Complications of Anterior Segment Surgery

15

Contents

15.1 Introduction

Cataract surgery in the modern setting means phacoemulsification with a small incision and a sutureless wound. This is a rapid procedure with a high rate of success, approximately 95 %. There still remains a small complication rate of approximately 4 %.

Some of these are serious complications and will often involve the vitreoretinal surgeon in remedying the situation.

15.2 Dropped Nucleus

15.2.1 Clinical Features

Dropped nucleus incidence 0.09–0.8 % (Aasuri et al. 2001; Kageyama et al. 2001; Mathai and Thomas 1999; Stilma et al. 1997)

The phrase ‘dropped nucleus’ has been used to describe dislocation of the nucleus (or part of the nucleus) of a cataract during phacoemulsification into the vitreous cavity. Dropped nucleus may happen to any case with an increased risk of capsular rupture or zonular dehiscence such as trauma, pseudoexfoliation or hard nuclei or because of the inexperience of the surgeon (Aasuri et al. 2001). The positive pressure applied by the infusion fluid during phacoemulsification means that a tear in the posterior capsule of the lens will result in the dislocation the contents of the anterior chamber (most often the lens) into the vitreous cavity. The higher density of the lens compared to the vitreous also encourages its dislocation into the posterior segment. The nucleus can be seen in the inferior vitreous accompanied by fluffy white soft cortical lens material.

- Uveitis. The lens material stimulates uveitis which in the short term can be controlled, if the nucleus remains in the posterior segment for months a chronic uveitis is stimulated, which may persist after surgery.

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- Glaucoma, a severe rise in intraocular pressure can usually be controlled by topical medication in the short term till removal of the nucleus is performed. However, if the nucleus remains in the eye for a prolonged period, the glaucoma may not reverse after lens removal.
- Retinal detachment. The disruption to the vitreous may produce retinal detachment by tearing the retina, 4–8 % of patients (Ross 1996; Oruc and Kaplan 2001). There is an increased risk of RRD approximately 4 % before PPV and 4 % after PPV with retinal tears also requiring treatment during PPV in a few patients (Hansson and Larsson 2002). RRD is reported earlier in these patients (mean 4 months) than after routine cataract extraction (mean 16 months) (Haddad et al. 2002).

The patient is understandably disappointed having expected a straightforward operation and improved vision. Instead, they often have reduced vision and discomfort from uveitis (56 %), raised IOP (52 %) and corneal oedema (46 %) (Gilliland et al. 1992). Pars plana vitrectomy and removal of the nucleus are required within 1 or 2 weeks to avoid glaucomatous damage or chronic uveitis or cystoid macular oedema (Rossetti and Doro 2002). Most patients if treated promptly will achieve good vision. However, occasionally, an eye will end up blind from associated choroidal haemorrhage or retinal detachment. Rarely dropped nucleus can present with endophthalmitis (Irvine et al. 1992). Also, the risk of endophthalmitis seems to be doubled over other surgery (Kim et al. 1996).

Note: Rapid referral for vitrectomy is required.

15.2.2 Surgery

Additional surgical steps (see Table 11.1; Figs. 11.1 and 11.2)

1. Sew up the cataract wound.
2. Clear the anterior segment and capsule of soft lens material.
3. Use the vitreous cutter to remove the soft lens material in the vitreous cavity.
4. Use the Fragmatome to remove the nucleus.
5. Detach the posterior hyaloid if required.
6. Insert an intraocular lens implant.

'Fishing' for the nucleus via the anterior segment by the phacoemulsification surgeon is not advisable as this can cause giant retinal tears from traction on the vitreous even after anterior vitrectomy (Aaberg et al. 1997). The timing of surgery by PPV has created controversy in the past (Hansson and Larsson 2002; Al-Khaier et al. 2001; Bessant et al. 1998; Borne et al. 1996; Hutton et al. 1978; Kim et al. 1994; Margherio et al. 1997; Stefaniotou et al. 2003), but it is now recommended that a patient who has suffered a dropped

Table 15.1 Difficulty rating for PPV for dropped nucleus

Difficulty rating	Moderate
Success rates	Moderate
Complication rates	Low
When to use in training	Middle

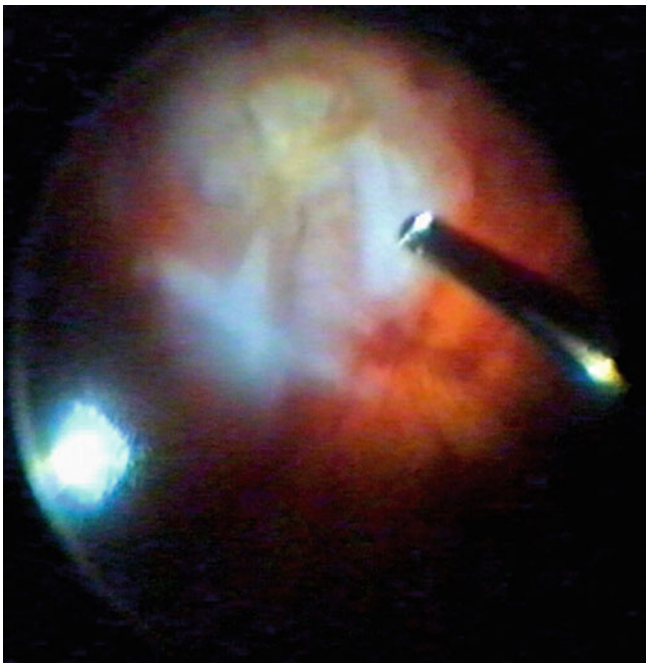

Fig. 15.1 Soft lens material can be removed easily by the vitreous cutter as can moderate amounts of lens nucleus

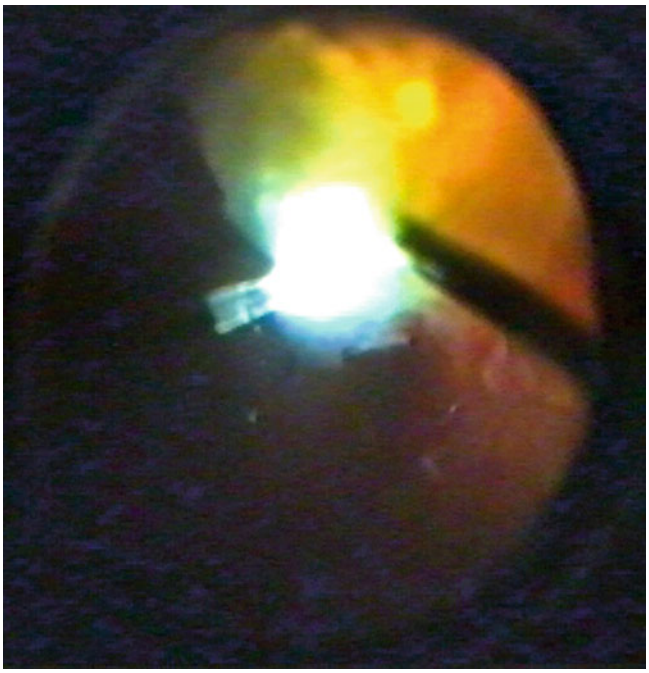

Fig. 15.2 The hard nuclear material is removed with a Fragmatome whilst supporting the lens with the light pipe. Whiter and fluffier softer lens material can be removed with the cutter

nucleus during phacoemulsification cataract extraction be operated on within 2 weeks from onset of the complication. This minimises the risk of secondary complications such as intractable glaucoma and cystoid macula oedema from the uveitis (Rossetti and Doro 2002; Yeo et al. 1999). Patients presenting with these complications in the short term usually have these reversed after PPV (Vilar et al. 1997).

15.2.2.1 Primary Management

If the surgeon who has dropped nucleus has the capability to perform a vitrectomy and removal of the fragments, then this can be performed immediately. However, unless this facility is available, it is best to close the eye, tidy up the vitreous, leave lens implantation until the next surgery and ensure closure of the cataract wound. By delaying the surgery for 1 or 2 weeks, it allows the use of elective surgical time and provides time to discuss the problem with the patient and allow them a chance to gather their thoughts before proceeding to another operation. Uveitis during this period readily responds to topical steroid therapy and raised IOP responds to topical therapy with temporary use of acetazolamide orally if required.

15.2.2.2 Vitrectomy Surgery

At PPV surgery, the first thing to do is to secure the anterior chamber. Most wounds are now so small that they can usually be left without a suture but check the wound and rehydrate if necessary; the wound has not usually sealed by the time of the PPV. If the wound remains unstable, use a 10/0 absorbable suture to close the wound, any pressure on the posterior edge of the wound will open it during the vitrectomy. Create sclerotomies as usual, and excise any vitreous from the anterior chamber by passing through the posterior capsule into the AC (do not use old wounds if you want to go from the front, and create a new paracentesis for the cutter to enter). Remove any soft lens material from within the capsule using the cutter on aspirate only, in the same fashion for a normal SLM aspiration during cataract extraction but by accessing from the posterior segment the via the posterior capsular break. Preserve as much capsule, anterior and posterior, as is possible, as it is the intention to put in a posterior chamber lens implant at the end of the vitrectomy, and this capability will depend on the amount of supporting capsule. Then perform a PPV, taking note whether the vitreous has detached or not. Gain access to the nucleus, remove any SLM from around the nucleus and then assess the size of the nucleus to be removed.

If there is less than a quarter of the nucleus in the posterior segment, a chop and cut procedure will be adequate, whereby the nucleus is delaminated against the cutter, and small fragments of nucleus are chopped by the cutter. If there is more than a quarter of the nucleus in the back of the eye, then a Fragmatome is required to phacoemulsify the nucleus to speed its extraction. In this case, it is prudent to apply a small protective bubble of heavy liquid to the posterior pole, as it is likely that the nucleus will occasionally fall from the Fragmatome tip and may strike the macula or the optic disc (Wallace et al. 1993). Set the power of the Fragmatome to low, perhaps 20 % of normal, and use a pulse mode of 8 pulses/s. This makes it easier to hold onto the lens nucleus during phacoemulsification. The nucleus has a tendency to shoot away from the Fragmatome tip when using the ultrasound on continuous. It should be possible to manipulate the nucleus in a cartwheel fashion; using the light pipe and Fragmatome, remove as much of the nucleus as possible in one sweep.

Use the on-demand system for the Fragmatome to avoid ultrasound near the retina causing any damage to the retinal surface:

- For linear aspiration, use foot pedal on direct depression.
- When the nucleus has been engaged by aspiration only, lift the nucleus away from the retina into the mid-vitreous.
- Once safely away from the retina, kick the foot pedal to the side to engage ultrasound on maximum to commence the phacoemulsification (Fragmatome).
- If the nucleus disengages and drops, cease aspiration (lift your foot) and start again.

Note: The aspiration is high even at 150 mmHg (the bore of the Fragmatome port is larger than a cutter) for a fluid filled eye; therefore, rapid cessation of aspiration is required to prevent globe collapse, even if the infusion bottle height has been increased.

