

Inside-out central venous catheter: an unusual finding in the usual route of catheterization

Aseem Gargava, Renu Upadhyay, Jitendra H. Ramteke, Sanjeeta Umbarkar

CVTA Department, Seth G S Medical College and KEM Hospital, Mumbai, Maharashtra, India

Correspondence to Renu Upadhyay, MBBS, DNB, Department of Cardiovascular and Thoracic Anesthesia (CVTA), Seth G S Medical College and KEM Hospital, Mumbai, Maharashtra, India. 400012.
Tel: +9196531664956;
e-mail: rupadhyay46@gmail.com

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Central venous catheterization is a common procedure in operation theatres as well as intensive care units. It is frequently used in cardiac surgery for hemodynamic monitoring as well as administration of fluid and various drugs like inotropes, vasopressors. Among various complications, infections and mechanical complications are most common. Malposition and kinking of central venous catheter (CVC) are likely to be incidental and underreported. Technical difficulty while threading the wire or inserting the catheter, may lead to CVC malpositioning. Also the CVP tracing and the checking of backflow from catheter ports are equally important. We present a case of such an unusual case of CVC malposition and importance of vigilant monitoring.

Keywords:

central venous catheter, extra-caval, kinking, malposition, superior vena cava

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Introduction

Central venous catheterization is an important procedure carried out by anesthesiologist in operation theaters as well as ICUs. This is a routine procedure in patients undergoing open-heart surgery and is frequently used for hemodynamic monitoring as well as administration of various cardiac drugs like inotropes and vasopressors. Among various complications, infections and mechanical complications are the most common [1]. Mechanical complications resulting from central venous catheterization are likely to be underreported in the literature [2]. Kinking of catheter has been reported; however, majority of such reports are related to pulmonary artery catheter insertion and not owing to central venous catheterization [3,4]. We discuss one such complication of malposition and kinking of central venous catheter (CVC) upon sternal retraction leading to its obstruction and the cause behind it.

Case report

We would like to report an unusual case of kinking of CVC inserted in right internal jugular vein. A 50-year-old male patient was posted for mitral valve replacement owing to severe mitral stenosis. After a complete preanesthetic evaluation, the patient was shifted inside the operation theater. Under standard anesthesia monitoring, left radial artery was cannulated. Using ultrasound guidance, CVC was inserted via right internal jugular vein and fixed at a 13-cm mark. All ports of catheter were aspirated to confirm free flow of blood and flushed with saline. The central venous pressure (CVP) waveform confirmed the location of catheter with pressure of ~ 21.7 cmH₂O

(Fig. 1). The patient thereafter underwent standard anesthesia induction, and surgery was initiated. Sternotomy was performed successfully, and sternum was retracted. Upon sternal retraction, the CVP waveform was lost, and fluid stopped flowing through the catheter. Aspiration of blood through all the ports was negative. However, transesophageal echocardiography (TEE) confirmed catheter tip at the junction of superior vena cava and right atrium (SVC-RA) seen in midesophageal bicaval view (Fig. 2). An attempt was made to withdraw a small length of catheter out, but it was stuck and not moving. Surgeons were immediately informed about the same, and they removed the chest retractors. The flow and CVP waveform resumed immediately after this. Hence, we concluded that the catheter was getting compressed by application of retractors. With minimal retraction, surgeons extended the dissection near the suprasternal region, and to our surprise, we found that the small portion of the CVC was seen outside the vein, while tip of catheter was not visible. Tip of CVC was traceable on TEE. CVC was also getting kinked by a band of fibrous tissue (Fig. 3). This band was carefully divided, and the surgeon repositioned the catheter successfully. On subsequent retraction, no such kinking of catheter occurred. We also attempted withdrawing out small length of catheter, and it was successful this time. The rest of the surgical procedure was uneventful.

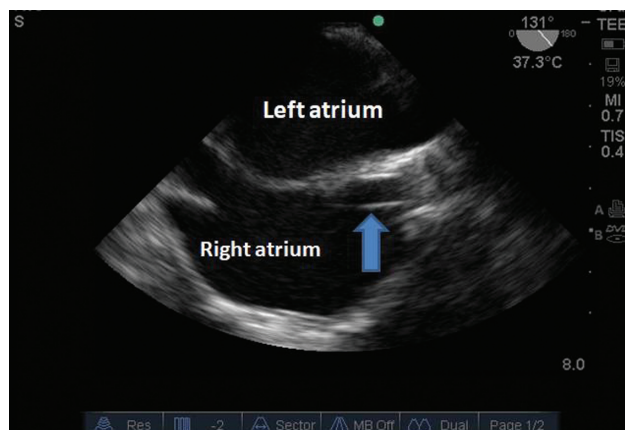
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Figure 1



Central venous pressure (CVP) tracing obtained after central venous catheterization.

