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Ultrasound-guided selective peripheral nerve block for the snakebite pain management in the emergency department: Our experience

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Abstract:

Envenomation from snakebites (SBs) is a significant public health hazard globally. The venomous SB is associated with moderate-to-severe pain. Weak opioids such as tramadol or acetaminophen are commonly used for pain management but often provide inadequate analgesia. We hereby report our experience of using ultrasound-guided selective superficial peroneal, sural, and saphenous nerve blocks for pain management following SBs in nine patients. The selective peripheral nerve blocks are achieved with a small amount of local anesthesia and without loss of motor functions.

Keywords:

Emergency department, pain, peripheral nerve block, snakebite

Introduction

Envenomation from snakebites (SBs) is a significant public health hazard globally, especially in tropical and subtropical nations. The venomous SB is associated with moderate-to-severe pain secondary to venom constituents' interaction with the pain pathways. Acute local pain is often recognized as the first sign of a venomous SB.[1] The intense pain following an SB usually lasts for 48–72 h in most cases.[1] The emergency department (ED) plays a crucial role in SB management by neutralizing venom and other supportive measures, including pain management. The severity of pain varies according to the amount and the biochemical composition of injected venom.[2] As the toxin spreads systemically, the pain may manifest as headache, chest pain, eye pain, back pain, abdominal pain, or generalized pain.[1] Although antivenom treatment can substantially reduce systemic pain, it fails to alleviate the local pain which may last several days.[1] Mild opioids such as tramadol or acetaminophen are commonly used for pain management but often provide inadequate analgesia.[3] Low-dose ketamine has been reported for pain management in ED.[4] Peripheral nerve blocks (PNBs) are gaining popularity in the emergency setting for pain management.[5] In this case series, we report acute pain management following SBs with ultrasound-guided selective PNBs in a series of nine patients. To the best of our knowledge, selective nerve blocks are not yet explored for SB pain management.

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Case Report

The data were obtained from the ED pain management database of a tertiary care center in Eastern India. Both viper and cobra bites were associated with severe local pain. The pain score of patients was assessed on a numerical rating scale (NRS). Conscious, oriented, hemodynamically stable patients with NRS ≥7 who agreed to pain relief under PNBs were selected. All patients were treated with anti-snake venom and were hemodynamically stable before performing PNBs. Ultrasound-guided selective blockade of superficial peroneal (SPN), sural (SN), and saphenous nerves in the lower extremity and superficial radial nerve (SRN) in the upper extremity was performed depending on the anatomical distribution of pain. Magnesium sulfate and glycerin were applied to reduce local swelling due to envenomation.[3] The local limb swelling was monitored closely, and patients at risk for compartment syndrome (CS) were excluded.[3] Complete blood count, coagulation profile, liver function test, and renal function test were done as per patient requirements. All patients were monitored in the ED and followed up after discharge for pain, limb swelling, and for any other complications. The authors attest that the manuscript adheres to the consensus-based clinical case reporting statement guidelines.

All the PNBs were performed in the ED by an emergency physician with expertise in ultrasound-guided PNBs. The patients were positioned to expose the area of nerve blockade, followed by disinfection of the skin. Standard monitoring was used during and after the performance of PNBs. A linear transducer probe (SonoSite EDGE II machine; SonoSite, Inc. Bothell, WA, USA) was used to localize the peripheral nerve. A 24 G 25 mm hypodermic needle was used to deliver the local anesthetic (LA) near the nerve terminal under ultrasound guidance using in-plane technique. The LA agent, ropivacaine 0.75%, 1.5–2 ml was used for each of the PNBs. The probe position, sonoanatomy, and area of sensory innervation of SPN and SN block are depicted in Figures 1 and 2, respectively. SRN block was performed in one patient to relieve pain in the dorsum of the hand.

The patient profile and details of the PNBs are shown in Table 1. The age of the patients was 36 (14.7), mean (standard deviation) years. The onset time of analgesia median (interquartile range) was 5 (4.5–5) min. The baseline NRS of the patients was 8.77 (1.20) and NRS 15 min after the block was 1.55 (0.88). The duration of analgesia was 15 (13–16) h. None of the patients in the series developed motor blockades following selective PNBs. Two patients requested repeat PNBs. One patient with a cobra bite on the left foot had persistent local pain

