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Original Research Article

Post Operative Analgesic Effect of Adductor Canal Block, Peri–Articular Injection or Infiltration between Popliteal Artery and Posterior Knee Capsule with Adductor Canal Block in Total Knee Arthroplasty: A Comparative Study

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Abstract

Aim: The aim of the present study was to compare the adductor canal block, peri–articular injection or infiltration between popliteal artery and posterior knee capsule with adductor canal block in total knee arthroplasty.

Methods: The present study was conducted at Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India in a total of 100 patients undergoing unilateral total knee arthroplasty.

Results: The entire study group included 65 male patients and 35 female patients. The mean age of the patients in the study group was 62 years with patients in ACB + IPACK group having a mean age of 61 years and patients in ACB group with a mean age of 63 years. The overall demo- graphic and perioperative characteristics in both the groups were similar. VAS score at rest after 8 h postoperatively, on day 1 and day 2 showed significantly ($p < 0.005$) better values in ACB+IPACK group compared to the ACB group. However, patients in both the groups did not experience severe pain that required any rescue medication. The mean range of movement (ROM) of knee on POD 2 was 72.86 degrees in ACB + IPACK group, which was significantly better ($p < 0.05$) than the ACB group (ROM = 64.26°).

Conclusion: In conclusion, ACB + IPACK is a promising technique that offers improved pain management in the immediate postoperative period without effecting the motor function around the knee joint resulting in better ROM and ambulation compared to ACB alone.

Keywords: adductor canal block, peri–articular injection, total knee arthroplasty

Introduction

Total knee arthroplasty (TKA) is considered to be one of the most painful procedures in orthopaedic surgeries. [1] Analgesia management after TKA is an important issue of particular concern for recovery and rehabilitation. Multimodal analgesia is incorporated into most clinical pathways to facilitate earlier ambulation, improve patient comfort, and enhance patient satisfaction. [2] Pain management in these surgeries aims to achieve more effective and functional results by using regional analgesia techniques alone or in combination, such as epidural analgesia (EA), femoral nerve block (FNB), sciatic nerve block (SNB), per articular injection, adductor canal block (ACB), infiltration between the popliteal artery and capsule of the knee (IPACK) block. [3] By utilizing a number of analgesic strategies, including "motor-sparing" peripheral nerve blocks and periarticular injections (PAIs), patients' recoveries may be enhanced by promoting early postoperative ambulation, improving pain scores, and reducing opioid consumption. [2]

Adductor canal block (ACB) is popular in patients undergoing total knee arthroplasty owing to its postoperative opioid sparing and motor-protective effects. It is considered as an element of the multimodal analgesia regimens. [4] The PAI (periarticular infiltration) technique is a simple blind technique applied intraoperatively by orthopedic surgeons, and it is based on a systematic infiltration method applied to all knee joint structures, usually by combining local anesthetic and various drug

selections. It may have motor-protective effects but may not provide complete analgesia. [5] The sensory coverage of the ACB is limited to the anteromedial part of the knee. [6] TKA patients who received ACB alone as postoperative analgesia may still complain of posterior knee pain. [7]

There is increasing interest in local anesthetic infiltration in the space between the popliteal artery and posterior capsule of the knee, which is called iPACK. [8] This approach blocks the terminal branches of the genicular nerves and popliteal plexus, which innervate the posterior capsule of the knee joint while sparing the major trunks of the tibial and common peroneal nerves. [9] The ACB combined with an iPACK block yields significantly better postoperative numeric rating scale (NRS) scores, knee range of motion, and ambulation distances compared to ACB alone. [10,1] This combination also decreases postoperative ambulatory pain scores and increases the compliance of patients to rehabilitation. [12] Optimal postoperative knee analgesia is important for not only patient comfort and satisfaction, but also for accelerating mobilization, functional recovery, and hospital discharge.

The aim of the present study was to compare the adductor canal block, peri–articular injection or infiltration between popliteal artery and posterior knee capsule with adductor canal block in total knee arthroplasty.

Materials and Methods

The present study was conducted at Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India from May 2020 to April 2021.A total of 100 patients undergoing unilateral total knee arthroplasty.

