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Research advancements in ultrasound-guided popliteal sciatic nerve block

HAO Zhimin*, CHEN Jianming, LI Xiongjuan, CHEN Lin

**Department of Anesthesiology, Southern University of Science and Technology Hospital, Shenzhen, Guangdong 518055,China*

Corresponding author: CHEN Lin, Email：826168217@qq.com

Abstract: Popliteal sciatic nerve block is commonly used for anesthesia and analgesia in foot and ankle surgery. The traditional localization method of body surface marker assisted neurostimulator is cumbersome and has a low success rate of blocking. Moreover, the safety of conventional nerve block techniques in patients with pre-existing neuropathy（e.g., diabetic peripheral neuropathy） remains unclear. The success rate of blockage can be greatly enhanced through the utilization of ultrasound guidance, reduce the volume of local anesthetic and shorten the onset time. In this paper, several common focal issues in popliteal sciatic nerve block were discussed, such as the position of the needle tip, the puncture plane, puncture path, the diffusion mode of local anesthetics and the injection volume and concentration, in order to provide a reference for clinical application.

Keywords: Ultrasound; Popliteal sciatic nerve block; Regional anesthesia; Postoperative analgesia

The sciatic nerve (SN) is the thickest nerve in the human body, originating from the fourth lumbar nerve (L4) to the third sacral nerve (S3). It passes below the piriformis muscle through the greater sciatic foramen into the gluteal region, descending between the greater trochanter of the femur and the ischial tuberosity, and along the posterior thigh. Near the knee joint, it divides into the tibial nerve (TN) and the common peroneal nerve (CPN) [1]. The SN mainly innervates the motor function of the muscles in the posterior thigh and below the knee, as well as the sensory function of part of the posterior thigh, posterior knee joint, and the area below the knee except the medial aspect of the lower leg. Popliteal sciatic nerve block (PSNB) is commonly used for anesthesia and postoperative analgesia in foot and ankle surgeries [2]. It has recently been demonstrated that ultrasound-guided PSNB for managing resting pain in patients can enhance comfort and compliance during intravascular surgical procedures. Interventional radiologists recommend mastering this block technique [3]. Previous methods using surface localization or nerve stimulation devices for nerve blocks often had a certain rate of incomplete block. Most studies have shown that ultrasound-guided PSNB significantly increases the success rate of the block, reduces the local anesthetic dose, and shortens the onset time, in line with the current accelerated rehabilitation surgical concepts [4-6]. In recent years, scholars have conducted numerous studies to improve the efficacy of ultrasound-guided PSNB. This article discusses several common focal issues in PSNB and provides references for clinical application.

1. Needle tip lcation: intrasheath, extrasheath, and intraneural

Anatomical studies have revealed that the main trunk of the SN and its branches (TN and CPN) are collectively surrounded by a nerve sheath, with no nerve fiber crossing between the two branches [7]. This nerve sheath differs from the epineurium: it extends from the origin of the SN to a certain distance distal to the bifurcation point, surrounding both branches. In the proximal segment of the SN, the nerve sheath does not completely encircle the nerve; in the popliteal segment, however, the nerve sheath completely wraps the SN and has a clear boundary with the epineurium. The two nerves are separated by the Compton-Cruveilhier septum and surrounded by their respective epineuria **(Figure 1)** [8]. Andersen *et al.* [9] found in cadaveric studies that the nerve sheath is a thin, transparent, and fragile tissue layer composed of multiple fascia layers that surrounds the epineurium. Injecting 10 mL of fluid into this sheath can spread 10-15 cm along the long axis of the nerve but cannot completely encase the nerve; in contrast, extrasheath injection can only spread 5-6 cm. Meanwhile, the researchers suggested that intrasheath injection is not intraneural injection (since intraneural injection leads to an increase in nerve diameter and the drug solution can spread 15-17 cm along the nerve). Therefore, they recommended injecting local anesthetics into the nerve sheath during PSNB. Missair *et al.* [10] used three-dimensional ultrasound to compare the diffusion of local anesthetics after intrasheath and extrasheath injections during PSNB. They found that the intrasheath injection group had a significantly larger amount of local anesthetic around the nerve than the extrasheath injection group (5.57 mL *vs* 1.48 mL), a longer longitudinal diffusion distance along the nerve (9.3 cm *vs* 5.6 cm), and a higher success rate of complete sensory block (90% vs 60%). Studies by Perlas, Choquet, *et al.* [11-12] also confirmed that compared with extrasheath injection, intrasheath injection improved the block success rate, accelerate the onset time, and prolong the sensory block duration without increasing the incidence of nerve injury.

Many previous studies have found that PSNB guided by a nerve stimulator has a high incidence of intraneural injection, yet no obvious clinical symptoms of nerve injury or electrophysiological abnormalities have been observed. They hypothesized that the structure of the SN may play a protective role for neural components: from proximal to distal, the neural components in the SN gradually decrease while non-neural components such as connective tissue gradually increase. Moreover, all nerve fibers inside the nerve are surrounded by a thick and tough perineurium, making it easier for the puncture needle to enter the connective tissue between nerve fascicles rather than directly pierce the perineurium to enter the nerve fascicles [13-14]. Some recent studies have also shown that ultrasound-guided intraneural injection can not only improve the block success rate and accelerate the onset time but also significantly reduce the dose of local anesthetic required for the block (only 6.6 mL), with no clinical symptoms of nerve injury observed within 6 months after the block. However, neuro-electrophysiological examinations at 5 weeks and 6 months after the block showed a decrease in the amplitude of action potentials, which was not different from the decrease observed with intrasheath injection [15-16]. Theoretically, during peripheral nerve blocks, the closer the injected local anesthetic is to the nerve fibers, the faster the onset and the more reliable the effect [12]. However, intraneural injection of local anesthetics may cause the nerve to suffer mechanical, vascular, or chemical injury [17]. Numerous animal experiments have shown that intraneural injection can lead to neuroinflammatory injury and axon death, while extraneural injection only causes mild or no neuro-histological changes and is relatively safe [18-19]. Additionally, due to the nerve's certain self-repair ability, obvious clinical symptoms often do not appear after injury. However, its subclinical injury (such as neuro-electrophysiological changes) is a high-risk factor for nerve injury when the nerve suffers a secondary insult [20]. In addition, the resolution of ultrasound commonly used in clinical practice is not sufficient to accurately distinguish between whether the needle tip is inside or between nerve fascicles, which may increase the risk of nerve injury. In conclusion, the current limited evidence does not support intraneural injection, but whether the popliteal sciatic nerve is an exception remains to be studied **(Figure 2)** [21].

2 Puncture plane: proximal to bifurcation, distal to bifurcation, and at bifurcation

The location of the SN bifurcation varies significantly [22-23]. Barbosa *et al.* [24] dissected 44 cadaveric specimens and found that 67.96% of SN bifurcations were below the apex of the popliteal fossa, 15.90% above the apex, 11.36% adjacent to the apex, and 4.78% in the gluteal region. In contrast, Vloka *et al.* [7] found that the bifurcation was approximately (60.5±27.0) mm above the popliteal crease. The high variability of the bifurcation location may be one of the reasons for the unpredictable block efficacy of single-injection PSNB guided by a nerve stimulator: it is impossible to accurately determine whether the local anesthetic is injected proximal or distal to the bifurcation [7]. Studies have shown that PSNB guided by a nerve stimulator, which separately blocks TN and CPN at the distal site, offers many advantages such as improving the block success rate and shortening the block onset time [25]. Similarly, ultrasound-guided separate blocking of TN and CPN at the distal site of the bifurcation is significantly superior to blocking the main trunk of the SN proximal to the bifurcation [26-27]. However, unlike nerve stimulators that can only roughly estimate the location of the bifurcation, ultrasound allows direct visualization of the SN bifurcation and provides real-time guidance for the advancement of the puncture needle and the diffusion of local anesthetics. Thus, studies have found that compared with separate blocking of TN and CPN, ultrasound-guided injection of local anesthetics at the bifurcation can significantly improve the block success rate, shorten the procedure time, block onset time, and anesthesia-related time [28]. This conclusion has also been verified in clinical observations by Perlas' team [11]. Notably, Tran *et al.* [29] compared the efficacy of intrasheath injections proximal to the bifurcation and at the bifurcation under ultrasound guidance and found no difference between the two groups in block success rate, procedure time, onset time, or total anesthesia-related time. They believed that the possible reason is that the nerve sheath acts as a barrier to restrict the outward spread of local anesthetics and allow free diffusion within the sheath, thereby increasing the contact area between the nerve and the local anesthetic. Therefore, injecting local anesthetics into the nerve sheath is more important than the injection plane. In summary, since the SN is surrounded by a nerve sheath along its entire course in the thigh, intrasheath injection can theoretically be performed at any plane. However, at the bifurcation, the two nerves split to form a natural groove where the nerve sheath is most easily identifiable, making it potentially the optimal puncture site [11].

