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Ultrasound Lumbar Transforaminal Injection in Paramedian Sagittal Oblique Approach with Out-Plane Electrical Stimulation Needle: Case Report of 2 Patients

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Background: We describe a new method of ultrasound-guided lumbar transforaminal injection with an electrical stimulation needle (NsUTFI) in 2 patients with disc herniation at the L5-S1 and L4-L5 levels, respectively. The patient provided HIPAA compliant consent for the inclusion of their clinical information in this report.

Case Report: NsUTFI was performed by eliciting sensory and/or motor stimulation of nerve roots by an electrical stimulation needle, which was inserted in an out-of-plane (OOP) trajectory just beyond the intertransverse ligament between the appropriate 2 transverse processes via a paramedian sagittal oblique (PSO) approach with a curved probe. Fluoroscopic confirmation was not done. Both patients reported 50% pain reduction at 2 weeks' follow-up.

Conclusion: We conclude that a new technique for lumbar radicular pain with NsUTFI with a PSO OOP needle trajectory at the intertransverse ligament may be safe and effective and should be further explored.

Key words: Electrical stimulation, paramedian sagittal oblique, transforaminal injection, ultrasound

BACKGROUND

Transforaminal injections (TFI) are commonly performed under fluoroscopy (FL) or computed tomography (CT) guidance. However, this requires a specialized area for the procedure and causes radiation exposure to patients and medical staff. In recent years, ultrasound-guided nerve blocks have gained momentum due to various advantages; however, ultrasound-guided transforaminal injections (UTFI) are not reported extensively due to shadowing of the foraminal area with bony structures, and the procedure is still evolving (1).

It is known that the efficiency of ultrasound-guided block increases when combined with nerve stimulation needles (2).

We describe a new technique of UTFI where electrical stimulation was used for TFI (NsUTFI).

Case 1

The patient provided HIPAA compliant informed consent for the inclusion of their clinical information in this report.

A 35-year-old man with a weight of 65 kg and BMI of 23.9 kg/m^2 presented with complaints of low back pain radiating to the posterolateral aspect of the right lower leg for 3 years. He reported a Numeric Rating Scale (NRS) for pain score of 5, Oswestry Disability Index (ODI) score of 50%, and medical therapy of paracetamol, baclofen, and pregabalin. His pain was aggravated

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with prolonged sitting, bending forward, standing, walking, and was relieved with lying down. Physical examination revealed normal reflexes, strength, and sensation. Magnetic resonance imaging (MRI) showed right posterocentral disc protrusion at the L5-S1 level with S1 nerve compression. The patient requested urgent relief, as he was travelling in 2 days and could not wait for his scheduled pain operation the following week. The decision was made to perform NsUTFI in the outpatient department (OPD) block area.

Case 2

The patient provided HIPAA compliant informed consent for the inclusion of their clinical information in this report.

A 19-year-old man with a weight of 58 kg and BMI of 22.1 kg/m^2 presented with a complaint of low back pain radiating to the lateral aspect of the left leg for 10 years (NRS 9, ODI 54%). His pain was aggravated with bending forward, standing, and walking. Physical examination revealed no neurological deficit. Bladder and bowel functions were normal. MRI showed left posterolateral prolapsed intervertebral disc L4-L5 with L5 nerve compression. The patient refused radiation exposure and thus NsUFTI at the level of L4-L5 on the left side was undertaken in the OPD block area. The patient provided HIPAA compliant consent for the inclusion of their clinical information in this report.

Procedure

An intravenous line was inserted, and routine monitors like noninvasive blood pressure (NIBP) and pulse oximetry were attached. The patient was placed in the prone position with a pillow placed under the abdomen to decrease lumbar lordosis. Under aseptic precautions a curved probe was used to scan the midline to identify the appropriate spinal level. At this point, the transducer was moved laterally to identify the lamina, zygapophyseal (ZP) joint, transverse process (TP), and the ala of the sacrum in sequence. The transducer was then moved back towards the midline until the edge of the ZP joint was visualized again. The lumbosacral ligament at the L5-S1 level and intertransverse ligament at the L4-5 level were observed as a hyperechoic band between the L5 TP and the sacral ala, and the consecutive TPs, respectively. The transducer was then tilted 20° to 25° medially.

