Clinical trial

Taking the 'ouch' out – effect of buffering commercial xylocaine on infiltration and procedure pain – a prospective, randomised, double-blind, controlled trial

I Younis, RP Bhutiani

Day Surgery Unit, Northwick Park and St Mark's Hospitals, Harrow, UK

Aims: To compare the effect of buffered commercial 1% xylocaine (with 1:200,000 adrenaline) and the unbuffered commercial 1% xylocaine (with 1:200,000 adrenaline) preparation on pain during infiltration and procedure.

Patients and Methods: A randomised, double blind controlled trial involving 85 patients who underwent bilateral vasectomy under local infiltration anaesthesia.

Results: Each patient served as his own control by receiving the buffered commercial preparation on one side and unbuffered commercial preparation on the other. Linear analogue pain scores during infiltration and procedure were recorded and analysed. The study demonstrated that pain perceived by the patient both during infiltration and the procedure was significantly lower when buffered commercial xylocaine was used as compared to the pain perceived with the use of unbuffered commercial xylocaine.

Conclusions: Use of buffered xylocaine is a simple, inexpensive and significantly effective way of reducing pain during infiltration and in surgical procedures performed under local anaesthesia.

Key words: Buffering – Xylocaine – Pain

The administration of local anaesthetics often causes significant discomfort. This is commonly perceived as a 'burning pain' sensation,¹ the severity of which depends on the type of local anaesthetic used² and the pain threshold of the patients. It can be severe enough for some patients to decline the procedure and demand general anaesthesia.

Slow infiltration of the agent, use of a small gauge needle, injecting during needle withdrawal and injection into deep dermal tissue as opposed to superficial^{1,3} as well as warming the preparation from room temperature to

body temperature^{4,5} are some of the procedures employed in an attempt to reduce the infiltration pain.

Xylocaine is the most widely used local anaesthetic agent. It has a pH of 6.36, which reduces to 3.82⁶ with the addition of 1:200,000 adrenaline. The low pH increases the stability and shelf life of the agent.⁷

The use of commercial xylocaine buffered with sodium bicarbonate is a common practise in the US.⁸ However, very few surgeons in the UK use pH-adjusted local anaesthetic due to lack of awareness.⁹ This may, in part, be due to the paucity data available on the effect of buffered

Correspondence to: Mr RP Bhutiani, Department of General Surgery, Northwick Park Hospital, Watford Road, Harrow HA1 3UJ, UK.
E-mail: bhutiani@aol.com

local anaesthetic on infiltration and procedure pain. Our search found only one study that had investigated this aspect of local anaesthesia. This study had, however, pooled the results of five surgeons each using different volumes of the anaesthetic agent with his or her individual technique of infiltration and procedure.¹⁰

We undertook this controlled, double-blind trial to evaluate if the use of a buffered xylocaine with 1:200,000 adrenaline imparts any significant reduction to the perceived pain during infiltration and the operative procedure, as compared to the use of unbuffered solution.

Patients and Methods

Ethical approval was obtained from the Harrow Research Ethics Committee and a Medicines (Exemption form Licences) (Special Cases and Miscellaneous Provisions) Order 1972 was obtained from the Medicines Control Agency for supply of 1% xylocaine with 1:200,000 Adrenaline from Northwick Park and St Marks Hospital pharmacy.

Titration and stability studies, performed by the Northwick Park and St Mark's Hospital pharmacological department, demonstrated that addition of 0.5 ml of 8.4% sodium bicarbonate reproducibly raised the pH of a 9.0 ml aliquot of commercial 1% xylocaine with 1:200,000 adrenaline from pH 3.82 to pH 7.0–7.2 without precipitation. Precipitation occurred with the addition of 0.8 ml or more of sodium bicarbonate. We adjusted the pH of the xylocaine with 1:200,000 adrenaline using the results of a titration study, just before the start of the operation list.

The procedure of vasectomy, possible complications, and the involvement of the patients in the study were fully explained by the surgeon (RPB) to every patient on each operating list. Each patient consented to the procedure and participation in the study. A total of 85 patients (average age, 29–55 years; mean age, 39.9 years) took part in the study.

One surgeon (RPB) undertook the procedure on all the patients to ensure a standardised technique of the infiltration and operative procedure. The standard procedure involved infiltrating the scrotal skin and the tissues around the vas on one side with 4.5–5 ml of local anaesthetic preparation followed by the vasectomy procedure on the same side through a 1 cm long incision. The procedure was then repeated for the other side. On average, the procedure on each side lasted 5 min.

Patients were randomly allocated to one of the four possible procedural groups from sealed instructions: (i) buffered preparation into left side first and commercial into right side; (ii) buffered preparation into right side first and commercial into left side; (iii) commercial preparation into left side first and buffered into right side; and (iv) commercial preparation into right side first and buffered into left side.

The scrub nurse was responsible for opening the instructions, ensuring that the correct preparation was given to the surgeon, and informing him of which side should be infiltrated first so ensuring that both surgeon and patient were blind to the type of preparation. Each patient served as his own control.

Figure 1 Pain score for buffered and commercial local anaesthetic agent during infiltration and procedure.

Figure 2 Pain score for buffered and commercial local anaesthetic agent: first side versus second side.

Each patient was asked to assess the level of his perceived discomfort/pain during infiltration at a point immediately after infiltration and during the procedure at a point immediately after the completion of the procedure for each side by using a visual analogue scale (VAS)¹¹ – a 10 cm line anchored at the ends with descriptors of ‘no pain’ and ‘worst imaginable pain’.

