

ORIGINAL RESEARCH

ORTHOPEDIC ANESTHESIA

Comparative analysis of the efficacy of intravenous tramadol plus ketorolac vs adductor canal block for postoperative pain in total knee arthroplasty

Ristiawan Muji Laksono ¹, Buyung Hartiyo Laksono ², Faundra Arieza Firdaus ³, Isngadi ⁴, Djudjuk Rahmad Basuki ⁵

Authors affiliations:

1. Ristiawan Muji Laksono, Department of Anesthesiology & Intensive Therapy, Medicine Faculty, Brawijaya University/ Dr. Saiful Anwar General Hospital, Malang, Indonesia; Email: ristiawanm@ub.ac.id; ORCID:{0000-0003-1558-809X}
2. Buyung Hartiyo Laksono, Department of Anesthesiology & Intensive Therapy, Medicine Faculty, Brawijaya University/ Dr. Saiful Anwar General Hospital, Malang, Indonesia; Email: buyung4nest@ub.ac.id
3. Faundra Arieza Firdaus, Department of Anesthesiology & Intensive Therapy, Hermina Hospital, Malang, Indonesia; Email: faundraaf@gmail.com
4. Isngadi, Department of Anesthesiology & Intensive Therapy, Medicine Faculty, Brawijaya University/ Dr. Saiful Anwar General Hospital, Malang, Indonesia; Email: drisngadi@ub.ac.id
5. Djudjuk Rahmad Basuki, Department of Anesthesiology & Intensive Therapy, Medicine Faculty, Brawijaya University/ Dr. Saiful Anwar General Hospital, Malang, Indonesia

Correspondence: Ristiawan Muji Laksono, Email: ristiawanm@ub.ac.id; Phone: +62 81233773593

ABSTRACT

Background & objectives: postoperative pain is a significant factor for the distress and sleep disturbance for the patients undergoing surgeries, and it is equally true for the knee arthroplasty. Anesthetists have employed various means to control pain including various analgesic drugs. For the last few decades, there has been an increased tendency to use regional blocks. This study aimed to compare the efficacy of Adductor Canal Block (ACB) with intravenous analgesia using tramadol plus ketorolac to relieve postoperative pain in knee arthroplasty.

Methodology: This study was conducted in 32 patients undergoing total knee arthroplasty. Group A received intravenous analgesia tramadol plus ketorolac (n=15), while group B received ACB (n=17) postoperatively. Numeric Rating Scale (NRS) was used to assess the pain at rest and on motion. Range of Motion (ROM) on flexion and extension, was examined in both groups on postoperative days 0, 1, 2, 3, and 4. Patients who had NRS-rest and NRS-motion >3, received, intravenous fentanyl 50 µg. The data obtained were statistically analyzed using the One-Way ANOVA test and Spearman test on SPSS 18.0 software.

Results: Intravenous analgesia group (Group A) significantly had greater ROM for flexion than the ACB group (P = 0.001), but not in the ROM-extension (P = 0.351). There was no significant difference in the NRS-rest and NRS-motion (P = 1.000). However, the NRS of the intravenous analgesia group was lower than the ACB group.

Conclusion: Intravenous analgesia with tramadol ketorolac is better than adductor canal block in providing a greater range of motion. However, both techniques did not have a significant difference in the Numeric Rating Scale. Gender and age are considered to be confounding factors for the study.

Abbreviations: ACB: Adductor Canal Block, ROM: Range of Motion, NRS: Numeric Rating Scale, NSAIDs: Non-Steroidal Anti-Inflammatory Drugs

Keywords: Adductor Canal Block; Intravenous analgesia; Numeric Rating Scale; Pain; Pain management; postoperative pain; total knee replacement

Citation: Laksono RM, Laksono BH, Firdaus FA, Isngadi, Basuki DR. Comparative analysis of the efficacy of intravenous tramadol plus ketorolac vs adductor canal block for postoperative pain in total knee arthroplasty. *Anaesth. pain intensive care* 2025;29(3):502-506. DOI: 10.35975/apic.v29i3.2534

Received: August 07, 2024; **Revised:** March 29, 2024; **Accepted:** April 09, 2025

1. INTRODUCTION

Total knee arthroplasty is done by replacing the tip of the femur with artificial material and joined it with the tip of the tibia that previously replaced with a metal stem. Between the two parts are connected with plastic as a shock absorber.¹ Total knee arthroplasty is widely used to treat patients with pain and immobilization caused by osteoarthritis and rheumatoid arthritis.² Nonetheless, total knee arthroplasty has risks including prosthetic dislocation due to infection, blood clots, problematic implants, prolonged pain, and neurovascular injury.³

