

Understanding cataract extraction

About 16million people worldwide are affected by cataracts, one of the most common causes of loss of useful vision. With our increasing aged population and rates of elective cataract surgery being used to monitor access to services, pharmacists are meeting more people who have had, or are about to have, a cataract removed. **Lucy Titcomb** explains the management of this condition

A cataract is an opacity in the lens of the eye. The word, derived from the Latin *cataracta* and the Greek *katarraktēs*, meaning white water falling, reflects the similarity between the quality of vision in a patient with cataracts and the blurred image of an object seen through a waterfall.

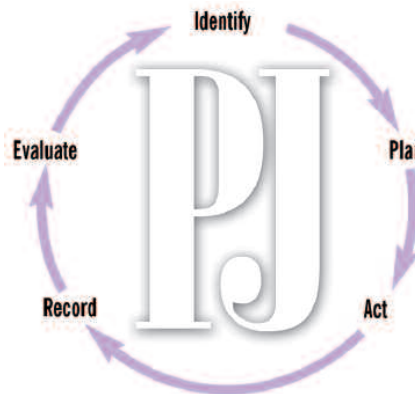
The lens is a biconvex, crystalline structure made up of protein and water, arranged in dense layers of fibres and covered with a clear, elastic membrane called the lens capsule. Coagulation of proteins in the lens leads to loss of transparency. The most common type of cataract develops with the ageing process ("senile" or "age-related" cataracts), but cataracts can have other causes (see Panel 1).

Cataracts are described as nuclear (central), cortical (peripheral) or posterior subcapsular (at the back of the lens, under the lens capsule) depending on the location of the opacity in the lens. Adult cataracts may also be classified as immature (where the lens has some remaining clear areas), mature (a completely opaque lens) or hypermature. A hypermature cataract has a liquefied surface that leaks through the lens capsule. This can cause inflammation of other structures in the eye and secondary glaucoma.

Most people with cataracts have similar changes in both eyes, although one eye may be worse than the other. Many have minimal



Blurred vision can be caused by cataracts



Identify knowledge gaps

1. What are the causes of cataracts?
2. What does cataract surgery involve?
3. What drugs are used before, during and after cataract surgery?

Before reading on, think about how this article may help you to do your job better. The Royal Pharmaceutical Society's areas of competence for pharmacists are listed in "Plan and record", (available at: www.rpsgb.org/education). This article relates to "common disease states" (see appendix 4 of "Plan and record").

Panel 1: Causes of cataracts

- Congenital (1 in 2,000 births), which can be hereditary (eg, cri du chat syndrome, Down, Edward and Patau syndromes), metabolic (eg, hypoglycaemic) or infectious (eg, toxoplasmosis, rubella, cytomegalovirus and herpes simplex)
- Ageing
- Trauma (including eye surgery)
- Eye disease (eg, uveitis, high myopia, retinitis pigmentosa, glaucoma)
- Systemic disease (eg, diabetes mellitus, galactosaemia, low serum calcium levels)
- Environmental exposure (eg, to UV light or lead)
- Radiotherapy
- Hereditary disorders (eg, neurofibromatosis, retinitis pigmentosa) — the heritability of age-related cataract could be 48–59 per cent
- Lifestyle factors (eg, poor nutrition, smoking, excess alcohol consumption)
- Drugs (eg, steroids [systemic, inhaled, periorbital, dermatological and nasal], long-term aspirin [≥ 10 years], gold, some antimalarials, phenothiazines, busulfan, amiodarone)

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visual disturbances and are not aware of their cataracts. However, for those over 55 years of age, cataracts are the leading cause of loss of vision. The sight of 59 per cent of people over 80 years and 71 per cent of people over 85 years is affected by cataract development, with women being more commonly affected than men (the prevalence ratio of females to males is 1.22).¹ It is estimated that 2.4million people aged 65 or over in England and Wales have a visually impairing cataract in one or both eyes and a further 225,000 new cases of visually impairing cataract are expected each year. Worldwide, five to 10 million new, visually disabling cataracts develop every year.

Patients with age-related cataracts develop symptoms gradually. Vision becomes blurred, bright lights cause glare and vision at low light intensities is impaired. There may also be changes in colour perception — typically xanthopsia, where white objects appear yellow and blues are less intense.

Diagnosis

Cataracts are often diagnosed by optometrists and GPs during routine eye examinations. There is, as yet, no proven pharmacological treatment for cataracts so patients are referred to an ophthalmologist for cataract extraction.

