

A STUDY COMPARING CHLOROPROCAINE WITH LIDOCAINE FOR SKIN INFILTRATION BEFORE INTRAVENOUS CATHETER INSERTION

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A prospective, double-blind, mixed, crossover study was conducted to determine the perception of pain associated with intradermal lidocaine and chloroprocaine for insertion of an 18-gauge intravenous catheter. A convenience sample of 64 healthy, adult volunteers was used. Each participant received an intradermal injection of lidocaine or chloroprocaine on the dorsum of one hand followed by insertion of an 18-gauge intravenous catheter. The procedure was repeated on the opposite hand with the other anesthetic. Half of the subjects received lidocaine first, and half received chloroprocaine first.

Subjects were asked to rate their pain on a 100-mm visual analogue scale immediately after injection of each

local anesthetic and immediately after insertion of the catheter. A repeated analysis of variance was used to determine whether there was significant difference in pain associated with the injections and with the insertion of the catheters.

There was no significant difference in the amount of pain associated with the intradermal injections ($P = .955$) or with insertion of an 18-gauge needle ($P = .977$). Both local anesthetics were effective in reducing pain from the initial injection of the local anesthetics to the insertion of the 18-gauge needle ($P = .000$).

Key words: Chloroprocaine, lidocaine, local anesthetics, visual analog scale.

Intravenous (IV) catheter insertion is required for all anesthetic procedures. Intravenous cannulation can be great source of anxiety and pain and is often the first encounter with an anesthesia provider and one of the first events to occur during the surgical experience.¹ Langham and Harrison² found a significant pressor response to venous cannulation, manifested by a 10% to 15% increase in mean arterial pressure and rate pressure product that was sustained for at least 3 minutes. To reduce the pain, a common procedure performed by anesthesia providers is the intradermal injection of a local anesthetic before IV cannulation. Brown³ found that patients, when given a choice, prefer local anesthetic before having an IV catheter inserted. However, local anesthetics may themselves produce pain on injection.

Traditionally, lidocaine has been used as the local anesthetic of choice for skin infiltration before IV cannulation. Morris et al⁴ and Marica et al⁵ attribute this to tradition and availability. Limited data exist regarding which local anesthetic is less painful on injection and which provides the best analgesia for IV cannulation. In the current literature comparing local anesthetic agents, conflicting results are reported.⁶ There are conflicting results regarding which local anes-

thetic (lidocaine vs chloroprocaine) creates more pain after the initial intradermal injection and which provides better analgesia for the insertion of an IV catheter.^{7,8} Morris et al⁴ tested 5 different local anesthetic drugs to measure their pain on infiltration (etidocaine 1%, bupivacaine 0.5%, mepivacaine 1%, chloroprocaine 2%, and lidocaine 1%). They found that of the 5, chloroprocaine and lidocaine were least painful and etidocaine the most painful. Berde and Strichartz⁶ also found that lidocaine was less painful than etidocaine. Marica et al⁵ found that 2% 2-chloroprocaine, independent of pH, causes less pain at intradermal skin infiltration than the more commonly used 1% lidocaine. They found that 2-chloroprocaine with the addition of sodium bicarbonate resulted in the lowest mean pain scores among the tested solutions: normal saline, 1% lidocaine, 1% lidocaine and 8.4% sodium bicarbonate, 2% 2-chloroprocaine, 2% 2-chloroprocaine and 8.4% sodium bicarbonate, and sodium bicarbonate.

Nuttall et al¹ reported a very different finding. They tested benzyl alcohol 0.9% in normal saline, 2-chloroprocaine 3%, lidocaine 1%, lidocaine 1% with preservative, alkalized lidocaine 1% with preservative, normal saline, and a control group. They found alka-

linized lidocaine to be the best local anesthetic for decreasing the pain associated with its injection and the best for attenuating the pain associated with IV catheter placement. They also found chloroprocaine to be significantly more painful on injection than most of the other drugs they tested.¹

Because of the inconsistent results reported in the literature, our study was designed to determine if there were differences in the amount of pain experienced in subjects when investigators administered intradermal injections of 2 local anesthetics, lidocaine and chloroprocaine, and to determine which was more effective in reducing pain when an 18-gauge IV catheter was inserted.

