Continuous Epidural versus Continuous Adductor Canal Block for Postoperative Pain Management in Total Knee Arthroplasty

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Abstract

Background: The aim of the study was to compare the study of continuous epidural and continuous adductor canal block for postoperative pain management in total knee arthroplasty (TKA). **Materials and Methods:** A total of 150 cases were recruited with 75 cases in each group; patients participated in the study were divided into the adductor canal block (ACB) group and continued epidural group. All the patients received the standardized anesthesia and analgesia on hospitalization. Outcome evaluations included the visual analog scale (VAS) scores during activity and at rest, range of motion, quadriceps strength, complication occurrence, total opioid consumption and sleep disruptions caused by pain, postoperative hospital stay, and postoperative nausea and vomiting (PONV) before discharge in all groups. **Results:** The lateral VAS scores of the knee were lower in the continuous epidural group at rest and during activity as compared with the ACB group. However, the overall knee VAS score, complication occurrence, total opioid consumption and sleep disruptions caused by pain, and PONV were similar between ACB and epidural groups. The urinary retention in patients receiving continuous epidural was common compared to no retention in the adductor group, early mobilization in the adductor group, and no muscle weakness in the ACB group. **Conclusion:** The ACB does not relieve the lateral knee pain at an early stage but offers comparable analgesic effect and enhanced effectiveness of the early rehabilitation compared to an epidural in patients who underwent TKA.

Keywords: Adductor canal block, analgesic, continuous epidural, pain control, rehabilitation, total knee arthroplasty

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Introduction

Total knee arthroplasty (TKA), one of the most common orthopedic surgeries, is performed in patients with end-stage osteoarthritis and other knee diseases such as rheumatoid arthritis. However, over 60% of patients do suffer from severe pain after TKA, which has affected the quality of sleep, appetite, and functional exercise. Therefore, postoperative pain management is essential for functional recovery, patients' return to work, and patient satisfaction after TKA.[1]

TKA is related to severe postoperative pain and effective postoperative analgesia after TKA remains a challenge. The incidence of moderate-to-severe pain after TKA is stated to be about 50%, and it may contribute to the immobility-related complications, the delay in hospital stay, and can interfere with the functional outcome.[2] Multimodal and multiple approaches to its relief have been tried, which involves neuraxial blockade, steroid and nonsteroidal analgesics, systemic opioids, local infiltration analgesia, intrathecal opioids, and peripheral nerve blockade.[3]

Early mobilization is the challenge after TKA when the patient has severe pain. Despite the comprehensive multimodal analgesic regimen, TKA is related often to intense postoperative pain.[4] Epidural analgesia being the viable alternative, however, it faces a relatively high rate of failure[5] and can result in side effects such as urinary retention and motor block,[6] with the latter potentially hindering mobilization.[7]

Recently, the adductor canal blocks (ACBs) have gained interest as the possible motor-sparing alternative. The adductor canal is the triangle-shaped canal bordered by the sartorius

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muscle superiorly, vastus medialis laterally, and adductor muscles of thigh medially. Saphenous nerve, the important sensory contribution from the femoral nerve to the knee, passes by this canal and exits on medial aspect of the distal thigh through the adductor hiatus. ACBs have been shown to protect the quadriceps muscle strength and ability to ambulate better than the femoral nerve blocks (FNBs) while providing the equivalent analgesia.[8]

However, while the studies exist comparing the FNB to epidural analgesia and the FNBs to the continuous ACBs (CACBs), there have been no studies that directly compare CACB to the epidural analgesia in terms of postoperative pain control and ambulation. Thus, we performed the nonrandomized, controlled trial to compare analgesic and the functional outcomes in between CACB and the epidural analgesia in the setting of the primary TKA.

We hypothesized that CACB is not inferior to the epidural analgesia that is either it would be better than epidural or equivalent to the epidural procedure at facilitating earlier postoperative mobilization, function, and the time to discharge with equivalent postoperative pain control.

Materials and Methods

This was the prospective, nonrandomized controlled study designed to evaluate the effectiveness of continuous epidural and continuous ACB for postoperative pain management in TKA. All patients undergoing total knee replacement (TKR) in ASA I, II, and III were included in the study. During the period between May 2018 and November 2018, patients were enrolled in the study after evaluation at the preoperative anesthesia clinic, and patients who accepted to participate in the study gave informed written consent.

