Choice of Anaesthesia

Richard M. H. Lee and Tom Eke

The term ‘anaesthesia’ is used to describe techniques to control the patient’s pain and unwanted movement during surgery. For the eye surgeon, the main components are *analgesia* (reduction or elimination of pain) and *akinesia* (reduction or elimination of movement). General anaesthesia techniques (involving loss of consciousness, and amnesia) were first discovered in the mid 1800s, and local anaesthesia (allowing painless surgery with the patient awake) in the late 1800s. Prior to this, surgeons (including cataract surgeons) needed strong assistants to hold the patient as still as possible, and relied on alcohol and/or plant extracts in an attempt to minimise surgical pain and its associated movements. The first recorded modern use of local anaesthetic was in 1884, with cocaine extract used for eye surgery. By the end of 1884, eye surgeons had already described using cocaine for retrobulbar, peribulbar, sub-Tenon’s, topical and topical-intracameral anaesthesia [1]. These techniques have been refined and improved, though the principles remain the same. Patient anxiety, if present, can be controlled with anxiolytic medications and/or intravenous sedation.

In the United Kingdom (UK) and many other countries, the vast majority of cataract surgery is done using local anaesthesia (LA) techniques. However, there will always be patients who are unsuitable for standard LA, and these patients may need general anaesthesia (GA), or intravenous (IV) sedation, or specialized LA techniques. The process of preparing a patient for surgery should include the choice of anaesthesia, and this process should be a team effort involving the surgeon, nursing and theatre staff. An anaesthetist (anesthesiologist) is mandatory for

R. M. H. Lee (✉)
Chelsea and Westminster Hospital, London, UK
e-mail: richard.lee1@chelwest.nhs.uk

T. Eke
Norfolk and Norwich University Hospital, Norwich, UK

C. Liu and A. Shalaby Bardan (eds.), *Cataract Surgery*,
https://doi.org/10.1007/978-3-030-38234-6_4

cataract cases requiring GA or IV sedation, and many other LA cases will benefit from (or require) the assistance of an anaesthetist. The choice and provision of anesthesia is the subject of UK national guidelines on cataract surgery and intraocular surgery [2–4]. Some other countries have national guidelines for cataract surgery that include mention of anaesthesia, but the UK is presently the only country to have a national guideline dedicated to LA for intraocular surgery [3].

Brief Description of Techniques

The techniques are described in brief, as there is no substitute to hands-on learning from an experienced practitioner.

General anaesthesia (GA). For much of the 20th century, GA was used for the majority of cataract surgery. General anaesthesia should give 'perfect' operating conditions, in that the patient is unconscious with no memory of the surgery (amnesia) and the globe is free of movement (akinetic). For surgical training, GA allows free conversation between trainer and trainee, because the patient cannot overhear the discussions. For example, the trainer can point out the dangers of a surgical manoeuvre, without risk of causing the patient distress. However, a GA approach uses a large amount of resources, in terms of time, personnel, and use of hospital beds and has its own risk profile including life threatening complications. Improved surgical techniques have therefore allowed LA to become the default anaesthetic technique for cataract surgery nowadays [3].

General anaesthesia is now reserved for cataract patients who really need it—for example children, patients with severe psychological/emotional problems, patients with learning difficulties or dementia who cannot co-operate, extreme anxiety, uncontrolled movement disorders, etc. While many GA cataract patients can now be managed as day-cases, it is often necessary to keep a GA patient in hospital overnight following surgery. Discussion of the necessary preparation and technique of GA is beyond the scope of this chapter.

Retro-bulbar anaesthesia (RBA). This technique tends to be mentioned first in lists of LA techniques, partly because it was the main LA technique used for the first part of the 20th century. RBA provides good analgesia, and the extra-ocular muscles are blocked, thereby providing good akinesia in addition. However, RBA is also considered to be the LA technique that carries the highest risk of sight-threatening or life-threatening complications. Serial national surveys show that RBA has largely fallen out of use for cataract surgery in the UK [5] although RBA is still widely used in some other countries. In 2017, the UK National Institute for Health and Care Excellence (NICE) published a guideline on Cataract in Adults, which stated 'do not offer RBA for people having cataract surgery' [4].

The technique of RBA involves using a sharp needle to inject the LA into the orbit, behind the eyeball [6]. Another term for RBA is the 'intra-conal' LA block, because the needle tip is aimed behind the eyeball, within the 'cone' of the four rectus muscles. The technique gives good analgesia and akinesia, albeit with a

small risk of serious complications. The main 'sight-threatening' complications are needle damage to the globe or optic nerve, or severe arterial bleeding into the orbit. The risk of globe perforation is much increased with larger (myopic) eyeballs, posterior staphyloma, abnormal globe-orbit relationship, longer needles, and gaze directed away from the needle. Needle damage to the optic nerve may also cause partial or complete blindness. Vision may be lost due to a vascular occlusion or without obvious cause ('wipe-out'). Inadvertent injection of LA under the coverings of the optic nerve will allow the LA to track back to the brain. This 'brainstem anaesthesia' can present within seconds or minutes of RBA, with loss of consciousness, apnoea, epileptic fitting, labile blood pressure and hypotension. With immediate life support and transfer to an intensive care unit, most patients will recover [3].

