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ORIGINAL RESEARCH REGIONAL ANESTHESIA

Adductor canal block is superior to intravenous analgesia for multimodal postoperative pain management in anterior cruciate ligament reconstruction

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Abstract

Background & objectives: Postoperative pain after reconstruction of the anterior cruciate ligament (ACL) is a source of psychological and physiological consequences, and it might be a precursor of chronic pain. We compared the effects of intravenous analgesia technique and the adductor canal block as multimodal pain management after ACL reconstruction.

Methodology: A prospective, comparative study was conducted at Dr. Saiful Anwar General Hospital, Malang, Indonesia. A total of 30 patients undergoing ACL reconstruction were randomly divided into two groups; Group IV received intravenous analgesia (n = 15), and Group ACB received adductor canal block (n = 15). The numerical rating scale (NRS), the length of hospital stay, and the use of rescue analgesic dose were measured until the third postoperative day. Data were analyzed using the independent T-test using SPSS 18.0.

Results: The NRS-rest and NRS-movement of the ACB group were significantly lower than in Group IV ($p < 0.05$). There was no significant difference in the length of hospital stay and the need for rescue analgesia in both groups ($p > 0.05$).

Conclusions: The adductor canal block technique is better used as multimodal pain management than intravenous analgesia for postoperative pain after anterior cruciate ligament reconstruction under spinal anesthesia with lower numerical rating scale scores at-rest and on-movement.

Keywords: Adductor canal block; Intravenous analgesia; Anterior Cruciate Ligament reconstruction; Postoperative pain

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1. Introduction

Anterior cruciate ligament (ACL) reconstruction is a common arthroscopic procedure.[1] Nearly 60,000 to 175,000 ACL reconstructions are being performed in the United States annually.[2] Postoperative pain has been reported to be the most common complaint after ACL reconstruction.[3] Canolly et al. reported that mean visual analog scale (VAS) post ACL reconstruction was 4.07 ± 2.26 in the first postoperative visit.[4]

Inadequate management of acute postoperative pain results in a decreased quality of life, affects daily physical functions, increased healthcare costs, and even progression into chronic pain.[5,6] Inadequate

postoperative pain management also delays the range of motion and quadriceps contraction restoration of the knee.[7] Postoperative pain management includes pharmacological and non-pharmacological therapies, cognitive-behavioral modalities, and multimodal therapy.[8] Multimodal therapy of knee reconstruction can be done using a combination of systemic pharmacological therapy, local, intra-articular or topical techniques, regional anesthesia, neuraxial anesthesia, and non-pharmacological therapies.[8] The intravenous analgesic - tramadol is commonly used in multimodal analgesia.[9] Tramadol is classified as a weak opioid receptor agonist with low affinity. Tramadol has more side effects, such as mild constipation, risks of overdose, respiratory depression, and even addiction, compared to other μ-opioid drugs.[10]

The adductor canal block (ACB) technique has potential for managing postoperative pain. ACB is done by injecting a local anesthetic into the adductor canal under the sartorius muscle. The adductor canal contains the saphenous nerve and the femoral artery. The saphenous nerve is the sensory nerve that innervates the lower leg, ankle, and foot with significant individual variability.[11] The ACB technique is an easy and reliable technique for the saphenous nerve block. The ACB technique is useful for analgesia after knee, foot, or ankle surgery (usually combined with popliteal blocks). This technique also produces infra-patellar nerve blocks that are useful for postoperative analgesia of the knee arthroscopy or the ACL reconstruction.[12] Larger volumes of local anesthetics can spread maximally to the adductor canal and produce sensory blocks in all parts of the knee without other motor blocks.[13]

A combination of adductor canal block (ACB) and other modalities is hypothesized more effective than the common intravenous analgesia in managing ACL postoperative pain. In addition, the number of clinical data comparing both techniques is limited. The study aims to compare the effects of intravenous analgesia technique and the adductor canal block as multimodal pain management in postoperative ACL reconstruction.

2. Methodology

This prospective study was conducted at Dr. Saiful Anwar General Hospital-Malang, Indonesia. The research method was approved by the health research ethics committee of Dr. Saiful Anwar General Hospital (No: 400/211/K.3/302/2018). All subjects provided written informed consent to be included in this study. The study subjects were 30 patients who underwent ACL reconstruction. The inclusion criteria included age between 15-60 y, BMI 18.5-24.9 kg/m^2, ASA I and II, being operated under a subarachnoid block. Patients who received other anesthesia techniques, experienced complications during surgery, and had incomplete medical records were excluded from the study.

