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Original Research Article

Intraoperative local infiltration anesthesia effect on post-operative pain after total knee replacement

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ABSTRACT

Background: Pain following TKA renders rehabilitation difficult. Local infiltration anesthesia (LIA) could significantly decrease post-operative pain. Aim was to assess the effect of peri-articular intraoperative LIA during primary TKA on post-operative pain.
Methods: This prospective, randomized and double-blind study included 150 patients, aged 65-74 years, of both sexes with stage 4 knee osteoarthritis who were assigned for primary TKA at Queen Alia Military hospital, Amman-Jordan, during the period May 2022–December 2022. Patients were divided into two groups. LIA group (GI, n=75) received a single peri-articular LIA during surgery. The cocktail comprised 75 mg diclofenac sodium, 100 mg bupivacaine, and 0.5 mg adrenaline. The cocktail was diluted in 100 ml of normal saline and split into two syringes, 50 ml each. Patients in control group (GII, n=75) received only 100 ml of normal saline. When patients had pain postoperatively, 1 mg morphine was given intravenously at 15-minute intervals. Primary outcomes were verbal analog scale (VAS) pain score from day 1 to 6 after surgery and overall morphine administration.
Results: On day 1 after surgery, the average VAS was 4.19 in the LIA group vs. 6.08 in group II ($p<0.002$), while it was 4.01 versus 4.78 ($p>0.05$) on day 6. Overall morphine requirement and pain scores from day 1 to day 6 after surgery were less in the LIA group than in the other group, 13.06 mg versus 20.75 mg ($p<0.004$).
Conclusions: Peri-articular LIA during TKA significantly improve post-operative pain and decreases morphine use.

Keywords: LIA, Morphine, Primary TKA, VAS pain score

INTRODUCTION

Total knee arthroplasty is a frequent orthopedic surgical technique to manage end-stage degenerative knee osteoarthritis in old people with a high frequency of degenerative joint morbidity. Total knee arthroplasty is correlated with remarkable pain after surgery and hardening rehabilitation.[1] Available pain control techniques after surgery include extradural analgesia, peripheral nerve blocks, local infiltration anesthesia (LIA), intravenous patient-controlled analgesia, and oral analgesia. Subarachnoid block anesthesia was correlated with an intense headache after surgery, hypotension during surgery, and risk of intrathecal infection.[1] Intravenous or oral opioids might induce emesis, somnolence, respiratory depression, and urinary retention.[1] LIA has the potential to avoid such events. Pain following total knee arthroplasty may render rehabilitation difficult. LIA, including an anesthetic drug, a non-steroidal anti-inflammatory drug, and adrenaline, could significantly decrease pain.

Kerr and Kohan first reported LIA in 2008.[2] It includes the administration of an anesthetic with non-steroidal anti-inflammatory and adrenaline or a corticosteroid.[3] LIA is used during surgery via injection into the posterior capsule of the knee and the soft tissues around the surgical field.[3]

Although LIA is used in total knee arthroplasty, the potency of LIA during total knee arthroplasty is not superior to other procedures.[4,5] Nevertheless, LIA was found to be safe.[6]

Aim

Our investigation aimed to assess the post-operative pain relief effect of peri-articular LIA (LIA) during primary total knee arthroplasty in subjects with knee osteoarthritis.

METHODS

This prospective, double-blind and randomized investigation included 150 patients, aged 65-74 years, of both sexes and with stage 4 knee osteoarthritis without severe deformities who were assigned for primary total knee arthroplasty using the medial para patellar approach at Queen Alia Military hospital, Amman-Jordan, during the period May 2022-December 2022, after receiving written and informed consent from the participants and approval from the local ethical committee of our Royal Jordanian medical services. Patients with chronic inflammatory joint diseases, on steroids, and with kidney failure were excluded.

Patients were divided into two groups. A tourniquet was placed on the operated limb and released following wound closure. Patients in the LIA group (GI, n=75) received a single-cocktail dose of peri-articular LIA during surgery. The LIA cocktail comprises 75 mg diclofenac sodium, 100 mg bupivacaine, and 0.5 mg adrenaline. The cocktail was diluted in 100 ml of normal saline and split into two syringes of 50 ml each. The injection was done at three points. The first injection was done prior to prosthesis cementation and implantation. The posterior capsule was infiltrated with 20 ml. During infiltration, the midpoint of the posterior capsule was avoided because of the proximity to the neurovascular bundle. The second injection was done following prosthesis implantation, and 60 ml was infiltrated into the released collateral ligaments, gutters, anterior supracondylar soft tissue, quadriceps cut ends, and retinaculum. The third injection was done before skin closure, and the remaining 20 ml was injected subcutaneously. Patients in the other group (GII, n=75) received only 100 ml of normal saline split into two syringes of 50 ml each.

When patients had distressing pain (≥5 on VAS), 1 mg of morphine was given intravenously for 15 minutes. This was discontinued on day 1 or 2 after surgery. Oral analgesics included 1 gm perfalgan four times daily for 5 days and 50 mg tramadol four times daily for 3 days.

Primary post-operative outcomes included verbal analog scale pain score after surgery from day 1 to day 6 and overall morphine requirement. The verbal analog scale pain scores ranged between 0 and 10, where 0 indicated no pain and 10 indicated the highest intense pain.[7]

Statistics

The Chi-square test was used for categorical parameters, and the Mann-Whitney U test was used for continuous parameters between both groups. A p value less than 0.05 was regarded as statistically significant.

RESULTS

There were no remarkable discrepancies between the groups regarding the characteristics (Table 1).

Table 1: Patients characteristics.