Peri-bulbar anaesthesia (PBA). In this technique, a sharp needle is also used for orbital injection but unlike with RBA, the needle is aimed away from the eyeball and muscle cone—an 'extraconal' injection [6]. Again, there is a good sensory and motor 'block', providing good analgesia and akinesia. Some practitioners suggest using two injections, one from the infero-temporal orbit and another medially. However, the volume of the first injection may push the globe medially, and increase the likelihood of a globe perforation [7]. Many clinicians believe that PBA is less likely to cause severe complications, compared to RBA, though all of the sight-threatening and life-threatening complications of RBA have also been reported with PBA. A 1996 survey found that 2% of UK ophthalmologists had experienced a patient death due to LA—at that time, almost all LA had been either RBA or PBA [8].

For those few cataract patients who require a needle block to the orbit, PBA is preferred to RBA. The UK guidance from NICE is that most adult cataract patients should have either sub-Tenon's or topical LA (see sections below), but 'if both sub-Tenon's and topical (with or without intracameral) anaesthesia are contraindicated, consider peribulbar anaesthesia' [4]. Current advice for administering PBA is to use a short needle and to administer only one injection, which should be in the far infero-temporal quadrant or (preferably) via the medial canthal area [9].

Sub-Tenon's anaesthesia (STA). This technique uses a blunt cannula (non-needle approach) to deliver the LA to the retrobulbar space, thereby avoiding the risks inherent to needle LA blocks. Again, there can be a good block with analgesia and akinesia though larger volumes of LA (around 3.5 ml or more) are needed for akinesia. Many cataract surgeons feel that STA gives the best balance of globe akinesia, analgesia and patient satisfaction together with a low risk of anaesthetic complications. The 2013 UK national survey showed that STA was used for over 50% of LA cataract operations in the UK [5]. The 2017 NICE guideline states that UK surgeons should 'offer sub-Tenon's or topical (with or without intracameral) anaesthesia for people having cataract surgery' [4].

Most clinicians will use a specially designed metal sub-Tenon's cannula (e.g. Stevens or Eagle type), though it is possible to use other types of blunt metal cannulae, or the plastic part of an intravenous cannula. The blunt cannula means that the risks of needle blocks appear to be much reduced though not completely

eliminated [10]. Cases of globe perforation have been described e.g. eyes with thin sclera, or attempted dissection in eyes with Tenon's scarring. If the metal cannula is directed very posteriorly, it can damage the short posterior ciliary arteries near to the optic nerve insertion, and cause ischemia of the optic nerve head or choroid. Advancing the metal cannula a little further still will risk optic nerve trauma and even brainstem anaesthesia: deaths have been reported with STA, as well as with sharp needle blocks.

Most clinicians will use spring-scissors to make a small 'snip' in the conjunctiva and Tenon's layer, in order to pass the cannula into the sub-Tenon's space. A good technique is to make the snip about 5 mm posterior to the limbus in the infero-nasal quadrant, exposing the bare sclera, and to pass the cannula just behind the equator before slowly injecting [11] (Fig. 1). Instead of using scissors, it is possible to make the initial hole with a pencil-point type instrument (e.g. lacrimal dilator or a 'conjunctival probe' (Blink Medical, Solihull, UK). Experienced clinicians may employ a 'no snip' STA technique, in which the metal cannula is pushed directly through conjunctiva and Tenon's, without the need for scissors or probe [12].

Topical anaesthesia (TA) and Topical-intracameral anaesthesia (TA-ICA). This means administering the LA topically, to the front of the eye. Most clinicians use LA eye-drops although it is also possible to use an LA gel [6]. Topical anesthesia means that all the risks of needle or STA blocks are avoided. However, there is no akinesia with TA, meaning that the eye may be mobile and this could potentially cause a surgical complication.

Topical anaesthesia is frequently augmented with additional LA that is placed into the anterior chamber at the start of surgery [13]. This is termed intra-cameral anaesthesia (ICA). The ICA can be given as a solution of lidocaine (which must be without preservative), or it can be combined with viscoelastic (e.g. Visthesia®, Carl Zeiss Meditec, Jena, Germany). Despite initial concerns, studies have shown that intracameral lidocaine is safe for the corneal endothelium [13].

Some practitioners will use a LA injection to block the facial nerve, in order to minimize lid squeezing with TA. With a modern lid speculum, a facial nerve block is usually unnecessary and many TA practitioners never use lid blocks. If a lid block is felt to be necessary, it is preferable to use the 'van Lint' block, which involves injection to the orbicularis muscle, behind the lateral orbital rim. More proximal blocks to the facial nerve (nearer to the ear) are more likely to have serious complications than the van Lint block.