Research subjects were divided into two groups. Group IV (n = 15) received intravenous multimodal analgesia; tramadol 3x10 mg and a non-steroidal anti-inflammatory drug (NSAID). Group ACB (n = 15) received an adductor canal block with 0.375% ropivacaine + methylprednisolone 60 mg, total volume 20 ml and an NSAID. Patients received subarachnoid blocks at L4-L5 or L3-L4. The ACB was done using a Spinocan™ 25G spinal needle. The intensity of pain was measured on a numeric rating scale (NRS), at rest (NRS-rest), and on movement (NRS-movement), at 6, 12, and 18 h postoperatively, and then on day 1, 2, and 3 postoperatively. Patients who suffered from pain with NRS>3 received a rescue dose of inj. fentanyl 50 μg. The length of hospital stay and the administration of rescue doses were recorded.

Statistical analysis:

The sample size was calculated based on the minimum number of participants with proportion using confidence interval (CI) 95%. Based on the calculation, the minimum number of patients in each group was 15. Data were analyzed using an independent t-test using SPSS version 18.0 software (IBM Corp, Chicago, IL, USA).

3. Results

The subjects' demographic data are shown in Table 1. Based on the statistical tests, both groups are equivalent. The mean age of the subjects was 27.13 ± 7.01 y in Group IV and 23.33 ± 7.19 y in Group ACB. The body mass index was 24.39 ± 0.246 kg/m^2 in Group IV and 24.39 ± 0.337 kg/m^2 in Group ACB. The inter-group differences were not statistically significant (P > 0.05). The NRS-rest in Group IV shows an increase at every observation time. The NRS-rest was 1.37 ± 0.64 at 6 h postoperatively, then increased to 3.50 ± 0.00 after three days. However, the NRS-rest in the Group ACB showed

Table 1: Demographic characteristic of the subjects

Characteristic	Group IV (n = 15)	Group ACB (n = 15)	p-value
Age (mean ± SD)	27.13 ± 7.01	23.33 ± 7.19	0.154
Gender [n (%)]			
Male	10 (66.7)	10 (66.7)	1.000
Female	5 (33.3)	5 (33.3)	
BMI (kg/m^2)	24.39 ± 0.246	24.39 ±0.337	

Data presented as mean ± SD; BMI: Body mass index;

Table 2: Comparative NRS-rest scores in the groups

Postoperative period	NRS-rest score		p-value
	Group IV	Group ACB	
6 hours	1.37 ± 0.64 (n = 15)	0.57 ± 0.25 (n = 15)	0.000
12 hours	1.57 ± 0.59 (n = 15)	0.50 ± 0.00 (n = 15)	0.000
18 hours	1.63 ± 0.74 (n = 15)	0.57 ± 0.26 (n = 15)	0.000
Day 1	1.63 ± 0.99 (n = 15)	0.57 ± 0.25 (n = 15)	0.000
Day 2	2.06 ± 0.73 (n = 9)	1.00 ± 1.22 (n = 6)	0.000
Day 3	3.50 ± 0.00 (n = 2)	Discharge	0.055

Data presented as mean ± SD; n = number of patients in the group at the time of observation; Group IV= received intravenous multimodal analgesia; tramadol 3x10 mg and a non-steroidal anti-inflammatory drug (NSAID); Group ACB= received an adductor canal block with 0.375% ropivacaine + methylprednisolone 60 mg, total volume 20 ml and an NSAID

Table 3. Comparative NRS-movement scores in the groups

Postoperative period	NRS-movement		p-value
	Group IV	Group ACB	
6 hours	1.63 ± 0.35 (n = 15)	0.57 ± 0.26 (n = 15)	0.000
12 hours	1.70 ± 0.41 (n = 15)	0.50 ± 0.00 (n = 15)	0.000
18 hours	1.70 ± 0.77 (n = 15)	0.57 ± 0.26 (n = 15)	0.000
Day 1	1.50 ± 0.65 (n = 15)	0.57 ± 0.26 (n = 15)	0.000
Day 2	2.17 ± 0.71 (n = 9)	1.17 ± 1.63 (n = 6)	0.000
Day 3	3.50 ± 0.00 (n = 2)	Discharge	0.124

