

Radiographic mislead: apparent arterial placement of subclavian central venous catheter due to mediastinal shift

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ABSTRACT

Optimal placement of central venous catheters (CVC) is essential for accurate monitoring of central venous pressure (CVP) in major surgeries and ensuring long-term use of the catheter for managing the critically ill patient. Accidental subclavian artery catheterization is one of the most serious complications of the procedure. Radiography is commonly used to ensure optimal placement of CVC tip and rule out subclavian artery catheterization in the absence of Doppler ultrasound and a pressure transducer. We present a case of a haemodynamically unstable and hypoxaemic patient with mediastinal shift, in which the anaesthesiologist was in a dilemma about the arterial placement of the right subclavian CVC. The CVC crossing the midline due to mediastinal shift gave the false impression of it being placed in subclavian artery rather than the vein. Subsequently, it was proved to be correctly placed in the subclavian vein.

Key words: Arterial catheterization, central venous catheter, midline crossing, mediastinal shift

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INTRODUCTION

Incidence of malposition of central venous catheterization (CVC) ranges from 1-60%.^[1] Accidental arterial catheterization is a devastating complication of CVC insertion.^[2-4] Often in critically ill patients, accidental arterial puncture does not reveal bright red pulsatile backflow.^[5,6] In such instances, we commonly rely upon the chest radiograph to ensure optimal placement of CVC in the absence of Doppler and pressure transducer. Right subclavian CVC crossing the midline and its location on the left side of the chest has been reported to be an obvious marker of arterial cannulation on chest radiograph, as the right subclavian vein does not cross the midline.^[5] We report a case of a patient with mediastinal shift to the left in whom the radiograph showed right subclavian CVC crossing midline to left, giving false impression of arterial placement. Dilemma in CVC position was ultimately resolved by a pressure transducer and blood gas analysis.

CASE REPORT

A 32-year-old lady with leiomyosarcoma of hand, underwent amputation of right forearm. On second postoperative day, her general condition gradually deteriorated. She was shifted to intensive care unit (ICU) in view of tachypnoea and desaturation to 84% on oxygen (60% by Venturi) support. She was haemodynamically unstable with a heart rate of 120/min and blood pressure (BP) of about 85/45 mmHg. Auscultation of chest revealed decreased air entry on the right side of chest. Patient did not co-operate for the noninvasive ventilation. She was intubated with a 7.0 mm internal diameter cuffed Portex® endotracheal tube (ETT) and started on dopamine infusion at 10 µg/kg/min through 18 gauge peripheral intravenous (IV) line. A 15 cm seven French triple lumen CVC was secured in the right subclavian vein in first attempt using the Seldinger technique, and backflow of blood was confirmed in all three lumens. We planned to administer inotropes through CVC once its placement was confirmed by a chest radiograph. Urgent portable

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chest radiograph was sought for and it showed CVC crossing the midline with gradual turn leftwards and downwards [Figure 1]. The position of the CVC tip was above and on the right side of carina, but it never in its course crossed the trachea [Figure 1]. The radiograph also revealed right-sided massive pleural effusion and tracheal shift to the left side [Figure 1]. Pressure transducer was not available at that point of time. So, to confirm correct placement of CVC tip, two separate samples for blood gas analysis were sent, one from CVC and another from radial artery, which confirmed that CVC was in subclavian vein. Ionotropes were then administered through the CVC and the patient improved haemodynamically. Malignant pleural effusion was diagnosed provisionally. Right-sided intercostal drain (ICD) was inserted. Plain and contrast computerized tomography (CT) of thorax revealed loculated right-sided pleural effusion with right-sided lung collapse and marked mediastinal shift of the cardia and great vessels to the left. Patient's condition gradually improved in the next three days. She was extubated and finally discharged from ICU on oxygen (35%) by Venturi.

