Epidural Anesthesia Versus Lumbar Plexus-Sciatic Nerve Blocks for Knee Surgery: A Prospective Comparative Study

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ABSTRACT

Introduction: It is unknown what the relative analgesic effectiveness and side-effect profile of peripheral nerve blockade (PNB) methods are when compared to lumbar epidural analgesia after major knee surgery when compared to lumbar epidural analgesia. The purpose of this study was to evaluate the effectiveness of lumbar plexus - sciatic nerve blocks vs epidural anaesthesia in patients having knee surgery.

Material and methods: 100 Patients having elective knee surgery were divided into two groups and assigned at random to one of the groups. In Group Epidural Anesthesia (EA) (n=50), the epidural anaesthesia was administered, while in Group Lumbar Plexus-Sciatic Nerve Blocks (LPSB) (n=50), the lumbar plexus and sciatic nerve blocks were administered, respectively. For each block, the onset of nerve blockade was assessed every 2.5 minutes, and the assessments continued for an additional 40 minutes after the nerve blocks were finished. For each patient, the following information was gathered: weight, age, gender, surgery site, onset of sensory and motor block, degree of motor block, sign of sensory block in the contralateral lower limb for the LPSB group, success in providing adequate anaesthesia, hemodynamic changes, time to first analgesic requirement (FAT), and satisfaction with the procedure from both the patient and the surgeon were recorded.

Results: There were no statistically significant differences between the two groups in terms of demographic data (age, gender, weight, and height), or in terms of the length of time spent undergoing surgery (Table 1). Sensory block occurred considerably later in the LPSB group (median: 14 min) compared to the EA group (median: 11 min) (p 0.05), and the duration of sensory block was much longer. Additionally, the start of motor block was substantially delayed in the LPSB group (median: 19 min) than it was in the EA group (median: 15 min) (p 0.05) in the same manner. There was a statistically significant difference between the LPSB and EA groups in terms of time to first analgesic need (p0.05). While the period of motor block regression (modified Bromage score 3 to 1) happened sooner in group EA (median: 110 min), it did so more slowly in group LPSB (median: 145 min).

Conclusion: Conducting LPSB with 0.375 percent ropivacaine offers effective anaesthetic with fewer problems as compared to epidural anaesthesia. There was a substantial difference in the duration of analgesia in the LPSB group compared to the EA group; however, the start of sensory and motor block occurred considerably later in the LPSB group than in the EA group.

Keywords: Epidural Anaesthesia, Lumbar Plexus-Sciatic Nerve Block, Knee Surgery, Ropivacaine

INTRODUCTION

Major knee surgery, such as total knee joint replacement (TKJR) and anterior cruciate ligament reconstruction (ACLR), is linked with moderate to severe postoperative discomfort, which may lead to immobility-related problems, a prolonged hospital stay, and a poor functional result.[1]

Neuroaxial methods in orthopaedic surgery have been more popular in recent decades, owing to findings that they result in less blood loss and less thromboembolic consequences than traditional analgesic approaches.[2,3]

PNB of one or more main nerves feeding the lower leg is an alternate regional anaesthesia method that may be used in conjunction with local anaesthesia. When compared to epidural analgesia, PNB has the potential to offer effective unilateral analgesia with a lower incidence of opioid-related and autonomic side-effects, less motor block, and a lower incidence of severe neurological sequelae. Continuous PNB methods, in contrast to epidural analgesia, seem to offer pain reduction that is superior to that provided by systemic opioid analgesia while also having a reduced incidence of side-effects. As a result of advancements in nerve localization technology, such as ultrasound imaging and continuous catheter technology, there has been a rise in interest in peripheral nerve blockade for lower limb surgery.[2-4]

Patients having knee surgery were included in this research, and the results were compared between the lumbar plexus - sciatic nerve blocks and epidural anaesthesia.

MATERIAL AND METHODS

From January 2019 to December 2020 (a period of two years), the research was conducted out at the Chalmeda Anand Rao Institute of Medical Sciences in Karimnagar, Telangana state, with permission from the institutional ethics committee and informed consent from all of those who took part.

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Criteria for inclusion are as follows:

- Physical Status I–III patients, according to the American Society of Anesthesiologists (ASA).
- Patients in the age group of 18 to 65 years
- Patients who choose to get knee surgery do so because they want to.

Criteria for exclusion include:

- In patients who are contraindicated to receiving epidural anaesthesia or peripheral blocks, or who are allergic to the anaesthetics utilised;
- A history of serious cardiovascular, renal or haematological disorders; a history of neurological or mental illnesses; or a combination of these factors.
- Chronic pain syndromes, substance addiction, and mental retardation are all possibilities.

Methodology

100 patients having elective knee surgery were divided into two groups using a random number generator. In Group Epidural Anesthesia (EA) (n=50), the epidural anaesthesia was administered, while in Group Lumbar Plexus-Sciatic Nerve Blocks (LPSB) (n=50), the lumbar plexus and sciatic nerve blocks were administered, respectively.

