Original Article/*Özgün Araştırma*

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Ultrasound-Guided Parasacral Ischial Plane Block for Lower Limb Surgeries in High-Risk Patients – Comparison of Two Sites of Needle Placement

Yüksek Riskli Hastalarda Alt Ekstremite Ameliyatlarında Ultrason Kılavuzluğunda Parasakral İskial Düzlem Bloğu – İki İğne Yerleştirme Bölgesinin Karşılaştırılması

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ABSTRACT

Objective: Parasacral Ischial Plane (PIP) block is a newer ultrasound-guided fascial plane approach to sacral plexus (SP). In the PIP block, the needle is inserted aiming towards the posteromedial surface of the ischium to inject the local anesthetic. Studies have shown PIP block to produce a good sensory block with no or partial motor block. We found that a small change of needle tip towards the end of posteromedial surface of ischium produces a good motor block. Hence, we compared the block characteristics of two sites of needle tip placement in the PIP block.

Methods: Thirty patients of ASA 3-4, aged 30 - 80 years, scheduled for lower limb surgeries, were included. They were randomly allocated into two groups based on the needle tip placement. Group 1 – end of posteromedial surface of the ischium and Group 2 – posteromedial surface of the ischium.Ultrasound-guided PIP block was given with 0.5% of ropivacaine with the needle tip placement as per the group. Onset of sensory block, motor block and degree of motor block were compared.

Results: Group 1 had shorter sensory and motor block onset time ($p<0.001$). Thirteen patients in Group 1 had complete motor block, while no patients in Group 2 had complete motor block at 30 minutes ($p<0.001$).

Conclusion: A small change of moving the needle tip towards the edge of posteromedial surface of ischium produces better block characteristics.

Keywords: Ultrasound guided, sacral plexus, PIP block, greater sciatic notch, pyriformis

ÖZ

Amaç: Parasakral İskiyal Plan (PIP) bloğu, sakral pleksusa (SP) yönelik daha yeni bir ultrason kılavuzluğunda fasyal plan yaklaşımıdır. Parasakral iskial plan bloğunda, iğne, lokal anesteziği enjekte etmek için iskiyumun posteromedial yüzeyine doğru hedeflenerek girilir. Çalışmalar, PIP bloğunun motor bloğu olmadan veya kısmi motor bloğu ile iyi bir duyusal blok ürettiğini göstermiştir. İskiyumun posteromedial yüzeyinin sonuna doğru iğne ucunda küçük bir değişiklik yapmanın iyi bir motor blok oluşturduğunu bulduk. Bu nedenle, PIP bloğunda iğne ucunun iki farklı yerleştirildiği bölgenin blok özelliklerini karşılaştırdık.

Yöntem: Alt ekstremite cerrahisi planlanan, 30 - 80 yaş aralığında, ASA 3-4 olan otuz hasta çalışmaya dahil edildi. İğne ucu yerleşimine göre rastgele iki gruba ayrıldılar. Grup 1 - iskiyumun posteromedial yüzeyinin sonu ve Grup 2 - iskiyumun posteromedial yüzeyi. Ultrason rehberliğinde PIP bloğu, iğne ucu yerleşimi gruba göre olacak şekilde %0,5 ropivakain ile verildi. Duyusal blok başlangıcı, motor blok ve motor blok derecesi karşılaştırıldı.

Bulgular: Grup 1'de daha kısa duyusal ve motor blok başlangıç süresi vardı ($p<0,001$). Grup 1'deki on üç hastada tam motor blok vardı, Grup 2'deki hiçbir hastada ise 30. dakikada tam motor blok yoktu ($p<0,001$).

Sonuç: İğne ucunu iskiyumun posteromedial yüzeyinin kenarına doğru hareket ettirmede küçük bir değişiklik daha iyi blok özellikleri üretir.

