Brief Communication

Undescribed Vascular Signatures: A Contraindication to Ultrasound-guided Parasagittal Infraclavicular Block! A Retrospective Observational Study

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Abstract

Background: The ultrasound-infraclavicular block (US-ICB) is a popular and efficient block for below-elbow surgeries. However, the vascular anatomy of infraclavicular area close to the brachial plexus has remained unresearched. We aimed to explore the presence of aberrant vasculature in the infraclavicular area that could pose a contraindication to US-ICB. **Methods:** In this retrospective observational study, we reviewed the US images of patients undergoing below-elbow surgery under US-ICB. Before performing the block, a scout scan of parasagittal infraclavicular areas was performed and the scan images were saved. The primary objective was to find the prevalence of aberrant vasculature due to which the US–ICB was abandoned. The secondary objective was to understand the pattern and position of the aberrant vessels. **Results:** Out of 912 patients, 793 patients underwent surgery under US–ICB and in 119 patients (13.05%), the USG-ICB was abandoned due to aberrant vasculature close to the brachial cords and intended position of the needle tip. The anomalous vessels were identified in the lower inner, lower outer, and upper outer quadrants around the axillary artery (AA). Some of these vascular structures also had classical patterns which we described as "satellites," "clamping," or "hugging" of the AA. **Conclusion:** Anomalous vascular structures in the infraclavicular area were seen in 13.05% of patients planned for US–ICB. We, therefore, recommend, that a thorough scout US scan should be mandatorily performed ICB and in the presence of aberrant vascular structures, an alternative approach to brachial plexus block may be adopted.

Keywords: Axillary artery, brachial plexus, infraclavicular, ultrasound

Introduction

The use of ultrasonography has revolutionized the practice of regional anesthesia and perioperative care. A careful preprocedural ultrasound (US) can give a lot of information to the clinician such as evaluation of tendons and various muscles.[1,2] Preprocedural US can surprise the anesthesiologist by revealing anomalous vascular structures that can change the course and conduct of a specific block.[3] For the supraclavicular and interscalene areas, vascular patterns of dorsal scapular and transverse cervical arteries have been clearly described.[4] The vascular structures in the posterior triangle of the neck and its potential impact on the supraclavicular approach have also been reported.[5] The US-infraclavicular block (ICB) is a popular and extremely efficient block for below-elbow surgeries. However, the infraclavicular vascular anatomy close to the brachial plexus has been an uninvestigated area. There has not been any human study to investigate the presence of aberrant vasculature in the infraclavicular area that could interfere with performance of US-ICB.

In this observational study, we reviewed US images of patients undergoing below-elbow surgery under US-ICB. The primary

Received: 07-01-2021 **Revised:** 23-03-2021 **Accepted:** 29-06-2021 **Available Online:** 15-09-2021

Access this article online

Quick Response Code:

Website: www.jmuonline.org

DOI: 10.4103/JMU.JMU_8_21

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How to cite this article: Diwan S, Sethi D, Bhong G, Sancheti P, Nair A. Undescribed vascular signatures: A contraindication to ultrasound-guided parasagittal infraclavicular block! A retrospective observational study. J Med Ultrasound 2021;29:203-6.

objective was to find the prevalence of aberrant vasculature in the infraclavicular area due to which the USG–ICB had to be abandoned. The secondary objective was to understand the pattern and position of the aberrant vascular structures in the infraclavicular area.

Materials and Methods

In our institute, the US-supraclavicular block (SCB), the parasagittal US-ICB, and the US-axillary block (AXB) are routinely employed in clinical practice. As per our institutional protocol, while performing the brachial plexus blocks, the US images of needle position and final injectate are downloaded against the patients' name and saved in dedicated folder for future review.

For this study, we reviewed the US saved images of patients who underwent below-elbow surgery under brachial plexus block from January 2015 to January 2020, after approval from the Institutional Ethics Committee of Sancheti Hospital, Pune, India (approval no. 4 obtained on Nov. 22th, 2018). Written informed consent was obtained from all the patients undergoing the surgery under brachial plexus block. Medical records of 912 patients undergoing below-elbow surgery under brachial plexus block belonging to the American Society of Anesthesiologists Physical Status classes 1–3 were included for final analysis. The records of patients under 20 years, preexisting brachial plexus injury, prior operative procedures in the neck or prior radiotherapy of the neck, pacemaker, and subclavian intravenous port in the infraclavicular were excluded from review.

