SAS Journal of Surgery
Abbreviated Key Title: SAS J Surg
ISSN 2454-5104
Journal homepage: https://www.saspublishers.com

OPEN ACCESS

Orthopedic & Trauma Surgery

Benefits of the Femoral Nerve Block in Total Knee Replacements: Analytical and Descriptive Study of a Series of 35 Cases

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DOI: 10.36347/sasjs.2023.v09i06.005 | **Received:** 22.04.2023 | **Accepted:** 30.05.2023 | **Published:** 06.06.2023

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Abstract **Original Research Article**

This study aims to analyze the effectiveness of femoral block in postoperative analgesia for total knee prostheses and evaluate the immediate functional outcomes in patients who received this type of analgesia. ***Methods*:** A retrospective study was conducted on 35 cases of total knee replacement between January 2017 and December 2020. Epidemiological, clinical, and preoperative radiological data were collected. The femoral block was performed using ultrasound guidance, and the anaesthetic product used was diluted bupivacaine. Different analgesia protocols were used, and postoperative follow-up was conducted to assess clinical and radiological outcomes. ***Results*:** The study included 35 patients with a mean age of 64 years, predominantly female (77.7%). Most patients were in good health without specific medical history. Knee osteoarthritis with genu varum was the most common indication for total knee replacement. The femoral block was successfully performed in all cases. The average postoperative stay was 8 days, and the immediate functional outcomes were satisfactory, with an average flexion of 90° and walking assistance within 6 days. ***Conclusion*:** The study demonstrates the effectiveness of femoral block in providing postoperative analgesia for total knee replacement. The immediate functional outcomes were favorable, with patients achieving satisfactory flexion and early mobility. The multimodal approach to analgesia, including the femoral block, proved beneficial in optimizing pain management and facilitating rapid recovery after surgery.

Keyword: Analgesia, femoral, nerve, block, prosthesis, total, knee.

INTRODUCTION

Knee arthroplasty is an orthopedic surgical procedure aimed at replacing the joint surfaces with metallic components. Its goal is to reduce pain and improve quality of life. Paradoxically, this surgery can cause intense postoperative pain that hinders rehabilitation and delays recovery. The management of postoperative pain plays a crucial role in the functional and even vital prognosis of the patient.

Inability to control postoperative pain has been associated with an increase in sympathetic system activity, resulting in vasoconstriction and damage to target organs, decreased intestinal motility, increased nausea and vomiting, negative regulation of immune function, chronic pain, prolonged hospital stay, and additional expenses.

Surgery is evolving towards a minimally invasive approach, aiming to minimize pain and enable a faster return to normal life. Numerous studies also show that the type of anesthesia and analgesia administered can influence the success rate of the surgical procedure, the rate of complications (surgical site infection, urinary retention, reflex ileus, nausea, and vomiting), as well as the patient's ability to safely participate in early postoperative rehabilitation sessions.

It is essential for the anesthesiologist and surgeon to be aware of the different available analgesic modalities in order to optimize outcomes. Analgesia plays an important role in improving the functional results of surgery and reducing postoperative morbidity and mortality.

Currently, new recommendations suggest a multimodal approach to postoperative pain management. The concept is to combine multiple analgesic substances and techniques with different and complementary mechanisms of action, thereby creating additive or even synergistic interactions [1]. Peripheral

nerve blocks are an integral part of these analgesic modalities. The femoral nerve block is an obvious choice as it covers the largest sensory territory of the joint.

The aim of our study, based on a retrospective observational case series and an extensive literature review, is to verify the effectiveness of the femoral nerve block in postoperative analgesia for total knee replacement, as well as to analyze the immediate functional outcomes in patients who have received this type of analgesia.

PATIENTS & METHODS

This retrospective study was conducted on 35 patients who underwent total knee replacement at the Traumatology-Orthopedics Service A of Avicenne University Hospital in Rabat between January 2017 and December 2020. Epidemiological, clinical, and preoperative radiological data were collected using an exploitation form. Postoperative follow-up of the patients was carried out to assess the clinical and radiological outcomes after total knee arthroplasty. The inclusion criteria included all patients who received a femoral block during total knee replacement at the Traumatology-Orthopedics Service of the university hospital between January 2017 and December 2020. Only complete records were included, while incomplete records and patients who did not receive a femoral block were excluded from the study.