	Group I	Group II	P value
No.	75	75	
Local infiltration anesthesia	yes	No	
Age (years) median (range)	71.4 (35-87)	68.4 (30-84)	0.424
Gender (%)			
Female	48 (64)	52 (69.3)	0.552
Male	27(36)	23(30.7)	
BMI (kg/m^2) median (range)	30.5 (25-33)	32.4 (27-35)	0.223

Patients in the LIA group experienced remarkably fewer pain scores from day 1 to day 6 after surgery than patients in group II. On day 1 after surgery, the median VAS pain score was 4.19 in the LIA group compared to 6.08 in group II ($p<0.002$). On day 2 after surgery, the LIA group experienced a pain score of 4.26 compared to 5.33 in group II ($p<0.05$). Discrepancies in pain scores on day 3 and day 6 after surgery were comparable but statistically remarkable. On day 3 after surgery, the pain score in the LIA group was 4.24 and that in group II was 4.91 ($p>0.05$). On day 6 after surgery, the pain score in the LIA group was 4.01 and that in group II was 4.78 ($p>0.05$) (Table 2).

Table 2: Verbal Pain scores after surgery.

	Group I	Group II	P value
Day 1 after surgery	4.19	6.08	<0.002
Day 2 after surgery	4.26	5.33	<0.05
Day 3 after surgery	4.24	4.91	>0.05
Day 6 after surgery	4.01	4.78	>0.05

The median morphine consumption used by patients in the LIA group was 13.06 mg, and that in group II was 20.75 mg ($p<0.004$).

DISCUSSION

Pain following total knee arthroplasty is crucial, as it may harden rehabilitation. A single dose of peri-articular LIA during surgery, including a combination of bupivacaine, non-steriodal anti-inflammatory agent, and adrenaline, is a stable and safe cocktail that enhances pain management

after surgery, as was demonstrated by decreased VAS pain scores during the period from day 1 to day 6 after surgery in our investigation. There were no remarkable discrepancies in pain scores between LIA and control groups.[8] Pain-ameliorating actions of LIA were found after surgery.[9] Discrepancies in pain scores between groups were more on day 1 and day 2 than on day 3 and day 6 after surgery. Various structures and layers must be infiltrated during local anesthetic infiltration for major surgery. The minimum volume of local anesthetic is enough for an efficient local infiltration to cover all structures. With traditional concentrations of local anesthetic solutions, high volumes have a risk of systemic toxicity. Anesthesia of the small nerve endings in and around joints does not need a high-concentration local anesthetic. The concentration of local anesthetic could be reduced, and the volume increased, keeping the overall dose safe. As the major joints lack major blood vessels, the risk of injecting a large bolus directly into circulation is small.[10] As local anesthetic injections are done close to the location of the operative insult, there is a potential for hitting the origin of pain induced by local inflammation and pain to supply efficient therapy near the origin of pain. Anesthetic adjuvants, such as anti-inflammatory agents, non-steroidal anti-inflammatory drugs, and cyclooxygenase (COX) 2 inhibitors, and steroids, as well as opioids and ketamine, have all been used. Epinephrine has the potential to lengthen the action of other locally active drugs as their clearance from the local location is delayed because of the epinephrine-related vasoconstriction. Long-acting local anesthetics have a limited period and wear off during hours following injection. Repeated injection of the local anesthetic is painful or unsuitable.[11]

LIA includes a local anesthetic, a non-steroidal anti-inflammatory drug, and adrenaline plus or minus morphine and steroid.[12] Ropivacaine as the local anesthetic or levobupivacaine was used to exclude bupivacaine-induced intense toxicity. Ropivacaine and levobupivacaine versus bupivacaine have mildly less anesthetic efficiency and less central nervous system and cardiovascular toxicity. LIA releases the therapeutic action by blocking pain conduction at its origin. The standard injection was done to systematically attain every part of the knee joint's tissue. The positive clinical outcomes of the LIA method were ascertained by good infiltration of most nerves supplying the knee. Only in the lower popliteal fossa, less solution could be spotted. The posterior part of the knee is the main common region where patients experience pain after surgery. To reduce this posterior knee pain, we completely infiltrated the posterior articular capsule with bupivacaine (0.5%) in the LIA groups. To begin with, it is important to have extra access to the posterior aspect, beginning with the local posterior infiltration anesthesia injection before implantation of the prosthesis.

Morphine requirement and usage were less in the LIA group in our investigation. Less morphine usage was found in patients who received LIA during total knee arthroplasty.[13,14] In our investigation, the decrease in morphine requirement and usage in the LIA group suggests that LIA enhanced pain management following total knee arthroplasty. The average (standard deviation) VAS pain score after surgery was 6.1 (1.1) in the control group.[15]

The average (standard deviation) of overall morphine usage was 20.6 (6.8) mg.[13] After surgery, LIA had better pain scores than subarachnoid morphine one day during rest and movement. The LIA procedure can have potential toxic adverse effects if not given properly. The toxic threshold in arterial samples for local anesthetic and maximum overall concentration is important.

3 patients in whom LIA was used (0.02%) and 4 patients in whom LIA wasn't used (0.026%) had prolonged surgical wound discharge that was treated with dressing and oral antibiotics.

Although this study only included patients with end-stage knee osteoarthritis whom knee replacement is the ideal treatment, it doesn't differentiate between patients with severe deformities and those with mild deformities in terms of the effect of extensive soft tissue release that's more commonly needed in severe deformities and its influence on post-operative pain, which might be considered as a limitation of this study.

CONCLUSION

Single-dose LIA during surgery may efficiently decrease pain after surgery from day 1 to day 6 and may decrease the requirement and usage of morphine. We recommend using LIA in total knee arthroplasty.

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