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Adductor canal block compared with periarticular bupivacaine injection for total knee arthroplasty - A prospective randomized trial

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Abstract

Background: In the recent years, the methods for pain control after total knee arthroplasty (TKA) have been extensively studied. Improvements in pain control, rapid functional recovery, decrease in period of the hospital stay following total knee arthroplasty is because of the widespread use of regional anesthesia in practice.

Aim of the study: To compare the efficacy of adductor canal blocks (ACB) and periarticular anesthetic injections (PAI) with bupivacaine in total knee arthroplasty.

Methods and Materials: Ninety patients undergoing primary total knee arthroplasty under spinal anesthesia were randomized to 1 of 3 groups: ACB alone (15 mL of 0.5% bupivacaine), PAI alone (50 mL of 0.25% bupivacaine with epinephrine) and ACB + PAI. The primary outcome in this study was the visual analog scale (VAS) pain score in the immediate postoperative period. Secondary outcomes included postoperative opioid use, activity level during physiotherapy, length of hospital stay and range of motion.

Results: The mean VAS pain score was significantly higher after use of ACB alone, compared with the score after use of ACB+PAI, on postoperative day 1 and POD3. Total opioid consumption through POD3 was significantly higher when ACB alone had been used compared with PAI alone and ACB + PAI. Opioid consumption in the ACB-alone group was significantly higher than that in the ACB + PAI group on POD2 and POD 3 and significantly higher than that in the PAI alone group on POD2. There was no significant difference in opioid consumption between the patients treated with PAI alone and those who received ACB + PAI. The activity level during physiotherapy on POD 0 was significantly lower after use of ACB alone than after use of PAI alone or ACB + PAI.

Conclusion: There is significantly higher pain scores after total knee arthroplasty done with an ACB and without PAI, suggesting that ACB alone is inferior for perioperative pain control. There were no significant differences between ACB alone, PAI alone and ACB + PAI with regard to other parameters measured.

Keywords: Total knee arthroplasty, Adductor canal block, Periarticular anesthetic injections

Introduction

Total knee arthroplasty (TKA) is an effective and satisfactory surgery to treat end-stage knee arthritis ^[1]. However, patients following TKA usually suffer a lot from undesirable pain ^[2]. Femoral nerve blocks have been shown to reduce opioid consumption and decrease postoperative pain scores, but it may weaken the quadriceps strength. Adductor canal block (ACB) is a newly developing analgesic protocol with fast functional recovery and good pain control. The advantage of ACB is sensory block for pain control while minimizing motor blockade to the quadriceps/extensor mechanism than greater motor block is typically seen with proximal femoral nerve blocks. Also many surgeons prefer to give periarticular injections with bupivacaine, the advantage being sensory nerve block that is similar to ACB without the risks of quadriceps weakness, falls, and neurologic dysfunction. Several recent randomized controlled trials (RCT) found that patients with ACB could suffer less pain at rest or during knee flexion, and were at decreased risk of compromising quadriceps strength and consumed less opioid painkiller after operation. Choosing a safe and effective analgesia is necessary to accelerate patients' recovery after the surgery. Therefore, in the present study, we are aimed at determining whether ACB alone or PAI alone or ACB + PAI makes a better performance for post-operative pain control and functional recovery for patients after TKA.

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Methods and Materials

It is a randomised prospective study. Study was conducted between May 2017 to April 2019. Patients with primary osteoarthritis of knee with an age group of 60 to 75 years managed by total knee arthroplasty were included in this study. Exclusion criteria were contraindications to spinal anesthesia, contraindications to a regional nerve block (such as an ipsilateral peripheral nerve issue), and an allergy to bupivacaine. In the preoperative area patients were randomized to 1 of 3 groups: ACB alone (30 patients), PAI alone (30 patients), and ACB + PAI (30 patients). For patients in the ACB-alone and ACB + PAI groups, an ACB was performed in the preoperative block area by the regional anesthesia team prior to surgery. The ACB was performed under ultrasound guidance at the mid-level of the thigh (at the midpoint between the anterior superior iliac spine and the superior pole of the patella) using 15 mL of 0.5% bupivacaine. For patients in the PAI-alone and ACB + PAI groups, the PAIs were performed intraoperatively, by the attending orthopaedic surgeon, with 50 mL of 0.25% bupivacaine. The combined dose of bupivacaine in the ACB + PAI group was below the maximum dose threshold of 2 mg/kg for all patients. A standard PAI protocol was followed. Prior to prosthetic implantation, 20 mL was injected through the posterior aspect of the capsule immediately adjacent to the femur and through the posterior-medial aspect of the inferior part of the capsule using a 20-gauge spinal needle. After prosthetic implantation, 30 mL was injected into the tissues around the medial collateral ligament (MCL), lateral collateral ligament (LCL), and medial meniscal border, medial aspect of the capsule, lateral aspect of the capsule, quadriceps tendon, prepatellar tissues, and subcutaneous tissues. The primary outcome was analysed by visual analog scale (VAS) pain scores in the immediate postoperative period till POD 3. VAS scores were recorded by orthopaedic resident, blinded to treatment group, every 6 hours throughout the hospital stay. VAS scores on each postoperative day were averaged and the daily averages were used for analysis. Secondary outcomes included length of hospital stay, activity level during physiotherapy and range of movements of knee. Length of hospital stay was calculated by measuring the time from the completion of surgery till discharge of the patient.