Eventually, the nucleus can be completely removed. If there is no posterior vitreous detachment, detach the posterior vitreous at this stage, difficult before as the nucleus is resting on the vitreous cortex. Perform an internal search to detect retinal tears or retinal detachment, and treat these as they arise, do not put gas in yet because insertion of intraocular gas may be problematic depending on the stability of the IOL.

Thereafter, perform secondary lens implantation, leaving the infusion on, and make a corneal wound with the keratome. Switch off the infusion and fill the anterior chamber with viscoelastic which acts as a plug, preventing the egress of fluid through the corneal wound. Assess the state of the capsule. If there is plenty of capsule available (i.e. enough to encapsulate securely the IOL), insert the lens implant into the bag. If not, place the lens implant into the ciliary sulcus (requiring at least two-thirds of the capsule remaining) and suture up the wound with 10/0 absorbable suture. If there is less than two-thirds of the capsule, insert an anterior chamber lens implant. A few surgeons recommend sulcus sutured lenses, but these have a high chance of dislocation in 6 years, approximately 25 % (Vote et al. 2006).

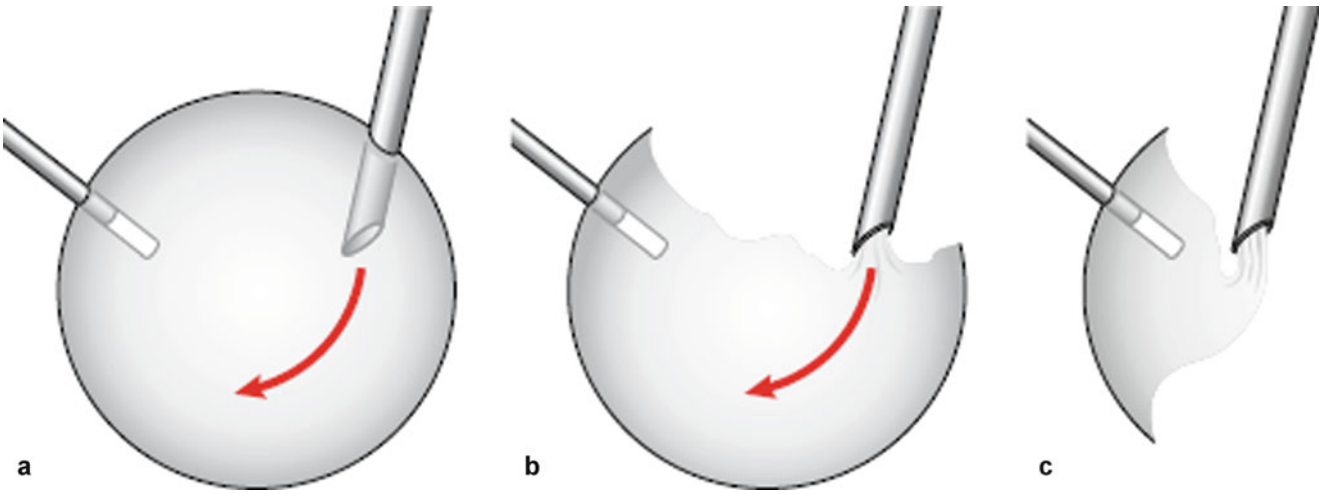

Fig. 15.3 Spike the lens or nucleus with the light pipe and, in a rotating manner, use the Fragmatome to emulsify and aspirate the nuclear fragments. Try to work towards the light pipe without dislodging the light pipe so that there is minimal need for re-engaging the nucleus, thereby reducing manipulation and time spent near the retina

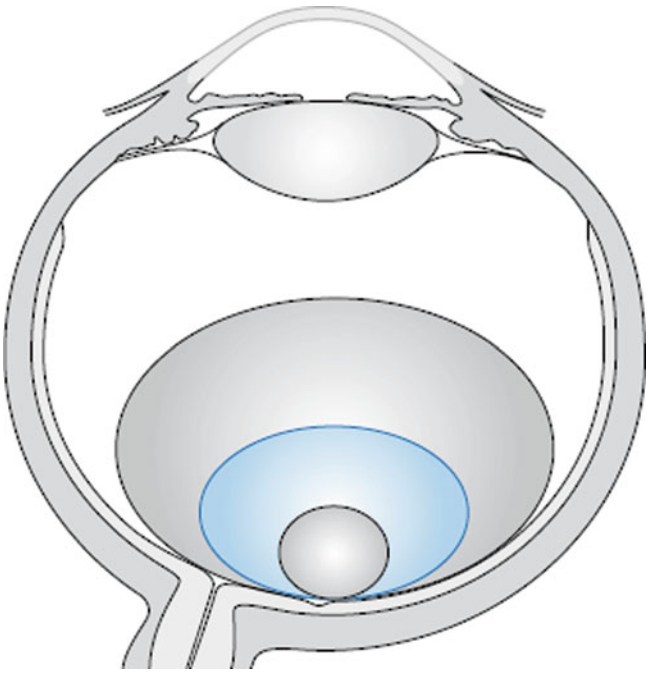

Fig. 15.4 Heavy liquids can be placed onto the posterior pole of the eye during removal of dropped nucleus. A small bubble shown in red has a very convex surface upon which the fragments will slip back down onto the retina. Increasing the size of the bubble flattens the surface of the heavy liquids, facilitating the maintenance of fragments in the mid-vitreous cavity. However, if the bubble becomes too large, then there is reduced space for working between the bubble and the anterior segment. An ideal size is indicated by the blue circle

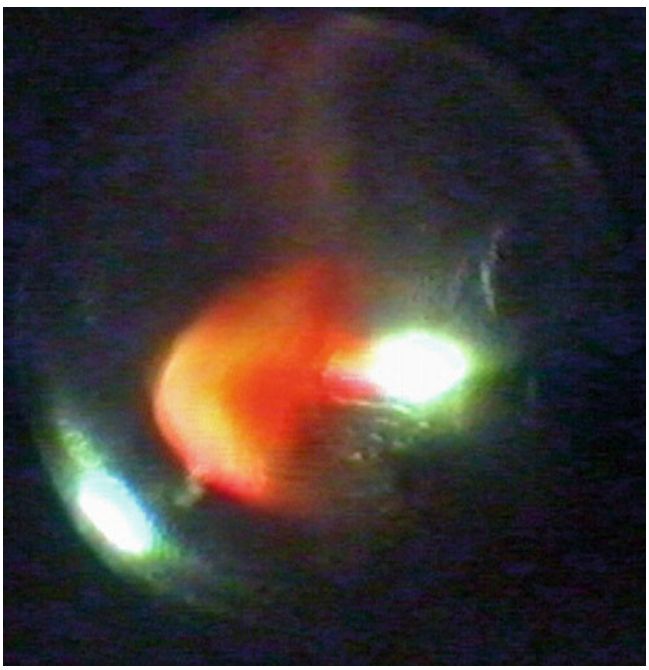

Fig. 15.5 This nucleus is blood stained because the eye has also suffered a choroidal haemorrhage

15.2.2.3 Difficult Situations

Concurrent retinal detachment and dropped nucleus: a mobile retina may cause problems whilst trying to perform Fragmatome extraction. In this case, heavy liquid will need to be inserted to stabilise the retina before removing the nucleus. Insert the IOL before the air exchange (with the posterior segment filled with heavy liquid) using viscoelastic in the anterior chamber as above. Remove the viscoelastic (it is difficult to do this after the air has been inserted), and then perform an air/heavy liquid exchange; you may need to wipe the posterior lens surface to avoid condensation (see Chap. 3). Treat any retinal breaks causing the retinal detachment either with the heavy liquid fill or under air.

Alternatively, if it is known that a retinal detachment is present, put the lens implant in early on, after clearing of the anterior chamber of SLM and vitreous.

Air may get into the anterior chamber in the presence of a large posterior capsule rent or zonule dehiscence and particularly if an anterior chamber lens implant is present; therefore, it is important to have most of your surgical manoeuvres completed before air insertion. If air enters the anterior chamber with further surgery still to be performed, fill the anterior chamber with viscoelastic to regain the view. However, when removing the viscoelastic, air will usually re-enter the anterior chamber. Although air in the anterior chamber is undesirable because of potential effects on the corneal endothelium, it is often necessary to leave this in and allow it to disperse postoperatively because you are unlikely to be able to refill the anterior chamber with fluid as this will fall into the air-filled posterior segment.

Note: If there is an unstable IOL in the presence of intraocular gas, it is often better to have the IOL sandwiched by gas, that is, gas in the anterior and posterior segments. If gas is in the posterior segment only, it tends to push the unstable IOL forwards and may cause capture of the pupil by the IOL edge.

If there is no support for the IOL and you anticipate needing an ACIOL or sutured or iris-clip IOL, do this at a second operation once the gas bubble has dispersed. These lenses could be problematic in the presence of gas with the possibility of:

- Dislocation
- Corneal touch
- Displacement from visual axis

Very occasionally, the dropped nucleus is associated with a choroidal haemorrhage. In this circumstance, remove the nucleus and fill the eye with silicone oil, without lens implantation. Wait for resolution of the choroidal haemorrhage at a later date, and then determine whether implantation is possible. However, the prognosis for vision in an eye like this is often poor, and it may be that vision will be limited and lens implantation is not appropriate.

15.2.2.4 Success Rates

Visual outcome is approximately a 60 % chance of 20/40 vision or better, that is, at least 20 % less than after routine cataract extraction (Hansson and Larsson 2002; Kim et al. 1994; Smiddy et al. 2003).

Surgical Pearl of Wisdom

'When you are performing combined vitrectomy and phako procedures, try to make the anterior rhexis a little smaller than usual so that the optic is entirely within the bag. This will prevent lens pupil capture and posterior synechiae forming in gas filled freshly pseudophakic eyes.

If some of the optic edge is not covered by anterior capsule, then all is not lost. Create a 4–5-mm posterior capsulotomy using the cutter and prolapse the lens optic through into the posterior segment; this seems to provide enough support to prevent anterior segment complications'.

D. Alistair H. Laidlaw, St Thomas' Hospital, London, UK

15.3 Intraocular Lens Dislocations

15.3.1 Clinical Presentation

Prosthetic intraocular lens implants can also dislocate into the posterior segment, especially silicone plate IOLs after YAG capsulotomy (typically at 2 months after the laser procedure) (Agustin and Miller 2000; Schneiderman and Vine 1995). In some patients with weak zonular fibres (myopes, trauma, exfoliation), the whole lens and capsule may dislocate. This may occur after minor trauma to the eye.

15.3.2 Surgery

Usually, there is not enough capsular support to allow the implant to be inserted into the sulcus, and the IOL must either be removed or sutured into place.