DISCUSSION

Indications for CVC use include ensuring an optimal venous access, haemodynamic monitoring, intravenous drug administration, parenteral nutrition, temporary haemodialysis, chemotherapy, and transvenous cardiac pacing.^[5,7] Complications of central venous catheterization include pneumothorax, malposition, and infection.^[1] The right subclavian vein is associated with the highest risk of malposition.^[8] Before using CVC as a conduit for ionotrope and fluid administration, one must consider two aspects. First, that CVC is indeed in

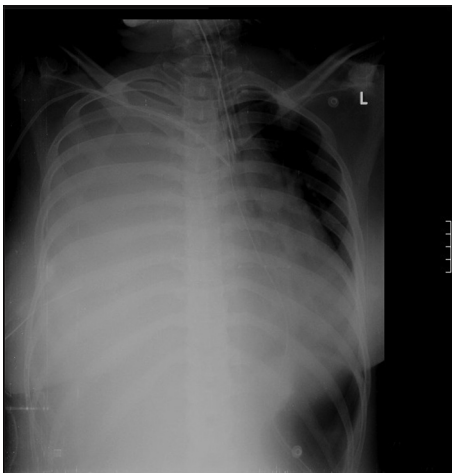


Figure 1: Chest radiograph showing right subclavian venous catheter crossing midline in mediastinal shift

the vein and not in the artery. Secondly, the tip of the CVC should be optimally placed.

In ICU settings, with patients often being hypotensive, hypoxaemic, or when the CVC abuts the superior vena caval (SVC) wall, one may not appreciate a bright red pulsatile backflow with arterial puncture.^[5,6] Chest radiograph is used to ensure optimal placement of CVC when Doppler and pressure transducers are unavailable.

Considering the first aspect, for confirmation radiologically that a right-sided CVC is not positioned in the subclavian artery, it should not cross the midline.^[5] This is because, the right subclavian vein does not cross the midline, but the left subclavian vein does.^[9] This finding on radiograph was so crucial in the report by Srinivasan *et al.*, that when the authors found the CVC tip of attempted catheterization of right subclavian vein crossing the midline and lying on the left side, they removed it immediately.^[5] The authors concluded that the right subclavian CVC crossing midline was an obvious indication that it was in the artery.

The radiograph of the present patient also showed a similar finding and we were in dilemma regarding the misplacement of the right CVC in the artery. But not all cases of misdirected right-sided subclavian CVC crossing the midline can be concluded to be in the artery. Misplacement into the contralateral left subclavian vein has also been reported, but in such a case, the radiograph revealed the catheter tip turning upwards, after crossing the midline.^[1]

In our patient, the right subclavian CVC catheter crossing the midline and then turning downwards, left us initially confused. Thus, the ionotropic administration through CVC was delayed. However, in the radiograph, the tracheal shift to the left due to massive pleural effusion was apparent. The CVC tip lying on the right side of trachea without crossing it, and lying above the carina provided us solace. It has been reported in the literature that if CVC is misplaced into the right subclavian artery, it will cross the trachea from right to left above the carina.^[7]

Considering the second aspect about the optimal position of a right sided CVC tip, Peres formula (height (cm)/10), right atrial electrocardiogram (ECG), and transesophageal echocardiography have been used as guides for the confirmation of correct placement of CVC.^[10] While assessing radiographically, current guidelines suggest that the right CVC tip should be sited above the carina so that it lies at the junction of the left and right innominate

veins and the upper SVC.^[11] The radiograph in our patient was similar. The blood gas analysis from the CVC and radial artery further reconfirmed the correct positioning and allowed us to start the ionotrope infusion through the CVC, without further delay.

CONCLUSION

The clinician must analyze the post-CVC insertion chest radiograph assiduously. Right subclavian CVC crossing the midline and turning downwards to the left may not indicate arterial placement when there is mediastinal shift. In such a scenario, whether the CVC is crossing the trachea and carina will help in determining the tip position radiologically.

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