The International Association for the Study of Pain (IASP) identifies pain as a subjective sensory and unpleasant emotional experience related to tissue damage.⁴ Post-operative pain is a significant complication felt by most patients.⁵ Physiological pain consists of a series of electrical and chemical events including the process of transduction, transmission, modulation, and perception. Transduction is the process of changing stimuli into electrical activity at the sensory nerve. Transmission is the process of delivering impulses from the peripheral nerve to the central nerve. Modulation is a nerve activity that aims to control the transmission of pain. Perception is the process of forming subjective responses of pain.⁶

The widely used procedure to treat acute pain and chronic pain is multimodal analgesia. In acute pain, the combination of peripheral nerve block and Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) is considered to be the best medication. The Adductor Canal Block (ACB) is one of alternative multimodal analgesias. The ACB technique is performed by injecting a local anesthetic agent into the adductor canal that contains the saphenous nerve and the femoral artery. This technique will produce infrapatellar nerve blocks that can reduce pain after arthroscopic knee surgery or anterior cruciate ligament

surgery.⁷ Due to its ability, the ACB technique is considered to be the total knee arthroplasty postoperative pain management. The most commonly used method for total knee arthroplasty postoperative pain management in Dr. Saiful Anwar General Hospital, Indonesia is intravenous analgesia using opioid tramadol. Study by Jing Wen et al.⁸ show the probability of side effects including nausea, respiratory depression, urinary disturbance, and somnolence. The study is needed to provide the new modality for total knee arthroplasty postoperative pain management in Dr. Saiful Anwar General Hospital. This study is to compare the pain intensity in total knee arthroplasty postoperative patients after receiving multimodal analgesia ACB and intravenous analgesia.

2. METHODOLOGY

This study was an experimental study in 32 patients with a total knee arthroplasty. All subjects provide consent forms to become subjects of the study. The research method was approved by the health research ethics committee of Dr. Saiful Anwar General Hospital (No: 400/211/K.3/302/2018). The inclusion criteria including age 15-65 years, physical condition ASA I-II, no subarachnoid blocks or peripheral nerve blocks contraindications, and complete medical data record. Exclusion criteria including incomplete medical record data, patients suffering from diabetes neuropathy, coagulopathy abnormalities, central or peripheral neurological disorders, and back anatomic abnormalities.

All research subjects are divided into two groups. Group A was treated with intravenous analgesia tramadol and ketorolac (n= 15), while group B was treated with ACB (n= 17) with 0.375% naropine regimen + methylprednisolone 60 mg TV 20 cc using a Spinocan® needle (25G, B.BRAUN, Indonesia). The Numeric Rating Scale (NRS) (rest and motion) and Range of Motion (ROM) (flexion and extension) on days 0, 1, 2, 3, and 4 after total knee arthroplasty were recorded. The NRS represents the patient's subjective pain parameters measured by Wong Baker Face and numerical parameters. ROM is a subjective parameter that is assessed from the degree that can be formed by the patient's knee in the recovery process. Patients who have rest and motion NRS values > 3 receive 50 µg of intravenous fentanyl.

The data was display as frequency and mean. The data obtained were statistically analyzed using the One-Way ANOVA test and the Spearman correlation test on SPSS software (version 18.0, IBM Statistic, USA).

3. RESULTS

This study was conducted on 32 patients who underwent a total knee arthroplasty. The characteristics

Table 1: The characteristic of the subjects

Characteristics	Group		p-value
	Group A (mean ± SD)	Group B (mean ± SD)	
Age (years old)	37.87 ± 20.91	60.82 ± 7.25	0.001
Gender			
• Male (%)	11 (73.3)	1 (5.9)	0.000
• Female (%)	4 (26.7)	16 (95.1)	

Group A: treated with intravenous analgesia tramadol and ketorolac; group B was treated with Canal Adductor Block with naropine regimen + methylprednisolone

of the subjects can be seen in table 1. The mean age of group A was 37.87 ± 20.91 years, while group B was 60.82 ± 7.25 years. The majority of group A was male, while group B was female patients. The different test shows that both the age and gender of the subjects significantly differed (Table 1).

There are no significant differences in the Numeric Rating Scale (NRS) rest and motion after receiving

intravenous analgesia or ACB. The NRS motion of the ACB group increases from 1st day to 4th days postoperation. The NRS motion of intravenous analgesia and ACB groups increased along with the hospitalization duration (Table 2).

