ORIGINAL ARTICLE

DOI: 10.4274/eamr.galenos.2024.18199
Eur Arch Med Res 2024;40(1):30-35

Comparing the Effectiveness of Adductor Canal and Popliteal Artery Capsule Block Combination Versus Epidural Analgesia for Postoperative Pain Management in Arthroscopic Knee Surgery: A Prospective Observational Study

Rasim Onur Karaoğlu, Esra Akdaş Tekin, Açelya Toprak Karaoğlu, Hakan Küçükkepeci

University of Health Sciences Turkey, Prof. Dr. Cemil Taşcıoğlu City Hospital, Clinic of Anesthesiology and Reanimation, İstanbul, Turkey

Abstract

Objective: Peripheral nerve blocks have gained popularity in recent years because of advancements in ultrasound-guided techniques and their proven effectiveness in providing targeted analgesia. In knee surgeries, combining a femoral nerve block or adductor canal block (ACB) with a subgluteal sciatic block, popliteal sciatic block, or the infiltration between the popliteal artery and the capsule of the posterior knee (IPACK) block has been shown to offer superior analgesia due to the comprehensive sensory innervation of the knee region.

Methods: This study was designed to compare the analgesic efficacy of ACB + IPACK block combination with single-dose epidural analgesia in arthroscopic knee surgery. The primary outcome was to assess analgesic efficacy at different time points (1st, 8th, and 24th hours post-block administration) between the ACB + IPACK block combination and epidural analgesia. Secondary outcomes included chronic pain outcomes at the 3-month post-surgery mark, discharge times, patient mobilization times, and postoperative analgesic requirements. This prospective observational study was conducted between August 15, 2022, and February 15, 2023. The study included patients over the age of 18 years who were scheduled to undergo arthroscopic knee surgery under spinal anesthesia and who had no limitations in cooperation or orientation.

Results: Both IPACK, ACB, and epidural analgesia demonstrated comparable efficacy in providing pain relief in arthroscopic knee surgery patients. The block group showed comparable postoperative analgesia to the epidural group at the 8th and 24th h, whereas the combined spinal epidural group provided more effective analgesia at the 1st h. Additionally, the block group was associated with shorter mobilization times than the epidural group. No significant differences were found in discharge times or chronic pain at 3 months between the two groups ($p>0.05$).

Conclusion: Both IPACK, ACB, and epidural analgesia can be effective options for managing postoperative pain in patients undergoing arthroscopic knee surgery. The findings of this study suggest that IPACK, ACB, and epidural analgesia can be effective options for managing postoperative pain in patients undergoing arthroscopic knee surgery. However, further randomized controlled trials are needed to confirm these findings.

Keywords: Knee arthroplasty, IPACK block, adductor canal block, pain management, mobilization, quadriceps strength

INTRODUCTION

Knee surgeries often involve a variety of postoperative pain management strategies, including peripheral nerve blocks, central neuraxial blocks, local anesthetic infiltration, and systemic analgesics. Among these, peripheral nerve blocks targeting the knee region have become increasingly popular because of their effectiveness in providing analgesia (1). Recently, the combination of adductor canal block (ACB) and infiltration

Address for Correspondence: Rasim Onur Karaoğlu, University of Health Sciences Turkey, Prof. Dr. Cemil Taşcıoğlu City Hospital, Clinic of Anesthesiology and Reanimation, İstanbul, Turkey
Phone: +90 505 681 42 24 **E-mail:** rasimonurkaraoglu@hotmail.com **ORCID ID:** orcid.org/0000-0002-9383-0673

Received: 26.12.2023
Accepted: 21.02.2024

Cite this article as: Karaoğlu RO, Akdaş Tekin E, Toprak Karaoğlu A, Küçükkepeci H. Comparing the Effectiveness of Adductor Canal and Popliteal Artery Capsule Block Combination Versus Epidural Analgesia for Postoperative Pain Management in Arthroscopic Knee Surgery: A Prospective Observational Study. Eur Arch Med Res Eur Arch Med Res 2024;40(1):30-35

between the popliteal artery and capsule of the knee (IPACK) block has emerged as a promising strategy (2,3).