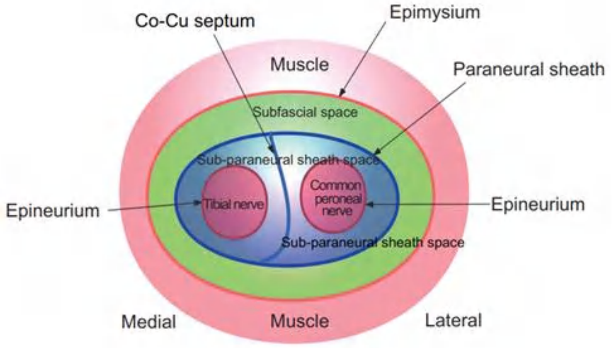

Fig.1 The epineurium and neurilemma surrounding the TN and CPN

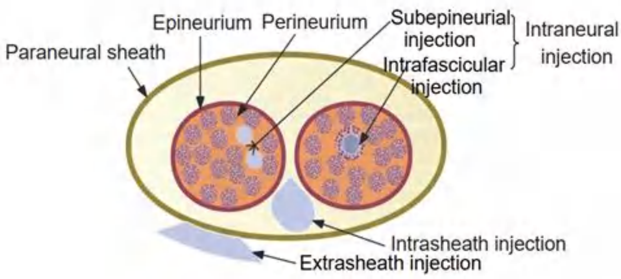

Fig.2 Schematic diagram of needle tip position during injection

3 Puncture approach

PSNB can be performed via multiple puncture approaches (e.g., posterior or lateral approach), but it usually requires the patient to be in the prone or lateral position. Patient positioning is not only time-consuming and labor-intensive but also increases pain in patients with lower limb fractures. Furthermore, it is unfavorable for patients with lumbar fractures, morbid obesity, hemodynamic instability, or those after general anesthesia [30-31]. Therefore, an increasing number of studies tend to explore performing PSNB in the supine position [23, 32]. Taha *et al.* [33] reported two medial approach PSNB techniques in the supine position: the patient only needs to slightly flex the knee (with slight or no tilt of the ipsilateral pelvis) to fully expose the medial and posterior aspects of the knee. Technique 1 involves placing a low-frequency probe on the medial thigh, first identifying and tracing the femoral artery and vein distally under ultrasound until they enter the posterior popliteal fossa and become the popliteal artery and vein. The SN usually runs alongside the popliteal vessels, and PSNB can be completed via out-of-plane needle insertion. Technique 2 involves placing a high-frequency probe in the popliteal fossa, identifying the SN located superficial to the popliteal vessels under ultrasound, and completing PSNB via in-plane needle insertion through the medial thigh (Figure 3). It should be noted that in the middle and lower segments of the thigh, the saphenous nerve courses in the anteromedial region, so both of the above puncture techniques carry the risk of injuring the saphenous nerve. Mistry *et al.* [30, 34] reported a modified lateral approach in the supine position: the affected limb is kept in a neutral position (without knee or hip flexion) or with slight internal rotation. A high-frequency or low-frequency ultrasound probe is placed perpendicularly on the lateral thigh above the popliteal fossa, and the probe is moved cephalad. The SN is identified between the hypoechoic muscles (vastus lateralis, long head of biceps femoris, semitendinosus, and semimembranosus muscles) and the hyperechoic femur (with or without visible popliteal vessels). PSNB can be completed via either in-plane or out-of-plane needle insertion from the lateral to the medial aspect of the thigh (Figure 4). In general, considering the risk of saphenous nerve injury during needle insertion with the medial approach, the lateral approach may be a better option, but this requires more studies to verify.

4 Diffusion pattern of local anesthetics

Circumferential diffusion of local anesthetics around the nerve is considered a guarantee for the success of ultrasound-guided peripheral nerve blocks and has been recognized by the American Society of Regional Anesthesia and Pain Medicine and the European Society of Regional Anaesthesia [35]. This also applies to PSNB: most studies have shown that circumferential diffusion of local anesthetics around the SN can improve the block success rate and accelerate the block onset time [36]. However, some studies have questioned this. They found that the efficacy of median nerve block seems unrelated to the diffusion pattern of local anesthetics: circumferential diffusion of local anesthetics around the nerve does not improve the block success rate, and it is impossible to determine whether the faster onset of circumferential diffusion block is due to the diffusion pattern or the larger dose of local anesthetic used [37]. This view has also been confirmed by Tiyaprasertkul *et al.* [38]: they compared the efficacy of single-point and three-point intrasheath injections at the SN bifurcation under ultrasound guidance and found no difference in block success rate within 30 min between the two groups. Although the three-point injection group had a slightly shorter onset time (12.5 min vs 15.8 min), the single-point injection group required fewer needle insertions and shorter needle insertion time, and three-point injection increased procedural difficulty. In addition, ensuring circumferential diffusion of local anesthetics may require multiple punctures or repeated injections, which may increase the risk of nerve injury, prolong the procedure time, and increase patient discomfort [39]. Therefore, some scholars believe that since the SN has a nerve sheath that restricts the free diffusion of local anesthetics within the sheath, it may not be necessary to deliberately pursue circumferential diffusion during PSNB, and effective block can be achieved simply by injecting the anesthetic into the nerve sheath. However, this still requires clinical verification [40]. Nevertheless, Nag *et al.* [41] showed that compared with single-point intrasheath injection (20 mL of 1.5% lidocaine mixed with epinephrine injected 2 cm above the bifurcation), two-point intrasheath injection (10 mL of 1.5% lidocaine mixed with epinephrine injected 2 cm and 6 cm above the bifurcation, respectively) did not significantly shorten the onset time of complete sensory block (16.7 min vs 12.1 min). However, because the local anesthetic diffuses more extensively along the longitudinal axis of the SN during two-point intrasheath injection, resulting in a longer length of nerve fibers exposed to the anesthetic, the onset time of complete motor block was shorter (20.9 min vs 14.5 min) and the block duration was longer (344.4 min vs 420.4 min).

