Original Article

Adductor canal blockade versus continuous epidural analgesia after total knee joint replacement: A retrospective cohort study

ABSTRACT

Background: Total knee arthroplasty is associated with intense pain postoperatively. Thus, adequate pain relief is essential in the immediate postoperative period to enable ambulation, initiation of physiotherapy, and prevention of postoperative complications. The objective of this study was to compare the effectiveness and early outcomes of adductor canal blockade (ACB) and continuous epidural analgesia (CEA) in patients who underwent a unilateral total knee replacement (TKR).

Materials and Methods: This is a retrospective cohort study that was conducted in Riyadh with 80 patients receiving a unilateral total knee arthroplasty from August 2017 to July 2018. Forty patients received ACB, and 40 received CEA exclusively. The primary outcomes measured were the degree of knee flexion and extension in physiotherapy sessions on postoperative day 1 and discharge, how soon patients walked after surgery, length of hospital stay (LOS), local anesthetic and total opioid consumption, postoperative blood drainage output, incidence of nausea and vomiting, and pain scores.

Results: Significantly more patients receiving ACB could flex their knee in the first 24 h postoperatively ($P < 0.05$), and the total drain output was also significantly less ($P < 0.05$). Pain in the first 8, 24, and 48 h was less in the ACB group using a Visual Analog Scale ($P < 0.05$). In addition, LOS, total opioid consumption, postoperative blood drain output, incidence of nausea and vomiting, and pain scores were significantly decreased after using ACB compared with epidural analgesia.

Conclusion: This study provided evidence that ACB as postoperative analgesia after TKR is associated with better outcomes in terms of facilitating early functional recovery and mobility, and consequently prevents major postoperative complications.

Key words: Adductor canal block; analgesic, arthroplasty; knee; rehabilitation

Introduction

Total knee replacement (TKR) is a common elective orthopedic procedure for the treatment of end-stage arthritic knee cases to improve the patient's pain, mobility, and quality of life.[1,2] TKR is associated with considerable pain during the early postoperative period which can significantly affect the patient's satisfaction, length of hospital stay (LOS), and functional recovery after the surgery.[3,4] Therefore, adequate and immediate pain relief is essential especially

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in the early postoperative period to enable ambulation, initiation of physiotherapy, and the prevention of other postoperative complications.[5] The current practice to manage postoperative TKR pain is by providing continuous and sufficient anesthesia using regional anesthetic techniques while preserving muscle function and reducing the side effects of regional anesthesia.[6]

Continuous epidural analgesia (CEA) is a common regional analgesia modality using the neuroaxial pathway for major orthopedic surgeries associated with decreased blood loss and fewer thromboembolic complications.[7,8] However, this type of analgesia has a relatively high failure rate and is associated with well-known side effects such as urinary retention and motor block.[9] Using adductor canal blockade (ACB) is a recent development for pain management for total knee arthroplasty. ACB, a relatively new type of block, primarily blocks the pain sensation while mostly preserving the quadriceps strength resulting in facilitating early rehabilitation after knee surgery.[10] ACB has been shown to be a very effective alternative to the femoral nerve block that provides similar analgesic efficacy and retains the motor strength significantly.[11]

It is hypothesized that ACB has better outcomes than CEA in terms of earlier postoperative mobilization, functional recovery, and time to discharge with efficient pain control. This retrospective cohort study aimed at comparing the early outcomes of ACB versus CEA in patients who underwent a unilateral TKR in terms of ambulation ability, early functional recovery, and pain control.

Materials and Methods

Study design

This is a retrospective cohort study, conducted in Riyadh, with 80 patients receiving a unilateral total knee arthroplasty from August 2017 to July 2018. Initially, data were collected from 145 patients, but 65 patients were excluded because they received ACB or CEA plus another modality of postoperative analgesia such as femoral nerve blockade or patient-controlled analgesia, patients in which the ACB or CEA catheter was accidentally dislodged, and patients who had a bilateral TKA or a revision of the TKA. The sample was realized as 80 patients, divided into two equal groups according to the type of postoperative analgesia, either ACB or CEA, they received.

