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Are we underestimating the frequency of malpositioned central venous catheters inserted via the left internal jugular vein? A case report and short review of literature

Case Report

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Abstract: Central venous cannulation is a widely used procedure in clinical medicine. Central venous catheters are inserted most often via the internal jugular and subclavian veins. One of the complications is malpositioning of the catheter, and some insertion sites carry a higher risk for that occurrence. We report a case of a malpositioned central venous catheter inserted via the left internal jugular vein in a patient with a ruptured diaphragm. Our objectives were to review the venous anatomy of the chest and the literature reporting malpositioned central venous catheters and to discuss the approach through the left internal jugular vein. Left internal jugular cannulation could carry a higher rate of malposition than reported, and anatomy gives a possible, simple answer. Contrast enhancement, although central venous catheters are radiopaque, is helpful when an approach through the left internal jugular vein is used and difficulties are encountered during insertion.

Keywords: *Central venous catheter • Malposition • Left internal jugular vein*

1. Introduction

Central venous (CV) cannulation is a widely used procedure in clinical medicine. Central venous catheters (CVCs) are inserted most often via the internal jugular and subclavian veins. One of the complications is malpositioning of the catheter. Ruesch and colleagues [1] concluded that fewer catheter malpositions occur with the use of internal jugular veins than with subclavian access. We report a case of a malpositioned CVC inserted via the left internal jugular vein (LIJV) in a patient with a ruptured diaphragm, with a review of the literature, and we propose an algorithm for managing malpositioned CVCs.

2. Case Report

A 31-year old man was admitted to the Emergency Department of our Clinical Centre after he had fallen from a height of 6 meters to the ground. The diagnosis was a ruptured left hemidiaphragm, with the stomach and lienal flexure of the colon prolapsing into chest cavity, and the patient was rushed to emergency surgery. After the induction of anaesthesia, a single-lumen CVC was inserted via the LIJV with the anterior approach and "catheter through cannula" technique. The cannulation of the LIJV was chosen because the pathological process involved the left hemithorax, and if complications of CVC cannulation occurred, they would not further compromise the patient's status.

The procedure was uneventful and successful after the first attempt. Free backflow of the dark venous

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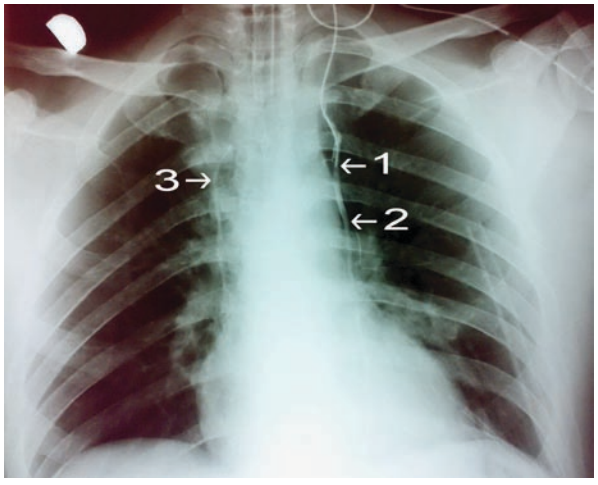
Figure 1. Chest radiograph showing malpositioned central venous catheter.



1.tip of the malpositioned central venous catheter
2.contrast medium solution in the inadvertently cannulated vein
3.contrast medium in the superior vena cava

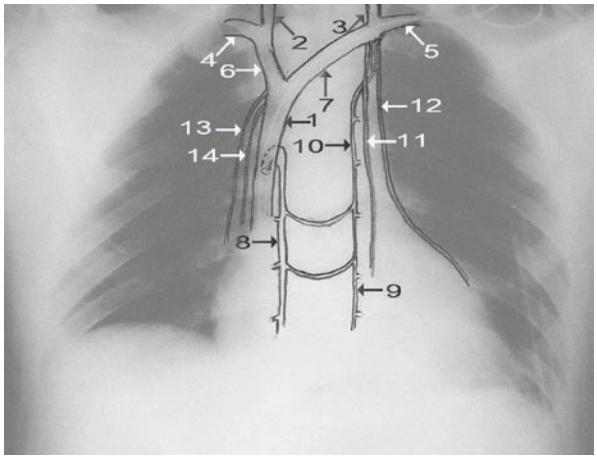
blood was obtained. During the surgical procedure, patient was given fluids through the inserted CVC, and CV pressure was monitored, with the curve having a typical pattern. After the procedure the patient was transferred to the surgical intensive care unit. A routine chest radiograph was performed on admission, and on that occasion 3 ml of iodinated contrast solution was used to better visualize the CVC. Interestingly, the chest radiograph (Figure 1) showed that the entry point of the CVC was the LIJV, but it did not seem to pass into left brachiocephalic vein (LBV); instead, it entered a vessel in the left mediastinum. The tip of the CVC (Figure 1, Arrow 1) and the contrast pattern in the cannulated vessel (Figure 1, Arrow 2) were clearly visible. Contrast could be also seen in the LBV and superior vena cava, suggesting centripetal venous blood flow from the cannulated vessel (Figure 1, Arrow 3).

Fluids that were infused through the CVC were flowing without difficulty, but the venous backflow could be obtained only when the patient turned his head to the opposite side. Aspiration of blood from the CVC could be performed without difficulty. At the same time, there were no radiologic signs that the malpositioned CVC had perforated the vein it had entered. Another CVC was introduced via left subclavian vein, with the infraclavicular approach and “catheter through cannula” technique, and the malpositioned CVC was extracted uneventfully.

