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Is There a Difference in Analgesic Efficacy Between Nerve Block and Intraarticular Administration of Analgesia for Patients Undergoing Knee or Hip arthroplasty?

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Is there a difference in analgesic efficacy between nerve block and intraarticular administration of analgesia for patients undergoing knee or hip arthroplasty?

Response/Recommendation for total knee arthroplasty (TKA): Local infiltration analgesia (LIA) and peripheral motor-sparing nerve blocks (PNBs), when performed properly, have similar analgesic efficacy after TKA.

Expert Voting: Agree 84.6%, Disagree 8.7%, Abstain 6.8%

Response/Recommendation for total hip arthroplasty (THA): A LIA can provide added analgesia for patients undergoing THA. A PNB has not demonstrated additional analgesic benefit after THA. In addition, PNB may interfere with muscular strength and therefore may delay the recovery process.

Expert Voting: Agree 75.2%, Disagree 15.1%, Abstain 9.7%

Level of Evidence: Moderate.

Rationale

Total hip and knee arthroplasties are associated with marked postoperative pain that must be controlled to allow the patients an optimal rehabilitation process. Enhanced recovery after surgery protocols for major joint arthroplasty provide major clinical and economic benefits, and pain control plays a crucial role in faster recovery and patient satisfaction [1]. Hence, a variety of regional and local techniques have been developed to provide analgesic benefit without undue reliance on opioids [2].

For patients undergoing orthopaedic procedures, local infiltration analgesia (LIA) and motor-sparing peripheral nerve block (PNB) can have an additional analgesic effect when performed properly. Early mobilization, reduced length of hospital stays (LOS) overall costs, reduced use of analgesics (especially opioids), and less frequent side effects (nausea and vomiting) are possible benefits of these analgesia techniques after total joint arthroplasty. Both LIA

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and PNB have been shown to be a safe and reproducible procedure that can reduce postoperative pain without interfering with rehabilitation protocol.

For LIA, a single local anesthetic such as ropivacaine or bupivacaine should be considered. The addition of epinephrine and/or tranexamic acid as part of the LIA cocktail provides other advantages, such as reduced postoperative bleeding. There is no clear evidence advocating the use of additional substances, like glucocorticoids, nonsteroidal anti-inflammatory drugs, opioids, or antibiotics. Application of LIA can be performed in one or more steps during the surgery; the exact anatomical location of the injections should be chosen based on the innervational anatomy of the target joint.

For PNB, a local anesthetic is applied by the anesthetist, optimally under ultrasound-guided visualization, before or after the surgical intervention. In the case of total knee arthroplasty (TKA), an adductor canal block (ACB) is achieved by injection of a local anesthetic around the sensory fibers of the femoral nerve (saphenous nerve) without causing any muscle weakness. In the case of total hip arthroplasty (THA), the analgesic effect around the hip is achieved by injection of local anesthetic in the soft-tissue envelope around the hip joint, where several nerves are blocked (femoral, obturator, superior gluteal, and sciatic nerves). Furthermore, the combination of these two techniques as a multimodal approach can theoretically strengthen their beneficial effects [3,4]. Even though some of those beneficial effects are statistically better, they may not always result in relevant clinical improvement.

A systematic review was done using three databases: Pubmed, Embase, and World of Science. The most appropriate MeSH terms were utilized in order to find all relevant papers about the analgesic efficacy of LIA and/or PNB in patients undergoing TKA or THA. A total of 351 papers were found. We included only comparative studies. After exclusion of nonrelevant studies, 102 papers were included for final evaluation, including randomized controlled trials (RCTs) and systemic review articles. We analyzed 90 TKA studies, nine THA studies, and three articles involving both TKA and THA.

In the systemic review of Andersen and Kehlet [5], the analgesic efficacy of LIA was evaluated. In patients undergoing THA, no additional analgesic effect of LIA compared with placebo was reported in trials with low risk of bias when a multimodal analgesic regimen was administered perioperatively. Compared with intrathecal morphine and epidural analgesia, LIA was reported to have similar or improved analgesic efficacy. In patients undergoing TKA, most trials reported reduced pain and reduced opioid requirements with LIA compared with a placebo or no injection. Compared with femoral nerve block, epidural or intrathecal morphine LIA provided similar or improved analgesia in the early postoperative period, but most trials had a high risk of bias due to administration of different systemic analgesia between groups. Overall, the use of wound catheters for postoperative administration of local anesthetic was not supported in the included trials, and LOS was not related to analgesic efficacy. Despite the many studies of LIA, the final interpretation is hindered by methodological insufficiencies in most studies, especially because of differences in the use of systemic analgesia between groups. However, LIA provides effective analgesia in the initial postoperative period after TKA in most randomized clinical trials, even when combined with multimodal systemic analgesia. In contrast, LIA may have limited additional analgesic efficacy in THA when combined with a multimodal analgesic regimen. Postoperative administration of local anesthetic in wound catheters did not provide additional analgesia when systemic analgesia was similar, and LOS was not related to the use of LIA with a fast-track setup.

