Local infiltration analgesia with ropivacaine in acute fracture of thoracolumbar junction surgery

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1. Introduction

Lumbar spine surgery usually causes severe pain, which can affect patient recovery. Opioid analgesics are the first line choice for management for postoperative pain but are usually associated with a number of undesired well-known side effects [1]. Effective postoperative pain management is an important factor to reduce the incidence of morbidity and to permit early leaving from hospital [2]. Continuous epidural analgesia has been a commonly used method, as a superior technique in comparison to intravenous analgesia regarding pain quality and incidence of side effects [3–5].

Local infiltration analgesia (LIA) is an attractive method because its safety, simplicity and low-cost for postoperative analgesia for many different surgeries. Their benefits in spine surgery however, are still controversial, as a number of original articles have been published on this issue with conflicting results. However, theirs are well known in other orthopedic surgery, as total hips or knee arthroplasty [6–9].

The aim of the present study was to clarify the effect of LIA with ropivacaine on postoperative pain for patients requiring spine surgery for thoracolumbar junction fracture.

2. Materials and methods

Seventy-six consecutive patients were included from January 2012 to December 2014 in this retrospective case control trial. Patients were divided into two groups: the R group which received a subfascial LIA with ropivacaine (20 milliliters, 7.5% whether 150 milligrams), made at the end of surgical procedure, before wound closure; the M group without LIA. That was two consecutives series. The first 38 patients have not received LIA, while the rest benefited from LIA.

2.1. Inclusion criteria

Consecutive patients with a thoracolumbar junction fracture (from T10 to L2), requiring posterior instrumented surgery and

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ASIA E were included. Exclusion criteria were polytrauma, patients requiring intensive care unit, three or more vertebra fractures, patients with dural tear and other ASIA grade.

2.2. Procedures

During the surgical procedure, all patients received general anesthesia using analgesics: paracetamol 1 gram IV, nefopam hydrochloride 20 milligrams IV and sufentanil (adjusted to patient weight). All patients underwent open posterior instrumented fixation without fusion, with pedicle screws (Colorado®, Medtronic®; XIAs®, Stryker®). Each patient received one drain, removed at 48 hours.

Postoperatively, patients were transferred to the post-anesthesia care unit (PACU) where they received 1 gram of paracetamol, nefopam hydrochloride (60, 80 or 100 mg depending on weight) and i.v. morphine.

After PACU, patients were transferred in orthopedic unit with an analgesic drug prescription: paracetamol 4g/day, nefopam hydrochloride 80 mg/day and i.v. morphine (patient controlled analgesia [PCA] treatment if the VAS >6) or oral morphine 10 mg on request.

2.3. Data collection and analysis

First point was to compare postoperative pain, which was assessed using a Visual Analogue Scale from 0–10 (VAS), where “0” indicated no pain and “10” indicated worst pain. Pain score was performed postoperatively upon the patient’s awakening in the PACU and before leaving the PACU. The average length of stay and time to the first morphine request were analyzed.

The morphine consumption was assessed postoperatively during 24 hours. Nurses in PACU and the hospitalization unit collected data in medical record.

Data were reported as mean and standard deviation. The Student’s t-test was applied to parametric data, and Mann and Whitney U-test to non-parametric data. A P value <0.05 was considered to represent statistical significance.

3. Results

Seventy-six patients were included, thirty-eight in the M group and the R group. No significant differences were observed with demographic data in Table 1.

Upon awakening in the PACU, and before leaving the PACU (1 hour), VAS was significantly reduced in the ropivacaine group (P = 0.0003 and P = 0.0002) (Table 2).

In the PACU, administration of morphine was 5.6 ± 6.3 mg in the R group and 10.8 ± 6.6 mg in the M group, respectively (P = 0.0007) (Fig. 1). Moreover, during the first 24 hours after surgery, the cumulated administration of morphine was significantly less in the ropivacaine group, 13.6 ± 11.5 mg versus 25.5 ± 14 mg in the M group (P = 0.001) (Fig. 2).

Table 1

<table>
<thead>
<tr>
<th>Demographic data from 76 patients.</th>
<th>M group</th>
<th>R group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>45.5 (17.6)</td>
<td>47.0 (17.8)</td>
<td>0.365</td>
</tr>
<tr>
<td>Sex (F/M)</td>
<td>9/29</td>
<td>15/23</td>
<td>0.154</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>79.3 (17.6)</td>
<td>75.8 (14.2)</td>
<td>0.154</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>173.0 (9.5)</td>
<td>170.7 (11)</td>
<td>0.154</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.4 (5.1)</td>
<td>26.0 (4.2)</td>
<td>0.33</td>
</tr>
<tr>
<td>Operative time (minutes)</td>
<td>55.1 (19.7)</td>
<td>61.1 (20.2)</td>
<td>0.111</td>
</tr>
</tbody>
</table>

Values are numbers means and standard deviations.