3. Discussion

Malpositioning of the CVC is one of the complications of CV catheterization. Schummer and colleagues [2] reported a 6.7% rate of malpositioning in a large prospective study that included more than 1700 catheterizations. Almost a third of the malposition cases involved left internal jugular vein (LIJV) cannulation [2]. When the frequency of malpositioning of the right internal jugular vein (RIJV) is compared with that of the LIJV, the rate is 4.3% versus 12%, respectively. There have been numerous reports of malpositioned CVC in different venous systems of the chest. The left internal mammary vein (LIMV) is a tributary of the LBV [3], and several reports have indicated involvement of this vein in CVC malpositioning [4,5]. Zaman and coworkers [6] described a case with no complications in which the left pericardiophrenic vein was cannulated, again during an attempt to establish central venous access via the LIJV. These cases, like ours, were all without symptoms, unlike the three cases described by Webb and associates [7], in which the LIMV was inadvertently cannulated, leading to chest pain during fluid administration. Cases involving the left superior intercostal, azygos, and left accessory hemiazygos veins have been described [8-10]. Persistent left superior vena cava, which is found in 0.3% to 0.5% of healthy individuals, can sometimes be the entry point for a malpositioned CVC when an approach through the LIJV is used, as presented by Ghadiali and colleagues [11]. Azygous cannulation has been associated with intermittent back pain [12]. Although most cases are resolved without complications, perforations of inadvertently cannulated veins, hemothorax, thrombosis, stenosis, and complete occlusion have been noted [9,13]. The exact position of the CVC cannot be determined with only posteroanterior chest radiographs. A lateral chest radiograph, contrast usage, phlebography, and computed tomographic angiography can help to determine which vessel is involved. In our case, use of contrast medium to improve the CVC visualization, although not mandatory, proved to be very helpful; we were able to not only better visualize the CVC, but also to determine the catheter position with more accuracy and rule out the involvement of contrast leakage if a vein had been perforated. Routine chest radiographs after CVC placements are common. However, Ferrel and his colleagues [14] found that such imaging rarely contributes to the diagnosis of any procedural complications after internal jugular access, especially if there is no clinical evidence of complications. In cases such as ours, repeated chest radiographs, together with clinical examination, play an

Figure 2. Posteroanterior radiograph of the same patient after left subclavian vein cannulation and incorporated diagram of thoracic veins (with only inferior tributaries of the brachiocephalic veins).



1. *Superior vena cava*
2. *Right internal jugular vein*
3. *Left internal jugular vein*
4. *Right subclavian vein*
5. *Left subclavian vein*
6. *Right brachiocephalic vein*
7. *Left brachiocephalic vein*
8. *Azygous vein*
9. *Hemiazygous vein*
10. *Accessory hemiazygous vein*
11. *Left internal mammary vein*
12. *Left pericardiophrenic vein*
13. *Right internal mammary vein*
14. *Right pericardiophrenic vein*

important role in the identification of complications such as vein perforation and hemothorax [15]. It is important to stress that complications can occur several days after the procedure. Girgin and colleagues [16] described a case of left-sided pneumothorax and concomitant right-sided hydrothorax developing 5 days after CVC insertion.

The malpositioned CVC in our case was narrow-bored, single lumen, 14 gauge, and we decided to remove it for safety reasons. When performing the test of venous blood backflow as a sign of CVC free position in a central vein, one must be aware that checking and rechecking is vital. In our case, venous backflow was obtained without difficulty after the insertion, but later in the course, it was possible only if the patient turned his head to the opposite side, which led to a suspicion of CVC malpositioning even before the chest film was obtained. The possible malposition of the CVC in our case involved the left internal mammary or accessory hemiazygos vein (Figure 2).

It is clear that some insertion sites are involved in malpositioning more often than others, as reported in observational studies [1,2,17,18]. The true incidence of CVC malpositions is unknown and might be higher than described. Did the distorted anatomy in our case have any influence in the CVC malpositioning? Sandroni and associates [4] stated that portal-to-systemic collateral circulation dilates the internal mammary vein and that patients with portal hypertension have a higher risk of malposition. Could our case be similar? Specifically, did the gastric prolapse into the chest cavity and increased intrathoracic pressure on the left side in our case cause dilatation or occasional phasic retrograde flow in the left inferior tributaries of the LBV, leading to higher risk for a malposition? The importance of CVC malpositioning in accessory chest venous systems is yet to be determined. It appears that access through the LIJV carries much more risk for CVC malpositioning than was previously assumed. A proposed reason for this lies in the anatomy of the venous systems of the chest. The orifices of the LIMV and left pericardiophrenic vein lie directly opposite the confluence of the LIJV with the left subclavian vein (LSV), as opposed to the right side (Figure 2).

Lastly, in the future, we must always take into account the following points, which could be an algorithm for managing suspected malpositioned CVCs.

- Consider malposition if the CVC insertion was difficult.
- Check and recheck the free backflow of venous dark blood.
- Consider the catheter's width when deciding whether to remove it; accessory chest veins are narrow, and if the extraction is difficult, requiring force, it is better to abandon the procedure and seek consultation.
- Contrast enhancement can be very helpful in determining the exact CVC position (even though CVCs are radiopaque) and possible complications (contrast leakage); it could be used when difficulties occur during insertion and backflow of the blood is poor.
- The LIJV approach could be associated with a higher frequency of malpositioning than reported, especially if a distorted anatomy or pathophysiological states are present.

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