Anahtar sözcükler: Ultrason klavuzluğunda, sakral pleksus, PIP blok, büyük siyatik çentik, piriformis

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INTRODUCTION

Sympatholysis secondary to central neuraxial block or general anesthesia (GA), for lower limb surgeries, can result in adverse hemodynamic changes and high perioperative mortality in high-risk patients (1,2). In such patients, lower limb surgeries can be done successfully under sciatic and femoral nerve block alone (3-6). Depending on the surgical indication, sciatic nerve block can be used alone or in combination with a lumbar plexus or femoral nerve block (7,8).

Compared with other approaches of sciatic nerve, the sacral plexus (SP) block technique consistently blocks the posterior femoral cutaneous nerve of thigh and is hence useful during tourniquet application (7,9,10). Various techniques to perform the SP block have been described (11-13). A novel ultrasound (USG) guided fascial plane approach to SP called Parasacral Ischial Plane (PIP) block, has been successfully studied in a few patients (14,15). The SP lies in a fascial plane formed by the pelvic fascia anteriorly, sacrum medially, piriformis and gluteus maximus posteriorly and ischium in the lateral part. The piriformis has no attachments to the ischium and attach to the greater trochanter laterally. A fascial plane exists between the piriformis muscle and the ischial bone. This fascial plane continues to the sacral plexus. Therefore, the local anesthetic will track medially to the SP when administered superficial to the ischium at the level of the greater sciatic foramen. Venkataraju et al. in their study of five patients of lower limb amputation, has used PIP block along with GA or spinal anesthesia. He has found the PIP block to give good postoperative analgesia. However, the author has not mentioned the motor blockade achieved by PIP block (14). In our previous case series of 10 patients, we used PIP block successfully as a sole anesthetic for lower limb wound debridement surgeries. We found the PIP block produces a good sensory block with no or partial motor block (16). Venkataraju et al. in his demonstration of the PIP block, describe the needle should be inserted aiming toward the posteromedial surface of the ischium. After bony contact, the drug was injected and the drug spread below the pyriformis towards the SP was observed (14). We found that the small change of needle tip towards the end of the posteromedial surface of the ischium to produce a good motor block. Hence, we decided to do a pilot study to compare block characteristics of two sites of needle tip placement (end of posteromedial surface of ischium vs posteromedial surface of ischium).

MATERIAL and METHODS

This prospective randomized single-blinded pilot study was conducted after approval from the institutional ethics committee (KIEC/TN2017/RR-21/33 2017/RR-21/ , 09/01/2023). The study was registered in Clinical Trials Registry – India (CT RI/2023/06/054251,21/06/2023, at www.ctri.nic.in) and with the principles of the Declaration of Helsinki, 2013. For recruitment, patients were explained the study protocol and their written informed consent was obtained for participation and publication of the study. Thirty patients of the ASA physical status 3-4, aged 30 - 80 years, scheduled for lower limb surgeries, were then included. Patients who were allergic to local anesthetics, had an infection at the site of the nerve block, and refused for nerve block were excluded. A web-based randomization program (www.randomizer.org) was used for generating randomization sequences. Serially numbered, opaque, sealed envelopes was used to maintain allocation concealment. The sealed envelopes were opened just before the surgery, to reveal allocation in the two groups. The groups were classified based on the point at which the needle touched the posteromedial surface of the ischium (Figure 1).

Group 1 – end of posteromedial surface of ischium

Group 2 – posteromedial surface of ischium

The study's main objective was to compare the block characteristics of two techniques of PIP block (onset time of sensory and motor block, degree of motor block).

