ABSTRACT
Background: Psoas sciatic block (Pso/Sci) is a modern anesthetic technique for lower extremities surgery. The use of this technique can avoid the adverse effects of the general anesthesia or the central neuroaxial blockade, especially in patients with multiple comorbidities.
Purpose: The purpose of this study is to compare the efficacy of combined Pso/sci as a sole anesthetic technique with conventional combined spinal epidural (CSE) anesthesia for patients undergoing total knee arthroplasty.
Methods: Eighty patients scheduled for total knee replacement were included in the study. Patients were divided into two equal groups: Pso/sci group received ultrasound guided with the use of nerve locator continuous Pso/sci and the second group (CSE) received CSE anesthesia. Onset of sensory and motor block time, hemodynamic changes, contralateral spread, first-time need for analgesia, incidence of complications, and patient and surgeon satisfactions were recorded.
Results: The block time was significantly higher in the (Pso/Sci) group. Two patients in (Pso/Sci) had contralateral spread. Sensory and motor block onsets were delayed significantly in (Pso/Sci). Hemodynamic changes occurred in the CSE; however, it was insignificant compared to Pso/sci group. The first analgesic request was significantly later in (Pso/Sci) compared to the CSE group. There were no differences found in both groups as regard complications, early mobilization, and patients and surgeons satisfaction.
Conclusions: Psoas sciatic block is an alternative safe and successful anesthetic technique, which can provide an adequate anesthesia for total knee surgery with less hemodynamic changes.
Key words: Combined spinal epidural; knee arthroplasty; psoas sciatic blockade

Introduction

Modern anesthetic technique such as ultrasound-guided nerve blockade is a common practice. Peripheral nerve blockade carries potential advantages such as hemodynamic stability, early ambulation, and better postoperative pain control.[1,2] Apart from providing a satisfactory postoperative analgesia, psoas compartment block with sciatic nerve block is a modern anesthetic technique for lower extremities surgery. This technique can avoid the adverse effects of general anesthesia or central neuroaxial blockade, especially in patients with multiple comorbidities with advantage of better postoperative pain control.[3]

Psoas compartment block provides blockade of the entire lumbar plexus including femoral, obturator, and lateral femoral cutaneous nerves. Sciatic nerve block produces blockade of posterior aspect of the knee. Using both blockades, the total knee arthroplasty can be done effectively.[1]
Some studies evaluated general anesthesia combined with peripheral nerve blockade; however, there are few studies compared the use of peripheral nerve blockade as a sole anesthetic technique with other anesthetic techniques.\[1,2\]

We aimed in the present study to investigate the advantages of continuous combined psoas sciatic block (Pso/Sci) as a sole anesthetic technique over the conventional combined spinal epidural (CSE) anesthesia for patients undergoing total knee arthroplasty.

Methods

After the approval of the Ethics Committee, Department of Anesthesia, Menoufia University, and written informed consent, 80 patients undergoing unilateral total knee arthroplasty were randomly allocated into two groups. The first group (40 patients) received continuous psoas compartment block combined with continuous sciatic block (Pso/Sci group) and the second group (40 patients) received CSE anesthesia (CSE group). All patients were between 50 and 65 years old with an American Society of Anesthesiologists (ASA) status of I to III. Patients’ exclusion criteria included contraindication of regional anesthesia, bleeding disorders, localized infection, neurological deficit, substance dependence, and uncooperative patients. On arrival to the operative theater, patients were attached to the standard monitoring and an intravenous cannula was inserted. All patients received 1–2 mg midazolam for sedation before the blocks.

Sciatic nerve blockade

The block was done under complete aseptic technique. The patient was positioned in the lateral recumbent position with the operative side uppermost. L4–L5 space was identified and marked by a line passing between the iliac crest and the vertebral column. The puncture point for the block was marked 5 cm lateral to L4–L5 space within the drawn line. Using curvilinear low-frequency U/S probe 2–5 MHz (Sonosite, M‑Turbo, Sonosite Inc., USA), the area was scanned longitudinally starting from the sacrum and moving cranially to identify the 4th transverse process then turned transversally in a rocking manner laterally to the end of the transverse process. The skin at the site of entry was infiltrated with 1 ml lidocaine 2% using 27G needle. A 100 mm 18G insulating pajunk needle (PAJUNK, PlexoLong, Germany) connecting to a nerve stimulator (Plexygon, Vygon Italia, Padua, Italy) with 0.8 mA initial current was advanced from medial to lateral proximal to the transverse process of L4 then advanced caudally to L4 until eliciting the quadriceps femoris contraction. When quadriceps femoris contractions persisted with a reduced current of 0.2 mA, a mixture of 20 ml lidocaine 1% and 20 ml bupivacaine 0.25% were injected after repeated negative aspiration. A multiperforated reinforced catheter was inserted through the pajunk needle and was advanced 5 cm distal to the needle tip. The needle was removed, and the catheter was fixed to the skin.

