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Case Report

Ultrasound-Guided Costoclavicular Brachial Plexus Block for Elbow Surgery in a Polytrauma Patient: A Case Report

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ABSTRACT:
Upper limb surgery is best performed under brachial plexus blocks which provide effective analgesia with less or minimal systemic complications than general anesthesia. This study discusses the management of a complex distal humeral fracture with an open segment in a polytrauma patient with costoclavicular brachial plexus ultrasound-guided block for an elbow operation. This technique afforded good anaesthesia and postoperative analgesia with less respiratory embarrassment as would be seen in trauma patients on general anaesthesia. Our findings confirm the safety and effectiveness of the costoclavicular approach and recommend its recommendation as a method of first choice in such difficult situations when the system can be affected.

Keywords: elbow fracture, peripheral nerve block, polytrauma management, postoperative analgesia, regional anesthesia, ultrasound guidance

INTRODUCTION:

Brachial plexus blocks are among the commonest regional anaesthesia techniques for upper limb surgeries as they offer analgesic benefit and avoid over-reliance on general anesthesia [1]. Conventional methods which include interscalene, supraclavicular and infraclavicular needle techniques have been practiced. But there are various risks with the use of these techniques such as phrenic nerve paralysis, incomplete block, and pneumothorax [2]. Recently, the costoclavicular block technique has been made available as an alternative which may not have the complications previously mentioned owing to its more superficial and more compact arrangement of the brachial plexus cords.

The costoclavicular brachial plexus block (CCBPB) approached just behind the midclavicular line aims the single insertion technique and the single positioning accepted requires lesser volume of local anesthetic due to closeness of the nerves. This method has proven effective in avoiding painful and life-threatening side effects of the traditional infraclavicular block [3]. Recent literature underlines the fact that this approach can lead to a remarkably reduced rate of ipsilateral hemi diaphragmatic paralysis often resulting from supraclavicular and interscalene blocks and subsequently enhance patient safety and comfort [4].

Sala-Blanch et al., argued there are anatomical benefits associated with the costoclavicular space; the lateral, medial, and posterior cords of the brachial plexus have a smaller, firmer, and more consistent location [5]. Similar nerve anatomy provides a greater margin of error in accurately placing the block and may improve the effectiveness and predictability of the block. Additionally, the costoclavicular block is situated near the surface of the skin and has a predictable pattern of vascular distribution which helps decrease the risk of nerve injury due to vascular puncture or other needle-related complications [6].

One of the major benefits of regional anesthesia rises from treating singly or a combination of traumatic injuries in a trauma and/or polytrauma patient population. Such patients often have multiple injuries that pose challenges on the administration of general anesthesia for example a chest trauma that may affect one's breathing [7]. The employment of regional techniques such as the costoclavicular block can be used to assist in meeting standards of sufficient anaesthesia and analgesia without the need for using general anesthetics with their associated respiratory depression and the consequent per-operative morbidity and mortality.

In this study, through demonstrating a step-by-step guide for the use of the CCBPB in a patient with multiple medical comorbidities or trauma, we hope to add to the literature supporting this technique as a safe and effective form of anesthesia for this patient population. This report on the technique conveys a demonstration that this technique is effective in reaching the required level of anesthesia as well as analgesia while minimizing the potential adverse effects and should be applied more often in medicine.

Case Presentation:

Patient Information:

A 34-year-old male presented for urgent surgical intervention following a fall from the first floor while fixing an air conditioning unit. The patient sustained multiple traumatic injuries, including an open displaced fracture of the distal end of the right humerus. He was initially brought by paramedics with a Glasgow Coma Scale (GCS) score of 11/15, which fluctuated between 11 and 13/15. There were no witnessed seizures, loss of consciousness, or vomiting.

Pre-Anesthesia Examination:

The patient was assessed to have a Mallampati class IV airway with limited mouth opening, indicating an increased risk of difficult airway management. Pulmonary examination revealed decreased breath sounds. Neurological examination showed fluctuating GCS scores with a best eye response of 3, best verbal response of 4, and best motor response of 6. The patient had a significant left zygomaticomaxillary complex injury, a right orbital injury including retrobulbar hemorrhage and fractures with muscle entrapment, bilateral rib fractures with minimal left pneumothorax, suspected stable compression fractures of T1 and T2, no traumatic brain injury (TBI), and no cervical osseous injury or definite major intra-abdominal injury.

