Effects of Local Anesthetics on Pain With Intravenous Catheter Insertion

By Margo A. Halm, RN, PhD, APRN-BC, CCRN

As one of the most common invasive nursing procedures, insertion of an intravenous catheter has a long track record of being painful, stressful, and a patient dissatisfier. In an effort to promote comfort during intravenous cannulation, nurses may use local anesthetics to infiltrate the skin surrounding insertion sites. Such infiltrations, however, are known to cause painful stinging sensations, most likely due to the acidity of the solution. Thus, the purpose of this clinical review is to describe the current evidence related to the following question: Do different local anesthetic agents vary in their effectiveness in reducing the pain associated with intradermal infiltrations, or with insertion of an intravenous catheter and advancement of the cannula?

Methods

The search strategy included MEDLINE, CINAHL, Cochrane, and DARE databases. Key words included intravenous insertion, lidocaine, normal saline, and pain. All types of evidence (nonexperimental, experimental, systematic reviews, expert opinion) were included, but only studies that enrolled adults and tested needle-syringe delivery were considered.

Results

The search yielded 15 primary studies but no systematic reviews or meta-analyses that had been published between 1993 and 2007. Two other studies explored patients’ preferences or nurses’ use of local anesthetics with insertion of intravenous catheters. Sample sizes ranged from 20 to 221. Populations studied were healthy volunteers, presurgical patients, and medical inpatients. Insertion sites included the dorsum of the hand and the volar aspect of the forearm. Intradermal needles were most commonly 27-gauge (25-gauge, 26-gauge, 29-gauge, and 30-gauge were less common). Amount of solution injected ranged from 0.1 to 1 mL (most 0.1-0.5 mL). Size of the intravenous catheter (18-20 gauge) was reported less often. Pain intensity was measured by means of a standard visual analog scale in all but 2 studies (these used the Wong-Baker Faces scale or interviews) at the time of needle insertion, subcutaneous infiltration with local anesthetic, first venous puncture, and advancement of the cannula. Adequacy of analgesia, defined as time to onset or extent (area) of analgesia, and total number of attempts and time required for catheter insertion were measured less often.

Table 1 summarizes the agents tested. Unbuffered or buffered 1% lidocaine was the most common comparison. Buffering lidocaine involves mixing 8.4% sodium bicarbonate in a ratio of 9:1, thereby increasing pH. Other agents evaluated were lidocaine with epinephrine or benzyl alcohol (a preservative with analgesic properties), 2% chloroprocaine, or 1% diphenhydramine. Saline with or without benzyl alcohol was also used as a placebo. Rate of administration was studied less often (slowly for 30 seconds vs rapidly for 5 seconds), as was temperature of agent (room temperature vs body temperature).

Pain With Subcutaneous Infiltration

In 8 of 11 studies (73%) in which unbuffered agents were compared with buffered agents, buffered lidocaine was superior in providing analgesia with...
subcutaneous infiltration. Warming buffered lidocaine also is associated with significantly reduced time to onset of intradermal analgesia, not to mention better overall pain relief with subcutaneous infiltration, suggesting an additive effect. In another large randomized controlled trial, researchers found that 0.9% bacteriostatic normal saline with benzyl alcohol was less painful than unbuffered 1% lidocaine. More research is needed to determine if normal saline with benzyl alcohol is more effective than buffered 1% lidocaine (warmed or room temperature) because most studies have shown the latter to be more effective in reducing pain at the infiltration site.

In terms of administration, the counter-irritation technique of scratching the skin close to where the subcutaneous injection is made 2 seconds before and continuing throughout needle insertion and infiltration significantly reduced pain. Scarfone et al also found slow administration had a greater impact on pain with subcutaneous infiltration than buffering had.

### Pain During Insertion of Intravenous Catheters

Larger catheter gauge was correlated with greater pain during intravenous insertion, and median pain scores for catheter insertion in the forearm were higher than scores for either the hand or wrist. Brown and Larson reported significantly less pain in patients receiving unbuffered 1% lidocaine (room temperature) than in patients receiving no pretreatment with a local anesthetic. Recalled pain with insertion of an intravenous catheter also was less for male and female patients who received lidocaine than for patients who did not.

In terms of patients’ preferences, male and female patients in this large study who received lidocaine with catheter insertion expressed a preference to have lidocaine again with other catheter insertions in the future.