The initial 50 consecutive patients received ACB + IPACK (Group 1, n = 50), and the subsequent 50 patients received ACB alone (Group 2, n = 50). Patients undergoing bilateral or revision total knee replacement, with history of bleeding diathesis or prior vascular surgery on femoral vessels on operated site, severe renal insufficiency, history of arrhythmia or seizures, sepsis, pre- existing lower extremity neurological abnormality and difficulties in comprehending visual analog scale (VAS) pain scores, were excluded from the study. All patients were given spinal anesthesia with 2.5 ml 0.5% hyperbaric bupivacaine at the L3/4 interspaces (alternatively at the L2/3 or L4/5 interspaces). All the surgeries were performed by a sin- gle surgeon (AVGR) using the medial parapatellar approach and posterior stabilized knee prosthesis was used in all the patients.

All patients received ACB in the immediate postopera- tive period under a high-frequency ultrasound guidance (SonoSite™, Inc., Bothell, WA 98021, USA) in which the adductor canal was identified beneath the sartorius muscle and 20 ml of 0.2% ropivacaine was injected in the canal using a 22-gauge 100-mm short-beveled regional block needle (Stimuplex® insulated B Braun Medical Germany). The patients in Group 1 received IPACK according to the technique described by Elliott et al[13] in which the patient was placed in a supine position and knee placed in position of 90° flexion. A low-frequency ultrasound probe was posi- tioned in the popliteal crease, and spinal needle was inserted from medial aspect of the knee from anteromedial to poste- rolateral direction in a plane between the popliteal artery and the femur. The tip of the needle was placed 1–2 cm beyond the lateral edge of the artery, and 15 ml of 0.2% ropivacaine was injected.

All the patients received celecoxib 200 mg and gabapentin 300 mg preoperatively 12 h before the surgery and received the same postoperative analgesic regimen which was paracetamol 1 g intravenously every 8 h for 3 days followed by oral paracetamol 1 g every 8 h for 1 month, gabapentin 300 mg given orally once daily for a period of 4 weeks. Intravenous diclofenac 75 mg along with a transdermal buprenorphine patch (5 mcg/h) was considered in the form of rescue analgesia in patients experiencing breakthrough pain. A uniform supervised rehabilitation protocol was followed after the surgery, and all patients were discharged 3 days after the surgery from the hospital. Postoperative pain at rest was the primary outcome measure which was assessed using the visual analog scale (VAS) (scale 0–10, where 0 = no pain and 10 = worst imaginable pain). All the patients were explained and taught the VAS score for self-assessment of pain at the time of enrollment for the study. VAS score was recorded at 8, 12, 24 and 48 h after surgery. The secondary outcome measures assessed were the range of movement (ROM) 2 days after the surgery and ambulation distance assessed by the number of steps walked by the patient 3 days after the surgery.

Statistical Analysis

We compared the primary and secondary outcomes between the ACB and ACB + IPACK group. Assessment of whether the data are normally distributed was made using the Kol- mogorov–Smirnov test. Continuous variables were analyzed using the Student's t test or the Wilcoxon signed-rank test. Categorical data were analyzed using the Chi-squared test or by Fisher's exact test, as appropriate. The SPSS 19.0 soft- ware (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. The nature of the hypothesis testing was two- tailed, and $P < 0.005$ was considered statistically significant.

Results

Table 1: Patient characteristics

Patient characteristics	Group 1	Group 2
Age	61	63
Sex (male/female)	35/15	30/20
Height (cm)	165	161
Weight (Kg)	79	75
Duration of surgery (min)	68	66
Preoperative VAS score at rest	6	5
Habitual analgesic intake		
None	10	12
Paracetamol/NSAID	32	28
Weak opioids	8	10

The entire study group included 65 male patients and 35 female patients. The mean age of the patients in the study group was 62 years with patients in ACB + IPACK group having a mean age of 61 years and patients in ACB group with a mean age of 63 years. The overall demo- graphic and perioperative characteristics in both the groups were similar.