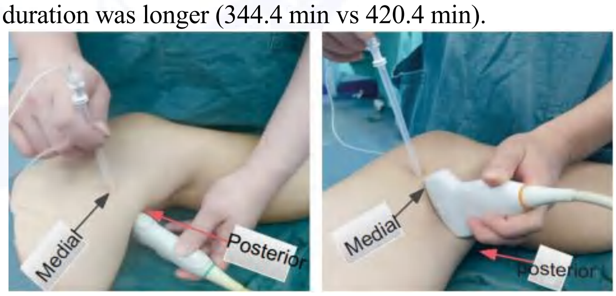

Fig.3 PSNB via the medial approach in the supine position

Fig.4 PSNB via the lateral approach in the supine position

5 Injection volume and concentration

The SN is the thickest nerve in the human body. During its downward course, different segments contain different neural components: from proximal to distal, the neural components gradually decrease, and by the popliteal segment, the neural components account for only 46%±11%. This may be the reason for the differences in the minimum effective volume (MEV) of local anesthetics required for blocking different segments. In addition, factors such as the type, concentration, and adjuvants of local anesthetics, the location of the needle tip, and the patient's age may affect the MEV required for block [42-45]. Jeong *et al.* [46] found that the median effective dose (ED50) of 0.5% ropivacaine was 6 mL, and the 95% effective dose (ED95) was 16 mL. Bang *et al.* [47] suggested that the MEV50 for intrasheath injection of 0.75% ropivacaine was 6.14 mL (4.33-7.94 mL), and the MEV90 was 8.9 mL (7.09-21.75 mL). Keplinger *et al.* [48] believed that the cross-sectional area of the SN varies greatly, so using the cross-sectional area of the nerve rather than a fixed volume to calculate the 99% effective dose (ED99) of local anesthetics is more reliable. The study found that the ED99 of 0.75% ropivacaine for blocking proximal to the bifurcation was 0.15 mL/mm². Cappelleri *et al.* [16] found in their study that the MEV90 for intraneural injection during SN block with 1% ropivacaine was 6.6 mL, with an onset time of approximately (19±12) min and a success rate of approximately 98%, but its safety remains to be verified. In addition, patients with comorbid peripheral neuropathy (e.g., diabetic peripheral neuropathy) may have increased sensitivity to local anesthetics, so the dose of local anesthetic required to complete the block is correspondingly reduced. For example, a study by Parthasarathy *et al.* [49] found that for patients with comorbid diabetic peripheral neuropathy, the MEV90 of ultrasound-guided intrasheath injection of 0.5% bupivacaine at the bifurcation was 5.85 mL.

6 Summary

As a commonly used clinical peripheral nerve block technique, improving the block efficacy of PSNB while reducing complications such as nerve injury has always been the goal that clinicians have been striving for. Current evidence indicates that the space between the nerve sheath and the epineurium between the two branches (TN, CPN) at the SN bifurcation is the optimal target for the puncture needle tip. However, the optimal puncture approach and injection dose, whether it is necessary to deliberately pursue circumferential diffusion of local anesthetics around the nerve during intrasheath injection, and the safety of intraneural injection still require further clinical verification.

Conflict of interest None

Reference

[1] Tomaszewski K A, Graves M J, Henry B M, et al. Surgical anatomy of the sciatic nerve: A meta-analysis [J]. Journal of orthopaedic research : official publication of the Orthopaedic Research Society, 2016, 10(34): 1820-1827.

[2] YS, Lu JJ, et al. Ultrasound-guided saphenous nerve and sciatic nerve block with indwelling catheter for postoperative analgesia of ankle fracture surgury[J]. Chin J Clin Res, 2019, 32(10): 1389-1392. **[In Chinese]**

[3] Discalzi A, Maglia C, Nardelli F, et al. Endovascular revascularization of critical limb ischemia: the role of ultrasound-guided popliteal sciatic nerve block for the procedural pain management[J]. Eur Radiol, 2024, 34(1): 287-293.

[4] Danelli G, Fanelli A, Ghisi D, et al. Ultrasound vs nerve stimulation multiple injection technique for posterior popliteal sciatic nerve block[J]. Anaesthesia, 2009, 64(6): 638-642.

[5] van Geffen GJ, van den Broek E, Braak GJ, et al. A prospective randomised controlled trial of ultrasound guided versus nerve stimulation guided distal sciatic nerve block at the popliteal Fossa[J]. Anaesth Intensive Care, 2009, 37(1): 32-37.

[6] Qi SY, Yun HF. Pain management scheme for joint replacement surgery under ERAS concept: multimodal preemptive analgesia[J]. Chin J Clin Res, 2023, 36(6): 948-951. **[In Chinese]**

[7] Vloka JD, Hadzić A, April E, et al. The division of the sciatic nerve in the popliteal Fossa: anatomical implications for popliteal nerve blockade[J]. Anesth Analg, 2001, 92(1): 215-217.

[8] Karmakar MK, Reina MA, Sivakumar RK, et al. Ultrasound-guided subparaneural popliteal sciatic nerve block: there is more to it than meets the eyes[J]. Reg Anesth Pain Med, 2021, 46(3): 268-275.

[9] Andersen HL, Andersen SL, Tranum-Jensen J. Injection inside the paraneural sheath of the sciatic nerve: direct comparison among ultrasound imaging, macroscopic anatomy, and histologic analysis[J]. Reg Anesth Pain Med, 2012, 37(4): 410-414.

[10] Missair A, Weisman RS, Suarez MR, et al. A 3-dimensional ultrasound study of local anesthetic spread during lateral popliteal nerve block: what is the ideal end point for needle tip position [J]. Reg Anesth Pain Med, 2012, 37(6): 627-632.

[11] Perlas A, Wong P, Abdallah F, et al. Ultrasound-guided popliteal block through a common paraneural sheath versus conventional injection: a prospective, randomized, double-blind study[J]. Reg Anesth Pain Med, 2013, 38(3): 218-225.

[12] Choquet O, Noble GB, Abbal B, et al. Subparaneural versus circumferential extraneural injection at the bifurcation level in ultrasound-guided popliteal sciatic nerve blocks: a prospective, randomized, double-blind study[J]. Reg Anesth Pain Med, 2014, 39(4): 306-311.

[13] Blanch XS, López AM, Carazo J, et al. Intraneural injection during nerve stimulator-guided sciatic nerve block at the popliteal Fossa[J]. Br J Anaesth, 2009, 102(6): 855-861.

[14] Sala-Blanch X, López AM, Pomés J, et al. No clinical or electrophysiologic evidence of nerve injury after intraneural injection during sciatic popliteal block[J]. Anesthesiology, 2011, 115(3): 589-595.

[15] Cappelleri G, Cedrati VLE, Fedele LL, et al. Effects of the intraneural and subparaneural ultrasound-guided popliteal sciatic nerve block: a prospective, randomized, double-blind clinical and electrophysiological comparison[J]. Reg Anesth Pain Med, 2016, 41(4): 430-437.

[16] Cappelleri G, Ambrosoli AL, Gemma M, et al. Intraneural ultrasound-guided sciatic nerve block: minimum effective volume and electrophysiologic effects[J]. Anesthesiology, 2018, 129(2): 241-248.

[17] Brull R, Hadzic A, Reina MA, et al. Pathophysiology and etiology of nerve injury following peripheral nerve blockade[J]. Reg Anesth Pain Med, 2015, 40(5): 479-490.

[18] Lupu CM, Kiehl TR, Chan VWS, et al. Nerve expansion seen on ultrasound predicts histologic but not functional nerve injury after intraneural injection in pigs[J]. Reg Anesth Pain Med, 2010, 35(2): 132-139.

[19] Farber SJ, Saheb-Al-Zamani M, Zieske L, et al. Peripheral nerve injury after local anesthetic injection[J]. Anesth Analg, 2013, 117(3): 731-739.

[20] Short A, Chan VWS, Perlas A. Is deliberate intraneural injection a case of "false economy" [J]. Reg Anesth Pain Med, 2016, 41(4): 421-423.

[21] Vlassakov K, Lirk P, Rathmell JP. Intraneural injection: is the jury still out [J]. Anesthesiology, 2018, 129(2): 221-224.