The data were analysed using a Wilcoxon matched pairs signed rank test. A probability value of $P < 0.05$ was taken to be significant.

Results

The pain scores of a total of 85 patients were analysed. Of these, 22 patients had been randomised to instruction (i) and 21 patients for each of the three remaining instructions (ii–iv).

Pain scores for infiltration pain with the commercial unbuffered preparation were significantly higher than the score when buffered preparation was used ($P = 3.74 \times 10^{-7}$) and the mean pain scores were 3.2 and 1.7, respectively (Fig. 1).

Pain scores for the procedure pain with the use of the commercial unbuffered preparation were significantly higher than with the use of the buffered preparation ($P = 2.25 \times 10^{-7}$) and the mean pain scores were 3.7 and 2.2, respectively (Fig. 1).

There was no statistically significant difference between pain scores of infiltration pain with the use of the buffered preparation between first and second side ($P = 0.17$; Fig. 2) or between left and right side ($P = 0.28$; Fig. 3).

Results were similar with the use of the commercial preparation ($P = 0.60$; Fig. 2: and $P = 0.81$; Fig. 3, respectively).

There was no statistically significant difference between pain scores of procedure pain with the use of the buffered preparation between first and second side ($P = 0.82$; Fig. 2) or between left and right side ($P = 0.56$; Fig. 3) and similar results were recorded with the use of the commercial preparation ($P = 0.50$; Fig 2: and $P = 0.97$; Fig. 3, respectively).

Discussion

The subcutaneous and intradermal infiltration of local anaesthetic agents is a fairly painful procedure. Attempts to reduce this pain have involved practices such as slow infiltration, injection of the agent during the withdrawal of the needle, warming the agent to room temperature, and the use of pH-adjusted anaesthetic agent.

The analysis of the data in our study confirms that the use of buffered xylocaine with 1:200,000 adrenaline significantly reduces infiltration pain ($P = 3.74 \times 10^{-7}$) and the procedure pain ($P = 2.25 \times 10^{-7}$) when compared to the pain experienced with the use of an unbuffered commercial preparation.

The study by Fitton *et al.*,¹⁰ although a cross-matched, double blind controlled study, has the drawback of fewer patients (30) as against 85 in our study. It also has the major drawback of having pooled the data of 5 different surgeons each with their own technique of infiltration of local anaesthetic agent and performing the procedure. It is well known that patient's perception of pain is different

Figure 3 Pain scores during infiltration and procedure: left side (L) versus right side (R).

in the hands of different surgeons, which has been attributed to the speed of injection, technique of injections, *etc.* This was avoided in our study by having only one surgeon perform the operation on all the participants by his standard technique.

Fitton *et al.*¹⁰ also used a variable amount (6–10 ml) of anaesthetic agent in different patients, whereas in our study the variation was kept small (4.5–5.0 ml) on each side. Any patient requiring more than 5 ml of the anaesthetic agent was excluded from the study, as we believe that varying the dose of anaesthesia would affect the perception of both the infiltration and the procedure pain. These factors might explain the difference in the results of our study and that of Fitton *et al.*¹⁰

The study by Fitton *et al.*¹⁰ found a significant difference for infiltration pain between left and right sides while our study has not corroborated that finding. This difference can possibly be explained by the inconsistencies in their study.

Unlike Orlinsky *et al.*¹² who found a significant difference in favour of the second injection, we have found no significant difference between the first and second injections.

Our study has demonstrated that there is a statistically significant reduction in the perception of pain during infiltration and the procedure with the use of buffered xylocaine solution as compared to the commercial unbuffered xylocaine preparation. As our study has shown no statistically significant difference in the perception of pain between either first and second or left and

right sides, with the use of commercial unbuffered xylocaine or the buffered commercial xylocaine, it can be safely concluded that the difference in the perception of pain with the use of buffered commercial xylocaine with 1:200,000 adrenaline and the unbuffered commercial solution was only due to the buffering of the anaesthetic agent.

The precise mechanism of action is unknown. It has been postulated that buffering reduces irritant H^+ ions and thus the pain. It has been suggested also that the greater proportion of anaesthetic in the uncharged (basic) form due to buffering allows more rapid diffusion of the agent across nerve membranes; this results in a greater concentration in the nerve axoplasm, hence blocking pain transmission almost instantaneously and, thereby, decreasing the initial pain upon injection.¹⁰

Conclusions

A recent UK survey showed that 85% of general surgeons had no knowledge of the benefits that raising the pH of the local anaesthetic agent could have on reducing pain on infiltration. Of the 112 general surgeons in the study, only one commonly increased the pH of the solution prior to use. Lack of knowledge was cited to be the main reason for not altering the pH.⁹ This is in stark contrast to the situation in the US, where pH-adjusted local anaesthetic agents are used commonly for procedures carried out under local anaesthesia.⁸ Organisations such as the

National Institute for Clinical Excellence and the patients who now have a wider access to information via the internet may well come to expect it from their doctors in the UK. Since this study, it has been our regular practice to use buffered xylocaine for all the procedures performed under local anaesthesia. It would be worth evaluating the safe buffering techniques for other local anaesthetic agents in common use such as Bupivacaine.

We hope this study will convince surgeons across the UK to use a buffered xylocaine solution for local anaesthetic surgery, as it is a simple, effective, practical and inexpensive way of reducing pain during infiltration and the operative procedure. We also hope that dental surgeons would follow this procedure so that children (and a significant number of adults) would not be as scared of going to the dentist as they are today.

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