Laboratory Findings:

Laboratory results showed a hemoglobin level of 15 g/dL, an INR of 1.41, and a creatinine level of 1.51 mg/dL. Other laboratory values were within acceptable limits.

Imaging Studies:

CT polytrauma imaging confirmed the left zygomaticomaxillary complex injury, right orbital injury with retrobulbar hemorrhage and fractures with entrapment of the medial rectus muscle, bilateral rib fractures without flail chest, minimal left pneumothorax, and suspected stable compression fractures of T1 and T2. There was no evidence of Traumatic Brain Injury (TBI), cervical osseous injury, or major intra-abdominal injury.

Intraoperative Course:

Standard monitors (ECG, BP, SpO2) were applied. Given the chest trauma findings on the CT scan, general anesthesia was avoided. The anesthesia plan involved a right brachial plexus block using the ultrasound-guided costoclavicular space block technique. The patient was positioned supine with the ipsilateral arm abducted to 90 degrees and the head turned slightly to the contralateral side. Using a high-frequency linear array transducer (12–15 MHz), the axillary artery and vein were visualized, and the brachial plexus cords were identified lateral to the artery. A single-shot injection of 30 mL of 0.75% ropivacaine was administered using a 22 G, 10 cm insulated, short-bevel needle under ultrasound guidance and nerve stimulation. The Sonographic anatomy confirmed the accurate visualization of the axillary artery and adjacent brachial plexus cords in the costoclavicular space, facilitating the successful administration of the brachial plexus block for effective analgesia during the surgical intervention (Figure 1).

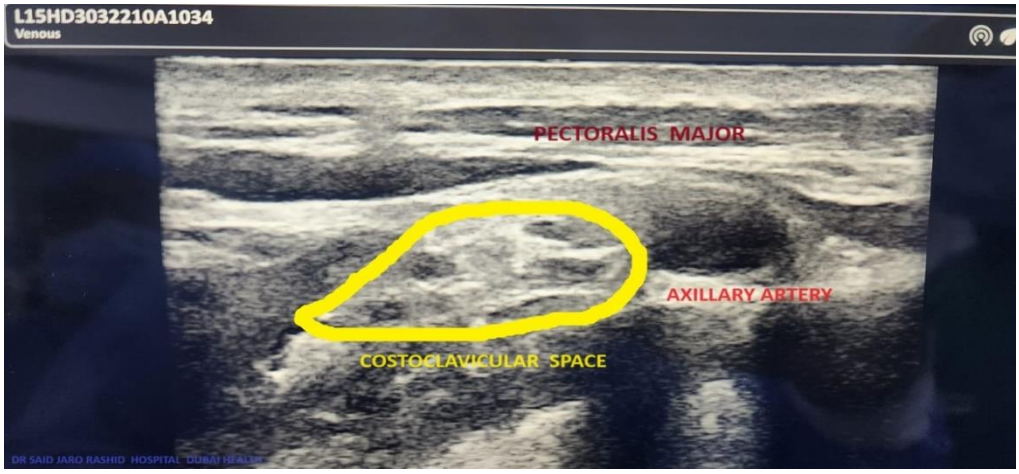

Figure 1. Sonographic anatomy of the Costoclavicular Space Block

Intraoperative and Postoperative Course:
Following the injection, complete sensory and motor block of the right upper limb was achieved within 10 minutes. The surgery, which involved the application of an external fixator to the right elbow, proceeded without any additional anesthetics and provided excellent analgesia for the next 10-14 hours postoperatively.

Post Anesthesia Care Unit (PACU):
In the PACU, the patient's vital signs were stable with a temperature of 37.2°C, heart rate of 68 bpm, respiratory rate of 19 breaths per minute, blood pressure of 116/69 mmHg, and an SpO2 of 98% on room air. The patient reported no pain with a pain score of 0 on the numeric scale. The modified Aldrete score was 10, indicating full recovery from anesthesia. The right arm was elevated, and neurological and respiratory assessments were within defined limits. The patient was discharged from the PACU in stable condition.