The US-ICB was used as a first-line approach for below-elbow surgery.[6] Before planning the block, a scout scan of the infraclavicular area was performed to identify the cords of brachial plexus and any aberrant vessels close to the neural target. The scan was performed with the probe placed medial to the coracoid process in the parasagittal plane, with the marker on the cranial side. In case of a clear scan without any aberrant vessels, the anesthesiologist performed the ICB using an in-plane needle approach. In case of identification of aberrant vessels, the ICB was abandoned and an alternative approach to brachial plexus block such as US-SCB or US-AXB was implemented.

For analyzing the vascular structures, the saved image of US-ICB was divided into 4 quadrants with the axillary artery (AA) in the center. The quadrants were which were labeled as upper outer (UO), upper inner (UI), lower outer (LO), and lower inner (LI). The position of the aberrant vasculature in US-ICB was defined about the AA, in relation to the four quadrants. The acquired data were presented and analyzed as absolute numbers and percentages.

Results

Out of 912 patients, 793 patients underwent surgery under US–ICB and in 119 patients (13.05%), the USG-ICB was abandoned due to aberrant vasculature identified close to the cords and intended position of the needle tip. As an alternative, US-SCB or US-AXB was performed in these patients for their surgery.

Figure 1 shows the position of these vascular structures around AA in these 119 patients. The vascular structures were observed in the LO quadrant in 32 patients (23.53%), in the LI and LO quadrants in 17 patients (14.29%), in the UO and UI quadrants in 28 patients (26.89%), and the LI, LO, and UO quadrants in 42 patients (35.39%). The vascular structures around AA were identified as either a single vessel or multiple isolated "satellites" spread out in all three quadrants except the UI in close proximity to the hyperechoic cords of brachial plexus [Figures 2 and 3]. In some patients, vascular structures had typical arrangement which we described as "clamping" or "hugging" the AA [Figures 4 and 5]. The schematic representation of the different outlay of vascular structures as seen in 119 patients is depicted in Figure 6.

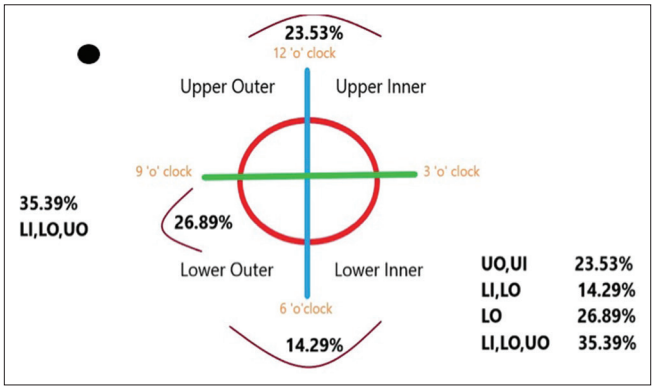

Figure 1: Diagrammatic representation of the distribution of vascular structures around the axillary artery in the ultrasound-infraclavicular block scan. Marker is cranial

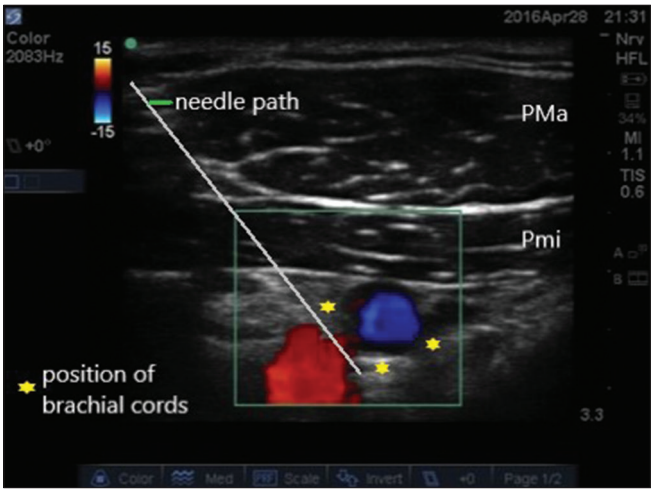

Figure 2: Single vessel in the lower outer quadrant close to the posterior and lateral cords