[22] Habumuremyi S, Kubwimana O, Archibong V, et al. Sciatic nerve variations around the piriformis muscle and bifurcation level: an anatomical study[J]. E Af Orth Jnl, 2024, 18(2): 58-64.
[23] Shah M, Damor P, Vyas M. A study of high division of sciatic nerve in human cadavers and its clinical significance[J]. Natl J Physiol Pharm Pharmacol, 2022: 1.
[24] Barbosa FT, Barbosa TRBW, da Cunha RM, et al. Anatomical basis for sciatic nerve block at the knee level[J]. Braz J Anesthesiol, 2015, 65(3): 177-179.
[25] March X, Pineda O, Garcia MM, et al. The posterior approach to the sciatic nerve in the popliteal Fossa: a comparison of single- versus double-injection technique[J]. Anesth Analg, 2006, 103(6): 1571-1573.
[26] Germain G, Lévesque S, Dion N, et al. Brief reports: a comparison of an injection cephalad or caudad to the division of the sciatic nerve for ultrasound-guided popliteal block: a prospective randomized study[J]. Anesth Analg, 2012, 114(1): 233-235.
[27] White L, Bright M, Velli G, et al. Efficacy and safety of proximal popliteal sciatic nerve block compared with distal sciatic bifurcation or selective tibial and peroneal nerve block: a systematic review and meta-analysis of randomised controlled trials[J]. Br J Anaesth, 2022, 129(6): e158-e162.
[28] Tran DQH, Dugani S, Pham K, et al. A randomized comparison between subepineural and conventional ultrasound-guided popliteal sciatic nerve block[J]. Reg Anesth Pain Med, 2011, 36(6): 548-552.
[29] Tran DQH, González AP, Bernucci F, et al. A randomized comparison between bifurcation and prebifurcation subparaneural popliteal sciatic nerve blocks[J]. Anesth Analg, 2013, 116(5): 1170-1175.
[30] Mistry T, Sonawane K, Keshri V, et al. Ultrasound-guided CAPS (crosswise approach to popliteal sciatic) block: a novel technique for supine popliteal Fossa block[J]. Cureus, 2022, 14(1): e20894.
[31] Soor B, Garg I. A case report of an ultrasound-guided popliteal sciatic nerve block: an asset for emergency lower limb debridement in a high-risk patient[J]. Cureus, 2024, 16(4): e57752.
[32] Samet RE, Dorsey N, Sappenfield JW, et al. The influence of patient position on ultrasound examination of the sciatic nerve in the popliteal Fossa: a cross-sectional study[J]. Australas J Ultrasound Med, 2023, 26(3): 142-149.
[33]Taha AM, Ahmed AF. Supine ultrasound-guided popliteal block: a medial approach[J]. Br J Anaesth, 2016, 116(2): 295-296.
[34] Mistry T, Sonawane K, Balavenkatasubramanian J, et al. CAPS (crosswise approach to popliteal sciatic) block: an alternative ultrasound-guided technique for supine popliteal Fossa block[J]. Br J Anaesth, 2022, 128(5): e299-e300.
[35] Choquet O, Morau D, Biboulet P, et al. Where should the tip of the needle be located in ultrasound-guided peripheral nerve blocks [J]. Curr Opin Anaesthesiol, 2012, 25(5): 596-602.
[36] Brull R, MacFarlane AJR, Parrington SJ, et al. Is circumferential injection advantageous for ultrasound-guided popliteal sciatic nerve block : a proof-of-concept study[J]. Reg Anesth Pain Med, 2011, 36(3): 266-270.
[37] Marhofer D, Karmakar MK, Marhofer P, et al. Does circumferential spread of local anaesthetic improve the success of peripheral nerve block [J]. Br J Anaesth, 2014, 113(1): 177-185.
[38] Tiyaprasertkul W, Bernucci F, González AP, et al. A randomized comparison between single- and triple-injection subparaneural popliteal sciatic nerve block[J]. Reg Anesth Pain Med, 2015, 40(4): 315-320.
[39] Ip V, Tsui B. Injection through the paraneural sheath rather than circumferential spread facilitates safe, effective sciatic nerve block[J]. Reg Anesth Pain Med, 2013, 38(4): 373.
[40] Nag K, Ravishankar M, Parthasarathy S, et al. Quantitative assessment of ultrasound-guided sciatic nerve block - A comparison of a single-point versus two-point injection technique: a randomised controlled, double-blinded trial[J]. Indian J Anaesth, 2023, 67(9): 802-808.
[41] Huang LL, Yu YL, Ji H, et al. Clinical effect of ropivacaine combined with dexmedetomidine in sciatic nerve block—Comment on Safe Application of Therapeutic Drugs in Neurology[J]. Chin J Clin Res, 2024, 37(4): 654. **[In Chinese]**
[42] Lei GY, Yang SL, Wu LL, et al. Intravenous injection of dexamethasone is non-inferior to perineural administration for popliteal sciatic nerve and saphenous nerve blocks: a randomized, controlled, triple-blind study[J]. Heliyon, 2024, 10(7): e28304.
[43] Coviello A, Iacovazzo C, Cirillo D, et al. Dexamethasone versus dexmedetomidine as adjuvants in ultrasound popliteal sciatic nerve block for hallux Valgus surgery: a mono-centric retrospective comparative study[J]. Drug Des Devel Ther, 2024, 18: 1231-1245.
[44] Parthasarathy S, Venkatesh TK, Saravanan B. Evaluation of age-based local anaesthetic dosing of bupivacaine for popliteal sciatic nerve block in children undergoing foot and ankle surgery: a prospective single arm interventional study[J]. Indian J Anaesth, 2023, 67(Suppl 4): S257-S260.
[45] Chen L, Shi XJ, Chen SQ, et al. Application of dexmedetomidine combined with ropivacaine intercostal nerve block in thoracoscopic pulmonary wedge resection[J]. Chin J Clin Res, 2025, 38(3): 437-440. **[In Chinese]**
[46] Jeong JS, Shim JC, Jeong MA, et al. Minimum effective anaesthetic volume of 0.5% ropivacaine for ultrasound-guided popliteal sciatic nerve block in patients undergoing foot and ankle surgery: determination of ED50 and ED95[J]. Anaesth Intensive Care, 2015, 43(1): 92-97.
[47] Bang SU, Kim DJ, Bae JH, et al. Minimum effective local anesthetic volume for surgical anesthesia by subparaneural, ultrasound-guided popliteal sciatic nerve block: a prospective dose-finding study[J]. Medicine (Baltimore), 2016, 95(34): e4652.
[48] Keplinger M, Marhofer P, Marhofer D, et al. Effective local anaesthetic volumes for sciatic nerve blockade: a clinical evaluation of the ED99[J]. Anaesthesia, 2015, 70(5): 585-590.
[49] Parthasarathy S, Chanda A, Saravanan B. Estimation of the minimum effective volume of 0.5% bupivacaine for ultrasound-guided popliteal sciatic nerve block in diabetic patients with neuropathy[J]. Indian J Anaesth, 2022, 66(7): 511-516.

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· 研究进展 ·

超声引导下腘窝坐骨神经阻滞的研究进展

郝志敏[1]， 陈剑明[2]， 李雄娟[2]， 陈林[1]
1. 南方科技大学医院麻醉科，广东 深圳 518055；2. 深圳市第二人民医院麻醉科，广东 深圳 518035

摘要： 腘窝坐骨神经阻滞常用于足踝部手术的麻醉与镇痛，但其传统的体表标志辅助神经刺激仪定位法操作繁冗，阻滞成功率低。而且对于已患有神经病变(例如糖尿病周围神经病变)的患者，常规神经阻滞技术的安全性仍不清楚。采用超声引导能明显提高阻滞的成功率、减少局麻药用量及缩短阻滞起效时间等。本文就腘窝坐骨神经阻滞中常见的几个焦点问题——针尖位置、穿刺平面、穿刺入路、局麻药的扩散方式及注射用量、浓度等进行了探讨，以期为临床应用提供参考。

关键词： 超声；腘窝坐骨神经阻滞；区域麻醉；术后镇痛
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Research advancements in ultrasound-guided popliteal sciatic nerve block

HAO Zhimin*, CHEN Jianming, LI Xiongjuan, CHEN Lin
**Department of Anesthesiology, Southern University of Science and Technology Hospital, Shenzhen, Guangdong 518055, China*
Corresponding author: CHEN Lin, E-mail: 826168217@qq.com

Abstract: Popliteal sciatic nerve block is commonly used for anesthesia and analgesia in foot and ankle surgery. The traditional localization method of body surface marker assisted neurostimulator is cumbersome and has a low success rate of blockage. Moreover, the safety of conventional nerve block techniques in patients with pre-existing neuropathy (e.g., diabetic peripheral neuropathy) remains unclear. The utilization of ultrasound guidance can greatly enhance the success rate of blockage, reduce the volume of local anesthetic and shorten the onset time. In this paper, several common focal issues in popliteal sciatic nerve block were discussed, such as the position of the needle tip, the puncture plane, puncture path, the diffusion mode of local anesthetics and the injection volume and concentration, in order to provide a reference for clinical application.