15.3.2.1 Removal of the IOL

- Insert a chandelier illumination.
- Perform the vitrectomy (it may or may not be detached) and make sure the vitreous is cleared away from the IOL. It is possible to elevate the IOL off the retina with the negative pressure of the orifice of the end of a flute needle and placed perpendicular to the surface of the optic. The IOL can then be lifted into the vitreous cavity and

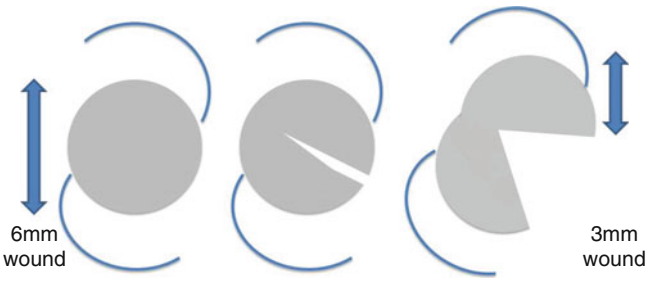

Fig. 15.6 To remove a flexible IOL from the AC through a small wound, first cut 75 % of the way across the optic; the IOL can then be removed through a smaller wound in one piece by pulling one-half through the wound and the other attached half follows behind

transferred to a forceps. If the flute will not hold the IOL, use forceps to grasp the edge of the optic or one of the haptics. Always keep a watch on the haptics making sure they do not scrape the retina or pull on vitreous.

- Dislocate the IOL into the anterior chamber but always be careful with the position of the IOL especially the haptics when under the iris and therefore unseen. There is the potential to engage the haptic into the vitreous base causing traction and retinal tears.
- Once in the anterior chamber, if the optic is of a soft material, it is worth cutting 75 % of the way through the optic (lens cutting scissors are available) so that it can be removed through a smaller wound in the corneal periphery. Note: It is not necessary to cut the optic in two and risk posterior dislocation of one-half, with a cut through the optic the IOL can distort and therefore exit through a 3-mm wound.
- An alternative method is to fold the IOL in the AC. Make a paracentesis at 6 o'clock and insert a dialler needle under the optic centrally. Through the superior 3-mm wound, insert lens folding forceps and push these down onto the optic whilst the dialler needle remains stationery this folds the IOL over the needle. Remove the needle and then remove the folded IOL through the wound.

15.4 Surgical Options for the Aphakic Eye

15.4.1 McCannell Sutured IOL

There are a number of variations for this method. The key is to insert (or relocate) a PC IOL (e.g. three-piece foldable) with the optic in front of the pupil and the haptics behind. This holds the IOL in the pupillary plane and tents the iris over the haptics so that they can be seen. A long needle 10/0 non-absorbable suture is inserted through the peripheral cornea and is then passed through the mid-iris under the haptic and through the iris again and out through the peripheral cornea opposite. The suture is retrieved by inserting a hook through a paracentesis adjacent to the haptic and using the hook to

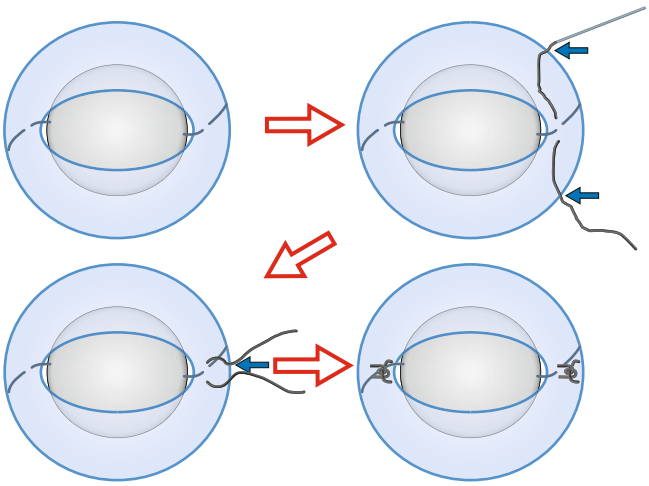

Fig. 15.7 For a McCannell suture (*1*) dislocate the optic through the pupil leaving the haptics posteriorly, (*2*) insert a suture using a long needle through the limbus (*solid arrow*) through the iris under the haptic and out through the limbus again (*solid arrow*) and cut off the needle, (*3*) create a paracentesis (*solid arrow*) and hook and draw out the loops of suture then tie over the haptic, and (*4*) repeat on other side and then push the optic through the pupil

retrieve the suture both near and distal to the haptic. The suture is now available to tie over the iris. Once done on both haptics, the optic can be reinserted into the posterior chamber.

Note: If repositioning a lens with capsule, the optic would need to be freed up from the capsule to allow anterior displacement through the pupil.

Problems:

- Iritis
- Secondary cystoid macular oedema
- Suture lysis and dislocation
- Haemorrhage from the iris
- Pigment dispersion

15.4.2 Iris-Clip IOL

Iris-clip IOLs are available which can be inserted into the pupillary aperture. These have flanges into which the iris can be inserted to stabilise the IOL postoperatively. Possible complications:

- Iritis
- Secondary cystoid macular oedema
- Dislocation
- Haemorrhage from the iris
- Pigment dispersion

15.4.3 Haptic Capture Method

Use a standard three-piece posterior chamber IOL:

- Insert a 23-G infusion line.
- Open the conjunctiva and create two scleral flaps (as for a trabeculectomy) at 180° to each other obliquely.

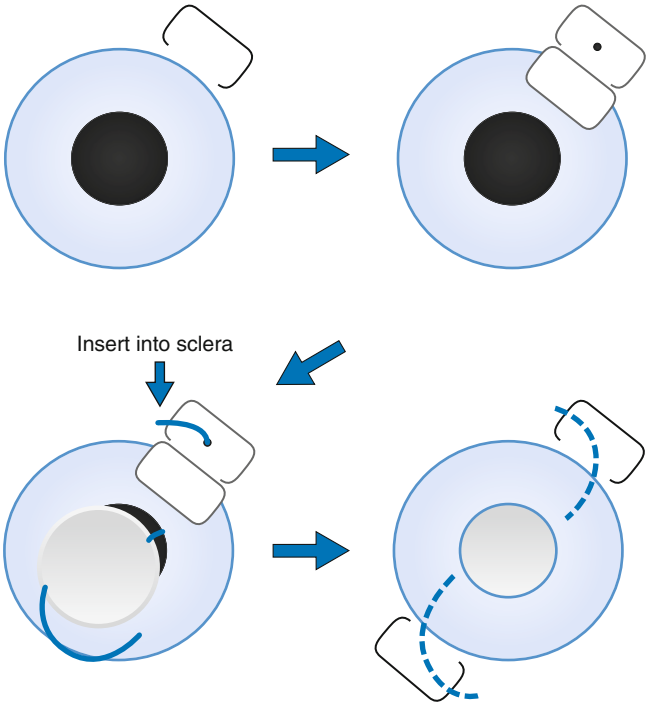

Fig. 15.8 The haptic capture technique can be used to place a standard three-piece foldable lens behind the iris in an aphakic eye. Create a scleral flap, then a sclerotomy in the bed of the flap, pull the end of the haptic through the sclerotomy and insert the end into the sclera at the edge of the flap incision, sew down the flap and repeat on the other side

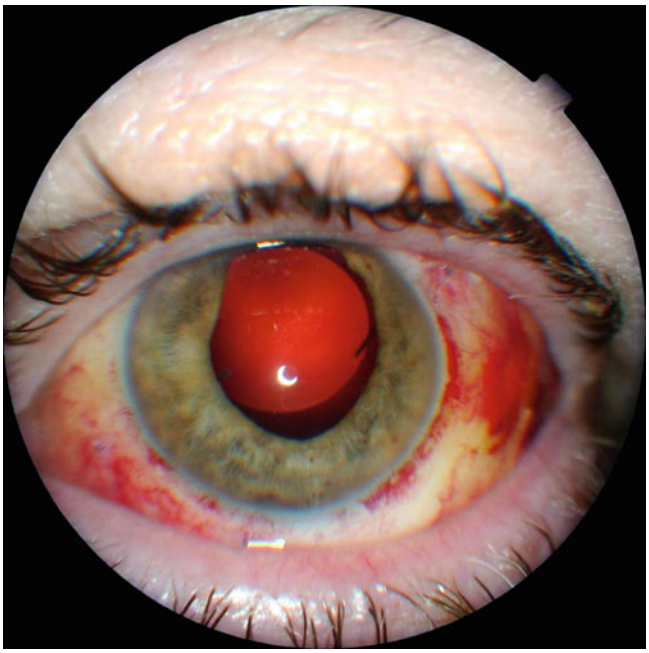

Fig. 15.9 An eye with a haptic capture IOL in situ 1 week after surgery

- A sclerotomy is fashioned at 2 mm from the limbus under one of the flaps. Insert the folded IOL through a corneal wound.
- Insert a 23-G forceps through the sclerotomy and grasp the tip of one of the haptics.
- Draw the haptic out through the sclerotomy and push the tip into the sclera at the edge of the flap to stabilise the haptic. Sew up the flap tightly.
- Repeat on the other side.
- Insert the remaining 23-G sclerotomies to inspect the retina and vitreous base.

  Complications:
- Lens tilt
- Lens iris touch or capture
- Lens dislocation
- Vitreous base damage and giant retinal tear
- Hypotony and conjunctival bleb formation

15.4.4 Anterior Chamber IOL

The modern design of open loop AC IOL is less likely to cause corneal decompensation than older closed loop models. This may be because the open loop allows the haptics to flex on rubbing the eye rather than vaulting the optic forwards as with the closed loop systems. They require a large 6-mm wound to insert and will require 10/0 non-absorbable suture to the wound. The suture can be removed 3–4 months after surgery. Remember to do a peripheral iridectomy to avoid pupil block. Postoperative IOP rise is a possible complication.

15.4.5 Sutured Posterior Chamber IOLs

PC IOLs can be sutured into the ciliary sulcus using a variety of methods but employing:

- Suture tied to the haptic of the IOL
- Long needles to insert the Prolene suture
- Trap doors of sclera under which the knot of the suture is buried

  A simple method:
- Tie the suture to the haptic, insert a 27-g needle through the sclera opposite and behind the iris and insert the long needle through orifice of the 27-g needle. Draw out the 27-g needle which pulls the long needle and suture with it.
- The long needle is passed partially through the sclera circumferentially a few times and will then stay tight without suturing.
- Repeat for the other side.

  Problems:
- Suture erosion
- Lens tilt
- Lens dislocation
- Vitreous haemorrhage

15.4.6 The Aphakic and Aniridic Eye

Occasionally, you will be presented with an aphakic eye which has also lost its iris, for example, aniridia or post-traumatic. In these cases, the use of silicone oil tamponade is problematic because there is no iris diaphragm to hold the oil in the posterior chamber and the oil will fill the anterior chamber risking glaucoma and corneal touch and decompensation. A clever technique has been described whereby sutures are inserted to hold the oil away from the cornea (Gentile and Eliott 2010).