Standard pre-anesthetic assessment was carried out and standard monitoring was followed in the intraoperative period. The ultrasound-guided femoral nerve block was administered, with the patient in supine position, using a linear probe (13–6 MHz), (Esaote, My Lab Sigma5, Spain) at the level of inguinal crease. A 5 cm needle (22G, Stimuplex, B Braun) was inserted from lateral to medial and 15 mL of 0.5% ropivacaine was slowly injected. To perform the PIP block, Sim's position with the leg to be operated in non-dependent position was followed. A 2–5 MHz curvilinear probe was placed on a line joining posterior superior iliac spine (PSIS) and the greater trochanter (GT), with one corner of the probe lying superficial to the PSIS. Then the probe was moved downwards and medially, similar to the Para sacral parallel shift (PSPS) (11). At the level of greater sciatic foramen, the posteromedial surface of the ischium was identified with the piriformis superficial to it. An 80–100 mm needle was inserted from lateral to medial using an in-plane approach, directing towards the end of the ischium (tip of the posteromedial surface) in the group 1 (red arrow in Figure 1) and towards the posteromedial surface of the ischium in group 2 (blue arrow in Figure 1). Twenty mL of 0.5% ropivacaine was injected, while observing its spread. Sensory block and motor block onset were assessed two minutes after administration of the block and every minute thereafter, by pinprick test and ankle movements, respectively. Motor power was categorized by assessing the plantar and dorsiflexion of ankle joint as 0 = normal motor power, 1 = reduced motor power, and 2 = complete block. At the end of 30 min, motor power was checked and that was taken as final. In patients with failure to attain loss of pain to pinprick

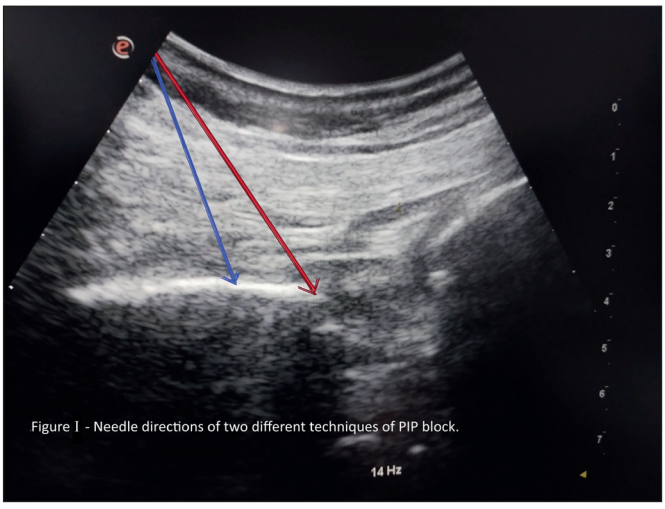

Figure 1. Needle directions of two different techniques of PIP block. **Red arrow:** Towards the end of the ischium (tip of the posteromedial surface) in the group 1. **Blue arrow:** Towards the posteromedial surface of the ischium in group 2.

after 30 min of administration of block, it was considered as a block failure and converted to GA. Tourniquet was used if required. Intraoperatively, fentanyl 50 µg intravenously was given if the patient had pain. This was repeated within 10 min interval to a maximum of 2 times, after which the block was considered a failure and the patient was given GA. The time required for first rescue analgesia and any complications were noted. After shifting the patient to post-anesthesia care unit, an assessment of pain was done using a 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, an intravenous injection of Tramadol 1 mg kg^{-1} was given as a rescue analgesic and the data collection was stopped. The onset of sensory block was calculated from the time of completion of drug injection till the patient had an absence of pain to pinprick. The onset of motor block was calculated from the time of completion of drug injection to the onset of reduced motor power. Time from the onset of sensory block to the time of first rescue analgesia was taken as the duration of analgesia.

All data were recorded on a predefined proforma, and appropriate statistical analysis was carried out using JASP software (Version 0.17.2), University of Amsterdam, Netherlands. The descriptive data is presented as mean and standard deviation (SD) for continuous variables. Normality of the data was checked using Shapiro-Wilk test. Either Independent t-test or Mann-Whitney U test was used to compare based on the normality of data.

RESULT

Of the 30 patients recruited, 29 were analyzed. One patient required an analgesic during the surgery (Onset of sensory block 15 min with no motor block) and was converted to GA. Of the 29 patients included in the study, 26 were males and 3 were females. The average age (years), height (cm), and weight (kg) were 60.66 ± 10.01, 165.29 ± 7.33, and 67.67 ± 13.57 respectively (Table I). Twenty-six patients were ASA III and 3 were ASA IV. Eighteen patients underwent foot surgery, while 11 underwent surgery of the leg below the knee joint. The sensory onset time, motor onset time and duration of analgesia did not have normal distribution in group 2 (Shapiro-Wilk test $p<0.05$). Hence Mann-Whitney U test was used to compare sensory onset time, motor onset time and duration of analgesia in the groups and the difference of means was estimated by Hodges Lehmann Estimate.