In the RCT of Spangehl et al., patients after TKA receiving LIA had similar pain scores, shorter LOS, less likelihood of peripheral nerve dysesthesia, but greater narcotic use on the day of surgery compared with patients receiving peripheral nerve blocks [6]. Periarticular injections provide adequate pain relief, are simple to use, and avoid the potential complications associated with nerve blocks.

In the RCT of Tanikawa et al., patients after TKA were randomly allocated to two groups: concomitant administration of femoral nerve block (FNB) and sciatic nerve block (SNB) or femoral nerve block and LIA. The patients in group SNB showed less pain than group LIA only on postoperative hours 0 and 3. Satisfactory postoperative analgesia after TKA was also achieved with LIA combined with FNB, while averting the risks associated with SNB. The influence on the progress of rehabilitation and LOS was similar for both anesthesia techniques. LIA offered a potentially safer alternative to SNB as an adjunct to FNB, particularly for patients who have risk factors for sciatic nerve injury [7].

In the RCT of Moreno et al., patients scheduled for primary unilateral TKA were randomly divided into two groups: continuous FNB and LIA. The visual analog score (VAS) and mean opioid consumption did not differ significantly between the groups. Muscle strength was significantly lower in the FNB group on days 0 and 1. Based on this study, FNB and LIA are associated with similar outcomes, and one cannot be recommended over the other [8].

In the two-group RCT of Kastelik et al., a direct comparison of LIA versus sciatic nerve and ACB for fast-track TKA was conducted. Patient satisfaction, postoperative oral morphine equivalents, and resting pain levels were comparable between groups. Both analgesic regimens allowed early mobilization after TKA with high patient satisfaction; LIA shortened the perioperative time [9].

Tanikawa et al. conducted a prospective RCT in patients after TKA with concomitant administration of SNB or LIA in both groups in addition to FNB. Average pain scores during the first 21 days after surgery were similar in the two groups and remained at low levels. There was no significant difference in the need for adjuvant analgesics, patient satisfaction level, time to achieve rehabilitation goals, or LOS. They concluded that LIA offers a potentially safer alternative to SNB as an adjunct to FNB [10].

Fenten et al. compared short-term (three months) and long-term (12 months) outcomes of FNB with catheter versus LIA for analgesia in fast-track TKA. There were no differences between groups in long-term functional capacity, patient satisfaction, or LOS. In the first two days, subjects in group FNB had slightly lower pain scores and used fewer opioids, and subjects in group LIA had a higher level of accelerometer activity. Both techniques were similar regarding long-term functional outcomes. Subjects in group FNB had slightly lower pain scores and lower opioid consumption after operation, lower maximum pain scores at three and 12 months, and were less likely to use any pain medication at 12 months [11].

Nagafuchi et al. aimed to assess whether LIA with continuous FNB is as effective as SNB combined with continuous FNB, and they concluded that SNB with FNB is superior to LIA with FNB for postoperative pain control within three to 12 hours of TKA [12].

Gudmundsdottir and Franklin conducted a prospective, double-blind, placebo-controlled RCT. TKA was performed under spinal analgesia, and every participant was given single-dose LIA intraoperatively. Patients received an ACB and were randomized into a 0.2% ropivacaine group and a control group receiving normal saline (placebo). First, a 20-mL bolus was given into the adductor canal, and four hours later, a continuous flow at six mL/hour was initiated for two postoperative days through a catheter placed in the adductor canal. The worst pain score during movement of the operated knee on post-operative day (POD)-1 and POD2 was similar between the groups. No other ambulation tests done on POD1 and POD2 showed any statistically significant difference. Morphine consumption on the day of surgery, POD1 and POD2, was

similar between the groups. No benefit of continuous infusion ACB added to a single-dose LIA compared with LIA alone on pain while ambulating on POD1 and POD2. Furthermore, the ACB showed no superiority in ambulation ability on the postoperative days [13].

In a prospective RCT of Fan et al., 157 patients undergoing TKA received either FNB or LIA; the research showed that no significant differences were observed between the treatment groups. The LIA provided a similar analgesic effect to FNB with a low incidence of complications [14]. In a triple-blinded RCT of Paulou et al., the analgesic efficacy of selective tibial nerve block versus partial LIA for posterior pain after TKA was investigated. Tibial nerve block did not provide superior analgesia when compared to LIA [15]. Hu et al. concluded that pericapsular nerve group (PENG) block combined with LIA could improve postoperative pain relief, reduce opioid use, and enhance recovery in THA patients without weakening the quadriceps muscle strength [16].

In the multicenter double-blinded RCT of Lin et al., in addition to spinal anesthesia and LIA, THA patients received either a PENG block or a sham block. Patients receiving a PENG block for analgesia in elective THA experienced less postoperative pain on day zero with preservation of quadriceps muscle strength. Despite short-term benefits in the first 24 hours, no quality of recovery or longer-lasting postoperative effects were detected [17].

