A simple and successful sonographic technique to identify the sciatic nerve in the parasacral area

Une technique échographique simple pour identifier avec succès le nerf sciatique dans la région parasacrée

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Abstract

Background The purpose of this study was to describe detailed sonographic anatomy of the parasacral area for rapid and successful identification of the sciatic nerve.

Methods Fifty patients scheduled for knee surgery were included in this observational study. An ultrasound-guided parasacral sciatic nerve block was performed in all patients. The ultrasound probe was placed on an axial plane 8 cm lateral to the uppermost point of the gluteal cleft. Usually, at this level the posterior border of the ischium (PBI), a characteristically curved hyperechoic line, could be identified. The sciatic nerve appeared as a hyperechoic structure just medial to the PBI. The nerve lies deep to the piriformis muscle lateral to the inferior gluteal vessels, and if followed caudally, it rests directly on the back of the ischium. After confirmation with electrical stimulation, a 20-mL mixture of 1% ropivacaine and 1% lidocaine with epinephrine was injected.

Results The sciatic nerve was identified successfully in 48 patients (96%). In those patients, the median time required for its ultrasonographic identification was ten seconds [interquartile range, 8–13.7 sec], and the block success rate was 100%.

Conclusion The described sonographic details of the parasacral area allowed for rapid and successful identification of the sciatic nerve.

Résumé

Contexte L'objectif de cette étude était de décrire de façon détaillée l'anatomie échographique de la région parasacrée pour une identification rapide et réussie du nerf sciatique.

Méthodes Cinquante patients devant subir une chirurgie du genou ont été inclus dans cette étude observationnelle. Un bloc du nerf sciatique parasacrée sous guidage échographique a été réalisé chez tous les patients. La sonde d'échographie était placée à 8 cm en dehors du point le plus haut du sillon interfessier. À ce niveau, habituellement, le bord postérieur de l'ischion (BPI) peut être identifié sous la forme d'une ligne courbe hyperéchogène. Le nerf sciatique apparaît comme une structure hyperéchogène immédiatement en dedans du BPI. Le nerf passe profondément contre le muscle piriforme, en dehors du paquet vasculaire fessier inférieur et, lorsqu'on le suit distalement, il repose directement sur la face postérieure de l'ischion. Après confirmation par stimulation électrique, 20 mL d'un mélange de ropivacaïne 1 % et de lidocaïne 1 % avec épinéphrine a été injecté.

Résultats Le nerf sciatique a été identifié avec succès chez 48 patients (96 %). Chez ces patients, le temps médian nécessaire à l'identification échographique a été de dix secondes (écart interquartile : 8 à 13,7 sec) et le taux de succès du bloc a été de 100 %.

Conclusion Les détails échographiques de la région parasacrée décrits ici ont permis une identification rapide et réussie du nerf sciatique.

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The sciatic nerve supplies all joints of the lower limb, the hamstring muscles, and nearly the entire leg and foot¹; therefore, a complete sciatic nerve block is usually needed in almost all lower limb surgeries. Various approaches

have been described to simplify the sciatic nerve block at different levels.²⁻⁷ The sciatic nerve arises in the parasacral area, and it exits the pelvis through the greater sciatic foramen, the lower lateral edge of which is formed by the posterior border of the ischium (PBI).¹ Unlike other approaches to a sciatic nerve block, the parasacral approach could block the entire sacral plexus as well.⁷ Recently, ultrasound guidance has been used to localize the sacral plexus.^{2,3} Ben-Ari *et al.*² used the PBI as a landmark, but they did not describe how to identify this landmark. The current study aimed to add further sonographic details to the above in order to simplify identification of the PBI and other landmarks and to facilitate rapid and successful identification of the sciatic nerve.

Methods

The Research and Ethical Committee of Abu Dhabi Knee and Sport Medicine Centre (ADKSMC, El Saif Tower, Electra St, Abu Dhabi, UAE) approved this study (# 08:02:10:08) in August 2010. The clinical part of the study was conducted from August to November 2010. After obtaining their written informed consent, 50 patients scheduled for hamstring anterior cruciate ligament reconstruction formed the study group. All patients received ultrasound-guided parasacral sciatic nerve blocks.

After application of routine monitoring and supplemental oxygen, the patients received midazolam 3 mg *iv*.

All blocks were performed by one experienced anesthetist using an S-Nerve ultrasound machine (SonoSite, Inc., Bothell, WA, USA), a curved probe (C60, 5-2 MHz), a 20G 12-cm insulated needle (Locoplex, Vygon, Ecouen, France), and a nerve stimulation unit (Plexygon, Vygon, Padova, Italy). The patient was positioned in the lateral decubitus position with the leg to be blocked uppermost and rolled forward with the knee flexed at a 90° angle (Sim's position). Skin antisepsis and sterile draping were performed, and the ultrasound probe was sheathed.