Data collection

Patient charts were reviewed to obtain demographic data such as age and gender. The ACB versus the CEA groups were evaluated using separate collection sheets. Anesthesia notes were reviewed to document the rate of the peripheral infusion pump (mL/h) for the ACB group and the epidural infusion pump (mL/h) for the CEA group for the first 3 days postoperatively. The local anesthetic agent used in ACB was ropivacaine 0.2%. The local anesthetic agent used in CEA was ropivacaine 0.1% in combination with fentanyl. Physiotherapy notes were reviewed to document the degree of knee flexion and extension on the first postoperative day and on discharge, specifying whether it was active, active-assisted, or passive range of motion (ROM) as well as how soon the patient walked postoperatively. The pain score at rest was noted 8, 24, and 72 h postoperatively using the Visual Analog Scale (VAS) data. Postoperative blood loss (drain output) on the first 2 postoperative days was recorded. Any incidence of nausea, vomiting, or neurological complications was documented. Finally, the number of days from admission until discharge was recorded (LOS).

The patient's medication charts were reviewed for total consumption of intravenous (IV) pain medication which included acetaminophen and tramadol in addition to opioid medications. Opioids medications included hydromorphone, morphine, and morphine sulfate. Operative room records were reviewed to document the operative time. A specific orthopedic arthroplasty surgeon performed the operation for each group. The anesthesia team performed the block using ultrasound guidance for the ACB group. All the ACB and the CEA procedures were documented as successful.

Ethical approval

The study was reviewed and approved by our internal institutional review board committee. Study IRB number: RC18/238/R. IRB approval date: 9 August 2018, King Abdullah International Medical Research Centre.

Statistical analysis

The data were analyzed using Statistical Package for Social Sciences (IBM Corp. Released 2011; IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY, USA). The variables were entered as numbers and percentages. The comparison between the categorical variables of the different groups was tested using Chi-square test. Quantitative data were described using mean and standard deviation for normally distributed data, while abnormally distributed data were expressed using median, minimum, and maximum. Significance of the results was judged at the 5% level.

Results

Demographics of included subjects

Table 1 displays the demographic data of the two groups (n = 80). The highest proportion of both groups

(42.5% ACB group and 40.0% CEA group) was age between 60 and 69 years with no significant difference between the two groups ($P = 0.90$). Furthermore, the majority of participants in both groups were female (87.5% ACB group and 77.5% CEA group) with no significant difference between the two groups ($P = 1.89$).

Local analgesic consumption

The distribution of local analgesic consumption is presented in Table 2. For day 1, most of the participants (55%) in the ACB group and 45% in the CEA group used 5–8 mL of analgesia per hour followed by 9–12 mL/h in both groups (37.5%).

For day 2, half (50.0%) of both groups used 9–12 mL/h followed by 5–8 mL/h with no significance difference between the two groups ($P = 0.930$). On day 3, proportionally more patients of the ACB group (22.0%) used only 0–4 mL/h compared with the CEA group (5.0%), a significant difference ($P = 0.006$).

Table 1: Demographic data of the ACB and CEA groups

	ACB *n*=40		CEA *n*=40		χ^2, *P*
	No.	%	No.	%	
Age (years)					
40-49	1	2.5	1	2.5	0.586 0.90
50-59	12	30.0	15	37.5	
60-69	17	42.5	16	40.0	
70+	10	25.0	8	20.0	
Gender					
Female	35	87.5	31	77.5	1.38
Male	5	12.5	9	22.5	0.189

ACB: Adductor canal blockade; CEA: Continuous epidural analgesia

Table 2: Comparison of consumption of analgesics day 1 to day 3

Analgesics consumption	ACB *n*=40		CEA *n*=40		χ^2, *P*
	No.	%	No.	%	
Cons. day 1 (mL/h)					
0-4	2	5.0	1	2.5	4.305 0.230
5-8	22	55.0	18	45.0	
9-12	15	37.5	15	37.5	
Max	1	2.5	6	15.0	
Cons. day 2 (mL/h)					
0-4	2	5.0	2	5.0	0.450 0.930
5-8	11	27.5	9	22.5	
9-12	20	50.0	20	50.0	
Max	7	17.5	9	22.5	
Cons. day 3 (mL/h)					
0-4	9	22.0	2	5.0	12.43 0.006*
5-8	1	2.5	10	25.0	
9-12	21	52.5	17	42.5	
Max	9	22.5	11	27.5	

