of cases after extracapsular cataract extraction and it represents the most common complication of cataract surgery. It is likely that most of these cases will undergo Nd:YAG posterior capsulotomy. If Nd:YAG posterior capsulotomy increases the risk of RD, as suggested by most studies reported in the literature, the impact of this treatment on the incidence of pseudophakic retinal detachment could be important. The incidence of RD after Nd:YAG laser has been estimated to be between 0% and 4.1% after a range of follow-up between 3 months and 4 years. Javitt et al. in their study found a 3.9 fold increase in the risk of retinal break or RD among patients that had undergone YAG capsulotomy. The relative risk of retinal break was also higher in the capsulotomy group versus the non-capsulotomy group. It appears that laser parameters including energy, number of laser exposures and burst mode, do not appear to have an influence in the occurrence of retinal detachment. Similarly, no correlation between capsulotomy configuration or interval between cataract surgery and YAG capsulotomy has been found.

After Clear Lens Extraction in Myopic Eyes

Removal of the crystalline lens in highly myopic patients remains a controversial surgical procedure in ophthalmology. This is, at least in part, due to the fact that myopic eyes have a higher incidence of retinal breaks, including giant retinal tears and RD than non-myopic eyes and thus, it would be expected that a higher incidence of complications might occur in myopic eyes after clear lens extraction. The incidence of RD after clear lens extraction in high myopes ranged from 0% to 8.1%, for a range of follow-up between 3 months and 7 years.

Risk Factors

It is not clear whether the risk of pseudophakic retinal detachment is affected by the sex of the patient. In some reports, men and women were equally likely to suffer detachment. However, in the majority of reports an increased risk was found in men. Younger patients, myopic patients, the occurrence of RD in the fellow eye, intraoperative vitreous loss, planned or unplanned posterior capsulotomy, vitreous incarceration into the wound etc carries higher risks for retinal detachment.

Pathogenesis

Vitreous changes following cataract surgery are probably responsible for the increased incidence of RD in pseudophakic eyes. The most important change in the vitreous after cataract surgery is the occurrence of posterior vitreous detachment (PVD). PVD is more common in those individuals in whom the crystalline lens has been removed. Vitreous wick into the wound, vitreous entangled on to the IOL etc may cause direct traction to the vitreous base leading to increased risk of retinal tear formation (Fig 5a). Heller and colleagues reported an incidence of 72% of vitreous detachments in a series of 102 aphakic eyes examined post mortem. Similarly, Friedman et al reported an incidence of 66% of vitreous detachments in 200 non myopic aphakic patients. When PVD occurs, 10-15% of eyes are expected to develop retinal tears, which could lead to the development of RD.

Clinical Findings

Patients with PRD, like those with other forms of rhegmatogenous RD, usually present to ophthalmologists with symptoms of flashes of light, floaters, decreased visual acuity, or visual field defects. Over 50% of pseudophakic retinal detachment occur during the first year after cataract surgery.

In patients undergoing Nd: YAG posterior capsulotomy,
most retinal detachment occur during the first 6 months following laser. Pseudophakic retinal detachment appears to have a predominance of small horse-shoe tears, often located anterior to the equator, near the ora serrata and usually in the supero-temporal quadrants. In most cases, the macula is already detached at presentation (Fig 5b). Difficulties to examine the fundus are usually encountered when evaluating patients with PRD. These difficulties are usually related to the presence of a small pupil, anterior and posterior capsule fibrosis, presence of cortical remnants, vitreous opacities, and optical aberrations related to the IOL. Due to poor visualization of the retina, retinal breaks are not found in 4.8–75% of pseudophakic retinal detachment.

Management

Since the first series by Tasman and Annesley on the management of PRD, the treatment of this condition has represented a challenge for vitreo retinal surgeons. Different surgical techniques have been used to manage PRD, including scleral buckling, pneumatic retinopexy, and primary pars plana vitrectomy with or without scleral buckling.

Surgical Techniques: Outcomes and Complications

1. Scleral Buckling Surgery

Although high anatomical success rates have been reported following scleral buckling in several studies; it appear to be somewhat less successful in pseudophakic than in phakic RD. Furthermore, it is likely that the high success rates observed in some series following scleral buckling techniques, at least following the introduction of pars plana vitrectomy could be due to selection bias, for example patients with proliferative vitreoretinopathy and poor prognosis may have undergone pars plana vitrectomy; instead of scleral buckling procedure. Using scleral buckling, retinal reattachment has been achieved in 80–100% of cases after one or more surgeries in many studies. The surgery is performed under local or general anaesthesia. The technique was recommended in the management of retinal detachment caused by a single break, no larger than 1 clock hour and located within the superior 8 hours of ocular fundus, or by a group of small retinal breaks within 1 clock hour, in the absence of grade C or D PVR and uncontrolled glaucoma. The use of pneumatic retinopexy in aphakic and pseudophakic eyes is a subject of controversy. Although pneumatic retinopathy has been used to repair pseudophakic retinal detachment, it seems that it is less successful in aphakic and pseudophakic eyes than in phakic eyes. In a prospective randomised clinical trial aphakic and pseudophakic eyes had a significantly lower reattachment rate than phakic eyes. Chen et al achieved anatomical reattachment in only 36% of pseudophakic retinal detachment treated with pneumatic retinopexy. A similar reattachment rate (37%) was found by Han et al. Both of them found a higher incidence of PVR following pneumatic retinopexy in pseudophakic eyes compared to phakic eyes. Complications of pneumatic retinopexy in the treatment of retinal detachment have included new retinal break formation, development of new retinal detachment, delayed subretinal fluid absorption, chronic macular detachment, PVR, macular pucker, subretinal gas, and endophthalmitis. Other rare complications include suprachoroidal gas, extension of retinal detachment, macular hole formation and entrapment of gas in the anterior chamber.

