Ultrasound-Guided Costoclavicular Brachial Plexus Block Mediates Painless Reduction of Distal Radius Fracture in the Emergency Department

First Author: M. Townsend Reeves

Classification: EM resident

Additional Authors: Katherine O'neil
Todd Slesinger

Affiliations: HCA Aventura Hospital

Research Type: Case Report Abstact

IRB Approval or Exemption: N/A

Mailing Address of First Author: 411 N FEDERAL HWY, BLDG 5, APT 502
Hallandale Beach, FL, 33009-3484

Email Address of First Author: matthew.reeves@hcahealthcare.com

Official submission to the FCEP Emergency Medicine Research Competition at Symposium by the Sea 2022

Ultrasound-Guided Costoclavicular Brachial Plexus Block Mediates Painless Reduction of Distal Radius Fracture in the Emergency Department – A Case Report

INTRODUCTION

The costoclavicular brachial plexus block (CCBPB) recently emerged as a safer, more attractive alternative to the traditional, sagittal paracoracoid approach to an infraclavicular brachial plexus block (ICBPB) for upper extremity regional anesthesia. The costoclavicular space (CCS) is the anterior portion of the superior thoracic aperture, located between the clavicle and first rib. It is bounded anteriorly by the subclavius and clavicular head of the pectoralis major muscle, and posteriorly by slips of the serratus anterior muscle and the chest wall. The brachial plexus cords traverse this space clustered together in a relatively superficial location lateral to the axillary artery, and share a consistent topographical relationship to one another. This is in stark contrast to the lateral infraclavicular fossa where the paracoracoid ICBPB is performed, as the brachial plexus lies relatively deep at this location, with the cords separated from one another and exhibiting substantial positional variation around the second part of the axillary artery. In the costoclavicular approach, the high-frequency linear ultrasound transducer is placed parallel to and below the mid-clavicle to visualize the CCS. The needle is advanced in-plane, in a lateral-to-medial direction, and directed between the brachial plexus cords for local anesthetic injection. This novel technique is unique in that it offers single shot, dense surgical anesthesia of the upper extremity below the shoulder due to the compact and anatomically consistent organization of the brachial plexus cords at this more superficial injection site.

CASE DESCRIPTION

We present a case of a 25-year-old male presenting to the Emergency Department with obvious right wrist deformity following a high-speed motor vehicle collision as a restrained driver. The patient braced his outstretched hand against the steering wheel during vehicular impact, resulting in traumatic injury to the wrist. Examination revealed a grossly deformed right wrist with dorsal swelling and severe pain to palpation. The radial pulse was intact, with normal sensorimotor function of the medial, radial, and ulnar nerves. Right wrist radiographs revealed a transverse-oriented fracture of the distal radius with dorsal angulation of the distal fragment, as well as an ulnar styloid fracture (**Image 1**). Despite opioid and NSAID analgesia with 50 μg IV Fentanyl and 15 mg IV Ketorolac, the patient was still reporting 10/10 pain with intolerance of radial manipulation. An ultrasound-guided CCBPB was performed using 20 mLs of 0.5% ropivacaine with subsequent development of dense, surgical anesthesia of the right upper extremity within ~15 minutes. Painless reduction of the distal radius fracture with improved angulation was achieved (**Image 2**).

Image 1 (Left). Initial lateral radiograph of right wrist demonstrating distal right radius fracture with dorsal angulation of fracture fragment.
Image 2 (Right). Post-reduction film with successful reduction and improved angulation of distal radius.

DISCUSSION

The CCBPB is a relatively novel upper extremity regional anesthesia approach described by Karmakar et al. in 2015 as an alternative to the classic sagittal paracoracoid approach. The consistent anatomical relationships of the CCS, in combination with the close proximity of the brachial plexus cords to one another and their superficial location relative to the skin surface, creates an ideal regional target location for anesthesia of the brachial plexus. A prospective, randomized, observer-blinded study comparing the two ICBPB approaches demonstrated faster onset of sensory blockade and earlier readiness for surgery in patients who received the costoclavicular block compared to those who underwent the lateral sagittal (paracoracoid) block approach. Other advantages of this block approach include its consistent sparing of the phrenic nerve. Evidence from cadaver studies have demonstrated that a costoclavicular block utilizing 20 mLs of methylene blue reliably spreads cephalad to the supraclavicular brachial plexus, consistently reaching the supraclavicular nerve and all trunks and cords of the brachial plexus, while sparing the phrenic nerve. The implications of these findings are that the costoclavicular brachial plexus provides safer, faster onset, and more reliable surgical anesthesia of the upper extremity compared to other brachial plexus block approaches, while preserving ipsilateral respiratory function.

The costoclavicular brachial plexus block is performed as follows:

1. Place patient in supine or semi-recumbent position with arm abducted 90 degrees.

2. Orient high-frequency linear array transducer just below and parallel to the mid-clavicle in the infraclavicular fossa.
3. Tilt the probe cephalad to identify the brachial plexus cords lateral to the axillary artery and vein, and in-between the subclavius and serratus anterior muscles in the costoclavicular space.
4. Apply color Doppler to identify any arteries and veins prior to needle insertion.
5. Insert echogenic block needle in-plane from a lateral to medial direction, aiming between the posterior and lateral cords, and inject a few milliliters of normal saline to confirm proper needle placement.
6. If anechoic fluid is visualized spreading between and separating the three brachial plexus cords, complete the block with 20 milliliters of local anesthetic.