*Significance of the results was judged at the 5% level. ACB: Adductor canal blockade; CEA: Continuous epidural analgesia

Blood loss

The mean blood loss was significantly higher in the CEA group (345.6 mL) compared with the ACB group (190.9 mL, $P = 0.001$) for days 1 and 2 and the total drainage [Table 3].

Pain experienced using the VAS

The mean pain score was significantly higher among the CEA group than the ACB group after 8 h (CEA 3.83 vs ACB 0.98, $P = 0.001$), 24 h (CEA 3.75 vs ACB 1.68, $P = 0.001$), and 48 h (CEA 2.85 vs ACB 0.48, $P = 0.001$) providing evidence that ACB provides superior pain management compared with CEA [Table 3].

The range of motion

The proportion of patients who achieved active ROM was higher among the ACB (65%) group compared with the CEA group (40%) in postoperative day 1 ($P = 0.017$), and the active ROM was also higher among the ACB (70%) group compared with the CEA group (52.5%) on discharge ($P = 0.038$) [Table 4]. It is noteworthy that more than half of the ACB group (55%) achieved significantly higher ($P = 0.002$) ROM degrees in flexion at postoperative day 1 [Table 5].

The time of first walk

The day of first walk was earlier among the ACB group (mean = 1.38) than the CEA group (mean = 2.80) with a highly significant difference ($P = 0.001$). In addition, the LOS was significantly lower among ACB group (mean = 6.63) when compared with the CEA group (mean = 7.45) ($P = 0.043$) [Table 5].

Administration of additional IV analgesics

Most of the patients in the CEA group (70%) required an additional IV analgesia which was significantly higher than the ACB group (42.5%) ($P = 0.012$) [Table 6].

Types of additional IV analgesics used

Most of the patients in the CEA group required hydromorphone (41.9%, $P = 0.004$) and morphine sulfate (19.4%), while the majority of the ACB group required morphine (23.5%), acetaminophen (29.4%), and tramadol (23.5%) as the first type of additional IV analgesia. The second line of analgesic used most frequently for the CEA group was morphine (84.6%) compared with ACB (0%, $P = 0.001$). None of the ACB patients needed a third type of additional IV analgesia.

Complications' incidence

The incidence of side effects in the ACB group was low. The majority (82.5%) experienced no nausea and vomiting compared with the CEA group where 55% of the patients experienced no side effect. About 27.5% of the CEA group suffered from nausea and vomiting and 10% suffered from

Table 3: Comparison of blood loss and pain experienced (VAS) day 1 to day 3

a. Comparison of blood loss day 1 to day 3			
	ACB *n*=40	CEA *n*=40	*t*-test *P*
Drainage 24 h (mL)			
Mean	190.9	345.6	7.98
SD	150.8	218.2	0.001*
Drainage 48 h (mL)			
Mean	77.1	130.9	3.95
SD	95.8	100.0	0.006*
Total drainage (mL)	268.0	476.5	6.21
Mean	201.9	292.9	0.001*
SD			

b. Comparison of pain experienced using the VAS scale day 1 to day 3			
	ACB *n*=40	CEA *n*=40	*t*-test *P*
Resting VAS 8 h			
Mean	0.98	3.83	12.2
SD	1.78	2.67	0.001*
Resting VAS 24 h			
Mean	1.68	3.75	8.25
SD	2.34	2.23	0.001*
Resting VAS 48 h			
Mean	0.48	2.85	11.6
SD	1.22	2.38	0.001*

*Significance of the results was judged at the 5% level. VAS: Visual Analog Scale; ACB: Adductor canal blockade; CEA: Continuous epidural analgesia; SD: Standard deviation

