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Analgesic effectiveness of Local Infiltrative Analgesia alone versus combined single dose adductor canal block with Local Infiltrative Analgesia: A single centre case control study

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ABSTRACT

Background: Both adductor canal block (ACB) and of Local Infiltrative Analgesia (LIA) have been shown to reduce pain after total knee arthroplasty (TKA). The efficacy of combining ACB and LIA remains controversial. The objective of this study is to analyse the effect of LIA + single dose ACB compared to LIA alone on early post-operative pain and mobilization in TKA.

Methods: This Cohort Prospective study analyses the Visual Analogue Score (VAS) pain scores and rehabilitation milestones at 24 h between LIA alone and LIA + single dose ACB in unilateral TKA operated by a single surgeon between August 2014 and February 2019.

Results: VAS at rest and on movement were significantly better in the combined LIA + ACB group (n = 151) compared to LIA (n = 120) alone at 24 h. All patients were able to achieve the desired milestones of sitting, standing by the bedside and walking with the help of a walker within 24 h of the surgery.

Conclusion: Though the VAS scores were statistically significant, the actual scores at rest and on movement in both groups were significantly better than preoperative scores with excellent pain relief. All patients in both groups were able to ambulate within 24 h. LIA alone significantly improved the pain scores and enabled early mobilization. Addition of single dose ACB to LIA did not significantly alter the milestones.

1. Introduction

Periarticular Local Infiltrative Analgesia (LIA) and Ultrasound guided Adductor Canal Block (ACB) have revolutionised pain management and early mobilisation following Total Knee Arthroplasty (TKA) over the last decade.[1–3] They have significantly reduced the postoperative opioid-use and average length of hospital stay.[4] ACB has replaced Femoral Canal Block (FCB) due to its quadriceps sparing effect thereby preventing falls.[5,6] ACB however, provides analgesia only to the medial compartment, thus sparing the posterior and lateral compartments.[4] LIA has the added advantages such as ease of usage, safety and analgesic effect on all the compartments.[2,4] There have been many studies demonstrating the superiority of either LIA or ACB over the older modalities such as opioid analgesia, epidural analgesia and femoral canal block.[7]

However, there is a paucity of studies comparing the outcomes of single dose ACB + LIA and LIA alone. Our Cohort prospective study, assessed whether addition of ACB to LIA had a better outcome compared to LIA alone. The primary and secondary objectives were to compare the effect on the Visual Analogue Score (VAS) and ambulatory status at 24 h between the two groups.

2. Methods

After Institutional Ethics Board Approval, all patients who underwent unilateral TKA at our tertiary care centre operated by the senior surgeon between August 2014 and February 2019 were considered for inclusion. Inclusion criteria were age between 18 and 85 years, American Society of Anaesthesiology (ASA) physical status classification I through III, and unilateral primary TKA under

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spinal anaesthesia. Exclusion criteria included revision or bilateral TKA, active infection, neuromuscular disorder, renal and hepatic disease, general anaesthesia and post-operative opioid use.

All those who met our inclusion criteria were categorised into two groups.

1. Control (Retrospective group) – Patients who received periarticular LIA only - from August 2014 to June 2016–120 patients were enrolled.
2. Cases (Prospective group) – Patients who received ACB in addition to periarticular LIA-from July 2016 to February 2019–151 patients were enrolled.

Demographic data including age, sex, side and body mass index (BMI) were collected. Duration of knee pain recorded in the clinical history was analyzed. Anesthetic technique and analgesic interventions were identified from a clinical regional anaesthesia database. Electronic medical record department (E–mrd) was accessed to record the VAS scores (1- 10) at 0, 6, 12 and 24 h at rest and on movement which was taken by pain management nurse. 0 was defined as the time at which spinal anaesthesia effect had worn off, confirmed by sensory and motor examination in the post-operative recovery room itself. 6, 12 and 24 h were noted from the time of giving spinal anaesthesia. E-mrd was accessed to record the milestones achieved at 24 h which was noted by the junior orthopedic registrar.

Outcome measures were.