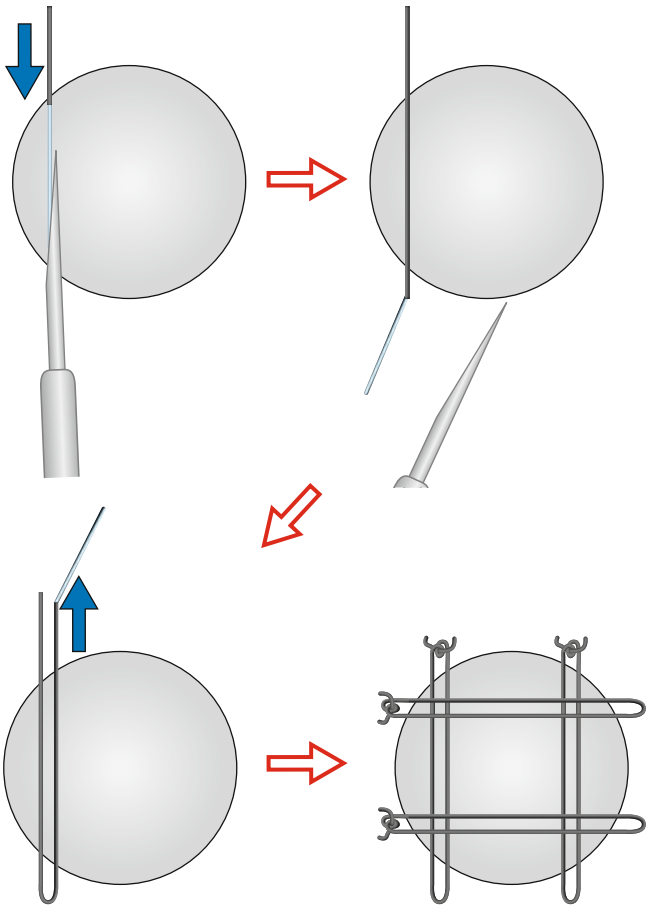

Fig. 15.10 In an aphakic–aniridic eye, a mesh of sutures can be used to prevent forward prolapse of silicone oil. First pass a 10/0 Prolene with a straight needle through the sclera 1-mm posterior to the limbus. Draw the needle out of the eye by engaging the suture needle into the lumen of a hypodermic needle, for example, 28 gauge. Pass the needle back in a similar fashion and then tie and bury the knot. Do this for two vertical and two horizontal sutures. The square mesh created will keep the oil in the posterior segment

Fig. 15.11 Removal of dislocated intraocular lens implants provides a number of challenges. In this patient, the capsule and lens have fallen backwards, but it remains hinged by the zonules at the 6 o'clock position. Many techniques exist to reposition such lenses including suturing of the lens to the sulcus, thereby avoiding complete removal of the lens. However, this runs the problems of suture erosion and breakage at a later date. Modern anterior chamber lenses are useful in the elderly if you wish to remove the lens in total, in which case this will need to be done through the anterior segment

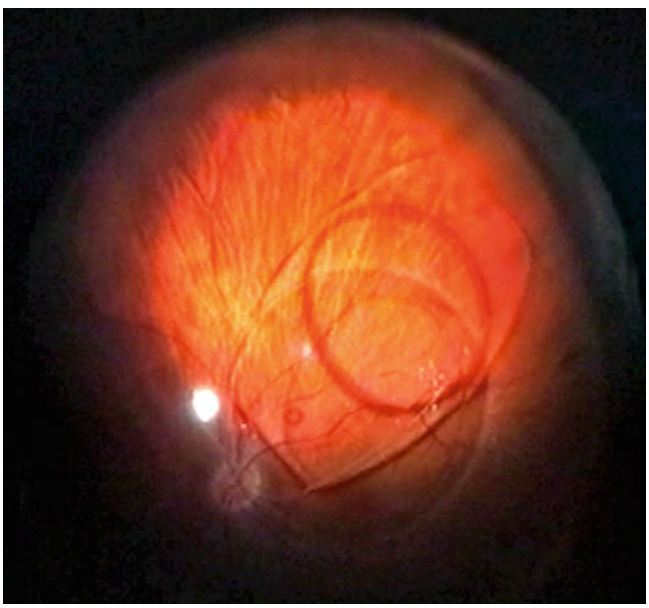

Fig. 15.12 Silicone plate haptic lens implants may dislocate posteriorly after YAG capsulotomy. These can be removed through the anterior segment and cut inside the eye to allow a smaller exit wound for the implant

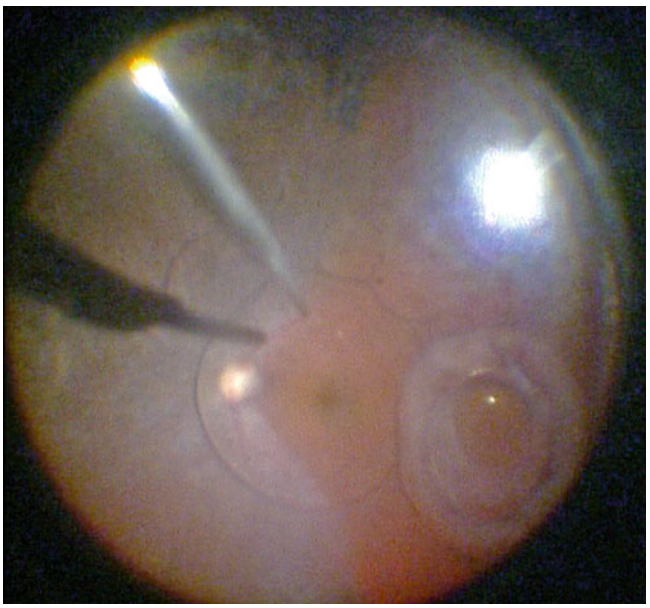

Fig. 15.13 If the zonular fibres give way, the whole lens and capsule can dislocate posteriorly. This can be seen years after PPV

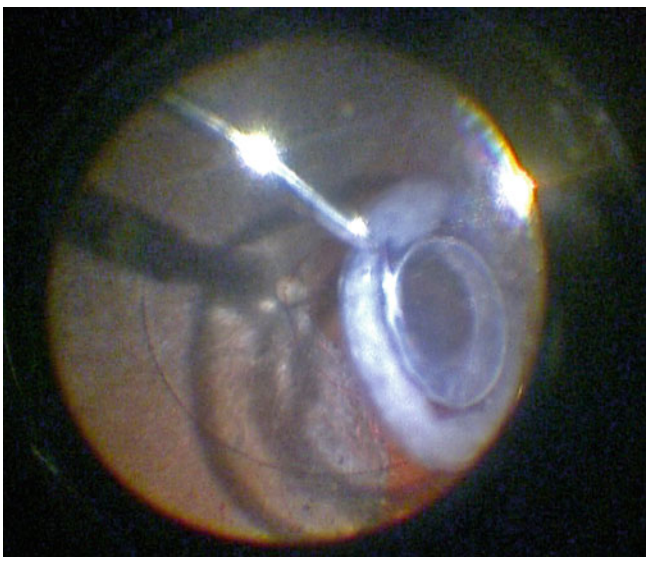

Fig. 15.14 The IOL can be lifted into the AC for removal

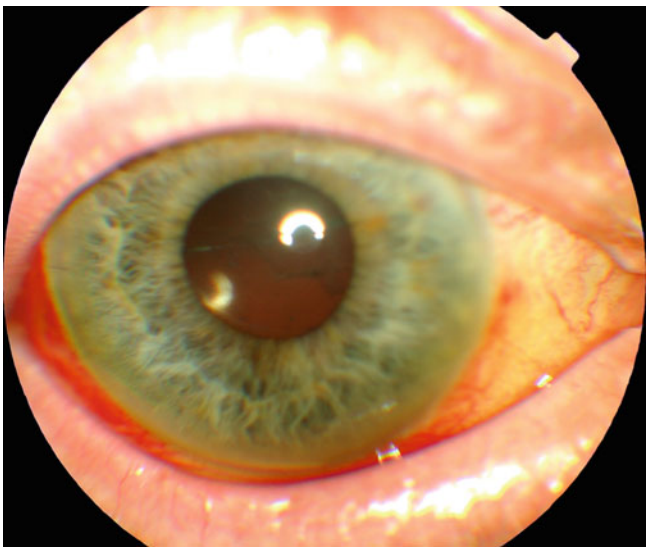

Fig. 15.15 A small hypopyon from postoperative endophthalmitis from *Staphylococcus epidermidis*

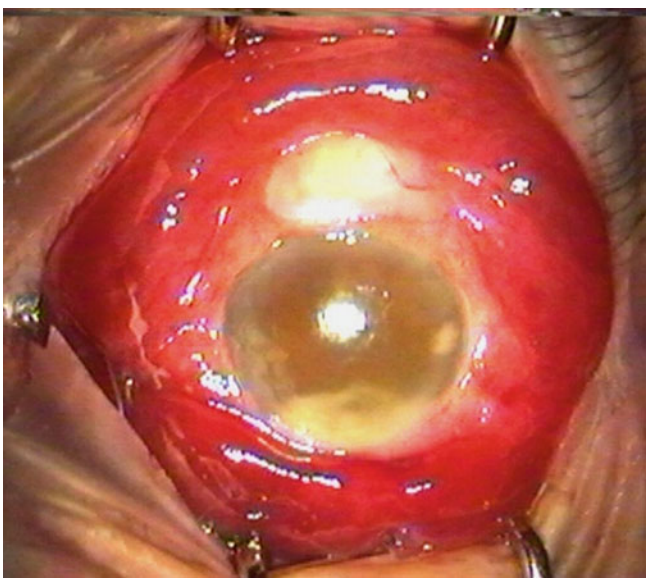

Fig. 15.16 This eye has suffered late postoperative endophthalmitis after trabeculectomy. There is a bleb abscess and a hypopyon

15.5 Postoperative Endophthalmitis

15.5.1 Clinical Features

Incidence of endophthalmitis in cataract surgery is 0.028–0.14 % (Javitt et al. 1991; Kamalarajah et al. 2004; Wykoff et al. 2010)

If a patient experiences severe pain in the first week after cataract surgery, the eye must be examined as quickly as possible for endophthalmitis. A high degree of urgency should be exercised because the sooner that the eye receives intraocular antibiotics, the greater the chance of recovery. The patient often experiences a drop in vision with an aching pain in the eye. The eye is inflamed with signs of anterior uveitis followed by the formation of a hypopyon. Fibrin may be deposited on the lens implant, and the iris blood vessels engorged. A view of the retina may not be possible because of infiltration of the vitreous with white cells, but a red reflex may be visible. If the retina can be observed, sheathing of the blood vessels and retinal haemorrhaging indicate a poorer prognosis for visual recovery.