The rationale for this study stems from the unique advantages of ACB and IPACK block. ACB selectively blocks the anterior sensation of the knee while minimizing motor loss compared with traditional femoral nerve blocks. IPACK block is a newer technique that targets sensory branches of the sciatic nerve supplying the posterior knee joint. When combined, these blocks have shown enhanced analgesia and reduced opioid consumption in knee surgeries (4). However, despite the advantages of these blocks, epidural analgesia remains the gold standard method in knee surgeries because of its effectiveness, reproducibility, and ability to reduce opioid consumption. However, its side effects, such as urinary retention, delay in mobilization, nausea, and hypotension, have led to a preference for peripheral nerve blocks.

Therefore, this study was designed to compare the analgesic efficacy of ACB + IPACK block combination with single-dose epidural analgesia in arthroscopic knee surgery. Our aim was to assess the primary outcome of analgesic efficacy at different time points (1st, 8th, and 24th hours post-block administration) between the ACB + IPACK block combination and epidural analgesia. Secondary outcomes include chronic pain outcomes at the 3-month post-surgery mark, discharge times, patient mobilization times, and postoperative analgesic requirements. The hypothesis of this study was that the ACB + IPACK block combination would provide comparable or superior analgesia to epidural analgesia, with potential benefits in terms of side effects and recovery times.

METHODS

Study Design

This study was conducted as a prospective observational study.

Setting

The study was conducted between August 15, 2022, and February 15, 2023, following the approval of the University of Health Sciences Hamidiye Faculty of Medicine Ethics Committee (approval number: E-48865165-302.14.06-139413, date: 08.07.2022). This study was conducted in accordance with the Declaration of Helsinki. Informed consent forms were obtained from all patients.

Participants

The study included patients over the age of 18 years who were scheduled to undergo arthroscopic knee surgery under spinal anesthesia and who had no limitations in cooperation or orientation. Patients who did not consent to participate, were under 18 years old, were scheduled for general anesthesia, had diseases limiting cooperation, and were using more than 3 months of gabapentin, pregabalin, or opioid were excluded. In addition, patients with one or more of the following conditions were excluded from the study: previous coagulation or bleeding disorder, receiving anticoagulant therapy, allergy/sensitivity to local anesthetics and/or opioids, and infection in the procedure area.

Variables

The primary outcome compares analgesic efficacy at different time points (1st, 8th, and 24th hours post-block administration) between the ACB + IPACK block combination and epidural analgesia. Secondary outcomes include chronic pain outcomes at the 3-month post-surgery mark, discharge times, patient mobilization times, and postoperative analgesic requirements.

Data Sources/Measurement

Patient data, including age, gender, American Society of Anesthesiologists physical status classification system (ASA) scores, comorbidities, postoperative visual analog scale (VAS) scores, mobilization and discharge times, VAS score at 3 months, and postoperative analgesic requirements, were recorded. The severity of pain was assessed using the VAS at the 1st, 8th, and 24th h after block administration. Mobilization and discharge times were also documented. Follow-up was conducted by contacting the patients again on the 90th day.

Bias

The study was designed to minimize potential bias by excluding patients with certain conditions and using a standardized protocol for the administration of ACB + IPACK block and epidural analgesia.

Study Size

Statistical power analysis was performed, determining a sample size of 70 patients to achieve 95% power based on similar studies. A total of 80 patients were included in the study, with 40 receiving IPACK and ACBs and 40 undergoing combine spinal epidural, after excluding case losses.

Quantitative Variables

Quantitative variables such as age, ASA scores, postoperative VAS scores, mobilization and discharge times, and VAS score at 3 months were recorded and analyzed.

Statistical Analysis

Data analysis was performed using Python version 3.9.12 and the SciPy package. The Shapiro-Wilk test was used to assess data distribution. Chi-square and Fisher's exact tests were employed for categorical data, independent t-tests for parametric data, and Mann-Whitney U tests for non-parametric data. Statistical significance was set at $p<0.05$.

RESULTS

Participants

A total of 90 patients who underwent arthroscopic knee surgery under regional anesthesia between August 15, 2022, and February 15, 2023 were initially included in this study. However, ten patients were excluded at different stages because of incomplete data and the procedure being changed to general anesthesia. Therefore, the final analysis was conducted on 80 patients who were divided into two groups based on the chosen method for postoperative analgesia: IPACK and ACB (group 1) and epidural analgesia (group 2) (Figure 1).

