ULTRASOUND GUIDED POPLITEAL SCIATIC NERVE BLOCK WITH SAPHENOUS NERVE BLOCK FOR PATIENTS UNDERGOING BELOW KNEE SURGERY: A CLINICAL STUDY

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Abstarct:
Background: Spinal anaesthesia remains a well-established and important technique for lower limb surgeries but with proven hemodynamic changes especially in patient with grade 3 or 4. We therefore tested the hypothesis that ultrasound guided popliteal sciatic nerve block along with saphenous nerve block is an effective alternative to central neuraxial blockade in patients undergoing below knee surgery and can be used as an sole anaesthetic technique

Methods: Patients undergoing below knee surgery in Mahatma Gandhi Medical College from March 2021 to June 2022 were included in this prospective analysis. Exposures were defined as patients undergoing ultrasound guided saphenous nerve block along with saphenous nerve block with 15 ml of 0.5% Ropivacaine for each Nerve. The outcome was defined as percentage of successful block, onset time for sensory and motor block onset time and intraoperative hemodynamic changes, duration of post operative analgesia. Descriptive statistics of the study were calculated and the data was analyzed using an SPSS 23.0 software program.

Results: Surgery was performed successfully with no additional analgesic requirement in all patients. The mean duration for sensory and motor block onset time was 26.04±3.07 minutes and 31.63±2.90 minutes respectively. Hemodynamic parameters were maintained stable throughout the procedure. The average duration of postoperative analgesia was 9.34±1.26 hours. Patients' overall satisfaction as assessed by three-point Likert scale was satisfactory.

Conclusion: The ultrasound-guided combined popliteal sciatic and adductor canal block is an effective alternative technique for below knee surgeries with stability of hemodynamic parameters and pain management.

Keywords: Ultrasound, popliteal sciatic nerve block, saphenous nerve block, Ropivacaine

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INTRODUCTION:

The most important responsibility of an anesthesiologist is to provide an adequate surgical plane of anaesthesia along with keeping in mind how to minimize the complication along with postoperative analgesia. Central neuraxial block remains an important technique for lower limb surgeries but with major hemodynamic changes especially in patient with grade 3 or 4. There are certain complication because of sub arachnoid block faced preoperatively, intra operatively and postoperatively.[1,2]

Challenges faced preoperatively are but not limited to, infection at the site of injection, deformities of the vertebral column Coagulopathy or other bleeding diathesis severe hypovolemia or increased intracranial pressure etc.[2] Complications faced intraoperatively which can be curtailed by peripheral blocks are: Hypotension, Bradycardia, Dyspnoea, High spinal, shivering. The most important complication faced post operatively is of post-dural puncture headache.[3,4] Few limited reports exist on femoral, obturator and sciatic nerve block in patients with multi organ dysfunction undergoing lower limb surgeries.[5-7]

Our study aimed to delineate the sensory and motor block onset time, hemodynamic parameters and duration of post op analgesia in patients posted for below knee surgery under combined ultra sound guided popliteal sciatic and saphenous nerve block as sole anesthetic technique. Thus we hypothesize that peripheral nerve block are an effective alternative to central neuraxial blockade and general anesthesia in patient undergoing below knee surgery.

MATERIALS AND METHODS:

Approval from institution ethical committee was obtained (MGMCH/IEC/JPR/2021/1166) and the study was registered in Clinical Trial Registry of India (CTRI/2022/03/041040). Written informed consents were obtained from the patients with ASA physical status I to IV, aged 20 to 80 years scheduled for below knee surgeries from March 2021 to June 2022 enrolled in this prospective study. Patients being allergic to local anesthetics, on any kind of opioids or other analgesics for chronic pain, a refusal for peripheral nerve block and with neurological deficit were excluded from the study.

Routine investigations, kidney function, liver function and coagulation profile test were obtained and nothing by mouth was ordered 8 hours prior to surgery. Preoperatively all patients were made familiar with a standard 10 cm visual analogy scale (VAS score) on preoperative visit, in which 0 represents no pain and 10 represents worse pain imaginable.