Study population

- Group: (A) Patients undergoing TKA were subjected to continuous ACB for postoperative analgesia
- Group: (B) Patient in this group were given continuous epidural anesthesia for postoperative analgesia
- Study design: Nonrandomized controlled trial noninferior study with a cutoff of 10% (i.e., if the pain score of ACB is more than epidural by 10% then it would not be considered inferior to the epidural)
- Study location: Department of Anesthesiology and Critical Care
- Study duration: 7 months
- Sample size: One fifty patients.

Inclusion criteria

- All patients undergoing unilateral TKA in ASA I, II, and III.

Exclusion criteria

- Patients were not included if they had the body mass index more than 40, had the history of alcohol or drug abuse, were taking opioid pain medications chronically for more than 6 months, had the contraindication to either general or spinal anesthesia, refused to participate, or did not ambulate at the baseline or allergic to local anesthesia.

Screening/Survey

A total of 171 patients were screened, of which 9 were rejected to participate in the study and 12 were not fit according to inclusion criteria, and finally, 150 patients for TKR were found fit according to the criteria.

Staff qualification and training

All the patients were examined by an expert physician and orthopedics and after that routine clinical examination was performed.

Quality-control measures to check data completeness and consistency

Local and Hindi language was preferred to ask the screening questions during the initial screening of patients with valid identity proof and also recorded the data.

Study tool

- Case reporting form
- Consent form.

Procedure and methodology

Patients were enrolled by an anesthesiologist into two groups. Seventy-five patients were enrolled in an ACB group and 75 to the continuous spinal–epidural anesthesia group.

- In all patients (both groups), the following drugs were given preoperatively (1 h before the surgery): tablets of etoricoxib 60 mg, paracetamol 1000 mg, pantoprazole 40 mg, and pregabalin 75 mg
- Intraoperative: Both the groups of patients received spinal anesthesia with 3.2 ml of 0.5% bupivacaine (H) in the lateral position (surgical side down) which is maintained for 7 min, and also anterior and posterior capsule infiltration was done with mixture of morphine 5 mg, dexamethasone 8 mg, 0.5% bupivacaine (P) 20 ml, NS, total 40 ml
- Postoperative: Started with either epidural 0.125% bupivacaine at the rate of 6 ml/h or adductor 0.125% bupivacaine (P) at the rate of 6 ml/h and the same tablets which were given 1 h prior to surgery were given after 6 h of surgery in the postoperative period.

ACB patients received ultrasound (US)-guided ACB 4 h after spinal anesthesia. After sterile preparation and draping, approximately halfway between the anterior superior iliac spine and the patella, at the mid-thigh level, the adductor canal was visualized using a high-frequency linear US transducer (S-Nerve US, SonoSite Inc., Bothell, WA 98021, USA). The transducer was placed transverse to the longitudinal axis of the extremity to identify the adductor canal underneath the sartorius muscle. The femoral artery was first identified as a visible pulsatile structure, with the vein just inferior and the saphenous nerve just lateral to the artery [Figure 1]. From the lateral side of the transducer, a 22G 50-mm length, short-beveled regional block needle (Stimuplex® insulated B Braun Medical Germany) was inserted in the plane through the

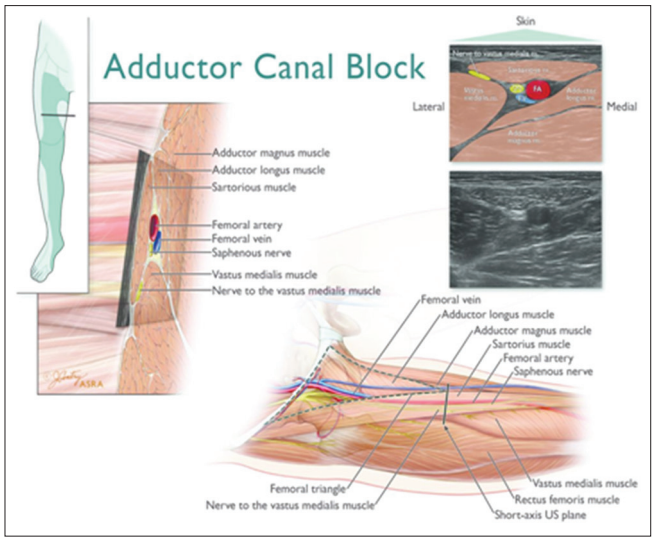

Figure 1: Adductor canal block [Image adapted from American Society of Regional Anesthesia and Pain Medicine (ASRA) image gallery]

sartorius muscle. With the tip of the needle placed just lateral to the artery and the saphenous nerve, 20 ml of 0.5% bupivacaine was injected to expand the adductor canal.

