Warming lignocaine reduces the pain of injection during peribulbar local anaesthesia for cataract surgery

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Abstract

Aims—To test if the simple technique of warming lignocaine reduces the pain of injection during local anaesthetic cataract surgery.

Methods—Sixty patients undergoing peribulbar local anaesthesia for cataract surgery were allocated randomly to receive either warm (37°C) or cold (room temperature) plain 2% lignocaine for the injection. Pain was assessed subjectively by asking the patients to score their pain from 0 (no pain) to 10 (most severe pain imaginable).

Results—The mean pain score for the warm group was 2.3 (SD 1.3) in comparison with a mean score of 5.5 (1.0) for the cold group ($p < 0.01$).

Conclusions—The process of warming lignocaine to 37°C has been found to reduce significantly the pain of injection during peribulbar local anaesthesia. It is recommended that this technique be more widely adopted in order to minimise patient's discomfort.

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Infiltration of the skin and subcutaneous tissues with local anaesthetic solutions often produces pain and a burning discomfort which is often severe enough to be the most unpleasant part of a surgical procedure performed under local anaesthesia.^{1,2} There is an increasing trend for local anaesthesia (mainly peribulbar or retrobulbar injections) during cataract surgery in the UK,³ and therefore the need to relieve patient anxiety and pain is important.

Various techniques have been employed in order to reduce patient discomfort during the administration of a local anaesthetic. In ophthalmic surgery, local anaesthetic cream such as EMLA applied to the skin of the lower lid before retrobulbar injection has been shown to be beneficial in terms of pain relief during needle entry.⁴ The disadvantages of this method, however, are that EMLA cream requires to be in contact with the skin for 60–90 minutes for effective anaesthesia, it can become misplaced or rubbed off, and significantly it will have no effect on the pain caused by the injection of the anaesthetic agent itself. Another method of providing a comfortable block and one which is gaining popularity in the UK, is to give a pre-injection with local anaesthetic solution diluted to 10% of the full strength with balanced salt solution.⁵ Amethocaine 1% drops are also commonly

instilled into the conjunctival sac to provide anaesthesia before anaesthetic injection through the conjunctiva; however, this universally causes a temporary stinging discomfort to the patient.

There have been several reports in the literature suggesting that warming anaesthetic solutions reduces the pain associated with anaesthetic injection; however, much of the evidence is anecdotal and several conflicting conclusions have been drawn. There have been no published studies to examine the efficacy of this technique in ophthalmic practice and we have, therefore, designed our own double blind randomised trial to assess the potential benefit of warming 2% plain lignocaine to body temperature during peribulbar anaesthesia for cataract surgery.

Patients, materials, and methods

Sixty patients undergoing routine extracapsular cataract surgery under local anaesthetic were recruited to the study. Informed consent was obtained and they were allocated randomly to receive either 2% lignocaine hydrochloride (Phoenix Pharmaceuticals Ltd, Pharma Hameln GmbH, Germany) at room temperature (17–20°C, 'cold') or body temperature (37°C, 'warm'). There were 13 males and 17 females in the cold group with an age range of 63–101 years and a mean of 79.9 (SD 9.2) years. In the warm group there were 12 males and 18 females, with an age range of 63–92 years and a mean age of 79.8 (SD 7.1) years.

A pilot study had shown that prewarming 5 ml ampoules of lignocaine to 45°C in a thermostatically controlled water bath (Grant Instruments, Cambridge) and then drawing up 8 ml into a 10 ml syringe resulted in a final temperature of 37°C if the injection was given within 30–40 seconds. Room temperature vials were taken from the stock cupboard.

The study was performed double blind. The patients were unaware of the solution temperature, and the injections were all given by a single investigator who had knowledge of the solution temperatures; however, a separate investigator who was blind to the trial asked the questions relating to the pain perceived. A standard peribulbar technique was employed using a single entry site through the infero-temporal conjunctival fornix which had been anaesthetised with topical 1% amethocaine drops. In all cases 7–8 ml of 2% plain lignocaine and 150 IU of hyalase (CB Pharmaceuticals Ltd, Wrexham) in a 10 ml syringe with a 25 mm, 25 gauge sharp tipped needle (Microlance 3, 25 GI 0.5×25 No 18,

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Becton Dickinson) was used. The needle was aimed tangentially to the globe and a periconal injection aimed into the anterior half of the orbit was made over a 30–40 second period. The commonly employed two injection technique, with a second injection into the medial compartment of the orbit was avoided to prevent possible confusion arising between the pain of the two injections (the second injection being likely to be relatively pain free compared with the first). Patients were asked to comment on the pain of the injection rather than the needle entry.