RESULTS

In our case series, we studied a group of patients ranging in age from 24 to 90 years, with a mean age of 64 years. The majority of patients were women (27 women and 8 men), resulting in a sex ratio of 0.3. Most of the patients (57%) were in good health without any specific medical history (ASA I). Among the patients with medical history (43%), the majority were being treated for hypertension alone (17% of cases), followed closely by those suffering from both hypertension and diabetes (9% of cases). Other patients had different medical conditions, including rheumatoid arthritis, Parkinson's disease, acute rheumatic fever, or ankylosing spondylitis. Regarding surgical history, the majority of patients (80%) did not have any previous surgical interventions.

Among the 35 patients who underwent total knee replacement (TKR), the main reason was osteoarthritis with genu varum (60% of cases), followed by osteoarthritis with genu valgum (26% of cases). Two patients had osteoarthritis related to rheumatoid arthritis, two had it related to a tumor, and one patient had it related to ankylosing spondylitis. Among the cases studied, 30 had osteoarthritis, with 17 classified as stage III, 10 as stage IV, and 3 as stage II.

All 35 patients underwent unilateral TKR, with 11 for the left knee and 24 for the right knee. The anesthesia used for all cases was combined spinal anesthesia with a femoral block.

The femoral block was performed using diluted bupivacaine at 0.125. This method was carried out using ultrasound to locate the nerve and inject the anesthetic. The femoral block was maintained continuously for 48 hours, but in the absence of adequate equipment, it could be administered discontinuously every 8 to 12 hours (figure 1).

Figure 1: Ultrasound repair during femoral blocking

Different analgesia protocols were used among the 35 cases studied. Thirteen patients followed a protocol combining non-steroidal anti-inflammatory drugs (NSAIDs) and nefopam, 11 received NSAIDs alone, 10 received nefopam alone, and one patient received intravenous paracetamol infusion. In our study, five patients received protected amoxicillin as antibiotic prophylaxis, while the others received a first-generation cephalosporin. Among the 35 cases studied, seven patients required blood transfusion, which represents 20% of the sample. Among the transfused patients, five received two units of blood each, while the other two received three and four units respectively. Data on rehabilitation were available for 22 out of the 35 cases

studied. Among them, six patients underwent immediate rehabilitation, three started rehabilitation sessions in less than three days, thirteen started within three days, and one patient received rehabilitation sessions after the third day. Our rehabilitation protocol included several stages such as cryotherapy, reclining position, circulatory and toning massage of the quadriceps, static quadriceps exercises, patellar mobilization, and knee extension and flexion exercises. The use of the arthromotor was a reassuring method for patients, allowing the regulation of flexion and extension movements (figure 2).

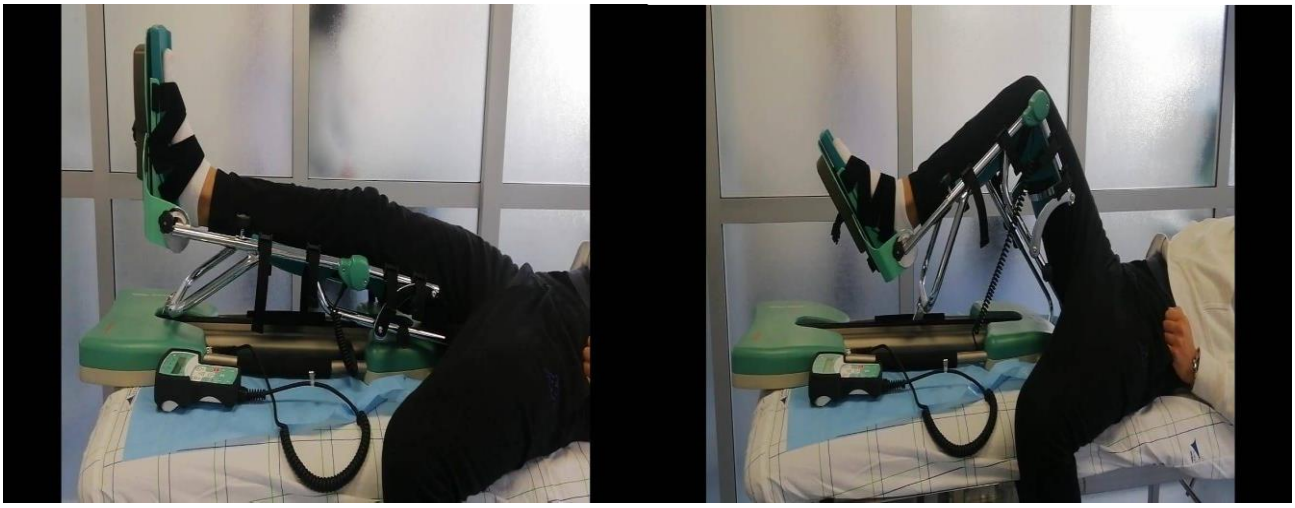

Figure 2: Photos taken in the new physical therapy center: Picture 1: a total extension; picture 2: a 90° flexion