Local anaesthetic infiltration with a 25-gauge (G) needle with 2 mL of 2% lidocaine at the needle entry point was done. A 10-cm long, 5-mm active tip, 22-G radiofrequency needle (Cosman RFG-1B RF generator, Cosman Medical, Inc, Burlington, MA) was advanced in an out-of-plane (OOP) trajectory until the needle tip punctured the ligament (Fig. 1). Electrical stimulation with 2 Hz and 2 mA was started and the needle was advanced just beneath the TP to elicit motor contractions at the corresponding myotomes as well as nonpainful paraesthesia using sensory electrical stimulation with 50 Hz and one mV current. In a failure to elicit the above, the needle was redirected either above or below the first trajectory. At positive confirmation of both, 2 mL of 1% lidocaine with 4 mg of dexamethasone sodium phosphate was injected after negative aspiration. The patient was instructed to rest in bed for 30 minutes post procedure. Pain was evaluated via the NRS after 30 minutes and 2 weeks after the procedure.

RESULT

In both patients, NsUTFI was performed on the first attempt. Operation time, defined as the time taken from the first needle puncture of the skin to the injection of the injectate, was 6 minutes, 45 seconds and 5 minutes, 15 seconds for the first and second patient, respectively (Table 1). The distance of the needle entry point from the midline was 3.5 cm and 3.7 cm in the first and second patients, respectively. The first patient reported decreased sensation at the L5 and S1 dermatomes and 40% improvement in pain at 30 minutes (NRS 3), which further reduced to NRS 2 at 2 weeks (Table 2). The second patient reported 20% pain relief at 30 minutes (NRS 7), which further reduced to NRS 5 at 2 weeks. The patients reported no motor weakness following the procedure. There was no significant change in the ODI scores at follow-up in both patients.

DISCUSSION

UTFI is described with axial or paramedian orientation of curved low-frequency ultrasound probes with either in-plane or out-plane needle orientation, with no method found superior to the other. All human studies of UTFI utilized FL or CT confirmation for correct placement of the needle (1). In the present series, dye confirmation could not be performed in either patient. Sato et al (3) performed US-guided L5 selective nerve root block (SNRB) with a nerve stimulation needle, in which the final needle tip position elicited a nonpainful tapping sensation in the affected L5 neural region by motor stimulation under 1 mA. In the present series,

