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CASE REPORT

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# Ultrasound-guided costoclavicular approach infraclavicular brachial plexus block for vascular access surgery

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**ABSTRACT**

**Introduction:** We report the use of a newly described regional technique, ultrasound-guided costoclavicular approach infraclavicular brachial plexus block for surgical anesthesia in two high-risk patients undergoing 2nd stage transposition of basilic vein fistula.

**Methods:** Both patients had features of difficult airway, American Society of Anesthesiologists (ASA) physical status class III and central venous occlusive disease. The common approach, i.e., ultrasound-guided supraclavicular brachial plexus block was technically difficult with inherent risk of vascular puncture due to dilated venous collaterals at the supraclavicular area possibly compromising block quality. The risk of general anesthesia (GA) was significant as patients were morbidly obese with possible risk of obstructive sleep apnea postoperatively. As an alternative, we performed the ultrasound-guided costoclavicular approach infraclavicular brachial plexus block with 20 mL local anesthetic (LA) ropivacaine 0.5% delivered at the identified costoclavicular space using in-plane needling technique. Another 10 mL of LA was infiltrated along the subcutaneous fascia of the proximal medial aspect of arm.

**Results:** Both surgeries of >2 hours' duration were successful, without the need of further local infiltration at surgical site or conversion to GA.

**Conclusions:** Ultrasound-guided costoclavicular approach can be an alternative way of providing effective analgesia and safe anesthesia for vascular access surgery of the upper limb.

**Keywords:** BBF transposition, Costoclavicular approach, Infraclavicular brachial plexus block, Regional anesthesia, Ultrasound, Vascular access surgery

## Introduction

Costoclavicular approach, a variant of ultrasound-guided infraclavicular brachial plexus block, was recently introduced and its technical description (1) and cadaveric anatomical study (2) had been published. The original authors had performed more than 100 blocks (1) using this technique without any complications. We report the use of this technique for surgical anesthesia in two high-risk patients who underwent 2nd stage transposition of basilic vein fistula.

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## Case description

Both subjects had end-stage renal failure (ESRF), diabetes mellitus, hypertension, dyslipidemia and poor functional status, New York Heart Association (NYHA) Class III. They were also morbidly obese with features of difficult airway (Fig. 1), central venous occlusive disease and likely to have obstructive sleep apnea, based on STOP-BANG Sleep Apnea Questionnaire score (>4). The body mass index (BMI) for Case A was 33 kg/m$^2$ and Case B was 35.6 kg/m$^2$. Overall, they were classified as American Society of Anesthesiologists (ASA) physical status class III.

Surgery for 2nd stage basilic vein transposition (3, 4) often requires general anesthesia (GA) or regional anesthesia as it involves two skip-arm incisions at the medial aspect of the arm, a more invasive and painful procedure (Fig. 1). Transposition of basilic vein can be done as a one-stage or two-stage procedure (3, 4). There is no clear superiority of the one-stage over the two-stage procedure of transposed basilic vein. In our center, the surgeons often do two-stage procedure.

In the two-stage procedure: an end-to-side anastomosis is made between the basilic vein and the brachial artery in


**Fig. 1 -** Case description (Case B). (**A**) Case B – difficult airway features: central obesity, Mallampati Class IV, short neck, buffalo hump with neck lipoma, receding chin with thyromental distance less than 2 fingerbreadth. (**B**) Successful surgery – basilic vein transposition under monitored sedation with ultrasound-guided costoclavicular approach infraclavicular brachial plexus block; standard American Society of Anesthesiologists (ASA) monitoring employed all the time during block procedure and surgery.

the antecubital fossa usually under local anesthesia (LA) during the first stage. The second stage procedure is performed 4 to 6 weeks later during which the arterialized basilic vein is transposed to a more anterior and superficial position over the biceps muscle. This involves dissection of the basilic vein through two longitudinal skip incisions, one over the distal part of the basilic vein near the anastomosis and the other at the level of the proximal arm to allow full mobilization of the basilic vein up to its confluence with the brachial vein. During dissection of the basilic vein, all tributaries are ligated with suture and/or surgical clips and divided. A superficial anterolateral arm tunnel is made between the two incisions with a tunneler, the patient will receive 3000 units of unfractionated heparin intravenously; fistula vein is then transected and the vein is retracted off the proximal incision, dilated with heparinized solution and routed via the tunnel, after which the two ends of the fistula are re-anastomosed.