After disinfection of the lumbar or thoracic region, according to the surgery site, with 0.5% alcohol chlorhexidine solution, an epidural 20G multi-hole catheter (Perifix® B. Braun-with holes at 5, 9, and 13 mm from the blunt point) was introduced with 18G epidural Tuohy needle using the loss of resistance to air technique for epidural space identification. The catheter was introduced immediately before the surgery approximately 4 cm–6 cm in the epidural space. The insertion site was chosen by the anesthesiologist in charge so that the catheter tip would be located in the median site of dermatomes involved in the surgical injury. A 2 μm antibacterial filter was added to an epidural catheter and was maintained until postoperative epidural infusion completion. The epidural catheter was fixed to a patient's skin with transparent adhesive dressing to allow a minor turn of the catheter between the insertion point and adhesive fixation, aiming at minimizing the possibility of epidural catheter movement.[9]

Statistical analysis

The analysis of the primary and secondary outcomes and categorical data were analyzed using the Chi-square test or Fisher's exact test. Normal distributed data were statistically tested using the independent's *t*-test. The results were presented as mean ± standard deviation or median with an interquartile range as appropriate. $P < 0.05$ was considered statistically significant. The data were analyzed using the software IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

Observation/Results

There were no statistically significant differences between the groups in demographic data including age, gender, ASA, duration of surgery, and also the time of rescue analgesia ($P > 0.05$) [Table 1]. The association of sensory and motor block duration was found to be statistically significant ($P < 0.05$) [Table 2] between the groups continuous epidural and ACB. Postoperative pain score was higher in the epidural group from 6 h to 20 h than the ACB group, and it was statistically significant at 8, 10 24, and 48 h; the pain was relatively less in ACB than the epidural group. The time of urine output was statistically less as compared to in the ACB group than Epidural ($P < 0.05$) [Table 3]. Continuous adductor analgesia provides superior ambulation, lower pain scores, faster discharge, and greater patient satisfaction when compared to epidural analgesia for primary TKR surgery. The pain was relatively less in ACB than epidural group [Chart 1]. The heart rate [Chart 2], Systolic Blood Pressure [Chart 3] and Diastolic Blood Pressure [Chart 4] were measure pre-operatively and post-operatively until 140 minutes at a difference of 10 minutes and there was not much deviation was observed in both the groups.

Discussion

Adequate postoperative pain control is the cornerstone of providing high-quality care to the patients undergoing TKA, whereas the prior meta-analysis has reported that the peripheral nerve blocks, particularly those involving femoral nerve, may provide effective pain relief with improved side effect profile compared to the epidural analgesia following TKA,[10] and the additional studies have reported the enhanced functional outcomes observed in the patients who have CACB compared to the continuous FNBs,[11-13] and there have been no studies comparing CACB directly to lumbar epidural analgesia following the TKA. Hence, we performed the prospective, nonrandomized, controlled trial comparing ACB to our institution's procedure of pain control for TKA and the use of the lumbar epidural analgesia. It was found that CACB offered lower pain scores, superior ambulation, faster time to discharge, and better patient satisfaction when compared to the epidural analgesia for TKA. There was a little difference between the two groups themselves in terms of outcomes.

The present study entitled "Comparative study of continuous epidural and CACB for postoperative pain management in TKA surgeries" was performed so as to analyze the efficacy and better procedure for TKA; this is the reason we have opted for nonrandomized controlled trial. Our study was in accordance with Tan *et al*.,[1] Yugal *et al*.,[5] and Kayupove *et al*.[6] We have not opted for a case–control study because it was very difficult to convince a healthy person to go through anesthesia process, while mostly other were the case reports which include only one or two cases which would not be the correct choice for our study.