Data presented as mean ± SD; n = number of patients in the group at the time of observation; Group IV= received intravenous multimodal analgesia; tramadol 3x10 mg and a non-steroidal anti-inflammatory drug (NSAID); Group ACB= received an adductor canal block with 0.375% ropivacaine + methylprednisolone 60 mg, total volume 20 ml and an NSAID

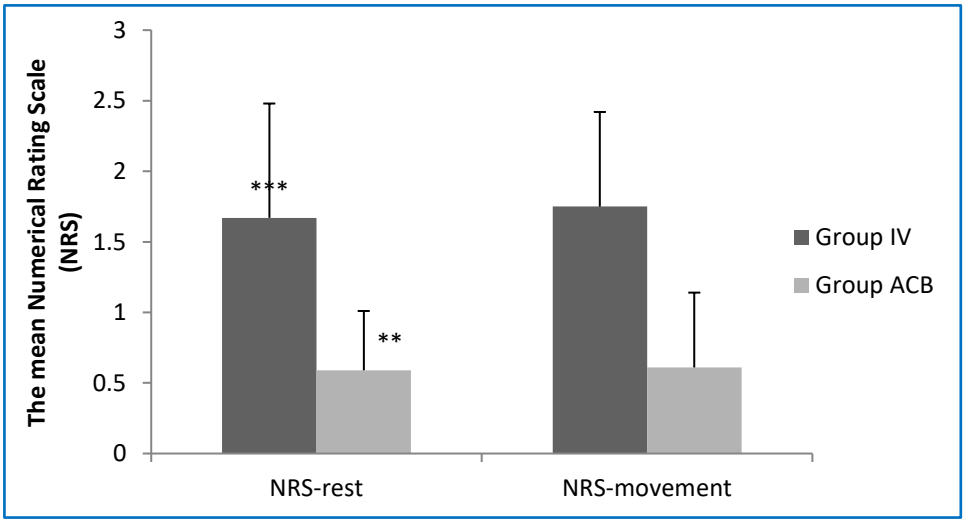

Figure 1: The comparison of NRS-rest and NRS-movement in the Group IV and Group ACB

a fluctuating value. In general, the NRS-rest and NRS-movement of Group IV were significantly higher than in the Group ACB ($p < 0.05$) (Table 2 & 3). The mean of NRS-rest in Group IV was 1.67 ± 0.81 and 0.59 ± 0.42 in the Group ACB ($p = 0.000$). The mean NRS-movement was 1.75 ± 0.67 in Group IV, and 0.61 ± 0.53 in the Group ACB ($p = 0.000$) (Figure 1).

In the NRS-rest cross table, Group IV experienced more mild pain than Group ACB. In the sixth postoperative hour, 11 patients from Group IV experienced mild pain, while only one patient in the Group ACB (Table 4).

The NRS-movement cross table showed the same results as the NRS-rest cross table. Patients in Group IV mostly experienced mild pain, whereas, in Group ACB, most patients did not experience pain (Table 5).

The length of hospital stay and the use of rescue analgesia were also recorded. The length of hospital stay in Group IV and Group ACB was not significantly different. However, Group IV had a higher percentage of hospitalizations than Group ACB. One patient in both groups needed a rescue dose of 50 µg of fentanyl (Table 6).

Table 4: The comparative cross table of NRS-rest in the groups

Group	Time	Discharged from hospital	Pain Intensity			Total
			None	Mild Pain	Moderate Pain	
Group IV	6 h	0	4	11	0	15
	12 h	0	2	13	0	15
	18 h	0	3	12	0	15
	Day 1	0	3	11	1	15
	Day 2	6	0	9	0	15
	Day 3	13	0	2	0	15
Group ACB	6 h	0	14	1	0	15
	12 h	0	15	0	0	15
	18 h	0	14	1	0	15
	Day 1	0	14	1	0	15
	Day 2	9	5	1	0	15
	Day 3	15	0	0	0	15

Group IV= received intravenous multimodal analgesia; tramadol 3x10 mg and a non-steroidal anti-inflammatory drug (NSAID); Group ACB= received an adductor canal block with 0.375% ropivacaine + methylprednisolone 60 mg, total volume 20 ml and an NSAID