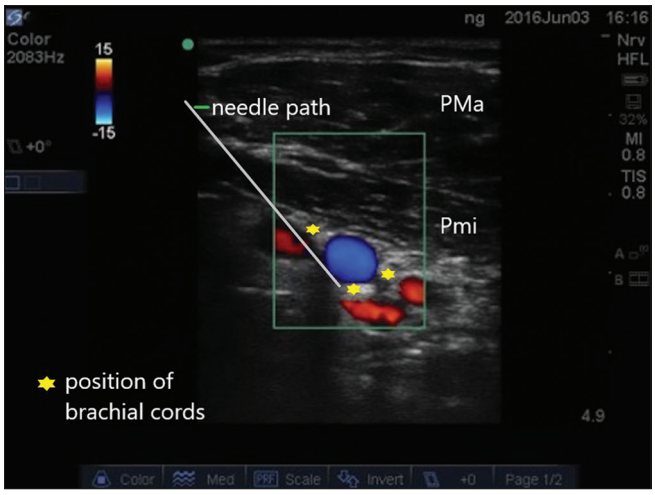

Figure 3: "Satellites" of the axillary artery – Isolated multiple vessels around the axillary artery close to the of brachial cords

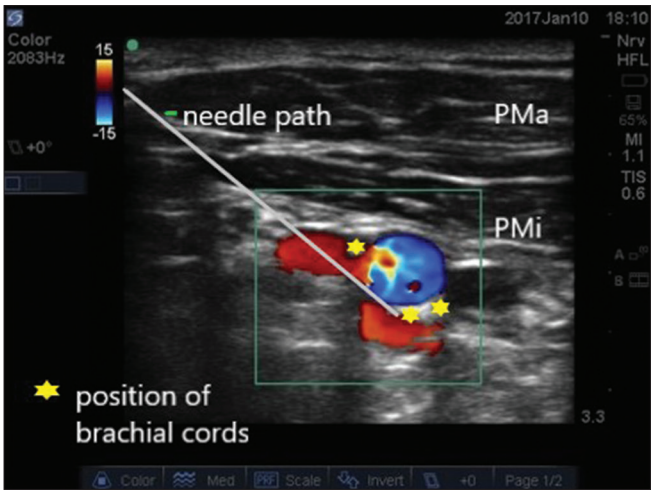

Figure 4: "Clamping" the axillary artery – Vascular structure seen fused with the axillary artery

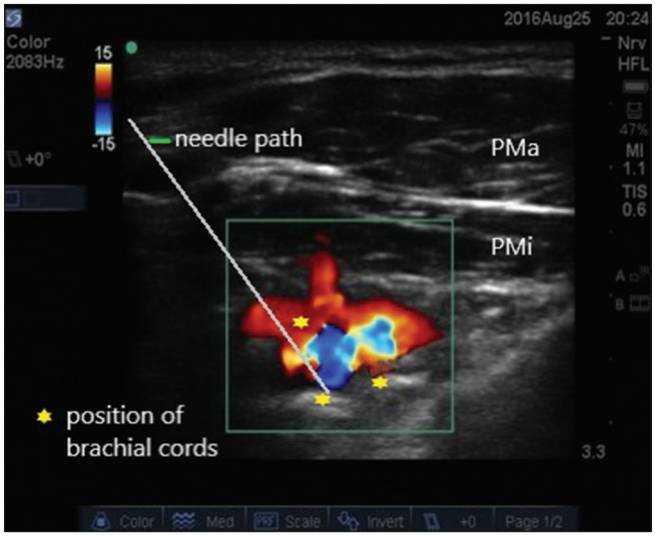

Figure 5: "Hugging" the axillary artery – Vascular structure in three quadrants surrounding the axillary artery

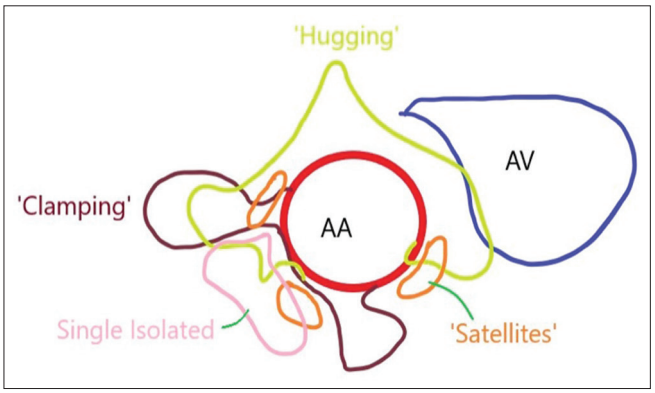

Figure 6: Schematic representation of vascular structures around the AA and the AV: AA-Axillary artery, AV: Axillary vein

Discussion

Key findings

In our observational study, a parasagittal US scan during ICB revealed anomalous vasculature in the vicinity of the brachial plexus cords in 119 of 912 patients (13.05%). Some of these vascular structures also had classical patterns which we describe as "satellites" "clamping," or "hugging" the AA. Unlike the supraclavicular and axillary area, the vessels in the infraclavicular space are not compressible; hence, it is important to identify these aberrant vessels before performing the ICB.