2. Pneumatic Retinopexy

Pneumatic retinopexy was introduced in the mid 1980 as an outpatient procedure to treat selected retinal detachment. The technique was recommended in the management of retinal detachment caused by a single break, no larger than 1 clock hour and located within the superior 8 hours of ocular fundus, or by a group of small retinal breaks within 1 clock hour, in the absence of grade C or D PVR and uncontrolled glaucoma. The use of pneumatic retinopexy in aphakic and pseudophakic eyes is a subject of controversy. Although pneumatic retinopathy has been used to repair pseudophakic retinal detachment, it seems that it is less successful in aphakic and pseudophakic eyes than in phakic eyes. In a prospective randomised clinical trial aphakic and pseudophakic eyes had a significantly lower reattachment rate than phakic eyes. Chen et al achieved anatomical reattachment in only 36% of pseudophakic retinal detachment treated with pneumatic retinopexy. A similar reattachment rate (37%) was found by Han et al. Both of them found a higher incidence of PVR following pneumatic retinopexy in pseudophakic eyes compared to phakic eyes. Complications of pneumatic retinopexy in the treatment of retinal detachment have included new retinal break formation, development of new retinal detachment, delayed subretinal fluid absorption, chronic macular detachment, PVR, macular pucker, subretinal gas, and endophthalmitis. Other rare complications include suprachoroidal gas, extension of retinal detachment, macular hole formation and entrapment of gas in the anterior chamber.

3. Primary Pars Plana Vitrectomy (with or without scleral buckling)

Probably due to difficulties in visualisation of retinal breaks in pseudophakic retinal detachment; many surgeons are now using pars plana vitrectomy, combined or not with scleral buckling, in the surgical repair of retinal detachment in pseudophakic patients. Advantages of pars plana vitrectomy over scleral buckling techniques include the identification of retinal breaks by using internal search with the indirect viewing system and scleral indentation. Thus retinal breaks undetectable preoperatively can be found in many instances during pars plana vitrectomy. If breaks are not identified a higher failure rate may be expected. Furthermore minimal refractive changes would be expected following pars plana vitrectomy without scleral buckling. Intraoperative difficulties include formation of moisture droplets on the posterior surface of the IOL during air fluid exchange seen mostly with eyes in which posterior capsule is open. Chilled infusion fluid, coating the posterior surface of the IOL with balance salt.
solution and visco elastic substance may help in tackling this problem. In cases where silicon oil internal tamponade was used droplets of silicon may remain adherent to the IOL after silicone oil removal and may be extremely difficult to remove. In these circumstances semi fluorinated alkanes can be used to facilitate the clearance of IOL. Using pars plana vitrectomy with or without scleral buckling, in various studies retinal reattachment has been achieved in 88-100% of cases after one or more surgeries. In 62-82% of cases, a visual acuity of 20/50 was achieved post operatively. Campo et al. in their retrospective review of vitrectomy for pseudophakic retinal detachment without scleral buckling concluded that the overall anatomical success was achieved in 88% of cases with a single surgery, and in 96% of cases with subsequent operation. In this study however they had excluded cases with PVR gradeC OR worse changes. The results of randomised, prospective trial comparing scleral buckling with pars plana vitrectomy in pseudophakic retinal detachment have been presented by Brazitikos etal. A higher anatomical success was achieved after a single surgery using pars plana vitrectomy (94%) compared with scleral buckling (83%)60.Complications of vitrectomy with/without buckle include increased intraocular pressure, cystoid macular edema, PVR and macular pucker, iatrogenic retinal breaks, anterior synecchia and iris capture, submacular choroidal hemorrhage, new retina tear formation, central retinal artery occlusion, full thickness macular hole, dislocation of the IOL, and suprachoroidal hemorrhage. There does not seem to be an agreement on either scleral buckling or pars plana vitrectomy is the best choice in pseudophakic retinal detachment. SPR group did not find any significant between the two groups in pseudophakic retinal detachment.76 Factors influencing good outcome include less extensive retinal detachment and the ones sparing macula. Less favourable to poor vision are expected in cases with PVR, poor presenting vision, longer duration of symptoms before presentation, preoperative choroidal detachment, vitreous hemorrhage, large retinal break (More than or equal to 1 clock hour) or break located posterior to equator and occurrence of intraoperative hemorrhage.

7. Post Cataract Surgery Endophthalmitis

Endophthalmitis involves inflammation of the intraocular cavities, usually caused by an infection. Non infectious (sterile) endophthalmitis may be a result of retained lens material and toxic agents.

Incidence

Various studies in western countries have reported endophthalmitis incidence rates varying from 0.04% to 0.12% after cataract surgery. The national survey on blindness and visual outcome after cataract surgery conducted in India in 2001 to 2002 showed a prevalence of 0.6%. A study conducted in Asian population demonstrated the incidence to be 0.07%. Study from a tertiary eye centre in South India reported the incidence to be 0.05%.

Classification

Acute Postoperative Endophthalmitis

The infection within six weeks of intraocular surgery is termed acute postoperative endophthalmitis. Since the cataract surgery is the most common intraocular surgery, postoperative endophthalmitis are reported is around 0.1percent. The infection occurs from the normal ocular surface flora, contaminated surgical supply, and some of the surgical complications. The contaminated surgical supplies include irrigating solutions, viscoelastics, and intraocular lenses. The surgical complications include wound dehiscence, vitreous-wick syndrome, suture abscess, and wound site infection. According to EVS study coagulase negative staphylococcus is the most common organism associated with post operative endophthalmitis. Couple of reports from India on spectrum of post operative endophthalmitis stated that pseudomonas and fungi were the most common organism. Another study from South India concluded nocardia to be the most common pathogen.

