

Inadvertent Vertebral Vein Cannulation: Anatomical Considerations and Practical Aspects

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ABSTRACT

A routine vascular procedure, the central venous catheterization requires recognition of malposition to avoid its serious sequelae. This case report discusses the complications encountered following presumed right internal jugular vein cannulation in a trauma patient. Cervical spine imaging done as part of a trauma protocol revealed a catheter in the right vertebral vein. Inadvertently mispositioned catheter emphasizes the significance of ultrasound-guided central vein catheterization even if the cannulation is done using standard anatomical landmarks.

Keywords: Anatomical landmarks, Central venous catheter malposition, Inadvertent vertebral vein cannulation.

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INTRODUCTION

The right internal jugular vein is a commonly accessed central vein as it provides a direct path into the superior vena cava. Malposition of catheter into other veins cannot be detected as there is no difference between color and pulsatility of blood flow. Misplaced catheters in those with a normal anatomy has its repercussions. Herein are the reviewed practical options to prevent the same.

Case Description

This 22-year-old male was brought to the emergency room following an alleged history of road traffic accident. He was in a shock state requiring resuscitation in the emergency room. Right jugular venous puncture was obtained in the first pass guided by the standard anatomical landmarks. There was a free venous blood return from all three catheter ports. Catheter was assumed to be located higher up in the internal jugular vein on the post-cannulation chest radiograph (Fig. 1). Screening of cervical spine

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done as a part of trauma protocol revealed right vertebral vein cannulation as seen on three-dimensional volume rendered image (Fig. 2). Catheter entry is seen at the level of C4 foramina. The catheter was promptly removed and the opposite internal jugular vein cannulated under ultrasound guidance.

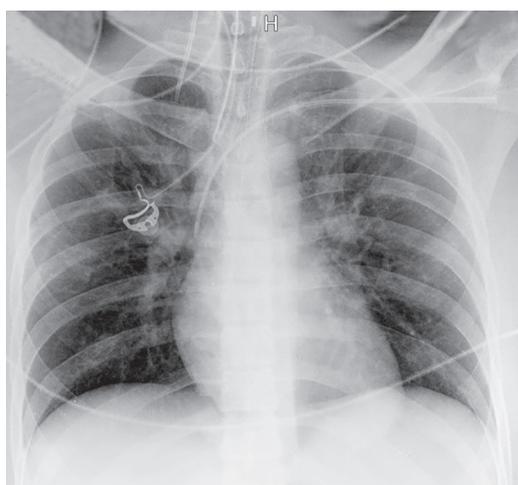


Fig. 1: Chest X-ray

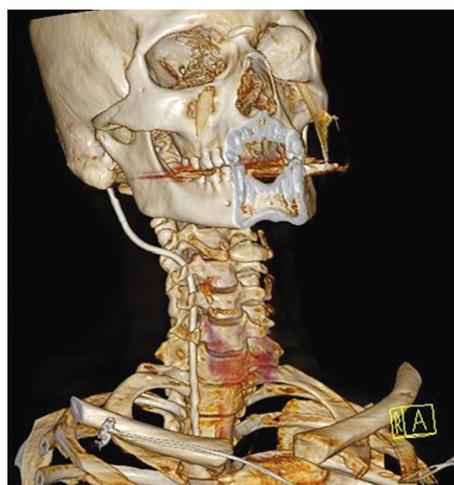


Fig. 2: CT neck (3D reconstruction)

DISCUSSION

Anatomic Considerations for Internal Jugular Vein Cannulation

Mechanical complications of percutaneous neck cannulations are often related to the close anatomy of vessels in the area. External jugular vein, anterior jugular vein, thyroid vein, and vertebral vein lie in the vicinity of internal jugular vein. Vertebral vein passes through transverse foramina from atlas and exits at C6 vertebrae travelling on lateral aspect of cervical vertebrae. Downwards in its course, it passes anterior to first part of subclavian artery, when it lies posterior to internal jugular vein. Internal jugular vein is usually accessed at a depth of 1–1.5 cm from cutaneous puncture site in majority of cases.^{1,2} Anatomic variations in internal jugular vein cannulation site exist that are missed by blind cannulation using anatomic landmarks. An operational information about the field's anatomy helps acquaint the operator of the needle's path.

Ultrasound Considerations for Internal Jugular Vein Cannulation

Use of ultrasound for central vein cannulation does not preclude the need for knowledge of anatomic landmarks. The mechanical complications related to the close anatomic relationships of neck vessels can be avoided with its use. Ability to visualize the vein as well as needle, and guidewire during procedure as well as viewing different approach planes helps reduce complication rates with an increase in success rate. Reported success rates stand at 99% following ultrasound guided insertion vs 78% using landmark technique.³

Internal Jugular Vein Cannulation in an Emergency

Central venous cannulation can be done during emergency in high acuity cases in the emergency department as well as in the intensive care unit. The average access time from skin to vein and the number of attempts was less in the ultrasound guided group vs landmark guided group ($p < 0.001$).⁴ Reported complication rates were significantly lower with ultrasound guided cannulation vs landmark guided cannulation [4.6% vs 16.9%, OR = 3.7 (95% CI 1.1–12.5)].⁵

Confirming Position of Catheter in the Central Vein

The anatomic proximity of vessels in the neck makes it difficult to discern exact position of catheter on plain chest radiograph. Visualization of catheter passage using real-time ultrasound make its reported sensitivity of 0.70 (95% CI, 0.49–0.86) and specificity of 0.99 (95% CI, 0.98–1.00) to detect catheter malposition.⁶

Practical Aspects

Positioning affects caliber and anatomic relation of jugular vein influencing cannulation. The factors increasing malposition risk of include abnormal weight/height ratio, degree of neck rotation, posterior approach, and sole reliance on landmark technique.

Excessive neck rotation to the opposite side to aid distinguishing the surface landmarks changes anatomy of internal jugular vein, making the catheter prone to malposition. Neck should be rotated no more than 30° away from the puncture site⁷ in patients with high body mass index.⁸ Unless contraindicated, placing patient in Trendelenburg position leads to central vein filling enhancing the view and ease of cannulation on real-time ultrasound.

CONCLUSION

The mechanical complications of percutaneous neck cannulations are often related to the close anatomy of vessels in the area. Excessive head rotation alters vascular relationships influencing a deep insertion of puncture needle and inadvertent vertebral vein cannulation. Use of surface landmarks under real-time ultrasound guidance enhances safety of the procedure even in high acuity situations.

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