Combined spinal epidural block

The patient was in the sitting position, L3–L4 space was marked then the area was sterilized and draped. LA was applied in the track by 27G needle with 5 ml Lidocaine 1%. Portex CSE kit needle through needle was used for the technique (PORTEX, Smiths Medical ASD, Inc., USA). The epidural space was detected by loss of resistance technique using normal saline. When the epidural space was detected, a 27G 120 mm pencil point spinal needle was passed through the epidural needle to puncture the dura. The correct position was confirmed when cerebrospinal fluid was dripping from the spinal needle. A volume of 2.5 ml (12.5 mg) of heavy marcaine of 0.5% (Bupivacaine hydrochloride 0.5%, 5 mg/ml, AstraZeneca) was injected for spinal anesthesia. The spinal needle was removed, and the epidural catheter was advanced 4 cm distal to the needle tip and fixed to the skin.
After block was done all the patients returned back to the supine position, the sensory block was assessed by cold perception using ice packs. The motor block was assessed by Bromage scale (3 = no flexion of hip, knee and foot; 2 = no flexion of hip and knee with foot flexion; 1 = no flexion of hip with flexion of knee and foot; 0 = full flexion of hip, knee and foot). Sensory and motor blocks were assessed every 10 min for 3 times. Bilateral assessment was done in Pso/sci group to detect contralateral epidural spread of local anesthetics. Inadequate sensory and motor blocks after 30 min of injecting the local anesthetics, the block was considered to be a failed block. Cases with failed block received general anesthesia and were excluded from the study.

All patients in both groups received intraoperative sedation using 1–2 mg/kg/hr propofol infusion. If a patient experienced pain (visual analog scale [VAS] ≥3), a bolus of 5 ml lidocaine 2% was injected in the epidural catheter in CSE group or in the catheter that was inserted in (Pso/Sci) group. Continuous LA infusion was followed using 0.125% bupivacaine at a rate of 7–10 ml/h according to the patient response and hemodynamics. Heart rate and blood pressure were recorded every 5 min intraoperatively; bradycardia and hypotension were considered if the heart rate and the mean blood pressure were 30% below the starting baseline. Bradycardia was treated by IV 0.5 mg atropine, and hypotension was managed by 10–15 mg IV ephedrine. Intra- and post-operative side effects such as bradycardia, hypotension, nausea and vomiting were recorded. Age, gender, weight, ASA class, and duration of surgery (time from skin incision until skin closure) were recorded.

The block quality was used as our primary outcome. The block quality was assessed by the block time, the onset of sensory and motor blocks, and the duration of the sensory block. Block time was defined as the time taken to finish the block, the onset of sensory and motor blocks was defined as the time from block time to the occurrence of the block, and the duration of the sensory block was defined as the time from the onset of the block to the first call of analgesia.

Secondary outcomes were the hemodynamic changes, incidence of complications, patient and surgeon satisfactions, and time of mobilization. Time of mobilization was defined as the time after admission to the surgical ward when the patient can get out of bed for more than 15 min with or without support.

**Statistical analysis**

Sample size was calculated using GraphPad instat program version 3 (GraphPad Software Inc., California, USA). Based on the previous studies, Pso/sci implementation showed significant difference over spinal anesthesia and paravertebral block regarding intraoperative and postoperative parameters. At the level of significance 0.05 and power of 95%, the calculated sample size was 25 patients. The number of patients randomized in the present study in each group was 40 patients in each group to ensure reliable results.

Data were analyzed using SSPS software 12.0 (SSPS Inc., Chicago, IL, USA) and represented as mean ± standard deviation and P < 0.05 was considered to be statistically significant.

**Results**

Eighty patients were included in the study and randomly allocated into two equal groups of 40 patients each, namely, CSE group and Pso/Sci group. The total number of patients recruited for the study was 80 patients. The number of patients who required general anesthesia and showed peri-operative failed block were three patients in CSE group versus 5 patients in PSO/SCI group (P > 0.05). A total of 72 patients with successful block were included in the study.

The study groups are shown in the flow chart [Figure 1]. The demographic data were comparable between the two groups with no significant differences [Table 1].