Chronic Endophthalmitis

The eyes with chronic endophthalmitis do not present with a fulminant clinical picture. The inflammation appears weeks to months after an intraocular surgery, and many exhibit waxing and waning of symptoms. Typically the eye responds partially to topical and or oral corticosteroids but recurs following withdrawal or tapering of corticosteroid. The usual causative microorganisms of chronic or low grade endophthalmitis are Propionibacterium acnes, Staphylococcus epidermis, Corynebacterium species, and fungi.

Diagnosis:

Clinical Diagnosis

The clinical diagnosis of endophthalmitis is a constellation of symptoms and signs. The symptoms include reduction of vision, lid edema, congested eye, and pain. There may or may not be hypopyon and exudates in the pupillary area but the vitreous and retina shows exudates, seen ophthalmoscopically or detected by ultrasonography. The severe cases manifest with large hypopyon and loss of red reflex. The degree of involvement depends on whether it is an acute or chronic infection. Pain is an associated symptom in acute post cataract endophthalmitis: it was typically absent in 25 percent of the eyes in patients recruited in the EVS.

Microbiological Diagnosis

The microbiological diagnosis of endophthalmitis is based on the isolation of pathogens from the vitreous or aqueous humor obtained by diagnostic vitrectomy or anterior chamber aspiration.
on the microscopy and culture of the microorganisms. The samples for investigation are the anterior chamber (AC) and/or the vitreous fluid. The AC fluid is collected by the anterior chamber paracentesis, the undiluted vitreous fluid by vitreous tap or biopsy. The AC and vitreous fluid (usually 0.5 ml) collected in a sterile syringe is sent to the microbiology laboratory immediately after the collection, and the cassette containing the fluid at the end of the vitrectomy.

**Microscopy**

Smears made from aqueous or vitreous fluid on glass slides are stained for bacteria (Gram and Giemsa stain) and fungi (KOH and calcofluor white). Although smear examination to determine etiology is a rapid method, it suffers with low sensitivity.

**Culture**

A host of media must be included for favourable growth of aerobic and anerobic bacteria and fungi; the total number of media depend solely on the sample volume. The media include both solid (blood agar, chocolate agar, potato and Sabourauds dextrose agar) and liquid media (thioglycolate broth, brain heart infusion). The culture media must be examined daily for 2 weeks for any microbial growth. The vitreous biopsy collected in a syringe is inoculated in drops onto the culture media per se without streaking.

**Technique Of Vitreous Biopsy**

**Biopsy Using Needle**

The eye is prior anesthetized. The sample is obtained with a 25-gauge needle attached to a small volume (2ml) syringe. The eye is stabilized with a pair of forceps. The needle is positioned perpendicular to the eye wall at a distance of 3 or 3.5mm from the limbus (pars plana region) depending on the status of the lens. If the media is relatively clear one should make an attempt to visualize the needle tip. Attempt should be made to withdraw approximately 0.2ml of vitreous without undue suction pressure. Alternately one can use a butterfly needle for needle biopsy of vitreous. In case of a dry tap one should resort to vitreous biopsy using a vitreous cutter.

**Biopsy Using Vitreous Cutter**

The eye is prior anesthetized. The aspiration tubing of the vitrectomy instrument is cut and fitted with a female (at the proximal end) and male (at the distal end) attachment. A 2ml syringe is fitted to the proximal end of the aspiration tubing. The vitreous cutter is introduced through a pars plana sclerotomy wound. As the vitrector cuts the vitreous the assisting surgeon or the nurse applies low continuous suction at the beginning of the vitrectomy to obtain the desired vitreous volume. Following this, the syringe is removed and the two ends of the aspiration tubing are attached for further vitrectomy. At the conclusion of the vitreous biopsy, the intravitreal drugs are administered into the mid vitreous cavity. The needle biopsy is recommended if one does not wish to perform vitrectomy. It is easy to obtain larger sample volume with vitrectomy.

**Molecular Diagnosis**

Currently the conventional microbiological tests are considered gold standard despite their limitations. They are inconclusive in delayed postoperative endophthalmitis. These tests also take longer time to confirm the clinical suspicion in addition to the sub optimal sampling and fastidious growth requirements of certain organisms. Molecular methods, in contrast, provide highly sensitive tests that have the ability to amplify and detect trace amount of target organism DNA present in the sample. Several studies have shown the high sensitivity of polymerase chain reaction (PCR) based on the culture media.

Cross contamination is an inherent danger and source for false positive results. Recent improvements in amplification technology such as real-time PCR, DNA chips, etc. may help in application of PCR techniques to rapid diagnosis of postoperative infections. The culture positivity was 69 percent (excluding equivocal growth) in the EVS.

**Management**

**Principles**

The triad of management of acute postoperative endophthalmitis are diagnosis, intravitreal drug therapy, (antibiotics and corticosteroid), and vitrectomy. The microbiological diagnosis confirms the clinical suspicion. The intraocular drug therapy consists of both antibiotic and corticosteroid. While the combination of antibiotics is directed against common gram-positive and gram negative microbes, culture and sensitivity are still necessary. They help not only to establish the causative agent, but also to choose the culture adjusted antibiotic and should a repeat injection be necessary in persistent infection. Finally, vitrectomy is often considered necessary to debulk the vitreous cavity so that the ocular media clear faster.

**Antibiotics**

**Intraocular Antibiotics**

The intraocular antibiotics are the mainstay of treatment in infective endophthalmitis. Since one has to inject the antibiotics usually before the microscopy report is available, it is recommended to inject two antibiotics. The current recommendations are ceftazidime (2.25mg in 0.1ml) (for gram-negative organisms) and vancomycin (1mg in 0.1ml) (for gram–positive organisms). The antimicrobial sensitivity profile of amikacin and ceftazidime was 89 percent against gram-negative organisms, and all gram positive cocci were...
sensitive to vancomycin in the EVS study. Amikacin may given in the dose of 400mcgms in 0.1m especially in the setting of suspected severe gram negative infections. For fungal infections intravitreal Amphotericin B (5 mic in 0.1ml) and Voriconazole (50mic in 0.1 ml) are useful.