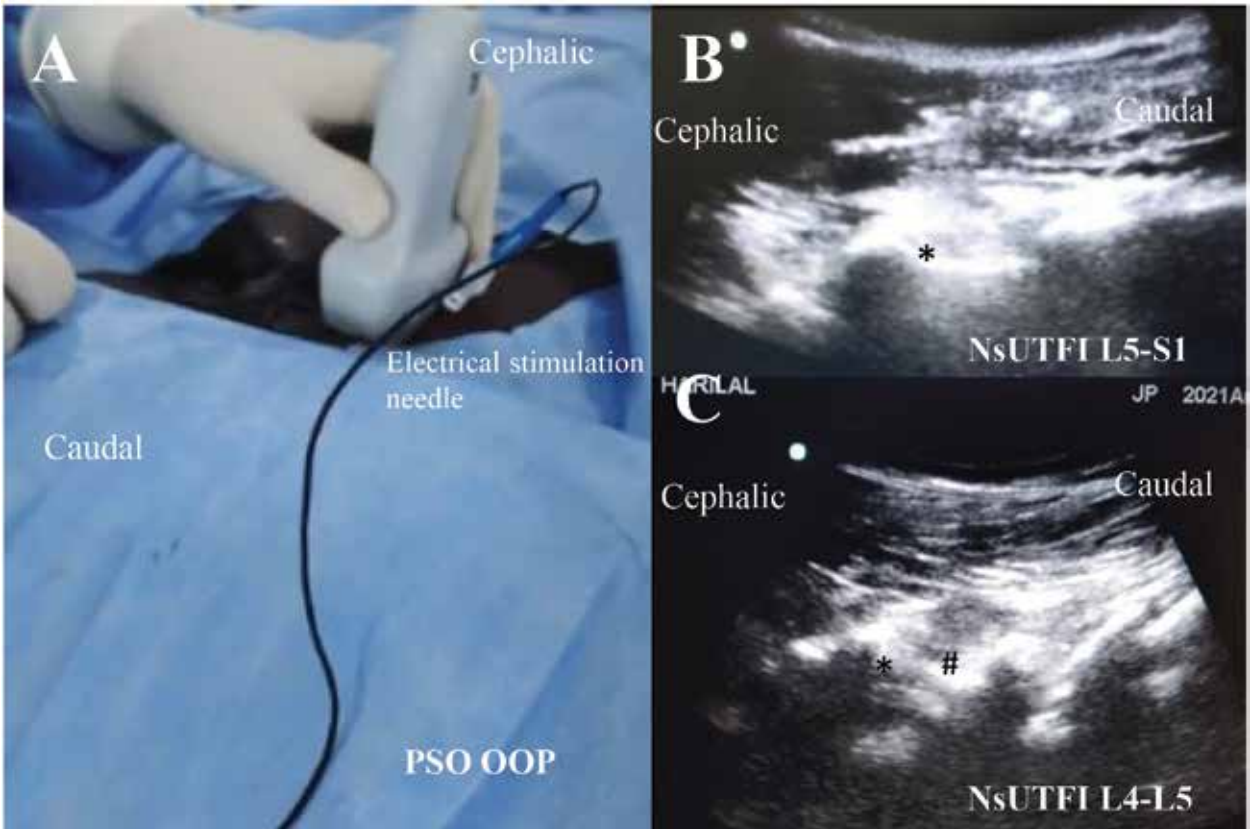

Fig. 1. A) Curved probe in PSO with OOP needle B) NsUTFI at L5-S1 C) NsUTFI at L4-L5
Abbreviations: NsUTFI, electrical stimulation-guided transforaminal injection; OOP, out-of-plane; PSO, paramedian sagittal oblique

both sensory and motor stimulation were used to increase the probability of placement of the needle tip near the nerve root. The advantage of this approach includes simulation of paresthesia in the affected dermatomes by sensory stimulation.

Previously for UTFI, the PSO probe with an in-plane needle trajectory showed difficult needle placement at the L5-S1 level (5). In another study for L5 SNRB, the OOP needle trajectory was found effective with parasagital (PS) probe orientation (3). In the present patients, PSO with an OOP needle trajectory was used. Remission of symptoms of spinal radicular pain with this new approach, especially at the L5 level, indicates a promising new technique of UTFI.

Studies have shown that a drug volume more than 0.5 mL at the nerve root level is essential for passage inside the epidural space (4). In the present series, 2 mL of drug volume may have further warranted correct and efficacious drug placement, especially as a decrease in symptoms was noted in both patients post procedure.

Table 1. Procedure characteristics

Procedure Characteristics	Case 1 (NsUTFI L5-S1)	Case 2 (NsUTFI L4-L5)
Number of attempts	1	1
Sensory stimulation	50 Hz, 0.6 mV	50 Hz, 0.5 mV
Motor stimulation	2 Hz, 0.8 mA	2 Hz, 0.9 mA
Distance of the needle entry point from the midline	3.5 cm	3.7 cm
Operation time	6 min 45 s	5 min 15 s

Abbreviation: NsUTFI, electrical stimulation-guided transforaminal injection

Table 2. NRS and ODI scores in 2 patients

Patient	Baseline (Pain NRS/ ODI)	30 min (Pain NRS)	2 wks (Pain NRS/ ODI)
Case 1	5/54	3	2/50
Case 2	9/50	7	5/47.5

Abbreviations: NRS, Numeric Rating Scale; ODI, Oswestry Disability Index

NsUTFI has few limitations. The needle could have been placed at the nerve root level away from the epidural space and desired location of the transforaminal injection. However, medial placement of the needle at the transition point of the ZP joint and the TP and the use of a larger drug volume probably ensured drug solution at the correct location. Secondly, though we successfully performed NsUTFI at L5-S1, the acoustic window for the block might be difficult in obese patients.

In conclusion, NsUTFI may be performed with a PSO OOP orientation of a RF needle with sensory and motor stimulation when placed at the transition point of the ZP joint and the TP without radiographic confirmation. However, further studies are recommended.

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