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Effect of suprainguinal fascia iliaca block on recovery quality after total knee arthroplasty: a prospective, randomized controlled, double-blind, multicenter study

Muhammed Halit Satıcı[1], Mahmut Sami Tutar[1], Yasin Tire[1], Betül Kozanhan[1], Ahmet Erarkadaş[1], Ahmet Yıldırım[2], Ahmet Yaşar Dağ[3], Nuray Altay[3]

[1]Department of Anesthesiology and Reanimation, Konya City Hospital, Konya, Turkiye
[2]Department of Orthopedics and Traumatology, Konya City Hospital, Konya, Turkiye
[3]Department of Anesthesiology and Reanimation, Faculty of Medicine, Harran University, Şanlıurfa, Turkiye

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ABSTRACT

Aims: Total knee arthroplasty (TKA) is a common procedure for patients with advanced gonarthrosis, often leading to significant postoperative pain. Effective pain management, including multimodal analgesia with peripheral nerve blocks, is essential. The suprainguinal fascia iliaca block is a technique that targets key nerves responsible for knee sensation and is similar in effect to the lumbar plexus block. This research aims to evaluate whether suprainguinal fascia iliaca block improves the quality of recovery-15 scores in TKA patients.

Methods: A randomized, prospective, controlled, multicenter study was conducted with 60 patients undergoing TKA. Participants were allocated to either group S (received SIFIB with local anesthetic) or group C (received SIFIB with saline solution). The primary outcome measured was the quality of recovery-15 (QoR-15) score 24 hours post-surgery. Secondary outcomes included postoperative numeric rating scale scores, the requirement for rescue analgesia, time to first rescue analgesia, postoperative complications (nausea and vomiting), the necessity for antiemetics, and patient satisfaction.

Results: Group S had significantly higher QoR-15 scores [124 (121-129) vs. 98 (92-101); p<0.001] and lower numerical rating scale scores at all time points compared with group C (p<0.001). The total amount of tramadol consumed within the first 24 hours postoperatively was higher in group C [145 (80-225) mg vs. 0 (0-0) mg; p<0.001].

Conclusion: Suprainguinal fascia iliaca block significantly enhances postoperative recovery and pain management in TKA patients, presenting a viable alternative to other regional blocks for knee surgery.

Keywords: Multimodal analgesia, postoperative recovery, quality of recovery-15 score, Suprainguinal fascia iliaca block

INTRODUCTION

Total knee arthroplasty (TKA) is a predominant orthopedic procedure, particularly in individuals with advanced gonarthrosis and restricted joint mobility.[1] After TKA, patients experience severe pain, which could be successfully treated with various variants of multimodal analgesics.[2,3] With the extensive adoption of ultrasound (US) technology, peripheral nerve blocks have been widely utilized as a component of multimodal analgesia.[4,5] The sensory innervation of the knee region is provided by the femoral, obturator, and lateral femoral cutaneous nerves that originate from the lumbar plexus, as well as the sciatic nerve that originates from the sacral plexus.[6,7] These nerves need to be targeted to provide analgesia in knee surgeries.[8] Peripheral nerve blocks and fascia iliaca blocks are frequently used for analgesic purposes in lower extremity surgeries, such as knee surgery.[9-11] This block can be performed in two ways: suprainguinal and infrainguinal, which target the femoral nerve, obturator nerve, and lateral femoral cutaneous nerve.[12,13] The suprainguinal fascia iliaca block (SIFIB) shows a similar effect to the lumbar plexus block that targets the femoral nerve, obturator nerve, and lateral femoral cutaneous nerve.[14] Some studies show that SIFIB was applied for postoperative analgesia in TKA. However, none of these studies evaluated the quality of recovery.[9-11]

In this study, we proposed that patients undergoing TKA who receive the SIFIB will show improved quality of recovery-15 (QoR-15) scores and aimed to evaluate the effect of SIFIB on postoperative recovery by using the QoR-15 score, while also assessing secondary outcomes, such as postoperative Numerical Rating Scale (NRS) scores at rest and during movement, patient satisfaction levels, time to first request for rescue analgesia, number of patients requiring rescue analgesia, total consumption of rescue analgesics, antiemetic use, and incidence of complications, including nausea, vomiting.

