Ultrasound-Guided Placement of Combined Superficial Cervical Plexus and Selective C5 Nerve Root Catheters: A Novel Approach to Treating Distal Clavicle Surgical Pain

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Treating the pain that patients experience from repair of distal clavicle fracture can be a challenge for the anesthesia provider. This may be because of the dual innervation in this region. Dual innervations of the distal clavicular region also make selecting the correct regional block difficult. This article describes the first successful use of 2 separate ultrasound-guided perineural catheters placed for the purpose of treating distal clavicle pain and maintaining the analgesia. This technique also allows for the preservation of distal motor control in the affected limb.

Keywords: Distal clavicle repair, perineural catheter, selective C5 nerve root block, superficial cervical plexus block, ultrasound guidance.

Treating the pain that patients experience from repair of distal clavicle fracture can be a challenge for the anesthesia provider. This may be because of the dual innervation in this region. Dual innervations of the distal clavicular region also make selecting the correct regional block difficult. Some of the many factors that make this difficult to treat are fracture locations and complexity, surgical incisions over mixed innervations, and surgical positioning and manipulation. These factors, combined with the desire to release patients with most of the motor control of the distal arm intact, suggest that a single block may not cover the entire origin of the surgical pain.

In this case report, the author presents a novel approach to completely treating this problem. The case study outlines the first successful concurrent perineural catheter placement for treatment of distal clavicle pain. These catheters were placed under ultrasound guidance at the superficial cervical plexus and selective C5 nerve root. This unique combination completely alleviated the entire surgical pain for a patient undergoing repair of a complex distal clavicle fracture. Additionally, the motor function in the forearm and hand was well preserved.

To the author's knowledge, this unique and effective approach has not been previously described.

Review of Literature

The use of regional anesthetic techniques for shoulder pain is not new. The primary technique incorporates the use of the interscalene block. The distal clavicle is, however, only partially innervated by the nerve supply shared by the shoulder. Although effective in relieving shoulder pain, this technique carries numerous complications, described well by Brull and colleagues. Some of these include phrenic nerve palsy (in up to 100% of cases with the nerve stimulator technique), recurrent laryngeal nerve block (3% to 21%), Horner syndrome caused by stellate ganglion block (5% to 75%), total spinal paralysis (0.4% to 4%), and convulsions (0.2% to 3%). These troublesome complications have been reported when using traditional volumes of 20 to 30 mL.

One of the important factors that reduce the overall effectiveness of the interscalene block for distal clavicle surgical pain is the inability to cover all the distributions incised by the surgery. In contrast, the use of cervical plexus block for clavicular pain is relatively new. Traditionally, the cervical plexus block has been associated with procedures such as carotid endarterectomy. It has been suggested that the cervical plexus block is superior to the interscalene block in controlling the pain from clavicle surgery. The combination of indwelling superficial cervical plexus, and selective C5 nerve root catheters is a novel approach to alleviating the unique pain associated with distal clavicle fracture repair. A similar approach was suggested by Anirban Pal et al and was performed with the aid of a nerve stimulator for the interscalene block. This was combined with a traditional landmark approach for the superficial cervical plexus block and was done as an alternative to general anesthesia for a patient with severe dilated cardiomyopathy. The analgesia was sufficient to provide anesthesia for the entire surgical repair, but no mention of sustained pain control was included.

The use of reduced volumes of local anesthetic to preserve neighboring distributions has been investigated. The incorporation of ultrasound guidance to allow for precise control of local anesthetic spread has undoubtedly allowed this to flourish in the anesthesia community. There is an ever-expanding view that the incorporation
of ultrasound guidance into placement of regional blocks increases safety and speed and decreases complications and overall volumes of local anesthetic use. Placement of interscalene blocks with and without ultrasound guidance for pain control of shoulder surgery has also been investigated.

The placement of perineural catheters at the brachial plexus offers sustained pain control and addresses the issue of limited time of analgesia. Ip and Tsui explored several topics relating to these catheters for pain relief in shoulder surgery, such as placement techniques and prevention of accidental dislodgment. Several articles advocate a particular nerve block such as the supraclavicular technique for distal shoulder surgery and point out that the role of the outpatient perineural catheter is expanding. There are also many articles advocating the use, sometimes the exclusive use, of regional anesthesia in various techniques to reduce the incidence of complications related to general anesthesia and shoulder surgery. This choice of exclusive regional vs general anesthesia may reduce the anesthetic risk profile to a patient undergoing shoulder surgery, particularly in beach chair position. The important question remains of which anesthesia technique is the best for surgical repair of distal clavicle fracture.

The anatomy of the neck, particularly the nerve anatomy, is complex. However, an understanding of the relevant anatomy is important in the consideration of the proper regional blocks for distal clavicle repair. The distal clavicle and anterior superior shoulder area derives nerve involvement from both the cervical plexus and brachial plexus. This fact alone should alert the anesthesia provider that a single block will probably be insufficient for complete coverage of distal clavicle surgical pain. The cervical plexus supplies the fascia and skin above the clavicle and shoulder to the region of the acromion. It also supplies the first 2 intercostal spaces anteriorly through the superficial cervical plexus and supraclavicular nerves. These nerve branches emerge from C3 and C4. The brachial plexus innervates the entire upper extremity, both sensory and motor, specifically the skin over the deltoid muscle. The shoulder joint itself is innervated by the brachial plexus. The various portions of the shoulder joint pull innervations from suprascapular, axillary, and musculocutaneous nerves as well.