All patients were followed by the hospital's acute pain service postoperatively for the management of their infusions. Postoperative pain at rest was measured using the visual analog scale (VAS) till 48 h after surgery. VAS during knee flexion and extension were measured in the morning and evening on postoperative day 1. We have used VAS for measuring the pain

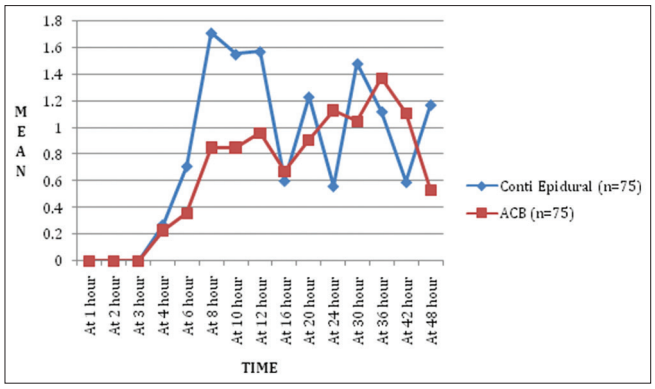

Chart 1: Mean postoperative pain score

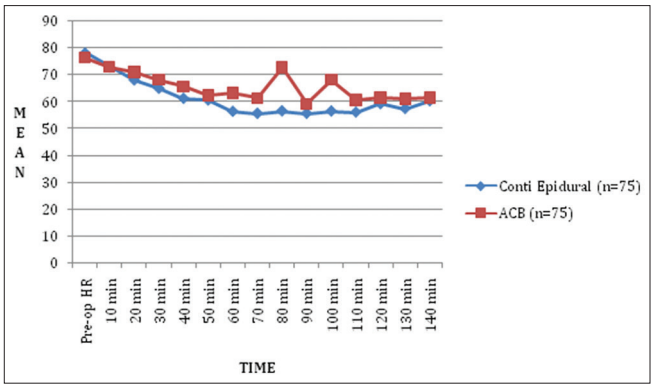

Chart 2: Heart rate

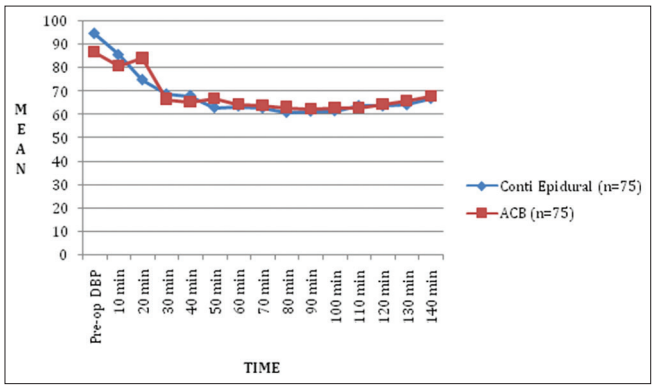

Chart 3: Systolic blood pressure

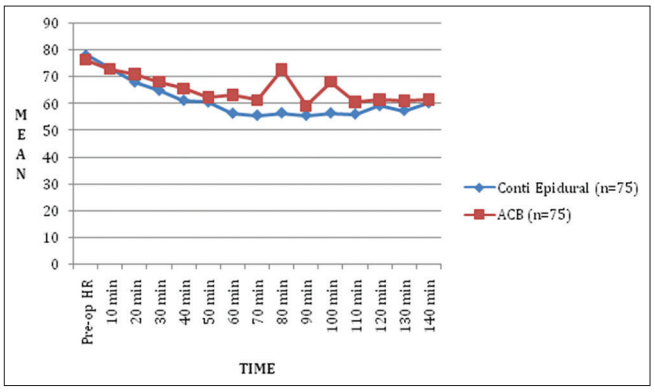

Chart 4: Diastolic blood pressure

during stand-up and walking on postoperative day 2, and the results were recorded by research assistants who were blinded from group randomization. Kayupove *et al*.[6] and Kampitak *et al*.[14] used the similar tools in their respective studies, and also, VAS is used as a gold standard for measuring pain.

In the present study, the mean age of the patients of group continuous epidural and ACB was 65.48 ± 7.97 and 65.95 ± 6.55 years, respectively, while females were in majority in both the groups and the ASA II was in most of the cases, and the time of surgery for ACB group was 71.5 ± 8.1 min, and that of epidural group, it was 77.2 ± 9.3 min, and the association was found to be statistically insignificant ($P > 0.05$) [Table 1]. Our findings were in accordance with Kampitak *et al*.,[11] Kayupove *et al*.,[6] and Hegazy and Sultan[15] who also establish a nonsignificant association for age, sex, ASA, and time duration of surgery.