The mean NRS rest and motion between the two groups did not have a significant difference. The mean NRS rest in the intravenous group and ACB was 0.00 ± 0.0 ($P = 1.000$), while the mean NRS motion was 1.2 ± 0.753 in the intravenous group and 1.2 ± 0.752 in the ACB group ($P = 1.000$). In general, the Range of Motion (ROM) flexion and extension in the intravenous analgesia group was greater (3.61 ± 0.49) than the ACB group (3.27 ± 0.69) ($P = 0.001$) (Table 3).

Based on the NRS value, all patients in both groups experienced mild pain. Based on the ROM flexion and extension, the ACB group mostly experienced mild pain and most patients in intravenous group experiences mild pain on day one, then develops into moderate pain until days four postoperation (Table 4).

The correlation test also perform to find the correlation between ROM value and observation duration (day post-operation) after post-operative pain management.

The Spearman correlation test showed that the ROM value was correlated with time observation. The ROM flexion has a correlation coefficient $r = 0.798$, while the ROM extension has a correlation coefficient $r = 0.852$. It mean that ROM value and observation time has a positive strong correlation. The ROM value of the patients increas along with the increase of post-operation day.

4. DISCUSSION

A total of 32 patients who underwent total knee arthroplasty were divided into two treatment groups. The difference test (t-test) between groups showed that both the age and gender had a significant difference ($p < 0.05$). It means that age and gender may become a cofounding factor for the study. A cofounding factor is an external factor that is expected to influence the results of the study.⁹ The intravenous analgesia group was dominated by male patients with the mean age of 37.87 ± 20.91 years. The ACB group was dominated by female patients with a mean age of 60.82 ± 7.25 years. This difference happens due to the limitation of the subject in the research area. The mean NRS rest and motion in the two groups did not have a significant

difference. The mean NRS rest in the intravenous group and the ACB was 0.00 ± 0.0 ($P = 1.000$). The mean NRS motion was 1.2 ± 0.753 in the intravenous group and was 1.2 ± 0.752 in the ACB group ($P = 1.000$). In the static condition, the NRS rest of the ACB group indicates the patient does not feel pain. However, in the moving condition the patient experiencing mild pain, indicated by NRS motion value 1.2.¹⁰ The NRS-motion of both groups generally shows an increase after day one postoperation. There is a significant difference in the mean ROM flexion between the intravenous group (3.61 ± 0.49) and the ACB group (3.27 ± 0.69) ($P = 0.001$). On the other hand, the ROM extension did not show a significant difference. Range of Motion (ROM) represents the total angle that can be formed by the patient's knee after a total knee arthroplasty. In this study, the

Table 2. Numeric Rating Scale (NRS) rest and motion

Group	Day post operation	NRS-rest	NRS-motion
A (n=15)	Day 0	0	0
	Day 1	0	1
	Day 2	0	1
	Day 3	0	2
	Day 4	0	2
B (n=17)	Day 0	0	0
	Day 1	0	1
	Day 2	0	1
	Day 3	0	2
	Day 4	0	2

Group A: treated with intravenous analgesia tramadol and ketorolac group B was treated with Canal Adductor Block with naropine regimen + methylprednisolone

Table 3. The mean Range of Motion (ROM)

	Groups		P value
	A	B	
ROM flexion (mean± SD)	3.61 ± 0.49	3.27 ± 0.69	0.001*
ROM extention (mean± SD)	3.01 ± 1.55	2.79 ± 1.48	0.351

*Group A: treated with intravenous analgesia tramadol and ketorolac; Group B was treated with ACB with naropine regimen + methylprednisolone; *) significantly different with $p < 0.05$*

intravenous analgesic has a better ROM value than the ACB group. The previous studies by Brennan et al. comparing ROM values between ACB analgesia and Femoral Nerve Block show no significant difference.¹¹

Intravenous analgesia and ACB was less effective in reducing the NRS after TKR. This study result does not support Li and Ma's study which stated that ACB is effective for TKR postoperative pain management.¹² This study supports the study by David et al.¹³ which compared the ACB and Femoral Nerve Block techniques for total knee arthroplasty surgery, also shows the ineffectiveness of the ACB in reducing NRS values. Tan et al.¹⁴ declare that the use of single-shot ACB doesn't relieve pain after total knee arthroplasty. However, continuous administration of the ACB can reduce pain after total knee arthroplasty after 48 hours.¹⁵ Kim et al.¹⁶ stated that continuous use of ACB (starting 1 hour before surgery) in patients undergoing total knee arthroplasty reduce the NRS value. The study also has a different result with the previous study by Jing Wen et al.⁸ stated that the use of intravenous opioid is effective for pain management after total knee arthroplasty. Intravenous analgesia tramadol and ketorolac are still ineffective to reduce the NRS or produce the great ROM extension. The ineffectiveness of both techniques may be influenced by the demographic characteristics of the subjects.