If using gel for TA, then it is important to think about the efficacy of the pre-operative iodine solution. Iodine (or equivalent) is routinely used to sterilize the conjunctiva prior to surgery. However, if gel is used for TA then it may form a physical barrier to commensal bacteria and prevent the iodine from reaching them. Therefore, if using gel TA it is important to instill iodine prior to the gel, or alternatively one should rinse the gel carefully from the conjunctival fornices before applying the iodine. Most practitioners find it most expedient to simply use LA drops prior to instilling iodine and not use gel LA at all.

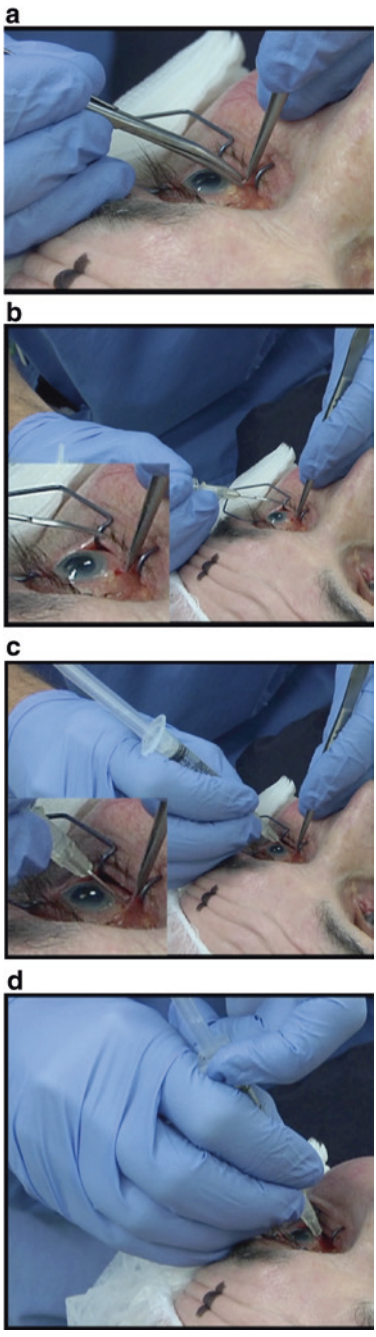

Fig. 1 Sub-Tenon's anaesthesia. **a** Instruments are round-ended spring scissors (e.g. Westcott) and conjunctival forceps (e.g. Moorfields). Local anaesthetic and iodine drops are instilled; a lid speculum may be used. A small cut (snip) is made in the conjunctiva & Tenon's layer, about 5mm behind the limbus, in the infero-nasal quadrant. This will expose the bare sclera and allow access to the sub-Tenon's space (**b**, **c**) the sub-Tenon's cannula is advanced, following the curvature of the sclera, to just behind the equator **d** local anaesthetic is slowly injected, and the cannula is withdrawn

Because TA and TA-ICA techniques do not affect the extra-ocular muscles, it is possible for the eye to move during surgery. Surgeons can use this to their advantage by instructing the patient to keep looking toward the microscope light and this will help to minimise kinesia while keeping the eye 'on axis', facilitating the operation. This 'mobile eye' can be particularly useful for patients who cannot adopt a standard position under the operating microscope e.g. those with orthopnea or kyphosis. However, a small proportion of patients are unable to keep the eye still and in these rare cases it is possible to give additional anaesthesia via STA 'on the table'. If a TA patient complains that the light is too bright, it is usually adequate to simply dim the microscope light, then brighten it again after a minute or so.

There has been some debate as to whether TA may be associated with an increased rate of surgical complications, because of the potentially 'mobile eye'. Proponents of TA may argue that TA makes surgery easier, because a 'block' LA from STA or PBA may contribute to vitreous bulge, and the immobile eye may not be on axis. A review of publications that compared 'block' LA with TA or other 'kinetic' LA found no difference in posterior capsule rupture rates [14].

Subconjunctival LA. A subconjunctival injection of 0.5–1 ml of LA can be given by the surgeon at the start of cataract surgery. This technique was reasonably common when scleral tunnels were used for phacoemulsification. Now that most surgeons use clear corneal incisions, subconjunctival LA is rarely required for cataract surgery. The technique is useful for glaucoma surgery (e.g. trabeculectomy), in cases where akinesia is not required.

Anxiolytics, and intravenous sedation. It is to be expected that most or all patients will have a degree of anxiety regarding their cataract surgery. In most cases, this anxiety can be much reduced by a careful pre-operative explanation of the process of cataract surgery. Most patients appreciate having a person's hand to hold during the surgery, with instructions to 'squeeze my hand if you have any discomfort or concerns'.