In the operation theatre, standard monitors were attached such as pulse oximeter, non-invasive blood pressure and electrocardiograph. Maintaining a strict aseptic precaution, ultrasound machine was placed on the opposite side of the limb that had to be blocked. For Saphenous nerve block we asked patient to slightly abduct and flex the leg and the probe was placed on the medial aspect of thigh. Orienting the US probe transversely with respect to the sartorius muscle, it was moved on the medial side of the knee. The sartorius muscle was found superficially (medially) and posterior to the vastus medialis, which was detected anteriorly. The saphenous nerve and SBDGA (saphenous branch of descending genicular artery) were deep to the sartorius muscle in a subsartorial fascial plane, and the gracilis muscle was situated immediately posterior to the sartorius muscle. Once the nerve is identified as hyperechoic round to oval structure which is surrounded by perineural fat pad, 15 ml of 0.5% ropivacaine was injected in sub sartorial plane as a field block.

For Popliteal Sciatic nerve block we asked patient to make the injured leg in semi flex position form the knee and linear transducer was placed in the popliteal crease. The popliteal artery is first located with the transducer in the transverse position near the popliteal crease, sometimes assisted by colour Doppler US, at a depth of around 3–4 cm. When the popliteal vein is merely superficial (posterior) to the artery, it travels alongside it. The biceps femoris muscles, as well as the semimembranosus and semitendinosus muscles, are located on either side of the artery (medially). The tibial nerve is visible as an oval or spherical hyperechoic structure with a honeycomb pattern superficially and laterally to the vein. The CPN is seen significantly more superficially and laterally to the tibial nerve once the tibial nerve has been located. The transducer should be moved closer until the sciatic nerve can be seen before it divides, merging with the tibial and peroneal nerves. This junction can be found extremely close to the popliteal crease or, less frequently, more proximally in the thigh, but it typically occurs at a distance of 5 to 10 cm from the crease. After identifying the Vlokas Sheath (where both component of sciatic nerve lies) 15ml of 0.5% ropivacaine was infiltrated after continuous negative aspiration. Upon injecting separation of two nerves will be visualised. After achieving adequate sensory and motor blockade surgery was started. Failure was defined when adequate surgical anaesthesia was not achieved after 40min of administration of block and would have been converted to general anesthesia. Tourniquet was not used in any of the cases.

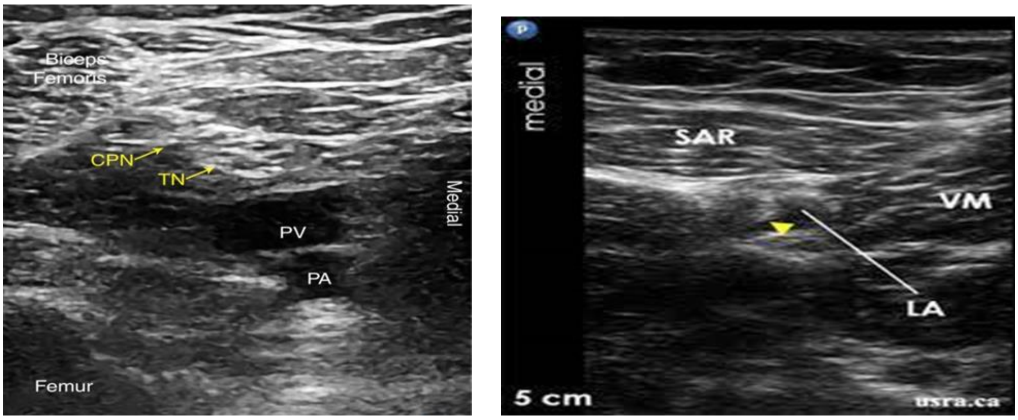

Fig.1:- USG Image showing Common Peroneal Nerve and Tibial Nerve (Lt) and sartorius and vastus medialis(Rt)

Sensory block and motor block onset was assessed after 15 minutes 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 will be defined as time from completion of block administration to loss of pin-prick sensation and motor block onset as time from completion of block administration to loss of movements at ankle joint. The time required for first rescue analgesia and any complication were noted. Assessment of pain was done after shifting the patient to post anaesthesia care unit using visual analogue scale. When VAS score >4 rescue analgesia in the form of tramadol 1 mg/kg was given intravenously. Overall patients' satisfaction was assessed based on three-point Likert scale.

Statistical analysis

Descriptive statistics of the study were calculated and the data was analysed using an SPSS statistics 23.0 program. The continuous data were expressed as numbers, mean and standard deviation and qualitative data wee expressed as numbers and percentages.

RESULTS:

Among the 50 patients, 14 were male and 36 were female; 18 had ASA Grade I, 24 had ASA Grade II and 8 had ASA Grade III. The average age, weight and height are described in Table 1.