Corresponding Author: Muhammed Halit Satıcı, halit_satici@hotmail.com

METHODS

Ethics Approval and Registration

The Harran University Faculty of Medicine Ethics Committee (Date: 12.02.2024, Decision No: 24.01.42) approved this study. This study was registered in the ClinicalTrials.gov database (number NCT06386575, date: April 15, 2024). The study followed the ethical criteria outlined in the Declaration of Helsinki. We strictly applied the guidelines outlined in the Consolidated Standards of Reporting Trials (CONSORT) statement.[15] We obtained written and verbal consent from patients.

Patient Population and Inclusion/Exclusion Criteria

This research was conducted from April 2024 to July 2024 at Şanlıurfa City Hospital and Harran University Faculty of Medicine. The study included patients aged between 18 and 65, classified as ASA I-III, undergoing unilateral TKA, and hospitalized for a minimum of 24 hours. We excluded patients who did not provide consent, those who refused spinal anesthesia, individuals for whom regional anesthesia was contra-indicated, those with bleeding disorders, patients on anticoagulants, individuals with infections at the peripheral nerve block site, those allergic to local anesthetic (LA), and emergency cases

Randomization

The investigation was conducted as a prospective, randomized controlled, double-blind, multicenter trial. We obtained written and verbal consent from patients before randomization. Randomization was performed in the operating room on the day of surgery. SPSS V.26.0 was used to generate numbers from 1 to 60. The results were placed in a sealed opaque envelope with the same serial number. Each patient was given a random ID throughout the study. All patients were randomized 1:1 into two groups of 30 people: group C (received SIFIB with saline solution) and group S (received SIFIB with LA). The physician providing randomization was blinded to other study phases. After this stage, a different researcher opened the envelopes and was removed from the study. The investigator who performed the block was blinded to the patients regarding LA or saline solution and did not participate in data collection and evaluation. An anesthesiologist with at least five years of experience in both centers performed SIFIB. These individuals did not participate in other study stages. Two anesthesia doctors recorded the results.

Standard Anaesthesia and Postoperative Analgesia Protocol

Each patient received standard monitoring and anesthesia management. The patients were given 20-gauge intravenous (IV) cannulation, and 15 ml/kg/h isotonic fluid was started. Before spinal anesthesia, 0.02 mg/kg midazolam was administered for sedation. Spinal anesthesia was administered using 3 ml of 0.5% heavy marcaine through a 26-gauge needle through the L3-L4 or L4-L5 intervertebral space in a sitting position. Subsequently, the patients were left to the surgical team for TKA. Postoperatively, all patients were administered IV 1 g paracetamol +IV 20 mg tenoxicam +IV dexamethasone 8 mg for postoperative analgesia in the postanesthetic care unit (PACU). Paracetamol 3×1 g+tenoxicam 2×20 mg were administered continuously. SIFIB was applied to all patients in the PACU. However, the patients in group C were administered 40 ml of saline solution during SIFIB administration, whereas the patients in group S were administered 40 ml of 0.25% marcaine. All patients were administered IV 1 mg/kg tramadol as a rescue analgesic when the NRS scores were ≥4. All patients with nausea and vomiting were administered 4 mg IV ondasetron.

Ultrasound-Guided Suprainguinal Fascia Iliaca Block

SIFIB was conducted immediately postoperatively in the block performance room that utilized an in-plane technique with a high-frequency linear transducer (10-18 MHz, MyLabFive; Esaote Europe BV, Philipsweg 1, 6227 AJ, Maastricht, Netherlands). The transducer was placed on the femoral crest to sonographically visualize the femoral artery, femoral nerve, fascia iliaca, and iliacus muscle. The continuity of the fascia iliaca between the iliacus and sartorius muscles was observed by moving the transducer laterally. Subsequently, the transducer was rotated superolateral to the oblique plane and positioned just medial to the anterior superior iliac spine. Sonoanatomically, the abdominal muscles, deep circumflex artery, iliacus muscle, sartorius muscle, and fascia iliaca were identified within the same image. Utilizing the in-plane technique, an 80-mm peripheral block needle (B. Braun, Melsungen AG, Germany, 80 mm, 21 G) was advanced from caudal to cephalad into the space between the fascia iliaca and iliacus muscle. After the needle tip position was confirmed by injecting 1 ml of isotonic fluid, 40 ml of 0.25% bupivacaine or 40 ml of saline solution was slowly administered into the area.

