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**WHAT'S NEW IN INTENSIVE CARE**

# A new extra-thoracic, in-plane, longitudinal, real-time, ultrasound-guided access to the axillary vein

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## Introduction

The Centers for Disease Control and prevention guidelines for the prevention of catheter-related bloodstream infections recommend using "a subclavian site, rather than an internal jugular or a femoral site, in adult patients" for central venous catheterization (CVC) [1]. However, this preferred approach, whether supra- or infra-clavicular, is hindered by the increased risk of mechanical complications, especially pneumothorax.

Ultrasound-guided CVC, in real-time rather than static imaging (indirect guidance), increases the venipuncture and cannulation safety and success rates.

Here, we describe a new technique to access the axillary vein, outside of the thoracic cavity, using in plane, real-time, ultrasound guidance in mechanically ventilated patients.

## Technique

Before the procedure, the mechanically ventilated patient is placed in a neutral supine position with his/her head laying in the neutral position, and the left arm kept at 90° abduction and supination (Fig. 1a). After applying ultrasonographic gel on the probe, this and its cord are covered with a sterile sheath.

An ultrasound (US) prescan of the upper arm just distal to the left axillary crux to visualize both the axillary artery and vein in the longitudinal plane (Fig. 1b and c) is performed using a MyLabOne ultrasonographic machine with a 10-MHz 40-mm linear probe (The Esaote Group, Genoa, Italy). Attention is paid to apply the least possible pressure on the probe to avoid compressing the vessels. The patency of the vein is then assessed with Doppler and/or color flow. The same is performed for the artery.

In a third step, the operator holding the probe in the left hand and a syringe with an attached needle in the right hand punctures the axillary vein under direct longitudinal visualization "in-plane" of both the vein and the needle (Fig. 2). The skin puncture site is as close as possible to the distal short side of the probe. Due to the bending of the vein anterior wall under the pressure generated by the needle touching this wall (so-called "tenting effect"), a quick, sharp movement of the needle toward the lumen of the vein is often needed to perforate it.

Confirmation of the intravascular position of the needle is facilitated when the bevel of the needle is observed as a white dot within the lumen of the axillary vein (Fig. 2c). Aspiration of 1–2 mL of blood confirms also the right position of the needle within the vein. The absence of pulsatile flow does not rule out arterial puncture in patients with low arterial pressure. A J-shaped wire is then inserted, and its intravascular position confirmed with real-time US (Fig. 3a–c). Inadvertent ascension of the guidewire in the left internal jugular vein is ruled out by US of the neck. The insertion length of the guidewire should be limited to 20 cm to obviate guidewire-induced arrhythmia. After enlarging the skin puncture and using the Seldinger technique, the tract is dilated with dilators of increasing size, and the catheter is introduced and secured. Before injecting any liquid, aspiration controls the final intravascular position of the catheter, which is then rinsed with heparinized serum. The length of the catheter insertion is 20 cm.