Table 5: The cross table of NRS-movement in the groups

Group	Time	Discharged from hospital	Pain Intensity			Total
			None	Mild Pain	Moderate Pain	
Group IV	6 h	0	0	15	0	15
	12 h	0	0	15	0	15
	18 h	0	3	12	0	15
	Day 1	0	3	12	0	15
	Day 2	6	0	9	0	15
	Day 3	13	0	2	0	15
Group ACB	6 h	0	14	1	0	15
	12 h	0	15	0	0	15
	18 h	0	14	1	0	15
	Day 1	0	14	1	0	15
	Day 2	9	5	0	1	15
	Day 3	15	0	0	0	15

Group IV= received intravenous multimodal analgesia; tramadol 3x10 mg and a non-steroidal anti-inflammatory drug (NSAID); Group ACB= received an adductor canal block with 0.375% ropivacaine + methylprednisolone 60 mg, total volume 20 ml and an NSAID

4. Discussion

Until recent past the optimum procedure for postoperative acute pain management after ACL reconstruction was considered to be multimodal analgesia.[3] In practice, a combination of peripheral nerve blocks and one or more classes of analgesic drugs, such as NSAIDs, opioids, etc., are needed to manage postoperative pain.[14] According to Bendinger and Plunkett[15], the NRS scale ranges from 0 (no pain) to 10 (severe pain). The pain intensity after ACL reconstruction is classified as moderate pain and requires adequate treatment. The adductor canal block is part of the peripheral nerve blocks commonly used for surgical procedures on the lower limbs. The previous study found that the mean NRS of ACL reconstruction is 3.7 ± 2.2.[16] Many research has been carried out to determine the appropriate analgesia modalities for ACL reconstruction. The most common modality was the femoral nerve block (FNB). However, it reduces the quadriceps femoris muscular strength following ACL reconstruction surgery.[17] Because of that, other methods with minimal effects on the motor function was needed.

In our study, the ACB group had a significantly lower NRS than IV group. The NSR-rest and NRS-movement in the ACB group show that the pain intensity ranged from no pain to mild pain, while in the IV group the majority experiences mild pain. The adductor canal contains the saphenous nerve and the femoral artery. The saphenous nerve innervates the medial side of the lower limbs and the soles of the feet. The ACB technique is performed by injecting anesthetic agents under the Sartorius's muscle. The ACB technique also produces infra-patellar nerve blocks and useful for postoperative analgesia.[18] The combination of ACB and NSAIDs prospected to produce greater analgesia. The main target of NSAIDs is the pain control system in the periaqueductal gray matter (PAG) and the rostral ventromedial region of the medulla. The interaction of NSAIDs and opioids increases impulse flow which inhibits pain. One of the analgesia mechanisms performed by NSAIDs is through inhibition

of cyclooxygenase, which leads to a decrease in Gamma-Aminobutyric Acid (GABA) in PAG. Decreased GABA will produce analgesic effects.[19]

The duration of hospitalization represents the speed of the patient's recovery. In this study, the length of hospital stay in both groups did not show a significant difference. However, all patients in the ACB group were discharged from the hospital on the second day postoperative. The use of rescue analgesics is also one of the parameters to determine the efficacy of the analgesia techniques. There was no significant difference in the use of rescue analgesics between the groups in our study. One patient in both groups received a rescue dose of fentanyl 50 µg. The result is different from the study by Sharma et al.[20], which showed that both intravenous analgesia and ACB groups received rescue doses. However, the intravenous group received a rescue dose earlier than the adductor canal block group. The previous study shows that the ACB technique has a better recovery function than FNB but has the same analgesic effect.[21] In this study, the ACB technique had a better analgesic effect than the intravenous analgesic technique but has the same hospital stay and the need of rescue dose.

5. Conclusion

The adductor canal block technique is superior to intravenous analgesia for multimodal postoperative pain management of anterior cruciate ligament reconstruction under spinal anesthesia with lower scores on numerical pain rating scale at rest and on movement.

6. Conflict of interest

The authors declare there is no conflict of interest. No external funding was involved in the study. Informed written consents were obtained from all participants.

7. Data availability

The numerical study data is available and can be requested to the authors directly.

8. Authors' contribution

RML, II, DRB: Concept, design of study or acquisition of data, analysis, and interpretation of data

TAS: Methods, data curation

AAA: Methods, Manuscript revision

II, HD: Manuscript drafting, revising

RML: Final approval of the version to be published.

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