Original Contribution

Comparison of local anesthetic effect of lidocaine by jet injection vs needle infiltration in lumbar puncture★★★★★★★★

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A R T I C L E   I N F O

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A B S T R A C T

Background: Usual routes of drug administration are often painful and invasive. Nowadays, using jet injection has been introduced successfully, as a noninvasive and painless method of anesthetic delivery in performing different procedures.

Objective: The objective of the study is to compare the local anesthetic effect of lidocaine by jet injection vs needle infiltration in performing lumbar puncture in the emergency department (ED).

Methods: A randomized single-blind controlled study was performed in 65 patients needing lumbar puncture recruited from the ED from July to November 2014. We enrolled 44 patients and excluded 21 patients by the exclusion criteria. Local lidocaine was delivered in 1 group by jet injector (group B), whereas in the other group conventional method, needle infiltration was used (group A). In both groups, intravenous midazolam 1 mg was administered as an anxiolytic drug before the procedure. Patients’ pain score (visual analog scale [VAS]) from 0 to 10 was recorded during both drug delivery and performing the procedure itself. The observer who collected patients’ data and fulfilled the questionnaire was blinded to the study.

Results: During lidocaine injection, the mean ± SD VAS score was 5.27 ± 1.77 in group A and 2.95 ± 1.81 in group B (mean difference, 2.31; 95% confidence interval, 1.22–3.41) (P < .001). During performing the procedure, the mean ± SD VAS score in groups A and B was 3.77 ± 1.77 vs 2.18 ± 1.50 (mean difference, 1.59; 95% confidence interval, 1.22–2.58) (P < .001).

Conclusions: Injecting lidocaine by jet injector is less painful than infiltrating it by needle and syringe.

1. Introduction

Lumbar puncture (LP) is a painful procedure performed daily on many patients worldwide. Yet, it is often being performed with local anesthetic infiltration by needle and syringe, EMLA cream (lidocaine + prilocaine), or sometimes with sedation. Nonetheless, patients often experience some pain, either at the time of lidocaine infiltration or at the time of procedure itself. Different methods have been proposed to alleviate pain. Because still no “gold standard” method exists, there is room for development of innovative analgesic methods that are simple to use, painless, cost-effective, and time saving.

Jet injection, conceived by Robert Hingson, is a nearly painless route of drug administration [1]. Since 1940s, it has been used for different purposes including the delivery of vaccine (in rapid mass inoculation) and insulin (in diabetic patients) [2]. It was performed very simple. Literally, a wipe of the skin and the tip of the injector with an alcohol sponge before drug delivery was all that necessary before lidocaine injection. The use of needleless jet injectors has less setup time, less risk of infection, and cross contamination; hence, their use is more cost-effective. They require less safety equipment than needle infiltration, thereby reducing risk of needle stick among health care providers.

Needle-free jet injection systems have been developed for intradermal administration of vaccines, insulin, heparin, midazolam, ketamine, and local anesthetics [3–7].

There have been numerous attempts to reduce pain on intravenous (IV) cannulation by jet injectors. In 2003, Lysakowski et al [7] evaluated the efficacy, safety, and cost-effectiveness of a jet-injector with lidocaine for the insertion of a peripheral IV cannula, and they found that lidocaine was effective in reducing pain during the procedure. In 2000,
Cooper and Bromley [8] studied a needle-free system in local anesthesia before venous cannulation, and they concluded that the device delivered a less painful subcutaneous injection than a 25G needle.

Jet injectors of lidocaine have been used to alleviate pain in other more painful procedures [9–11]. In 2012, Ferayorni et al [9] tested needle-free jet injection of lidocaine for local anesthesia during LP in infants younger than 3 months. Their results showed less crying and probably less mean pain score in the jet injector group.

Because there has been no similar study in adult patients undergoing LP, this study was designed to compare the anesthetic effect of lidocaine by jet injector vs local needle infiltration. This study might help physicians to do LP faster, easier, and safer.

2. Materials and methods

2.1. Participants

We conducted a randomized single-blind parallel group study (with block randomization) in patients undergoing LP recruited from the EDs of Shariati and Imam Khomeini Hospitals, 2 tertiary referral centers, from July to November 2014. Eligible patients were older than 18 years, having clinical indications for performing LP, with no exclusion criteria. We excluded patients with any contraindications to LP, lidocaine hypersensitivity, no cooperation, or no consent to participate in the study (Fig. 1). The treating emergency physician diagnosed patients and confirmed LP indications. The subjects were randomly divided into 2 groups of 22 each: a needle injection group (A) and a jet injection group (B). Each patient had a code in block randomization, and the chief investigator, emergency physician, and the triage nurse were aware of the assignment and patient’s group. The specified drug, equipment, and dose were provided by the triage nurse based on the

Table 1

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<tr>
<th>Demographic feature of study groups</th>
<th>Group A (n = 22)</th>
<th>Group B (n = 22)</th>
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<tbody>
<tr>
<td>Sex</td>
<td></td>
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<tr>
<td>Woman</td>
<td>20 (66.6%)</td>
<td>10 (33.4%)</td>
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<tr>
<td>Men</td>
<td>2 (14.2%)</td>
<td>12 (85.8%)</td>
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<tr>
<td>Age (y)</td>
<td>44.27 ± 12.25</td>
<td>41.22 ± 14.40</td>
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Fig. 1. CONSORT flow diagram.