Descriptive Data

Demographic characteristics, including age, gender, and ASA scores, were comparable between the two groups, with no significant differences observed. In group 1 (IPACK and ACB), the mean age was 50.1 years, whereas in group 2 (epidural analgesia), it was 49.4 years. The gender distribution in group 1 comprised 18 males and 22 females, whereas in group 2, there were 21 males and 19 females. Regarding the ASA scores, group 1 included 11 ASA I, 24 ASA II, and 5 ASA III patients, whereas group 2 comprised 14 ASA I, 23 ASA II, and 3 ASA III patients. In terms of comorbidities, group 1 had 32 patients with additional diseases and 12 patients without any additional disease, whereas group 2 had 29 patients with additional diseases and 11 patients without any additional disease. All demographic data are presented in Table 1.

Outcome Data

Comparison of postoperative pain scores between the two groups revealed that the block group (group 1) provided equally effective postoperative analgesia as the epidural group (group 2) at the 8th and 24th hours ($p>0.05$). However, at the 1st hour, the combined spinal epidural group (group 2) provided more effective analgesia than the block group ($p=0.021$). The mean 1st hour VAS score in group 1 was 2.12±0.76, significantly higher than the score of 1.64±0.62 in group 2 ($p=0.021$). No significant differences were found in the 8th hour (group 1: 2.17±0.88, group 2: 1.92±0.74) and 24th hour (group 1: 2.49±1.04, group 2: 2.24±0.94) VAS scores. The VAS scores of the patients at the 1st, 8th, and 24th h are presented in Table 2. Regarding mobilization time, the patients in group 1 had a significantly shorter duration of 1.16 days than the patients in group 2, whose mobilization time was 1.68 days ($p=0.037$). However, there was no significant difference in discharge times between the two groups, with

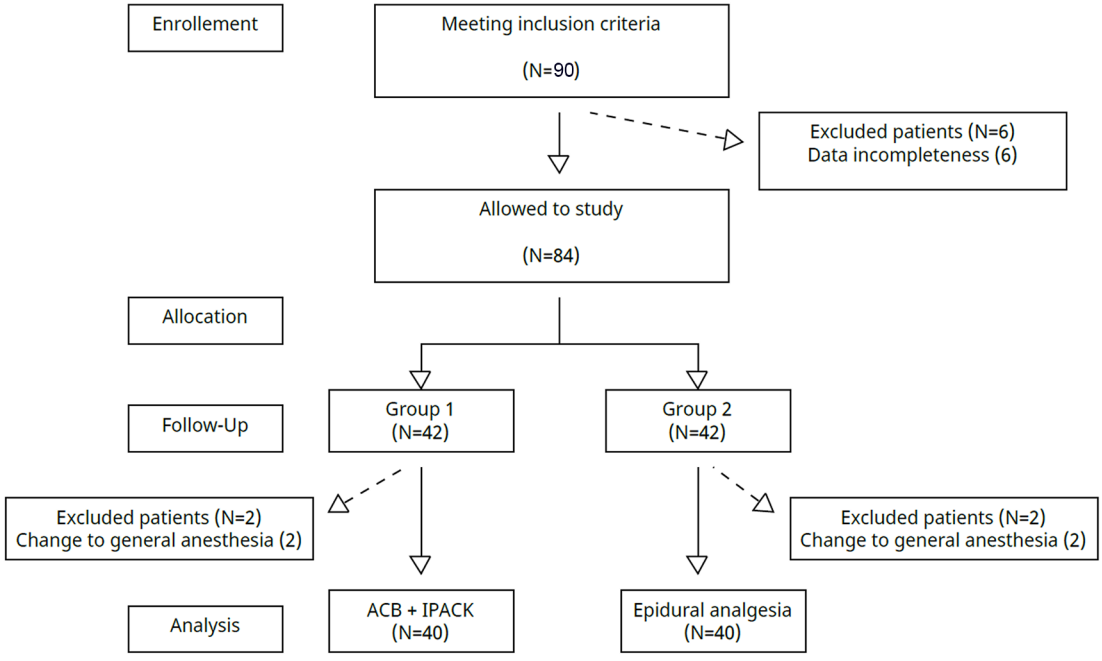

Figure 1. Consolidated standards of the reporting trials flow diagram
ACB: Adductor canal block, IPACK: Infiltration between the popliteal artery and the capsule of the posterior knee

