Original Article

Ultrasound-guided popliteal sciatic and adductor canal block for below-knee surgeries in high-risk patients

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ABSTRACT

Background and Aims: Central neuraxial block and general anaesthesia in patients with significant comorbidities are associated with considerable peri-operative morbidity and mortality. This study aims to delineate peripheral nerve block as a suitable alternative technique in high-risk patients posted for below-knee surgery. **Methods:** Twenty patients with the American Society of Anesthesiologist's (ASA) physical status grade III and IV, aged 30–80 years, scheduled for below-knee surgery from May 2018 to February 2019 were enrolled in this prospective study. All patients received ultrasound-guided popliteal sciatic block with 20 ml 0.5% ropivacaine and adductor canal block with 10 ml 0.375% ropivacaine. The peripheral nerve block success rate, sensory and motor block onset time, haemodynamic parameters, duration of post-operative analgesia and patient's satisfaction were recorded. Descriptive statistics of the study were calculated and the data was analysed using an SPSS statistics 21.0 program. **Result:** Surgery was performed successfully with no additional analgesic requirement in all patients. The mean duration for sensory and motor block onset time was 3.35 ± 0.49 (mean ± standard deviation) and 4.65 ± 0.48 (mean ± standard deviation) minutes respectively. Haemodynamic parameters were maintained stable throughout the procedure. The average duration of postoperative analgesia was 7.5 ± 0.8 (mean ± standard deviation) hours. Patient overall satisfaction as assessed, by three-point Lickert's scale, was satisfactory. **Conclusion:** Ultrasound-guided combined popliteal sciatic and adductor canal block is an effective alternative anaesthetic technique for below-knee surgeries with stability of haemodynamic parameters and pain management in high-risk patients.

Key words: Adductor canal, below-knee surgery, popliteal sciatic, ultrasound

INTRODUCTION

In high-risk patients with significant cardiovascular and other systemic disorders, scheduled for below-knee surgeries, administration of central neuraxial block or general anaesthesia is usually associated with adverse haemodynamic effects and high peri-operative mortality.[1,2]

With good knowledge of dermatomes, myotomes and osteotomes of lower limbs and the use of ultrasound for precise perineural deposition of local anaesthetics, there is an increase in the success rate with prolonged duration and decrease in the incidence of complication associated with peripheral nerve blocks.[3,4]

Spinal anaesthesia remains an established technique for lower limb surgeries.[5,6] There are few case reports on femoral, obturator and sciatic nerve blocks in patients with multi-organ dysfunction undergoing lower limb surgeries.[7-9] Our study aimed to delineate

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the sensory and motor block onset time, haemodynamic parameters and duration of post-operative analgesia in high-risk patients posted for below-knee surgery under combined ultrasound-guided popliteal sciatic and adductor canal block as sole anaesthetic technique. Thus, we hypothesised that peripheral nerve blocks are an effective alternative to central neuraxial blockade and general anaesthesia in high-risk patients undergoing below-knee surgeries.

METHODS

After approval from Institution's Ethical committee (KIMS/IEC/A03-2018) and written informed consent, patients with ASA physical status III–IV (diabetes, hypertension, hepatorenal disease, ischemic heart disease), aged 30–80 years scheduled for below knee surgeries from May 2018 to February 2019 were enrolled in this prospective study. Patients allergic to local anaesthetics, on opioids and other analgesics for chronic pain, a refusal for peripheral nerve block and with neurological deficits were excluded from the study. Routine investigations, coagulation profile, renal and hepatic function tests were obtained and 'nil per oral' order was placed six hours prior to the surgery. The study was performed in accordance with the Declaration of Helsinki (2013).

In the operation theatre, standard monitors were attached such as an electrocardiograph, non-invasive blood pressure and pulse oximeter. All sterile aseptic precautions were taken and the ultrasound machine (LOGIQ™ e GE Healthcare, India) was placed on the opposite side of the limb that had to be blocked. For adductor canal block, the patient lay supine with an extended leg in a neutral position or rotated slightly outwards. A high-frequency linear ultrasound probe was placed on the anterior aspect of the patient's thigh at the mid-thigh level. The femur bone was identified and probe moved medially until the boat-shaped sartorius muscle and femoral vessels lying beneath it was visualised. A 21 gauge insulated needle was inserted via in-plane technique, 10 ml of 0.375% ropivacaine was deposited on either side of the femoral artery after negative aspiration [Figure 1]. Then for popliteal sciatic nerve block, the patient was lain laterally on the opposite side of the limb which has to be blocked., The limb to be blocked was flexed partially at hip and knee joint. Using a high-frequency linear probe, a scan of popliteal fossa was conducted to identify separate tibial and common peroneal nerves lying superficially and posteriorly to popliteal