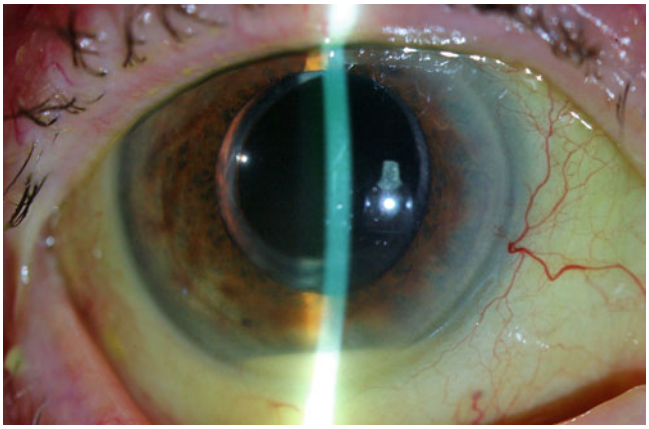

Fig. 15.17 A chronic postoperative endophthalmitis shows a hypopyon in a relatively quiet eye

Note: Be aware that hypopyon and pain are not always present (Wisniewski et al. 2000).

The priority is to inject intravitreal antibiotics as soon as possible.

Blebitis in patients with trabeculectomy may also lead to late endophthalmitis. In contrast to early postoperative infection, *Staphylococcus epidermidis* is less common in these cases (Ciulla et al. 1997). The risk of retinal detachment is 8.3 % in postoperative endophthalmitis (Doft et al. 2000).

15.5.2 Surgery

Intervention should be performed as soon as possible after the infection is suspected because delay will lead to further risk of visual loss.

Note: It is better to insert antibiotics occasionally inappropriately than to miss a case of endophthalmitis.

15.5.2.1 Vitreous Tap

A fine needle is inserted transconjunctivally through the pars plana 3.5 mm from the limbus; topical anaesthesia can be used although the patient may feel the insertion of the needle in the inflamed eye. In endophthalmitis in an elderly patient, the vitreous is often liquefied and the tap procedure successful in obtaining a specimen for microbiological examination. Remove 0.1 ml of fluid vitreous. Leave the needle in situ and detach the syringe to send the sample to the laboratory and attach the antibiotics for insertion. The antibiotics should be drawn up in a 1-ml syringe. There is a dead space of 0.04 ml in the needle; therefore, you will need 0.14 ml in the syringe to inject 0.1 ml and prime the needle. Your pharmacy should make double the volume of the dose to allow you to prime the needle. Some antibiotics crystallise when inserted through the same needle; therefore, you may need two injection sites. The space created by the removal of the fluid vitreous will be filled by the antibiotics (for suggested drug dosages, see Chap. 15).

Table 15.2 Difficulty rating for vitreous biopsy for endophthalmitis

Difficulty rating	Low
Success rates	Moderate
Complication rates	Low
When to use in training	Early

15.5.2.2 Vitreous Biopsy

This involves the use of a vitreous cutter and will provide a sample whether the vitreous is liquefied or not. The increased reliability of the technique however may be outweighed by any delay in getting access to the vitrector and setting up any machinery. Small-gauge instruments are ideal because there is no need for suturing or opening the conjunctiva. Place a three-way tap in the vitrector aspiration line and use this to extract the sample into a 1-m syringe. Cap the syringe and send to the laboratory. As you remove the sample, maintain pressure in the eye by pressing on the globe away from the biopsy site. Inject the antibiotics and gradually release the pressure.

No significant difference in complication rates or culture positive rates has been demonstrated between vitreous needle taps and vitreous biopsy by vitrectomy cutter (Han et al. 1999).

15.5.3 Infective Organisms

Only 56–69 % of samples are culture positive (Kamalarajah et al. 2004; Han et al. 1996). The bacteria involved vary from the virulent *Staphylococcus aureus*, *Streptococcus pyogenes*, *Hemophilus influenzae* (Yoder et al. 2004), coliforms, *Pseudomonas aeruginosa* (Eifrig et al. 2003) and *Klebsiella* (Scott et al. 2004) to the less virulent *Staphylococcus epidermidis* (coagulase-negative staphylococci) and *Propionibacterium acnes* (Meisler and Mandelbaum 1989). The less virulent organisms have a much better visual prognosis. Coagulase-negative staphylococci are the commonest pathogens and appear to come from the patient's eyelids or conjunctiva (Bannerman et al. 1997). More recently methicillin-resistant *Staphylococcus aureus* has been implicated in postoperative endophthalmitis (18 % of culture positive endophthalmitis in one publication), with in vitro sensitivity to gentamicin and vancomycin (Deramo et al. 2008). Occasionally, fungal postoperative infections are seen (Narang et al. 2001).

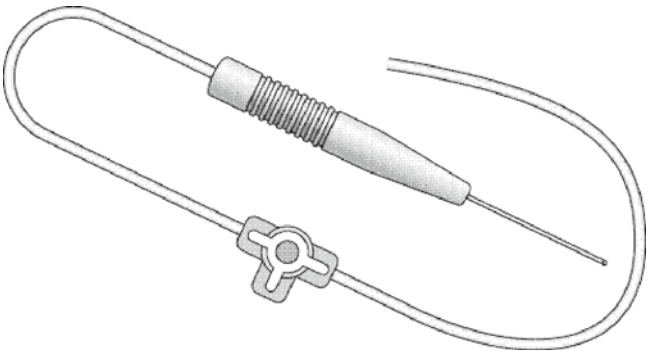

Fig. 15.18 When taking a sample, attach a 3-way tap to the cutter to allow aspiration of fluids from the tubing

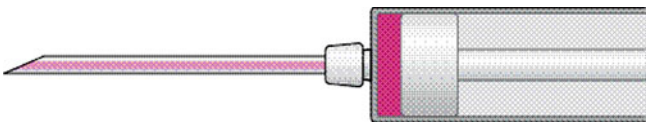

Fig. 15.19 There is a dead space of approximately 0.04 ml in the needle which must be accounted for during intravitreal injections

Frequency of isolation of organisms in positive biopsies (94 % are gram positive) (Han et al. 1996):

Coagulase-negative staphylococci	70 %
Staphylococcus aureus	10 %
Streptococci	9 %
Gram negative	6 %
Enterococci	2 %
Other gram positive	3 %

15.5.4 Antibiotics

Intravitreal antibiotics are injected and provide a high concentration of drug to treat the infection. For this reason, systemic antibiotics appear to add little to the therapeutic dose (Endophthalmitis Vitrectomy Study 1995). Likewise, topical antibiotics will provide additional dosage to the anterior chamber but not to the vitreous and are only required in moderate application. Third-generation cephalosporins are useful in combination with vancomycin. Both persist in the eye for a week at therapeutic doses (Ferencz et al. 1999; Gan et al. 2001). Vancomycin is useful for gram-positive organisms and Cephalosporins for gram-negative organisms. In the latter, resistance has been described in 11 % of gram-negative organisms (Han et al. 1996).

Aminoglycosides (gentamicin and amikacin) have been used in the past but are associated with retinal vascular occlusion in some patients which causes profound irreversible loss of vision (Campochiaro and Conway 1991; Waltz and Margo 1991; Jackson and Williamson 1999; Campochiaro and Lim 1994; Seawright et al. 1996).

Table 15.3 Difficulty rating for PPV for endophthalmitis

Difficulty rating	Moderate
Success rates	Very low
Complication rates	High
When to use in training	Late

Intravitreal steroid has been used as an adjunctive treatment but may be associated with a poorer visual outcome (Shah et al. 2000).

Repeat biopsy may be required in 10 % for worsening inflammation, in which case the repeat biopsy has been associated with a positive culture in 42 %. Repeat biopsy is often associated with a poor visual outcome (Doft et al. 1998).

15.5.5 The Role of Vitrectomy

Immediate PPV at presentation has been suggested from subgroup analysis in the Endophthalmitis Vitrectomy Study for those patients who present with light perception vision (Results of the Endophthalmitis Vitrectomy Study 1995). However, only patients whose irises were visible were included in this study, thus excluding those with severe hypopyon and corneal changes. Furthermore, those who were randomised to not receive PPV were not offered a PPV in follow-up to clear vitreous debris. This group may have had reversible loss of vision from vitreous debris. For these reasons, immediate PPV should only be performed rarely. The fluid from the cassette from the vitrectomy machinery (containing BSS and diluted vitreous) can also be sent for culturing or bacteria with yields of 76 % (Chiquet et al. 2009). Polymerase chain reaction (PCR) to detect bacterial DNA can be useful especially if the patients have received prior antibiotic therapy. PPV may be required at a later stage to clear vitreous debris if there is visual potential.

15.5.6 Success Rates

There is a 50 % chance of moderate vision and 13 % chance of NPL (Kamalarajah et al. 2004); one-third achieve 20/40 or better (Ng et al. 2005; Doft et al. 1994). The best results are obtained by those patients with coagulase-negative staphylococci.

Visual results by organism (Endophthalmitis Vitrectomy Study Group 1996):

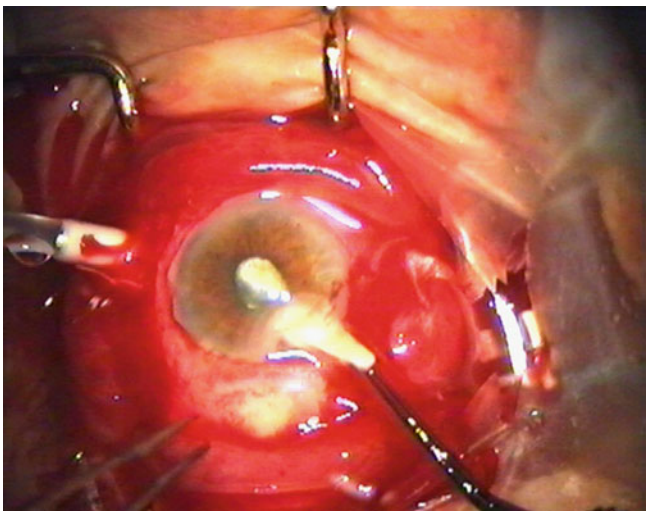

Fig. 15.20 When operating on endophthalmitis, it will be necessary to clear the anterior segment. The hypopyon may removed and may have a fibrinous quality. The vitreous may be very murky, and there may be pus on the retina and the retina may show vasculitis

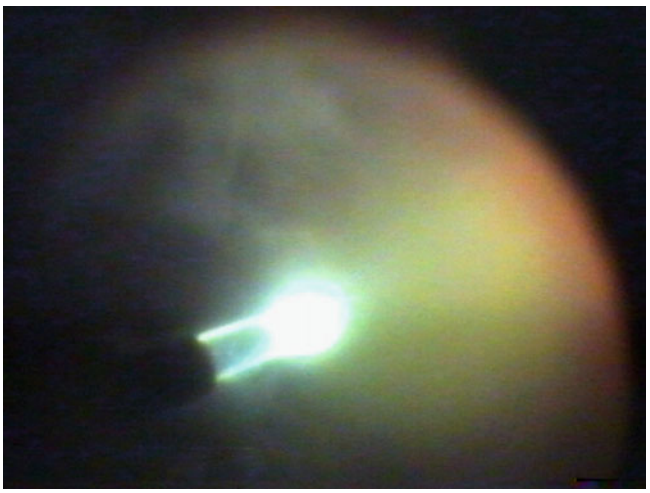

Fig. 15.21 See previous figure

(Rates of 20/100 or better)