Table 1. Demographic data of the groups			
	Group 1 (n=40)	Group 2 (n=40)	p-value
Age (years)	50.1±16.8	49.4±18.4	0.82
Gender (M/F)	18/22	21/19	0.76
ASA (I/II/III)	11/24/5	14/23/3	0.59
Additional disease yes/no	32/12	29/11	0.8
ASA: American Society of Anesthesiologists physical status classification system, M/F: Male/Female			

Table 2. VAS scores of the patients at the postoperative 1st, 8th, and 24th h			
	Group 1 (n=40)	Group 2 (n=40)	p-value
VAS (1st hour) Mean ± SD (min/med/max)	2.12±0.76 1/2/4	1.64±0.62 1/2/3	0.021
VAS (8th hour) Mean ± SD (min/med/max)	2.17±0.88 1/2/3	1.92±0.74 1/2/3	0.095
VAS (24th hour) Mean ± SD (min/med/max)	2.49±1.04 1/2/4	2.24±0.94 1/2/4	0.101
VAS: Visual analog scale, SD: Standard deviation, min: Minimum, med: Medium, max: Maximum			

group 1 having a mean discharge time of 2.24 days and group 2 having a mean discharge time of 2.4 days (p=0.33).

Main Results

If the patient failed to tolerate pain, 1000 mg paracetamol and 100 mg contramal as rescue analgesia were administered. Rescue analgesia was required in 5 patients in both groups, and no significant difference was detected (p>0.999). To evaluate chronic pain at 3 months, VAS scores were assessed for all 80 patients in the study. The mean VAS score in group 1 was 1.22, whereas it was 1.16 in group 2. No significant difference was observed between the two groups in terms of this parameter (p=0.1).

DISCUSSION

The most important finding of this study was that both IPACK, ACB, and epidural analgesia demonstrated comparable efficacy in providing pain relief in arthroscopic knee surgery patients. The block group showed comparable postoperative analgesia to the epidural group at the 8th and 24th h, whereas the combined spinal epidural group provided more effective analgesia at the 1st h. Additionally, the block group was associated with shorter mobilization times than the epidural group. No significant differences were found in discharge times or chronic pain at 3 months between the two groups.

Peripheral nerve blocks have become increasingly favored in recent years because of the advancements in ultrasound-guided techniques and their proven effectiveness in providing targeted pain relief. In knee surgeries, the combination of femoral nerve block or ACB with subgluteal sciatic block, popliteal sciatic block, or IPACK block has been identified to provide superior pain relief because of the comprehensive sensory innervation of the knee region (5).

IPACK block, which targets the sensory articular branches of the sciatic nerve that innervate the posterior knee joint, has emerged as an effective technique for alleviating posterior knee joint pain. When combined with the ACB, it enhances postoperative pain relief and reduces opioid consumption compared with the ACB alone (6,7). Studies have also reported comparable efficacy between the IPACK block and the genicular nerve block, another peripheral nerve block for posterior sensory block of the knee (8). Moreover, surgeons have achieved similar results to the combination of IPACK and ACB through periarticular local anesthetic infiltration on the posterior part of the knee (9).

The use of peripheral nerve blocks and local anesthetic infiltration in knee surgeries achieves effective postoperative pain relief with minimal motor block. This approach is particularly advantageous considering the undesirable side effects of opioids, such as nausea, vomiting, and constipation (10-12). In addition to reducing opioid consumption, IPACK block and ACB have demonstrated effective postoperative pain relief for knee surgeries, aligning with the principles of multimodal pain control (7,10).

In terms of patient mobilization and discharge, continuous peripheral nerve blocks have been associated with longer durations than single-dose blocks (13,14). However, it has been observed that ACB catheters, which aim to minimize motor loss, facilitate earlier mobilization and discharge compared with femoral nerve catheters (15). The duration of hospitalization and mobilization times were shortened in the IPACK block group compared with that in the epidural analgesia group (16,17). Another study comparing subgluteal sciatic nerve block + femoral nerve block with ACB + IPACK block found that the IPACK group exhibited better early motor function (18).

Postoperative chronic pain is a significant concern in knee surgeries, affecting approximately 10% of patients and increasing to 20% in some cases (19,20). Epidural analgesia has been widely recognized as an effective method for preventing chronic pain by providing successful perioperative analgesia control (17).

The efficacy of IPACK block in preventing chronic pain is still limited, with few studies available (11). However, our study found that ACB + IPACK block was as effective as epidural analgesia in preventing chronic pain.