Block technique

The technique used in the current study relied on the identification of the PBI. The PBI appears as a hyperechoic line with a characteristic curve distinguishing it from the surrounding structures. To locate the PBI, the ultrasound probe was placed on an axial plane with its medial edge about 8 cm lateral to the uppermost point of the gluteal cleft. Usually, the PBI could be identified at this level. Otherwise, the probe was maneuvered in three steps: upwards, downwards, and tilt (Fig. 1). First, the probe was slid upwards (cranially) to localize the ala of the ilium (a continuous hyperechoic oblique bony structure), and the probe was then slid downwards (caudally) until a gap in this oblique bony structure (the greater sciatic foramen) started to appear. At this point, the ultrasound probe was tilted slightly caudally. In this plane, the gap became wider and the PBI, the lateral bony edge of the gap, could be identified.

Fig. 1 The parasacral sciatic nerve block technique. [A] The ultrasound probe was placed on an axial plane 8 cm lateral to the uppermost point of the gluteal cleft. The posterior border of the ischium (PBI), a characteristically curved hyperechoic line, usually could be identified at this level. If not, [B] the probe was slid cranially to locate the ala of the ilium (a hyperechoic oblique bony structure

descending laterally). [C] This oblique bony structure was followed caudally until a gap in this structure (the greater sciatic foramen) appeared. [D] At this point, the probe was tilted slightly caudally. The gap became wider and its lateral bony edge, the PBI, was identified. The sciatic nerve appeared as a hyperechoic structure just medial to the PBI

Fig. 2 The parasacral area in a cadaver (A) and corresponding sonographic images of a patient in the study (B, C). Within the parasacral area, the sciatic nerve lies between the piriformis muscle and the pelvic fascia, separating it from pelvic structures. The inferior

gluteal and internal pudendal vessels lie medial and deep to the sciatic nerve, respectively. (Panel A was obtained and modified with permission from <http://www.anatomyatlases.org>, plate 6.8, accessed October 15, 2011)

Fig. 3 The relation of the sciatic nerve to the hip. [A] The sciatic nerve (arrow) arises from the sacral plexus deep and medial to the posterior border of the ilium. [B] It then emerges through the greater sciatic foramen just medial to the posterior border of the ischium.

[C] For a short distance, it lies directly on the back of the ischium before [D] it becomes separated from the ischium by the superior gemellus. At its proximal course (from A to D), the sciatic nerve runs inferoposterolaterally

The sciatic nerve appeared as a hyperechoic structure just medial to the PBI. The nerve is deep (anterior) to the piriformis muscle and lateral to the inferior gluteal vessels (Fig. 2, supplementary online videos), and if followed caudally, it comes to rest directly on the back of the ischium (Fig. 3, supplementary online videos). The ultrasound probe might be adjusted further (rotated and/or rocked) to achieve a better sonographic nerve appearance. The scanning time from placement of the ultrasound probe on the patient until the recognition of the sciatic nerve was defined as the ultrasound identification time.

While attempting to avoid vascular injury, the needle was advanced inferior to the probe via an out-of-plane approach towards the sonographically identified nerve. When the needle tip came close to the nerve, the nerve stimulator, set at 1-mA current intensity, was switched on. If hamstring, leg, or foot twitches were elicited, the sonographic identification of the sciatic nerve was considered a success. The needle tip was adjusted under ultrasound guidance to maintain any of these muscle responses with a current intensity of 0.3–0.5 mA. After careful aspiration, 20 mL of the local anesthetic mixture—prepared by mixing 1% ropivacaine 10 mL and 1% lidocaine with

epinephrine 10 mL (1:100,000) —was slowly injected in 5-mL increments.

Block assessment and measurements

The sensory block was assessed by testing the pinprick sensation along the plantar and dorsal surfaces of the foot. The sensory block was classified as the following: grade 0 = normal sensation; grade I = impaired sensation; grade II = unable to recognize pinprick sensation in both skin areas. The motor block was assessed by testing the plantarflexion and dorsiflexion of the foot. The motor block was classified as the following: grade 0 = normal muscle power; grade I = motor weakness; grade II = complete motor paralysis in both directions. The assessment was performed every five minutes until grade II sensory and motor blocks were achieved or to a maximum of 45 min. Patients with grade II sensory and motor blocks were considered to have a successful block. The following data were recorded: the successful identification rate, ultrasound identification time, block success rate, onset of grade II sensory and motor blocks, and any complication. All measurements were assessed by the assistant.

Once grade II sensory and motor sciatic nerve blocks were achieved, femoral, obturator, and lateral femoral cutaneous nerve blocks were performed. Patients underwent a neurological assessment before hospital discharge and also during the physiotherapy visits for one month postoperatively.