Fig. 2. Jet injector- INJEX.
code, and it was injected to the patient by the emergency physician. One observer who was blinded to the study and did not see the exact procedure in progress collected all data. Pain score during both drug injection and LP were recorded. Side effects, vital signs, number of times LP repeated, and the need for fentanyl administration were all collected by the observer.

2.2. Drug administration

All patients were interviewed and the method of drug administration, visual analog pain score (VAS) (where 10 represented the worst imaginable pain and 0 was pain free), possible complications were explained to them, and informed written consent was obtained. Demographic data, including age, sex, and side effects (eg, nausea, dizziness, blurred vision, hypotension, headache, etc), patient and physician satisfaction, number of times LP repeated, and vital signs, were registered by the observer. Patient and physician satisfaction were recorded using a qualitative ordinal scale (1, very good, to 5, very bad). In group A, side effects, drowsiness was seen in 8 patients all in group A, headache was seen in 1 patient in group A and 2 patients in group B, and agitation was seen in 1 patient in group A (data shown in Fig. 3). Twelve patients in group A and 20 patients in group B had no side effects (P = .010).

There were no significant differences in number of times LP repeated, patient or physician satisfaction, and other vital signs except heart rate between the 2 groups. Thus, as the success rate of LP was concerned, there was no significant difference between the 2 groups. Data are shown in Table 5.

4. Discussion

Pain of needle insertion while doing LP is a minor medical problem. However, this procedure is distressing for most patients especially children. Patient relaxation and cooperation are very important during LP because many of the procedures ended up in false and incorrect results. Our study demonstrated that performing LP by lidocaine jet injection was less painful than by needle and syringe infiltration. Effectiveness of lidocaine anesthesia in both groups had no significant differences. Visual analog scale score had normal distribution in our sample (P = .035 and .007, respectively). Comparing side effects, drowsiness was seen in 8 patients all in group A, headache was seen in 1 patient in group A and 2 patients in group B, and agitation was seen in 1 patient in group A (data shown in Fig. 3). Twelve patients in group A and 20 patients in group B had no side effects (P = .010).

Knowing that Jet with lidocaine decreases pain related to different procedures begs the questions as to how this intervention compares with other analgesic or anesthetic methods.

There have been numerous attempts to reduce pain on IV cannulation by jet injector. In 2003, Lysakowski et al [7] evaluated the efficacy, safety, and cost-effectiveness of a jet-injector of lidocaine for insertion of peripheral IV cannula. They allocated patients to 4 groups. In group 1 (no-treatment), a jet-injector was applied to the patient's skin in the usual manner, but no injection was performed; in group 2, jet-injection was performed with 0.5 mL of physiological saline, in group 3 with 0.5 mL of lidocaine 1% and in group 4 with 0.5 mL of lidocaine 2%. They found that lidocaine 2% was more effective in reducing pain during the procedure [7].

In 2000, Cooper and Bromley [8] studied the effectiveness of a needle-free system for local anesthesia before venous cannulation, and they concluded that the device delivered a less painful subcutaneous injection than a 25G needle, but perhaps provided less effective skin anesthesia for venous cannulation. They also pointed out that jet injection might be better suited to areas where deeper subcutaneous space existed [8].

In 2012, Hajiseyedjavady et al [10] showed that lidocaine jet injection provided more effective and rapid anesthesia, resulting in less

<table>
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<th>Table 2</th>
<th>Vital signs of study groups (mean ± SD)</th>
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<tr>
<td></td>
<td>Group A (n = 22)</td>
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<tr>
<td></td>
<td>During injection</td>
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<tr>
<td>Heart rate</td>
<td>101.4 ± 11.9</td>
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<tr>
<td>Respiratory rate</td>
<td>18.4 ± 2.21</td>
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<td>Table 3</td>
<td>Other features of study groups</td>
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<tr>
<td></td>
<td>Group A (n = 22)</td>
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<tr>
<td>No. of times LP repeated</td>
<td>10 (52.6%)</td>
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<tr>
<td>Need for fentanyl administration</td>
<td>0 (0.0%)</td>
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<tr>
<td>Side effects</td>
<td>10 (83.3%)</td>
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pain and a great rate of successful ABG sampling comparing to topical lidocaine gel application.

Saghi et al. [11] in 2014 conducted a double-blind randomized clinical trial in patients with small facial wounds needing skin closure and assigned them to either the jet injection group or the needle infiltration group and evaluated the anesthetic effect of lidocaine in both groups. Their results showed that mean pain score during the anesthetic procedure was lower in the jet injector group compared with the needle infiltration group. Moreover, time to initiation of local numbness was significantly longer in the jet injection group than in the needle infiltration group. Nevertheless, suture procedure related pain did not differ significantly between the 2 groups [11].

5. Limitations of the study

One limitation of our study was that we could not make patients blinded to the study. Our sample size was not sufficient to detect the exact drugs' effects and adverse events. Further clinical trials with larger sample sizes and longer follow-up should, therefore, be performed to identify adverse events.

6. Conclusion

This study shows that performing LP by lidocaine jet injection might be less painful than lidocaine needle infiltration. Lidocaine jet injection might be safer for both the physician and patients. Lumbar puncture success rate in both groups was the same. There was no need for narcotic administration in either group.

References