In addition to knee surgeries, the versatility of IPACK block is evident in other clinical applications such as algology and perioperative analgesia, as well as in procedures such as radiofrequency ablation (21,22). Emerging techniques such as the IPACK block and saphenous, peroneal, accessory obturator, nerve to vastus medialis, and articular branch of the obturator nerve (SPANK) block have expanded the options for sensory blockade in the lower extremities (23).

Study Limitations

This study has several limitations that should be considered. The lack of randomization and the potential for confounding factors should be considered when interpreting the results. The only criterion for mobilization time was the patient's ability to get out of bed and walk. The VAS score was used to define chronic pain. Symptoms such as paresthesia, burning, and stinging were not questioned. The volume of local anesthetic used for the block may not be standardized because of the lack of a minimum effective concentration for the IPACK block.

CONCLUSION

In conclusion, this study found that IPACK, ACB, and epidural analgesia demonstrated comparable efficacy in providing pain relief in arthroscopic knee surgery patients. The block group showed comparable postoperative analgesia to the epidural group at the 8th and 24th h, whereas the combined spinal epidural group provided more effective analgesia at the 1st h. Additionally, the block group was associated with shorter mobilization times than the epidural group. No significant differences were found in discharge times or chronic pain at 3 months between the two groups. Further randomized controlled trials are needed to confirm these findings.

Ethics

Ethics Committee Approval: The study was conducted between August 15, 2022, and February 15, 2023, following the approval of the University of Health Sciences Turkey, Hamidiye Faculty of Medicine Ethics Committee (approval number: E-48865165-302.14.06-139413, date: 08.07.2022).

Informed Consent: Obtained.

Authorship Contributions

Surgical and Medical Practices: R.O.K., A.T.K., H.K., Concept: R.O.K., A.T.K., H.K., Design: R.O.K., A.T.K., H.K., Data Collection or Processing: R.O.K., A.T.K., H.K., Analysis or Interpretation: E.A.T., Literature Search: R.O.K., A.T.K., H.K., Writing: R.O.K., A.T.K., H.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Memtsoudis SG, Cozowicz C, Bekeris J, Bekere D, Liu J, Soffin EM, et al. Peripheral nerve block anesthesia/analgesia for patients undergoing primary hip and knee arthroplasty: recommendations from the International Consensus on Anesthesia-Related Outcomes after Surgery (ICAROS) group based on a systematic review and meta-analysis of current literature. Reg Anesth Pain Med 2021;46:971-85.
2. Kertkiatkachorn W, Kampitak W, Tanavalee A, Ngarmukos S. Adductor Canal Block Combined With iPACK (Infiltration between the Popliteal Artery and Capsule of the Knee) Block vs Periarticular Injection for Analgesia After Total Knee Arthroplasty: A Randomized Noninferiority Trial. Journal of Arthroplasty 2021;36:122-9.
3. Manickam B, Perlas A, Duggan E, Brull R, Chan VWS, Ramlogan R. Feasibility and Efficacy of Ultrasound-Guided Block of the Saphenous Nerve in the Adductor Canal. Reg Anesth Pain Med 2009;34:578-80.
4. Sinha SK, Abrams JH, Arumugam S, D'Alessio J, Freitas DG, Barnett JT, et al. Femoral nerve block with selective tibial nerve block provides effective analgesia without foot drop after total knee arthroplasty: A prospective, randomized, observer-blinded study. Anesth Analg 2012;115:202-6.
5. Spangehl MJ, Clarke HD, Hentz JG, Misra L, Blocher JL, Seamans DP. The Chitranjan Ranawat Award: Periarticular Injections and Femoral & Sciatic Blocks Provide Similar Pain Relief After TKA: A Randomized Clinical Trial. Clin Orthop Relat Res 2015;473:45-53.
6. Sankineani SR, Reddy ARC, Eachempati KK, Jangale A, Gurava Reddy A V. Comparison of adductor canal block and IPACK block (interspace between the popliteal artery and the posterior capsule of knee) with periarticular injection for analgesia after total knee arthroplasty: a prospective randomized controlled study. J Arthroplasty 2018;28:1391-5.
7. Batko BD, Ippolito JA, Bland K, Nossaman BD, Thomas LC, Yuratich D, et al. The Effect of the IPACK Block on Pain After Primary TKA: A Prospective, Randomized, Double-Blinded, Placebo-Controlled Study. Journal of Arthroplasty [Internet]. 2020 Jun 1 [cited 2023 Jan 7];35(6S):S173-7. Available from: https://pubmed.ncbi.nlm.nih.gov/32005622/
8. Akesen S, Akesen B, Atıcı T, Gurbet A, Ermutlu C, Özyalçın A. Comparison of efficacy between the genicular nerve block and the popliteal artery and the capsule of the posterior knee (IPACK) block for total knee replacement surgery: a prospective randomized controlled study. Acta Orthop Traumatol Turc 2021;55:134-40.
9. Et T, Korkusuz M, Basaran B, Yarımoğlu R, Toprak H, Bilge A, et al. Comparison of iPACK and periarticular block with adductor block alone after total knee arthroplasty: a randomized clinical trial. J Anesth 2022;36:276-86.
10. Mou P, Wang D, Tang XM, Zeng WN, Zeng Y, Yang J, et al. Adductor Canal Block Combined With IPACK Block for Postoperative Analgesia and Function Recovery Following Total Knee Arthroplasty: A Prospective, Randomized, Controlled Study. J Arthroplasty 2022;37:259-66.

