Ocular Local Anaesthetics

Overview

Local anaesthetics (LAs) are used in the initial assessment of minor eye trauma, the removal of superficial foreign bodies, measurement of intraocular pressure using applanation tonometry and in ocular surgery. Application of LAs in the correction of strabismus is being explored[1].

These agents should not be used for long-term management of ocular pain: they are toxic to the corneal epithelium. They also abolish the corneal reflex so increasing the risk of corneal damage. Topical non-steroidal anti-inflammatory drugs (NSAIDs), such as diclofenac eye drops, may have some role in pain management but their efficiency is uncertain and they should not be used as a substitute for oral analgesia (paracetamol, oral NSAIDs)[2].

LAs work by blocking initiation and propagation of neuronal action potentials. Small-diameter, myelinated nerves are most susceptible to LA action - but not exclusively so - and therefore patients will often report preservation of sensory modalities other than pain.

See also separate Eye Injuries, Corneal Foreign Bodies, Injuries and Abrasions and Diagnosing Conjunctival Problems articles.

Anaesthetic drops

There are a number of anaesthetic drops available. Subtle differences between them make them more or less appropriate in different individuals. New drops appear in the literature from time to time (such as diphenhydramine - developed for its hypoallergenic properties) but this is not yet licensed here in the UK[3].

- **Examples** - lidocaine hydrochloride, oxybuprocaine hydrochloride, proxymetacaine hydrochloride, tetracaine hydrochloride (amethocaine hydrochloride)[2].
- **Use** - largely for initial assessment of minor trauma and for removal of conjunctival and corneal foreign bodies. There is some debate about their use in surgery, particularly cataract surgery, where some authors claim equal or better analgesia to injected LA[4]. However, in the UK, injected LA is very much the norm for ocular surgery in the absence of complicating factors (see below).
- **Contra-indications** - known hypersensitivity reaction, neonates.
- **Caution** - hypertensive patients[5].
- **Administration** - these come in single-dose preparations. Warn the patient of brief stinging on application: proxymetacaine stings a little less (useful in highly anxious patients and children)[6]. Tetracaine produces a more profound anaesthesia. Pain that is not relieved by topical LA suggests a more serious problem than superficial corneal or conjunctival injury[2].
- **Ocular side-effects** - transient stinging; epithelial and stromal keratitis if overused[5]. They are, however, known to inhibit corneal epithelial cell healing and so interfere with repair of corneal epithelial wounds. Tetracaine is a particular problem in this respect. For these reasons, repeated administration of LA drops should be avoided and they should not be given to patients to take home for pain relief.
- **Systemic side-effects** - none noted with these topical drops.

Injected anaesthetics

- **Examples** - lidocaine hydrochloride is the most commonly used agent but individual surgeons may use other agents such as bupivacaine and cocaine.
- **Use** - minor operations, oculoplastic surgery, anterior segment and cataract surgery.
Contra-indications and cautions - see individual drug monographs. Other contra-indications for LA use in intraocular surgery include patient refusal and concurrent medical conditions preventing correct positioning of the patient. Such patients require general anaesthesia.

Administration - local subcutaneous injection to skin, subconjunctival injection, sub-Tenon injection (see below), peribulbar and retrobulbar injections. The latter two carry a greater risk of adverse effects and are not commonly used. Maximal arterial plasma concentrations vary with each drug: using longer-acting drugs is preferable to repeated injections. The drugs should not be injected into traumatised or inflamed tissues, as this increases the likelihood of systemic absorption and adverse effects.

Ocular side-effects - none from the drug if correctly administered. Peribulbar and retrobulbar injections are trickier and can result in retrobulbar haemorrhage, globe puncture, optic nerve damage, muscle palsy and seventh cranial nerve complications. Systemic side-effects - rare but can occur if a very large dose is injected or if a normal dose is inadvertently injected intravenously. These include vasovagal reactions, confusion, respiratory depression, convulsions, hypotension and bradycardia.

Choice of anaesthetic in ocular surgery

The choice of anaesthetic in ocular surgery depends on the procedure, the patient and, to a lesser extent, the surgeon's preference. There are office-based tests that can help evaluate the suitability of a given patient for local anaesthesia - these are best carried out by the operating surgeon. There are wide variations in practice across the UK.