The average time to bear weight on the operated leg was five days, with a range of two to ten days. The total duration of hospital stay ranged from eight to thirty-two days, with an average of seventeen days, while the post- operative stay duration ranged from six to sixteen days, with an average of eight days. Patients who required a prolonged stay were either awaiting blood transfusion, which could take time, or had complications related to their medical history, such as cardiac problems or renal insufficiency requiring dialysis. However, this did not have a significant impact on the functional outcomes of the operated knee, with rapid recovery of flexion to 90 degrees and the ability to walk with the assistance of a crutch or walker on average after six days.

DISCUSSION

The management of pain in total knee replacements (TKR) is a crucial step towards achieving a positive outcome, enabling early mobilization from the very first day. Furthermore, it has been reported that peripheral nerve block techniques provide effective and safe control of acute postoperative pain, ensuring the implementation and completion of a precise and intensive joint rehabilitation program.

The femoral block is an anesthesia procedure that aims to block the femoral nerve, the lateral femoral cutaneous nerve, and the obturator nerve by using the diffusion of a local anesthetic. It is sometimes referred to as a "three-in-one" femoral nerve block, although successful blocking of the obturator nerve is rare with its use. Traditionally, this block was performed using nerve stimulation, but the use of ultrasound is increasingly common to improve the success rate and reduce accidental arterial or intra-neural complications. The femoral block is a mixed block, affecting both motor and sensory functions, resulting in numbness in the anterior, lateral, and medial parts of the thigh and causing profound weakness of the quadriceps muscle.

To perform this block, the patient is positioned in a supine position, and ultrasound is used to locate the nerve at the confluence of the iliac muscle and psoas muscle. A needle is inserted laterally and advanced under ultrasound guidance. Ultrasound is also used to visualize the injection of the anesthetic around the femoral nerve. In some cases, a catheter may be left in place for continuous pain relief during the postoperative period [2].

However, the femoral block predictably causes weakness of the quadriceps muscle, increasing the risk of falls during the postoperative period. To prevent these falls, patients are often instructed to use a knee immobilization device that allows them to walk until they are able to lift the affected leg. Attempts have been made to adjust the concentration of the anesthetic to reduce quadriceps weakness, but the degree of weakness remains relatively constant regardless of the concentration or dosage schedule of the administered anesthetic [3, 4].

According to a recent meta-analysis by Ilfeld *et al.*, [5], the postoperative risk of falls after a femoral nerve block or lumbar plexus block is estimated to be 7%. A study conducted by Sharma *et al.*, [6] in their own institution over a period of 2 years found a fall rate of 1.6% in patients who received a femoral block for total knee arthroplasty (TKA), resulting in a subsequent

surgical intervention rate of 0.4%. The benefits of the femoral nerve block in TKA have been demonstrated in a recent Cochrane review comprising 47 randomized controlled trials involving 2,710 patients. The authors concluded that there was no substantial difference in pain relief between epidural anesthesia and femoral nerve block during the first 72 postoperative hours. However, the femoral nerve block was noted to result in fewer episodes of nausea and vomiting and greater patient satisfaction [7].

Multimodal analgesia is an approach that combines various medications and routes of administration to control postoperative pain. The goal is to provide better pain relief while reducing the adverse effects of opioids. This may involve the use of peripheral nerve blocks, peri-articular injections, and oral analgesics from different tiers. Multimodal analgesia aims to simultaneously modulate multiple pain pathways while minimizing the side effects associated with excessive opioid consumption.