Keywords: Ultrasound; Popliteal sciatic nerve block; Regional anesthesia; Postoperative analgesia

坐骨神经(sciatic nerve,SN)是人体最粗大的神经，起源于第4腰神经(L4)至第3骶神经(S3)，在梨状肌下方经坐骨大孔进入臀部，在股骨大转子和坐骨结节之间下行，沿股后部，在近膝关节附近分为胫神经(tibial nerve,TN)和腓总神经(common peroneal nerve,CPN)[1]。SN主要支配大腿后部和膝盖以下肌肉的运动，以及部分大腿后部、膝关节后部和膝部以下除小腿内侧的感觉。腘窝坐骨神经阻滞(popliteal sciatic nerve block,PSNB)常用于足踝手术的麻醉与术后镇痛[2]。近来已被证明，超声引导下的PSNB用于管理静息痛患者，可提高血管内手术过程中的舒适度和依从性。介入放射科医生都推荐掌握这种阻滞技术[3]。以往采用体表定位或神经刺激仪引导进行神经阻滞常存在一定阻滞不全的几率，而大部分研究表明超声引导下PSNB能明显提高阻滞的成功率、减少局麻药用量及缩短阻滞起效时间等，符合目前的加速康复外科理念[4-6]。近年来，学者们针对提高超声引导下PSNB的阻滞效果进行了许多研究，本文探讨了PSNB中常见的几个焦点问题，为临床应用提供参考。

1 针尖位置：神经鞘内、神经鞘外与神经内

解剖学研究发现SN主干及其分支TN、CPN共同被神经鞘包绕，两分支之间无神经纤维交叉[7]。该神经鞘不同于神经外膜，从SN起始一直延伸到分叉点远端包绕两分支一段距离；在SN起始段，神经鞘并未完整地包绕神经一周；而在腘窝段，神经鞘完整包裹SN，与神经外膜分界清晰；两根神经由“康普顿-克吕韦耶”隔膜间隔开，并被各自的神经外膜包绕(图1)[8]。Andersen等[9]在尸体研究中发现神经鞘是包绕在神经外膜外的由多层筋膜组成的、薄的、透明的、脆弱的组织层，在此鞘内注射10 mL液体可沿神经长轴扩散10~15 cm，但并

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通信作者：陈林，E-mail: 826168217@qq.com
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不能完全包裹神经；而鞘外注射仅能扩散5~6 cm；同时研究人员认为鞘内注射并非神经内注射（因神经内注射时神经的直径增加，药液可沿神经扩散15~17 cm），因此建议在行PSNB时将局麻药注射到神经鞘内。Missair等[10]采用三维超声比较了PSNB时鞘内注射与鞘外注射后局麻药的扩散，发现鞘内注射组神经周围麻药量明显多于鞘外注射组（5.57 mL *vs* 1.48 mL），沿神经纵向扩散距离较长（9.3 cm *vs* 5.6 cm），完全感觉阻滞成功率较高（90% *vs* 60%）。Perlas及Choquet等[11-12]的研究也证明与鞘外注射相比，鞘内注射可提高阻滞成功率、加速起效时间和延长感觉阻滞时间，且不增加神经损伤发生率。

以往许多研究发现神经刺激仪引导下的PSNB神经内注射发生率很高，但并未出现明显的临床神经损伤症状或电生理异常，他们推测可能是SN的结构对神经成分起到了保护作用：从近端到远端，SN内的神经成分逐渐减少，结缔组织等非神经成分逐渐增多，且在神经内部所有的神经纤维都被厚而坚韧的神经束膜包绕着，使穿刺针更易进入神经束之间的结缔组织而非直接刺穿神经束膜进入神经束内[13-14]。最近一些研究也表明超声引导下神经内注射不仅可提高阻滞成功率、加速起效时间，还能大幅减少阻滞所需局麻药用量（仅需6.6 mL），且阻滞后6个月内未发现神经损伤的临床症状；然而阻滞后5周、6个月的神经电生理检查显示动作电位的幅度降低，但与神经鞘内注射的降低幅度无差异[15-16]。理论上讲，外周神经阻滞时注射的局麻药越靠近神经纤维，起效越快、效果越可靠[12]，但神经内注射局麻药可能导致神经遭受机械性、血管性或化学性损伤[17]。许多动物实验都表明神经内注射可导致神经炎性损伤和轴突死亡，而神经外注射仅引起轻微损伤或无神经组织学改变，相对比较安全[18-19]；且由于神经具有一定的自我修复能力，损伤后常不表现出明显的临床症状，但其亚临床损伤（如神经电生理改变）是神经遭受二次打击时出现神经损伤的高危因素[20]。另外，目前临床常用的超声分辨率还不足以精确分辨出针尖是在神经束内还是神经束之间，这可能增加神经损伤的风险。总之，目前有限的证据尚不支持神经内注射，但腘窝坐骨神经是否例外尚有待研究（图2）[21]。

2 穿刺平面：分叉点近端、远端与分叉点

SN的分叉点位置变异很大[22-23]。Barbosa等[24]解剖了44例尸体标本，发现SN分叉点67.96%在腘窝顶点下方，15.90%在顶点上方，11.36%紧靠顶点，还有4.78%在臀区；而Vloka等[7]发现分叉点大致在腘横纹上方（60.5±27.0）mm。分叉点变异性大的特点可能是神经刺激仪引导的单点PSNB阻滞效果不确定的原因之一：因无法准确判断局麻药是注射到分叉点近端还是远端[7]。研究表明神经刺激仪引导下PSNB在远端分别阻滞TN、CPN可带来许多优势：如提高阻滞成功率、缩短阻滞起效时间等[25]。同样，超声引导下在分叉点远端分别阻滞TN、CPN也明显优于分叉点近端阻滞SN主干[26-27]。然而，不同于神经刺激仪仅能大致推测分叉点的位置，超声下能直视SN分叉点，实时引导穿刺针的行进及局麻药的扩散，因而有研究发现相比分别阻滞TN、CPN，超声引导下在分叉点注射局麻药可明显提高阻滞成功率、缩短操作时间、阻滞起效时间及麻醉相关时间[28]，该结论在Perlas团队的临床观察中也得到验证[11]。值得注意的是，Tran等[29]比较了超声引导下分叉点近端和分叉点神经鞘内注射的效果发现，两组间阻滞成功率、操作时间、起效时间及总的麻醉相关时间并无差异，他们认为可能的原因是神经鞘就像屏障一样限制局麻药外扩并在鞘内自由扩散，从而使神经与局麻药的接触面更广，因此将局麻药注射到神经鞘内比在哪个平面注射更重要。总的来说，由于SN在大腿的整个行程中都有神经鞘包绕，理论上在任何平面都可行鞘内注射，但在分叉点两根神经分裂形成一个天然的凹槽，此处神经鞘膜最易识别，因此可能是最佳穿刺点[11]。

3 穿刺入路

PSNB可有多种穿刺入路（如后侧入路或外侧入路），但通常都需要在俯卧位或侧卧位下完成，体位摆放不仅费时费力、增加下肢骨折患者的疼痛，且可能不利于腰椎骨折、病态肥胖、血流动力学不稳定或全麻后的患者[30-31]，因此，越来越多的研究倾向于探索在仰卧位下完成PSNB[23,32]。Taha等[33]报道了2种仰卧位下内侧入路PSNB技术，患者仅需稍屈膝（可稍微倾斜或不倾斜同侧骨盆），充分暴露膝部内侧和后侧；技术1是将低频探头置于大腿内侧，超声下首先识别股动静脉并向下追踪，直至其进入后侧的腘窝成为腘动静脉，SN通常与腘血管伴行，可通过平面外进针完成PSNB；技术2是将高频探头置于腘窝，超声下识别位于腘血管浅面的SN，穿刺针经大腿内侧平面内进针完成PSNB（图3）。需要注意的是，在大腿中下段，隐神经走行于前内侧区域，因此以上2种穿刺技术均有损伤隐神经的可能。Mistry等[30,34]报道了一种仰卧位下的改良外侧入路：患肢保持中立位（不需屈膝或屈髋）或轻微内旋，高频或低频超声探头垂直置于腘窝上大腿外侧，头侧移动探头，在低回声的肌肉（股外侧肌、股二头肌长头、半腱肌和半膜肌）和高回声的股骨之间识别SN（腘血管可见或不可见），由大腿外侧向内侧平面内或平面外进针均可完成PSNB（图4）。总的来说，考虑到内侧入路进针时有损伤隐神经的风险，因此外侧入路或许是更好的选择，但这需要更多的研究来验证。