With any operation, the initial choice is between a general anaesthetic (GA) and LA. LA is used in 95% of cataract operations in the UK. When the decision is made to use an LA, the choice is between an injected anaesthesia and drops.

GA is generally considered most appropriate for children and younger cataract patients. GA is also normally offered in trauma cases and to patients who will have trouble keeping still because of, for example, significant tremor or confusion or distress.

Injected local anaesthetic

Injected anaesthetics are routinely used for oculoplastic procedures.

Usually the LA is infiltrated directly into the skin around the operation site. For globe surgery (e.g., cataract operation), LA may be administered through the lower lid and under the globe (peribulbar/retrobulbar anaesthesia). Highly effective anaesthesia and extraocular muscle block can be achieved but this method may be associated with serious complications.

Alternatively, in globe surgery, the sub-Tenon's technique involves making a very small incision in the anaesthetised conjunctiva, the passage of a pre-curved blunted needle into the space between it and the globe (the sub-Tenon's space) and infiltration of the anaesthetic. Good anaesthesia is achieved with generally a good muscle block.

In a study comparing patient satisfaction, the sub-Tenon's technique revealed itself to be superior to the peribulbar technique, particularly when higher doses of hyaluronidase (see 'Agents added to LAs', below) were added.

The sub-Tenon's technique: what to expect

If a patient is told that they will have an 'injection in the eye' (such as the local anaesthetic before cataract surgery or steroid treatment in severe uveitis), they will experience the following:

- An anaesthetic drop will be administered.
- A small spring will be applied to hold the lids open (painless).
- A small incision will be made in the conjunctiva: they should not feel it.
- They will probably feel the agent being infiltrated in: there may be a burning or stinging sensation. Some patients feel nothing.
- The spring is removed and a pad is placed over the eye.
Discomfort/pain varies between individuals and depends on what is being injected. Patients will commonly have a red eye or may have a small subconjunctival haemorrhage afterwards: this should resolve over 24-48 hours.

In both these LA techniques, pain and muscular function are affected but sight is preserved; the degree varies from one patient to another, as does the experience. Many describe seeing colours, waves and rainbow-like images.

A significant number of patients fear intra-operative visual experiences. Retrospectively, about 20% of individuals actually describe their experience as frightening (this correlates highly with pre-operative anxiety).

**Risks of injected local anaesthetic**
These should be explained to the patient at the consent stage of proceedings. Generally, these are very safe techniques. Localised self-limiting haemorrhage is reasonably common but serious.

Sight-limiting complications are very rare, occurring in 0.06% of injected LAs. They are 2.5 times more common in peribulbar/retrobulbar LA than with the sub-Tenon's technique and include retrobulbar haemorrhage, intravenous injection and globe perforation. Whilst there are no absolutely safe techniques, the sub-Tenon's block appears still to be the safest option to date [7, 11].

Patients on anticoagulants or antiplatelet agents are at significantly increased risk of minor complications associated with injected LAs [12].

**Drops**
Locally applied anaesthetic drops also have a place in cataract operations, being used in about 22% of UK operations. They are easy to apply and are associated with minimal discomfort and side-effects. Their principal problem lies in the fact that they do not block muscular action. This can be an issue in procedures where movements of a millimetre or less can have serious consequences.

It has been suggested that postoperative discomfort is greater following topical anaesthesia but this point remains contentious [13].

**Agents added to local anaesthetics**

- **Fluorescein** - the dye is combined with either lidocaine or proxymetacaine eyedrops, to enable visualisation of corneal epithelial defects, and used for tonometry.
- **Adrenaline (epinephrine)** - effectively diminishes local blood flow, so decreasing systemic absorption and prolonging local effect. Very low concentrations are used (in the order of 1:80,000 to 1:200,000). This is reserved for use in injected LAs and is not added to eye drops.
- **Hyaluronidase** - this enzyme is added to increase tissue permeability to injected fluid, usually at a concentration of 15 units/mL.

**Further reading & references**

2. Corneal superficial injury; NICE CKS, September 2012 (UK access only)

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