A posterior paravertebral route was used to block the lumbar plexus at the L3 vertebral level, and the procedure was successful.

Under strict aseptic circumstances, 3 mL of 2 percent lidocaine was injected subcutaneously into this site. The procedure was performed under aseptic conditions. It was necessary to insert and connect a Stimuplex A® 150-mm needle (Braun Medical, Melsungen, Germany) to a nerve stimulator (Stimuplex S®, B.Braun Medical, Germany) with a starting output of 1.5 mA and 2 Hz to the nerve stimulator. To touch the transverse process of L3, the needle was inserted four millimetres lateral to the spinous process of L3 and guided slightly cephalic (not medially or laterally) to contact the transverse process. Following the process's contact, the needle was repositioned caudally to the transverse process and moved 1.5 cm further into the procedure. It was determined that the quadriceps muscle was in close proximity to the plexus by contracting it in response to electrical stimulation. The needle was then advanced until muscle twitches were elicited with currents between 0.33 and 0.5 mA at 2 Hz. Following a negative aspiration, 30 mL of 0.375 percent ropivacaine was administered into the wound. Following a negative aspiration, 20 mL of 0.375 percent ropivacaine was administered into the wound. A semirecumbent posture was established with a head-up angle of 30–45° with regard to the operating table, and patients were then extubated.

For each block, the onset of nerve blockade was assessed every 2.5 minutes, and the assessments continued for an additional 40 minutes after the nerve blocks were finished. Patients were eliminated from the research if they did not have sensory and motor block by the end of the procedure, and their operation was performed under general anaesthetic instead. Additionally, indications of sensory block were looked for in the opposite lower limb, as well as the upper extremity. Sensory evaluation with a blunt 21-gauge needle revealed loss of pinprick sensation in the sciatic (sole of foot), femoral (anterior thigh), lateral cutaneous (lateral thigh), and obturator (medial thigh) nerve territories, as well as loss of pinprick sensation in the obturator (medial thigh) nerve territories. When evaluating knee extension (femoral nerve), thigh adduction (obturator nerve), dorsi-flexion, and plantar flexion of the foot were performed, it was determined that there was motor block (common peroneal and tibial nerves). The motor block was also evaluated using a modified Bromage Score Scale (0–3), which consisted of the following items: 1, unable to lift either extended leg (able to move joints of knee and ankle); 2, unable to raise both extended legs and flex knee (unable to move joint of ankle); 3, unable to move knee and foot. 0, no motor impairment (able to move hip, knee, and ankle joints). The time interval between the completion of the lumbar plexus and sciatic nerve blocks and the occurrence of sensory and motor block at the related nerve territories was defined as the time interval between the completion of the lumbar plexus and sciatic nerve blocks and the occurrence of sensory and motor block at the related nerve territories.

Using a conventional technique, epidural anaesthesia was administered at the L3-L4 interspace, with the operative knee in the dependent position, throughout the procedure. Dermatological infiltration was done under strict aseptic circumstances using 2 mL of 2 percent lidocaine solution. Through the L3-4 interspace, a 20-G Tuohy needle with a 20-G catheter (Perifix, B. Braun, Germany) was placed, and the epidural space was identified using the loss of resistance method. The catheter was subsequently advanced about 3 centimetres cephalic to its final position. The administration of a test dosage of 3 ml of 2 percent lidocaine with epinephrine (freshly added) at a ratio of 1:200,000 was performed to determine if intrathecal or IV injection had occurred. A negative reaction was followed by the administration of 15 mL of 0.75 percent epidural ropivacaine (112.5 mg), followed by the patient being shifted to the supine position. The epidural ropivacaine was administered in 3 ml/10s, which was a fast rate. As an additional measure of sensory level, the loss of pinprick technique was used at 2.5-minute intervals for 40 minutes after the conclusion of the epidural block to evaluate sensory level. A blunt 21-gauge needle was used to evaluate pinprick sensation along the left anterior axillary line in a cephalic-to-caudal manner, and the results were recorded. Sensory block was defined as the period of time between epidural injection and the development of sensory block at the T10 dermatome, measured in minutes. Following the completion of the epidural block, the motor block was evaluated at 2.5-minute intervals for 40 minutes using a modified Bromage Score Scale. The time between the administration of epidural anaesthesia and the incidence of motor block at each scale was used to determine the onset of motor block. The length of time that sensory blocks lasted (the time gap between the operation and the necessity for the first analgesic prescription) was recorded.

For each patient, the following information was gathered: weight, age, gender, surgery site, onset of sensory and motor block, degree of motor block, sign of sensory block in the contralateral lower limb for the LPSB group, success in providing adequate anaesthesia, hemodynamic changes, time to first analgesic requirement (FAT), and satisfaction with the procedure from both the patient and the surgeon were recorded.

STATISTICAL ANALYSIS

The IBM SPSS Statistics programme, version 20.0, was used to analyze the information. The independent t-test was used to compare mean across groups, while the Chi-square test was utilized to compare categorical variables between groups. A p value of less than 0.05 was deemed statistically significant.

