A new trick to a routine procedure: taking the fear out of the axillary vein stick using the 35° caudal view

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Aims
The axillary vein is frequently used to implant pacemaker and defibrillator leads. We describe a technique utilizing the caudal fluoroscopic view to facilitate axillary venous access without contrast.

Methods and results
Outcomes of device implants or upgrades utilizing this technique were examined during a 1-year period at our institution. Of 229 consecutive implants, only 9 patients required an alternate technique for lead implantation. There were zero cases of pneumothorax.

Conclusions
The caudal view allows for optimal appreciation of the anterior border of the lung and the first rib. This simple technique increases the implanter’s appreciation of and control over the access needle depth relative to the lung and first rib, thereby reducing pneumothorax risk.

Keywords
Axillary • Vein • Access • Device • Pacemaker • Defibrillator • Lead implantation

Implantation of pacemaker or defibrillator leads through a transvenous route has been in practice for the past 55 years.¹ Obtaining transvenous access may be achieved by various methods. Commonly used methods include a cephalic vein cut down, or using the modified Seldinger technique to access the axillary or subclavian vein. Some operators use fluoroscopy and intravenous contrast to visualize the venous anatomy to facilitate access,² while others utilize ultrasound.³

The cephalic vein approach is a particularly useful technique that eliminates the risk for a pneumothorax; however, it is more time consuming and multiple leads may be difficult to insert into a small cephalic vein.⁴–⁶ A subclavian stick to achieve access should yield fewer issues in passing multiple leads; however, it is more prone to subclavian crush and thus is least optimal in terms of lead longevity.⁷ Many operators use an axillary vein stick to obtain venous access using either ultrasound guidance or fluoroscopy guidance with or without intravenous contrast.⁸,⁹ Since the needle is aimed downwards, towards the lung, there is still a risk for pneumothorax. We describe our preferred method of obtaining axillary venous access which is quick, does not require intravenous contrast, and allows optimal visualization of the lung for improved safety.

Our preferred incision is at the deltopectoral groove or just slightly medial and parallel to it. After anaesthetization of the skin and subcutaneous tissue at the deltopectoral groove, an incision is made parallel to the groove and a pocket is made medially at the level of the fascial plane (see Figure 1). This incision allows for easy conversion to a cephalic vein cut-down if desired and allows for needle entry to be shallow as the needle approaches the axillary vein. An empty 3 cc syringe is attached to a micropuncture needle and the tip of the needle is inserted into the fascia/pectoral muscle at a shallow angle. The needle should be almost parallel to the tissue and angled 60–70° from the caudal–cranial axis (see Figure 1 and Figure 2). This allows the needle to follow a course parallel to the axillary vein (see Figure 3A). Data from Hsu et al.¹⁰ report that the most common location of the lateral axillary vein is at the intersection of the anterior second and third ribs. The medial end of the axillary vein is usually located radiographically just inferior to the intersection of the first rib and clavicle (see Figure 3A).

Under AP fluoroscopy, the needle is angled towards the region of the first rib just inferior to the clavicle (see triangle in Figure 3A). Negative pressure is applied using a 3 cc syringe on the micropuncture
needle. To increase control and stability of the micropuncture needle, the fifth finger of the hand holding the syringe may be extended and placed on the field (see Figure 2 inset). The fluoroscopy camera is moved to 35° caudal. This caudal view allows the needle to be visualized as it approaches the lateral aspect of the first rib and allows one to see the anterior outline of the lungs (see Figure 4). Depending upon the patient’s body habitus and rib orientation, a more caudal angle may be required to visualize the first rib horizontally. Elderly patients with kyphosis or patients who are placed on a wedge will require more caudal angle. Under caudal fluoroscopy, the needle is advanced towards the target region (see white box in Figure 4). Axillary vein access will be obtained en route towards the first rib in this region. This is usually achieved within seconds of needle advancement. The operator will feel the syringe fill with blood once venous access is obtained. The hand should then be immediately relaxed and syringe gently supported. The syringe is then removed and a micropuncture wire advanced into the vessel. If the blood flow appears arterial or the advanced micropuncture wire is determined to be in the arterial system, an AP cine of the needle tip or micropuncture wire is obtained to mark the axillary artery. The subsequent needle approach may be directed inferior to this location to obtain venous access. If access is not obtained by the time the needle reaches the first rib, the camera may be placed back into AP projection and the needle brought back slightly and angled to a more cranial or caudal target on the first rib. The caudal view may then be used again on the approach towards the rib. With experience, the operator may choose to remain in the caudal position while adjusting the needle orientation.

This technique differs from other micropuncture approaches utilizing the first rib and an AP only view. Especially in obese patients with significant amounts of subcutaneous tissue, if the micropuncture needle is inserted laterally and advanced towards the first rib, a small miscalculation of the angle of the needle could result in the needle under the first rib, and therefore a pneumothorax. If the operator chooses to enter the tissue perpendicularly on the first rib to ensure that the needle does not travel under the first rib, the angle of entry will be acute. Obtaining venous access at a steep angle may put the lead at increased flexion stress. In addition, the operator’s hand may be very close to the X-ray and there is no radiographic appreciation of how far the needle is away from the lung. With our approach, the outline of the lung is directly visualized in addition to the needle distance from the rib. The needle also enters the vasculature at a shallower angle, thus reducing flexion stress on the lead.

In our experience, this technique has facilitated venous access with an extremely low rate of complications. Of 229 consecutive implants or device upgrades utilizing this technique between 1 November 2013 and 31 October 2014, only nine patients required an alternate technique to ultimately obtain venous access. One-hundred and twelve

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**Figure 1**  (A) An incision is made parallel to the deltopectoral groove (dotted line). (B) A pocket is made medially at the level of the fascial plane. The cephalic vein has been isolated with an ethibond tie and the suggested micropuncture needle approach is depicted by the arrow. The needle angle should be $\sim 60^\circ - 70^\circ$ from the cranial–caudal axis. The grey circle denotes the location of needle entry.
Figure 2  A micropuncture needle is inserted into the fascia/pectoral muscle at a shallow angle to the tissue and at a 60–70° from the caudal–cranial axis. The flouroscopy camera is at 35° caudal orientation. The fifth finger of the hand holding the syringe may be extended to stabilize the needle.

Figure 3  (A) AP venogram. The triangle, located at the inferior border of the intersection of the clavicle and anterior first rib, denotes the target area for the micropuncture needle approach. The arrow denotes the suggested micropuncture needle approach from the pocket. Note that the 60–70° angle of the needle mirrors the course of the axillary vein. (B) 35° caudal venogram. This view allows for excellent spatial appreciation of the first rib relative to the subcutaneous tissue anterior to it and the lung posterior to it.
patients underwent pacemaker implant, 78 patients underwent ICD implant, and 39 patients underwent CRT implant. Fifty-three per cent of the patients were male. Ten implants were right-sided. Conversion to cephalic cut-down or use of intravenous contrast was performed if venous access was not obtained in $\sim 1$ min. There were eight conversions to cephalic vein cut-down and intravenous contrast was used in one patient. There was only one significant haematoma, which did not require evacuation. There were zero cases of pneumothorax.

Our technique of axillary venous access is rapid, requires no intravenous contrast, is reproducible and carries minimal risk. Access from a more parallel angle to the vessel may prove beneficial to lead longevity$^{13}$ and increases the chance that venous access will be obtained en route towards the first rib rather than directly on the rib. The $35^\circ$ caudal view allows for optimal visualization of the lung border and first rib and therefore should reduce the chance for pneumothorax.

**Conflict of interest:** None declared.

**References**