The benefits of regional anesthesia clearly outweighed the risk of GA in these case reports (5). Brachial plexus block would provide effective analgesia, safe anesthesia, improved fistula flow (6, 7) and primary patency rate (8) without airway manipulation and hemodynamic swing, which is often seen in GA. Nevertheless, both cases could still be performed under balanced GA with advanced airway devices, careful induction and maintenance of anesthesia plus multimodal analgesic regime. On the other hand, performing a peripheral nerve block in an obese patient can be technically challenging owing to poor, degraded sonogram view and the target structures, which are often deeply seated, resulting in risk of block failure. Despite the above challenges, avoiding GA in this group of patients is paramount and they would truly benefit from a peripheral nerve block.

Ultrasound-guided supraclavicular brachial plexus block (USSCB) is the most popular and commonly used regional technique for upper extremity surgery. The vessels in the vicinity of supraclavicular fossa area include the subclavian artery, dorsal scapular artery, transverse cervical artery and their venous counterparts. In patients with central venous occlusive disease (9) which is a common problem in ESRF, the venous collaterals can be dilated and engorged (Fig. 2). This would distort the normal sonoanatomy of the supraclavicular area leading to needling difficulty using USSCB with inherent risk of vascular punctures and inadequate block. In addition, USSCB may miss the lower trunk of the brachial plexus (ulnar sparing) in 15% of the cases even with the use of corner pocket technique (10). Providing anesthesia to the medial aspect of arm and forearm is an important area for basilic vein transposition surgery and to achieve adequate block coverage of this area can be intricate. This could explain the need for surgeons to supplement the USSCB block by infiltrating LA at the incision site, especially when incision extends to the proximal part of arm. Another possible explanation is that T2 cutaneous innervation, which comes from the intercostobrachial nerve, may not be covered by brachial plexus block.

Alternative regional technique, i.e., conventional approach of infraclavicular brachial plexus block (7) at the lateral infraclavicular fossa area was also challenging in our cases due to poor sonoanatomy image. The cords of the brachial plexus were not clearly visible and lay deep at about 5-6 cm from the skin (Fig. 3). This approach would be technically difficult with risk of a failed block. Axillary brachial plexus block was not considered in above cases because it is not adequate to cover surgery above elbow level. We proceeded with the

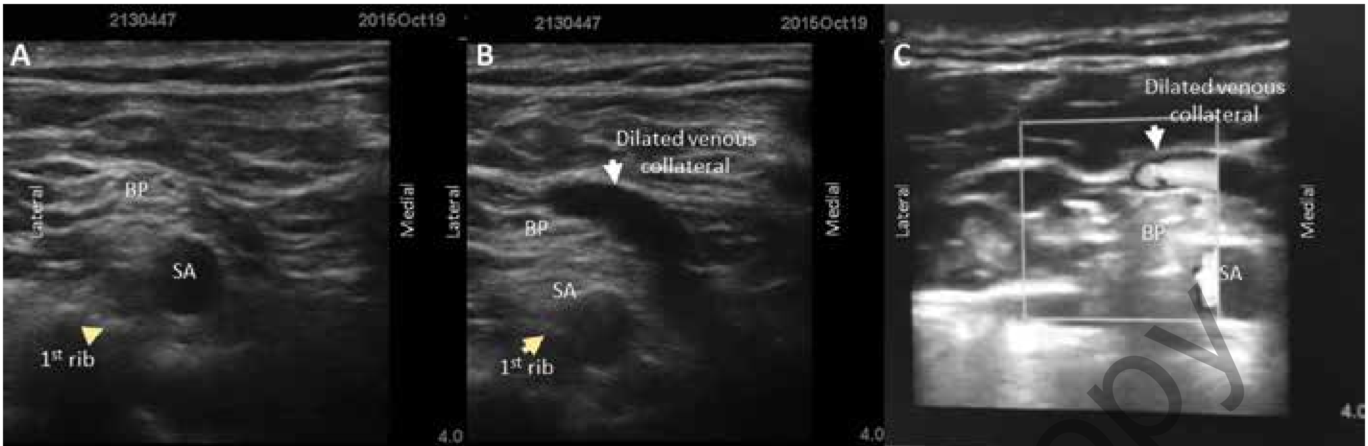


**Fig. 2 -** Sonogram over supraclavicular area (poor tissue echogenicity): (**A**) Transducer compressed, (**B**) Transducer released, revealing grossly dilated venous collateral, (**C**) (still image from mobile phone video clip). Scanning of lateral aspect of supraclavicular area showed presence of dilated collaterals, which would pose needling difficulty with risk of vascular puncture and ineffective block. SA = subclavian artery; BP = brachial plexus, dilated venous collateral (white arrow), 1st rib (yellow arrow).


**Fig. 3 -** Conventional lateral parasagittal infraclavicular approach. (**A**) and (**B**) extremely poor sonoanatomy and deep target structure at 5-6 cm. SA = subclavian artery.



costoclavicular approach because sonogram of the area was visible and accessible to needling. The cords were relatively superficial at costoclavicular space at around 3-4 cm when compared to conventional position at lateral infraclavicular fossa (Fig. 4) and were clustered together in a triangular arrangement lateral to the axillary artery.