Primary: VAS score at 24 h at rest and on movement.

Secondary: Milestones (sitting, standing by the bedside and walking with help of a walker) achieved at 24 h.

2.1. Analgesia technique

ACB was given to patients in case group by a single senior anesthetist using ultrasonography (USG) after giving spinal anaesthesia under all aseptic precautions after painting and draping the anteromedial aspect of the thigh. Ropivacaine 0.2% 15 ml was given with spinal needle 0.70 x 88 mm/22 G x $3^{1/2}$". ACB was given as per described standard technique.[8]

2.2. Surgical technique

All patients were treated by a single senior surgeon with same surgical technique in both groups. 3 doses of 1.5 g Cefuroxime, first dose 30 min before the incision, and 2 doses postoperatively at 6 h interval. Unilateral TKA with posterior stabilized/posterior cruciate substituting prosthesis was done. After ensuring all aseptic precautions, a midline patellar incision was made. The incision was deepened in layers till the fascia of quadriceps is reached. Arthrotomy was performed using the midvastus approach. Synovial tissue was reflected and not excised. The femur and tibia were sized and prepared subsequently. The canal was plugged with a bone piece. Patellaplasty was done in all cases as described by Agarwala et al.[9] after denervation and removal of osteophytes. Periarticular LIA was injected in the posterior capsule, collateral attachments, synovium, Hoffa's fat pad, tissue adjoining the arthrotomy incision and subcutaneous tissue. Final implantation was done with cement. Closure done in layers in standardized manner. Skin closed with subcuticular sutures with 2-0 undyed vicryl (Ethicon Inc., Johnson and Johnson, Somerville, New Jersey, United States of America).

LIA was given to patients in both groups, details of which are given in Table 1.

Negative suction drains were used in all patients, clamped for the first 4 h and removed 12 h postoperative on the day of surgery.

Perioperative Pain management protocol for TKA was as mentioned in Table 1.

All the patients were encouraged to sit, stand by the bedside and walk with the help of a walker on the day of surgery by the physiotherapists. The same was continued till day of discharge.

2.3. Statistical analysis

Data recording was done using MS Excel. Descriptive statistics for quantitative data (Age & BMI) was done using mean ± SD. Data was compared between the two groups – cases & control. Graphical representations have been given wherever applicable. The Visual Analogue Scale (VAS) score at rest and movement was analyzed between the two groups at 24 h by unpaired T test & Mann Whitney *U* test based on normality testing. Statistics software used was Medcalc. Level of significance was considered as $P < 0.05$.

3. Results

A total of 286 patients underwent unilateral TKA during the study period. Of these, 15 were excluded (7- use of given general anaesthesia, 8- opioid use). The remaining 271 met the inclusion criteria and were grouped into a Control (120 patients) and Case group (151 patients) as described previously.

There was no statistically significant difference in the age, sex, BMI and side involved between both groups (Table 2). The groups had no significant difference in the ASA status.

The duration of knee pain was not statistically significant between the two groups (p- 0.2995).

VAS (at rest) at 0, 6, 12 and 24 h was significantly lower in the combined ACB + LIA (Case) group (Table 3).

Similarly, VAS (on movement) at 0, 6, 12 and 24 h was also significantly lower in the ACB + LIA (Case) group (Table 4).

All patients in both groups were able to achieve the desired milestones of sitting, standing by the bedside and walking with the help of a walker within 24 h of the surgery under supervision of the physiotherapist.

There were no symptoms suggestive of local anesthetic systemic toxicity (LAST), complications directly attributable to ACB, such as local bleeding, infection, or postoperative neuropathy in any of the patients.