Outcome Measures

24 hours following surgery, the patient's quality of recovery was gauged by recording their QoR-15 scores, which served as the primary outcome measure. The QoR-15 score is composed of fifteen questions for a total of 150 points. The five domains include pain (n=2), physical comfort (n=5), physical independence (n=2), psychological support (n=2), and emotional state (n=4). The questions range in score from 1 to 10.[16,17]

Secondary outcome assessments were postoperative NRS ratings at rest and during mobility at 3, 6, 9, 12, 18, and 24 hours postoperatively. A score of 0 indicates no pain, while 10 indicates the most severe pain. In addition, the research measured patient satisfaction using a Likert scale 24 hours after surgery, the total quantity of rescue analgesia used, the duration until the initial administration of rescue analgesics, problems such as nausea and vomiting, and the need for antiemetics. We recorded the age, weight, height, laboratory findings, and duration of surgery for patients in both groups.

Patient satisfaction was assessed using a Likert scale, with a score of 1 representing "not satisfied at all," 2 representing "unsatisfied," 3 representing "neutral," 4 representing "satisfied," and 5 representing "very satisfied."

Sample Size

A minimal clinically important difference (MCID) in the quality of recovery after surgery and anesthesia is defined as

a change of ≥8 points in the global QoR-15 score.[18] In the pilot study, including 10 patients, the global QoR-15 score in the control group at 24 hours postoperatively was 100.3±11.49. Based on this data and using a Cohen's D effect size of 0.696 in an independent groups T test model, it was determined that 27 patients per group were needed to achieve 80% power with a maximum type I error of 5%. Taking into account the potential dropout rate, the required sample size for each group was calculated to be 30 patients, resulting in a total of 60 patients for the study.

Statistical Analysis

The IBM Statistical Pack Age for Social Sciences (IBM-SPSS Inc., Chicago, IL, USA) 22.0 program was used for analysis. Data conformity to the normal distribution was examined using the Shapiro-Wilk test. Continuous variables were expressed as mean, standard deviation, or (median 25-75 percentile) based on their distribution status, and categorical variables were expressed as numbers and percentages. In the analysis of continuous variables, the independent sample student's T test was applied after meeting parametric test assumptions. Otherwise, the Mann-Whitney U test was used. The Fisher exact test and Chi-square test were used to analyze categorical variables. Analysis of variance (ANOVA) was utilized for repeated measurements between groups at different times. A Kaplan-Meier curve was constructed for time to the first analgesic medication requirement, and the groups were compared using the log-rank test. Statistical significance was accepted as p<0.05.

RESULTS

We initially assessed 65 patients for eligibility; however, we excluded five patients due to their refusal to participate. The remaining 60 patients were randomized and treated based on the protocol (group C, n=30; group S, n=30) (Figure 1). Patient characteristics and duration of surgery were similar between the groups (Table 1).