**Systemic Antibiotics**

Systemic antibiotics were a standard of care in infective endophthalmitis in the past. A limited number of antibiotics only can be used in endophthalmitis since many of them do not actually cross the blood retinal barrier, and even if they do, many do not attain an intravitreal concentration much above the MIC of the infecting organism to be effective. The ones that cross the blood retinal barrier include cefazoline, ceftazidime, and ciprofloxacin. Oral fluoroquinolones (such as ciprofloxacin and gatifloxacin) could be a good choice for infective endophthalmitis because they are easy to administer, and the intravitreal penetration of oral ciprofloxacin/gatifloxacin is above the MIC of several common infective microorganisms. Ciprofloxacin is superior to gatifloxacin in Pseudomonas infection. The important question, however, is should or should not one include systemic antibiotics in the standard therapy for infective endophthalmitis. In a randomized controlled clinical trial the EVS demonstrated that systemic antibiotics (intravenous cefazidime and amikacin) do not benefit the patients further than the intravitreal antibiotics combined with vitreous tap or vitrectomy in management of post cataract/post secondary IOL endophthalmitis. The EVS recommendations could apply to recent cataract and secondary IOL surgery though recent publications justify (or even encourage) use of systemic antibiotics in the management of many varieties of infective endophthalmitis including delayed postoperative infections.

Systemic antibiotics are always recommended for fungal endophthalmitis. Intravenous amphotericin B is fungicidal though it has several systemic toxicity. Hence oral ketoconazole (200 mg twice daily) or itraconazole (100 mg twice daily) are recommended. The treatment is usually continued for 6 weeks. Recently oral voriconazole has shown to be an effective antifungal antibiotic. All patients with systemic antifungal need liver function tests at the initiation of treatment, and at intervals of 2 weeks.

**Technique of Intravitreal Drug Injection**

Intravitreal drugs, antibiotics or corticosteroid, are given after vitreous tap biopsy or vitrectomy. Only in cases of repeat intravitreal injection one may not obtain another vitreous biopsy though it is a good practice to obtain vitreous sample for further microbiological study. It is always more convenient to inject the drugs into an anesthetized eye.

The desired drugs are prepared by the surgeon or under his direct supervision in a tuberculin syringe. Each drug is prepared separately and labelled. While a 24-gauge needle is good for preparation, a 30-gauge needle is good for the final injection. The drug is injected into the mid-vitreous cavity through pars plana (3.5 to 4 mm from limbus) either using the previous sclerotomy (if the injection is following vitrectomy) or a new pars plana site. Each injection is given separately using different syringes and needles. The bevel of the needle should point towards the pupil and the injection is given slowly. It is always a good practice to see the needle tip in the mid-vitreous cavity before injection. Ensure that the intraocular pressure of the eye is not increased after the injection.

**Corticosteroids**

The corticosteroids are anti-inflammatory drugs. They are known to act on the arachidonic acid cycle by acting on the phospholipase A2 pathway. The primay goal of corticosteroid therapy in infective endophthalmitis is to reduce the host inflammatory response to infection and resultant tissue damage. Experimental studies have shown that intravitreal dexamethasone prolongs the half life of intravitreal vancomycin. Intravitreal dexamethasone is usually given in the dose of 0.4mg in 0.1ml. Corticosteroids are not recommended currently in fungal endophthalmitis.

**Vitrectomy**

Vitrectomy debulks the vitreous cavity, reduces the load of bacteria and toxins, and makes space for intravitreal drugs. The decision for vitrectomy is made in the following situations like lack of improvement or actual worsening of the condition clinically after 48 hours of conservative treatment, moderate to advanced stage of infection (absence of red reflect) on initial presentation, suspected fungal infection and chronic endophthalmitis. Despite this advantages vitrectomy is not offered as the sole treatment. It is always combined with intravitreal antibiotics injection. The EVS re-examined the role of vitrectomy in post cataract endophthalmitis and recommended intravitreal antibiotics for eyes presenting with vision of hand movements or better and core vitrectomy and intravitreal antibiotics for eyes with light perception or worse presenting vision. The EVS also noted that while the media clarity was faster with vitrectomy, it did not increase the risk of retinal detachment.

**Vitrectomy Technique**

This can be performed under local anesthesia which may not take up or sustain as good as a non inflamed eye or can be performed under general anesthesia. Preparation of the eye is like any other standard three port vitrectomy. A 6mm infusion cannula is recommended as the choroid is usually thickened in these eyes. One can remove anterior chamber exudates and fibrin over the IOL surface using a bent 30 gauge cannula...
before vitrectomy in pseudophakic eyes. It may be difficult to visualise the infusion cannula due to media haziness. A sample undiluted vitreous is obtained at the beginning of the surgery. Only a core vitrectomy is advised for fear of causing retinal detachment if one contemplates on vigorous vitrectomy. At the conclusion of vitrectomy intracocular drugs are injected into the mid vitreous cavity.

Complications

Complications of endophthalmitis may be due to intravitreal drug administration or due to vitrectomy. Intravitreal antibiotic therapy can cause macular infarction especially reported with amino glycosides. Intravitreal corticosteroids has a very large window of safety. The vitreoretinal related retinal complications include iatrogenic retinal breaks and retinal detachment. Treatment failures lead to hypotony and phthisis.