Results

Table 1: Showing Patient demography.

	ACB (n = 30)	PAI (n = 30)	ACB + PAI (n = 30)
Age	66	68	66
Female sex (%)	70	66	68
Body mass index (kg/m ²)	29.2	29.8	30.2
Operative time (min)	110	100	120

The results was analysed by using following parameters as follows,



Fig 1: Showing Adductor canal block.

1) VAS Pain Scores

Patients who received ACB alone had significantly higher VAS pain scores compared with those who received ACB + PAI, on POD 1, at which time the mean scores were 4.2 (95% confidence interval [CI]) versus 3.6 (95% CI), and on POD 3 (mean scores, 4.6 [95% CI] versus 4.2 [95% CI]). There were no significant differences in VAS scores between the PAI-alone and ACB + PAI groups or between the ACB-alone and PAI-alone groups from POD 0 till POD3 (Table 2).

Table 2: Showing mean VAS score.

	ACB	PAI	ACB + PAI
POD 0	3.8	3.2	3.0
POD 1	4.2	4.0	3.6
POD 2	4.3	4.2	3.9
POD 3	4.6	4.5	4.2

2) Length of hospital Stay

There was no significant difference in the length of hospital stay among the treatment groups.

Table 3: Showing mean discharge in days of each group.

	ACB	PAI	ACB + PAI
Mean discharge (days)	12	14	12

3) Activity Level During Physiotherapy-

The activity level during physical therapy on POD 0 was significantly lower in the ACB-alone group (28 ± 30 steps) than in the PAI-alone (44 ± 22 steps) and ACB + PAI (50 ± 40 steps) groups, but there was no significant difference between the PAI-alone and ACB + PAI groups on POD 0. There were no significant differences among groups with regard to activity level during physiotherapy at the later time points (POD 1 to POD 3).

Table 4: Showing Activity Level During Physiotherapy in each group.

	ACB	PAI	ACB + PAI
POD 0	28 +/- 30	44 +/- 22	50 +/- 40
POD 1	34 +/- 10	45 +/- 20	54 +/- 14
POD 2	45 +/- 12	48 +/- 18	56 +/- 10
POD 3	52 +/- 16	54 +/- 26	60 +/- 34

4) Knee Range of Movements -

There was no significant difference in the knee range of movements at 1st week & 3rd week postoperatively between ACB-alone (90 ± 15), ACB + PAI (100 ± 15) groups and PAI-alone (85 ± 10) & ACB-alone (100 ± 25), ACB + PAI (110 ± 10) groups and PAI-alone (95 ± 30) respectively.

Table 5: Showing Knee Range of Movements in each group.

	ACB	PAI	ACB + PAI
1st week	90 +/- 15	85 +/- 10	100 +/- 15
3 rd week	100 +/- 25	95 +/- 30	110 +/- 10



Fig 2: Showing Periarticular Bupivacaine injection.

Discussion

Improved perioperative pain control following total knee arthroplasty can lead to higher patient satisfaction and more rapid functional recovery. PAI and ACB are both used for pain control in total knee arthroplasty, although their relative efficacy is still in a debate. This randomized controlled trial demonstrated significantly higher pain scores when patients underwent a total knee arthroplasty with ACB but without PAI. We found that there is good pain control after use of ACB + PAI compared with that after use of ACB alone. There were significant differences in our primary outcome measure of VAS scores and in some of our secondary measures like activity level during physiotherapy, knee range of movements, days of hospital stay. There was no significant difference in the length of hospital stay among the treatment groups. Also, there were no significant differences among groups with regard to activity level during physiotherapy at the later time points (POD 1 to POD 3) and in knee range of movements.

Conclusion

There is significantly higher pain scores after total knee arthroplasty done with an ACB and without PAI, suggesting that ACB alone is inferior for perioperative pain control. There were no significant differences between ACB alone, PAI alone and ACB + PAI with regard to other parameters measured. More prospective randomized controlled studies comparing ACB alone, PAI alone or ACB + PAI are required to arrive at a definitive conclusion.

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