Alkalisation of lignocaine to reduce the pain of digital nerve blockade

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Abstract

Objective—To see if the alkalisation of lignocaine caused a reduction in the pain of injection for digital nerve blockade.

Methods—The study was a prospective randomised double blind study with each patient acting as their own control. During the study period, all patients aged 16 years and over presenting to the accident and emergency department with a condition requiring digital nerve blockade were considered for inclusion in the study. Each patient received an injection of both alkalinised and non-alkalinised lignocaine. The pain of each injection was then assessed on a visual analogue scale.

Results—98 patients were entered in the study. The mean difference in pain scores between the non-alkalinised and alkalinised injections was 0.739, P < 0.001, 95% confidence interval 0.47 to 1.01.

Conclusions—Alkalisation of lignocaine reduces the pain of injection for digital nerve blockade.


Key terms: alkalinised lignocaine, digital nerve block; pain scoring

Digital nerve blockade using lignocaine is a commonly performed procedure in accident and emergency (A&E) departments. The local infiltration of lignocaine is often associated with considerable discomfort.

Lignocaine becomes unstable at a high pH; lignocaine solutions are therefore manufactured with an acidic pH to give a prolonged shelf life.

The pH range of commercially available plain lignocaine, for local anaesthesia, ranges between 4.0 and 7.0.

Xylocaine (Astra pharmaceuticals) is the only named brand of lignocaine available in the United Kingdom and is manufactured within a pH range of 6.7 to 7.0. All other lignocaine is British Pharmacopoeia (BP) and is manufactured with a pH range of 4.0 to 5.5.

Several studies have shown that in healthy volunteers, raising the pH of lignocaine causes a significant reduction in the pain of injection\(^1\); however, these studies have all involved small patient numbers.

Our aim was to see whether, in the setting of a busy A&E department, alkalising lignocaine for digital nerve block is a practical proposition, and to confirm that it does indeed reduce the pain of infiltration.

Methods

Ethics approval was obtained from the Frenchay NHS Trust ethics committee. All patients aged 16 years and over, who required a digital nerve block, were included in the study.

Written consent was obtained from all patients; patients with known hypersensitivity to lignocaine were excluded.

The study was prospective, randomised, and double blind in design.

For the purposes of the study 1% plain lignocaine BP was used. This is manufactured to a pH range of 4.0–5.5, although in the samples tested the pH range was 4.39–4.53.

The lignocaine was alkalinised by adding 0.6 ml of 8.4% sodium bicarbonate to 4.4 ml of 1% lignocaine; this gave a measured pH of 7.38 to 7.51. Each patient was randomly assigned a trial pack which contained a 10 ml ampoule of lignocaine and two glass ampoules of diluent marked A and B. These had previously been prepared by the hospital pharmacy and had been randomised to contain either normal saline or 8.4% sodium bicarbonate.

The test solutions were made up by drawing up 4.4 ml of lignocaine into a 5 ml syringe and then adding 0.6 ml of diluent A which had been drawn up using a 1.0 ml syringe to allow accurate measuring. The same procedure using a different pair of syringes was performed using diluent marked B.

Each patient received an injection of both alkalinised lignocaine and non-alkalinised lignocaine. The order of injection and the side of injection were both randomised; patients with an even A&E number received the first injection on the radial side of the digit, whereas those with an odd A&E number received the first injection on the ulnar side. The lignocaine mixed with diluent A was always given first.

Digital nerve block was then performed by slowly injecting 1.5 ml of the test solutions using a 25G needle either side of the digit at the level of the base of the proximal phalanx.

Patients were asked to score the pain of each injection on a previously validated visual analogue pain scale.\(^7\) Adequacy of anaesthesia was assessed by testing for pain sensation at 5 min and at 10 min.

Results

Ninety-eight patients were entered in the study, with an age range of 16 to 80 years. Ten patients required additional lignocaine for a satisfactory digital nerve block.

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Sixty patients recorded the alkalinised injection as being less painful than the non-alkalinised.

Eleven patients indicated there was no difference between the two injections. Twenty-seven patients scored the alkalinised injection as being more painful. These results are shown in the figure.

The differences in pain scores between the non-alkalinised and alkalinised injections for each patient were analysed using the paired $t$ test. This gave a mean difference in pain scores of 0.739 ($P < 0.001$), with a 95% confidence interval of 0.47 to 1.01.

Analysis of variance showed that order of injection, side of first injection, and digit type did not have a significant effect.

Discussion

Our results confirm previous reports that suggest that raising the pH of lignocaine reduces the pain of injection. The reason for this is uncertain, although it is thought to be due to changes in the ratio of ionised to non-ionised lignocaine. As the pH of lignocaine is raised towards its pKa value of 7.9, the proportion in the uncharged form increases; it is thought that only the uncharged form of lignocaine is capable of diffusion through interstitial tissues and across nerve membranes. Thus the decreased pain of injection may be due to a more rapid onset of anaesthesia.

A previous study using healthy volunteers showed that there was a 4.5-fold difference in the pain scores between buffered and unbuffered lignocaine; however, only a small volume of lignocaine was given by injection (0.5 ml). The differences in pain scores in our study were much smaller but still statistically significant. This may in part, be explained by the larger volume of injection used in our study and by other factors such as differing anxiety levels between healthy volunteers and patients.

In a clinical setting, the digital nerve block provides the ideal opportunity for assessing the effects of alkalinisation on the pain of lignocaine injection. The volume and site of injection can be standardised and the patients act as their own controls; it is the difference in pain scores between the two injections, rather than the absolute pain score, which is therefore the important factor.

There has only been one previous study looking at the effects of alkalinisation of lignocaine when used for digital nerve blockade. This study also showed a statistically significant difference in pain scores between alkalinised and non-alkalinised lignocaine. It was, however, a small study involving 31 patients, and the volume of injection was not standardised; furthermore, the alkalinised lignocaine had been prepared in batches, assuming a shelf life of approximately one week.

We conclude from our study that alkalinisation of lignocaine produces a significant reduction in pain of injection and that it is a simple and safe procedure which can be carried out in a busy A&E department.

Although Xylocaine is less acidic than lignocaine BP, we would not recommend its use as an alternative to alkalinisation of lignocaine BP. The lower end of its pH range is 6.7, compared to 7.38 for the alkalinised lignocaine in our study. Furthermore, the study which compared Xylocaine with unbuffered lignocaine BP in healthy volunteers did not show a statistically significant difference between the pain scores.

We do, however, acknowledge that the differences in pain scores were small and that other factors such as needle size, speed of injection, and the temperature of lignocaine may all affect the pain of infiltration.

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