Most patients can be managed with explanation, but some will need pharmacological anxiolysis or sedation. For anxiety, many patients will be happy with a low dose of an oral benzodiazepine (e.g. diazepam 5 mg). If intravenous sedation is required, then an anaesthetist must give this, with appropriate backup measures in place [3].

What Anaesthetic Drugs Can Be Used?

Lidocaine (previously known as lignocaine) is the mainstay drug for LA in eye surgery. It can be given as an injection for STA or PBA block. If used for ICA it is important that the lidocaine should be a preservative-free solution. Standard strengths of lidocaine are 1% and 2%. Bupivacaine has a longer period of action, so may be useful for blocks in cases that are expected to take a long time although this is rarely the case for cataract surgery. For TA, surgeons can use proxymetacaine (proparacaine), lidocaine, oxybuprocaine or tetracaine. However there is a

risk of corneal epitheliopathy with tetracaine that may require surgery being postponed to a later date [5].

Historically, adrenaline (epinephrine) was frequently added to the LA mixture for needle blocks. However, this gives no real advantage and could potentially cause ischaemia in vulnerable globes (e.g. some types of glaucoma, risking 'wipe-out') and therefore adrenaline is best avoided. Hyaluronidase is an enzyme that aids penetration of the LA mixture through the orbital tissues. It allows faster onset of akinesia, and appears to reduce the likelihood of extra-ocular muscle damage and diplopia following 'block' LA. However, patients can occasionally develop a severe orbital inflammation following the use of animal-derived hyaluronidase, and this can be sight-threatening [15]. In some countries (e.g. USA) it is possible to obtain hyaluronidase that is made with recombinant DNA technology, and this appears to have a much lower risk of hyaluronidase orbitopathy. The NICE guideline on cataract surgery [4] states 'Consider hyaluronidase as an adjunct to sub-Tenon's anaesthesia, particularly if trying to stop the eye moving during surgery' [4].

Intracameral lidocaine will dilate the pupil, though the effect is not sufficient to replace the pre-operative mydriatic drops in routine cataract surgery. Mixtures of lidocaine and mydriatics are more effective, though they take time to work (up to 90 s) and the pupil may not be as large as with standard pre-operative drops. A commercially available solution, Mydrane® (Thea Pharmaceuticals, Clermont-Ferrand, France), comprises lidocaine 1%, tropicamide 0.02% and phenylephrine 0.31% [16]. Some clinicians use Mydrane instead of pre-operative dilating drops and standard ICA, others use it in the management of small pupil and intra-operative floppy iris syndrome.

Complications of LA Techniques and Reducing the Risk

The main complications of LA have been discussed above: sharp needles can cause sight-threatening complications by needle penetration of globe or optic nerve, or severe arterial bleeding, known as orbital haemorrhage or retrobulbar haemorrhage [6]. Blunt-cannula STA will reduce but not eliminate this risk [6, 10]. Vascular occlusions have been reported with both PBA and STA [17]. Brainstem anaesthesia has been reported with sharp needle blocks but also with STA and deaths have occurred [18, 8]. LA techniques may also cause diplopia from direct damage to the muscle or toxicity towards the LA agent used. There are some patient characteristics that may increase the risk of sight-threatening LA complications and the clinician should be aware of these when choosing the anaesthesia for the patient.

Severe arterial bleeding (orbital haemorrhage) may occur with needle blocks. It presents as an increasing proptosis and hard orbit, usually with some obvious bleeding into the orbit or under the conjunctiva. Milder cases can be managed with counter-pressure to the orbit and observation. Some give osmotic agents such as

acetazolamide or mannitol. More severe cases may require a lateral canthotomy and/or cantholysis [19]. This complication occurs almost exclusively with needle blocks, though it appears to be less likely if the needle is used in the far infero-temporal or medial approach [3]

Myopic eyes are usually significantly larger than average, as evidenced by the axial length measurement in the biometry printout. Clinicians should remember that these eyes are also wider than average and very myopic eyes are highly likely to have a posterior staphyloma [20]. These staphylomas are often in the infero-temporal part of the globe, meaning that highly myopic eyes are at a much greater risk of globe perforation when needle LA is used [21]. Therefore it would be preferable to avoid using a needle block for these eyes and if absolutely necessary, the medial canthal approach with a short needle should minimize the risk of perforation [9].

Eyes with scleral thinning and/or conjunctival scarring may be unsuitable for STA because of the risk of globe perforation. In eyes with progressive scarring problems (e.g. pemphigoid), STA should be avoided because it may exacerbate the scarring. Thin sclera (e.g. patients with rheumatoid disease or scleritis) could potentially be ruptured by a metal sub-Tenon's cannula [22]. If there has been previous squint surgery or retinal surgery, particularly if there has been a plomb or encircling band, it may be difficult or impossible to dissect the layers to give a STA block. Globe perforation has been described when attempting to dissect past an encircling band [23]. An encircling band may make the eyeball more 'hourglass shaped', mimicking or exacerbating the effect of a posterior staphyloma: thus eyes with previous encircling band may be 'higher risk' for sight-threatening complications of any type of 'block' LA.

