Unintentional arterial puncture during cephalic vein cannulation: case report and anatomical study

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Background. The cephalic antebrachial vein is often used for venous access. However, superficial radial arteries of the forearm are known and unintentional arterial puncture can result from attempts to cannulate the lateral veins of the arm.

Methods. Accidental puncture of a superficial radial artery during peripheral venous cannulation prompted us to study the anatomy of 26 specimens and to assess the relationship between the radial artery and the cephalic vein in the forearm.

Results. In two cases, we found accessory branches of the radial artery close to the cephalic forearm vein. Venous cannulation at the lateral wrist carries a small risk of arterial puncture if arterial anomalies are present.

Conclusions. If venous cannulation is attempted at the radial side of the wrist, palpation for pulsation should reduce the danger of arterial puncture.


Keywords: arteries, radial; forearm; veins, cannulation; veins, cephalic

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Peripheral venous cannulation is frequent. The cephalic vein of the forearm (cephalic antebrachial vein) is often used, because it is large and normally present.¹ However, damage

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can be caused to adjacent structures such as branches of the radial nerve during venous cannulation.\textsuperscript{1}

The radial artery usually has a constant position and lies some distance away from the cephalic antebrachial vein.\textsuperscript{2} However, superficial radial arteries of the forearm have been described.\textsuperscript{3} These can lie close to the radial veins of the hand, where they form the cephalic vein of the forearm,\textsuperscript{1} but careful measurements of this are not available.

We report accidental puncture of the radial artery during peripheral venous cannulation and describe variations of the relationship of the radial artery to the cephalic vein in the forearm.

**Case report**

An 89-yr-old female with a BMI of 17 kg m\textsuperscript{-2} presented for dynamic hip screw for a fractured femur. Spinal anaesthesia was used for the procedure and continuous monitoring of arterial pressure with a radial artery cannula was intended.

For venous cannulation, a tourniquet was applied around the upper arm and cannulation of the right cephalic antebrachial vein was attempted with an 18G venous catheter with no prior palpation of the access vessel. Unintentionally, a superficial radial artery was punctured, which was noticed on connection of an infusion set. The misplaced catheter was left in place during surgery to allow measurement of arterial pressure. Another venous catheter was introduced into a vein on the dorsum of the hand. The procedure was completed uneventfully, with no clinical signs of ischaemia or pain distal to the accidental puncture, and the patient was discharged from hospital after 8 days following an uncomplicated recovery. No sequelae of arterial puncture were apparent at the time of discharge.

**Methods and results**

Twenty-six hands and forearms (10 right, 16 left) of unknown gender were obtained from human cadavers owned by the Institute of Anatomy, Histology & Embryology, Medical University of Innsbruck. The cadavers had been preserved in a mixture of formaldehyde and carbol as previously described.\textsuperscript{4}

Each specimen was carefully dissected using a skin incision on the dorsum and radial aspect of the arm reaching from the metacarpal bones to a point 10 cm proximal of the radial styloid process. Superficial structures of the radial forearm (radial nerve, radial artery and concomitant veins, antebrachial cephalic vein network, superficial radial artery if present) were displayed. Intersections of the (superficial) radial artery with roots of the cephalic antebrachial vein were recorded. The location of the intersection was determined in relation to the most distal point of the styloid process. At each of these intersections, the distance between artery and vein (as separated by connective tissue) was assessed.

Measurements were made with callipers to an accuracy of 0.5 mm. Where applicable, results are summarized as mean (SD).

We found an intersection between the radial artery and the cephalic vein (or roots) in 25 of the 26 specimens. In one instance, tendons separated the artery and the vein at the point of intersection. In 23 of the 25 specimens with an intersection, this was located in the anatomical snuffbox, 8 (3) mm distal to the styloid process. At these intersections, the mean distance between the two vessels (as separated by connective tissue) was 4 (2) mm. In two instances, a variant superficial radial artery crossed onto the dorsal forearm proximal to the anatomical snuffbox. This superficial artery crossed the course of the cephalic vein at a distance of 28 and 20 mm proximal to the styloid process, respectively (Fig. 1). The distance between artery and vein was 1 mm in each case.

**Discussion**

The radial artery branches off the brachial artery within the cubital fossa, and passes along the radial side of the forearm. At the wrist, it winds around the radial aspect of the carpus and reaches the dorsum of the hand deep to the tendons of extensors pollicis longus/brevis and the abductor pollicis longus, which together delineate a region referred to as the ‘anatomical snuffbox’ or ‘tabatière’.\textsuperscript{2} Subsequently, the radial artery runs to the palmar aspect of the hand between the two heads of the first interosseous dorsalis muscle.\textsuperscript{2} Among the peculiarities of the radial artery, location superficial to the above tendons has been described,\textsuperscript{2,3} but no reports into the distances between arteries and the cephalic vein have been published. (Rodriguez-Niedenfuhr and co-workers\textsuperscript{3} have published a comprehensive review of upper limb arterial variations.) In the present investigation, two of the 26 specimens featured such an accessory artery. In one of these specimens, a superficial radial artery with a lesser diameter than the radial artery was located superficially to the brachioradialis muscle, close to the cephalic vein. In the second specimen, a superficial radial artery with a diameter exceeding that of the parent radial artery was found superficially near veins ideally suited for cannulation (Fig. 1).

We found that in most cases the radial artery is located at a safe distance from the antebrachial cephalic vein; in these cases, the risk of arterial puncture during venous cannulation is negligible, as the artery runs several millimetres deep to the vein. However, a small number of patients have superficial radial arteries. In these patients, accidental arterial puncture could occur during venous cannulation. The frequency of these superficial arteries has been reported as 0.5–1%.\textsuperscript{3} Although this is small, cannulation of the cephalic vein is probably one of the most frequent events in routine anaesthesia, so the absolute number of patients who might sustain accidental puncture of a superficial radial artery may be high.
Accidental radial artery puncture can cause complications such as temporary occlusion, pseudoaneurysm and haematoma formation. These adverse effects are infrequent, but standard venous cannulae (14, 16 and 18G) are larger than the usual arterial cannula (20G), so damage from accidental puncture could be greater. Injury to the branches of the superficial radial nerve during cephalic vein cannulation, leading to neuroma formation, has recently been described. Unrecognized arterial injection of thiopentone can cause tissue ischaemia and necrosis. In addition to lack of attention by the operator, other risk factors for inadvertent arterial puncture include morbid obesity, darkly pigmented skin, thoracic outlet syndrome, pre-existing anatomical variations and limited cooperation during cannulation. Palpation of the vessel before puncture should help to detect the presence of an accessory artery. If arterial cannulation is suspected, arterial pressure can be measured, or blood gas analysis can be done. Other signs of suspected puncture include noting bright red blood on connection of an infusion set, intense pain and distal ischaemia.

In conclusion, the cephalic vein of the forearm is large and constant, usually allowing easy cannulation. Possible arterial injury, unintentional arterial injection of drugs and nerve damage are disadvantages of this procedure. Before puncture of the cephalic forearm vein, the vessel should be carefully palpated.

References