In a prospective double-blind RCT of Ye et al., ultrasound-guided PENG block and LIA for postoperative analgesia after THA were compared. There was no clear difference in morphine requirements during the first 24 hours postoperatively, in the total postoperative morphine consumption, or in the postoperative resting VAS pain scores. The exercise VAS score in the PENG group was significantly higher than that in the LIA group within 12 hours after surgery. There was no significant difference in hip function, LOS, or incidence of complications between the two groups. Therefore, the analgesic effect and functional recovery of ultrasound-guided PENG block for THA were not superior to those of periarticular LIA [18].

A double-blind, placebo-controlled RCT by Kuchalik et al. compared LIA and FNB for postoperative pain management in patients undergoing THA. During surgery, patients in group LIA received a mixture of 300 mg (150 ml) ropivacaine, ketorolac 30 mg (1 ml), and adrenaline 0.5 mg (0.5 ml) (total volume 151.5 ml) periarticularly and subcutaneously, while group FNB received 151.5 ml of saline periarticularly in a systematic way by the surgeon. A LIA significantly reduced pain intensity on standing and mobilization and rescue analgesic consumption compared to femoral nerve block without causing significant major side effects. No differences were found in home discharge, quality of life, or hip dysfunction between the groups. They concluded that LIA is the preferred method for postoperative pain management following THA compared to PNB [19].

There are controversial opinions and conflicting results regarding the use of PNB in patients undergoing THA. Marques et al. concluded that local anesthetic infiltration is effective in reducing short-term pain and LOS [20], while Yin et al. concluded that it does not influence the later stages of recovery [21]. A meta-analysis done by Jiménez-Almonte et al. after analyzing 35 RCTs reported that local infiltration analgesia reduced pain scores and opioid consumption when compared with placebo, but there was no difference between LIA and PNB [22]. This meta-analysis involving 2,296 patients compared LIA and PNB (femoral nerve block, 3-in-1 block, lumbar plexus block, psoas compartment block, and fascia iliaca compartment block) and found no difference in pain scores and opioid consumption 24 hours after THA.

When comparing three groups: LIA combined with spinal anesthesia, only spinal anesthesia, and spinal anesthesia with fascia iliaca compartment block (FICB), Demeulenaere et al. found a lower pain score for LIA up to four hours postoperatively [23]. In opposition to FICB, the spinal anesthesia group had better rehabilitation potential at 12 hours postoperatively. Thus, they concluded that LIA is a beneficial adjuvant therapy to spinal anesthesia in THA, and adjuvant FICB only provides lower opioid consumption. Another RCT made by Lennon et al. found that adding an erector spinae plane block to patients who have already received neuroaxial blocks, local anesthetic infiltration, and oral multimodal analgesia does not provide additional analgesic benefit [24].

Another promising analgesic method has been emerging, which consists of ultrasound-guided pericapsular nerve block (PENG) preoperatively [16,18]. This technique has not demonstrated differences in pain control, hip function, and LOS when compared with LIA. Therefore, PENG should not be used as a single analgesia technique. However, as happens with LIA, PENG is advantageous to the femoral nerve block technique as it is simpler and does not interfere with the quadriceps muscle strength, which could affect the recovery process. Another RCT by Ye et al. compared ultrasound-guided PENG with LIA in 80 patients and concluded that the analgesic effect and functional recovery of PENG applied alone after THA are not superior to those of LIA [18]. However, a combination of PENG and LIA has been shown to improve postoperative pain relief without weakening the quadriceps muscle [3,4] (14,15). Nevertheless, it did not translate into improved quality of recovery or longer lasting postoperative effects (15).

The RCT by Yang et al. compared lumbo-sacral plexus block (LSPB) and LIA in 117 patients undergoing THA under general anesthesia, examining postoperative quality of life (QoL) and pain [25]. Using the EQ-5D as an index for QoL, they showed that LSPB is better than LIA for up to six months postoperatively. However, the overall analgesic effect of LIA within 72 hours postoperatively was no less than that of LSPB.

Based on the evaluation of current evidence, it appears that use of LIA and/or PNB in patients undergoing TKA provides additional analgesic efficacy. This is not, however, entirely true for patients undergoing THA. Due to the lower level of pain, patients undergoing THA do not seem to benefit from the use of PNB, but administration of LIA may provide additional analgesic efficacy without interfering with early rehabilitation.

CRediT authorship contribution statement

Akos Zahar: Writing – review & editing, Writing – original draft, Visualization, Supervision, Methodology, Conceptualization. **Maciej Breborowicz:** Writing – review & editing. **Laszlo Bucsi:** Writing – review & editing. **Ernesto Guerra Farfan:** Writing – review & editing. **Yuri Lara Tarachenko:** Writing – original draft, Methodology, Investigation, Formal analysis. **Gerda L'Aune:** Writing – original draft, Methodology, Formal analysis, Data curation. **Nandor J. Nemes:** Writing – original draft, Methodology, Formal analysis, Data curation. **Dragan Radoicic:** Writing – review & editing. **Benjamin F. Ricciardi:** Writing – review & editing. **Salvador O. Rivero-Boschert:** Writing – review & editing. **Shaojie Wang:** Writing – review & editing.

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