Statistical analysis was performed using SPSS® for Windows v12 (SPSS Inc., Chicago, IL, USA). Qualitative, parametric, and non-parametric quantitative variables were presented as frequency (%), mean (standard deviation), and median [interquartile range], respectively.

Results

All patients were males with American Society of Anesthesiologists physical status I. Their mean age and body mass index were 28.1 (8) yr and 27.6 (4.0) $\text{kg}\cdot\text{m}^{-2}$, respectively. The sciatic nerve was identified successfully in 48 patients (96%). In those 48 patients, the median ultrasound identification time was 10 [8 - 13.7] sec (Fig. 4); the block success rate was 100%, and the median onset times of grade II sensory and motor blocks were 10 [5 - 20] min and 15 [5 - 20] min, respectively.

The nerve identification was unsuccessful in two (4%) obese patients (body mass index $> 35 \text{ kg}\cdot\text{m}^{-2}$). In the first patient, neither the sciatic nerve nor any other bony landmark could be identified. In the second patient, the needle tip could not be traced. Although other sacral plexus branches were not assessed, three patients noticed impaired

Fig. 4 The correlation between the ultrasound identification time (sec) and the body mass index ($\text{kg}\cdot\text{m}^{-2}$)

sensation of the penile skin and scrotum that resolved with regression of the sciatic block. All patients had painless surgery and no opioids were required. No complications were noted.

Discussion

The described sonographic details and probe maneuvers allowed rapid and highly successful identification and blockade of the sciatic nerve.

The parasacral area is a space at the back of the pelvis between the piriformis muscle and the pelvic fascia. The sciatic nerve lies within the parasacral area before it exits the pelvis^{1,8} (Fig. 2). Recently, ultrasound guidance has been used to localize the sciatic nerve²⁻⁵; however, in its proximal course, the sciatic nerve is deep and difficult to identify. Therefore, bones, which are easily identified sonographic landmarks,⁴ have been used to localize the nerve.²⁻⁵ Karmakar *et al.*⁵ identified the sciatic nerve midway between the ischial tuberosity and the greater trochanter. At the level of ischial spine, Chan *et al.*⁴ identified the nerve superficial to the ischium. Within the parasacral area, Ben-Ari *et al.*² identified the sacral plexus in relation to the PBI. The current study aimed to supplement this initial work by adding a more comprehensive description which shows how sonography can be used effectively to identify the sciatic nerve. The anatomical features described below were utilized during the ultrasound-guided blocks in this study:

- a) The PBI forms the lower lateral boundary of the greater sciatic foramen¹ and has a characteristically curved hyperechoic appearance. It can be identified simply at the level of the uppermost point of the

gluteal cleft or by following the three described probe maneuvers (Fig. 1).

- b) The sciatic nerve is the most lateral structure emerging through the greater sciatic foramen¹; therefore, it appears just medial to the PBI (Fig. 2).
- c) If followed slightly caudally, the sciatic nerve characteristically changes its relation to the ischium from being medial to its posterior border to resting on its back (Fig. 3).
- d) Since the sciatic nerve runs from deep to superficial (Fig. 3), a slight caudal tilting of the ultrasound probe may improve its sonographic appearance.
- e) The relation of the sciatic nerve to the piriformis muscle and other vascular structures within the parasacral area could ensure its identification (Fig. 2). In thin patients, peristaltic movement of intrapelvic structures could be seen deep to the nerve (supplemental online video).

Bendtsen *et al.*³ modified the technique of Ben-Ari *et al.*² They followed the ilium to localize the ischium while placing the ultrasound probe parallel to a line connecting the posterior superior iliac spine and the greater trochanter. In this position, the longitudinal axis of the probe was almost parallel to the course of the sciatic nerve in this region,¹ resulting in a more or less longitudinal view of the nerve. The probe placement in the current study allowed a shortcut view of the nerve with simultaneous identification of the inferior gluteal vessels medial to the nerve.

No complications were noted in the current study; however, voiding problems have been reported when using the parasacral sciatic nerve block.⁹ At this depth, the needle tip may not be identified precisely,⁴ that may result in injury of other pelvic structures (with overly deep needle advancement),¹⁰ inadvertent intravascular or intraneural injection. Electrical stimulation is important to confirm nerve identification and to decrease the risk of intraneural injection. The results of this study may not be generalized as the morphology of the greater sciatic notch is markedly affected by sex,¹¹ and the ability to visualize nerves is more compromised in geriatric and obese patients.¹²

In conclusion, the described sonographic details of the parasacral area facilitated rapid and successful identification of the sciatic nerve, which resulted in a successful block.

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Conflicts of interest None declared.

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