The block time was significantly shorter in CSE group than in the Pso/Sci group with P < 0.05. The onset of the sensory block in CSE group was significant longer with P value 0.037 compared to the Pso/Sci. The motor block onset in CSE group was significantly shorter than in Pso/Sci group with P = 0.012. The first postoperative call for analgesia (duration of sensory block) was significantly higher in Pso/Sci compared to the CSE (P = 0.027). Table 2 shows the characteristics of both blocks.

All patients in CSE group showed no hip, knee, or foot flexion (100%). In Pso/Sci group, 31 patients (88.5%) showed no flexion of hip, knee, and foot; however, 4 patients (11.5%) showed no hip and knee flexion with foot sparing. No statistical significance was found between the two groups regarding the degree of motor blockade (Bromage scale) P > 0.05. Two patients in Pso/Sci (5.7%) had extended block to the contralateral limb.

There were no statistically significant differences as regard hemodynamics in both groups during all times of measurement [Figures 2 and 3]. Eight patients in CSE group (21.6%) needed 10–15 mg iv ephedrine to support the blood pressure intraoperatively compared to two patients in Pso/Sci (5.7%) (P > 0.05). No patients experienced bradycardia, nausea, or vomiting in both groups.
All patients in CSE group (100%) were satisfied by the anesthetic technique compared to 32 patients in Pso/Sci group (91.4%) ($P > 0.05$). The three patients who were not satisfied in Pso/Sci group experienced intraoperative discomfort, which was alleviated by 2 mg Midazolam. Surgeon satisfaction was higher in CSE group (100%) than in Pso/Sci group (90%), the surgeon complained of contralateral limb movement in four patients. There was no statistical significant between both groups regarding patients' and surgeons' satisfaction. Time to mobilization was statistically insignificant shorter in Pso/Sci compared to CSE ($P > 0.05$).

**Discussion**

Some studies compared the postoperative analgesic effects of different peripheral nerve blocks in patients undergoing orthopedic procedures. However, few studies focused on the anesthetic effectiveness of nerve block as a sole anesthetic for the surgical procedure. In the present study, we focused on the effectiveness of psoas and sciatic nerve blocks, as an anesthetic technique in patients undergoing total knee replacement.

Eighty patients undergoing elective knee arthroplasty were recruited in our study and were divided into two groups, first group received Pso/sci and the second group received CSE anesthesia. Five patients from (Pso/Sci) and three patients
from (CSE) group were excluded from the study due to failure of the block. Our hypothesis was that Pso/sci could be an effective anesthesia technique for total knee arthroplasty. This hypothesis was proved in our study when the block was successful.

The high success rate in Pso/sci as an anesthetic technique might be due to the use of both ultrasound and nerve locator and injecting a high volume (40 ml) of local anesthetic. Similar to our result, Amiri et al. found that lumbar plexus block could be used as an anesthetic method for patients undergoing hip arthroplasty with little side effects.\(^4\)

In the present study, the onsets of sensory and motor block in (Pso/Sci) group were comparable to Horasanli et al. study.\(^5\) The authors recorded 13 min for sensory onset and 18 min for the motor block. In contrast, Amiri et al. demonstrated a sensory block onset time of 130 ± 36 s which is significantly less than other studies.\(^4\) The authors used a mixture of 10 ml lidocaine 2% and 10 ml bupivacaine 0.5% in 10 ml normal saline in lumbar plexus block for hip surgeries, but they did not explain the reason for this rapid onset.

In another study, Aksoy et al. found that Pso/sci block was an effective anesthetic method with little intraoperative hemodynamic instability in patients undergoing hip arthroplasty.\(^6\) The Pso/sci block in our study was insufficient for the surgical procedure in 12.5% of the recruited patients with similar percentage in Aksoy et al. study (7.8%). Similar to our study, Farney et al. succeeded to use a local anesthetic method, that is, lumbar and sciatic nerve blocks as the only anesthetic method for lower limb surgery.\(^5\) The authors showed high success rate similar to our study with no side effects.

Horasanli et al. compared the use of combined lumbar plexus and sciatic nerve blocks with epidural anesthesia in knee surgery.\(^5\) The authors showed similar results to the present study as regard the advantage of the local anesthetic technique over the epidural anesthesia in keeping stable intraoperative hemodynamics with insignificant differences as regard patients’ and surgeons’ satisfaction.