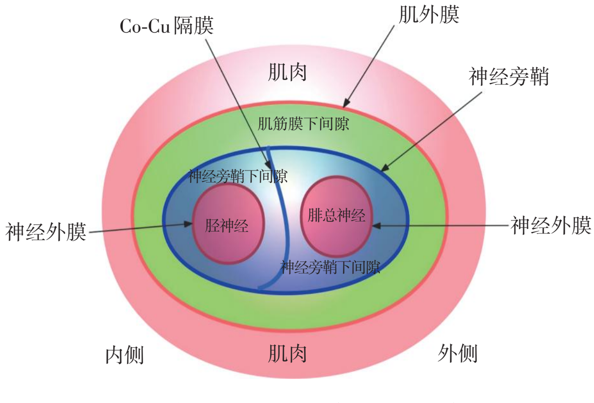

图1 包绕TN和CPN的神经外膜和神经鞘
Fig.1 The epineurium and neurilemma surrounding the TN and CPN

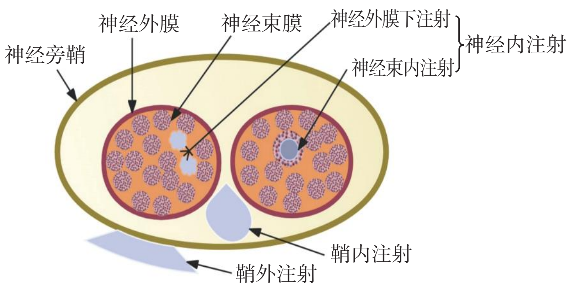

图2 注射时针尖位置示意图

Fig.2 Schematic diagram of needle tip position during injection

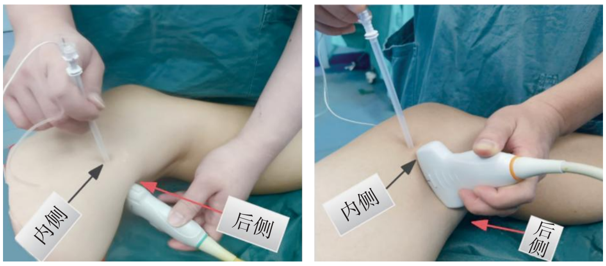

图3 仰卧位下内侧入路PSNB示意图

Fig.3 Schematic diagram of PSNB via the medial approach in the supine position

图4 仰卧位下外侧入路PSNB示意图

Fig.4 Schematic diagram of PSNB via the lateral approach in the supine position

4 局麻药的扩散方式

局麻药在神经周围包绕神经环形扩散被认为是超声引导下外周神经阻滞成功的保证，也得到了美国区域麻醉和疼痛医学学会和欧洲区域麻醉学会的认可[35]。这同样也适用于PSNB：大部分研究都表明局麻药绕SN神经环形扩散可提高阻滞成功率、加速阻滞的起效时间等[36]。但也有研究对此提出了质疑，他们发现正中神经阻滞效果似乎与局麻药的扩散方式无关：局麻药围绕神经环形扩散并不能提高阻滞成功率，也无法确定环形扩散阻滞起效快是由于扩散方式引起的还是因所用局麻药用量大引起的[37]。这一观点也在Tiyaprasertkul等[38]的研究中得到了证实：他们比较了超声引导下SN分叉点单点与三点鞘内注射的效果，发现两组30 min内阻滞成功率无差异，虽然三点注射组起效时间稍短（12.5 min *vs* 15.8 min），但单点注射组进针次数少、进针时间短，而且三点注射增加了操作的难度。另外，要保证局麻药环形扩散可能需要多点穿刺或重复注射，可能增加神经损伤的风险、延长操作时间、加剧患者的不适[39]。因此，有学者认为因SN有神经鞘可限制局麻药在鞘内自由扩散，PSNB时可能不必刻意追求环形扩散，只需将麻药注入神经鞘内即可达到有效的阻滞，但这仍需要临床验证[40]。尽管如此，黄莉莉等[41]的研究结果表明相比单点鞘内注射（分叉点上2 cm处注射1.5%利多卡因+肾上腺素混合液20 mL），虽然两点鞘内注射（分叉点上2 cm和6 cm处分别注射1.5%利多卡因+肾上腺素混合液10 mL）并不能明显缩短完全感觉阻滞的起效时间（16.7 min *vs* 12.1 min），但由于两点鞘内注射时麻药沿SN纵向扩散更广，使暴露于麻药的神经纤维长度更长，因此完全运动阻滞起效的时间更短（20.9 min *vs* 14.5 min），且阻滞持续时间更长（344.4 min *vs* 420.4 min）。

5 注射容量与浓度

SN是人体最粗大的神经，在其下行过程中不同的节段所含神经成分不同，从近端到远端，神经成分逐渐减少，至腘窝段其所含神经成分只有46%±11%，这可能是阻滞不同节段所需局麻药的最小有效容积（minimum effective volume，MEV）不同的原因。另外，局麻药的种类、浓度、辅剂、针尖的位置及患者的年龄等都可能影响阻滞所需的MEV[42-45]。Jeong等[46]发现0.5%罗哌卡因的半数有效剂量为6 mL，95%有效剂量为16 mL；Bang等[47]认为0.75%罗哌卡因鞘内注射的MEV_{50}为6.14 mL（4.33~7.94 mL），MEV_{90}为8.9 mL（7.09~21.75 mL）。Keplinger等[48]认为SN的横截面积差异很大，因此应用神经的横截面积而非固定的容量来计算局麻药的99%有效剂量（99% effective dose，ED_{99}）更可靠，研究发现0.75%罗哌卡因在分叉点近端阻滞的ED_{99}为0.15 mL/mm^2。而Cappelleri等[16]研究发现1%罗哌卡因SN阻滞时神经内注射的MEV_{90}为6.6 mL，起效时间约为（19±12）min，成功率约98%，但其安全性尚有待验证。另外，对于合并有外周神经病变（如糖尿病周围神经病变）的患者，可能对局麻药敏感性增加，因此完成阻滞所需的局麻药量也相应减少。如Parthasarathy等[49]的研究发现对于合并有糖尿病周围神经病变的患者，超声引导下在分叉点处鞘内注射0.5%布比卡因的MEV_{90}为5.85 mL。

6 小 结

PSNB作为临床常用的外周神经阻滞技术，如何在提高其阻滞效果的同时减少神经损伤等并发症一直都是临床医生努力的目标。就目前的证据表明在SN分叉点两分支（TN、CPN）之间神经鞘膜与神经外膜之间的间隙是穿刺针尖的最佳靶点；但最佳穿刺入路和注射用量、鞘内注射时是否必须刻意追求局麻药围绕神经环形扩散及神经内注射的安全性仍有待临床进一步验证。

利益冲突 无

参考文献

[1] Tomaszewski KA, Graves MJ, Henry BM, et al. Surgical anatomy of the sciatic nerve: a meta-analysis [J]. Journal of orthopaedic research : official publication of the Orthopaedic Research Society, 2016, 10(34):1820-1827.