The subjective response to pain was assessed by asking the patients to choose an integer between 0 and 10, where 0 represented no pain and 10 the worst pain imaginable. Linear visual analogue scales, whereby a mark is made on a continuous line, are a commonly used method of scoring pain. It was felt, however, that this group of elderly patients with poor vision and who were lying supine, would be unlikely to accurately place a mark at the desired location on such a scale. Since the linear analogue scores were ordinal, a non-parametric Mann Whitney U test was used for the statistical analysis.

Results

The subjective assessment of pain experienced by the patients during injection of the local anaesthetic is represented in Table 1 as a frequency table. The mean pain score for the warm group (2.3 (SD 1.3)) was significantly lower than that of the cold group (5.5 (1.0)) (Mann Whitney U statistic=25, $p<0.01$).

Discussion

The practice of warming local anaesthetic agents was first described in 1967⁶ and since then there have been many anecdotal reports; however, there is considerable disagreement in the literature as to the efficacy of this technique. Several studies have shown that warming lignocaine significantly reduced the pain of injection^{7–9} whereas other workers have reported no difference.^{10,11} Only two studies were performed double blind,^{7,11} and in two studies there was no standardisation of the injection site.^{9,10} In one study, varying volumes of anaesthetic solution were used,¹⁰ while it has been shown that factors such as needle size, volume of anaesthetic, and speed of injection may all affect the pain of injection.¹² There has been only one report in the ophthalmic literature which stated that preheating local anaesthetic agents used for retrobulbar and facial nerve blocks greatly decreased patient discomfort, although no evidence to substantiate this claim was produced.¹³

Table 1 Subjective assessment of pain during peribulbar injection

Patient group	No of patients with pain score											Total
	0	1	2	3	4	5	6	7	8	9	10	
Cold	0	0	0	0	5	10	12	2	1	0	0	30
Warm	1	8	8	9	2	2	0	0	0	0	0	30

In this study lignocaine ampoules were preheated with the use of a water bath which has the advantage of being thermostatically controlled such that desired temperatures can be preset conveniently. 'Wet' incubation, however, does carry the theoretical risk of chemical or organism contamination of the outside of the ampoules which can enter the solution on opening. Dry incubators, baby bottle warmers, and yoghurt makers are also available and used by dentists and anaesthetists, although these have the drawback of needing to be thermometer verified.

The study was performed 'double blind', in as far as this was possible, by having a separate investigator who was blind to the trial asking the questions relating to the pain perceived. True operator blinding was not feasible as the solution temperature could be detected through the syringe and it is conceded that this could be a source of bias – for instance, in the way the injection was administered.

The reason for the decrease in pain associated with warm lignocaine is not known, although a number of hypotheses have been suggested. Nerve endings are sensitive to cold, and greater pain may be due simply to greater nociceptor stimulation by the colder solution. Local anaesthetics in clinical use are usually supplied as a salt between hydrochloric acid (HCl) and a weak base (L), and dissociate in the presence of water as follows:

where the square brackets denote concentration. Dissociation of salt (equation (1)), is usually complete, therefore equation (2) becomes the limiting step in the dissociation. The dissociation constant (K_a) of a local anaesthetic is defined as follows:

$$K_a = \frac{[H^+] \times [L]}{[LH^+]} \quad (3)$$

where [L] is the concentration of local anaesthetic free base, [LH⁺] is the concentration of protonated (charged) anaesthetic and [H⁺] the hydrogen ion concentration. It has been postulated that aromatic amine local anaesthetics penetrate cell membranes in the uncharged form and bind to the putative intracellular receptor(s) in the charged form.¹⁴ The ratio of these two species is determined by the dissociation constant (K_a) of the anaesthetic and the hydrogen ion concentration according to equation (3). The K_a of a given anaesthetic is an equilibrium quantity and workers have shown that the K_a increases with increases in temperature.¹⁵ It can be seen, therefore, that the higher temperature (via an increase in K_a) would result in a greater concentration of the free base form of anaesthetic, facilitating more rapid diffusion and a faster onset of neuronal blockade.¹⁵ A similar theory has been proposed for the reduction in the pain of injection after the alkalisation of local anaesthetic solutions where a decreased [H⁺] also gives rise to an increased free base to charged anaesthetic ratio.¹⁶

Many dental practitioners have adopted the technique of warming lignocaine to 37°C

before injection; however, it has not become common practice among the medical profession. Often the patient's main fear is of the anaesthetic injection, and we have shown that patients' discomfort can be reduced by this method, thereby making these unpleasant procedures more acceptable.

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