Panel 2: Risks associated with cataract surgery

Bleeding Bleeding is uncommon because the site of the incision is the avascular cornea. Rarely choroidal bleeding occurs, which can lead to blindness.

Bullous keratopathy Corneal swelling, due to the disruption of the endothelial layer of the cornea which controls the water content of this part of the eye, can cause cloudy vision.

Cystoid macular oedema Cystoid macular oedema is the accumulation of fluid at the macula resulting in decreased visual acuity.

Glaucoma Secondary glaucoma can result from inadequate flushing of viscoelastic materials used in the eye during surgery, post-operative inflammation or the use of steroids post-operatively. A large rise in intraocular pressure would cause pain and possibly nausea and vomiting.

Infection Infection occurs in approximately 1 in 1,000 cases. Treatment of post-operative infection may involve additional surgery, injection of intraocular antibiotics and intensive topical treatment with antibiotics.

Loss of nucleus If the lens is dropped into the vitreous during surgery, further surgery will be required.

Opacity in the posterior capsule The development of an opacity in the membrane holding the lens is a relatively common risk but easily resolved by laser treatment.

Perforation of the globe Perforation of the globe is a risk associated with the use of injectable local anaesthetics.

Retinal tear or detachment Short-sighted patients have an increased risk of a retinal tear or detachment. Flashes and floaters are signs of a retinal tear.

Uveitis Inflammation of the uveal tract can be caused by trauma such as surgery.

Ophthalmic assessment At the ophthalmic clinic a thorough examination will be performed. The surgeon will discuss with the patient how the cataract impacts on his or her day-to-day activities, such as ability to drive. The patient will be advised not to drive to the appointment because mydriatic drops will be used and the patient will not be able to see clearly enough to drive home.

Visual acuity is measured using an eye chart and the eye is examined through a dilated pupil to visualise fully the lens opacity and assess the eye for signs of other diseases, such as optic disc cupping (seen in glaucoma) or abnormal vasculature (seen in diabetic retinopathy). This pre-operative work is essential because 80 per cent of patients undergoing cataract surgery in the UK are over 70 years old and serious co-existing eye conditions are common. Also, the presence of these conditions can affect the degree of visual improvement the patient can expect from cataract extraction.

Intraocular pressure is measured following instillation of local anaesthetic drops and fluorescein dye. The length of the eye will be measured using ultrasonography or a laser and the curvature of the cornea (to determine its focusing power) will be measured using keratometry. These measurements will be used to calculate the strength of intraocular lens to be implanted.

Risks The risks of surgery will be explained and a decision about anaesthesia and length of hospital stay made before an informed consent

document is signed. Risks associated with cataract surgery are detailed in Panel 2.

Most patients undergo cataract surgery as day cases and under local anaesthesia. Patients will be given instructions about food and drink and whether to take their medicines as usual on the day of surgery. These instructions will vary, depending on the time of surgery and the type of anaesthesia agreed.

Routine pre-operative tests such as electrocardiography, full blood count and glucose and electrolyte measurements are not generally performed for patients undergoing local anaesthesia because these measurements do not result in a reduction of adverse events.²

Cataract surgery

Cataract surgery accounts for a significant proportion of the surgical workload of most ophthalmologists and is the most common elective surgical procedure performed in the UK. According to Hospital Episode Statistics, almost 300,000 such operations were performed in England alone in 2003–04, with 92 per cent of patients being treated as day cases.

Cataract removal is one of the oldest surgical procedures having been performed as early as 800BC. At that time the lens was dislocated with a needle. The removal of the patient's lens results in a loss of refractive power and this is normally replaced by the insertion of an intraocular implant. Such lenses were originally developed during the 1939–45 war by an ophthalmic surgeon involved in the treatment of Royal Air Force pilots who had pieces of shattered plastic aeroplane canopies imbedded in their eyes. The pilots exhibited little or no reaction to the imbedded material, which prompted the development of a plastic lens. The first lens implantation was performed in 1950.

The main aims of modern cataract surgery are:

- To restore vision (to meet the patient's needs)
- To achieve the desired refractive outcome (Although the surgeon will aim to reduce the patient's dependence on spectacles as much as possible, the patient may require distance glasses for best vision and will probably need reading glasses. In any case, the patient's prescription for glasses will change after the operation.)
- To improve quality of life
- To ensure patient safety and satisfaction

Successful removal of the cataract will prevent the development of hypermaturity and give the health care professional a better view in — particularly important for managing eye diseases, such as glaucoma, and monitoring for diabetic retinopathy. Cataract removal and replacement with an intraocular lens will also give the patient a better view out. The most popular method of cataract removal used today is phacoemulsification.