All patients achieved a satisfactory sensory and motor blockade and successful completion of surgery was undertaken using popliteal sciatic nerve block and saphenous nerve block. No additional analgesic requirement was there throughout the procedure. The mean duration of sensory and motor block onset time was 26.04±3.07 minutes and 31.63±2.90 minutes respectively. Average duration of post-operative analgesia which was assessed using VAS was 9.34±1.26 hours. (Table 2). Throughout the procedure hemodynamic status of the patient remained stable without gross fluctuation from the baseline (Table 3). Most of the time the patients perceived mild pain and the highest pain levels was at 10 hours postoperatively after that it gradually declined (Table 4).

Patients' satisfaction was used using three points Likert scale was satisfactory with 14% having score of 1, 80% with score of 2 and remaining 6% with a score of 3. No intraoperative complication were noted (Table 5).

Table 1. General characteristics

Characteristics	Mean	SD	Minimum	Maximum
Age (years)	43.66	19.684	18	79
Weight (kg)	68.70	9.759	42	88
Height (inch)	65.90	1.787	60	68

Table 2. Block characteristics

Block characteristics	Mean	SD	Minimum	Maximum
Sensory block onset (minutes)	26.04	3.079	18	30
Motor block onset (minutes)	31.63	2.901	25	38
Duration of Analgesia (hour)	9.34	1.266	8	10

Table 3. Haemodynamic parameters at different intervals

Intervals	Pulse rate		SBP		DBP	
	Mean	SD	Mean	SD	Mean	SD
0 minute	88.02	15.36	136.30	19.27	77.86	10.52
5 minutes	88.18	15.19	135.54	17.57	79.34	8.55
10 minutes	87.62	14.03	134.80	16.24	76.38	11.24
15 minutes	86.90	13.54	134.00	19.28	77.14	8.65
25 minutes	86.84	13.00	133.84	17.06	75.16	9.46
30 minutes	85.28	12.23	133.38	15.56	77.58	9.83
60 minutes	85.22	13.74	134.48	16.57	75.72	10.02
120 minutes	81.44	13.53	135.96	18.09	73.98	10.05

Table 4. VAS Score at different time intervals

Intervals	Mean	SD	Minimum	Maximum
Immediate Postop	0.00	0.00	0	0
15 minutes	0.00	0.00	0	0
30 minutes	0.00	0.00	0	0
45 minutes	0.00	0.00	0	0
1 hour	0.00	0.00	0	0
1 hour 30 minutes	0.00	0.00	0	0
2 hours	0.50	0.50	0	1
3 hours	0.58	0.49	0	1
4 hours	1.00	0.00	1	1
6 hours	1.46	0.50	1	2
8 hours	2.66	0.84	2	4
10 hours	3.38	0.49	3	4
12 hours	2.14	0.70	1	3
14 hours	2.20	0.40	2	3
16 hours	1.60	0.49	1	2
18 hours	0.38	0.49	0	1

Table 5. Satisfaction Scale

Scale	Frequency	Percent
1	7	14.0%
2	40	80.0%
3	3	6.0%
Total	50	100.0%

DISCUSSION:

We observed that regional anaesthesia seems to be a good option for patients undergoing below knee surgeries and one of the approaches we used is combined popliteal sciatic nerve along with saphenous nerve block which seems to be a viable option for surgical anaesthesia. Furthermore use of ultrasound to block the peripheral nerves remains a relatively safe approach for high risk patients.[8,9] Few case reports are published for peripheral nerve blocks performed for lower limb surgeries.

For blocking the saphenous nerve, there are many approaches along its course like: perifemoral, subsartorial, and transsartorial approaches. Although adductor canal block or transartorial approach is commonly performed we went for subsartorial approach. A comparative study was performed by Head SJ et al on 91 patients and they found that saphenous nerve visibility, block success rate or onset between the two groups had no difference but the adductor canal group provided a better vascular landmark visibility.[10]