Table 2: Comparison of postoperative VAS scores and distance walked between both the groups

	Group 1	Group 2	P Value
VAS 8 h PO	1.4336 ± 0.6437	2.9134 ± 0.64550	< 0.001
VAS POD 1	2.07 ± 0.4346	3.1832 ± 0.72467	< 0.001
VAS POD 2	2.58 ± 0.7278	3.4500 ± 0.67460	< 0.001
ROM (°)	72.8672 ± 9.51	64.2600 ± 8.25	< 0.001
Distance walked	8.53 ± 1.85	7.1362 ± 1.434	< 0.001

VAS score at rest after 8 h postoperatively, on day 1 and day 2 showed significantly ($p < 0.005$) better values in ACB+IPACK group compared to the ACB group. However, patients in both the groups did not experience severe pain that required any rescue medication. The mean range of movement (ROM) of knee on POD 2 was 72.86 degrees in ACB + IPACK group, which was significantly better ($p < 0.05$) than the ACB group (ROM = 64.26°).

Discussion

Postoperative pain management after total knee arthroplasty (TKA) continues to evolve with better treatment strategies being formulated to improve patient satisfaction, clinical outcomes and reduce opioid use in the immediate postoperative period. [14-16] Appropriate perioperative pain management has been shown to result in faster recovery and rehabilitation leading to better functional outcome in patients undergoing TKA. This has necessitated the development of multimodal analgesia regimens involving the use of both regional anesthesia and systemic analgesics. [17]

ACB is a peripheral nerve block, which has been reported to provide a significant pain relief and earlier mobilization in patients due to its quadriceps strength sparing. [18] However, this technique provides pain relief only anteriorly and medially due to its lack of effect on deep genicular nerves and as a result posterior knee pain is not addressed by this technique, which precludes complete knee extension and thereby early ambulation leading to delayed rehabilitation. [19,20] Different techniques to block the contribution of sciatic nerve to the posterior capsule without involving the common peroneal nerve have been attempted without a significant success. [21] The entire study group included 65 male patients and 35 female patients. The mean age of the patients in the study group was 62 years with patients in ACB + IPACK group having a mean age of 61 years and patients in ACB group with a mean age of 63 years. The overall demo- graphic and perioperative characteristics in both the groups were similar.

VAS score at rest after 8 h postoperatively, on day 1 and day 2 showed significantly ($p < 0.005$) better values in ACB+IPACK group compared to the ACB group. However, patients in both the groups did not experience severe pain that required any rescue medication. The mean range of movement (ROM) of knee on POD 2 was 72.86 degrees in ACB + IPACK group, which was significantly better ($p < 0.05$) than the ACB group (ROM = 64.26°). The technique of IPACK involves infiltrating the space between the popliteal artery and the posterior capsule with a local anesthetic to block the deep genicular nerves supplying the posterior aspect of the knee joint. The technique involves a very selective block of the terminal sensory branches of the posterior aspect of the knee without the involvement of motor branches of the tibial and peroneal nerves leading to a reduced pain without effect on muscle power. [22] This leads to better ambulation which in turn translates to better

rehabilitation and recovery of the patient. In our study of the two groups, we found that ACB + IPACK group reported better VAS scores on day 0 as well as day one with significantly better ROM and ambulatory distance when compared with ACB group. The main complaint of patients with only adductor block on day 1 was pain in posterior region of knee joint.

Zheng et al [23] compared the ACB + IPACK, and FNB + single-injection popliteal sciatic nerve block (SPSNB) groups and found better quadriceps femoris muscle strength scores in the ACB + IPACK group. Similarly, Reddy et al [24] showed that the ambulation rate was better in combinations that included IPACK. Alsheikh et al [25] compared the ACB and EA groups and found that the initial mobilization rate was better in the ACB group. In a RCT comparing the effect of sciatic nerve block (SNB), posterior capsule infiltration (P-LIA) and a control group receiving sham-SNB and sham-P-LIA, Safa et al [26] concluded that patients receiving SNB had a transient reduction in cumulative opioid consumption in the early postoperative period (12 h) compared to the other groups. They concluded that P-LIA has no additive effect on patient pain control. However, the technique described by this study group was a non-specific infiltration done without the guidance of ultrasound.

Conclusion

In conclusion, ACB + IPACK is a promising technique that offers improved pain management in the immediate postoperative period without effecting the motor function around the knee joint resulting in better ROM and ambulation compared to ACB alone. Further studies evaluating the dose, concentration and administration (single shot vs. continuous infusion) of the anesthetic used in this technique will probably help in having better pain control after TKA.

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