### Table 1

Comparison of local anesthetics

<table>
<thead>
<tr>
<th>Study</th>
<th>No pretreatment</th>
<th>No benzyl alcohol</th>
<th>With 1:1000 epi epi</th>
<th>With saline</th>
<th>Slowly</th>
<th>Rapidly</th>
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<tbody>
<tr>
<td>Steinbrook et al</td>
<td>184</td>
<td></td>
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<td>Parham and Pasieka</td>
<td>42</td>
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<tr>
<td>Martin et al</td>
<td>40</td>
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<tr>
<td>Scarfone et al</td>
<td>42</td>
<td>X</td>
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<td>Jones et al</td>
<td>40</td>
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<tr>
<td>Colaric et al</td>
<td>20</td>
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<td>122</td>
<td>X</td>
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<tr>
<td>Hattula et al</td>
<td>33</td>
<td>X</td>
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<td>40</td>
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<tr>
<td>Brown and Larson</td>
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<td>Brown</td>
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<td>Burns et al</td>
<td>60</td>
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<td>Windle et al</td>
<td>221</td>
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<tr>
<td>Ales et al</td>
<td>64</td>
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</table>

Abbreviation: Epi, epinephrine.

a All designs randomized except Brown and Larson.
Strong evidence from 2 large randomized trials suggest pain outcomes during intravenous insertion of catheters are not significantly different in patients receiving unbuffered versus buffered lidocaine (room temperature),16 or in patients receiving unbuffered 1% lidocaine or 0.9% bacteriostatic normal saline with benzyl alcohol.17 Therefore, although buffering may not be as important for reducing pain during intravenous insertion of catheters, it clearly offers the advantage of reducing pain associated with subcutaneous infiltration, a factor that could contribute considerably to patients’ satisfaction with the overall experience of intravenous catheter insertion.

Recommendations Based on Current Evidence

Although some investigations have small samples, the combined findings from available studies may be considered class I evidence (Table 2) in support of buffered lidocaine providing less painful local anesthesia before intravenous cannulation. Warming lidocaine to body temperature (37°C), counter-irritation, and administering the anesthetic slowly for 30 seconds are promising class IIb techniques that warrant more study. Class IIa evidence also exists in support of using 1% lidocaine or normal saline with benzyl alcohol to reduce pain associated with insertion of intravenous catheters.

Despite this research evidence, Brown4 found that only 30% of registered nurses always offered intravenous lidocaine to reduce patients’ fear and pain after the hospital policy was changed to use lidocaine with every insertion of an intravenous catheter in an adult. Nurses with higher self-perceived skills in inserting intravenous catheters and personal experience of having an intravenous catheter inserted with lidocaine were more likely to use this intervention. Another 23% used lidocaine only if patients appeared anxious, the intravenous site was a painful area, or multiple attempts had been made earlier. The other 47% of nurses did not offer lidocaine because they believed it made catheter insertion more difficult (flattening and obliterating veins), or thought that it was not reasonable to stick patients twice, or thought that there would not be sufficient pain relief to warrant the intervention. Beliefs about more difficult insertion were not validated in 1 large study,19 where intradermal lidocaine did not significantly
Use counter-irritation technique with subcutaneous infiltration

Use buffered lidocaine for subcutaneous infiltration

Evidence-Based Practice Recommendations

Table 2

<table>
<thead>
<tr>
<th>Class</th>
<th>Criteria</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Class I</td>
<td>Definitely recommended</td>
<td>Interventions always acceptable, safe, effective; considered definitive standard of care</td>
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<tr>
<td>Class IIa</td>
<td>Acceptable and useful</td>
<td>Interventions acceptable, safe, and useful; considered intervention of choice by most experts</td>
</tr>
<tr>
<td>Class IIb</td>
<td>Acceptable and useful</td>
<td>Interventions also acceptable, safe, and useful; considered optional or alternative by most experts</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>Promising, evidence lacking, premature</td>
<td>Treatment of promise, but limited evidence</td>
</tr>
<tr>
<td>Class III</td>
<td>May be harmful; no benefit documented</td>
<td>Interventions with no evidence of any benefit; often some evidence of harm</td>
</tr>
</tbody>
</table>


Table 3

Integrating findings into practices for inserting intravenous catheters

Evidence-Based Practice Recommendations

- Use buffered lidocaine for subcutaneous infiltration
- Hold/roll lidocaine syringe in hands to increase to body temperature before administration
- Use counter-irritation technique with subcutaneous infiltration
- Administer lidocaine slowly for 30 seconds

increase insertion time or the number of attempts for successful cannulation. Therefore, despite its small sample, Brown’s nurse follow-up study provides a glimpse into the challenge we face as nurses in moving to evidence-based practice to ensure that the care that patients receive at the bedside is in line not only with patients’ preferences, but with the best research evidence we have available (Table 3).

FINANCIAL DISCLOSURES

None reported.

REFERENCES

15. McNelis K. Intradermal bacteriostatic 0.9% sodium chloride containing the preservative benzyl alcohol compared with intradermal lidocaine hydrochloride 1% for attenuation of intravenous cannulation pain. AANA J. 1998;66(6):583-585.
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