[2] 喻翔卿，赵以松，陆季娟，等．超声引导下隐神经与坐骨神经联

合置管阻滞应用于踝关节骨折术后镇痛[J]. 中国临床研究，2019，32(10)：1389-1392.
[3] Discalzi A，Maglia C，Nardelli F，et al. Endovascular revascularization of critical limb ischemia：the role of ultrasound-guided popliteal sciatic nerve block for the procedural pain management[J]. Eur Radiol，2024，34(1)：287-293.
[4] Danelli G，Fanelli A，Ghisi D，et al. Ultrasound vs nerve stimulation multiple injection technique for posterior popliteal sciatic nerve block[J]. Anaesthesia，2009，64(6)：638-642.
[5] van Geffen GJ，van den Broek E，Braak GJ，et al. A prospective randomised controlled trial of ultrasound guided versus nerve stimulation guided distal sciatic nerve block at the popliteal Fossa[J]. Anaesth Intensive Care，2009，37(1)：32-37.
[6] 齐诗园，恽惠方. 加速康复外科理念下关节置换术疼痛管理方案——多模式超前镇痛[J]. 中国临床研究，2023，36(6)：948-951.
[7] Vloka JD，Hadzić A，April E，et al. The division of the sciatic nerve in the popliteal Fossa：anatomical implications for popliteal nerve blockade[J]. Anesth Analg，2001，92(1)：215-217.
[8] Karmakar MK，Reina MA，Sivakumar RK，et al. Ultrasound-guided subparaneural popliteal sciatic nerve block：there is more to it than meets the eyes[J]. Reg Anesth Pain Med，2021，46(3)：268-275.
[9] Andersen HL，Andersen SL，Tranum-Jensen J. Injection inside the paraneural sheath of the sciatic nerve：direct comparison among ultrasound imaging，macroscopic anatomy，and histologic analysis[J]. Reg Anesth Pain Med，2012，37(4)：410-414.
[10] Missair A，Weisman RS，Suarez MR，et al. A 3-dimensional ultrasound study of local anesthetic spread during lateral popliteal nerve block：what is the ideal end point for needle tip position [J]. Reg Anesth Pain Med，2012，37(6)：627-632.
[11] Perlas A，Wong P，Abdallah F，et al. Ultrasound-guided popliteal block through a common paraneural sheath versus conventional injection：a prospective，randomized，double-blind study[J]. Reg Anesth Pain Med，2013，38(3)：218-225.
[12] Choquet O，Noble GB，Abbal B，et al. Subparaneural versus circumferential extraneural injection at the bifurcation level in ultrasound-guided popliteal sciatic nerve blocks：a prospective，randomized，double-blind study[J]. Reg Anesth Pain Med，2014，39(4)：306-311.
[13] Blanch XS，López AM，Carazo J，et al. Intraneural injection during nerve stimulator-guided sciatic nerve block at the popliteal fossa[J]. Br J Anaesth，2009，102(6)：855-861.
[14] Sala-Blanch X，López AM，Pomés J，et al. No clinical or electrophysiologic evidence of nerve injury after intraneural injection during sciatic popliteal block[J]. Anesthesiology，2011，115(3)：589-595.
[15] Cappelleri G，Cedrati VLE，Fedele LL，et al. Effects of the intraneural and subparaneural ultrasound-guided popliteal sciatic nerve block：a prospective，randomized，double-blind clinical and electrophysiological comparison[J]. Reg Anesth Pain Med，2016，41(4)：430-437.
[16] Cappelleri G，Ambrosoli AL，Gemma M，et al. Intraneural ultrasound-guided sciatic nerve block：minimum effective volume and electrophysiologic effects[J]. Anesthesiology，2018，129(2)：241-248.
[17] Brull R，Hadzic A，Reina MA，et al. Pathophysiology and etiology of nerve injury following peripheral nerve blockade[J]. Reg Anesth Pain Med，2015，40(5)：479-490.
[18] Lupu CM，Kiehl TR，Chan VWS，et al. Nerve expansion seen on ultrasound predicts histologic but not functional nerve injury after intraneural injection in pigs[J]. Reg Anesth Pain Med，2010，35(2)：132-139.
[19] Farber SJ，Saheb-Al-Zamani M，Zieske L，et al. Peripheral nerve injury after local anesthetic injection[J]. Anesth Analg，2013，117(3)：731-739.
[20] Short A，Chan VWS，Perlas A. Is deliberate intraneural injection a case of “false economy”[J]. Reg Anesth Pain Med，2016，41(4)：421-423.
[21] Vlassakov K，Lirk P，Rathmell JP. Intraneural injection：is the jury still out[J]. Anesthesiology，2018，129(2)：221-224.
[22] Habumuremyi S，Kubwimana O，Archibong V，et al. Sciatic nerve variations around the piriformis muscle and bifurcation level：an anatomical study[J]. E Af Orth Jnl，2024，18(2)：58-64.
[23] Shah M，Damor P，Vyas M. A study of high division of sciatic nerve in human cadavers and its clinical significance[J]. Natl J Physiol Pharm Pharmacol，2022：1.
[24] Barbosa FT，Barbosa TRBW，da Cunha RM，et al. Anatomical basis for sciatic nerve block at the knee level[J]. Braz J Anesthesiol，2015，65(3)：177-179.
[25] March X，Pineda O，Garcia MM，et al. The posterior approach to the sciatic nerve in the popliteal fossa：a comparison of single- versus double-injection technique[J]. Anesth Analg，2006，103(6)：1571-1573.
[26] Germain G，Lévesque S，Dion N，et al. Brief reports：a comparison of an injection cephalad or caudad to the division of the sciatic nerve for ultrasound-guided popliteal block：a prospective randomized study[J]. Anesth Analg，2012，114(1)：233-235.
[27] White L，Bright M，Velli G，et al. Efficacy and safety of proximal popliteal sciatic nerve block compared with distal sciatic bifurcation or selective tibial and peroneal nerve block：a systematic review and meta-analysis of randomised controlled trials[J]. Br J Anaesth，2022，129(6)：e158-e162.
[28] Tran DQH，Dugani S，Pham K，et al. A randomized comparison between subepineural and conventional ultrasound-guided popliteal sciatic nerve block[J]. Reg Anesth Pain Med，2011，36(6)：548-552.
[29] Tran DQH，González AP，Bernucci F，et al. A randomized comparison between bifurcation and prebifurcation subparaneural popliteal sciatic nerve blocks[J]. Anesth Analg，2013，116(5)：1170-1175.
[30] Mistry T，Sonawane K，Keshri V，et al. Ultrasound-guided CAPS (crosswise approach to popliteal sciatic) block：a novel technique for supine popliteal Fossa block [J]. Cureus，2022，14(1)：e20894.
[31] Soor B，Garg I. A case report of an ultrasound-guided popliteal sciatic nerve block：an asset for emergency lower limb debridement in a high-risk patient[J]. Cureus，2024，16(4)：e57752.
[32] Samet RE，Dorsey N，Sappenfield JW，et al. The influence of patient position on ultrasound examination of the sciatic nerve in the popliteal fossa：a cross-sectional study[J]. Australas J Ultrasound Med，2023，26(3)：142-149.
[33] Taha AM，Ahmed AF. Supine ultrasound-guided popliteal block：a medial approach[J]. Br J Anaesth，2016，116(2)：295-296.
[34] Mistry T，Sonawane K，Balavenkatasubramanian J，et al. CAPS (crosswise approach to popliteal sciatic) block：an alternative ultrasound-guided technique for supine popliteal fossa block[J]. Br J Anaesth，2022，128(5)：e299-e300.
[35] Choquet O，Morau D，Biboulet P，et al. Where should the tip of the needle be located in ultrasound-guided peripheral nerve blocks[J]. Curr Opin Anaesthesiol，2012，25(5)：596-602.
[36] Brull R，Macfarlane AJ，Parrington SJ，et al. Is circumferential injection advantageous for ultrasound-guided popliteal sciatic nerve block?：a proof-of-concept study[J]. Reg Anesth Pain Med，2011，36(3)：266-270.
[37] Marhofer D，Karmakar MK，Marhofer P，et al. Does circumferential spread of local anaesthetic improve the success of peripheral nerve block [J]. Br J Anaesth，2014，113(1)：177-185.