11. Patterson ME, Vitter J, Bekeris J, Bukowiec L, Edwards CJ, Henshaw DS. The Effect of the IPACK Block on Pain After Primary TKA: A Prospective, Randomized, Double-Blinded, Placebo-Controlled Study. J Arthroplasty 2020;35:S173-7.

12. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am 2007;89:780-5.

13. Ilfeld BM. Continuous Peripheral Nerve Blocks: An Update of the Published Evidence and Comparison With Novel, Alternative Analgesic Modalities. Anesth Analg 2017;124:308-35.

14. Chong MA, Wang Y, Dhir S, Lin C. Programmed intermittent peripheral nerve local anesthetic bolus compared with continuous infusions for postoperative analgesia: A systematic review and meta-analysis of randomized trials. J Clin Anesth 2017;42:69-76.

15. Dobson SW, Stouffer ND, Weller RS, Shields JS, Edwards CJ, Henshaw DS. Comparison of Femoral Nerve Catheter, Adductor Canal Catheter, and Periarticular Liposomal Bupivacaine Infiltration for Postoperative Analgesia After Primary Total Knee Arthroplasty: A Randomized, Double-Blinded, Controlled Study. J Arthroplasty 2023;38:824-30.

16. Tak R, Gurava Reddy AV, Jhakotia K, Karumuri K, Sankineani SR. Continuous adductor canal block is superior to adductor canal block alone or adductor canal block combined with IPACK block (interspace between the popliteal artery and the posterior capsule of knee) in postoperative analgesia and ambulation following total knee arthroplasty: randomized control trial. Musculoskelet Surg 2022;106:155-62.

17. Fowler SJ, Symons J, Sabato S, Myles PS. Transition from acute to chronic pain after surgery. Lancet 2019;393:1537-46.

18. Zheng FY, Liu YB, Huang H, Xu S, Ma XJ, Liu YZ, et al. The impact of IPACK combined with adductor canal block under ultrasound guidance on early motor function after total knee arthroplasty. Braz J Anesthesiol 2022;72:110-114.

19. Glare P, Aubrey KR, Myles PS. Transition from acute to chronic pain after surgery. Lancet 2019;13;393:1537-46.

20. Wylde V, Beswick A, Bruce J, Blom A, Howells N, Gooberman-Hill R. Chronic pain after total knee arthroplasty. EFORT Open Rev 2018;3:461.

21. Kim J, Lee K, Kim Y, Lee HH, Park HJ. Using the iPACK block to reduce chronic pain in a patient with knee osteoarthritis: A case report. J Clin Anesth 2021:74.

22. Kose S, Kose H, Tulgar S, Akkaya O, Gurkan Y. Ultrasound-guided pulsed radiofrequency between the popliteal artery and capsule of the knee (R-PACK); a new technique for relief of chronic posterior knee pain. Indian J Anaesth 2022;66:474-5.

23. Padhy S, Patki AY, Kar AK, Durga P, Sireesha L. Comparison of sensory posterior articular nerves of the knee (SPANK) block versus infiltration between the popliteal artery and the capsule of the knee (IPACK) block when added to adductor canal block for pain control and knee rehabilitation after total knee arthroplasty---A prospective randomized trial. Indian J Anaesth 2021;65:792-7.