Ultrasound guided infraclavicular axillary vein cannulation, coming of age

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In this month’s journal Ahn and colleagues¹ report the effect of arm abduction on the success of central catheter placement after ultrasound guided infraclavicular axillary vein (AXV) cannulation. We discuss these findings and reflect on the development of this particular route of access to central veins.

This paper presents good evidence that arm abduction increases the success of central catheter placement with this approach from the right side and therefore reduces one problem of this procedure. This has parallels with peripherally inserted central catheters (PICC) placement where it is routine to put arms out on a board,² albeit primarily to aid vein access on the medial aspect of the upper arm.

The malposition rate when the AXV was punctured in the neutral position and was significantly higher than with the arm abducted. It is suggested that arm abduction opened up the curve between the subclavian vein and superior vena cava (SVC) to aid central passage of the guidewire. Interestingly there were four arterial punctures in the neutral group but none in the abducted group, which might also suggest abduction favourably altered either the size of the vein, or its degree of overlap with the artery. This was not measured by the authors.

There are other measures to reduce or correct misplacement of central venous catheters. These include:

(a) External pressure over the ipsilateral internal jugular vein (IJV) vein with a finger or the ultrasound probe. This effect can be achieved in PICC placements by asking the patient to put their chin on the clavicle.

(b) Ultrasound imaging of the ipsilateral IJV and contralateral SVC to check and correcting any misplacement of the guidewire.³

(c) Insert J tip pointed caudally.

(d) Avoid excessive traction on arm.

(e) Ask the patient to take a deep breath in as the guidewire or catheter is passed. This may cause a similar change in vein angles as with arm abduction as mediastinal contents descend on inspiration.

(f) Use other x-ray and ECG/electromagnetic guidance for guidewire catheter insertion.⁴

(g) Needle bevel direction during venepuncture.⁵

Clinicians are likely to use a combination of such techniques in their clinical practices. The report only covers right sided placements, so it can be questioned whether this approach would help with left sided procedures. Similarly its effects on landmark based approaches to the subclavian vein (SCV) are not known, but it might be expected to be similar. Arm boards are generally available to attach onto operating tables but not theatre trolleys or ward beds, which could present a practical difficulty, and operators might find the abducted arm gets in their way. The same effect might be achieved with the patient’s hand behind their head. Provision of simple arm boards which are supported under a mattress could be useful for this application and arterial catheters and nerve blocks.

This report and other publications³⁶ point to an increased use of this route of access internationally but we believe there are still many clinicians who are unfamiliar with it, which we highlight below.

History of infraclavicular AXV approaches

Landmark based percutaneous SCV approaches have been used successfully for many years but are marred by small but persistent rates of insertion failure, pneumothorax, haemothorax and other complications even in expert hands.⁷ ⁸ In the 1980s there were limited descriptions of landmark AXV approaches but these never achieved popularity because we believe the landmarks were difficult to identify.⁹

The era of ultrasound guidance

Early reports on ultrasound guidance almost exclusively related to cannulation of the IJV. There was a common belief that the clavicle made visualization of the SCV impossible. This is true for the section of vein obscured by bone in adults, but missed the point that the vein can be visualized above the clavicle and more laterally as the AXV. In the late 1990s we and others¹⁰ started to use ultrasound to access the ‘subclavian vein’ following failed landmark techniques and on reflection recognized it was actually a new approach to the AXV. Subsequent years saw a gradual uptake of the technique with a number of clinical series, ultrasound and anatomical descriptions.¹¹ ¹² Today it is increasingly reported internationally as in this cited paper from Korea. We believe it is now generally the technique of choice when infraclavicular AXV/SCV approaches are indicated in both adults and children.¹³

Many reports still mistakenly label more lateral infraclavicular approaches as relating to the SCV. This distinction may seem pedantic as the AXV becomes the SCV over the first rib, but approaches and risks are very different between the two techniques (Table 1).

An alternative to both is a supraclavicular approach, but this may have higher risk of haemothorax with vein transfixion, but is...
popular in neonates where a larger vein makes the procedure easier.\textsuperscript{14, 15}

Two recent Cochrane analyses considered the role of ultrasound guidance in various routes of accesses\textsuperscript{16, 17} and concluded benefit at the IJV but not femoral or AXV/SCV routes. The latter we believe is likely to relate to a lack of adequate studies, rather than an inherent failure of ultrasound at these and other sites.

Ultrasound in skilled hands gives high success rate and low risk of complications but reported incidence of wires and catheters going into neck or contralateral side is up to 15%, unlike right IJV which is much lower. This detracts from the approach unless other measures are used (as above), hence the interest in this report.

**When should the AXV be used?**

We use this approach as follows: as a rotational site (e.g. with a thrombosed or infected IJV site). To keep catheters away from oropharyngeal and tracheostomy secretions. To improve patient comfort and cosmetic appearances. To make tunneling easier from the chest wall. To improve the stability of pacing wires.\textsuperscript{18}

**Relative contraindications**

These include: large bore catheters and dilators which don’t traverse corners easily into SVC. Deeper veins (>5 cm) can cause difficulty as in morbid obesity or very muscular patients. When there is an actual or planned dialysis AV fistula on that side. When there is a small vein (less than 1.5 cm cross sectional diameter) or marked collapse during inspiration.

**Which catheters do we use it for?**

These include: standard multilumen catheters in anaesthesia and intensive care patients. Insertion of pacing guidewires. Insertion of soft long-term Hickman lines and ports. Off-label insertion of PICCs devices with the advantage of placing a small diameter soft catheter in a larger vein than lower in the arm, with potentially lower thrombotic risk. In case of difficulty in passing wires and catheters centrally, the use of nyttion guidewires and x-ray guidance can help greatly.

**Table 1 Main Differences Between the US-guided AXV Approach and Landmark SCV Approach**

<table>
<thead>
<tr>
<th>US-guided AXV puncture</th>
<th>Landmark SCV puncture</th>
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<tr>
<td>Steep lateral approach of the needle</td>
<td>Flat medial approach of the needle under the clavicle</td>
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<tr>
<td>Accurate needle visualization with in/out of plane approach</td>
<td>No needle visualization as blind spot under the clavicle</td>
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<tr>
<td>Low risk of arterial, pleural and nerve damage</td>
<td>Greater risk of arterial, pleural and nerve damage</td>
</tr>
<tr>
<td>Reduced risk of catheter pin-off</td>
<td>Increased risk of pin-off</td>
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<tr>
<td>In case of arterial damage: Possibility to apply pressure in case of arterial puncture and surgical access for repair (axillary-femoral bypass)</td>
<td>In case of arterial damage: no possible external compression and need for open thoracotomy or clavicle resection.</td>
</tr>
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</table>

**Applied ultrasound anatomy**

High resolution ultrasound probes (usually up to 12–15 MHz) give very good views of axillary and cephalic veins, axillary artery and its branches, the pleura, and brachial plexus. Look out for and avoid thoracocromial trunk (TAT) arterial branches anterior to vein before performing the venepuncture.

**Training**

This approach has the advantages listed above but cannot be considered a preferred choice for novices. The paper from Ahn\textsuperscript{1} suggests that the operators have to complete at least one year of training, with the traditional cannulation sites (IJV) by using real-time ultrasound guidance. This is in accordance with what we already suggested\textsuperscript{10} in the past, as there is a learning curve at different insertion sites, which has to be achieved and maintained.

**References**