One should also consider the relationship of the globe to the orbit. Older cataract patients may have a degree of enophthalmos, due to age-related atrophy of the orbital fat. Long-term glaucoma treatment with prostaglandin eye-drops can also cause this effect. Marked enophthamos, or any significant abnormality of the orbit, may make it difficult or impossible to give a sharp-needle LA safely via the traditional infero-nasal approach.

Patients with ocular movement disorders (e.g. nystagmus) may need a 'block' LA, in order to obtain globe akinesia during surgery. Some patients with congenital nystagmus may have a 'null position' of gaze that would allow TA but otherwise a 'block' LA may be necessary. If the patient has a significant head tremor or other movement disorder (e.g. Parkinson's disease) it may be possible to schedule LA surgery at the time of day that the tremor is minimal, or alternatively it may be necessary to use GA.

Orbital injections of LA could potentially cause orbital infection, by inoculating bacteria into the orbit through the LA needle/cannula. It is standard practice to instil iodine or similar bacteriocidal into the eye prior to cataract surgery to minimize the risk of endophthalmitis: to minimize the risk of orbital infection, this iodine should be instilled prior to any trans-conjunctival LA. In practice, severe orbital inflammation after LA appears to be more commonly associated with the use of animal-derived hyaluronidase in the LA mixture, therefore a 'hot orbit' post-operatively may need treatment with oral steroid in addition to antibiotics.

Conjunctival granulomatous inflammation may occur after sub-Tenon's LA. Smaller incisions and minimal dissection will probably make this less likely to occur.

The term 'wipe-out' is used to describe unexplained visual loss following surgery. Glaucoma patients may be at higher risk. It is possible that anaesthesia technique may account for some cases of wipe-out. Possible mechanisms include direct optic nerve damage from a needle or cannula, vascular occlusion caused by a needle or cannula, vasoconstriction from adrenaline (epinephrine) in the mixture, or prolonged compression of the optic nerve from a large volume of LA and/or use of orbital compression after the LA. Thus, careful attention to LA technique is required to minimise incidences of wipe-out [6, 17]

In summary, one should remain vigilant, anticipate the possibility of serious LA complications, choose the right technique for the patient and eye, and have processes in place to deal with any potential problems. The 2012 Royal Colleges' national guideline on LA for ophthalmic surgery points out that any cataract patient can potentially have a life-threatening problem, though this may not be attributable to anaesthesia. The Guideline states that *'Ideally, an anaesthetist should be available in the theatre complex, particularly when needle blocks such as peribulbar, retrobulbar, and sub-Tenon's blocks for difficult cataracts, or when complex or long cases are being performed. If an anaesthetist is not available in the hospital or ophthalmic unit, peribulbar or retrobulbar techniques should only be used if appropriately skilled staff are immediately available in the operating theatre. A clear, agreed and regularly tested pathway to enable the patient to receive appropriate advanced medical care, including intensive care, should be in place for isolated units*" [3].

Preparing the Patient

When preparing a patient for cataract surgery, one should consider what type of anaesthesia would be appropriate for the patient. For most patients LA is appropriate and is the best choice [3]. The exact technique of anaesthesia may depend on features of the cataract, the eye, the orbit, the patient, the surgical team and the place where the surgery is done. For cataract surgery, the commonest techniques are either STA or TA/ICA. However, a significant proportion of patients will require an anaesthetic technique that is different to the department's 'default' technique, for reasons outlined above. Thus, pre-operative assessment should include explanation of the surgery, and an assessment of patient anxiety level and ability to cooperate with LA [3]. A frequently asked question is whether or not the patient is 'able to lie flat and still for 20 min'. A significant proportion of patients are unable to do this for a large variety of reasons. Depending on the reason for inability to lie flat and/or still, most of these patients can have LA for cataract surgery [24].

In the UK, pre-operative assessment are normally conducted by specially trained nurses, with input from surgical and anaesthetic teams as needed. The

2012 Guideline on LA for Ophthalmic Surgery states that the patient's medical history should be recorded, in order to plan safe surgery and also to facilitate the safe management of any emergency that might occur. The main aspects that should be recorded are past and present illnesses, medications and allergies, past surgery and anaesthesia (and any complications), communicable diseases, ability to lie flat and still, psychosocial issues (anxiety, confusion, panic attacks, claustrophobia, etc.) and communication issues.