Table 4: Comparison of the ROM type ACB vs CEA

	ACB *n*=40		CEA *n*=40		χ^2, *P*
	No.	%	No.	%	
Type of ROM day 1 extension					
Active	26	65.0	16	40.0	8.13 0.017*
Active-assisted	14	35.0	19	47.5	
Passive	0	0.0	5	12.5	
Range	-30.0 to -0.2		-5.0 to 0.2		
Mean±SD	5.7±10.0		2.2±9.0		
Type of ROM day 1 flexion					
Active	26	65.0	16	40.0	8.13 0.017*
Active-assisted	14	35.0	19	47.5	
Passive	0	0.0	5	12.5	
Range	0.0 to 91.8		0.0 to 65.6		
Mean±SD	18.0±115.0		37.2±120.0		
Type of ROM D/C extension					
Active	28	70.0	21	52.5	5.33 0.038*
Active-assisted	12	30.0	15	37.5	
Passive	0	0.0	4	10.0	
Range	-25.0 to 0.0		0.0 to 0.0		
Mean±SD	5.4±10.0		0.0±0.0		
Type of ROM D/C flexion					
Active	28	70.0	21	52.5	5.33 0.038*
Active-assisted	12	30.0	15	37.5	
Passive	0	0.0	4	10.0	
Range	90.0 to 107.2		80.0 to 104.5		
Mean±SD	9.0±125.0		13.5±130.0		

*Significance of the results was judged at the 5% level. ROM: Range of motion; ACB: Adductor canal blockade; CEA: Continuous epidural analgesia; SD: Standard deviation; D/C: Discharge

other complications. The incidence of complications among the CEA group was higher than ACB [Table 6].

Discussion

Based on the current literature, this is the first retrospective study conducted to investigate the efficacy of ACB versus CEA after a unilateral total knee arthroplasty in terms of postoperative mobilization, functional recovery, and a reduced time to discharge with efficient pain control. Due to the limited data regarding the two types of analgesia, ACB was compared with other analgesic modalities which were supposed to be superior to epidural analgesia.

ACB showed statistically significant results in several aspects compared with CEA for pain control during the resting state within the first postoperative 8, 24, and 48 h. Despite the perception that ACB provides inferior analgesia due to its incomplete sensory coverage of the knee, direct comparison of pain scores, local anesthetic, and opioid consumption between the two groups showed that ACB had significantly lower visual analog pain scores. Literature supports the superiority of ACB over other modalities including femoral nerve block[12-14] and local infiltration analgesia.[15,16]

However, postoperative opioid consumption was not significantly different between the groups. The incidence of postoperative nausea and vomiting was significantly higher in the CEA group than the ACB group. These findings supported similar results obtained in the study by Kayupov *et al*.,[17] who concluded that the ACB group has superior pain control compared with the CEA group with less postoperative nausea and vomiting in the early postoperative period. Moreover, a meta-analysis conducted by Gerrard *et al*.[4] demonstrated that CEA was associated with significantly higher rates of postoperative nausea and vomiting when compared with several types of peripheral nerve blocks. Based on this level of evidence, ACB may be considered as the best analgesic technique choice after TKR.

The second notable finding produced in this study was the degree of knee flexion on day 1 postoperatively which was found to be significantly better in the ACB group. In addition, evidence was generated that early ambulation during the physiotherapy sessions was increased in the ACB group as reported by Kayupov *et al*.[17]

A possible explanation for this finding is that ACB preserves the quadriceps strength and walking ability,

Table 5: Comparison between ACB and CEA regarding ROM (extension and flexion) at day 1, day of first walk postoperatively, and LOS

a. Comparison of ACB and CEA: ROM (extension and flexion) day 1

	ACB		CEA		χ^2, *P*
	No.	%	No.	%	
Extension					
<0	3	7.5	2	5.0	0.65
0	33	82.5	36	90.0	0.422
>0	4	10.0	2	5.0	
Flexion					
<90	7	17.5	19	47.5	8.25
90	11	27.5	16	40.0	0.002*
>90	22	55.0	5	12.5	

b. Comparison of ACB and CEA: Day of first walk postoperatively and LOS

	ACB *n*=40	CEA *n*=40	*t*-test *P*
Day of first walk			
Range	1.0-3.0	1.0-5.0	15.25
Mean	1.38	2.80	0.001*
SD	0.63	1.07	
LOS (days)			
Range	4.0-9.00	5.0-15.0	2.06
Mean	6.63	7.45	0.043*
SD	1.37	2.14	