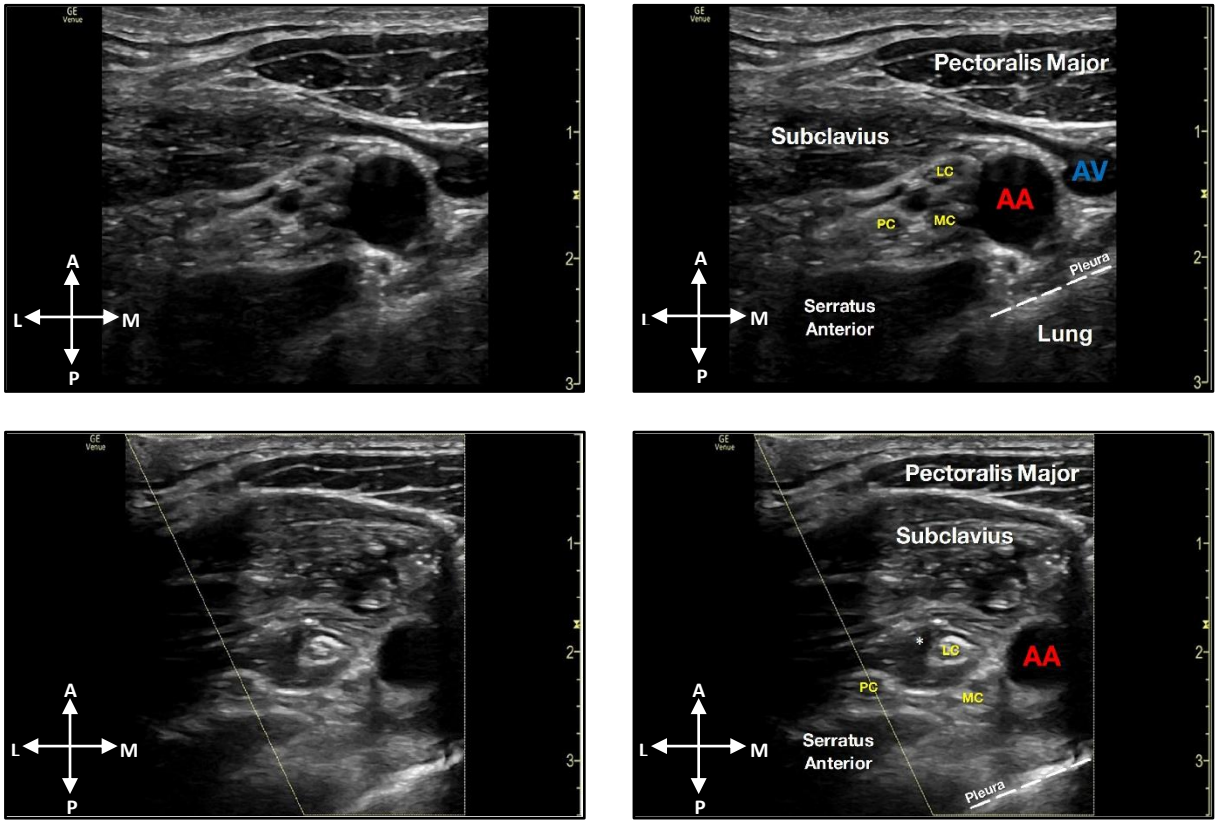

Image 3 (Top Left) and **4 (Top Right)**. Normal sonoanatomy of the costoclavicular space for CCBPB performance, unlabeled and labeled.
Image 5 (Bottom Left) and **6 (Bottom Right)**. Post-CCBPB performance, unlabeled and labeled, with anechoic local anesthetic injectate enveloping and spreading apart the various cords of the costoclavicular brachial plexus.

This case illustrates a relatively novel approach to brachial plexus blockade and regional anesthesia of the upper extremity. To our knowledge, this is the first reported case of the CCBPB technique utilized in the emergency department to provide rapid and effective upper extremity analgesia to facilitate distal radius fracture reduction in the peri-traumatic period.

REFERENCES

1. Karmakar MK, Sala-Blanch X, Songthamwat B, Tsui BC. Benefits of the costoclavicular space for ultrasound-guided infraclavicular brachial plexus block: description of a costoclavicular approach. *Reg Anesth Pain Med*. 2015;40:287–288.

2. Demondion X, Herbinet P, Boutry N, Fontaine C, Francke JP, Cotten A. Sonographic mapping of the normal brachial plexus. *AJNR Am J Neuroradiol*. 2003;24:1303–1309.

3. Sala-Blanch X, Reina MA, Pangthipampai P, Karmakar MK. Anatomic basis for brachial plexus block at the costoclavicular space a cadaver anatomic study. *Reg Anesth Pain Med*. 2016;41:387–391.

4. Li JW, Songthamwat B, Samy W, Sala-Blanch X, Karmakar MK. Ultrasound-guided costoclavicular brachial plexus block sonoanatomy, technique, and block dynamics. *Reg Anesth Pain Med*. 2017;42:233–240.

5. Songthamwat, B., Karmakar, M. K., Li, J. W., Samy, W., & Mok, L. (2018). Ultrasound-Guided Infraclavicular Brachial Plexus Block: Prospective Randomized Comparison of the Lateral Sagittal and Costoclavicular Approach. *Reg Anesth Pain Med*. 2018;43:825–831.