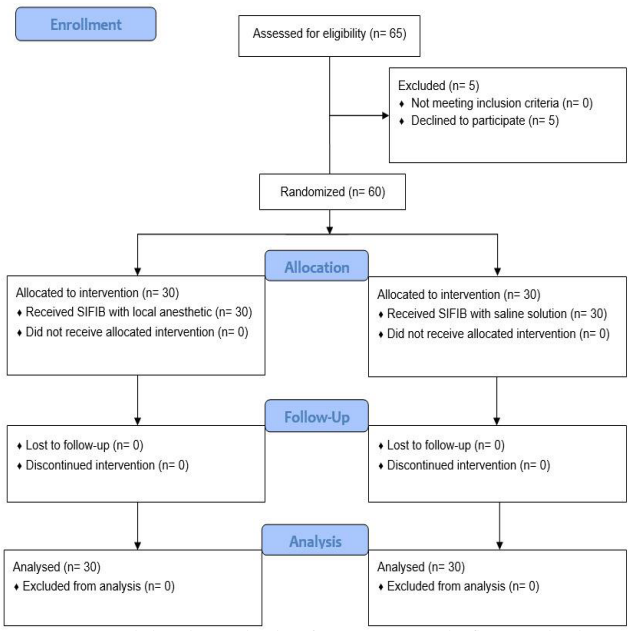

Figure 1. Consolidated standards of reporting trials flow study diagram describing patient progress through the study. SIFIB, Suprainguinal fascia iliaca block

SIFIB: Suprainguinal fascia iliaca block

Table 1. Baseline characteristics by groups

Factors	Group C (n=30)	Group S (n=30)
Age (year)	58±8	58±5
Female	23 (76.7%)	22 (73.3%)
ASA		
1	2 (6.7%)	4 (13.3%)
2	21 (70%)	20 (66.7%)
3	7 (23.3%)	6 (20%)
Smoking	6 (20%)	3 (10%)
Coronary artery disease	4 (13.3%)	4 (13.3%)
Hypertension	11 (36.7%)	11 (36.7%)
Lung disase	3 (10%)	8 (26.7%)
Height (cm)	164±7	165±7
Weight (kg)	72±11	72±10
Surgery time (min)	103 (90-120)	103 (90-120)

Data presented as mean±standard deviation, median (Q1-Q3), or n (%), cm: Centimeter, Kg: Kilogram, min: Minutes, ASA: American Society of Anesthesiologists physical status

Primary Outcome

We compared two randomized assigned groups who underwent knee arthroscopy, focusing on their postoperative recovery measured by the QoR-15 score. Group S had significantly higher QoR-15 scores than group C [124 (121-129) vs 98 (92-101); p<0.001]. Group S had considerably higher scores in postoperative pain, physical comfort, physical independence, psychological support, and emotional state than another area to other group (p<0.001 for each) (Table 2).

Table 2. Total and dimensional QoR-15 scores of the participants

Quality of recovery	Group C (n=30)	Group S (n=30)	p value
Pain	12 (10-14)	19 (19-20)	<0.001
Physical comfort	34 (32-36)	44 (43-45)	<0.001
Physical independence	8 (6-8)	10 (8-10)	<0.001
Psychological support	13 (13-14)	17 (16-18)	<0.001
Emotional state	30 (28-32)	36 (33-36)	<0.001
Total QoR-15 score	98 (92-101)	124 (121-129)	<0.001

Data presented as median (Q1-Q3), QoR-15: Quality of recovery-15

Secondary Outcomes

Pain scores: At 24 h postoperatively, the NRS scores at rest and during movement were consistently smaller in group S at all time points, and this difference was statistically significant at 3, 6, 9, 12, and 24 hours postoperatively. In addition, when the change over time of the NRS scores at 24 hours postoperatively was evaluated for rest and movement, the time-group interaction was statistically significant for NRS scores during rest and movement. (p<0.001 and p<0.001, respectively) (Figure 2 a, b).

Rescue analgesia requirement: Rescue analgesia was administered to group C, whereas 25 patients in group S did not require rescue analgesia (p<0.001). The number of patients requiring rescue analgesia was significantly higher in the control group at all time intervals. The difference between the groups was statistically significant for the "0-6" and "6-12" time intervals (p<0.001 for both), but it was not statistically significant in the "12-24" time interval (p=0.706) (Table 3).