The time of onset of sensory block for Group 1 was 4.93 ± 2.34 min and that for Group 2 was 13 ± 4.91 min ($p<0.001$, Hodges Lehmann Estimate -7 (CI of -5 to -11) min) (Figure 2). The time of onset of motor block for Group 1 was 10.29 ± 4.51 min and that for Group 2 was 17.64 ± 5.44 min ($p=0.001$, Hodges Lehmann Estimate -7 (CI of -4 to -10) min). The time for complete motor block in the Group 1 was 17 ± 2 min (Figure 3). The mean duration of analgesia in the Group 1 was 13.43 ± 2.98 hr and that for Group 2 was 12.21 ± 3.88 hr ($p=0.30$) (Table II). Thirteen patients in Group 1 had complete block, while no patients in Group 2 had complete block at 30 min (13 patients had partial block and 2 patients had normal motor power. (Kendall Tau-b of -0.91, $p<0.001$).

Table I: Demographics of Group 1 and Group 2

	Group 1 (n = 14)	Group 2 (n =15)
Age (years)	63 ± 5	62 ± 6
Weight (kg)	60 ± 6.5	65.5 ± 7.5
Height (cm)	165.5 ± 5	165 ± 5
Sex (Male/Female)	12/2	14/1
Surgery (Leg n (%)/ Foot n (%))	4 (28.57%)/10 (71.43%)	7 (46.67%)/8 (53.33%)
Tourniquet used (No. of patients)	4	5

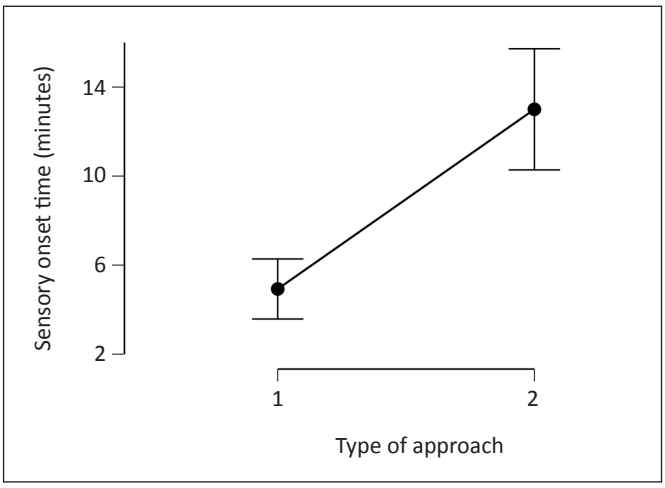

Figure 2. Onset of sensory block between Group 1 and Group 2.

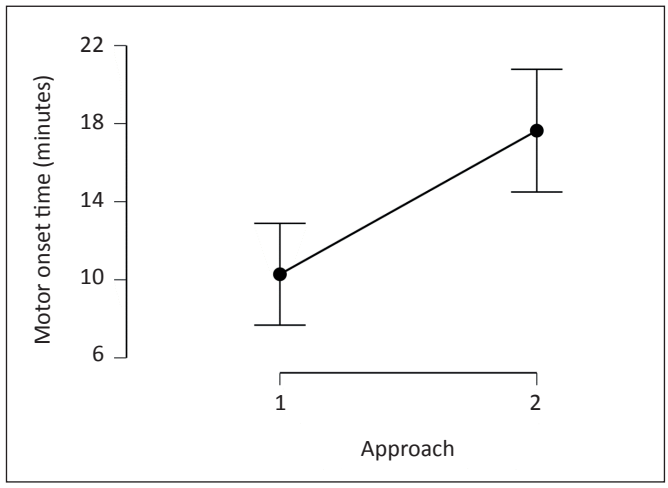

Figure 3. Onset of motor block between Group 1 and Group 2.

