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Peripheral Nerve Stimulation at the Spinoglenoid Notch May Have Advantages Over Suprascapular Notch - Case Report

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Background: Modulation of the suprascapular nerve (SSN) and axillary nerves using peripheral nerve stimulation (PNS) is increasingly being used to treat patients with chronic shoulder pain.

Case Report: Our patient presented with chronic shoulder pain secondary to glenohumeral joint osteoarthritis. Ultrasound guidance was used for PNS lead placement at the spinoglenoid notch and at the deltoid for suprascapular and axillary nerve modulation, respectively. After a 60-day treatment period with PNS, the patient had clinically significant pain reduction. No complications were observed.

Conclusions: Stimulating the suprascapular nerve (SSN) at the spinoglenoid notch offers optimal patient positioning and has a lower risk of pneumothorax, intravascular injection, and residual motor block compared to the suprascapular notch approach. PNS of the SSN at the spinoglenoid notch is a safe, alternative, and novel use of PNS.

Key words: Neuromodulation, suprascapular nerve, chronic shoulder pain

BACKGROUND

Shoulder pain is the third most common musculoskeletal complaint and nearly 20% of the general population will suffer from shoulder pain during their lifetime (1). The suprascapular nerve (SSN) provides the greatest contribution to overall shoulder innervation (2). Modulation of nerves using peripheral nerve stimulation (PNS) is increasingly being used to treat patients with chronic shoulder pain (3). Placement of stimulator leads under image guidance either with fluoroscopy or ultrasound (US) is typically performed at the suprascapular notch to modulate the SSN and deltoid to modulate the axillary nerve at the quadrangular space in patients with chronic shoulder pain. The SSN is also accessible at the spinoglenoid notch and stimulation at this location may have advantages over the suprascapular notch.

CASE PRESENTATION

Patient is a 78-year-old woman with multifactorial chronic right shoulder pain secondary to glenohumeral joint osteoarthritis and rotator cuff pathology. Initial treatment included physical therapy and steroid injection with minimal response along with acetylsalicylic acid, gabapentin, and oxycodone. She was offered a total shoulder arthroplasty but wanted to avoid surgical interventions. Past medical history is significant for hypertension, obesity, lumbar-thoracic scoliosis, lumbar fusion, and gout. Physical examination was notable for mildly limited active range of motion for abduction and external rotation, pronounced scapular hiking with scapular substitution, end-range pain, and positive subacromial impingement signs. Pain and weakness were present with supraspinatus activation. Passive range of motion was normal.

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After obtaining consent, the patient elected to undergo a US-guided PNS 60-day implant. The procedure was carried out using a sterile technique and under direct sonographic guidance to ensure accurate needle placement. Patient was side-lying and placed in a lateral decubitus position (Fig. 1). A high-frequency 12 MHz to 5 MHz linear array US transducer (GE Healthcare, LOGIQ e, Wauwatosa, WI) was used to advance a 17-G 12-cm introducer needle under continuous US guidance utilizing both in- and out-of-plane approaches at the spinoglenoid notch for SSN modulation and at the deltoid for modulation of the axillary nerve approximate to the quadrangular space (Figs. 2 and 3). The patient was followed at 2 months poststimulator placement. Pain was recorded using a numeric rating scale. Pain recordings included average daily pain intensity, best pain relief, and worst experienced pain.

After 2 months of stimulation, the patient had clinically significant pain reduction, improvement in the worst pain experienced, and improvement in the best pain relief (Table 1). No complications were noted during the procedure or during the follow-up timeframe. At 6 months poststimulator placement, the patient continued to report at least 50% improvement in pain with improved shoulder range of motion and function (Table 1).

DISCUSSION

The SSN provides sensory innervation to the posterior glenohumeral joint, subacromial bursa, coracoacromial ligament, and acromioclavicular ligament (2), playing a major role in chronic shoulder pain. The SSN could also be directly injured leading to shoulder pain. Causes of SSN neuropathy include paralabral cysts adjacent to the spinoglenoid notch, mass effect, traction during overhead sports, scapular fracture, iatrogenic injury, and traction from a retracted rotator cuff tendon (4).

The SSN has both motor and sensory fibers and originates from the fifth and sixth cervical nerve roots. After traveling through the posterior neck triangle via the brachial plexus, it proceeds laterally and enters the supraspinous fossa via the suprascapular notch underneath the superior transverse scapular ligament. The nerve exits the supraspinous fossa to enter the infraspinous fossa lateral to the base of the spine of the scapula via the spinoglenoid notch (5).

Percutaneous PNS is a temporary treatment designed to generate proprioceptive afferent signals believed to

Fig. 1. Patient positioning demonstrated in side-lying in lateral decubitus position.