Case Summary
A 23-year-old woman, with an ASA category 1, presented for open reduction internal fixation of a distal clavicle. She sustained this complex fracture during a fall from about 1.8 m (6 ft). She denied any general anesthetics in the past but stated she had an epidural during her last vaginal delivery. After her anesthesia interview, a plan to place a superficial cervical plexus catheter was instituted, with the understanding that it might not cover her entire surgical pain. She agreed to be evaluated postoperatively to determine if a selective C5 catheter would be beneficial to her. The author believed that the selective C5 catheter placement would be effective if the incision extended beyond the cervical plexus distribution, and that it would reduce the incidence of complications associated with the traditional interscalene block.

The patient was placed on standard monitors in the preoperative holding area and given 2 mg of midazolam. The patient’s head was turned away from the site approximately 30 degrees. The neck was then prepared with sterilizing solution, and the posterior border of the sternocleidomastoid (SCM) muscle was marked with a sterile marker. A clear sterile drape was positioned over the mark, and a linear ultrasound probe (Sonosite M-Turbo, Sonosite Inc) was placed to the superior lateral aspect of the neck. Five milliliters of 2% lidocaine with epinephrine was infiltrated at the distal portion of the SCM border mark in an out-of-plane orientation. The probe was then repositioned to allow for in-plane needle guidance. A 10-cm stimulating Tuohy needle (Contiplex Stim continuous nerve block tray) was placed in-plane, and final position was confirmed using ultrasound guidance (Figures 1 and 2). A clear occlusive dressing was then applied over the looped catheter. An infusion system with 0.2% ropivacaine was initiated at 8 mL/h.

The patient’s head was placed in a neutral position. A short axis view of the brachial plexus was obtained using the same equipment. Three milliliters of lidocaine with epinephrine was infiltrated under the probe in an in-plane fashion. A single injection was then administered to the superficial surface of the C5 nerve root, with good resolution of her existing pain. The patient stated that she had sensory loss over the distal clavicle area. She then underwent general anesthesia for a repair of the distal clavicle. She received 100 µg fentanyl and 1,000 mg of intravenous acetaminophen (Oxirmev, Cadence Pharmaceuticals). Immediately following her uneventful general anesthetic, she was evaluated in the postanesthesia care unit. She stated she had some deep, dull pain of “3” on a 1 to 10 verbal numeric rating scale (VNRS).

The patient was evaluated on postoperative day 1 and reported “deep shoulder pain,” rating it an “8” on a 10-point VNRS. No motor block was evident. She stated that approximately 11 hours after catheter placement her pain
dramatically increased and any movement of the arm or shoulder caused her pain to become a “10” on the VNRS. She also stated that she had numbness to the incisional area.

She was transferred to the preoperative area where she was prepared and draped for placement of a C5 nerve root catheter. An ultrasound machine (SonoSite M-Turbo) was used to obtain a short axis view of the brachial plexus. A linear transducer set to 2 cm was selected. Three milliliters of 2% lidocaine with epinephrine was infiltrated under the probe in an in-plane fashion. This 25-gauge infiltration needle was visualized, as was the infiltration. A 10-cm stimulating Tuohy needle (Contiplex Stim continuous nerve block tray) was visualized in-plane and was guided to the superficial surface of the C5 root. Eight milliliters of 2% lidocaine was administered, and perineural spread was visualized. A perineural catheter (Contiplex Stim continuous nerve block tray) was then placed at the C5 deep surface. A clear occlusive dressing was carefully applied over both catheters. An infusion device (On-Q Painbuster, I-Flow, LLC) for the selective C5 block was set to 4 mL/h. On completion of the selective C5 catheter, she stated that...
her pain was reduced to “0” on a 10-point VNRS.

The 2 infusion systems (1 each for the cervical plexus and C5 catheters) were sent to the inpatient unit and subsequently home with the patient. She was discharged from the hospital a few hours later, reporting a VNRS pain score of “0” and with her distal arm motor function intact (Figures 3 and 4).

**Discussion**

The postoperative visit revealed that the patient’s pain was primarily confined to the axillary distribution. The superficial cervical plexus catheter was providing appropriate pain control to the mid and distal clavicle incisional area; however, the “deep shoulder pain” required additional treatment. The additional intervention of a selective C5 root catheter successfully treated and maintained her residual pain. The small injection volume was indeed effective in complete resolution of the patient’s distal clavicle pain. This suggests that infiltration done selectively around the C5 root can alleviate pain confined to the axillary distribution while preserving the C6 and C7 motor and sensory contributions to the arm. Both catheters were placed in the preoperative holding area with resources and staff who were familiar with the procedures.

This article suggests that the surgical pain associated with distal clavicle repair arises from 2 separate areas: the cervical plexus and primarily the C5 nerve root. This is believed to be the first time that this novel approach of a combination of superficial cervical plexus and selective C5 perineural catheters was successfully placed under ultrasound guidance. This effective method warrants further investigation to determine its feasibility and reliability for widespread use.

**REFERENCES**


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