DISCUSSION:

Use of the CCBPB guided by ultrasound in this case makes it clear that this block is an efficient method of providing anesthesia for a polytrauma patient receiving an elbow procedure. The anatomical injuries sustained by the patient included bilateral rib fractures and minimal left pneumothorax; hence, the anesthetic approach chosen needed to cause less compromising of the respiratory status. The costoclavicular block is a less invasive procedure that allowed the patient to avoid the potential side effect of general anesthesia (i.e. suppression of the respiratory activity. This can also be supported by the results of Xing et al., who stated that, not only is the costoclavicular block effective in providing anesthesia but also helps in preventing complications like respiratory ones compared to other brachial plexus blocks [8].

In this case the costoclavicular block provided sensory and motor block within 10 minutes which helped to stand the external fixation of the elbow without using any supplementary anesthetic. This quick onset and intellectual magnitude speak to the effectivity of the block. Tran et al. published a study that showed that the new costoclavicular block is more rapid to onset in relation to the lateral sagittal infraclavicular block, with comparable success in sensory and motor blocks [9]. This implies that the costoclavicular approach provides more effective avenues for upper extremity surgeries [10].

The patient's stable hemodynamic parameters and low postoperative pain requirements also support the exclusion of the costoclavicular block as a causative factor for postoperative pain. After arriving in the PACU the patient had no pain with a stable vital signs and continued to be monitored. These results are in line with the previous findings of Xing et al., who reported that CCB blocks offer prolonged pain relief and stable intraoperative blood pressures [11]. Such outcomes can especially be valuable in polytrauma patients who may have more dynamic clinical conditions.

In addition, the fact that several complications that usually result from other brachial plexus blocks such as phrenic nerve paralysis and pneumothorax do not occur when using the costoclavicular block also indicates the safety of the procedure [12]. To our best knowledge there was no evidence of diaphragmatic paralysis or vascular puncture with this case. This study by Bailey et al. also proved that the application of the costoclavicular block can significantly reduce the incidences of such complications compared to supraclavicular and interscalene blocks to prevent or manage the patients with thoracic injuries [13].

The structural constancy of the costoclavicular space provided a sufficiently precise single-shot injection for this patient to achieve a success rate for the block. This is a big plus compared to other techniques as noted by Amaral et al. who emphasized that improvement in the visualization of the cord through the costoclavicular window reduces the need for twice injection and the risk for block failure while improving patient satisfaction [14].

The efficacy and practicality of the costoclavicular block in the treatment of this patient with a long fracture history can be used to advocate for the use of this block in trauma patients in general. The control of adequate anesthesia and postoperative analgesia with a comparable rate of complications explains why this technique is so important [15]. Silva et al. also affirmed the efficiency of the costoclavicular block as a reliable and cost-effective method for reducing the rate of complications for diverse surgeries and encouraging its wider use as a standard practice [16].

This case demonstrates that the ultrasound-guided CCBPB is suitable for complex polytrauma patients. However, further research studies with larger sample sizes and multicentre trials should be conducted to validate the feasibility and the side effects of the costoclavicular block compared with other brachial plexus techniques for different surgical procedures among varying patient populations. Research on the effects of using this approach over longer time intervals and the patient satisfaction metrics could offer crucial practical information about using this approach.

CONCLUSION:

The CCBPB aided by an ultrasound device was used to administer regional anesthesia for this patient. Even with the presence of bilateral rib fractures, minimal

pneumothorax, and reduced GCS there was no need for general anesthesia as the Brachial Plexus Block made for complete sensory as well as motor blockade in 7-10 minutes. Significant hemodynamic stability and post-operative analgesia were documented in the patient, which conveyed the safety of the block. It reemphasizes the role and mainly the potential outcome of costoclavicular as a complete or a single supplement block for upper extremity surgeries particularly for patients with multiple injuries and/or contraindicated for general anesthesia and thus endorses its utilization as one among the reginal anesthetic techniques.