The Guideline states that, for a routine patient with no special concerns, examination should be limited to: pulse (rate and rhythm), blood pressure, hearing/comprehension/cooperation, and tremor/abnormal movements. Examination by a doctor should only be needed for those who need input from an anaesthetist for general anaesthesia, intravenous sedation, or if the nurses' assessment indicates that a medical examination would be appropriate, whether or not the patient was due for cataract surgery. Axial length is of relevance to anaesthesia choice, particularly if needle blocks are to be considered—of course, this is routinely measured for cataract patients. Where clinically indicated, the Guideline recommends: pulse oximetry if patient is breathless, examination for sepsis elsewhere in the body, assessment of ability to position appropriately for surgery [3].

Special tests are not necessary for most patients prior to LA cataract surgery. Historically, cataract patients would have a pre-operative physical examination, blood tests (full blood count, renal function tests) and electrocardiogram. There is now good evidence, from well-designed large prospective randomized trials, that these tests are not necessary for routine cataract patients [25, 13]. The Royal Colleges' Guideline states that '*for the patient with no history of significant systemic disease and no abnormal findings on examination at the nurse-led assessment, no special investigations are indicated. In general, tests should only be considered when the history or physical findings would have indicated the need for an investigation even if surgery had not been planned*' [3]. There are some special cases, as follows. For patients on anticoagulants (particularly warfarin), the clotting profile/INR should be assessed within 24 h of surgery. For patients on dialysis, the electrolytes should be assessed on the day of surgery. Screening for infection should be in line with local protocols. The Guideline has advice on the management of patients with diabetes, ischaemic heart disease, hypertension, anticoagulants, renal and pulmonary disease. The Guideline pre-dates the common usage of direct oral anti-coagulants (DOACs) - these, and other agents such as aspirin, should normally be continued for routine cataract surgery.

Consent

Patients must sign a consent form for cataract surgery. At the time of writing this (2018), there is no requirement for a specific consent form to be signed for the anaesthesia. The 2012 Guideline states that the process of surgery should be explained to the patient, and that there should be some mention of anaesthesia.

Written information should be provided. '*Consent must be obtained in the full knowledge of both general and special risks relevant to the operation and anaesthesia. It is the responsibility of the individual administering the anaesthetic to discuss possible complications of the anaesthetic. A separate consent form for the anaesthetic per se is not required, although it is advisable to record the discussion in the patient records*' [3].

More recently, the case of Montgomery versus Lanarkshire [26] has highlighted the need for specific discussions about the likelihood of complications. The court ruled that the surgical consent process should be a dialogue, with risks discussed not just in percentages but also in terms of significance of those risks. The explanation should be comprehensible (i.e. in plain language), and the doctor should discuss all significant risks of the proposed procedure, and also the risks of any reasonable alternatives or variants. The test of 'material risk' is whether in the particular case, 'a reasonable person in the patient's position would be likely to attach significance to the risk, or the doctor is or should reasonably be aware that the particular patient would be likely to attach significance'. In the context of anesthesia for cataract surgery, this means that the clinician should discuss the relative risks of the proposed anaesthesia technique (and the risks of alternative anaesthesia techniques) as part of the process of agreeing which anaesthetic technique to use, and obtaining formal consent.

The discussions of relative risk are made more difficult because of the controversies in ophthalmic anaesthesia, and the lack of hard data on relative risk. The relative risks of sight-threatening and life-threatening complications for the different LA techniques are not fully understood. To ascertain this information would need a prospective randomised trial so large that it could probably never be organised. However, it does appear that needle blocks are more likely to cause sight-threatening or life-threatening complications; blunt-cannula STA lowers this risk and TA/ICA should not have any of these risks. Using TA/ICA avoids these risks, but the potentially 'mobile eye' means that there may possibly be an increased likelihood of surgical complications in certain cases. The evidence-based NICE guideline on cataract surgery in adults [4] advises to use TA/ICA or STA as the default, and that PBA should only be considered if both these techniques are contraindicated. This implies that if needle LA for cataract surgery is required, the reasons for doing so should be explicitly recorded, and the risks discussed with the patient.

Which Anaesthetic to Use, When?

Every patient is different and while surgical teams will often have their preferred 'default' anaesthesia technique, there will always be patients who are unsuitable for the default anaesthesia approach. The following is a guide only and the advice may not apply to your particular patient.

Previous LASIK or other refractive surgery. These patients were usually myopic prior to their corrective procedure. Thus the patient may not need spectacles, yet the globe will remain 'myopic' with a long, wide eye and possible posterior staphyloma. Needle LA is best avoided for these eyes although one could use a single medial peribulbar LA if strictly necessary. Preferred techniques would be STA or TA/ICA.