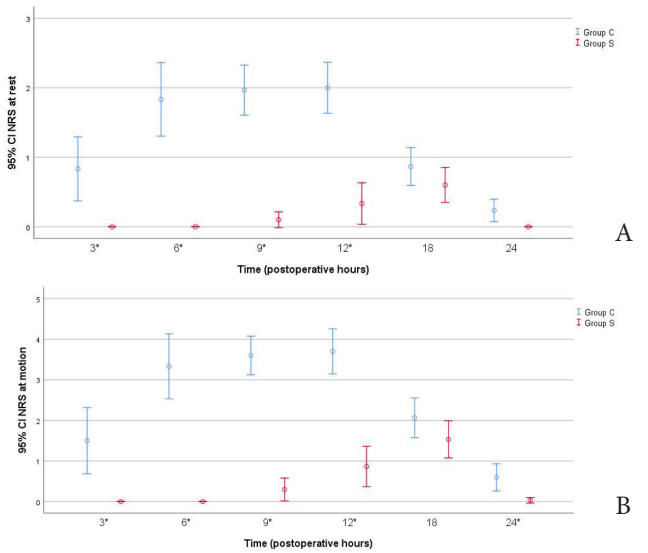

Figure 2. a) Postoperative numerical rating scores at rest with 95% CI, *p<0.05, b) Postoperative numerical rating scores at motion with 95% CI

CI: Confidence interval, NRS: Numerical Rating Scale

The total amount of tramadol consumed within the first 24 hours postoperatively was higher in group C [145 (80-225) mg vs 0 (0-0) mg; p<0.001] (Table 3). The median time to administer rescue analgesics was 6 (3-9) and 18 (18-18) h in groups C and S, respectively (p<0.001) (Table 3). Patients in the control group requested analgesia significantly earlier compared with group S (p<0.001) (Figure. 3).

Table 3. Postoperative rescue analgesic characteristics among groups

Factors	Group C (n=30)	Group S (n=30)	p value
First rescue analgesic time (h)	6 (3-9)	18 (18-18)	<0.001
Tramadol consumption (mg)	145 (80-225)	0 (0-0)	<0.001
Rescue analgesic usage, time frame (h)			
0-6	19 (63.3%)	0 (0%)	<0.001
6-12	30 (100%)	2 (6.7%)	<0.001
12-24	5 (16.7%)	3 (10%)	0.706
0-24	30 (100%)	5 (16.7%)	<0.001

Data are presented as median (Q1-Q3), or n (%)

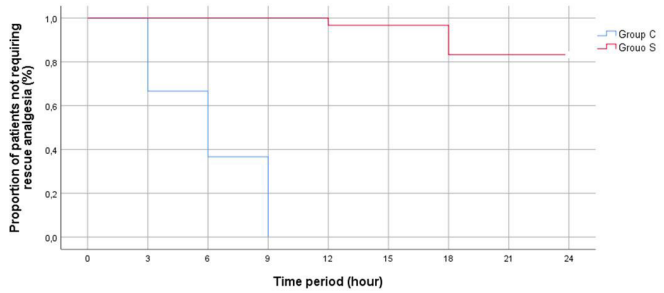

Figure 3. Kaplan Meier plot showing the percentage of patients not requiring rescue analgesia over time

Advers Events, and Likert Scale: In the postoperative 24-hour period, postoperative nausea and vomiting (PONV) was observed in 9 (30%) and 1 (3.3%) patient in groups C and S, respectively (p=0.006). The requirement for antiemetic drugs was significantly lower in group S (1 vs. 9 patients, p=0.006). Additionally, patient satisfaction scores on the Likert scale were significantly higher in group S [5 (5-5) vs. 3 (3-4); p<0.001].

DISCUSSION

This prospective, randomized, controlled, multicenter, double-blind study of patients undergoing TKA showed that SIFIB significantly improved postoperative recovery, evidenced by higher QoR-15 scores, lower pain scores, lower need for rescue analgesia, fewer side effects, and higher patient satisfaction in group S. This study is the first to comprehensively investigate the use of SIFIB in TKA using the QoR-15 scores.