Coagulase-negative staphylococci	84 %
Gram negative	56 %
Staphylococcus aureus	50 %
Streptococci	30 %
Enterococci	14 %

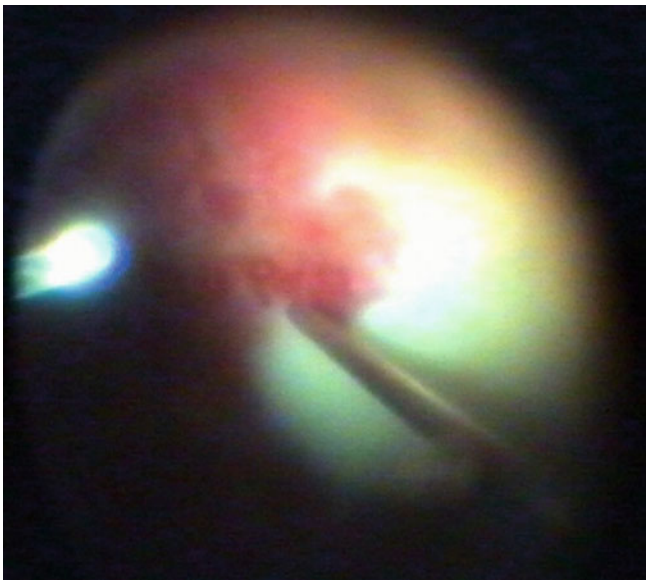

Fig. 15.22 See Fig. 15.20

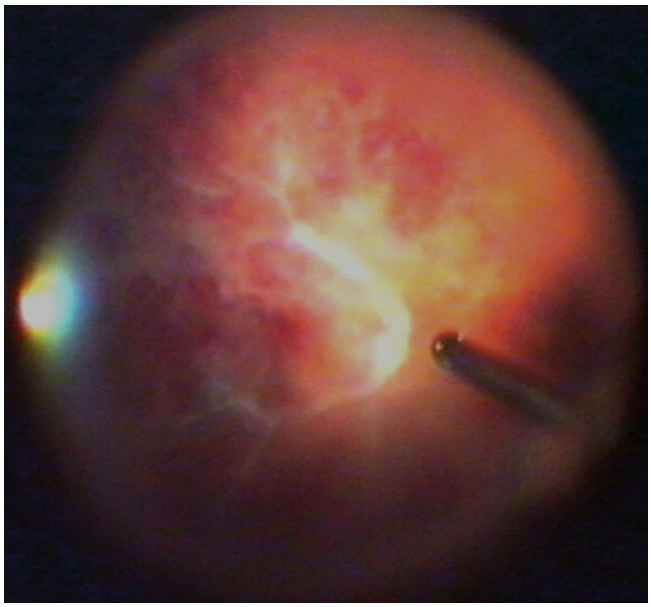

Fig. 15.23 See Fig. 15.20

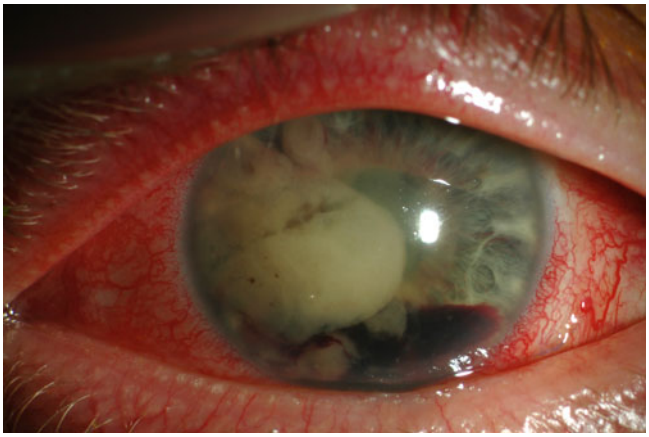

Fig. 15.24 A patient with endophthalmitis after placement of a radiotherapy plaque to treat a ciliary body malignant melanoma. The patient had raised IOP treated with YAG peripheral iridectomy; this caused an egress of pus into the anterior chamber. Vitreous biopsy and aqueous tap revealed Staphylococcus coagulase negative. Intravitreal antibiotics with systemic ciprofloxacin allowed resolution of the infection

15.6 Chronic Postoperative Endophthalmitis

This often masquerades as a panuveitis postoperatively; consequently, months may pass before infection is considered. These eyes may have a white capsular plaque indicating the foci of infection around the IOL. The chronic endophthalmitis is caused by low-virulence bacteria classically *Propionibacterium acnes* or *Staphylococcus epidermidis* but also from other organisms (Chien et al. 1992; Chen and Roy 2000). In chronic endophthalmitis, the surgical approach can be separated into three stages:

1. Vitreous biopsy and intravitreal antibiotics with surgical capsulectomy.
2. If the above fails, move on to PPV.
3. Then to removal of the IOL

The best results are often obtained by PPV and removal of the IOL and capsule, but these have visual consequences. Despite eradication of the infection, the patient may still require medical therapy for chronic uveitis and CMO (Meisler and Mandelbaum 1989).

Consider the possibility of a retained nuclear fragment in chronic postoperative uveitis; see later in this chapter.

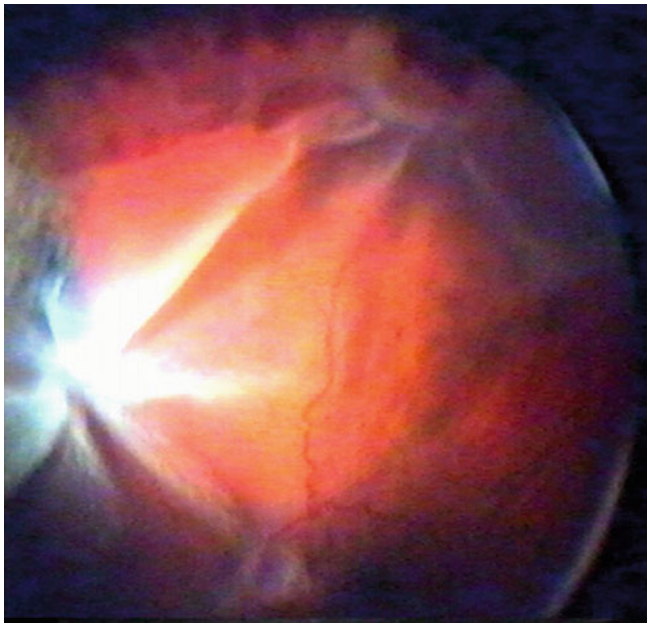

Fig. 15.25 An incarceration site has been created at the point of penetration of the back of the eye by a local anaesthetic needle. This has caused a retinal detachment similar to the types seen in perforating injury in trauma

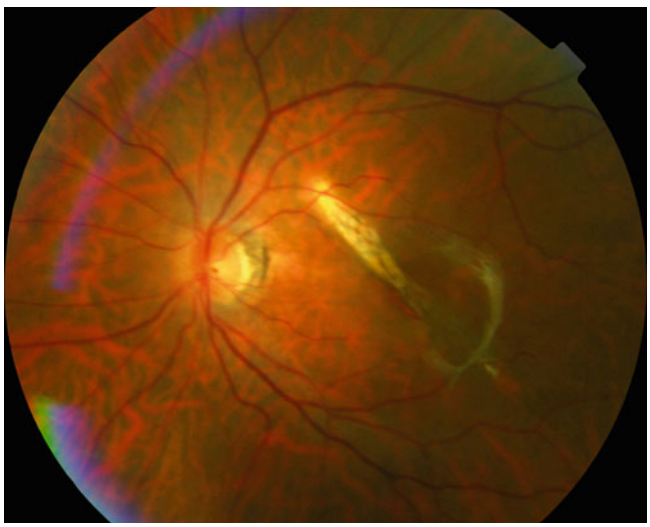

Fig. 15.26 The perils of orbital needle injections are illustrated in this patient who has a choroidal needle track clearly visible transecting the fovea. (Courtesy of Alistair Laidlaw)

15.7 Needlestick Injury

15.7.1 Clinical Features

- Incidence. Globe penetration from the local anaesthetic needle in all patients is 0.014 % and, in patients with axial length more than 26 mm is 0.7 % (Duker et al. 1991), and posterior staphyloma is 0.13 % (Edge and Navon 1999).
- 53 % of cases of globe perforation are myopic (Gadkari 2007).
- 55 % of cases are in eyes with normal axial lengths (Duker et al. 1991).

The needle used in local anaesthesia for ophthalmic surgery may penetrate the walls of the eye. The risk has been described in retrobulbar, peribulbar and even sub-Tenon's injections (Frieman and Friedberg 2001) but is less common

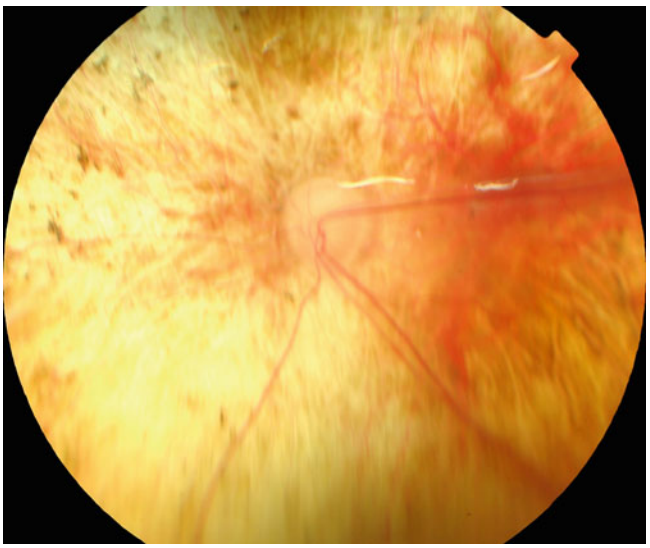

Fig. 15.27 10 years after the injection of local anaesthesia into the eye causing scleral rupture (ocular explosion), the choroid and RPE are atrophic, the retinal is flat with oil in situ and the vision is poor at hand movements