*Significance of the results was judged at the 5% level. ACB: Adductor canal blockade; CEA: Continuous epidural analgesia; ROM: Range of motion; LOS: Length of hospital stay; SD: Standard deviation

also supported by studies conducted by Jaeger *et al*. and Seo *et al*.[11,13]

This study measured the effect of ACB and CEA in terms of total drain output after TKR. The total drain output was less and statistically significant in the ACB group compared with the CEA group. No previous study directly compared the total drain output in ACB and CEA following TKR. The rationale behind the reduced output should be investigated in future studies.

Another noteworthy finding is a statistically significant difference between the groups, in favor of ACB, in terms of the degree of knee flexion and extension at discharge as well as the LOS. This finding was also reported by Kayupov *et al*.[17] The authors also reported that ACB decreased the need for morphine after TKR among most of the patients which is consistent with the current results.[16]

This study had some limitations. First, it was a retrospective nonrandomized study. Second, there were multiple inpatient healthcare providers involved in evaluating subjects' pain and functional recovery. To minimize bias, physiotherapy staff was educated regarding the primary goals of ambulation distance and functional recovery before discharge. Finally, the study sample size was relatively small, thus the results cannot be generalized.

Table 6: ACB vs CEA: Additional IV analgesic use, types of additional IV analgesic used, and incidence of complications

a. ACB vs CEA: Additional IV analgesic use

	ACB *n*=40		CEA *n*=40		χ^2, *P*
	No.	%	No.	%	
Additional IV analgesics					
No	23	57.5	12	30.0	6.14
Yes	17	42.5	28	70.0	0.012*

b. ACB vs CEA: Types of additional IV analgesic used

	ACB		CEA		χ^2, *P*
	No.	%	No.	%	
First requirement type	*n*=17		*n*=31		
Morphine	4	23.5	2	6.5	10.38
Acetaminophen	5	29.4	4	12.9	0.004*
Tramadol	4	23.5	6	19.4	
Hydromorphone	4	23.5	13	41.9	
Morphine sulfate	0	0.0	6	19.4	
Second requirement type	*n*=6		*n*=26		
Morphine	0	0.0	22	84.6	20.47
Acetaminophen	1	16.7	4	15.0	0.001*
Tramadol	1	16.7	0	0.0	
Hydromorphone	3	50.0	0	0.0	
Morphine sulfate	1	16.7	0	0.0	
Third requirement type	*n*=0		*n*=4		
Morphine	0	0.0	1	25.0	
Acetaminophen	0	0.0	1	25.0	
Tramadol	0	0.0	1	25.0	
Hydromorphone	0	0.0	1	25.0	
Morphine sulfate	0	0.0	0	25.0	

c. ACB vs CEA: Incidence of complications

	ACB *n*=40		CEA *n*=40	
	No.	%	No.	%
No incidence	33	82.5	22	55.0
Nausea and vomiting	2	5.0	11	27.5
Nausea	4	10.0	1	2.5
Vomiting	1	2.5	2	5.0
Other	0	0.0	4	10.0

*Significance of the results was judged at the 5% level. ACB: Adductor canal blockade; CEA: Continuous epidural analgesia; IV: Intravenous

Conclusion

This study provided evidence that ACB is the postoperative analgesia of choice after TKR with superior results in facilitating patients' early functional recovery and mobility, avoiding major postoperative complications following TKR. This research also highlights the need to review our epidural physiotherapy, medical protocols, and clinical practices to improve patient outcomes.

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Conflicts of interest

There are no conflicts of interest.