Although SIFIB was initially widely applied in hip surgery, subsequent studies have emphasized that SIFIB for postoperative analgesia in knee surgeries is an integral part of multimodal analgesia.[19] A study reported that SIFIB in hip surgery increased QoR-15 scores.[20] In another study, QoR-15 scores were evaluated postoperatively in patients who underwent knee arthroplasty after IV magnesium sulfate. In this study, QoR-15 scores were higher than the control group. Lower pain levels, higher emotional states, and greater physical comfort were also exhibited.[21] In our study, QoR-15 scores were higher in patients treated with SIFIB 24 hours postoperatively than those in the control group. Patients treated with SIFIB had higher postoperative pain, physical comfort, physical support, physical independence, and emotional state scores. The QoR-15 score is a validated measure evaluating the quality of postoperative recovery and includes pain, physical comfort, physical independence, psychological support, and emotional state. Furthermore, the overall improvement in these recovery parameters was consistent with previous studies that emphasize the benefits of regional anesthesia techniques in improving the quality of postoperative recovery.[22]

The literature reported an eight-point difference as MCID for the QoR-15 score.[18] Our study's MCID for QoR-15 score was >8 points and was statistically significant, indicating that SIFIB in knee arthroplasty speeds up recovery and makes the postoperative experience more comfortable.

In patients undergoing TKA treated with SIFIB, pain scores and amount of rescue analgesia were low, and the duration of initial rescue analgesia application was long.[9-11,20,23] A study highlighted the potential impact of the combination of an adductor canal block and infiltration of local anesthetic between the popliteal artery and the capsule of the knee (IPACK) in patients undergoing knee arthroscopy. This technique resulted in higher QoR-15 scores at 24 hours, along with lower rescue analgesia consumption and reduced pain scores.[24] Similarly, a meta-analysis emphasized the potential of various peripheral nerve blocks to significantly decrease pain scores and rescue analgesia requirements in patients following knee arthroplasty.[25] Another study reported the potential of femoral and adductor canal blocks to reduce the consumption of rescue analgesia in knee arthroplasty patients.[26] Additionally, it has been documented that the potential for pain reduction in patients undergoing lower extremity surgery is significant after applying a selective SIFIB.[27]

Our study showed that NRS scores were consistently lower at rest and during movement in patients undergoing SIFIB at all postoperative time points, highlighting the sustained analgesic efficacy of the intervention. Additionally, the significant time-group interaction for NRS scores indicates that the technique reduces immediate postoperative pain and positively affects pain progression over time. The amount of rescue analgesia was considerably higher in the control group at 24 h. In the 24 hours, rescue analgesia was administered to all patients in group C, whereas only five patients in group S required rescue analgesia. Patients in the control group requested analgesia earlier. Group S had a significantly longer time to first request rescue analgesia, indicating the long-term analgesic effect of the advanced technique. Our results were consistent with existing literature advocating multimodal analgesia to reduce opioid requirements and improve pain management outcomes.

Our study showed that the rates of nausea and vomiting due to tramadol use were significantly higher in the control group, significantly increasing the need for antiemetic drugs in this group. Similar mobilization times between both groups indicate that the effects of spinal anesthesia diminished similarly over time. Simultaneously, the high efficacy of SIFIB resulted in patients in group S achieving higher scores on the Likert satisfaction scale, emphasizing improved patient well-being in the postoperative period, showing the clinical benefits of SIFIB.

Limitations

Limitations of this study, we did not evaluate the combinations of SIFIB with other anesthesia techniques or its long-term effects. Future research should investigate the long-term outcomes of SIFIB and its effectiveness when used in combination with different peripheral nerve blocks, which will offer valuable insights into the long-term benefits and broader applications of SIFIB in various surgical settings.

CONCLUSION

The SIFIB has been demonstrated to significantly improve postoperative recovery and pain management in patients undergoing TKA. This technique provides effective analgesia, contributing to enhanced patient comfort and a reduction in the need for additional pain medications. Given its efficacy and favorable safety profile, the SIFIB represents a promising alternative to other regional anesthesia techniques commonly used in knee surgery. Its potential to minimize complications associated with certain blocks further underscores its utility in optimizing perioperative care and promoting faster functional recovery.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the Ethics Committee of Harran University Faculty of Medicine (Date: 12.02.2024; Decision No: 24.01.42).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Registered Database

The study was registered on the ClinicalTrials.gov database under the identifier NCT06386575.

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