Outcome and Prophylaxis

The outcome of current treatment of post operative endophthalmitis is encouraging with the judicious use of intravitreal drugs and vitrectomy more than half of the patients obtain 6/12 vision and three quarters obtain 6/36 or better in the EVS patient population. The EVS identified 9 independent risk factors for poor outcome which includes old age, diabetes, presence of corneal infiltrate or ring ulcer, non intact posterior capsule, a low( less than 5mm Hg) or high (more than 25mm Hg) intra ocular pressure, rubeosis iridis an absent red reflex, and presenting visual acuity of light perception only. Careful preoperative evaluation, meticulous preparation of the eye prior to surgery, pre operative conjunctival culture adjusted topical antibiotics etc can be used as prophylactic measures to prevent this devastating complication.

Toxic Anterior Segment Syndrome

Toxic anterior segment syndrome (TASS) is a sterile postoperative inflammatory reaction caused by a non-infectious substance that enters the anterior segment, resulting in toxic damage to intraocular tissues. Since 1980 there have been several reports of a severe form of anterior segment inflammation after cataract surgery that resulted in hypopyon formation and varying degrees of anterior segment damage from toxic substances. This was initially referred to as sterile postoperative endophthalmitis, which is a misnomer since the inflammation primarily involves only the anterior segment of the eye. In 1992, Monson et al accurately termed this condition toxic anterior segment syndrome (TASS). It is noteworthy that some cases of TASS – those with localized corneal endothelial damage – have been termed toxic endothelial cell destruction syndrome (TECDS).

Clinical Findings of TASS

This most commonly occurs acutely following anterior segment surgery of any kind, but it can have a delayed onset. The post operative inflammation is sterile (Gram stain and culture negative) and is due to a non infectious substance that accidently enters the anterior segment, eliciting toxic cellular and extra cellular damage to intra ocular tissues.

Hallmark of TASS starts within 24 hrs of cataract surgery, limited to the anterior segment of the eye, is always Gram stain and culture negative, and improves with steroid treatment. The anterior segment inflammation is typically quite severe, usually resulting in hypopyon formation (Figure 7,B). Another common sign of TASS is diffuse, limbus–to–limbus corneal oedema (Figure 7,A). This latter finding is apparently due to widespread endothelial cell damage. In severe cases of TASS, fibrin formation may also be noted in the anterior chamber and on the surface of the iris and IOL. The syndrome can result in permanent iris damage, which may cause a dilated, irregular pupil that constricts and dilates poorly (Figure 7A), and or trabecular meshwork damage. Although TASS patients frequently have decreased intraocular pressure, permanent trabecular meshwork damage may eventually lead to ocular hypertension or secondary glaucoma.

It is difficult to differentiate TASS from infectious bacterial endophthalmitis. Although there are several helpful differentiating symptoms or signs of TASS it typically occurs within 24 hours compared with 4 to 7 days for infectious bacterial endophthalmitis; it is almost always limited to the anterior segment; it improves with topical and/or oral steroids and commonly presents with diffuse corneal edema - none is specific enough to definitively diagnose TASS or completely rule out an infectious etiology.

Etiology of TASS

Although rare, TASS is a growing problem for intraocular surgeons, especially because it often represents an endemic outbreak of cases at a specific surgical center. The possible causes of TASS are summarised in table 8. Since the causes of TASS are numerous and varied, it can be difficult for the surgeon and faculty at a surgical center to isolate a cause directly.

The histopathologic hallmark of TASS is toxic anterior segment damage – cellular necrosis and/or apoptosis and extracellular damage resulting in a severe acute inflammatory immune response.

Treatment of TASS

Main treatment for TASS based on prevention because once the toxic agent enters the eye and causes damage, the clinician can do little other than suppress the secondary inflammatory immune response. Once an infectious etiology has been
ruled out, the mainstay of treatment for TASS is intense topical corticosteroid drops. The patient should be started on a regimen of prednisolone acetate 1 % drops every 1-2 hours and carefully followed, especially during the first days of topical corticosteroid use, to ensure that the inflammatory condition is not worsening and is stabilizing. Careful slit lamp examination allows the surgeon to document resolution of anterior segment inflammation and corneal edema.

The IOP should also be closely followed. As soon as the cornea clears sufficiently, the patient should have a gonioscopic evaluation to look for peripheral anterior synechias, specular or cofocal microscopy of the corneal endothelium is also helpful at this point to assess the degree of endothelial cell damage.

Clinical Course

The clinical outcome of individual patients with TASS depends on many factors such as the type and amount of substance introduced into the eye, the duration of exposure to the substance, and when treatment occurred in the course of the injury. Patients with relatively mild cases show rapid clearing of the cornea (days to weeks). Patients who have severe TASS generally have permanent damage to the eye such as persistent, corneal edema, significant trabecular meshwork damage that leads to uncontrolled IOP, chronic anterior segment inflammation, cystoid macular edema, iris damage that may lead to permanently fixed and dilated pupil. 189

How to Avoid TASS

As the mainstay of treatment for TASS centers on prevention, it is critically important that the entire surgical team (surgical nurses, operating room technicians, residents, physicians, and pharmacists) knows what is appropriate for use in the eye. This is especially true for anyone involved in cleaning and sterilizing ophthalmic instruments. Those involved in ordering ocular medications to be used in anterior segment surgery or preparing these medications should also be involved. Ensure that everyone involved in cleaning and sterilizing reusable intraocular instruments is thoroughly instructed in the protocols to properly clean and sterilize the instruments (i.e., preventing the possibility of toxic residues from accumulating on the reusable instruments). Reusable instrument use should be kept to a minimum, particularly those that are high risk for contamination (e.g., cannulas or damaged instruments). The reusable instruments that cannot be switched or are chosen not to be switched to disposable types, e.g., I/A tips and phacoemulsification handpieces, should be thoroughly rinsed at the conclusion of each cleaning step with sterile, deionized water. It is especially important to rinse the phacoemulsification hand piece and I/A tips through both inflow and aspiration ports.