Pain management

In our study, the postoperative pain score was higher in the epidural group from 6 h to 20 h than the ACB group, and it was statistically significant at 8, 10 24, and 48 h ($P < 0.05$); the pain was relatively less in ACB than the epidural group [Chart 1]. Kayupov *et al*.[6] in their study reported a similar result as in the present study as mean daily pain scores were significantly different ($P = 0.009$). Patients in the CACB group had significantly lower-pain scores. Additional studies have reported improved functional outcomes observed in patients who have CACB compared to the continuous FNBs.[8-10] Kampitak *et al*.'s[11] results were also in accordance with our study as they say that pain on movement at different times of group ACB was significantly lower. ACB was significantly better than any other during 48 h, postoperatively. These results may be considered a significant advantage since better pain relief on motion can enhance early mobilization and facilitate physiotherapy after the surgery. Grevstad *et al*.[16] reported that ACB reduced the VAS with 32 mm, during the active flexion of the knee, in the patients with rigorous pain after TKA.

Despite the apprehension for the potentially inferior analgesia with CACB compared to the epidural provided its incomplete sensory coverage of knee, direct comparison of pain scores and opioid consumption among the groups revealed that everyday pain scores were lower consistently in CACB groups compared to the epidural analgesia group.

Time of urine output

Although ACB has several advantages over the conservative analgesic methods, there are various side effects such as the other peripheral nerve blocks like catheter site infection,[17] nerve palsy,[14] heel ulceration because of a decrease of sensation,[18] and the risk of falls because of motor blockade were not recorded in our study. In addition, the use of the catheter comes at additional financial cost and also requires the specialist labor for the catheter management.[19]

Table 1: Demographic profile of studied patients

Parameters		Conti Epidural ($n=75$)	ACB ($n=75$)	p
Mean Age		65.48±7.97	65.95±6.55	0.694
Sex	Male	33	34	0.869
	Female	42	41	
ASA	I	7	3	0.051
	II	58	51	
	III	10	21	
Duration of Surgery		77.2±9.3	71.5±8.1	0.060

Table 2: Evaluation of block parameters in the studied groups

Parameters	Conti Epidural ($n=75$)	ACB ($n=75$)	p
Sensory Block Duration (Sec)	535.6±201.15	431.73±160.21	<0.001
Motor Block Duration (Sec)	519.2±221.98	435.6±161.09	0.009
Time of Rescue Analgesia	1041.0±569.9	954.72±538.18	0.342

Table 3: Outcome parameters of the studied group

Parameters	Continuous Epidural ($n=75$)	ContinuousACB ($n=75$)	p
Time of Urine Output (min)	666.8±220.37	496.53±141.79	<0.001

In the present study, the time of urine output was statistically less as compared to in ACB group than epidural ($P < 0.05$) [Table 3]; similar results were reported by O'Donnell and Dolan[20] and stated that epidural analgesia has a significant failure rate and requires more intensive nursing vigilance including high dependency admission to manage hypotension. Combined with the potential for the adverse effects including urinary retention, hypotension, pruritus, and motor blockade, epidural anesthesia may delay recovery.

Epidural anesthesia may lead to urinary retention, pruritus, and hypotension in the early postoperative period. The use of the FNB may potentially cause the nerve damage, and various reports have observed secondary infection in the setting of an indwelling catheter in the patients who had gone through a peripheral nerve block.[21] These adverse effects may lead to the potential morbidities that make ACB more appealing because of its limited adverse effects.[22]

Limitations

- A comparatively larger sample size might have helped in further reducing bias
- The difference in injection site may bring about the different spread of local anesthetic drugs and may affect the duration and effectiveness of pain relief and physical outcome. Further studies would be needed to define the optimal injection site of ACB.

Strengths

- The data were analyzed in accordance with the consent pro forma.

Conclusion

ACB is the promising option when used as analgesic technique for the patients in very severe pain after TKA and it also results in greater in-patient ambulation, greater patient satisfaction, pain control, and the greater proportion of the patients discharged on early postoperative period compared to the epidural analgesia in the setting of the primary TKA. ACB with multimodal analgesia for TKR was related to a greater reduction of opioids. The time of urine output was less significant in the ACB group than the continuous epidural group ($P < 0.05$).

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Nil.

Conflicts of interest

There are no conflicts of interest.

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