In this study, the demographic characteristics of the subject were significantly different ($p < 0.05$). This difference is considered to be a confounding factor that may affect the result of the study. Several studies have shown if demographic factors affect postoperative chronic pain. Research by Satghare et al.¹⁷ in three ethnicities in Singapore, including China, India, and Malays, showed that the incidence of chronic

postoperative pain often occurred in patients aged 60 years and over. Gender also considers influencing chronic postoperative pain according to Teik Tay et al.¹⁸ and Greenspan et al.¹⁹ study. The prevalence of postoperative pain in women was higher than in men. Therefore, further analysis is needed to analyze the impact of patient demographics in post-operative pain intensity and the effectiveness of multimodal pain management after total knee arthroplasty.

5. LIMITATIONS

Moreover, the study is limited by the minimum number of study subjects in Dr. Saiful Anwar General Hospital, Malang, Indonesia.

6. CONCLUSION

In conclusion, intravenous analgesia with tramadol ketorolac has a greater Range of Motion than Adductor Canal Block. However, both techniques did not have a significant difference in the Numeric Rating Scale. Gender and age considered to be confounding factors for the study.

7. Data availability

The numerical data generated during this research is available with the authors.

8. Funding

The study utilized the hospital resources only, and no external or industry funding was involved.

9. Conflict of interest

Table 4. Pain intensity based on ROM flexion and ROM extension

Group	Days postoperation	ROM flexion		ROM extension	
		Mild pain (%)	Moderate pain (%)	Mild pain (%)	Moderate pain (%)
A (n=15)	Day 0	15 (100)	0(0)	15(100)	0(0)
	Day 1	14 (93.35)	1(6.6)	14(93.35)	1(6.6)
	Day 2	0(0)	15(100)	0(0)	15 (100)
	Day 3	0(0)	15(100)	0(0)	15(100)
	Day 4	0(0)	15(100)	0(0)	15(100)
B (n=17)	Day 0	17(100)	0(0)	17(100)	0(0)
	Day 1	17(100)	0(0)	17(100)	0(0)
	Day 2	14(82.3)	3(17.6)	14(82.3)	3 (17.6)
	Day 3	3(17.6)	14(82.3)	2(11.7)	15(88,2)
	Day 4	1(5.8)	16(94.1)	1(5.8)	16(94.1)

Group A: treated with intravenous analgesia tramadol and ketorolac ;g roup B was treated with Canal Adductor Block with naropine regimen + methylprednisolone

The authors declare no conflict of interest.