References

1. Bert JM, Gross M, Kline C. Patient demand matching in total knee arthroplasty: Is it necessary? Am J Knee Surg 2001;14:39-42.
2. Berliner JL, Brodke DJ, Chan V, SooHoo NF, Bozic KJ. Can preoperative patient-reported outcome measures be used to predict meaningful improvement in function after TKA? Clin Orthop Relat Res 2017;475:149-57.
3. Fowler SJ, Symons J, Sabato S, Myles PS. Epidural analgesia compared with peripheral nerve blockade after major knee surgery: A systematic review and meta-analysis of randomized trials. Br J Anaesth 2008;100:154-64.
4. Gerrard AD, Brooks B, Asaad P, Hajibandeh S, Hajibandeh S. Meta-analysis of epidural analgesia versus peripheral nerve blockade after total knee joint replacement. Eur J Orthop Surg Traumatol 2017;27:61-72.
5. De Luca ML, Ciccarello M, Martorana M, Infantino D, Letizia Mauro G, Bonarelli S, *et al*. Pain monitoring and management in a rehabilitation setting after total joint replacement. Medicine (Baltimore) 2018;97:e12484.
6. Bauer MC, Pogatzki-Zahn EM, Zahn PK. Regional analgesia techniques for total knee replacement. Curr Opin Anaesthesiol 2014;27:501-6.
7. Carr AJ, Robertsson O, Graves S, Price AJ, Arden NK, Judge A, *et al*. Knee replacement. Lancet 2012;379:1331-40.
8. Choi PT, Bhandari M, Scott J, Douketis J. Epidural analgesia for pain relief following hip or knee replacement. Cochrane Database Syst Rev 2003:Cd003071.
9. Hermanides J, Hollmann MW, Stevens MF, Lirk P. Failed epidural: Causes and management. Br J Anaesth 2012;109:144-54.
10. Patterson ME, Bland KS, Thomas LC, Elliott CE, Soberon JR Jr, Nossaman BD, *et al*. The adductor canal block provides effective analgesia similar to a femoral nerve block in patients 20 undergoing total knee arthroplasty – A retrospective study. J Clin Anesth 2015;27:39-44.
11. Jaeger P, Nielsen ZJ, Henningsen MH, Hilsted KL, Mathiesen O, Dahl JB. Adductor canal block versus femoral nerve block and quadriceps strength: A randomized, double-blind, placebo controlled, crossover study in healthy volunteers. Anesthesiology 2013;118:409-15.
12. Kuang MJ, Ma JX, Fu L, He WW, Zhao J, Ma XL. Is adductor canal block better than femoral nerve block in primary total knee arthroplasty? A GRADE analysis of the evidence through a systematic review and meta-analysis. J Arthroplasty 2017;32:3238-48.e3.
13. Seo SS, Kim OG, SeoJH, Kim DH, Kim YG, Park BY. Comparison of the effect of continuous femoral nerve block and adductor canal block after primary total knee arthroplasty. Clin Orthop Surg 2017;9:303-9.
14. Jaeger P, Zaric D, Fomsgaard JS, Hilsted KL, Bjerregaard J, Gyrn J, *et al*. Adductor canal block versus femoral nerve block for analgesia after total knee arthroplasty: A randomized, double blind study. Reg Anesth Pain Med 2013;38:526-32.
15. Kampitak W, Tanavalee A, Ngarmukos S, Amarase C, Songthamwat B, Boonshua A. Comparison of adductor canal block versus local infiltration analgesia on postoperative pain and functional outcome after total knee arthroplasty: A randomized controlled trial. Malays Orthop J 2018;12:7-14.
16. Tong QJ, Lim YC, Tham HM. Comparing adductor canal block with local infiltration analgesia in total knee arthroplasty: A prospective, blinded and randomized clinical trial. J Clin Anesth 2018;46:39-43.
17. Kayupov E, Okroj K, Young AC, Moric M, Luchetti TJ, Zisman G, *et al*. Continuous adductor canal blocks provide superior ambulation and pain control compared to epidural analgesia for primary knee arthroplasty: A randomized, controlled trial. J Arthroplasty 2018;33:1040-4.e1.