An ultrasound machine, Sonosite M-Turbo® (Fujifilm Sonosite Inc., Bothell, WA, USA), with L38x 10-5 MHz linear array probe was used. Block was performed with a 100 mm Stimuplex® needle (B-Braun Medical, Melsungen, Germany) using an in-plane approach. The ultrasound probe was placed beneath the clavicle in horizontal fashion (Figs. 4 and 5) with arm abducted to obtain the transverse sonogram of the costoclavicular space. Sonogram showed all three cords of the brachial plexus (BP) lied within the costoclavicular space (Figs. 4 and 5). Needle will come from lateral to medial direction, which may offer protection against vascular and pleural puncture as the needle tip is more likely to encounter the cords of the brachial plexus before reaching the artery and/or pleura (1, 2).

LA ropivacaine 0.5% 20 mL was delivered at the costoclavicular area and another 10 mL was infiltrated along the subcutaneous fascia at the proximal medial part of the arm. The latter infiltration was performed under ultrasound guidance to block the intercostobrachial nerve (11). The intention of this pre-operative supplemental injection was to achieve surgical anesthesia and to minimize risk of conversion to GA.

Case A was ready for surgery 30 minutes after the block, while Case B, took 25 minutes after the block. Additional

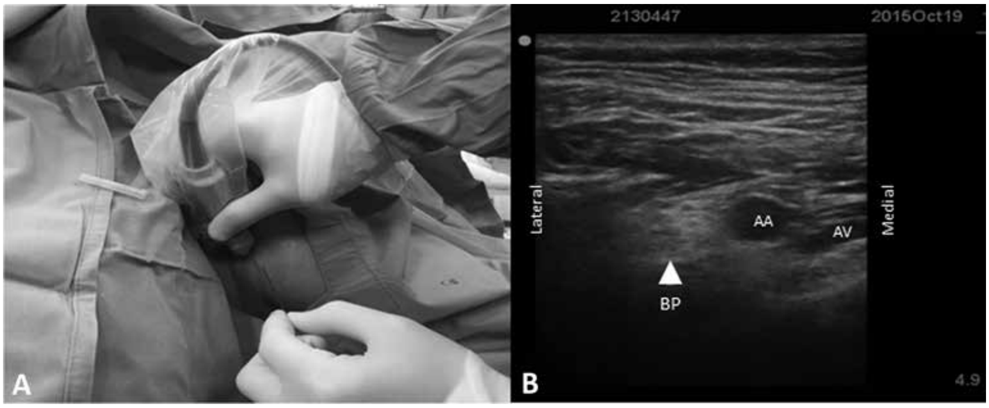


**Fig. 4 -** Ultrasound-guided costoclavicular approach infraclavicular brachial plexus block. Needling and orientation of the transducer. Transverse sonogram showing all 3 cords of the brachial plexus (BP) within the costoclavicular space. (**A**) and (**B**) real procedure on patient (case reports); overall sonogram showed degraded images with poor tissue echogenicity. AA = axillary artery; AV = axillary vein; BP = brachial plexus (thick arrow).


**Fig. 5 -** Ultrasound-guided costoclavicular approach infraclavicular brachial plexus block. (**A**) and (**B**) demonstration on a thin model (not related to case reports); better sonogram images. AA = axillary artery; AV = axillary vein; BP = brachial plexus (white arrow).



analgesic, intravenous (IV) fentanyl 50 mcg was given prior to the beginning of the operation in Case A. Due to long surgical time, Case B received supplemental analgesics: IV fentanyl 35 mcg and IV morphine 2 mg plus monitored sedation with target controlled infusion (TCI) propofol at infusion rate of between 0.5-1.5 mcg/mL using Schneider model to achieve Richmond Agitation and Sedation Scale (RASS) of -2 to 0. Both surgeries were successful without the need of LA infiltration or conversion to GA. The duration of surgery for Case A was 2 hours 15 minutes while case B took longer, 3 hours 50 minutes. Post-operatively, patients were given regular dose of oral paracetamol and diclofenac. The block effect resolved by 24 hours from the time of block given, and patients did not require additional rescue analgesia apart from their regular dose of oral paracetamol and diclofenac. Both patients were satisfied with the anesthetic technique.

## Conclusion

Ultrasound-guided costoclavicular approach to block the brachial plexus has been shown to be successful for upper extremity proximal vascular access surgery. It can be considered as one of the options when other approaches seem impossible and sonogram of the costoclavicular area can be obtained. However, further randomized studies should be done to compare this approach with other conventional techniques.

## Disclosures

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