Single Local Infiltration Analgesia (LIA) Aids Early Pain Management After Total Knee Replacement (TKR): An Evidence-Based Review and Commentary

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Abstract *Background:* There is controversy in the literature regarding the role of single local infiltration analgesia (LIA) after total knee replacement (TKR). *Questions/Purposes:* Is single LIA really efficient in controlling pain after TKR? *Methods:* A Cochrane Library and PubMed (MEDLINE) search related to the justification LIA after TKR was analyzed. The main criteria for selection were that the articles were focused in the aforementioned question. *Results:* Two hundred ninety-nine articles were found until February 9, 2017, but only 27 were selected and reviewed because they were focused on clinical experience with LIA following TKR. Fifteen of them were considered level of evidence (I-II) while 12 had a lower level of evidence (III-IV). LIA reduced the amount of perioperative opioid administration and enabled adequate pain management in conjunction with oral medication without adverse effects. No clinically marked effects on the functional outcome after TKR were detected. *Conclusion:* Single dose LIA provides effective analgesia in the initial postoperative period after TKR in most randomized clinical trials, systematic reviews, and meta-analyses.

Keywords total knee replacement · local infiltration analgesia · efficacy

Introduction

Improvements in pain management techniques in the last decade have had a major impact on the practice of total knee

replacement (TKR). Adequate postoperative analgesia with minimal side effects is essential for early mobilization and recovery in patients undergoing TKR. Local infiltration analgesia (LIA) with ropivacaine has been introduced as a popular method for decreasing postoperative pain after TKR. LIA is widely applied in patients undergoing TKR. The purpose of this review is to investigate whether single LIA is associated with improved pain management that lowers narcotic consumption, avoids narcotic side effects, accelerates return of function, and shortens hospital stay without causing wound or other complications after TKR.

Methods

A review has been performed on the influence of the role of LIA in patients undergoing TKR. The search engines were MEDLINE (PubMed) and the Cochrane Library, and the final date was 9 February 2017. The keywords used were TKR and analgesia. Two hundred ninety-nine articles were found, but only 21 were selected and reviewed because they were deeply focused on the aforementioned question.

Of the 299 articles reviewed, only 27 were finally considered because they were fully focused on the question of this article. Fifteen of the 27 were of high level of evidence (grades I-II) [2, 5–10, 12, 14, 17, 21, 22, 24, 26, 27] and 12 were of low level of evidence (grades III-IV) [1, 3, 4, 11, 13, 15, 16, 18–20, 23, 25].

Results

Meta-Analyses and Randomized Controlled Trials

As an alternative to intravenous or intrathecal patient-controlled analgesia (PCA), LIA consistently reduced post-op narcotic usage in the first 48 h after TKR. In all studies, LIA was used as a component of a multimodal approach to

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postoperative pain management. In nearly all studies, pain management was improved as evidenced by lower pain VAS scores. In some studies, equivalence was found but in no reported studies was pain management inferior when LIA was used. Different LIA recipes were employed. Most studies included ropivacaine, ketorolac, and betamethasone. In several studies, morphine was also included along with epinephrine. Schotanus et al focused on the use of epinephrine comparing injections with and without addition of this drug. He found no difference in pain relief and duration of relief and therefore advised against inclusion of epinephrine in the LIA formula [15].

Several RCT's and meta-analyses commented specifically on reduced narcotic consumption as a benefit of LIA compared to patient-controlled intravenous or epidural analgesia protocols. A specific benefit noted was less nausea and vomiting in the LIA groups [1, 5, 8, 12, 18]. In general, the benefit of the LIA approach was most apparent in the first 48 h after surgery. Beyond that reports of pain and narcotic consumption tended to equalize. One weakness noted in the systematic reviews was the large variety of traditional pain management approaches applied in the wide variety of multimodal pain pathways.

No differences in wound healing of infection-related complications were reported in any of the studies. There was no consistent finding regarding an effect on length of stay in studies which commented specifically on these variables [5, 10, 12, 15]. Two studies focused on any effect or difference between LIA and controls in terms of patient-reported outcomes in long-term follow-up. No differences in functional outcomes or in patient-reported outcomes were noted at 1-year follow-up [5, 10, 12, 15].

Discussion

The literature reports strongly support the use of LIA as a component of a multimodal approach to pain management after TKR. It appears to help reduce pain in the early postoperative period and helps to reduce narcotic consumption and narcotic-related side effects such as nausea and vomiting. It also appears to be safe and has not been associated with an increased risk of wound infection or other complications. It does not appear to have a benefit over long-term follow-up with respect to functional recovery or patient-reported outcomes.

On our unit at La Paz in Madrid, Spain, we have used the single-dose LIA approach for the past 7 years [6, 11, 15, 16, 19, 21]. Our single LIA approach includes intra-articular infiltration of posterior capsule, medial and lateral capsule and ligaments, before closure, of 80 cm³ saline with adrenalin 300 µg, morphine sulfate 10 mg, tobramycin 100 mg, betamethasone sodium phosphate 6 mg, betamethasone acetate 6 mg, and ropivacaine 200 mg diluted with saline to a final volume of 80 cm³.

The aforementioned single LIA approach has always been used within the context of a multimodal blood-loss prevention approach (MBLPA) that in addition to single LIA includes tourniquet with 100 mmHg above systolic

pressure, released after skin closure; ideally, but not mandatory, preoperative Hb evaluation and, if under 13 g/dL, preoperative treatment with intravenous iron treatment. The surgical blood-saving protocol includes closure of the femoral canal with bone graft plug. If a drain is used, vacuum suction is not started for 2 h after closure and the drain is removed after 24 h. We use the aforementioned single LIA cocktail both in primary and revision TKR.

Regarding TXA, initially we used intravenous TXA in two doses: 15 mg/kg weight in 100 cm³ saline slowly infused in 15–20 min before tourniquet release, and a second identical dose after 3 h [11, 15, 16]. We also used intra-articular TXA in different proportions [6, 19, 20] even in patients with bleeding disorders (hemophilia) [19]. No differences were found between intra-articular and intravenous TXA [6]. Currently, we favor intra-articular administration of 2 g of undiluted TXA (20 cm³ total volume) after closure of the arthrotomy and before tourniquet release.

With the current protocol, our length of stay in hospital is 2–3 days in primary TKR and 4–5 days in revision TKR (unpublished data). Patients are discharged walking with two crutches and with oral analgesics and anti-inflammatory drugs.

In conclusion, single LIA provides effective analgesia in the initial postoperative period after TKR in most randomized clinical trials, systematic reviews, and meta-analyses, as well as in our clinical practice.

Compliance with Ethical Standards

Conflict of Interest: E. Carlos Rodriguez-Merchan, MD, PhD has declared that he has no conflict interest.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed Consent: N/A.

Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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