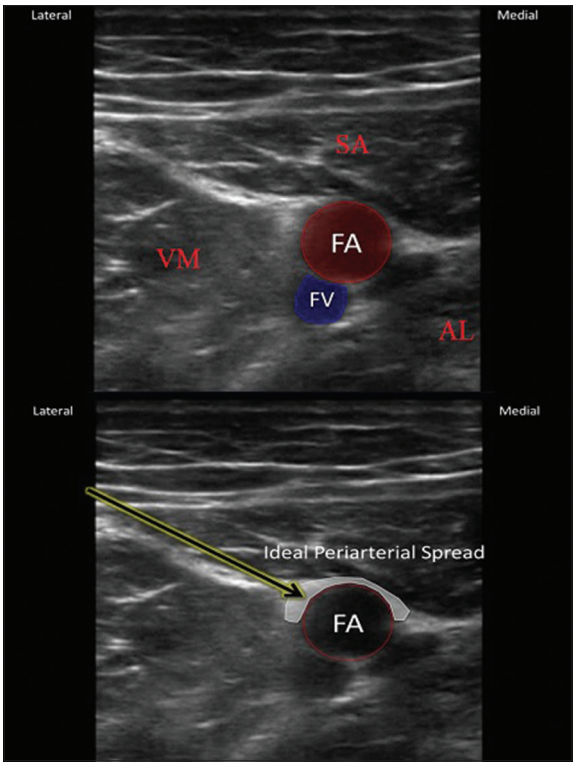

Figure 1: Ultrasound image of adductor canal and ideal periarterial spread of local anaesthetic agent. FA- Femoral artery, FV- Femoral vein, VM- Vastus medialis, SA- Sartorius, AL- Adductor longus muscle

artery. Movement of the probe proximally brings tibial and common peroneal nerves together to form the sciatic nerve at a variable point, above the popliteal crease. At this level, via out-of plane technique, using 21 gauge insulated needle, 20 ml of 0.5% ropivacaine was deposited after negative aspiration and real-time spread of local anaesthetic was visualised in sub paraneural space around the sciatic nerve [Figure 2]. All the patients received 0.03 mg/kg of intra-venous midazolam and oxygen was supplied by face mask throughout the procedure. Surgery was started after adequate sensory and motor blockade was achieved. In patients with failure to achieve adequate surgical anaesthesia after 20 minutes of administration of block, it was considered as a block failure and converted to general anaesthesia. Tourniquet was not used in any of the cases.

The primary objective of the study was to analyse the block success rate. The secondary objectives were to analyse the sensory and motor block onset time, haemodynamic parameters, duration of post operative analgesia and patient's overall satisfaction. Sensory block and motor block onset was assessed after two minutes following administration of block and every 30 seconds thereafter, by pin prick test and movements

at the ankle, respectively, and the time of block onset was noted. Sensory block onset was defined as time from completion of block administration to loss of pin-prick sensation and motor block onset as the time from completion of block administration to loss of movements at ankle joint. Haemodynamic parameters including heart rate, blood pressure and peripheral oxygen saturation were recorded at regular time intervals. The time required for first rescue analgesia and any complications were noted. After shifting the patient to post anaesthesia care unit, assessment of pain was done every 30 minutes using numeric rating scale (NRS,0–10 scale, with 0 being no pain and 10 being worst pain), when the NRS score was more than 3, injection Tramadol 1 mg/kg was given intra-venously as a rescue analgesic. Duration of post-operative analgesia was defined as the time interval between completion of block administration and first rescue analgesia (NRS >3). Twelve hours post-operatively, overall patient satisfaction was assessed based on three-point Lickert's scale (1, most satisfactory; 2, satisfactory; 3, not satisfactory).

Descriptive statistics of the study were calculated and the data was analysed using an SPSS statistics 21.0 program. The continuous data were expressed as numbers, mean and standard deviations and qualitative data were expressed as numbers and percentages.

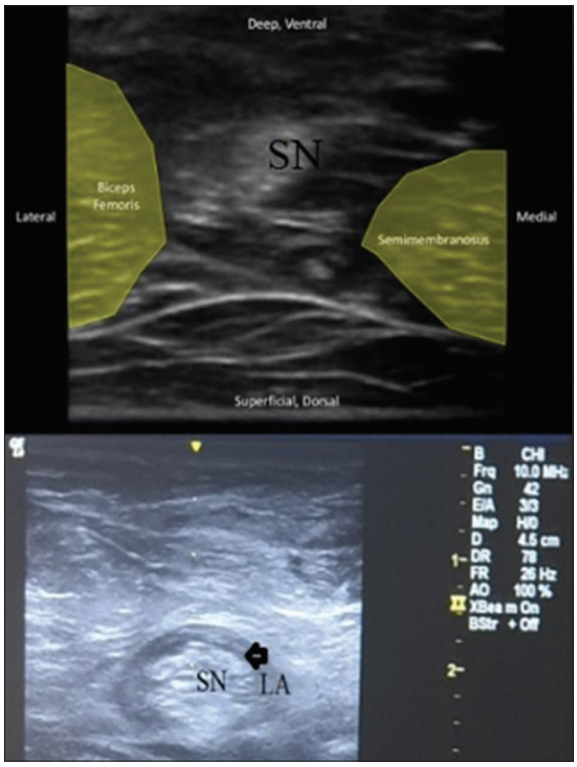

Figure 2: Ultrasound image of Sciatic nerve before bifurcation above the level of popliteal fossa and spread of local anaesthetic around the nerve following injection (Indicated by arrow). SN- Sciatic nerve, LA- local anaesthetic agent