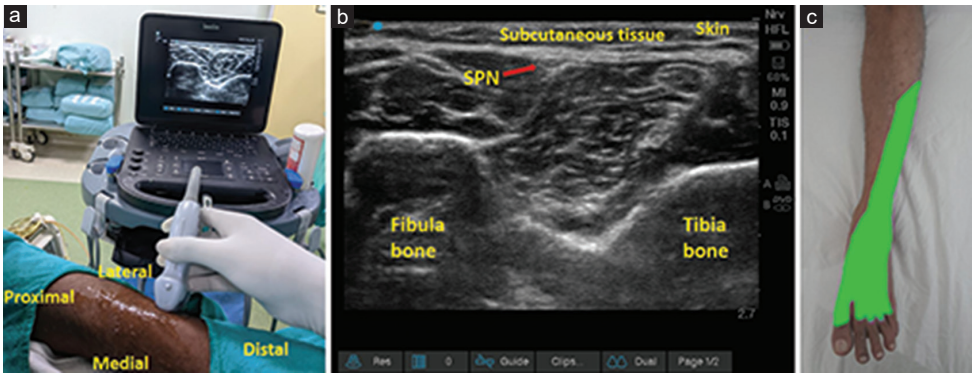

Figure 1: (a) Probe position at the middle and lower third of the anterolateral aspect of the leg for ultrasound-guided SPN block; (b) Sonoantomy of SPN; The area of sensory innervation of SPN (green). SPN: Superficial peroneal nerve

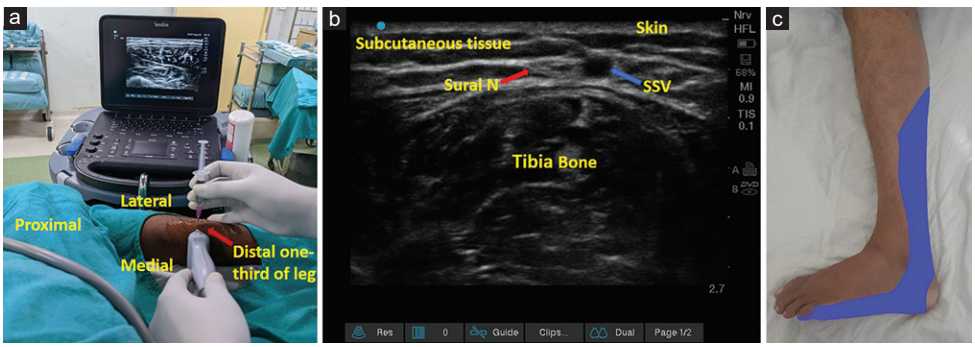

Figure 2: (a) Probe position at the middle and lower third of the posterior aspect of the leg for ultrasound-guided SN block; (b) Sonoantomy of SN; The area of sensory innervation of SN (blue). SN: Sural nerve

Table 1: Demographic profile and details of peripheral nerve blocks

Age (in years)/sex	Type of snakebite	Site of snakebite	No ASV vials given	Pain score (NRS) baseline	Pain score (NRS) 15 min postblock	Peripheral nerve blocked	Duration of analgesia (h)
36/male	Viper	Dorsum right foot	20	10	1	SPN + SN	16
37/female	Viper	Dorsum left foot	15	7	2	SPN	17
19/male	Viper	Dorsum left foot	20	10	2	SPN + SN	11
60/female	Viper	Right foot, great toe	25	10	2	SPN + SN	16
49/male	Cobra	Dorsum left foot	25	10	2	SPN + SN	13
50/female	Viper	Left foot great toe	20	9	1	SPN + SAN	18
18/male	Krait	Left hand dorsum	20	8	3	SRN	15
30/male	Cobra	Left foot dorsum	25	10	2	SPN	10
24/female	Viper	Left foot little finger	25	8	2	SN	14

NRS: Numerical rating scale, ASV: Anti-snake venom, SPN: Superficial peroneal nerve, SRN: Superficial radial nerve, SN: Sural nerve, SAN: Saphenous nerve

after 1 week of discharge and underwent debridement of local tissue with tooth removal under ultrasound-guided selective PNBs. Written informed consent was obtained from all the patients included in this case series.

Discussion

The major venomous snake species in India include *Naja naja, Naja kaouthia, Bungarus caeruleus, Daboia russelii, Echis carinatus, Hypnale hypnale,* and *Trimeresurus*.[3] The mechanism involved in venom-induced pain is complex and depends on the composition of the injected venom.[1,2] The pain severity varies according to the amount and biochemical composition of the venom, which is typically high for vipers.[2] Most venom constituents include various proteins, nonenzymatic compounds, serine proteases, metalloproteinases, digestive hydrolases, hyaluronidase, phospholipase A2, and three-finger toxins which interact directly with specific receptors and pain pathways to manifest severe local pain.[1] The metalloproteinases damage basement membranes, resulting in endothelial cell damage, and phospholipases A2 damage peripheral nerve endings.[1] The presynaptic neurotoxins (phospholipases) and postsynaptic neurotoxins (polypeptides) may cause permanent damage to nerve endings.[1] These venom compounds may indirectly cause severe pain secondary to ischemia due to local edema.[1] The antivenom attenuates systemic pain by neutralizing circulating venom compounds.[1] However, the local ischemia and inflammation may prevent antivenom from reaching the local injury site resulting in persistent local pain.[1]