4. Discussion

Older pain management modalities such as epidural analgesia, femoral nerve block and opioid analgesia are all fraught with their own set of side effects such as motor weakness, nausea, respiratory depression, constipation, epidural hematoma, thereby compromising early mobility at the cost of achieving analgesia.[10–16] Numerous studies have established the superiority of LIA and ACB over the older modalities in achieving early mobilisation with minimal side effects. ACB has significantly less risk of causing motor weakness.[3,5,8,17–20]

LIA and ACB both help alleviate pain following TKA without causing motor weakness, thereby facilitating early mobilisation within 24 h of surgery, which is known to reduce incidence of deep vein thrombosis and provides a positive feedback to the patient improving overall outcome of the surgery.[21]

The rationale of adding ACB to LIA has been questioned since LIA itself has shown excellent results and ACB provides analgesia only to the medial compartment.[22] The few studies in literature comparing the efficacy of the combination over LIA alone have shown mixed results.

The authors,[22] in a retrospective analysis of 298 unilateral TKA found that addition of ACB to LIA significantly improved the early

Table 1
Perioperative Pain management protocol.

Timing of Intervention	Dose	Route	Frequency	Details
Preoperative				
Gabapentin	300 mg	Oral	3 doses	Given at night, starting on night before surgery
Intraoperative				
Subarachnoid block	15–20 mg	Intrathecal		
0.5%Bupivacaine Heavy + Buprenorphine	1 μg/kg	Intrathecal		
Antibiotic Cefuroxime	1.5g	Iv		Prior to surgery, 2 doses thereafter, 12 hourly
Adductor canal block Ropivacaine	15 ml of 0.2%	Adductor canal	1 dose	Ultrasound guided, prior to surgery
Midazolam	0.02 mg/kg	Iv	1-2 doses	
Pantoprazole	40 mg	iv/oral postop	1 dose	Continued I dose daily before breakfast
Paracetamol	1g	Iv	1 dose	
Tranexamic acid	500–1000 mg(10 mg/kg)	Iv	1dose	
Methylprednisolone	500 mg	Iv	1 dose	
Ondansetron	4–8 mg	Iv	1 dose	
Local infiltration	Unilateral	Intra articular		The mixture is diluted to 100 ml and infiltration is done with 20 ml syringes and 18g needles
Levobupivacaine 0.5%	30 ml			
Clonidine	75 μg			
Fentanyl	100 μg			
Adrenaline 1:1000	2drops			
Ketorolac	30 mg			
Tranexamic acid	1g			
Postoperative on day of surgery				Drain kept clamped for 4 h, then released
Paracetamol	1g	Iv	2-3doses	
Ice application		Locally	4 times a day	For 2 days
Postoperative day 1				
Paracetamol	1g	Oral	2-3 times	
Tramadol	50 mg	IV		Rescue analgesic
Dalteparin sodium	5000U	Sc	Once daily	Till discharge
Buprenorphine patch	10 μg/h	Transdermal	once	
Nandrolone decanoate	100 mg	Im	1 dose	
Vitamin C	2g	Oral	5 doses	One dose a day
Multivitamin with Zinc		Oral	5 doses	One dose a day

Table 2
Demography.

Parameter	CASE Mean ± SD	CONTROL Mean ± SD	P value(<0.05 significant)
AGE **(Mann Whitney)**	64.86 ± 7.44	63.95 ± 8.04	0.4042
SEX **(Chi square test)**	Male- 25.83%(39) Female-74.17%(112)	Male- 17.50%(21) Female-82.50%(99)	0.1009784
BMI **(Mann Whitney)**	27.67 ± 4.42	28.08 ± 4.74	0.57
SIDE **(Mann Whitney)**	Left- 47.68% (72) RIGHT-52.32%(79)	Left-46.67%(56) RIGHT-53.33%(64)	0.4484663

Table 3
VAS at rest.

VAS (at rest)	CASE Mean ± SD	CONTROL Mean ± SD	P value(<0.05 significant) (Mann Whitney)
0 h	1.95 ± 1.72	2.76 ± 1.34	0.0003019
6 h	1.63 ± 1.24	2.06 ± 0.98	0.008147
12 h	1.37 ± 0.99	1.68 ± 0.94	0.01731
24 h	1.22 ± 0.95	1.68 ± 0.87	8.41e-06 (mean P value is less than 0.0001)

ambulation as compared to either LIA or Femoral Nerve Block (FNB) alone. Though there was no difference in the pain scores between the LIA and LIA + ACB groups, the scores were significantly better than the continuous FNB group.