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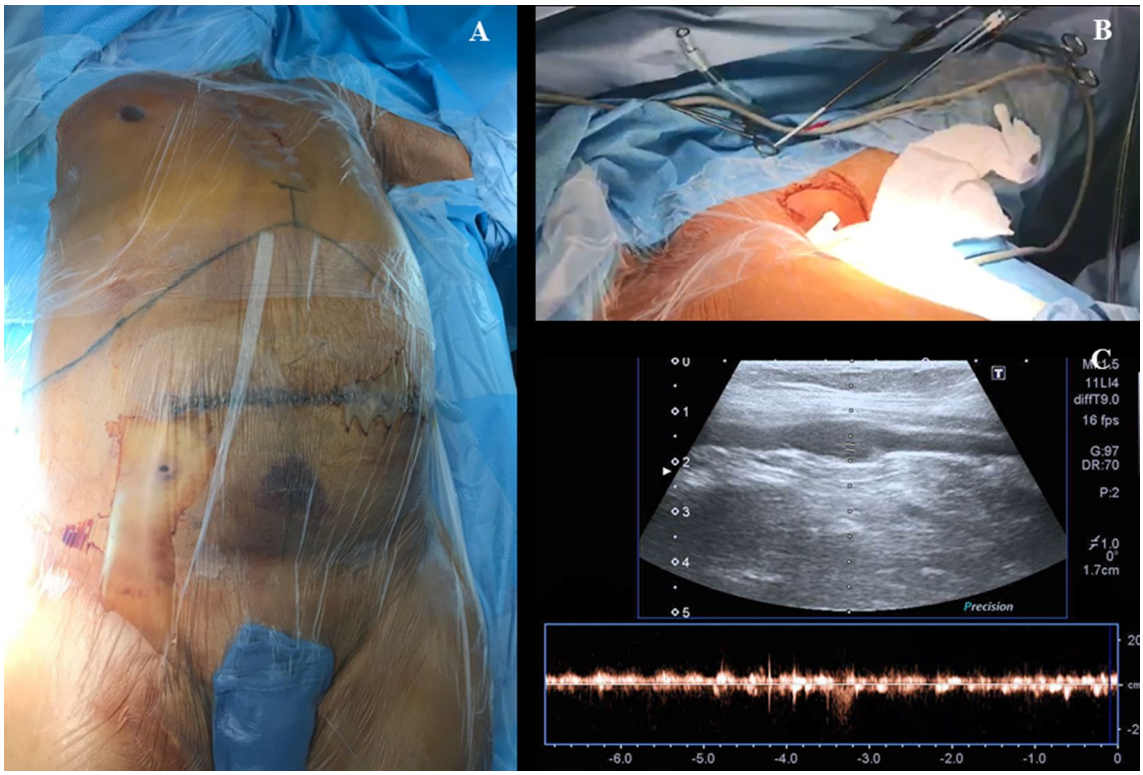


**Fig. 1** **a** Patient position during a liver transplantation; (**b** and **c**) US prescan of the axillary vein

When up to two punctures by two operators has failed, the percutaneous technique is aborted and converted to a cut-down technique. Upon removal of the catheter, the puncture site is sutured, compressed for several minutes, and dressed.

## Results

The axillary catheterization was attempted in 59 consecutive patients needing veno-venous bypass (VVB): 51 during liver transplantation [2] and 8 during complex liver resection (Table 1) [3]. A 15 Fr catheter could be placed in 56/59 cases (success rate = 95%) with 1,, 2 and 4 puncture attempts in 51, 4, and 1 case, respectively. In three patients, the access was used twice (at first transplantation and at re-transplantation). Five complications occurred in five patients (morbidity rate = 8.5%). The procedure failed in three (5%) patients and in each one, uneventful cut-down technique could be performed. Unintentional puncture of the axillary artery occurred in two (3.4%) patients. After compression of the puncture site, the axillary vein could be punctured and cannulated in both cases without further complication. The rate of misplacement of the catheter was nil. None of the following complications were observed within 90 days of surgery: wound infection, hematoma, pneumothorax, lymphedema, or neurological complication. 90-day mortality related to the catheter insertion was nil.

## Comments

This technique combines the advantages of the subclavian vein access while obviating its inherent risk of pneumothorax. As compared to the supraclavicular or infraclavicular route to access to the axillary or subclavian vein under ultrasonography [4], this risk of pneumothorax is simply eliminated in the proposed technique as the pleural cavity is out of the puncturing field. In addition, as compared to the approaches to the subclavian vein, the axillary approach allows holding the pressure on the puncture site in case of arterial injury.

Beyond the scope of the anatomical definition of the axillary vein [5], we have used here the term axillary vein, whereas we acknowledge that in some instances, one of the main tributaries of the axillary vein in the axilla was actually punctured.