Table II: Block characteristics of Group 1 and Group 2.

	Group 1(n = 14)	Group 2 (n =15)	P value
Sensory block onset time (min)	4.93 ± 2.34	13 ± 4.91	p<0.001
Motor block onset time (min)	10.29 ± 4.51	17.64 ± 5.44	p<0.001
Complete Motor block time (min)	17 ± 2		
Duration of analgesia (hr)	13.43 ± 2.98	12.21 ± 3.88	0.30

Mann-Whitney U test was used to obtain p values.

DISCUSSION

In our study, we compared the block characteristics of two approaches of the PIP block. We observed that that there was no complete motor block when the needle was superficial and to the surface of the posteromedial ischium, while when placed towards the end of the posteromedial ischium, the motor block was complete. There was a statistically significant difference in sensory and motor onset time between both the groups.

The sacral plexus originates in the para sacral area, and leaves the pelvis through the greater sciatic foramen. The infero-lateral part of the sacral plexus is formed by the posterior border of the ischium (PBI). The PBI is seen as a hyperechoic line with a distinctive curve separating it from the adjoining structures. Hence targeting the needle where the hyperechoic line (PBI) ends, brings the needle closer to the SP. This could have resulted in more amount of drug reaching the SP resulting in faster onset of block and complete motor block in Group 1 (Figure 4A, B). Thus, a small adjustment of the needle tip towards the edge of the posteromedial border of ischium has resulted in significant changes in block characteristics. The time to complete motor block in group 1 is comparable to that of study done by Taha et al (15 [5-20] minutes) (17).

Bendtsen et al., Ben-Ari et al., and Taha have described USG guided SP block. All these techniques target the SP after it exits the greater sciatic notch (11,17,18). In Taha's approach and the technique by Ben-Ari et al, the USG probe is placed in an axial plane at the level of uppermost point of gluteal cleft and moved downwards to obtain the short axis view of SP (17,18). Parasacral ischial plane block and technique by Bendtsen et al are similar. In both techniques, a curvilinear probe is held along the medial end of the line joining PSIS and GT. The probe is then moved infero-medially. At the level of the greater sciatic foramen, the ischium (posteromedial border) is located with the piriformis above it. In PIP block, the drug is injected in the plane between pyriformis and PBI. In the technique described by Bendtsen, the probe is moved further after visualising the greater sciatic foramen to obtain a longitudinal view of SP (11,14).

The SP being a deep structure with similarity to the surrounding tissues in the ultrasound, there is difficulty in locating it especially in obese patients (18). In contrast to other approaches, in PIP the PBI is readily identified as a sharp and hyperechoic structure with a curve distinguishing it from the nearby structures, making the block easier to administer. The identification of PBI is easy even in patients with obesity and tissue oedema. So, PIP block is an easy technique. Nerve blocks catheters can also be placed in PIP block for postoper-