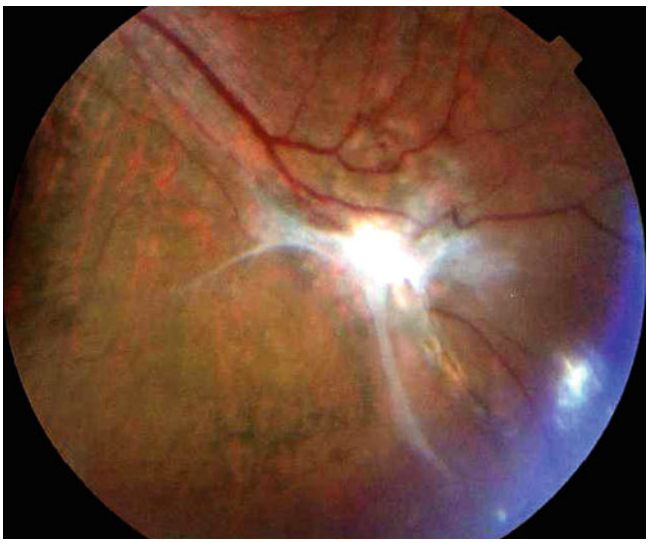

Fig. 15.29 An old incarceration site from a needlestick injury is seen with fibrous membranes tracking into the site of injury but without causing any retinal detachment associated with this

Fig. 15.28 This patient had undiagnosed posterior scleritis which had led to scleromalacia. In preparation for vitrectomy for vitreous haemorrhage (secondary to retinal vein occlusion and glaucoma), during sub-Tenon's injection of local anaesthesia, the cannula ruptured the thinned area of sclera and entered the eye causing a large area of scleral rupture and choroidal haemorrhage. The sclera was repaired with difficulty and the eye tamponaded with intraocular silicone oil. An early postoperative picture is shown with residual haemorrhage superiorly and an oil reflex. Eventually, the oil was removed with 6/60 vision from the retinal vein occlusion

now as topical anaesthesia is used. Particular care must be exercised in eyes that are 25 mm or longer. These myopic eyes have thin sclera and are vulnerable to injury. Penetration of the coats of the eye may cause haemorrhage in the choroid, subretinal space or into the vitreous, and tears in the retina can result in retinal detachment. The cataract surgeon may present a postoperative patient who has an eye filled with blood. The aetiology may be obscure, but it is wise to have an index of suspicion that the eye has been injured during the anaesthesia. Although not all tears of the retina produced in this way will result in retinal detachment, it is worth considering a vitrectomy to clear out vitreous haemorrhage and to allow visualisation of the retina. If RRD occurs, there is a 40 % chance of PVR (Duker et al. 1991; Edge and Navon 1999). Tears or retinal detachment can be dealt with by employing the principles outlined in the treatment of rhegmatogenous retinal detachment.

The incarceration sites from needlestick injuries are usually small but may be multiple as the person anaesthetising repeatedly inserts the needle whilst trying to reach the posterior orbit. Despite the penetration of the globe, most do not produce the tractional retinal detachment associated with larger incarceration sites seen in trauma. In rare circumstances if an attempt has been made to inject the local anaesthesia whilst the needle tip is in the eye, the pressure rise can induce a scleral rupture similar to a blunt trauma (Wadood et al. 2002; Minihan and Williamson 2000). The need for vitrectomy depends on the presence of vitreous haemorrhage or retinal detachment. PPV is required in 40–80 % (Puri et al. 1999; McCombe and Heriot 1995) with a 50 % chance of 20/40 vision or better.

Table 15.4 Difficulty rating for surgery for needlestick injury

Difficulty rating	Moderate
Success rates	High
Complication rates	Low
When to use in training	Middle

15.7.2 Surgery

Laser around the needle sites can be used to prevent accumulation of subretinal fluid, but these sites only uncommonly cause RD with the eye more often being operated upon for vitreous haemorrhage. Depending on the presentation, follow the principles outlined in the preceding chapters.

15.8 Intraocular Haemorrhage

Incidence of choroidal haemorrhage 0.04–0.16 % (Ling et al. 2004; Speaker et al. 1991)

Spontaneous choroidal haemorrhage occurs because of the sudden drop in intraocular pressure when the eye is opened during surgery. Any fragile blood vessels in the choroid may fracture and bleed causing the catastrophic 'expulsive haemorrhage'. The eyes of patients with high myopia, arteriopathy or old age are particularly at risk. Management of the condition is similar to treatment of choroidal haemorrhage in trauma. Presentations tend to be severe if these occur because the anterior surgeon does not see the haemorrhage until late. In contrast during retinal surgery, the haemorrhage is seen early and can often be controlled.

Fig. 15.30 A diffuse area of choroidal haemorrhage is shown superiorly in a high myope. These haemorrhages although occurring more commonly in high myopes often clear fairly quickly in these eyes

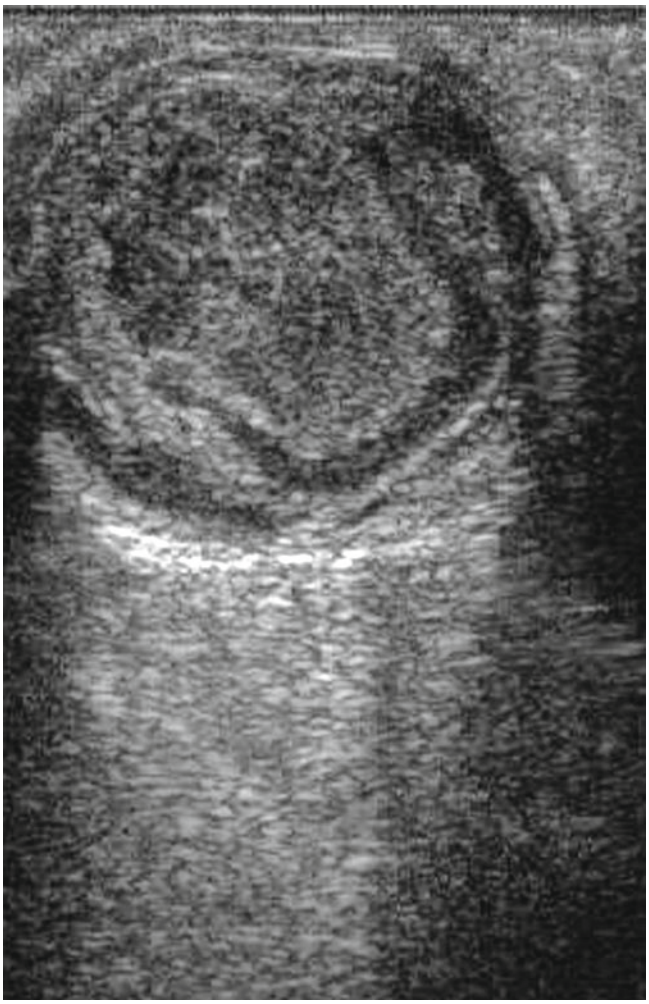

Fig. 15.31 A choroidal haemorrhage develops into a catastrophic haemorrhage because the cataract surgeon does not see anything happening until it is too late. The surgeon performing vitrectomy usually notices something happening because the retina is being visualised and therefore can react more quickly to limit the size of the haemorrhage. In this patient, an expulsive occurred during an extracapsular cataract extraction. At 3 weeks, there was some resolution of the heamorrhage allowing space to perform surgery. Using an AC maintainer, the vitreous heamorrhage was removed and liquified choroidal haemorrhage expelled. The eye was filled with silicone oil to await further choroidal haemorrhage resolution and repeat surgery. The eye achieved CF vision (see Fig. 15.32)

Fig. 15.32 See previous figure

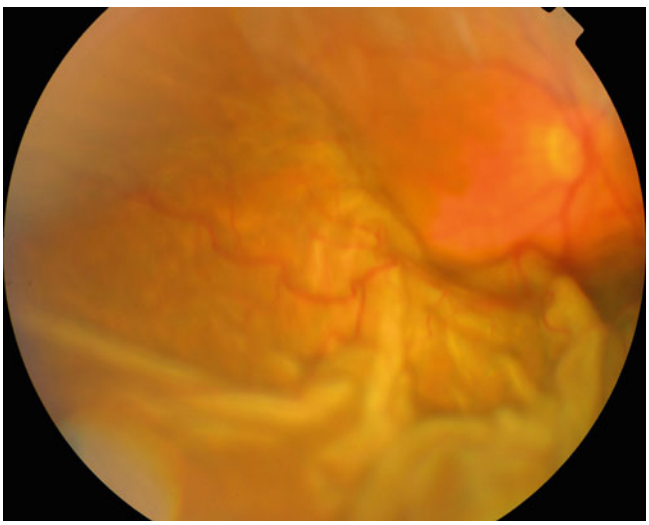

Fig. 15.33 A choroidal haemorrhage is settling after a complicated cataract operation. Secondary retinal detachment can occur with PVR. Close observation is required

15.9 Retinal Detachment

4-year incidence (Javitt et al. 1991):

All cataract extractions	1.17 %
With vitreous loss at the cataract extraction	4.9 %
Phacoemulsification	0.4 %

(Increased in white race, the young and those with YAG capsulotomy)

An increased risk of retinal detachment is associated with a previous cataract extraction. Approximately 30 % of rhegmatogenous retinal detachments are pseudophakic. This is easy to explain when the cataract surgery has been complicated by vitreous loss where the vitreous disruption results in a posterior vitreous detachment or in further shrinkage of the vitreous and retinal tear formation. However, even uncomplicated cataract surgery seems to induce a risk of retinal detachment. It may be that the loss of the larger volume of the crystalline lens, which is replaced, by the lower volume of the intraocular lens implant induces a structural change in the vitreous that must fill the gap. This may induce vitreous detachment or shrinkage. The retinal detachment risk appears at a mean of 15 months after the surgery. These patients may experience floaters and flashes but often present late and with their macula detached. Therefore, it is important that the cataract surgeon is aware of the risk and that the retina is examined postoperatively. Pseudophakic RRD can be treated by the usual modalities although posterior capsule opacification would tend to steer the surgeon towards PPV. See also Chap. 7.

15.10 Chronic Uveitis

Some patients may develop chronic uveitis after cataract extraction. Check the operation notes in case a complicated operation has been described which may indicate a missed or ignored dropped nuclear fragment. With anterior uveitis, check the angle with a gonioscope for a piece of nucleus inferiorly. Examination of the eye sometime after the cataract extraction reveals chronic vitritis often with raised intraocular pressure, but the nuclear fragment may have been absorbed. Removal of the vitreous by PPV may improve but not cure the uveitis.

Another cause is low-grade endophthalmitis; see above. Vision is often permanently reduced due to cystoid macular oedema.