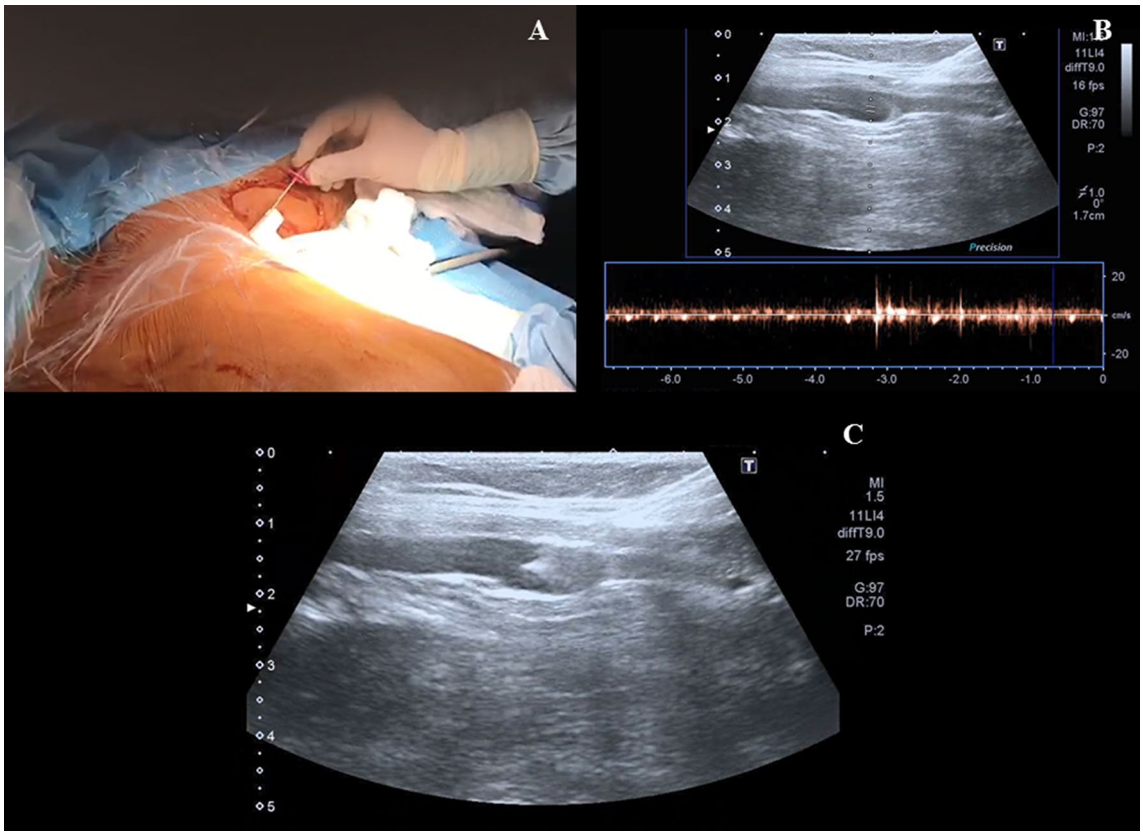


**Fig. 2** **a** Insertion of a needle along the axis of the US transducer; **b** US visualization of the needle on its way to the vein; **c** visualization of the needle bevel in the vein

The technique developed here could broaden the spectrum of possibilities in the field of CVC, e.g., for patients needing to have the head in neutral position, with neck and cervical spine injuries, with tracheostomy, and with an unhealed sternotomy wound, in oncological and hematological patients, for parenteral nutrition, and for placement of hemodialysis catheters. Further, the technique can be repeated in the same patient if needed. It is highly probable that the axillary approach described here does not have the documented advantage of the subclavian, i.e. decreased infection rates. Still, this undisputable potential risk might be acceptable in patients with no other possible central venous access. Training, supervision, and competence acquisition with the axillary access is needed [6].