Methods

After obtaining institutional review board approval at Brooke Army Medical Center, San Antonio, Texas, and the University of Texas, Health Science Center at Houston, we recruited 64 healthy adult volunteers to participate in a prospective, double-blind, mixed, crossover design study. Healthy subjects were used as opposed to patients to prevent confounding variables such as stress and different surgical procedures. Each participant signed a consent form approved by the institutional review board. A power analysis was calculated using an α of .05, a moderate effect size of 0.25, and a power of 0.80 to yield the number of subjects needed to be 64 per treatment.

The local anesthetics used were 1% lidocaine, an amide, and 2% 2-chloroprocaine, an ester, which are equipotent concentrations. A skin wheal was raised with 0.2 mL of local anesthetic using a 27-gauge needle attached to a 1-mL tuberculin syringe. The IV cannula insertion occurred after 1 minute, which was measured with a stopwatch. This 1-minute timeframe was to allow time for anesthesia to occur.

A 100-mm visual analogue scale (VAS) was used to evaluate the pain 2 times for each hand; first, after intradermal injection of local anesthetic and again after an 18-gauge IV catheter was inserted and removed. The VAS consisted of a 100-mm horizontal line with anchor points at both ends with the zero end being defined as "no pain" and the 100-mm mark on the opposite end being the "worst pain imaginable." The use of the VAS in clinical practice and research is well documented. It has been used to measure a variety of patient conditions from levels of acute pain to patient satisfaction. Reliability of the VAS is most frequently assessed by using test-retest methods, and correlations between the 2 administrations have been moderate to strong.⁹ Reville et al¹⁰ found that subjects were consistently able to reproduce VAS scores of pain

experience after a short time. Validity of the VAS has been assessed using several methods. The most common approach has been to correlate the VAS with other measures of the phenomenon. Acceptable levels of concurrent validity have been well substantiated for sensations such as pain.^{9,11}

A repeated analysis of variance was used to examine the effects of 2 intradermal injections of 2 local anesthetics and effect of the 2 anesthetics on pain when an 18-gauge IV catheter was inserted. An α of .05 was used for significance. A central issue surrounding the analysis of VAS data is the level of measurement represented by the method. The data on the VAS are considered at the ordinal level, which necessitates a nonparametric method of analysis. However, Maxwell¹² concluded that the analysis of variance is robust, and it makes little difference whether parametric or nonparametric tests are used for VAS scores.

A crossover design was used so that subjects served as their own controls. However, in such a design, when subjects are exposed to 2 different treatments, the first treatment can influence the second in a positive or negative way, and the order of the treatments can have an impact as well. To avoid these problems, we alternated the 2 local anesthetics so that chloroprocaine was used first in half the subjects and lidocaine was used first in the other half of the subjects. Also, the left and right hands were alternated and documented for the first drug tested on each participant. The Latin square method was used to ensure that the number of subjects who received chloroprocaine first and the number of subjects who received lidocaine first were equal.

We performed the local anesthetic injections and the IV catheter insertions by following a set protocol regarding skin preparation, donning of gloves, and direction of the needle bevel. Demonstration by the principal investigator was completed so that each injection and insertion were the same. We are nurses with 5 to 6 years' experience in IV catheter insertions. The same procedure was used for each subject. The study was double-blinded: neither the investigator injecting the local anesthetic and inserting the IV catheter nor the subject knew which local anesthetic was being used.

After the intended local anesthetic was injected, the participant was asked to make a mark on the VAS indicating the amount of pain experienced. Then an 18-gauge IV catheter was inserted into the peripheral vein on the dorsum of the hand in the site of the local anesthetic injection. Following this insertion of the IV catheter, each participant again was asked to rate the

pain experience by placing a mark on another 100-mm line printed on the same page. The same procedure was repeated on the other hand with the other local anesthetic. The marks on the VAS were measured with a millimeter ruler and the data entered into SPSS version 13 (SPSS, Chicago, Illinois) for analyses.