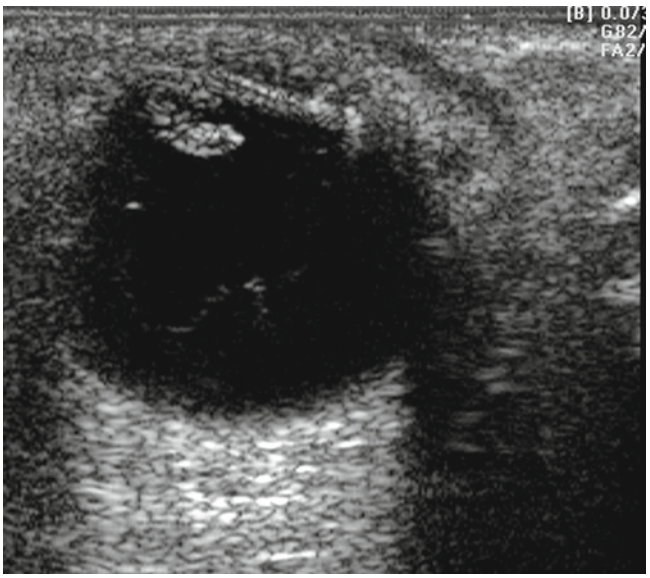

Fig. 15.34 An ultrasound of a patient with chronic uveitis after cataract extraction reveals lens material trapped in the capsule stimulating the uveitis

15.11 Postoperative Cystoid Macular Oedema

The vitreoretinal surgeon may be asked to insert intravitreal steroid for postoperative CMO, but although efficacious in the short term, the effect of the steroid is not lasting in improving the vision (Benhamou et al. 2003). Thankfully, most are self-limiting. Alternatively, intravitreal anti-VEGF agent can be used, thereby avoiding the IOP problems of IVTA.

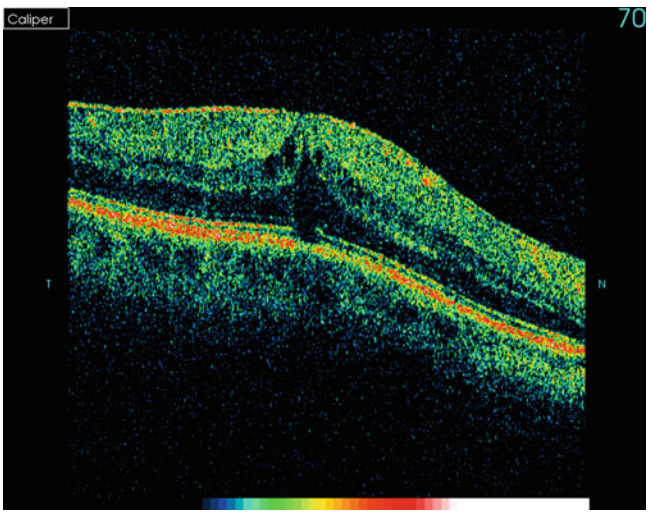

Fig. 15.35 Cystoid macular oedema can appear in vitrectomised eyes which subsequently have phacoemulsification cataract extraction. It is possible that the prostaglandins reach the macula more easily because the physical barrier of the vitreous has been removed

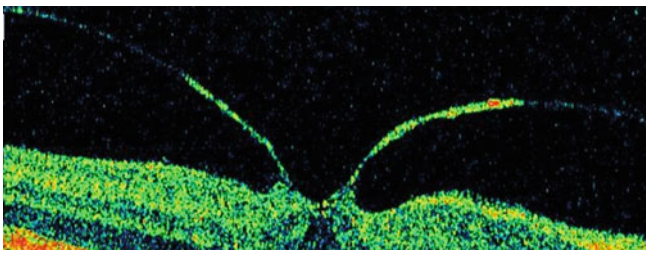

Fig. 15.36 Occasionally, patients will experience distortion a few weeks after cataract extraction, this may be due to rapid-onset vitreal traction which usually spontaneously separates

Notes:

- Beware of pain in the first week after cataract extraction indicating endophthalmitis.
- Beware of floaters in first year after cataract extraction and retinal detachment.
- Check if chronic uveitis in a pseudophakic started after the cataract extraction indicating an ignored dropped nucleus or Propionibacterium acnes infection.

15.12 Postoperative Vitreomacular Traction

Sudden onset of vitreomacular traction can be seen rarely after cataract extraction (Costen et al. 2007). This presents in the few weeks after surgery and usually spontaneously resolves if not PPV can be used. There can be some residual metamorphopsia however.

15.13 Postoperative Choroidal Effusion

Note: Do not confuse postoperative choroidal effusions with RRD. These have deep green colour and appear of thicker consistency than RRD. They are more likely to occur with glaucoma drainage procedures. Most will resolve spontaneously. If not, perform PPV with a long infusion cannula (6 mm); usually the suprachoroidal fluid will leak from the superior sclerotomies and green fluid when the infusion is switched on. Be careful when inserting small-gauge trochars to make sure that the trochar has penetrated into the vitreous cavity. Also drainage from the sclerotomy with trochars is less good. Once in the eye, a 30-G needle attached to a 1-ml syringe with the plunger out can be inserted transconjunctivally through the sclera and into the suprachoroidal space.

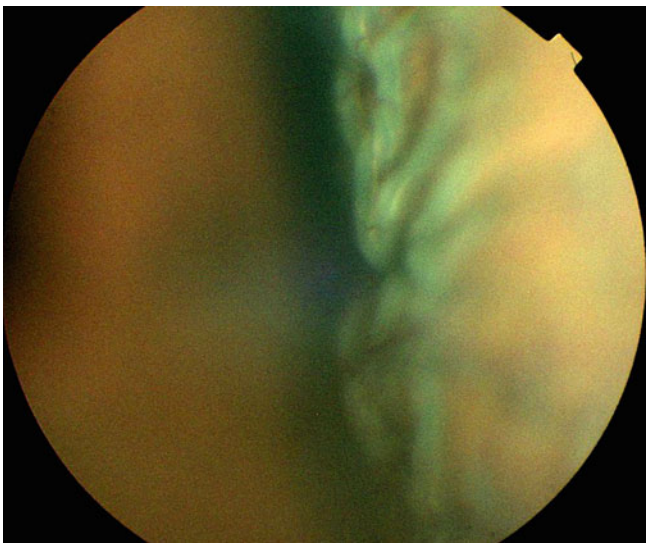

Fig. 15.37 Loss of intraocular pressure has caused the development of extensive choroidal effusions, which have a dark green colour. The disc can just be seen between the two edges of the choroidal effusions. In some instances, these may come into contact with each other. Drainage of choroidal effusions may be necessary to restore vision. If the effusions are recurrent, examine the eye with ultrasound biomicroscopy for a cyclodialysis cleft

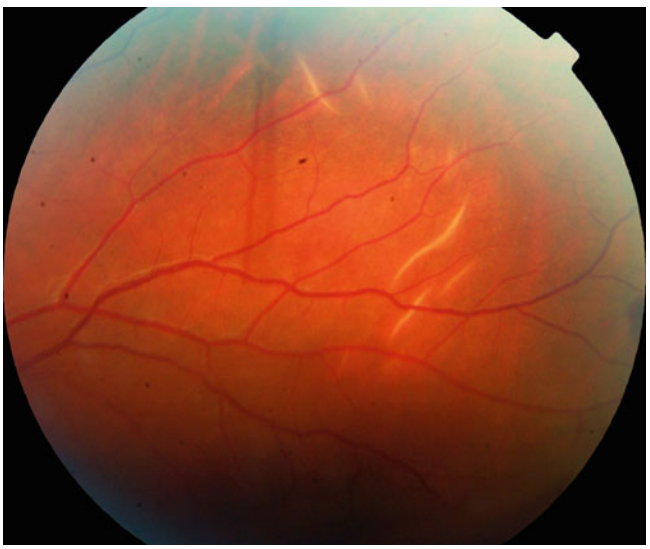

Fig. 15.38 A resolved effusion may leave some folds in the choroid in the early stages

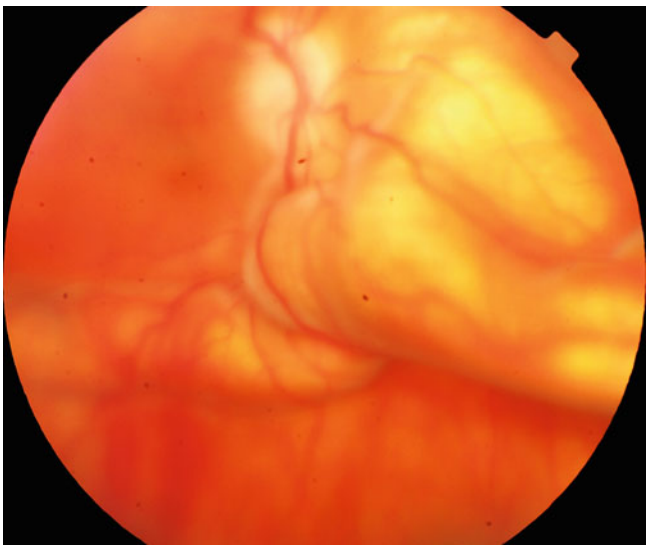

Fig. 15.39 Do not leave unstable anterior segment wounds in vitrectomised eyes. Any wound leak can cause severe hypotony with globe collapse as in this eye

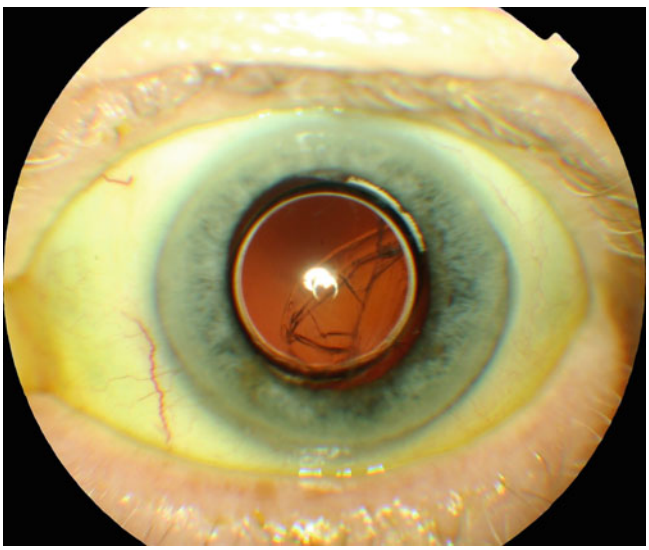

Fig. 15.40 The capsule of this patient has rolled up behind the lens implant reducing vision; this can be removed by surgical capsulectomy with the vitreous cutter, but the support for the IOL may be compromised by removal of the anterior hyaloid. Therefore, the patient must be warned about the possibility of dislocation of the IOL postoperatively

15.13.1 External Drainage

- Perform the PPV.
- With the syringe, press the needle onto the sclera and watch for the indentation internally.
- Once you are happy that the indent of the needle is under elevated choroid and retina, insert the tip of the needle into the suprachoroidal space.
- Allow passive fluid drainage (PPV infusion on).

There is a worry that the needle will penetrate the retina; however, this is unlikely. Indeed, the retina can settle onto the needle tip whilst flattening without being penetrated.

You can insert heavy liquids to encourage the drainage of any residual fluid. No internal tamponade is required. Note: This method of external drainage can be used for exudative RD with the needle inserted into the subretinal space, thereby avoiding a retinotomy.

15.14 Summary

Vitreoretinal procedures can be used to correct the various complications of intraocular surgery. The vitreoretinal surgeon requires anterior segment surgical skills because cataract extraction is often required during vitrectomy to maximise visualisation of the retina, and because vitreoretinal surgery may require anterior segment intervention in addition.

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