A magnetic resonance imaging study in volunteers identified the brachial cords positioned within 2 cm from the AA and approximately within 2/3 of a circle, which corresponds to the LI, LO, and UO quadrants of the lateral parasagittal ICB.[7] Further, the needle tip in the parasagittal US-ICB is positioned posterior to the AA in the LI and or the LO quadrants and traverses through the UO quadrant close to the lateral cord. We observed that the UO, LO, and LI quadrants were the "unsafe" quadrants as the aberrant vascular structures present in these quadrants were directly in the needle path or very close to the brachial plexus cords where the needle tip for US-ICB would be finally positioned.

Review of Literature

On reviewing the literature, we found only cadaveric studies that have previously described the vascular anomalies such as clumping of branches of AA in the infraclavicular area, the findings of these studies corroborate with our findings.[8,9] In another cadaveric study, variant branching of the lateral thoracic, subscapular, and posterior circumflex humeral arteries and its close relationship with terminal branches of the posterior cord was observed. The study also showed the subscapular and lateral thoracic arteries laid near the posterior cord or the radial nerve.[10] Recently, two case reports also described the anomalous course of axillary vessels seen on an US scan of the infraclavicular area.[11,12]

Our recommendation

The identification of deviation of the neurovascular structures from their classical anatomical location is extremely important for safely performing the ICB block. Considering the plethora of vascular structures around the second part of AA that lies near the brachial cords, we advocate to always do a scout US scan before the ICB and avoid a blind ICB. In the event of visualization of aberrant vascular structures in the infraclavicular area, it would be wise to adopt an alternative approach for brachial plexus block to avoid vascular puncture.

To our knowledge, we have not come across a similar prospective or a retrospective study which imparts knowledge regarding the vascular anomalies in the infraclavicular area close to the final needle tip position.

Conclusion

In this retrospective study, anomalous vascular structures in the infraclavicular area were seen in 13.05% of patients planned for parasagittal US-ICB. Therefore, we recommend that a scout scan should be performed before every ICB. Further, we also caution the regional anesthesiologist performing ICB by landmark techniques to be aware of these vascular structures in close vicinity of the needle tip.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Chang PH, Chen YJ, Chang KV, Wu WT, Özçakar L. Ultrasound measurements of superficial and deep masticatory muscles in various postures: Reliability and influencers. Sci Rep 2020;10:14357.
2. Chiu YH, Chang KV, Chen IJ, Wu WT, Özçakar L. Utility of sonoelastography for the evaluation of rotator cuff tendon and pertinent disorders: A systematic review and meta-analysis. Eur Radiol 2020;30:6663-72.
3. Manickam BP, Perlas A, Chan VW, Brull R. The role of a preprocedure systematic sonographic survey in ultrasound-guided regional anesthesia. Reg Anesth Pain Med 2008;33:566-70.
4. Murata H, Sakai A, Hadzic A, Sumikawa K. The presence of transverse cervical and dorsal scapular arteries at three ultrasound probe positions commonly used in supraclavicular brachial plexus blockade. Anesth Analg 2012;115:470-3.
5. Weiglein AH, Moriggl B, Schalk C, Künzel KH, Müller U. Arteries in the posterior cervical triangle in man. Clin Anat 2005;18:553-7.
6. Nerve Block. 21 Jan 2021. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.
7. Sauter AR, Smith HJ, Stubhaug A, Dodgson MS, Klaastad Ø. Use of magnetic resonance imaging to define the anatomical location closest to all three cords of the infraclavicular brachial plexus. Anesth Analg 2006;103:1574-6.
8. Saeed M, Rufai AA, Elsayed SE, Sadiq MS. Variations in the subclavian-axillary arterial system. Saudi Med J 2002;23:206-12.
9. Lee JH, Kim DK. Bilateral variations in the origin and branches of the subscapular artery. Clin Anat 2008;21:783-5.
10. Olinger A, Benninger B. Branching patterns of the lateral thoracic, subscapular, and posterior circumflex humeral arteries and their relationship to the posterior cord of the brachial plexus. Clin Anat 2010;23:407-12.
11. Chandrabose RK, Sandhu NS. Infraclavicular neurovascular anatomic anomaly seen via ultrasound. Anesthesiology 2018;128:389.
12. Murata H, Hida K, Ogami-Takamura K, Hara T. Importance of careful identification of the axillary vessels during ultrasound-guided costoclavicular brachial plexus block. Reg Anesth Pain Med 2019;44:138-40.