The local pain following envenomation can be incapacitating, challenging to manage, and potentially resistant to common analgesics. However, SB pain management is often suboptimal or neglected. Neglected moderate-to-severe pain may result in patient discomfort and predispose them to chronic pain syndrome or long-term psychosocial sequelae.[6,7] There exists a limited choice of analgesics for pain control in SBs. Mild opioids such as tramadol or acetaminophen are recommended for pain control.[3] The drugs like aspirin and other nonsteroidal anti-inflammatory drugs are not recommended owing to coagulopathy, particularly with vasculotoxic envenomation.[3] Opioids such as morphine can increase the risk of respiratory depression in neurotoxic envenomation.[3] Brandehoff *et al*. demonstrated the effectiveness of low-dose ketamine for pain control following SB.[4] However, even low-dose ketamine is associated with unwanted side effects such as dizziness, nausea, feeling of unreality, fatigue, and headache, and provides only a short duration of analgesia.[4] These common side effects can mimic systemic signs of envenomation and may exacerbate existing discomforts and hence be undesirable for SB patients. The studies have demonstrated the safety and efficacy of ultrasound-guided selective PNBs for various traumatic and procedural pain.[5,8,9] Barton *et al*. reported the use of fascia iliaca compartment femoral nerve block with 20 ml of 0.25% bupivacaine for the management of crotalid SB pain refractory to opioids.[10] However, femoral nerve block only provides a limited area of analgesia of the foot and is associated with motor blockage which is undesirable for ED settings.[11] Seo *et al*. reported the use of an intravenous regional block with 0.5% mepivacaine and 30 mg of ketorolac for a patient who presented with allodynia and hyperalgesia 3 months after the SB.[12] Bhattarai *et al*. successfully treated complex regional pain syndrome developed 3 weeks following SB with sympathetic ganglion block.[6] DeYoung *et al*. recently reported the use of ultrasound-guided popliteal sciatic nerve block with 0.5% ropivacaine in a case of stingray envenomation pain refractory to treatment with intravenous morphine, acetaminophen, and ketorolac.[13] Most of the patients in the present series had SBs in the lower extremities (foot). The local pain at the site of the bite persisted after treatment with anti-snake venom which neutralizes the systemic pain. The selective blockade of sensory innervation of the foot can be achieved by SPN, SN, and saphenous nerve blocks. The selective PNBs have the advantage of providing partial or complete analgesia as per the selection of the number of nerve blocks and

retention of motor function.[7] Although rare, CS can be a dreaded complication following vasculotoxic SBs.[14] Patients with grossly elevated white blood cell count and aspartate aminotransferase levels and rapidly progressing limb edema on arrival at ED have a high risk of developing CS.[14] Hence, a judicious patient selection to exclude CS is paramount as the nerve block can mask the critical symptoms of CS, such as pain, paraesthesia, and paralysis.[13] Monitoring of patients at risk for CS is key for early detection. Optimal management of severe pain following SB in ED by emergency physicians can prevent the development of chronic pain syndromes.[6]

Conclusion

The ultrasound-guided selective PNBs of SPN, SN, and saphenous nerves provide evidence of satisfactory analgesia for SB envenomation in the lower extremities. The selective block of the above peripheral nerve can provide adequate analgesia and retains motor functions. With careful patient selection and appropriate monitoring of patients, ultrasound-guided PNBs can be a dependable analgesia choice to relieve severe local pain in SB patients. Further controlled studies can establish the safety and efficacy of selective PNBs for SB pain management.

Author contributions statement

CRM: Conceptualization (lead); Methodology (lead); Software and investigation (lead); Formal Analysis; Writing – original draft (lead); Supervision, Project administration. RVR: Methodology (support); Investigation (support); Data Curation; Writing – original draft (lead); Writing – review and editing; Visualization. NS: Methodology (support); Software and investigation (support); Writing – review and editing; Visualization. IMS: Investigation (lead); Resources; Writing – original draft (support); Writing – review and editing. SD: Software and investigation (support); Writing – review, and editing; Visualization. CRM did the overall supervision of the whole study and all authors made a substantial contribution. All authors have read and agree to the content of the final manuscript.

Conflicts of interest

None declared.

Consent to participate

The authors certify that they have obtained all appropriate written consent forms from the patients. In the form, the patients have given their consent for the images and other clinical information to be reported in the journal. The patient understands that their name and initials will not be published, and due efforts will be made to conceal the identity, but anonymity cannot be guaranteed.

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