Our study demonstrates a significantly better VAS pain score in the LIA + ACB group, though all patients in both groups achieved the desired ambulatory status by 24 h. The scores though significant, were less than 2 and 3 respectively at rest and on movement in both groups. Thus, all patients achieved significant pain relief, thereby enabling early mobilization. The difference was statistically

Table 4
VAS on movement.

VAS(At movement)	CASE Mean ± SD	CONTROL Mean ± SD	P value(<0.05 significant) (Mann Whitney)
0 Hr	2.23 ± 1.86	3.10 ± 1.45	6.367e-05 (mean P value is less than 0.0001)
6 Hr	2.04 ± 1.27	2.62 ± 1.11	0.001015
12 Hr	1.87 ± 0.99	2.24 ± 1.02	0.01223
24 Hr	2.05 ± 0.93	2.37 ± 1.07	0.01196

significant, but clinically irrelevant.

Anderson et al., in a double blinded randomised study, found that pain scores with LIA + ACB were better compared to LIA + Placebo on the day of the surgery. The pain scores however, were not significantly different on postoperative days one and two.[23] The authors however, used a continuous ACB, which was different from our study where a single dose ACB was given preoperatively. We have shown better pain scores in the ACB + LIA group in spite of not keeping a catheter in place for a continuous ACB, which can have a potentially higher risk for infection.

Dieter et al.[24] have also described a significant improvement in ambulation and pain relief when LIA was combined with ACB, contrary to our study.

Gwam et al., on the contrary, noted no significant difference in the VAS score, length of stay and opiate requirements in patients who had ACB alone as compared to the patients who had a combination of ACB and multimodal periarticular analgesia (MPA).[25] They have shown that ACB alone could suffice for pain management.

Similarly, a recent meta-analysis of six studies has shown that peri articular infiltration had improved postoperative pain scores and reduced opioid use as compared to the ACB group.[4]

A meta-analysis of 3 studies involving 337 patients[26] investigated the efficacy and safety of combined ACB with Periarticular infiltration (PI) as compared to PI alone for pain management after TKA. The authors found that combined ACB with PI for patients undergoing TKA achieved earlier ambulation compared with PI alone in the early postoperative period (p-0.04). However, there was no significant difference in pain score, morphine consumption, and length of hospital stay between the 2 groups (p- >0.05). With respect to mobilization ability recovery, the meta-analysis showed that patients in the ACB + PI group promoted earlier postoperative ambulation than those in the PI group. This difference may be considered clinically relevant, given the desire for early and effective rehabilitation after TKA. Early ambulation within 24 h after TKA has been shown to help increase range of motion, decrease deep venous thrombosis of the legs, enhance muscle strength and gait control, and reduce length of hospital stay.[21,27] Moreover, early pain relief and rehabilitation is known to increase the short and mid-term functional capacity as well.[28]

We found similar ambulatory outcomes with all patients achieving the desired goals at 24 h.

Our study has several limitations. First, it is a retrospective, Cohort Prospective observational, nonrandomized study. Although demographically similar, preoperative dependence on walker for ambulation was not recorded. No attempt was made to assess outcomes based on distance walked, stair climbing or comparison of pre and post procedure ambulation aid requirement, as the study was not powered for such an analysis. Opioid dependence was not recorded which could possibly influence the outcome. Ideally, a larger cohort distributed in a randomised manner with a longer follow up analysis of multiple variable mentioned above would be best suited to draw stronger conclusions on the efficacy of combined LIA + ACB.

5. Conclusions

Our study has shown that LIA alone achieves significant pain relief and enables early mobilization. Supplementing LIA with a single dose ACB, though achieved significantly better VAS scores at 24 h, the difference was not clinically relevant. All patients in both groups achieved the desired ambulatory goals. Thus, the addition of ACB did not alter the clinical outcomes.

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Declaration of competing interest

All the authors declare that they have no conflict of interest, nor have they received any financial aid which would influence the outcome of the submitted study.

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