Results

A convenience sample of 64 healthy adults was used and consisted of 38 men and 26 women ranging in age from 22 to 64 years (mean, 35.9 years; SD, 8 years). A repeated analysis of variance was calculated to determine if there were any statistically significant differences in pain, comparing the 2 local intradermal injections and when an 18-gauge IV catheter was inserted. There was no significant difference in the perception of pain from the 2 local intradermal injections ($P = .995$). Both intradermal injections of the anesthetic agents caused approximately the same amount of pain (lidocaine mean, 23.42; SD, 16.052; chloroprocaine mean, 22.25; SD, 17.257). The range for the initial lidocaine injection was from 0 to 80, and the range for the initial chloroprocaine injection was 2 to 70.

There was no significant difference in the perception of pain between the 2 local anesthetic agents when an 18-gauge IV catheter was inserted ($P = .977$). The pain associated with an 18-gauge IV catheter insertion was approximately the same (lidocaine mean, 3.16; SD, 5.934; chloroprocaine mean, 4.04; SD, 8.35). The range was 0 to 25 for lidocaine and 0 to 48 for chloroprocaine.

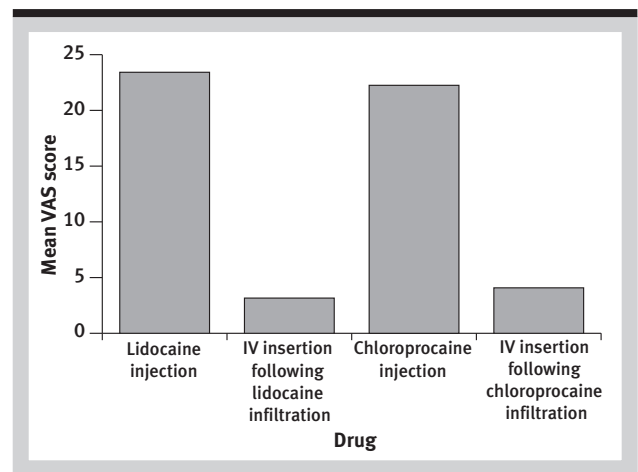
A significant difference was found between the pain scores for the initial injection of the local anesthetic

and the insertion of the IV catheter, indicating that both drugs were very effective ($P = .000$). The mean difference in the perception of pain between the intradermal injection of lidocaine and insertion of an 18-gauge needle was 20.27; the mean difference for chloroprocaine was 18.17 (Figure and Tables 1 and 2).

Discussion

In our clinical setting, the usual practice for adults is to perform an intradermal infiltration of 1% lidocaine before IV cannulation. Because no statistically significant difference was found in the difference in pain for the intradermal injections of 2 local anesthetics or the insertion of an 18-gauge needle, the choice should be made on other factors such as cost, availability, and provider preference. The cost to the US Government for

Figure. Pain perception*



* VAS indicates visual analog scale; IV, intravenous.

Table 1. Amount of pain associated with intradermal injection and intravenous (IV) cannulation*

| | Pain perception for lidocaine | Pain perception for chloroprocaine | <i>P</i> |
|-------------------|-------------------------------|------------------------------------|----------|
| Initial injection | 23.42 ± 16.052 | 22.25 ± 17.257 | .995 |
| IV cannulation | 3.16 ± 5.934 | 4.08 ± 8.346 | .977 |

* Data are given as mean ± SD visual analog scale scores.

Table 2. Effectiveness of 2 local anesthetics

| | Pain during infiltration | Pain during IV insertion | Mean difference | <i>P</i> |
|----------------|--------------------------|--------------------------|-----------------|----------|
| Lidocaine | 23.42 ± 16.052 | 3.16 ± 5.934 | 20.27 | .000 |
| Chloroprocaine | 22.25 ± 17.257 | 4.08 ± 8.346 | 18.17 | .000 |

Data are given as mean ± SD amount of pain as measured by a visual analog scale.

a 30-mL vial of 1% lidocaine is \$4.28 compared with \$9.20 for a 30-mL vial of 2% 2-chloroprocaine. With the cost of chloroprocaine nearly double that of lidocaine, the use of lidocaine for skin infiltration is the most economical choice. However, both local anesthetics are relatively inexpensive and are effective in reducing the pain associated with an 18-gauge catheter insertion and should be implemented to reduce the pain.

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