Myopic eye. See above

Previous explant surgery for retinal detachment. Eyes with an encircling band may become somewhat 'hourglass shaped' giving the same effect as a posterior staphyloma. Thus an encircling band may increase the likelihood of a perforation from a needle LA. The band or explant means that it may be difficult or impossible to pass the cannula for STA. Thus, TA/ICA would be preferable, though in some circumstances it may be appropriate to consider a single medial peribulbar LA

Anxious patient. The patient should be asked why they are anxious about the surgery pre-operatively. Often, all that is needed is explanation and reassurance. Many patients worry that they will not be able to breathe under the drapes, or that they will not be able to keep the eyelids open or stay still. A reclining surgical chair, a hole in the surgical drape, and a person to hold the patient's hand with an agreed method of communication if the patient wishes to request more analgesia is often all that is needed. With good pre-operative assessment and explanation, sedation may be avoided. Others consider mild anxiolytics such as benzodiazepines (e.g. Diazepam 5 mg) IV sedation or general anaesthesia.

Claustrophobia. Again, this issue should be picked up at the pre-operative assessment and not during surgery. Explanation and reassurance may be all that is needed. A 'trial' of positioning and draping in the surgical chair as part of the pre-operative assessment may help patient decide whether their level of claustrophobia enables them to cope with the draping process. Many patients will appreciate having the surgical drape held away from the mouth and nose and/or a large hole in the paper surgical drape. Some patients may require a translucent drape, removal of most of the paper drape, or a 'turban' type drape with cloth wrapped around the head and the face exposed, save for a 20×20 cm transparent sticky drape over the surgical area. Again, a hand-holder and reassurance will be helpful. The surgeon should ensure that the patient is happy to proceed, prior to commencing surgery.

Patient cannot lie flat. There are many reasons why a patient would be 'unable to lie flat and still for 20 minutes'. Often there is an element of anxiety and/or claustrophobia. There are several approaches that can be taken, depending on the reason that the patients cannot lie flat [27]. For orthopnoeic patients with a flexible neck, it may be possible for the patient to sit upright with neck extended, facing the overhead microscope—the surgeon will usually need to stand rather than sit. If there is significant spinal curvature or rigidity, it may be necessary to adopt the 'face to face upright seated position', with the surgeon facing the patient and the microscope rotated toward the horizontal. In this technique, it is preferable to use TA/ICA, in order to ensure that the eye is 'on axis'. Face to face positioning

can be very useful for 'extreme' cases such as those patients who need to be very upright, or are unable to transfer from wheelchair to operating chair [28].

Cataract surgery on both eyes on the same day. It would not be desirable to have a 'block' LA for both eyes, because this may mean that both eyes need to be padded and/or the vision may be poor for some hours, until the block wears off. Often these patients are GA patients, but if LA is used then it would be preferable to use TA/ICA for one or both eyes.

Which Technique is Best for Cataract Surgery?

The above discussion has explained that there is no such thing as a 'best technique of anaesthesia that is perfect for all cataract patients'. Most patients will be suitable for LA, and most patients would be suitable for either TA/ICA or STA. Neither of these LA techniques is absolutely perfect and neither would be suitable for 100% of eyes, 100% of patients or 100% of surgeons. As explained above, each technique has its own risk profile although needle blocks appear to be inherently more prone to sight-threatening or life-threatening complications. Therefore the decision-making process should involve a proper assessment of the patient and discussion of the relative risks of the different anaesthesia techniques. As explained by NICE guidelines, *'If both sub-Tenon's and topical (with or without intracameral) anaesthesia are contraindicated, consider peribulbar anaesthesia. Do not offer retrobulbar anaesthesia for people having cataract surgery'* [4].

How Can I Find Out More About Eye Anaesthesia?

We hope that this short chapter will stimulate the reader to take an interest in eye anaesthesia. Modern books on ophthalmic anaesthesia explain more about techniques [29, 6], but there is no substitute for hands-on learning from experts. Some centres of excellence offer training in ophthalmic anaesthesia techniques, and several societies worldwide also offer practical training as part of scientific meetings. The British Ophthalmic Anaesthesia Society was formed in the mid 1990s, and has annual meetings that include practical hands-on training (www.boas.org). The original Ophthalmic Anesthesia Society (USA) had its first scientific meeting in 1987, and meets annually in Chicago (www.eyeanesthesia.org). In India, the Ophthalmic Forum of Indian Society of Anaesthesiologists (OFISA) meets every two years (ofisa.sankaranethralaya.org). At the time of writing, a new European Society of Ophthalmic Anaesthesia is being set up (link via www.boas.org). Every four years, the World Congress of Ophthalmic Anaesthesia (WCOA) provides a global forum for ophthalmologists and anaesthetists to meet and exchange ideas. Refining and improving anaesthesia techniques should lead to fewer complications and better outcomes for our cataract patients.