Horasanli et al. showed contralateral spread of the local anesthetics in 20% of their patients who received lumbar plexus block; however, in our study, we showed that the contralateral spread occurred in only 5.7% in the PSO/SCI group.\(^5\) The local anesthetic spread through the epidural sheath could occur in the posterior psoas compartment blockade, which explained the contra‑lateral anesthesia effect. The incidence of contralateral spread reported by Biboulet et al., when they used the Dekrey’s L3 approach for psoas block was 16%.\(^8\) Parkinson et al. found contralateral spread in 26.6% although they used the same approach as Biboulet et al.\(^8,9\) The incidence of contralateral spread is affected by different approaches and techniques. Our approach for psoas block was better in reducing contralateral spared. The approach was 5 cm lateral to L4–L 5 space and quite away from mid-line and the epidural sheath.

Biboulet et al. studied the postoperative analgesic effects of patient-controlled analgesia, femoral nerve block, and psoas block.\(^9\) The authors found that psoas block showed better pain control in the early postoperative period with little analgesic requirement. However, in late postoperative, there was no significant difference in all groups as regard VAS and morphine consumption. In the present study, we inserted catheters to bolus local anesthetics for postoperative pain control. The injection of local anesthesia through the catheters in the psoas and sciatic areas can explain the lower analgesic requirement and VAS during early and late postoperative periods.

We found that the first call for analgesia, which was considered to be the sensory block duration, was significantly longer in pso/sci than in CSE. This “longer/elongated” duration might be
due to the big volume of local anesthetics injected for Pso/sci. Horasanli et al. recorded 360 min postoperative analgesic time for lumber plexus sciatic block, which is relatively shorter than our results.[5] The shorter analgesia time might be because the authors used a less volume and lower concentration of ropivacaine. The addition of epinephrine can increase the analgesic time. Greengrass et al. compared the use of either ropivacaine or bupivacaine with addition of epinephrine in Pso/sci and showed longer analgesic time.[10]

In our study, Pso/Sci technique provided adequate level of anesthesia with more hemodynamic stability compared to the CSE technique. The hemodynamic changes in the CSE group were insignificant compared to the Pso/Sci group. Aksoy et al. and de Visme et al. did two different studies to compare the ultrasound Pso/sci with spinal anesthesia in hip arthroplasty.[6,11] The authors found that patients in psoas sciatic group had significant hemodynamic stability compared to the spinal anesthesia group. Our result was different because the milder effect of epidural anesthesia on hemodynamics compared to spinal anesthesia on hemodynamics is more stable.

In both groups, we did not report a significant difference as regard the incidence of postoperative complications that were consistent with Horasanli et al. study.[5] However, Türker et al. found that hypotension, nausea and vomiting were significantly frequent in epidural group compared to psoas block group.[12] Zaric et al. reported higher incidence of complications in epidural group compared to femoral sciatic group.[13] Fowler et al. did a meta-analysis and reported similar incidence of complications in patients received epidural anesthesia when compared to patients who received femorosciatic block except for hypotension, which was more common in the epidural group.[14]

Adali et al. showed that combined sciatic and lumber plexus block were effective in lower extremities surgeries.[15] The authors reported no differences in patients and surgeons satisfaction when compared to the conventional spinal anesthesia technique.[15] Jankowski et al. and Ganidagli et al. in two different studies found that knee arthroscopy patients who received psoas compartment block were satisfied by the technique due to less postoperative pain and recovery time compared to other anesthesia techniques.[1,16] Horasanli et al. demonstrated high surgeons’ satisfaction in lumber plexus sciatic block patients compared to epidural group with the same satisfaction in both groups among the patients.[5] Our study showed similar results as regard patients’ satisfaction; however, surgeons were more satisfied, with no significant difference, with patients received CSE technique. The contralateral limb movement was the main reason behind the lower score of the surgeons’ satisfaction.

In the present study, we found that local nerve block has no advantage over neuroaxial block regarding early mobilization. Parker et al. concluded in a cochrane review that peripheral nerve blockade can provide better postoperative analgesia but does not have a direct influence on early mobilization.[17] Valentin et al. and Macfarlane et al. did two different studies to show the effect of neuroaxial block on patients undergoing hip surgery.[18,19] The authors found that central neuroaxial block did not affect the postoperative early mobilization. Our is different from Valentin et al. and Macfarlane et al. regarding the type of block and the surgical procedure. Mobilizing patients in our center is under the control of the surgical protocol that might affect our results.

**Conclusions**

Knee arthroplasty procedure could be done under psoas sciatic blockade. The block has peri-operative advantages over the standard CSE technique. Moreover, it is associated with less hemodynamic changes and prolonged postoperative analgesia.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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