RESULTS

A total of 20 patients with significant comorbidities scheduled for below-knee surgery were enrolled in this prospective study [Table 1]. All patients obtained an adequate sensory and motor blockade and the surgery was performed successfully under ultrasound-guided popliteal sciatic and adductor canal block, with no additional analgesic requirement [Table 2]. The mean duration for sensory and motor block onset time was 3.35 ± 0.49 and 4.65 ± 048 minutes respectively. Haemodyanamic parameters were maintained stable without gross fluctuation from baseline value throughout the procedure. Average duration of post-operative analgesia as assessed by NRS was 7.5 ± 0.8 hours. Patient satisfaction as assessed by three-point Lickert's scale was satisfactory, with 75% of patients were graded as per Lickert's scale 1 and 25% of patients were graded as per Lickert's scale 2. There were no intra-operative complications recorded.

DISCUSSION

High-risk patients with sepsis, multi-organ dysfunction, cellulitis, coagulopathy and other significant comorbid conditions serve a particular challenge in perio-perative anaesthetic management. Neuraxial blocks can be catastrophic due to instability of haemodynamic parameters and coagulopathy.[10] General anaesthesia can result in high morbidity with significant hypotension, myocardial depression and mechanical ventilation-related complications.[11]

Table 1: Patient characteristics	
Age (years)	59.65±15.57
Sex (Male/Female)	16/4
ASA (III/IV)	17/3
BMI (kg/m^2)	23.58±2.10
Type of surgery	**No. of patients**
(1) Below knee amputation	14
(2) Diabetic foot debridement	3
(3) Distal tibia plating	3

Table 2: Block characteristics	
Success rate	20/20 (100%)
Sensory block onset	3.35±0.49 minutes
Motor block onset	4.65±0.48 minutes
Duration of analgesia	7.5±0.8 hours
Lickert's satisfaction scale	1 (75%), 2 (25%)

Ultrasound-guided peripheral nerve blocks remains a safe alternative for such patients.[12,13] There are few case reports based on lower limb surgeries performed under peripheral nerve blocks. Baddoo *et al.* published a case series of ten patients posted for above-knee amputation surgery, land mark technique of three-in-one block and Labat's approach of sciatic block were administered and reported as a partial block in the three cases.[14] However, the use of ultrasound ensures adequate block and facilitates rapid block onset and prolonged duration with a decrease in drug dosage and systemic complications. Shamim *et al.* studied combined femoral and sciatic nerve block under ultrasound guidance and reported it a safe and satisfactory anaesthetic technique for above- and below-knee amputation surgeries in high-risk patients.[9] But, the lateral cutaneous nerve of the thigh from lumbar plexus and the posterior cutaneous nerve of the thigh from sacral plexus should be blocked to achieve the complete anaesthesia for above-knee surgeries.[15]

Proper anatomical knowledge is the key point for the success of peripheral nerve blocks. The two branches of the sciatic nerve: common peroneal and tibial nerve supply the leg and foot along with a sensory terminal branch of femoral nerve i.e., saphenous nerve, which provides sensory innervation to the medial part of leg and foot. Thus popliteal sciatic and adductor canal block provide adequate anaesthesia for below-knee surgeries. Yun Suk Choi *et al*. reported below-knee surgery sucessfully performed in two patients with severe cardiac dysfunction under ultrasound-guided femoral and popliteal sciatic nerve block with the stable intra-operative haemodynamic parameters.[8] But, presently there are no published literature on ultrasound-guided combined popliteal sciatic and adductor canal block for below-knee surgeries. The present case series affirms successful below-knee surgeries under combined ultrasound-guided popliteal sciatic and adductor canal block as sole anaesthetic technique, with rapid sensory and motor block onset, decrease the dosage of local anaesthetic agent, better stability of haemodynamic parameters, good post-operative analgesia and no adverse complications.

The most important independent predictor of persistent pain is the degree of pain relief in the immediate post-operative period. An adequate post-operative pain management has been reported to prevent the development of chronic pain.[16] Peripheral nerve block has an additional advantage of adequate post-operative pain management and in our study, the average duration of post-operative analgesia was 7.5 ± 0.8 hours.

We acknowledge a few limitations of our study: only a single bolus dose of the drug was administered. Single-shot adductor canal and sciatic blocks are simple to perform but provide analgesia for a limited duration, which can be overcome by inserting a perineural catheter and performing continuous perineural local anaesthetic infusions. Secondly, dual technique with peripheral nerve stimulator and under the ultrasound guidance further increases success rate and reduces complications, particularly, in high-risk patients. Further randomised trials are required to establish the superiority of peripheral nerve block over the central neuraxial block and general anaesthesia for lower limb surgeries in high-risk patients.

CONCLUSION

Ultrasound-guided combined popliteal sciatic and adductor canal block is an effective alternative anaesthetic technique for below-knee surgeries with better stability of haemodynamic parameters and pain management in high-risk patients.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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