Phacoemulsification First used in the late 1960s, phacoemulsification accounted for 98

Successful removal of the cataract will prevent the development of hypermaturity

per cent of all cataract surgery in England in 2003–04 (Hospital Episode Statistics). A tiny incision is made on the side of the cornea and a probe with a needle-like tip is inserted into the eye. The anterior part of the lens capsule is dissected and the lens is broken into tiny pieces by ultrasonic vibration (40Hz). The lens fragments, suspended in a stream of irrigating fluid, are aspirated from the eye through the probe. The posterior part of the lens capsule is left in place and a foldable intraocular lens is placed inside the capsule to replace the opaque lens. The incision self heals and no stitches are necessary.

Drugs used in cataract extraction

Patients with pre-existing inflammatory conditions of the eye may be given a pre-operative course of topical corticosteroids (eg, dexamethasone 0.1 per cent drops or prednisolone acetate 1 per cent drops, every two hours for two weeks before surgery) to reduce peri- and post-operative inflammation. In severe cases, oral (prednisolone 40mg *od* for two weeks before surgery, reduced by 5mg *od* per week post-operatively) or intravenous (methylprednisolone 500mg approximately one hour before surgery) corticosteroids are also prescribed.

Starting at least 30 minutes before surgery, the following types of eye drop are instilled to dilate the pupil and maintain the dilation during surgery:

- An antimuscarinic (usually cyclopentolate) which causes mydriasis by blocking parasympathetic innervation to the sphincter muscle of the iris
- Phenylephrine, a sympathomimetic, which causes mydriasis by stimulating the radial muscle of the iris

Some surgeons use a non-steroidal anti-inflammatory drug (diclofenac or flurbiprofen) to inhibit the formation of prostaglandins which cause miosis (contraction of the sphincter muscle of the iris) when released in response to the trauma of surgery. If an NSAID is used, the pre-operative regimen should start two hours before surgery, with one drop instilled every 30 minutes.

Anaesthesia In theatre, local anaesthetic drops precede the instillation of antiseptic eye drops (povidone iodine 5 per cent) administered to reduce the number of bacterial colonies on and around the eye. These drops are not commercially available in the UK but can be imported from the US (Betadine ophthalmic solution) or purchased from hospital manufacturing units such as Ipswich, Moorfields or Torbay in England, Tayside Pharmaceuticals in Scotland or Belfast in Northern Ireland.

General anaesthesia is suitable for patients admitted as day cases if a sufficiently short-acting regimen is used (eg, an infusion of propofol or etomidate, vecuronium and isoflurane). General anaesthesia may be considered for:

- Patients who decline local anaesthesia even after careful counselling and an explanation of the risks involved
- Patients who are confused and unable to comply with instructions or unable to communicate and whose safety might be compromised
- Patients with a marked uncontrolled tremor (eg, in Parkinson's disease)
- Patients with a medical condition severe enough to limit acceptable positioning (eg, orthopnoea, kyphoscoliosis)
- Young patients
- Patients who have previously experienced a severe reaction, allergy or other complication to local anaesthesia



Geoff Tompkinson/SPL

Phacoemulsification is the most common method of cataract removal

Patients with pre-existing inflammatory conditions of the eye may be given a pre-operative course of topical corticosteroids

Local anaesthesia may be achieved by use of topical eye drops, with or without an intracameral injection (into the anterior chamber of the eye), or by a variety of injectable methods, the most popular being sub-Tenon's (under Tenon's capsule, which covers the posterior two thirds of the eyeball) and peribulbar (around the eye).

Topical anaesthesia involves the use of oxybuprocaine, tetracaine, bupivacaine or proxymetacaine eye drops or lidocaine gel and the intracameral injection of preservative-free lidocaine usually at a concentration of 1 per cent. Sub-Tenon's or peribulbar injections involve the use of lidocaine and bupivacaine or prilocaine injections often combined with hyaluronidase, used as a spreading agent. After administration of a local anaesthetic injection, a pouch containing mercury is applied to the closed eye for about five minutes. The small weight assists even spread of the injected anaesthetic.

During surgery After the attainment of an adequate degree of anaesthesia, the surgeon makes an incision at the edge of the cornea and introduces a viscoelastic material such as sodium hyaluronate into the anterior chamber to coat the corneal endothelium and protect it from damage during surgery. The eye is irrigated with a balanced salt solution (some surgeons add a prophylactic antibiotic [eg, cefuroxime] to the solution) while the lens is removed and replaced by the implant.