Figure 2



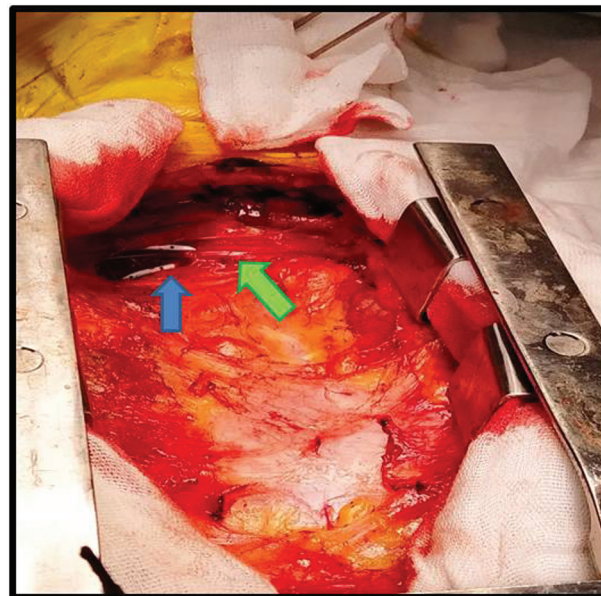
TEE midesophageal bicaval view showing CVC tip (arrow) at the SVC-RA junction. CVC, central venous catheters; SVC-RA, superior vena cava and right atrium; TEE, transesophageal echocardiography.

Discussion

CVCs are cannulation devices designed to access the central venous circulation and are inserted via wire guidance (i.e. the Seldinger technique). They have multiple uses including administration life-supporting fluids, potentially irritant drugs, blood products, parenteral nutrition, hemodialysis, transvenous heart pacing, and monitoring of hemodynamics by measuring CVP [5]. CVC placement requires training and experience. It is associated with risks, even when performed by trained professionals.

The most common complications associated with neck and thorax CVC insertion are infection (5–26%), hematoma (2–26%), and pneumothorax (up to 30%) [6]. Other complications of CVC placement include extravasation of infusate, unrecognized arterial

Figure 3



Intraoperative view showing extracaval part of CVC (blue arrow) getting kinked by fibrous tissue (green arrow). CVC, central venous catheters.

placement, hemothorax, chylothorax, cardiac tamponade, and mediastinal hemorrhage [7–10]. Catheter malpositioning and kinking has been reported as incidental finding and is less than 7% [7].

Malposition means CVC tip not lying in the ideal position, that is, at SVC-RA junction, and catheter being outside of SVC. It can be of two types: intracaval malpositioning and extracaval malpositioning. Extracaval malpositioning can occur in mediastinum, pleura, pericardium, esophagus, and others [11].

Despite the level of skill of the operator and the use of ultrasound guidance, CVC placement can still result in kinking and malpositioning.

Prompt diagnosis can be done only by vigilant monitoring. The signs such as absence of CVP tracings, negative aspiration, and unable to administer fluids or drugs through all the ports are sufficient indicators demanding further investigation. While insertion of CVC, one may face technical difficulty while threading the wire or inserting the catheter which is an important sign of CVC malpositioning. Chest roentgenogram is helpful to confirm the location of catheter but it can be mainly used in ICU and postoperative period [12]. Another method of localization of CVC tip is via ultrasonographic visualization of bubbles in RA, after injection of 10 ml of agitated normal saline through CVC [13–15]. Significant limitations of

this technique include the inability to visualize the alignment of the catheter and the presence of any aberrant course. TEE is a real-time procedure that can confirm the location of catheter tip intraoperatively; however, its use in every routine case is not warranted. It is important to note that TEE can locate only the catheter tip in the SVC opening into RA, and the entire course of catheter in the vein cannot be traced. So, any abnormal kinking or malposition of catheter in the vein might be missed by TEE.

In our case, the CVC was not just kinked but also stuck, and withdrawal of same was not possible as well. Moreover, the characteristic disappearance of CVP tracing and negative aspiration was present. It was an unusual malpositioning as some portion of CVC was in mediastinum while the tip was re-entering into SVC. It made it look like a normal CVC placement initially, and even the TEE confirmed the same. It would have been missed if not for an open-heart surgery. In our case, even after the use of ultrasonography guidance, this complication could not be avoided, as catheter got out of vein in an area of blank spot of scanning via ultrasonography (proximal CVC) and TEE (terminal CVC). Here, operator judgment can also make the difference by the perception of any difficulty while guidewire and catheter insertion.

We therefore reported this case as an unusual finding in the usual route of catheterization. In our case, it may be due to fibrous bands, which distorted the anatomy of SVC and led to this complication.

Conclusion

So, the take home message is that when the CVP waveform could not be obtained despite the change of the transducer, flushing the unit, and repeated zeroing, along with negative aspiration of blood, then a strong suspicion of misplacement of CVC should be kept in mind. This complication can probably be avoided by

continuous vigilant monitoring of CVP tracing by the anesthesiologist with extra care during the sternal retraction procedure.

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Conflicts of interest

There are no conflicts of interest.

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