References

1. Knapp H. On cocaine and its use in ophthalmic and general surgery. Arch Ophthalmol. 1884;13:402.
2. Cataract Surgery Guidelines. The Royal College of Ophthalmologists. 2010.
3. Local anaesthesia for ophthalmic surgery. Joint guidelines from the Royal College of Anaesthetists and the Royal College of Ophthalmologists. 2012.
4. Cataracts in adults: management. National Institute for Health and Care Excellence (NICE). 2017.
5. Lee RMH, Thompson JR, Eke T. Severe adverse events associated with local anaesthesia in cataract surgery: 1 year national survey of practice and complications in the UK. Br J Ophthalmol. 2016;100:772–6.
6. Jaichandran VV, Kumar C. Jagadeesh. Principles and Practice of Ophthalmic Anaesthesia: Jaypee Brothers Medical Publishers; 2017.
7. Ball JL, Woon WH, Smith S. Globe perforation by the second peribulbar injection. Eye. 2002;16:663–5.
8. Eke T, Thompson JR. The National Survey of Local Anaesthesia for Ocular Surgery I. Survey methodology and current practice. Eye. 1999;13:189–95.
9. Kumar CM. Needle-based blocks for the 21st century ophthalmology. Acta Ophthalmol. 2011;89:5–9.
10. Kumar CM, Eid H, Dodds C. Sub-Tenon's anaesthesia: complications and their prevention. Eye. 2011;25:694–703.
11. Guise P. Sub-Tenon's anesthesia: an update. Local and regional anesthesia. 2012;5:35–46.
12. Allman KG, Theron AD, Byles DB. A new technique of incisionless minimally invasive sub-Tenon's anaesthesia. Anaesthesia. 2008;63:782–3.
13. Minakaran N, Ezra DG, Allan BDS. Topical anaesthesia plus intracameral lidocaine versus topical anaesthesia alone for phacoemulsification cataract surgery in adults. Cochrane Database of Systematic Reviews 2020, Issue 7. Art. No.: CD005276. https://doi.org/10.1002/14651858.CD005276.pub4
14. Lee RM, Foot B, Eke T. Posterior capsule rupture rate with akinetic and kinetic block anesthetic techniques. J Cataract Refract Surg. 2013;39:128–31.
15. Silverstein SM, Greenbaum S, Stern R. Hyaluronidase in Ophthalmology. J Appl Res. 2012;12.
16. Labetoulle M, Findl O, Malecaze F, Alio J, Cochener B, Lobo C, Lazreg S, Hartani D, Colin J, Tassignon MJ, Behndig A. Evaluation of the efficacy and safety of a standardised intracameral combination of mydriatics and anaesthetics for cataract surgery. Br J Ophthalmol. 2016;100:976–85.
17. Creese K, Ong D, Sandhu SS, Ware D, Alex Harper C, Al-Qureshi SH, Wickremasinghe SS. Paracentral acute middle maculopathy as a finding in patients with severe vision loss following phacoemulsification cataract surgery. Clin Exp Ophthalmol. 2017;45:598–605.
18. Quantock CL, Goswami T. Death potentially secondary to sub-Tenon's block. Anaesthesia. 2007;62:175–7.
19. Burkat C, Lemke B. Retrobulbar hemorrhage: anterolaterateral anterior orbitotomy for emergent management. Arch Ophthal. 2005;123:1260–2.
20. Ohno-Matsui K. Proposed classification of posterior staphylomas based on analyses of eye shape by three-dimensional magnetic resonance imaging and wide-field fundus imaging. Ophthalmology. 2014;121:1798–809.
21. Edge R, Navon SE. Scleral perforation during retrobulbar and peribulbar anesthesia: risk factors and outcome in 50,000 consecutive injections. J Cataract Refract Surg. 1999;25:1237–44.
22. Faure C, Faure L, Billotte C. Globe perforation following no-needle sub-Tenon anesthesia. J Cataract Refract Surg. 2009;35:1471–2.

23. Frieman BJ, Friedberg MA. Globe perforation associated with subtenon's anesthesia. Am J Ophthalmol. 2001;131:520–1.
24. Injarie A, Clancy GP, Eke T. Prevalence, surgical management, and complication rate in patients unable to lie flat for cataract surgery. J Cataract Refract Surg. 2013;39:1120–2.
25. Schein OD, Katz J, Bass EB, Tielsch JM, Lubomski LH, Feldman MA, Petty BG, Steinberg EP. The value of routine preoperative medical testing before cataract surgery. Study of Medical Testing for Cataract Surgery. N Engl J Med. 2000;342:168–75.
26. UK Supreme Court. Montgomery v Lanarkshire Health Board (Scotland). UKSC 11, 2015.
27. Rentka A, Kemeny-Beke A. Factors to be considered when performing cataract surgery in patients unable to recline flat. Semin Ophthalmol. 2018;33:443–8.
28. Sohail T, Pajaujis M, Crawford SE, Chan JW, Eke T. Face-to-face upright seated positioning for cataract surgery in patients unable to lie flat: Case series of 240 consecutive phacoemulsifications. J Cataract Refract Surg. 2018;44:1116–22.
29. Kumar C, Dodds C, Gayer S, editors. Ophthalmic anaesthesia. OUP Oxford; 2012.