REFERENCES:

1. Brattwall M, Jildenstål P, Warrén Stomberg M, Jakobsson JG. Upper extremity nerve block: how can benefit, duration, and safety be improved? An update. F1000Res. 2016;5 doi. 10.12688/f1000research.7292.1.
2. Kaye AD, Allampalli V, Fisher P, Kaye AJ, Tran A, Cornett EM, et al. Supraclavicular vs. Infraclavicular Brachial Plexus Nerve Blocks: Clinical, Pharmacological, and Anatomical Considerations. Anesth Pain Med. 2021;11(5):e120658 doi. 10.5812/aapm.120658.
3. Reeves MT, O'Neil K, Slesinger TL. Costoclavicular Brachial Plexus Block Facilitates Painless Upper Extremity Reduction: A Case Report. Clin Pract Cases Emerg Med. 2023;7(4):221-6 doi. 10.5811/cpcem.59091.
4. Oh C, Noh C, Eom H, Lee S, Park S, Lee S, et al. Costoclavicular brachial plexus block reduces hemidiaphragmatic paralysis more than supraclavicular brachial plexus block: retrospective, propensity score matched cohort study. Korean J Pain. 2020;33(2):144-52 doi. 10.3344/kjp.2020.33.2.144.
5. 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(3):387-91 doi. 10.1097/aap.0000000000000393.
6. Beh ZY, Hasan MS. Ultrasound-guided costoclavicular approach infraclavicular brachial plexus block for vascular access surgery. J Vasc Access. 2017;18(5):e57-e61 doi. 10.5301/jva.5000720.
7. Dattatri R, Jain VK, Iyengar KP, Vaishya R, Garg R. Anaesthetic considerations in polytrauma patients. J Clin Orthop Trauma. 2021;12(1):50-7 doi. 10.1016/j.jcot.2020.10.022.
8. Xing T, Ge L. Ultrasound-Guided Brachial Plexus Block by Costoclavicular Space Approach: A Narrative Review. Medical Science Monitor. 2023;29 doi. 10.12659/MSM.939920.
9. Dost B, Kaya C, Ustun YB, Turunc E, Baris S. Lateral Sagittal Versus Costoclavicular Approaches for Ultrasound-Guided Infraclavicular Brachial Plexus Block: A Comparison of Block Dynamics Through A Randomized Clinical Trial. Cureus. 2021;13(3):e14129 doi. 10.7759/cureus.14129.
10. Zhu M, Sun W. Application and Research Progress of Ultrasound-Guided Brachial Plexus Block Through Costoclavicular Space Approach in Upper Limb Surgery. Altern Ther Health Med. 2024;30(1):24-30 doi.
11. Xing T, Ge L. Ultrasound-Guided Brachial Plexus Block by Costoclavicular Space Approach: A Narrative Review. Med Sci Monit [Internet]. 2023 2023/07//; 29:[e939920 p.]. Available from: http://europepmc.org/abstract/MED/37448107, https://medscimonit.com/download/inPress/idArt/939920 https://doi.org/10.12659/MSM.939920, https://europepmc.org/articles/PMC10353486, https://europepmc.org/articles/PMC10353486?pdf=render.
12. Lang J, Cui X, Zhang J, Huang Y. Dyspnea induced by hemidiaphragmatic paralysis after ultrasound-guided supraclavicular brachial plexus block in a morbidly obese patient. Medicine. 2022;101(2):e28525 doi. 10.1097/md.0000000000028525.
13. Bailey JG, Donald S, Kwofie MK, Sandeski R, Uppal V. Critical structures in the needle path of the costoclavicular brachial plexus block: a cadaver study. Canadian Journal of Anesthesia/Journal canadien d'anesthésie. 2021;68(8):1156-64 doi. 10.1007/s12630-021-01990-8.
14. Amaral S, Lombardi R, Drabovski N, Gadsden J. Infraclavicular versus costoclavicular approaches to ultrasound-guided brachial plexus block: a systematic review and meta-analysis. Brazilian Journal of Anesthesiology (English Edition). 2024;74(2):744465 doi. https://doi.org/10.1016/j.bjane.2023.09.004.
15. Han JU, Yang C, Song JH, Park J, Choo H, Lee T. Combined Intermediate Cervical Plexus and Costoclavicular Block for Arthroscopic Shoulder Surgery: A Prospective Feasibility Study. J Pers Med. 2023;13(7) doi. 10.3390/jpm13071080.

16. Silva GR, Borges DG, Lopes IF, Ruzi RA, Costa P, Mandim B. [Ultrasound-guided costoclavicular block as an alternative for upper limb anesthesia in obese patients]. Braz J Anesthesiol. 2019;69(5):510-3 doi. 10.1016/j.bjan.2019.01.004.