Table 2

<table>
<thead>
<tr>
<th>Results.</th>
<th>M group</th>
<th>R group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awakening VAS</td>
<td>6.24 (2.20)</td>
<td>4.08 (2.62)</td>
<td>0.0003</td>
</tr>
<tr>
<td>VAS after 1 hour</td>
<td>1.84 (0.89)</td>
<td>0.87 (0.84)</td>
<td>0.00002</td>
</tr>
<tr>
<td>Time to first morphine request (min)</td>
<td>25.9 (17.5)</td>
<td>38.0 (32.7)</td>
<td>0.024</td>
</tr>
</tbody>
</table>

Values are numbers means and standard deviations. VAS: Visual Analogue Scale.

The time to first morphine request in PACU was 38 ± 32.7 minutes in the R group versus 25.9 ± 17.5 minutes in the M group (P = 0.024).

In the M group, 15.8% (6/38) of patients required PCA versus 2.6% in the R group (P = 0.028).

The average hospital stay was 8.5 ± 2.8 days in the R group versus 8.2 ± 2.5 days in the M group (P = 0.3; NS).

No clinical signs of wound infection, local or systemic toxicity of ropivacaine were observed. No patient required surgical recovery for infection.
Table 3

<table>
<thead>
<tr>
<th>Studies</th>
<th>Patients (n)</th>
<th>Operation</th>
<th>Anesthesia</th>
<th>Infiltration protocol</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teddy et al. (1981)</td>
<td>46</td>
<td>Lumbar discectomy</td>
<td>20 ml bupivacaine 0.25% or 20 ml saline 0.9%</td>
<td>Intramuscular, before wound closure</td>
<td>LIA decreased morphine consumption</td>
</tr>
<tr>
<td>Chadduck et al. (1999)</td>
<td>50</td>
<td>Lumbar decompression</td>
<td>40 ml bupivacaine 0.25% or 40 ml saline 0.9%</td>
<td>Intramuscular, before wound closure</td>
<td>LIA decreased morphine consumption</td>
</tr>
<tr>
<td>Mack et al. (2001)</td>
<td>30</td>
<td>Lumbar discectomy</td>
<td>15 ml bupivacaine 0.25% or 15 ml saline 0.9%</td>
<td>Intramuscular, before wound closure</td>
<td>No effect</td>
</tr>
<tr>
<td>Yörükoğlu et al. (2005)</td>
<td>40</td>
<td>Lumbar discectomy</td>
<td>30 ml bupivacaine 0.25% or 30 ml saline 0.9%</td>
<td>Intramuscular, before wound closure</td>
<td>No effect</td>
</tr>
<tr>
<td>Gurbet et al. (2008)</td>
<td>40</td>
<td>Lumbar decompression</td>
<td>30 ml bupivacaine 0.25% or 30 ml saline 0.9%</td>
<td>Intramuscular, before wound closure</td>
<td>LIA decreased VAS, time to first analgesia, sedation scale</td>
</tr>
<tr>
<td>Esmail et al. (2008)</td>
<td>166</td>
<td>Lumbar discectomy</td>
<td>20 ml lidocaine 2% or 20 ml saline 0.9%</td>
<td>Subcutaneous, before incision</td>
<td>LIA decreased VAS, time to first analgesia</td>
</tr>
<tr>
<td>Ozyilmaz et al. (2012)</td>
<td>40</td>
<td>Lumbar discectomy</td>
<td>20 ml levobupivacaine 0.75% or 20 ml saline 0.9%</td>
<td>Intramuscular, before wound closure</td>
<td>LIA decreased VAS, time to first analgesia</td>
</tr>
<tr>
<td>Rahmanian et al. (2014)</td>
<td>60</td>
<td>Lumbar decompression</td>
<td>30 ml bupivacaine 0.25% or 30 ml saline 0.9%</td>
<td>Intramuscular, before wound closure</td>
<td>No effect</td>
</tr>
</tbody>
</table>

LIA: local infiltration analgesia; VAS: Visual Analogue Scale.

4. Discussion

The study demonstrated an overall analgesic efficacy of LIA of ropivacaine for thoracolumbar junction fracture surgery, for the first 24 hours postoperative period.

No study was interested in the unique LIA of ropivacaine in spine surgery.