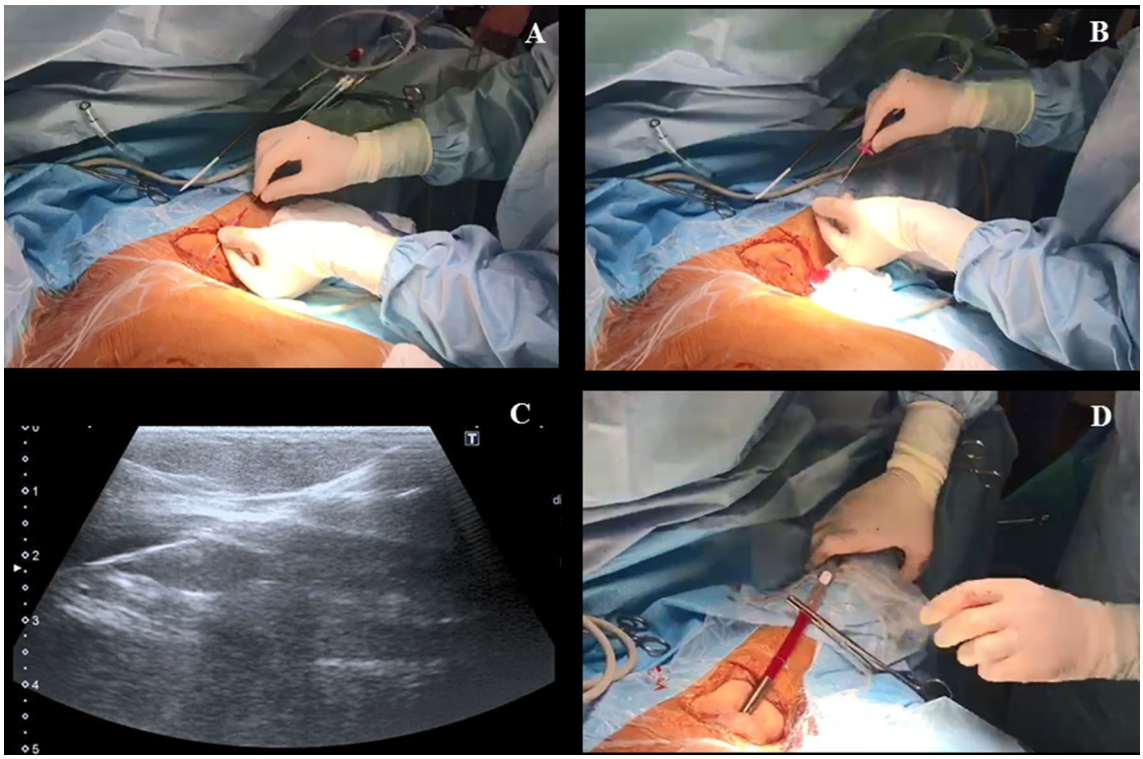


**Fig. 3** **a** and **b** Insertion of a guide wire along the axis of the US transducer; **c** guide wire visualization in the vein; **d** catheter in place secured to the skin

**Table 1 Baseline characteristics and results of axillary vein puncture in 59 patients**

| | |
|---|---|
| Surgery | |
| Liver transplantation | 51 |
| Liver resection | 8 |
| Repeat axillary vein puncture | 3 (5%) |
| Venous puncture success | 56 (95%) |
| Number of venous punctures | |
| 1 | 51 |
| 2 | 4 |
| 4 | 1 |
| Failure of venous puncture[a] | 3 (5%) |
| Axillary artery puncture | 2 (3.4%) |
| 90-day mortality related to axillary puncture | 0 |

[a] Successful catheterization via cut-down technique in all three cases

## Conclusions

In-plane, real-time, ultrasound-guided axillary vein (or one of its main tributaries) cannulation in the axilla in mechanically ventilated patients is a safe and reliable alternative method of central venous cannulation.

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**Compliance with ethical standards**

**Conflicts of interest**
The authors declare that they have no conflict of interest.

**Ethical approval**
An approval by an ethics committee was not applicable.

## Publisher's Note



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