10. Authors' contribution

RML: Concept, methods, investigation, writing original draft,

BHL: investigation, writing original draft,

FAF: investigation, writing original, statistical analysis

I: investigation, writing revision, statistical analysis

DRB: writing revision, visualisation,

11. REFERENCES

- Gemayel A, Varacallo M. Total knee arthroplasty (TKR) techniques. In: StatPearls. Treasure Island: StatPearls Publishing; 2019. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK499896/>
- McDonald DD, Molony SL. Postoperative pain communication skills for older adults. *West J Nurs Res.* 2004;26(8):836–52. [PubMed](#) DOI: [10.1177/0193945904269292](https://doi.org/10.1177/0193945904269292)
- Kotela A, Wilk-Frańczuk M, Żbikowski P, Łęgosz P, Ambroziak P, Kotela I. Revision knee arthroplasty in patients with inherited bleeding disorders: a single-center experience. *Med Sci Monit.* 2017;23:129–37. [PubMed](#) DOI: [10.12659/msm.899580](https://doi.org/10.12659/msm.899580)
- Kumar KH, Elavarasi P. Definition of pain and classification of pain disorders. *J Adv Clin Res Insights.* 2016;3:87–90.
- Garimella V, Cellini C. Postoperative pain control. *Surg Clin North Am.* 2013;26(2):191–6. [PubMed](#) DOI: [10.1055/s-0033-1351138](https://doi.org/10.1055/s-0033-1351138)
- Bourne S, Machado AG, Nagel SJ. Basic anatomy and physiology of pain pathways. *Neurosurg Clin N Am.* 2014;25(4):629–38. [PubMed](#) DOI: [10.1016/j.nec.2014.06.001](https://doi.org/10.1016/j.nec.2014.06.001)
- Rasouli MR, Viscusi ER. Adductor canal block for knee surgeries: an emerging analgesic technique. *Arch Bone Jt Surg.* 2017;5(3):131–2. [PubMed](#)
- Li J, Ma Y, Xiao L. Postoperative pain management in total knee arthroplasty. *Orthop Surg.* 2019;11(5):755–61. [PubMed](#) DOI: [10.1111/os.12535](https://doi.org/10.1111/os.12535)
- Skelly A, Dettori J, Brodt E. Assessing bias: the importance of considering confounding. *Evid Based Spine Care J.* 2012;3(1):9–12. [PubMed](#) DOI: [10.1055/s-0031-1298595](https://doi.org/10.1055/s-0031-1298595)
- Breivik H, Borchgrevink PC, Allen SM, Rosseland LA, Romundstad L, Breivik Hals EK, et al. Assessment of pain. *Br J Anaesth.* 2008;101(1):17–24. [PubMed](#) DOI: [10.1093/bja/aen103](https://doi.org/10.1093/bja/aen103)
- Brennan PT, Villa JM, Rossi MD, Sanchez-Gonzalez MA, Lavernia CJ. Rehabilitation outcomes for total knee arthroplasties: continuous adductor canal block versus continuous femoral nerve block. *Geriatr Orthop Surg Rehabil.* 2018;9:1–7. [PubMed](#) DOI: [10.1177/2151458518756190](https://doi.org/10.1177/2151458518756190)
- Li D, Ma G. Analgesic efficacy and quadriceps strength of adductor canal block versus femoral nerve block following total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2016;24(8):2614–9. [PubMed](#) DOI: [10.1007/s00167-015-3874-3](https://doi.org/10.1007/s00167-015-3874-3)
- Kim DH, Lin Y, Goytizolo EA, Kahn RL, Maalouf DB, Manohar A, et al. Adductor canal block versus femoral nerve block for total knee arthroplasty. *Anesthesiology.* 2014;120(3):540–50. [PubMed](#) DOI: [10.1097/ALN.000000000000119](https://doi.org/10.1097/ALN.000000000000119)
- Tan Z, Kang P, Pei FX, Shen B, Zhou ZK, Yang J. A comparison of adductor canal block and femoral nerve block after total knee arthroplasty regarding analgesic effect, effectiveness of early rehabilitation, and lateral knee pain relief in the early stage. *Medicine (Baltimore).* 2018;97(48):1–8. [PubMed](#) DOI: [10.1097/MD.0000000000013391](https://doi.org/10.1097/MD.0000000000013391)
- Zhang LK, Zhang BY, Quan RF, Xu H, Sun YJ, Zhou JH. Single shot versus continuous technique adductor canal block for analgesia following total knee arthroplasty: a PRISMA-compliant meta-analysis. *Medicine (Baltimore).* 2019;98(20):e15539. [PubMed](#) DOI: [10.1097/MD.0000000000015539](https://doi.org/10.1097/MD.0000000000015539)
- Kim MK, Moon HY, Ryu CG, Kang H, Lee HJ, Shin HY. The analgesic efficacy of the continuous adductor canal block compared to continuous intravenous fentanyl infusion with a single-shot adductor canal block in total knee arthroplasty: a randomized controlled trial. *Korean J Pain.* 2019;32(1):30–8. [PubMed](#) DOI: [10.3344/kjp.2019.32.1.30](https://doi.org/10.3344/kjp.2019.32.1.30)
- Satghare P, Chong SA, Vaingankar J, Picco L, Abdin E, Chua BY, et al. Prevalence and correlates of pain in people aged 60 years and above in Singapore: results from the WISE study. *Pain Res Manag.* 2016;2016:1–9. [PubMed](#) DOI: [10.1155/2016/7852397](https://doi.org/10.1155/2016/7852397)
- Tay GT, Willcocks AL, Chen JF, Jastrzab G, Khor KE. A descriptive longitudinal study of chronic pain outcomes and gender differences in a multidisciplinary pain management centre. *Pain Stud Treat.* 2014;2(2):56–69. DOI: [10.4236/pst.2014.22010](https://doi.org/10.4236/pst.2014.22010)
- Greenspan J, Craft R, LeResche L, Nielsen L, Berkley K, Fillingim R, et al. Studying sex and gender differences in pain and analgesia: a consensus report. *Pain.* 2007;132(Suppl 1):26–46. [PubMed](#) DOI: [10.1016/j.pain.2007.10.014](https://doi.org/10.1016/j.pain.2007.10.014)