Many studies demonstrated a reduction of postoperative pain and overall consumption of morphine with LIA in abdominal surgery, gynecological surgery and orthopedic surgery [9–13]. Andersen and Kehlet [9] achieved in 2014 a systematic review of the literature concerning the LIA in total hip arthroplasty (THA) and total knee arthroplasty (TKA) including 27 studies. They concluded that the LIA were effective in TKA but not in THA. However, protocols and molecules used were different between studies, bringing no consensus on protocols to use.

The choice of the postoperative analgesic regime after major lumbar spine surgery may include continuous epidural analgesia [3,4], patient controlled analgesia (PCA) [14] or intrathecal morphine administration [15,16]. The first author to suggest the use of LIA in lumbar spine surgery were Mullen and Cook in a technical note in 1979 [17].

Some studies were performed to determine the place of LIA in the postoperative pain management in spine surgery, with conflicting results (Table 3).

In a study with 50 patients requiring lumbar decompression, Chadduck et al. [19] assessed the role of LIA with bupivacaine in early postoperative pain control after lumbar decompression but the study did not provide any advantages.

Esmail et al. [23] and Yörükoğlu et al. [21] concluded that LIA with lidocaine (Esmail) or bupivacaine (Yörükoğlu) were ineffective to manage postoperative pain in spine surgery.

Mack et al. [20] showed that LIA with bupivacaine delayed time to first analgesic request.

Teddy et al. [18] have brought out that LIA with bupivacaine decreased analgesic consumption only in the first two hours.

Some studies showed that a combination of bupivacaine and corticosteroids reduced the cumulated morphine dose and postoperative pain [26,27].

Bianconi et al. assessed the LIA with ropivacaine; first of all after joint replacement surgery and then after spine fusion surgery with ropivacaine continuous wound instillation. These studies provide the same results with a reduction of postoperative pain and morphine consumption [8,28]. Kristenpsen provided the same results in 2014 with patients who received multi-holes catheters with ropivacaine installation [29].

A retrospective, case-control study, managed by Elder et al. [27], was conducted to analyze postoperative outcomes in patients who received local anesthetic infusion pumps (0.5% marcaine) into the subfascial aspects of the wound after lumbar spinal fusion surgery. This study showed that patients who received infusion used less narcotic medications than case-matched.

The possible limitations of the study are no randomization, no double-blind trial or case-placebo trial. This study is a case-controlled trial of two consecutive series.

Ropivacaine is very interesting for LIA because of its vasoconstrictive properties and decreased neuro- and cardiotoxicity compared with bupivacaine [30,31]. Albright in 1979 [32] reported a series of 6 cardiac arrests after bupivacaine utilization.

We do not have results in the literature for surgical site infections due to local anesthetic (AL). The AL have, in vitro, bacteriostatic and bactericidal activity [33,34] but it seems that ropivacaine is devoid of antibacterial effect [35,36]. Liu et al. in 2006 [37] highlighted a 0.7% risk of infection with catheter.

The use of morphine and non-steroidal anti-inflammatory drugs (NSAIDs) in the management of postoperative pain is effective but can cause many side effects [1]. We should cut with their large use in the postoperative period in order to get better quality of life for our patients.

Despite the promising results of LIA techniques in TKA, but not THA [9,12,13,36], the optimal concentration, volume and site for the LIA need to be clarified in spine surgery. For all technical wound infiltration, a dose–response relationship was demonstrated [8,28]. For the same volume, the increase in the concentration used enhances the effect. Given the dose–effect relationship, the lower toxicity of ropivacaine is an important asset.

The concept of multimodal analgesia was born in the 1990s under the leadership of teams involved in the management of postoperative pain such as Dahl et al. [38] or Kehlet [39,40]. Nowadays analgesic strategy is changing. We should personalized analgesic prescription for each patient. The associations of systemic analgesics and local analgesia or locoregional are the foundation of this multimodal analgesia.

The important finding of this study is that analgesia provided by LIA of ropivacaine was greater than systemic analgesia in controlling postoperative pain during the first 24 hours after surgery.

Finally, intraoperative infiltration with ropivacaine seems to be, according to the results of this study, an effective alternative.
5. Conclusion

In conclusion, the results from this study carried on patients after thoracolumbar surgery, confirm that an intraoperative LA with ropivacaine (20 ml, 7.5%) provides analgesia, with a low morphine consumption and a good postoperative pain control. However, further studies, especially randomized, double blind, placebo-controlled trial, should be done before drawing general recommendations.

Ethical statement

The manuscript has not been previously published in whole or in part or submitted elsewhere for review.

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Disclosure of interest

The authors declare that they have no competing interest.

References