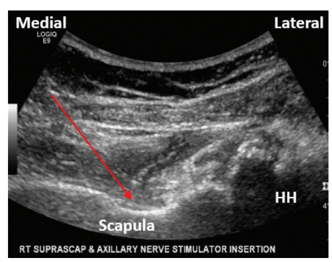

Fig. 2. US image parallel and inferior to the spine of the scapula. The red arrow shows the medial-to-lateral approach to the SSN at the spinoglenoid notch. US: ultrasound; SSN: suprascapular nerve; HH: humeral head.

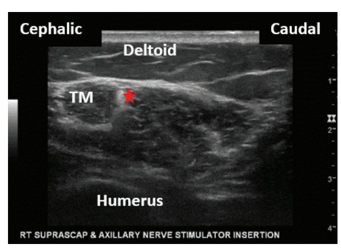

Fig. 3. US image parallel to the humeral shaft showing an out-of-place approach to the axillary nerve. The red star indicates needle placement. US: ultrasound; TM: teres minor.

Table 1. Pain numeric rating scale.

Follow-up Period	Average Pain 1-10	Worst Pain 1-10	Best Pain 1-10	% Improvement
Baseline	6/10	10/10	2/10	N/A
2 Mo	3/10	6/10	0/10	50%
6 Mo	N/A	N/A	N/A	50%

restore the balance of peripheral inputs to the central nervous system and reverse maladaptive changes in central pain. (3)

PNS has been successful in treating many chronic pain conditions, including nerve injury, complex regional pain syndrome, occipital neuralgia, and postsurgical pain (6). In the shoulder joint, a randomized controlled trial (7) of adults with chronic hemiplegic shoulder pain after stroke showed that 3 weeks of treatment of single-lead PNS at the axillary nerve led to greater pain reduction compared with usual care and is maintained for at least 12 weeks after treatment.

The SSN is classically blocked at the suprascapular notch. Posterior, superior, and anterior approaches may be used, the most common being posterior. Pneumothorax is the most significant complication of the SSN block, which could be minimized by positioning the patient's ipsilateral hand to the contralateral shoulder and using the superior rather than posterior approach (5). It is also important to consider that the shape of the suprascapular notch is variable across individuals when using it as a landmark for procedures. While the most common presentation is a U-shaped or semicircular notch, the notch is not well defined in 15% of the population, absent in 8%, and only a bony foramen in 7% (8).

Interestingly, a fluoroscopic and cadaveric study conducted by Peng et al (9) to assess the actual needle position during the SSN block at the suprascapular notch found that the US image of this well-described technique is targeting the nerve on the floor of the suprascapular spine between the suprascapular and spinoglenoid notches rather than the suprascapular notch itself. The authors also concluded that the structure previously identified as the transverse ligament is actually the fascia layer of the supraspinatus muscle (9).

In addition to the risk of pneumothorax, other complications related to the SSN block at the suprascapular notch are intravascular injection and residual motor block (5). The suprascapular artery and vein are separated from the SSN by the superior transverse ligament of the scapula and needle insertion might puncture the vessels, potentially increasing the risk of hematoma or local anesthetic systemic toxicity (5). In regards to the residual motor block, this could lead to supraspinatus and infraspinatus weakness, but the duration and significance of this effect have not been well defined.

Neuromodulation at the SSN at the spinoglenoid notch and with the patient in a lateral decubitus position ensures needle placement to remain posterior to the scapula. Furthermore, given the spinoglenoid notch is more lateral and farther away from the lungs than the suprascapular notch, it has a much lower risk of pneumothorax (10). There is also a lower risk of the intravascular and residual motor block given the vessels are proximal and medial to the spinoglenoid notch, and the supraspinatus muscle has already been innervated at this level.

Finally, it is understood that some of the sensory branches of the SSN have already branched prior to the level of the spinoglenoid notch, and targeting the SSN at this level might provide a worse analgesic effect. While this may impact peripheral nerve blocks, the application and therapeutic effect of PNS may differ. The goal of PNS is not to block pain signals distally but to stimulate the nerve in a distal-to-proximal direction up to the brain cortex and promote neuromodulation. Hence, stimulating the nerve distally may still prove to accomplish the same outcome, while minimizing unwanted complications related to proximal sites.

Limitations

Limitations of the study are those inherent in a case report. The authors cannot conclude that the described approach at the spinoglenoid notch is superior in efficacy or safety with PNS and additional studies are warranted to further investigate.

CONCLUSIONS

Stimulating the SSN distally at the spinoglenoid notch may help reduce adverse effects and potential complications associated with the suprascapular notch approach without interfering with the goal of modulating pain response. PNS of the SSN at the spinoglenoid notch is a safe, alternative, and novel use of PNS.

Authors contributions

NP and MG provided direct patient care, collected data and performed the procedure. AA, JC, NP and MG contributed to drafting and revision of the manuscript.

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