Ultrasound water baths should be replaced daily since the dirty bath water often grows gram-negative bacteria such as Klebsiella or Pseudomonas species, which could lead to a buildup of heat-stable LPS endotoxins. The surgical center staff should remain vigilant when ordering any agents—irrigating solutions, OVDs, or other medications—that will be used in the eye during anterior segment surgery. This includes the ordering of complete intraocular medications of any kind.

Care should also be taken to check that the intraocular medications used during anterior segment surgery are preservative free and at the proper intraocular drug concentration.

In addition, the surgical staff should be attuned to the proper concentrations of medications and the proper pH and osmolality of vehicles needed during intraocular surgery.

8. Pseudophakic Cystoid Macular Edema

Cystoid macular edema has been recognized as a common cause of visual loss after cataract surgery for more than 20 years. Clinically significant CME in the past has been defined as patients who are symptomatic, experiencing a decrease in visual acuity (20/40 or worse) along with the clinical finding of the classic petaloid CME. Clinically significant CME in the past has been defined as patients who are symptomatic, experiencing a decrease in visual acuity (20/40 or worse) along with the clinical finding of the classic petaloid CME. The incidence of CME measured by OCT is as high as 41%. Clinically significant CME in the past has been defined as patients who are symptomatic, experiencing a decrease in visual acuity (20/40 or worse) along with the clinical finding of the classic petaloid CME.
CME necessitates treatment, or in fewer cases, it may be refractory to treatment. Although the pathogenesis of this entity is not completely understood; various etiologic factors have been suggested each of which serves as a target for a particular therapy. Proposed factors in the pathogenesis of pseudophakic CME include, but are not limited to, inflammation with the release of mediators, such as prostaglandins and leukotrienes, vascular instability, vitreomacular traction, ocular hypotony, and ultraviolet light damage.

The presence or absence of CME can be described in 3 ways: clinical examination showing cystic spaces at fovea (Fig 9a), angiographic examination showing the classic petalloid pattern (Fig 9b), and detected by OCT as increased thickness and volume of the fovea, often with cysts (Fig 9c), either 1) with symptoms and/or visual loss or 2) without symptoms or visual loss.

Treatment:

Non Steroidal Anti Inflammatory Drugs

Inflammation contributing to the PCME may be associated with the release of several mediators including prostaglandins, leukotrienes, histamine, acetylcholine, small peptides, bradykinin, and serotonin. In the recent years, prostaglandins, in particular, have received great attention as mediators of ocular inflammation. Aspirin and various NSAIDs (indomethacin, etc) inhibit prostaglandin synthesis by inhibiting the enzyme COX further along in the pathway, unlike corticosteroid which inhibits prostaglandin synthesis by inhibiting the enzyme phospholipase A2. Topical NSAIDs speed the recovery of the blood–aqueous barrier after cataract surgery and hence reduce inflammation after cataract surgery. The common NSAIDs available in the market approved by FDA are diclofenac, ketorolac, nepafenac, and bromfenac. A meta-analysis suggested that topical NSAIDs are effective in the prophylaxis and treatment of pseudophakic cystoid macular edema. However, whether these agents have a definite, long term, positive impact on vision remains to be seen.

The concentration of an NSAID in the aqueous humor is higher after topical administration than after systemic administration. In the 1970s, systemic indomethacin was introduced as a potential therapeutic modality for pseudophakic cystoid macular edema; however, it was not found to be effective.

Theoretically, NSAIDs may have a greater effect on retinal disease processes with an inflammatory component in comparison with corticosteroids, which do not inhibit COX. Many studies have reported that topical NSAIDs are effective in the prophylaxis of pseudophakic cystoid macular edema. Improvement in visual acuity in the treatment of patients with chronic aphakic or pseudophakic CME has been demonstrated in a multicenter clinical trial using topical 0.5% ketorolac.

However, no study has documented a long-term (more than 1 year) benefit of this prophylactic treatment. In 1998, a meta-analysis concluded that it is beneficial to treat PCME prophylactically; however, the long-term benefit of prophylactic treatment is unknown.

Cystoid macular edema after cataract surgery can be short-term (present for 6 months) or long-term (present for more than 6 months). Several studies suggested that topical NSAIDs may be beneficial in the treatment of PCME. Topical ketorolac and diclofenac were found to be equally effective for the treatment of chronic PCME; however, the study was limited by small study size and lack of controls. Again, the value of topical NSAIDs relative to corticosteroids is not clear and the benefit beyond 1 year remains unproven.

Side effects of topical NSAIDs

Burning, stinging, and conjunctival hyperaemia are allergic and hypersensitivity reactions. Severe toxic effects on the cornea such as corneal melts have been reported. Corneal haze and delayed wound healing have also been reported. Severe toxic effects on the cornea such as corneal melts have been reported with some preparations of diclofenac, ketorolac, nepafenac, and bromfenac. Newer topical NSAIDs such as bromfenac and nepafenac claim enhanced penetration to the posterior segment. However, the research reaching this conclusion was undertaken largely in animals. There is no concrete evidence in the form of large randomised trials that these more expensive agents have superiority compared with ketorolac.