In our study, we performed an ultra sound guided subsartorial technique for saphenous nerve blockade which proved to be an effective approach for anesthetizing the anteromedial lower extremity. Similar studies were done by Benzon et al for the transartorial and perifemoral approaches who anesthetized the medial leg and medial foot.[11] In our study we used ultrasound guidance for performing the saphenous nerve block and had 100% success rate while Vander et al performed similar block using landmark technique and found a success rate of 80%.[3] Similar study performed by Manickam where they did an ultrasound guided study evaluating the trans-sartorial peri-femoral approach.[12] In our study not a single patient was found to have quadriceps weakness which was assessed by asking the patient to walk, similar observation were made by Bouaziz et al who found that femoral nerve was not anesthetized and quadriceps strength was well preserved when saphenous nerve was blocked using a subsartorial approach. In situations where only blocking the distal branches of the femoral nerve is necessary and access to the groin is problematic, such as those involving obesity, large pannus, skin infection or maceration, prior femoral bypass surgery, femoral vessel catheterization, or hernia repair, this subsartorial approach may also provide additional benefits.[13]

For the sciatic nerve block we chose to go for lateral approach instead for posterior approach where patient comfort was more using ultrasound guidance and similar study was done by Hazdic A et al who compared posterior vs lateral approaches to block the sciatic nerve and concluded that lateral approach took longer to accomplish though patient satisfaction was better. Popliteal sciatic nerve provides coverage for postero-lateral compartment of leg with the help of its two branches that is common peroneal nerve and tibial nerve.[5]

Combining these two nerve blockade that is popliteal sciatic and saphenous nerve block provides adequate anaesthesia for below knee surgeries. Similar studies was done by Arjun BK et al who concluded that it is an effective, safer and good alternate approach for below knee surgery. To know how much patient was satisfied we used Likert 3 point scale and we came to conclusion that 80% of the patient had Likert point scale of 2.[14]

In the present study, on the hemodynamic front, vitals remained stable for the entire duration of surgery and no episodes of hypo or hypertension was noted. Similar study was done Vloka JD et al in 1995 who compared popliteal block with spinal anaesthesia and noted that former was devoid of any complication like hypotension, bradycardia etc.[15]

Peripheral nerve blockade also has an added advantage for providing adequate post-operative pain relief and in our study we got the average duration of pain relief of 8 to 10 hours. Similar studies were done by Rongstad K et al who performed popliteal sciatic nerve block for postoperative analgesia. It was performed on 86 patients in which 97% had a successful block and concluded that 95% of the patients were satisfied.[16] Assessment of pain was done using visual analogue scale and when VAS score was >4 first rescue analgesia was given to the patient. Similar studiy was done Lyzohub M. et al who performed ultra sound guided popliteal sciatic nerve block on 35 patients, although it was comparison between two approaches, he found VAS score of 5.7±1.0 hours.[17] Another added advantage to this block was that of sparing of quadriceps power. Though the studies have been done on adductor canal block compared to femoral nerve block, the sparing is comparable with transartorial approach.[18]

On the drug front we chose to go for ropivacaine and not bupivacaine for two reasons that is ropivacaine has been shown to be less cardiotoxic compared to bupivacaine. This factor was taken in to consideration because we included patient till ASA grade 4 which includes who are potentially cardiac unstable, and second reason was to maintain the uniformity in drug administration. Study to compare these two drugs on the basis of cardiotoxicity was done by Graf et al on 31 Guinea pig heart and concluded that ropivacaine isomer has less cardiodepressant effect.[19]

We do acknowledge some limitations. We only used a single shot blockade rather than putting a perineural catheter and performing a continuous perineural local infusion. Secondly using a peripheral nerve stimulator along with ultrasound would have improved the outcome. There is another factor of anatomical variation which led to different timing of block. A quite few cadaveric studies did report that branching of common peroneal nerve and tibial nerve from the sciatic nerve were not consistent. Vloka et al[5] reported that branching was observed 60.0±27.0 mm to the upper part of the popliteal fossa crease, and Saleh et al[20] reported that site is somewhere between 50.0 mm to 180.0mm. This can be a reason for why administering the agent at lower site than branching site can lead to limited regional anesthesia. Sample size included patient from 18 years and beyond therefore for obvious reasons we did not perform block in patient less than that so establishment of efficacy in those patient was not established. Since the block has been performed under a controlled environment the efficacy of block and utilization of the same has not been established in emergency condition.

CONCLUSION:

The ultrasound-guided combined popliteal sciatic and adductor canal block is an effective alternative technique for below knee surgeries with stability of hemodynamic parameters and pain management. Since it's an ultrasound guided block, setup with resource limitation or those who depend on peripheral nerve stimulator might not get a 100% success rate. Therefore many randomised trial are needed to establish that peripheral blockade may have superiority over central neuraxial blockade and general anaesthesia for lower limb surgery in high risk patient.

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