CARPAL LIGAMENT DECOMPRESSION UNDER LOCAL ANAESTHESIA: THE EFFECT OF LIDOCAINE WARMING AND ALKALINISATION ON INFILTRATION PAIN

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This study investigated the effects of alkalization and warming of lidocaine 1% on injection pain in patients undergoing carpal tunnel decompression. Sixty-four adult patients were randomly allocated into one of three groups: Group A \((n = 20)\) received plain lidocaine 1%, Group B \((n = 22)\) alkalized lidocaine and Group C \((n = 22)\) warmed and alkalized lidocaine. Pain on needle insertion and on infiltration was assessed using a 100 mm Visual Analogue Scale (VAS). There was no significant difference regarding pain on needle insertion whereas significant differences were noted in reference to infiltration pain. In Groups B and C (alkalinized lidocaine) the VAS scores on skin infiltration were significantly lower than in Group A, while the pain score in Group C (alkalinized and warmed lidocaine) was significantly lower than in Group B.


Keywords: alkalinization, carpal tunnel syndrome, lidocaine, local anaesthesia, pain, visual analogue scale

INTRODUCTION

Carpal tunnel decompression is the most commonly performed procedure in hand surgery. It may be performed by either the open or an endoscopic method using one of several anaesthetic techniques. Many surgeons perform carpal tunnel release under local infiltration anaesthesia and tourniquet ischaemia but concerns exist regarding patient tolerance to local anaesthesia and tourniquet application. Occasionally, the pain experienced on local anaesthetic injection can be significant, causing distress to the patient. Consequently, several methods have been employed to reduce injection pain (Avramidis et al., 2000; Lawrence and Desai, 2002).

Several clinical and laboratory studies have confirmed the favourable effects of alkalinization and warming of local anaesthetic agents on their potency and injection pain. However, to our best knowledge no study, except for a letter to the editor (Vossinakis, 2001), has examined these parameters in carpal tunnel surgery (Chow et al., 1998; Courtney et al., 1999; Mader et al., 1994; Masters, 1998; Michele et al., 1998; Milner et al., 2000; Ririe et al., 2000).

The aim of this study was to evaluate whether lidocaine alkalization and warming provide better anaesthesia during carpal tunnel decompression.

PATIENTS AND METHODS

This study was performed at the Veterans Army Hospital, Athens, Greece between January 2001 and May 2002 with the approval of the hospital’s Ethics Committee. During this period 64 patients were enrolled with clinical and electrodiagnostic evidence of median nerve compression at the wrist. The procedure was performed as a day case in a dedicated department under local infiltration anaesthesia. The patients were randomly allocated to three groups; A, B and C. In each group the total injected volume of local anaesthetic was 10 ml. Nine millilitres of plain lidocaine HCl 1% were mixed with either 1 ml of normal saline 0.9% or 1 ml of sodium bicarbonate 8.4% to produce a final volume of 10 ml. In group A \((n = 20)\), local anaesthesia of the palmar skin was performed along the line of the intended skin incision using plain lidocaine 1% mixed with normal saline (Astra, Zenerca), while in group B \((n = 22)\) 10 ml alkalized lidocaine 1% at room temperature \((22^\circ C)\) was administered. In group C \((n = 22)\) 10 ml alkalized lidocaine, previously warmed in a water bath to \(40^\circ C\) for 30 minutes, was injected. The lidocaine was injected slowly over 30 seconds after negative aspiration. The anaesthetic solution was injected through a 25 gauge needle which was inserted into the palmar skin and the anaesthetic solution was injected slowly along the line of the intended skin incision using plain lidocaine 1% mixed with normal saline (Astra, Zenerca), while in group B \((n = 22)\) 10 ml alkalized lidocaine 1% at room temperature \((22^\circ C)\) was administered. In group C \((n = 22)\) 10 ml alkalized lidocaine, previously warmed in a water bath to \(40^\circ C\) for 30 minutes, was injected. The lidocaine was injected slowly over 30 seconds after negative aspiration. The anaesthetic solution was injected through a 25 gauge needle which was inserted into the palmar skin and the anaesthetic solution was injected slowly along the line of the intended skin incision in a proximal to distal direction. The flexor retinaculum was released under direct vision through a 3 cm curvilinear skin incision, extending distally from the distal wrist crease. The skin incision was made 2–3 mm medial to thenar crease, in line with the long axis of the ring finger and the distal palmar wrist crease was never crossed. A forearm tourniquet was always used. In no case was synovectomy or neurolysis performed. The skin incision was sutured with 4–0 non-absorbable sutures and the hand was immobilized for 7 days in a removable splint. Pain was assessed on insertion of the needle and on injection of lidocaine using a 100 mm Visual Analogue Scale.
Injection pain depends on many factors including needle size, anaesthetic agent, rate of injection, injected volume, injected body area and temperature and pH of the agent. Alkalinization and warming of local anaesthetic solutions is common practice in a number of medical specialties, but not in hand surgery (Callear, 1995; Courtney et al., 1999). Lidocaine buffering appears more important than needle size in decreasing injection pain (Palmon et al., 1998) and alkalinization of plain lidocaine increases its pH from 6.4 to 7.7 (Palmon et al., 1998; Ririe et al., 2000). Several additives (adrenaline, clonidine, ketamine, hyaluronidase, CO₂ and bicarbonates) have been used to increase the anaesthetic potential and duration of the anaesthetic action (Nevarre and Tzarnas, 1998; Ririe et al., 2000; Wood et al., 1999). Addition of adrenaline to lidocaine increases its anaesthetic potential by reducing local absorption, but the acidity of the anaesthetic solution is then increased and as a result its infiltration may become more painful (Nevarre and Tzarnas, 1998; Ririe et al., 2000). Sodium bicarbonate has been added to various local anaesthetics to increase the proportion of the nonionized form of the drug and allow more molecules to cross cell membranes so as to shorten the latency and increase the potency of the solution. However, excessive alkalinization causes precipitation which decreases the bioavailability of the local anaesthetic and interferes with its activity. For example, ropivacaine at concentrations of 0.75% and 1.0% precipitates at pH 6.0 (Milner et al., 2000). Alkalinization of lidocaine may not accelerate the onset of regional upper limb nerve blockade (Chow et al., 1998) but significantly increases the rate of motor block, without changing the onset or extent of sensory block, when used for a median nerve block (Ririe et al., 2000).

Recently, EMLA has been used in carpal tunnel decompression surgery to reduce injection pain (Avramidis et al., 2000; Lawrence and Desai, 2002). However, it has a few significant disadvantages such as the increased cost and the need to apply the cream 60 to 120 minutes before the operation. Bicarbonate addition is fast and safe and the effectiveness of alkalinized lidocaine in carpal tunnel surgery has been alluded to, though not properly assessed (Vossinakis, 2001). However accidental injection of sodium bicarbonate can cause a serious chemical soft tissue injury. Another simple measure to reduce injection pain is warming of the local anaesthetic to body temperature or slightly higher. Warming and buffering may have a synergistic anaesthetic effect (Callear, 1995; Mader et al., 1994) as suggested by our study. Temperature elevation increases the dissociation constant (Ka) of the anaesthetic solution and decreases the pKa, favouring the presence of the uncharged form of lidocaine (pKa 7.7) that diffuses across the lipid cellular membrane of the neural cell axon (Courtney et al., 1999).

In conclusion, we have found that buffering lidocaine with bicarbonate and warming the anaesthetic solution...
helps to reduce pain on infiltration in patients undergoing carpal tunnel decompression.

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References