Corticosteroids

Corticosteroids can be administered by several routes, including intravenous, oral, periocular, intravitreal, and topical, in efforts to reduce the level of intraocular prostaglandins and other mediators that are thought to contribute to pseudophakic cystoid macular edema. Abe et al. showed that high-dose intravenous methylprednisolone might be effective in treating pseudophakic cystoid macular edema. CME resolved in three of four eyes, and visual acuity improved. It is unclear if this effect is temporary. Topical corticosteroids are commonly used in the prophylaxis and treatment of pseudophakic cystoid macular edema. Topical corticosteroids are often used concomitantly with topical NSAIDs, making it difficult to ascertain the steroid effect. It does appear that combination therapy with both topical corticosteroids and NSAIDs is more effective.
than using either agent alone. Long-term, randomized, controlled trials are needed for this modality. Periocular injections (sub-Tenon, subconjunctival) of corticosteroids may be advantageous over other routes of administration given their lower systemic side effects and sustained drug release. Common uses include prophylaxis (often perioperative) and postoperative treatment of pseudophakic cystoid macular edema. Intravitreal injections of triamcinolone acetonide are a promising tool for refractory pseudophakic cystoid macular edema, although there are no prospective randomized studies to date. Conway et al followed 8 treated eyes of 8 patients with refractory pseudophakic cystoid macular edema over a mean follow-up period of 20 months and found that all patients experienced improvement in pseudophakic cystoid macular edema both angiographically and clinically. Further study of the long-term efficacy and safety is needed for this modality.

Ophthalmic implant.

Permanent or biodegradable devices for steroid delivery to the vitreous are available (i.e., Retisert, Bausch & Lomb Pharmaceuticals, Tampa, FL; Ozurdex and Posurdex, Allergan, Inc., Irvine, CA). These implants may show promise in the prophylaxis and treatment of pseudophakic cystoid macular edema in the future. However, the utility of these ophthalmic implants so far is anecdotal or case series without appropriate control. For example, one study by Williams et al suggested that dexamethasone intravitreal implant Posurdex may be beneficial for a subset of the study patients with pseudophakic cystoid macular edema, although the subject number was small. Another implant, IIBI-20089, which uses the drug delivery system, Verisome, designed by Icon Bioscience to deliver triamcinolone acetonide for up to 1 year with one intravitreal injection has recently completed Phase I clinical trials involving subjects with chronic cystoid macular edema.

For comparing different routes of corticosteroid delivery (sub-Tenon vs. topical) Negi et al conducted a prospective, randomized, controlled trial including 54 eyes which concluded that sub-Tenon injection was as safe and effective as the alternate route of topical steroid delivery; however, the number of patients who had clinical CME was too small to draw meaningful conclusions. Complications of steroid use include 1) secondary ocular hypertension, 2) medically uncontrollable high intraocular pressure leading to glaucoma surgery, 3) postoperative infectious endophthalmitis (1:1,000), 4) non infectious endophthalmitis, 5) pseudo endophthalmitis (precipitated steroid crystals in anterior chamber) and 6) wound healing problems, recurrences are too common when corticosteroids wear off. The long-term benefit of corticosteroids is thus uncertain.

Carbonic Anhydrase Inhibitors

Carbonic anhydrase inhibitors, such as acetazolamide, affect the pumping of fluid from the subretinal space across the retinal pigment epithelial cells. No randomized, controlled, clinical trial demonstrating a sustained positive effect of carbonic anhydrase inhibitors on the prophylaxis and treatment of PCME exists to date.

Vascular Endothelial Growth Factor Inhibitor

The release of VEGF has been associated with angiogenesis both in vitro and in vivo. In addition, it has been implicated in the development of inflammatory macular edema because it disrupts the blood–retinal barrier and increases vascular permeability. In 2006, Mason et al introduced intravitreal bevacizumab as a promising treatment for refractory pseudophakic cystoid macular edema. A more recent interventional, retrospective, multicenter study concluded that intravitreal bevacizumab (Avastin) is well-tolerated and effective treatment for patients with refractory pseudophakic cystoid macular edema. No ocular or systemic ill effects were noted in the study. Studies to date have had small patient numbers and lack a long-term follow-up.

Surgical Therapy

Laser and vitrectomy surgical procedures for the treatment of PCME attempt to restore normal retinal vascular stability by lysing vitreous strands adherent to the cataract wound, intraocular lens, iris, or other anterior chamber structures and releasing vitreomacular traction.

There are several nonrandomized uncontrolled studies that suggested that some patients with vitreous adherence may benefit from Nd: YAG laser vitreolysis. Risks with this treatment include elevation in intraocular pressure and retinal tear/detachment. Nonetheless, laser vitreolysis may hold promise for certain patients with chronic pseudophakic cystoid macular edema. A 5-year prospective, randomized, controlled, multicenter (15 medical centers) study by Fung suggested that patients with chronic pseudophakic cystoid macular edema because of vitreous adherence to the wound and pupil distortion (without an intraocular lens implant) who underwent pars plana vitrectomy improved compared with the control group. A recent retrospective study analyzed 23 eyes with chronic pseudophakic cystoid macular edema refractory to medical therapy, Nd:YAG vitreolysis, or both with less severity than previously studied by Fung. Patient with vitreous incarcerations into the wound or vitreo corneal touch were excluded from the study. Notably, all eyes had resolution of pseudophakic cystoid macular edema by biomicroscopy after vitrectomy. The postoperative visual acuity improved by a mean of 3.3 Snellen lines, suggesting that pseudophakic...
cystoid macular edema can occur in eyes with no clinical vitreous disturbance. Removal of the intraocular lens from inflamed postoperative eyes with reimplantation at a later date may improve pseudophakic cystoid macular edema in refractory cases.

**Recommendations:**

Pseudophakic CME affecting the patient’s vision at the 2-month to 3-month postoperative period should be treated. The role of intravitreal anti-VEGF drugs for the treatment of PCME remains unproven. At this time, the strategy for the treatment of pseudophakic cystoid macular edema initially includes a combination of topical NSAID and topical corticosteroid. If no improvement in vision or resolution of edema is noted after 4 to 6 weeks, then posterior subtenons or intravitreal corticosteroid should be considered and in refractory cases vitrectomy should be considered.