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[2] Zhou Y, Zhang J, Chen J, et al. Prediction using T2-weighted magnetic resonance imaging-based radiomics of residual uterine myoma regrowth after high-intensity focused ultrasound ablation[J]. Ultrasound Obstet Gynecol, 2022, 60(5): 681-692.
[3] Paul PG, Mehta S, Annal A, et al. Reproductive outcomes after laparoscopic myomectomy: conventional versus barbed suture[J]. J Minim Invasive Gynecol, 2022, 29(1): 77-84.
[4] Daniels J, Middleton LJ, Cheed V, et al. Uterine artery embolisation versus myomectomy for premenopausal women with uterine fibroids wishing to avoid hysterectomy: the FEMME RCT[J]. Health Technol Assess, 2022, 26(22): 1-74.
[5] 郭顺, 曾晓琴, 李波, 等. 环泊酚与丙泊酚用于腹腔镜胆囊切除术全麻诱导与维持的比较[J]. 临床麻醉学杂志, 2023, 39(6): 601-604.
[6] Tsiampa E, Tsiampas K, Kapogiannis F. Perioperative and reproductive outcomes' comparison of mini-laparotomy and laparoscopic myomectomy in the management of uterine leiomyomas: a systematic review[J]. Arch Gynecol Obstet, 2024, 309(3): 821-829.
[7] 高玉蓓, 李寿春, 赵瑞珍, 等. 依托咪酯联合环泊酚全身麻醉对手术患者血流动力学和应激反应的影响[J]. 中国医药导刊, 2023, 25(3): 297-302.
[8] Apfelbaum JL, Hagberg CA, Connis RT, et al. 2022 American society of anesthesiologists practice guidelines for management of the difficult airway[J]. Anesthesiology, 2022, 136(1): 31-81.
[9] 马鑫, 沈勤, 吴宣. 腹腔镜子宫肌瘤切除术不同麻醉方案效果及对患者应激反应、认知功能的影响[J]. 中国计划生育学杂志, 2022, 30(9): 2006-2011.
[10] Carpinelli Mazzi M, Iavarone A, Russo G, et al. Mini-mental state examination: new normative values on subjects in southern Italy [J]. Aging Clin Exp Res, 2020, 32(4): 699-702.
[11] Catanese A, Siesto G, Cucinella G, et al. Factors influencing surgical outcomes of laparoscopic myomectomy. A propensity-score matched analysis[J]. Menopause Rev, 2022, 21(3): 149-156.
[12] Ota K, Katagiri Y, Katakura M, et al. Porous diaphragm syndrome presenting as hemothorax secondary to hemoperitoneum after laparoscopic myomectomy: a case report and literature review[J]. J Obstet Gynaecol Res, 2022, 48(4): 1039-1045.
[13] Boudova B, Hlinecka K, Lisa Z, et al. Hysteroscopic findings after laparoscopic and open myomectomy with or without uterine cavity breach: historical cohort study[J]. Minim Invasive Ther Allied Technol, 2022, 31(5): 789-796.
[14] 姚宏苏, 高亚萍, 朱翔, 等. 不同浓度七氟醚联合瑞芬太尼对腹腔镜胆囊切除术患者应激反应和认知功能的影响[J]. 现代生物医学进展, 2023, 23(22): 4390-4394.
[15] 刘璐. 环泊酚与小剂量右美托咪定复合麻醉对腹腔镜下子宫肌瘤切除术麻醉效果及术后应激反应的影响[J]. 实用妇科内分泌电子杂志, 2022, 9(19): 72-74.
[16] Wada S, Fukushi Y, Ono Y, et al. Influence of uterine cavity breach in laparoscopic myomectomy on the risk of obstetric complications[J]. Gynecol Minim Invasive Ther, 2022, 11(4): 221-223.
[17] Bettaiah R, Konda KR, M S N, et al. Intraperitoneal iatrogenic fibroid after laparoscopic myomectomy displacing the retroperitoneal structures[J]. J Minim Invasive Gynecol, 2023, 30(8): 603-605.
[18] Wang YC, Wu MJ, Zhou SL, et al. Protective effects of combined treatment with ciprofol and mild therapeutic hypothermia during cerebral ischemia-reperfusion injury[J]. World J Clin Cases, 2023, 11(3): 487-492.
[19] 刘旺生, 王萍. 不同全麻方式对老年腹腔镜子宫肌瘤剔除术患者氧合功能及认知的影响[J]. 中国老年学杂志, 2021, 41(9): 1847-1850.
[20] Au E, Thangathurai G, Saripella A, et al. Postoperative outcomes in elderly patients undergoing cardiac surgery with preoperative cognitive impairment: a systematic review and meta-analysis[J]. Anesth Analg, 2023, 136(6): 1016-1028.

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[38] Tiyaprasertkul W, Bernucci F, González AP, et al. A randomized comparison between single- and triple-injection subparaneural popliteal sciatic nerve block[J]. Reg Anesth Pain Med, 2015, 40(4): 315-320.
[39] Ip V, Tsui B. Injection through the paraneural sheath rather than circumferential spread facilitates safe, effective sciatic nerve block [J]. Reg Anesth Pain Med, 2013, 38(4):373.
[40] Nag K, Ravishankar M, Parthasarathy S, et al. Quantitative assessment of ultrasound-guided sciatic nerve block - a comparison of a single-point versus two-point injection technique: a randomised controlled, double-blinded trial[J]. Indian J Anaesth, 2023, 67(9): 802-808.
[41] 黄莉莉, 余云兰, 季惠, 等. 罗哌卡因联合右美托咪定在坐骨神经阻滞的临床效果——评《神经内科治疗药物的安全应用》[J]. 中国临床研究, 2024, 37(4):654.
[42] Lei GY, Yang SL, Wu LL, et al. Intravenous injection of dexamethasone is non-inferior to perineural administration for popliteal sciatic nerve and saphenous nerve blocks: a randomized, controlled, triple-blind study[J]. Heliyon, 2024, 10(7):e28304.
[43] Coviello A, Iacovazzo C, Cirillo D, et al. Dexamethasone versus dexmedetomidine as adjuvants in ultrasound popliteal sciatic nerve block for hallux Valgus surgery: a mono-centric retrospective comparative study[J]. Drug Des Devel Ther, 2024, 18:1231-1245.
[44] Parthasarathy S, Venkatesh TK, Saravanan B. Evaluation of age-based local anaesthetic dosing of bupivacaine for popliteal sciatic nerve block in children undergoing foot and ankle surgery: a prospective single arm interventional study [J]. Indian J Anaesth, 2023, 67(Suppl 4):S257-S260.
[45] 陈龙, 石显江, 陈斯乔, 等. 右美托咪定联合罗哌卡因肋间神经阻滞在胸腔镜肺楔形切除术中的应用 [J]. 中国临床研究, 2025, 38(3):437-440.
[46] Jeong JS, Shim JC, Jeong MA, et al. Minimum effective anaesthetic volume of 0.5% ropivacaine for ultrasound-guided popliteal sciatic nerve block in patients undergoing foot and ankle surgery: determination of ED50 and ED95[J]. Anaesth Intensive Care, 2015, 43(1):92-97.
[47] Bang SU, Kim DJ, Bae JH, et al. Minimum effective local anesthetic volume for surgical anesthesia by subparaneural, ultrasound-guided popliteal sciatic nerve block: a prospective dose-finding study[J]. Medicine (Baltimore), 2016, 95(34):e4652.
[48] Keplinger M, Marhofer P, Marhofer D, et al. Effective local anaesthetic volumes for sciatic nerve blockade: a clinical evaluation of the ED99[J]. Anaesthesia, 2015, 70(5):585-590.
[49] Parthasarathy S, Chanda A, Saravanan B. Estimation of the minimum effective volume of 0.5% bupivacaine for ultrasound-guided popliteal sciatic nerve block in diabetic patients with neuropathy [J]. Indian J Anaesth, 2022, 66(7):511-516.

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