The evaluation of the effect of multimodal anesthesia on postoperative length of stay can be complex due to various factors such as patient biases, medical history and comorbidities, postoperative complications, and social factors. A retrospective study conducted by Peters *et al.*, [19] examined the application of a multimodal anesthesia protocol in 200 patients undergoing arthroplasty, including a subgroup of 100 patients undergoing total knee replacement. This study highlighted the challenges in evaluation. In the subgroup of patients who underwent total knee replacement, the average length of stay was 3.1 days in the traditional group compared to 3 days in the multimodal group ($p = 0.7$). However, among the 50 patients who underwent total knee replacement and received multimodal anesthesia, 2 experienced postoperative complications, leading to anomalies in the statistical analysis of the effect of multimodal anesthesia on length of stay. Excluding these patients from the analysis reduced the average length of stay in the multimodal group to 2.5 days ($p = 0.002$). A more recent prospective randomized study conducted by Lamplot *et al.*, [20] randomized 36 patients undergoing total knee replacement to receive peri-articular injection and multimodal oral analgesics or patient- controlled analgesia (PCA). The authors reported a difference in length of stay between the multimodal group and the PCA group (1.9 days and 2.3 days respectively). Indeed, the length of stay for patients who received multimodal analgesia decreased by 56% compared to those who received PCA.

In our series, epidemiological data reveals that the average age of patients was 64 years, with an age range of 24 to 90 years. Compared to other studies, we observed differences in the mean ages. For example, Neryret's series [8] had an average age of 76.6 years, while Briard's series [9] was 68 years. A comparative graph highlights these variations [10, 11].

Regarding gender, our series included 27 women and 8 men, representing a ratio of 77.7% women and 33.3% men. Other studies also show a predominance of females due to the association between obesity and wearing high heels in women, which promotes knee wear. It is widely recognized that the female sex is a risk factor in the development of knee osteoarthritis [8-11].

Among the 35 patients who underwent total knee arthroplasty (TKA), the surgical indications were distributed as follows: 60% of cases had knee osteoarthritis with genu varum, 26% had knee osteoarthritis with genu valgum, two cases were related to rheumatic disease, two cases were related to tumor pathology, and one case was associated with inflammatory pathology.

The Ahlback classification was used to evaluate knee osteoarthritis in patients. Out of the 35 cases studied, 30 had knee osteoarthritis, with 17 classified as stage III, 10 as stage IV, and 3 as stage II, based on joint space narrowing and subchondral changes. This classification is also used in other series, where the percentages of patients reaching stages III, IV, and V are high, exceeding 90% [12-15].

All our patients benefited from combined spinal anesthesia and femoral block, which has several advantages over general anesthesia. According to the literature, patients under spinal anesthesia have reduced pulmonary and cardiac complications, pneumonia, infections, acute kidney injuries, postoperative mechanical ventilation, or blood transfusion requirements, as well as reduced 30-day mortality compared to patients under general anesthesia [16].

The average length of hospital stay after TKA in our series is 8 days. This duration is similar to what has been observed in other specialized orthopedic centers. For example, in the arthritis clinic in Paris [8, 9], the average duration ranges from 5 to 8 days. In the series by Petchara [17], it was 5 days, and in the series by Karen Anderson [18], it was also 5 days. The relatively short duration in these two series is likely due to the implementation of an early and intensive rehabilitation program, with very early mobilization accepted by the patients due to effective pain management. American studies on patients undergoing TKA and benefiting from multimodal analgesia have shown impressive results with lengths of stay of 3 and 2 days. This can be explained by the use of multimodal analgesia and self-administered pain management. These results further emphasize the importance of analgesia in achieving a rapid recovery and patient satisfaction.

CONCLUSION

Postoperative pain control after TKA and the adverse effects of associated medications remain important factors for patient satisfaction. Additionally, postoperative complications can hinder patient discharge. Increasing evidence suggests that the choice of anesthesia during TKA can influence the risk of postoperative complications and mortality rates. A combination of multimodal analgesia, preventive analgesia, and neuroaxial analgesia, complemented by a nerve block, periarticular injection, or both, effectively controls postoperative pain while minimizing opioid-related adverse effects and improving patient satisfaction.

The ability of multimodal analgesic protocols to reduce hospital stay duration, although promising, is still controversial, and further investigation with large, high-quality randomized controlled trials is warranted. Surgeons should collaborate with anesthesiologists and pain management specialists to develop a tailored multimodal protocol that aligns with the expertise of all physicians involved in the care of TKA patients.

Ethics Approval and Consent to Participate

Ethical approval was not sought. Written consent was obtained from the patients.

Availability of Data and Materials

The datadets used and analysed during the study are available from the corresponding author.

DECLARATION OF CONFLICTING INTEREST

The authors declare that there is no conflict of interest.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors Contributions

All authors have read and approved the final manuscript.

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