**9. Progression of Diabetic Retinopathy After Cataract Surgery**

Diabetic patients have an increased risk of developing cataract. This risk is related to age, severity of retinopathy, duration of the disease and, possibly, systemic hypertension. Cataract surgery in diabetic patients, forms a significant part of every eye department’s workload. It is obviously important that such patients are managed appropriately to minimise visual loss from progression of diabetic retinopathy.

In diabetics with little or no retinopathy, has the same good prognosis as cataract surgery in non-diabetics. However, in the presence of significant diabetic retinopathy the results can be disappointing.

Severe visual loss following cataract surgery in diabetics may be due to worsening macular oedema, continuing anterior and posterior segment proliferation, posterior capsule opacification, or unrelated events, such as retinal vein occlusion and ischemic optic neuropathy. Risk factors associated with worsening retinopathy after cataract surgery include pre-existing severe treated or untreated retinopathy, poor glycaemic control, increasing age, and planned or unplanned posterior capsule disruption. Non-proliferative diabetic retinopathy can rapidly progress to severe diffuse macular oedema in the months following uncomplicated cataract extraction. Jaffe and Burton and later Schatz et al emphasised that the retinopathy progressed rapidly in the operated eye compared with the fellow, control phakic eye. Pollack et al as well as Cunliffe et al showed that macular oedema and neovascularisation can worsen after cataract extraction even with photocoagulation. Pollack et al also demonstrated that 81% of eyes with pre-existing background retinopathy developed clinical cystoid macular oedema after uncomplicated cataract surgery compared with only 32% of eyes without background retinopathy. This suggests that the blood-retinal barrier is significantly impaired, even in diabetics with no retinopathy and that cataract surgery worsens this impairment.

Preoperative and early postoperative photocoagulation for macular oedema appears to reduce but not to eliminate the risk of visual loss. For this reason, careful preoperative assessment and regular follow up, if necessary using fluorescein angiography, are essential. Fluorescein angiography is particularly required to differentiate between pseudophakic cystoid macular oedema and worsening diabetic macular oedema which may require photocoagulation.

Neovascular glaucoma and rapidly progressive proliferative diabetic retinopathy can occur after extracapsular cataract surgery in treated and untreated proliferative diabetic retinopathy. Pollack et al described the rapid development of severe retinal ischaemia confirmed by fluorescein angiography in the 3 months following uncomplicated extracapsular cataract surgery. The visual results of extracapsular cataract surgery in treated proliferative diabetic retinopathy with maculopathy are frequently poor. However, good results have been reported in well treated proliferative diabetic retinopathy without maculopathy.

Adequate panretinal laser photocoagulation is therefore essential if there is severe peripheral retinal ischaemia or early retinal neovascularisation. This photocoagulation should be applied preoperatively. If this is not possible it can be done peroperatively using the laser indirect ophthalmoscope in the early postoperative period.

Age can be a useful predictor of outcome following cataract surgery in diabetics. Benson et al reported that 58% of patients under 63 achieved 6/12 or better but only 38% of their patients over 64 years of age achieved this level. Posterior capsular opacification is significantly more common in diabetics with retinopathy than in nondiabetics. Ionides et al stressed the importance of early capsulotomy to ensure an adequate retinal view.

Most previous reports have stressed that retinopathy may progress rapidly in the pseudophakic eye compared with the control fellow phakic eye. Heinricsson et al found that any progression of retinopathy appeared to be related to higher levels of haemoglobin A1c pre and post operatively and not to cataract surgery.

Role of intravitreal bevacizumab, an anti-vascular endothelial growth factor agent, injected at the time of cataract surgery on the postoperative progression of diabetic retinopathy (DR) and diabetic maculopathy was evaluated by Rizwan et al in their randomized control study and they concluded that it was safe and effective in preventing progression of diabetic
retinopathy and maculopathy in patients undergoing cataract surgery

**Recommendations**

Significant diabetic ocular pathology should be treated before cataract surgery is considered. This involves a multifaceted approach with laser panretinal photocoagulation as the primary treatment for proliferative retinopathy and focal macular laser for clinically significant macular edema. Additional treatment often involves intravitreal injection of vascular endothelial growth factor (VEGF) inhibiting medications or steroids at the time of cataract surgery especially in patients in whom adequate photocoagulation cannot be performed preoperatively or patients who are poor responders to conventional laser photocoagulation. The patient should be explained about chances of worsening of retinopathy following cataract surgery and also should be counselled to achieve tight control of systemic blood glucose, and this should be demonstrated in the patient’s hemoglobin A1c level prior to cataract surgery.

**Conclusion**

Cataract surgery is a procedure with a high patient satisfaction rate. However retinal complications do occur in some cases. Awareness of special risk factors, avoiding and recognizing complications early and managing them well can make this surgery one of the most effective procedures in medicine even safer.
Figure 3. IOL is freed from all its attachments so that it is freely mobile; 3a, b intraocular forceps being used to grasp the IOL and is brought to the anterior chamber. 3c IOL being removed from anterior chamber through a sclero corneal incision.

Figure 4. Ultrasound B scan with A scan showing choroidal detachment.

Figure 5a. Pseudophakic eye with ill-fitting anterior chamber IOL and vitreous wick. b. Pseudophakic retinal detachment involving the macula.

Figure 6a. Exudates in the pupillary area. Figure 6b. Intraoperative snap shot showing exudates plastered on to the surface of the retina in a case of bacterial post operative endophthalmitis.

Figure 7a.
Figure 7 Photographs showing some characteristic clinical findings of TASS. a: Diffuse limbus to limbus corneal edema and dilated and slightly irregular pupil, b: Hypopyon formation.

Table 8 Known causes of TASS

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<th>Intracocular lenses</th>
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<td>Polishing compounds</td>
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<td>Cleaning and sterilizing compounds</td>
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