At the end of the procedure, which usually lasts less than half an hour, subconjunctival injections of an antibiotic and a corticosteroid (eg, cefuroxime and betamethasone) are administered.

Post-operative care

After the operation the patient's eyelid is closed and a sterile eyepad applied or a plastic eyeshield is taped over the eye. The patient will be advised not to disturb the covering and will normally be reviewed the following day either by attendance at the hospital or by a telephone call to or from an ophthalmically trained nurse, after which the eye protection is removed. However, it is sometimes recommended that eyeshields are worn at night.

Patients will be warned not to wear make up and to avoid heavy lifting, strenuous exer-

Advances in cataract surgery

Ophthalmology is an area in which technology is used to good effect to improve outcome of surgery continuously and cataract extraction is no exception. Advances include:

- Improved and more efficient phacoemulsification machines
- New ways of in situ cataract disintegration
- Even smaller incisions
- Innovations in intraocular lens design, such as multifocal implants, accommodating implants, implants that reduce optical aberrations and adjustable implants
- Replacement of post-operative anti-inflammatories with a single injection

cise and swimming until after their four-week review.

On discharge from the hospital, the patient will be given an anti-inflammatory and antibiotic combination eye drop, such as Maxitrol (dexamethasone, neomycin and polymyxin), Tobradex (dexamethasone and tobramycin), or Betnesol-N or Vistamethasone N (betamethasone and neomycin). Alternatively, an anti-inflammatory eye drop, such as dexamethasone 0.1 per cent, prednisolone acetate 1 per cent or betamethasone 0.1 per cent, is supplied with an antibiotic eye drop, such as chloramphenicol 0.5 per cent. The antibiotics in these combinations provide broad spectrum cover as prophylaxis against post-operative infection.

Potent steroids will cause a rise in intraocular pressure in about 6 per cent of the population. If such a rise is expected, rimexolone 1 per cent or diclofenac 0.1 per cent eye drops may be used as an anti-inflammatory. The potential for this adverse effect may have been recorded previously in the patient's notes but for most people there is no way of predicting such a response.

If there is a large amount of post-operative inflammation or this is anticipated, a mydriatic-cycloplegic eye drop such as cyclopentolate may be included in the post-operative regimen. Many surgeons also routinely prescribe acetazolamide, an oral carbonic anhydrase inhibitor, to prevent a post-operative rise in intraocular pressure. If the patient is using other eye drops in the operated eye (eg, a beta-blocker for glaucoma), a fresh supply of these drops is issued to prevent the use of contaminated drops in a compromised eye.

Patients are advised that if they have discomfort they should take paracetamol every four to six hours but to avoid aspirin because of the risk of bleeding. Discomfort should subside after a day or two. If a patient experiences excessive pain, loss of vision or increasing redness of the eye, he or she should return to the hospital for prompt review. Patients usually take the first post-operative week off work.

Post-operative eye drops should usually be used four to six times a day and the patient sees a health care professional (either an ophthalmic surgeon, ophthalmically trained nurse, orthoptist or optometrist at the hospital or in the community) for a review after about four weeks. By that time the patient's eye will normally have settled to a sufficient degree to

allow measurement for new spectacles. The patient should have good distance vision, but will need reading glasses because the ability to focus is lost.

Eye drops are generally continued for four to six weeks after the operation and, therefore, the patient will often need more than the initial supply issued by the hospital particularly when the eyedrop bottle has been opened in the hospital and an in-use shelf life of less than 28 days has been allocated. With a maximum drop volume of 50µl (20 drops per ml), the patient should never require more than 10ml of eye drops.

The pharmacist should check the need for supplies requested more than six weeks after the operation. Prolonged use of topical corticosteroids without ophthalmic supervision due to lack of review of repeat prescribing can result in an iatrogenic glaucoma.³

Conclusion

The importance of cataracts as a public health issue will grow as life expectancy increases. Pharmacists can help to allay patients' fears by being able to discuss what is involved in this successful surgical intervention, which has improved the quality of life of so many patients.

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Action: practice points

Reading is only one way to undertake CPD and the Society will expect to see various approaches in a pharmacist's CPD portfolio.

1. Read the article on pp261–4 about nutraceuticals for eye health.
2. Look up which drugs might contribute to cataracts.
3. For different dosage regimens, make sure your preregistration trainee or dispenser is able to calculate how long a 5ml and 10ml bottle of eye drops lasts.

Evaluate

For your work to be presented as CPD, you need to evaluate your reading and any other activities. Answer the following questions: What have you learnt? How has it added value to your practice? (Have you applied this learning or had any feedback?) What will you do now and how will this be achieved

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Further reading

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