RESULTS

There were no statistically significant differences between the two groups in terms of demographic data (age, gender, weight, and height), or in terms of the length of time spent undergoing surgery (Table 1).

Within the LPSB group, ten (20 percent) people experienced contralateral spread of the disease. Sensory block occurred considerably later in the LPSB group (median: 14 min) compared to the EA group (median: 11 min) (p 0.05), and the duration of sensory block was much longer. Additionally, the start of motor block was substantially delayed in the LPSB group (median: 19 min) than it was in the EA group (median: 15 min) (p 0.05) in the same manner. Among the EA participants, the time from block placement to the first request for analgesia (and the duration of analgesia) ranged between 155 and 570 minutes (median: 242 minutes), whereas the period ranged between 254 and 730 minutes (median: 369 minutes) for the LPSB participants. A consequence of this difference was that the LPSB group required analgesics considerably later in the course of a day than the EA group (p0.05). While the period of motor block regression (modified Bromage score 3 to 1) happened sooner in group EA (median: 110 min), it did so more slowly in group LPSB (median: 145 min). Patients in the EA group had an intraoperative modified Bromage score of less than 2, whereas only 10 patients in the LPSB group had this score of less than 2. 32 patients in the EA group and 35 patients in the LPSB group had complete motor block (modified Bromage score 2), while just one patient in the LPSB group did. Neither group showed any significant differences in changes in arterial blood pressure or heart rate (p>0.05) (Table 2).

There were no serious events recorded in any of the patients. A significant difference in the incidence of problems between the two groups was not seen (p>0.05). There were two patients in the EA group who had a vasovagal response. Despite this, hypotension (10 patients in the EA group and 6 patients in the LPSB group) and bradycardia (5 patients in the EA group and 3 patients in the LPSB group) were seen in each group, with hypotension occurring more often in the EA group. One patient in the EA group vomited, and three patients in the EA group and one patient in the LPSB group were nauseated, according to the results. No clinical symptoms or indications of local anaesthetic toxicity were seen in any of the patients (Table 3).

DISCUSSION

According to a recent comprehensive analysis comparing lumbar epidural blocking with systemic opioid analgesia, the epidural group had superior dynamic pain ratings, but there was no difference in the overall frequency of side effects between the two groups. Hypotension, urine retention, and pruritis were more common in epidural patients, while systemic opioids produced greater drowsiness in patients who received systemic opioids (but no difference was found with respect to respiratory depression or postoperative nausea and vomiting).[5] Notably, none of the trials showed a better long-term result with PNB, which is likely because the choice of analgesic method is just one component of excellent postoperative treatment, which must also include professional physiotherapy and nursing care. The standard of care for routine hospital release and rehabilitation after major knee surgery varies widely across nations and institutions.[4-5] Chayen et al showed that a lumbar plexus block (L4-5 approach) for orthopaedic surgery of the lower limb was successful in delivering sufficient anaesthesia in 90 percent of the patients who underwent the procedure. 6 Dekrey's L3 approach (25 patients) and the L4-5 approach (23 patients) were used by Parkinson and colleagues to perform lumbar plexus block, and they reported that anaesthetic conditions for surgery were achieved in 24 patients (96 percent) using the L3 approach and 21 patients (91 percent) using the L4-5 approach. Our findings were comparable to those reported in this article. 7 According to Biboulet et al., who used Dekrey's L3 approach method, they were able to identify contralateral spread in 26.6 percent of patients who underwent sensory assessment. The findings of our research were consistent with those of the current literature.[8] It was observed in our research that the start of sensory and motor block for ropivacaine at LPSB was similar with the observations of Greengrass et al. and Piangatelli et al. It was observed in our research that the onset of sensory and motor block under epidural ropivacaine anaesthesia was comparable to the other investigations.[9-12] While not as severe as in our research, the study of Casati et al. found that the start of sensory block for EA occurred much later than in our study. According to the authors, this discrepancy may be related to the lower concentration and amount of ropivacaine utilised in this research (0.5 percent and 10 mL, respectively).[13] According to Zaric et al., the frequency of dizziness, pruritus, nausea/vomiting, and urine retention was higher in their epidural block group (0.2 percent ropivacaine plus sufentanil) than in patients who had a combined femoral and sciatic block (0.2 percent ropivacaine plus sufentanil) (0.5 percent ropivacaine). [14] It was found that the incidence of problems (with the exception of hypotension) was comparable to the frequency of complications associated with a combination femoral with sciatic block and epidural blockade, as

described by Davies et al. The findings of Davies et al.[15] are similar with our findings.

CONCLUSION

In contrast to epidural anaesthesia, we discovered that conducting LPSB with 0.375 percent ropivacaine offers effective anaesthesia with fewer problems than epidural anaesthesia. There was a substantial difference in the duration of analgesia in the LPSB group compared to the EA group; however, the start of sensory and motor block occurred considerably later in the LPSB group than in the EA group. According to the findings of this research, a combined lumbar plexus and sciatic nerve block provides a safe and effective alternative to epidural anaesthesia in knee surgery patients.

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