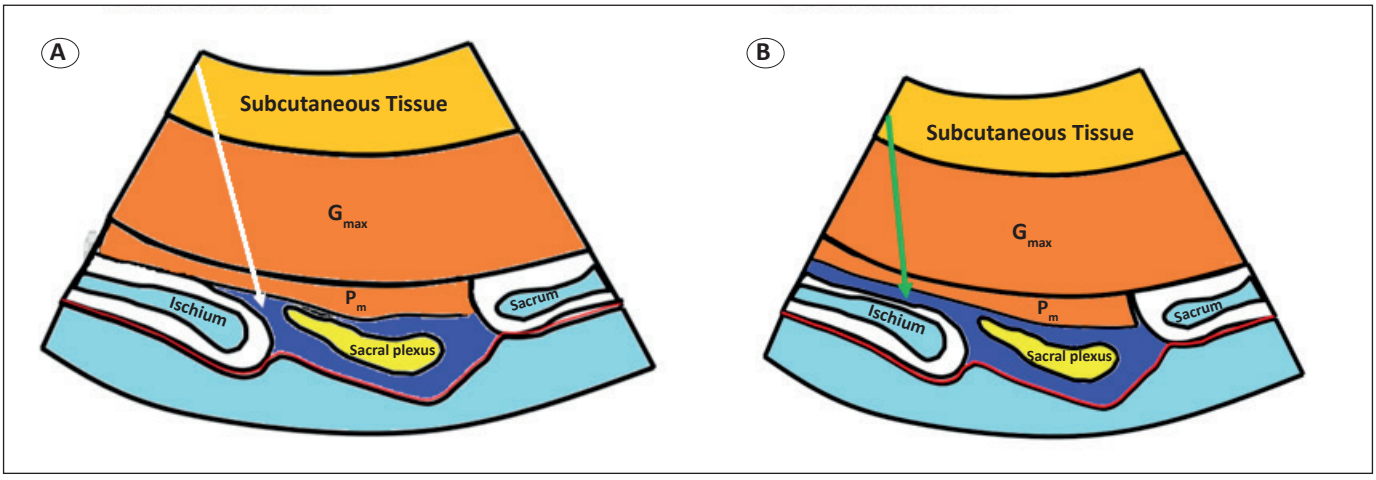

Figure 4. Comparison of drug distribution between two techniques of needle placement. **A) White arrow:** Towards the end of the ischium (tip of the posteromedial surface) in the group 1. **B) Green arrow:** Towards the posteromedial surface of the ischium in group 2. **G_{max}:** Gluteus maximus, **Pm:** Pyriformis.

ative analgesia (14). As the visualisation of SP is challenging, combined USG and nerve stimulator was used by Bendtsen et al., Ben-Ari et al. and Taha (11,17,18). As the desired end point was fascial plane drug spread, nerve stimulator was not needed in our study. Hence it can be useful in patients where above or below knee amputation is done.

In this present study we have not measured the time taken to perform the block. In our previous case series, we found the time taken to perform PIP block (from USG probe placement to complete deposition of drug) as less than 4 min (16). The time taken to perform the SP block has not been described in other techniques. Even though Taha claim the median USG identification time of SP to be 10 s, he has not studied the time taken to perform the block (17). The sensory and motor onset times compared in our study corresponded to SP block as this was our study interest.

Haematoma, rectal perforation, and neural injection are some of the complications of sacral plexus block (9,17,18). No complications were noted in the current study. The needle in PIP block is not close to any neurovascular structures, making it a safer approach. There are variations in the relationship between the sacral plexus and the piriformis muscle. In most cases, the piriformis lies superficial to the sacral plexus. In few cases, the sacral plexus divides the piriformis or it may lie superior to the piriformis muscle. Hence PIP block will not be successful in such patients (18-21).

The study has several limitations: 1. All our patients had diabetic feet for which they underwent wound debridement surgery. We did not study the success of this technique in orthopedic lower limb cases that require complete motor block. 2. All of our patients had wound debridement below the knee. Hence, patients requiring thigh surgeries need to be studied under PIP block. 3. The sensitivity of nerves to local anesthetics may vary among patients with diabetic neuropathy and can affect the outcomes of the study.

CONCLUSION

Despite PIP being a plane block, a small change of moving the needle till the end of posteromedial surface can produce sensory and motor blockade similar to other SP block techniques. Moreover, the ease of technique and absence of neurovascular injury in PIP block is advantageous compared to other techniques of SP block.

AUTHOR CONTRIBUTIONS

Conception or design of the work: KMS, SKEJ, IJ, NKS
Data collection: KMS, SJ, SKK
Data analysis and interpretation: KMS, SKEJ, IJ
Drafting the article: KMS, SKEJ
Critical revision of the article: KMS, NKS
Other (study supervision, fundings, materials, etc): SJ, SKK
The author (KMS, SKEJ, IJ, NKS, SJ, SKK) reviewed the results and approved the final version of the manuscript.

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