Research Article ISSN 2835-6276

American Journal of Medical and Clinical Research & Reviews

Central Venous Pressure Catheter Malposition from Right Internal Jugular Vein into the contra-lateral innominate vein: A Rare complication

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Received:15 July 2025; Accepted:18 July 2025; Published:25 July 2025

Citation: Dr Vishnu Datt, et al. Central Venous Pressure Catheter Malposition from Right Internal Jugular Vein into the contralateral innominate vein: A Rare complication. AJMCRR. 2025; 4(7): 1-6.

Abstract

CVCs are inserted for many different indications in cardiac surgery and ICU. These include administering drugs (anaesthetic and vasoactive agents, antibiotics, chemotherapy), monitoring central venous pressure (CVP)or hemodynamic monitoring, measurement of central venous oxygen saturation (SCVO2), renal replacement therapy, total parenteral nutrition, poor peripheral venous access, cardiac catheterization, and transvenous cardiac pacing. Despite the level of skill of the operator and the use of ultrasound guidance, CVC placement can result in CVC malposition.

Easy and uncomplicated catheterisation, free aspiration of blood and monitoring of catheterisation do not guarantee correct placement of the IJV catheter. Though, placement of a catheter through the RIJV is associated with the lowest incidence of malposition.

Ultrasound, ECG guidance, real-time X-ray imaging, surgical confirmation either by palpation in SVC or visualized in the RA, and saline injection test are definite confirmation and dramatically increase the successful placement of needles, guidewires, and catheters, but significant numbers of catheter misplacements can still occur, particularly if operators are not fully proficient in such techniques. A case of RIJV inserted CVP catheter malposition has been reported in 57 years old, 61 kg and 155cm height with short and thick neck patient presented with triple vessel CAD posted for OP-CABG surgery. Postoperative Chest X-Ray revealed a right sided CVP line catheter malposition in the contralateral innominate vein. Even though, the malposition of the CVP catheter inserted via RIJV is less frequently reported.

Keywords: CVP line, catheter malposition, left innominate vein, OP-CABG surgery, RIJV.

Introduction

Insertion of a central venous pressure (CVP) line is a routine practice in cardiac surgery as a part of the monitoring of intravascular volume status, right ventricular (RV) functions, or a surrogate of tricuspid regurgitation (TR) or other cardiac diseases like constrictive pericarditis, tamponade. Even CVP wave forms helps in diagnosing the several lesions such as tricuspid stenosis (TS), TR, constrictive pericarditis (CP), RV hypertrophy (RVH), pulmonary arterial hypertension (PAH) and nodal or junctional rhythm and atrial fibrillation (AF). It is also used for administration of anaesthetic and vasoactive agents, and vasodilators during cardiac surgery. The right internal jugular vein (RIJV) is the most used vein for CVP line insertion in cardiac surgery, due to its straight course to the right atrium (RA) and least chances of stenosis and thrombosis. [1,2,3]

Malposition can range from simple misplacement of the catheter tip to sophisticated issues like placement in the azygos vein or even the left atrium. Maddali et al. have reported 4% malposition in RIJV group as compared to the 22.3% of the LIJV group of paediatric patients with congenital heart disease.[4]

Misplacement of the superior vena cava (SVC) catheter to the perforation of the vena cava or the right atrium, which are associated with serious sequelae like cardiac tamponade, pleural effusion, hemopericardium, haemothorax, mediastinal hematoma and hypotension. [5,6] Central venous catheters (CVCs) are commonly utilized to gain vascular access for varied clinical indications. These include administering drugs, renal replacement therapy, total parenteral nutrition, poor peripheral venous access, cardiac catheterization, and transvenous cardiac pacing. Malposition in the innominate vein can lead to inaccurate central venous pressure readings, potential for vessel damage, and reduces the effectiveness of fluid or drug therapy. Anatomical variations, improper technique or subnormal patient position during cannulation can influence the angle of the catheter and increase the risk of the malposition. A 57 yrs male, weighing 61 kg, and 155 cm height, presented with off and on chest pain, diagnosed as triple vessel disease, posted for CABG. He has a short and thick neck. Following standard general anaesthetic induction, the 7 Fg, CVP line was inserted via RIJV by an experience cardiac anaesthetist. The OPCABG surgery involving LIMA to LAD and SVG to OM1 and RCA was performed successfully. However, the postoperative Chest X-Ray revealed a RIJV, CVP line malposition to the left innominate vein. The review of literature on the CVP line malposition will be discussed.

Case presentation

57 years, weighing 61kg and height 155cm, male patient presented with off and on chest pain for the last one year. He has short and thick neck. His BP was 138/96 mmHg and HR of 86 bpm. Transthoracic echocardiography revealed an EF of 37%,fraction shortening (FS) of 28%, LA -33mm, mild TR, with trace MR. Haematological and biochemical values were with in normal limits and prothrombin time of 12.6 seconds and INR of 1.2, and aPTT -35.3 second. Cardiac cath and angiography revealed a triple vessel disease involving LAD distal diffuse disease, OM1 ostio proximal 70 -90% block and mid RCA diffuse disease. He was posted for off pump coronary artery bypass grafting (OP-CABG) after obtaining an informed consent. Following standard narcotic based general anaesthesia induction, 7.5 FG, 15 cm, CVP line

was inserted via right internal jugular vein (RIJV) in first attempt by an experienced cardiac anaesthetist using standard middle approach without USG guide and secured at 13cm length. Though, some resistance was felt during negotiation of the guidewire, dilator and even during CVP catheter insertion. However, on aspiration of all the three ports, the free blood flow was confirmed. The CVP line was transduced that revealed a normal tracing and CVP of 8mmHg with typical waveform (a,c,v waves and X, and y descent). All the usual medications like heparin, protamine and anaesthetic drugs (fentanyl, midazolam, etomidate, vecuronium) and vasoactive agents (norepinephrine, dobutamine and NTG) were used through the CVP line achieved the desired effects. The patient remained haemodynamically stable throughout the procedure. OP-CABG surgery comprising LIMA- LAD, and SVG to OM1and RCA was performed successfully using standard mid-sternotomy approach. Dobutamine and NTG infusions were used through the CVP line port and the therapy was effective also in the maintenance of hemodynamics. The patient was shifted to the postoperative cardiac ICU for elective ventilation and further usual management.

A routine portable check x-ray chest was ordered, Surprisingly, which revealed the malposition of central venous catheter into the left innominate vein and normal lung fields and cardiac shadows (Figure 1). However, it was not withdrawn and left as such, and all medications were continued through it, and the CVP line was removed as usual on 4th postoperative day, the drugs and fluids administered through the CVP line were adequately effective without any complications. The rest of the course remained uneventful, and patient was discharged on the 7th postoperative day with the instructions to attend the follow-up after one week.

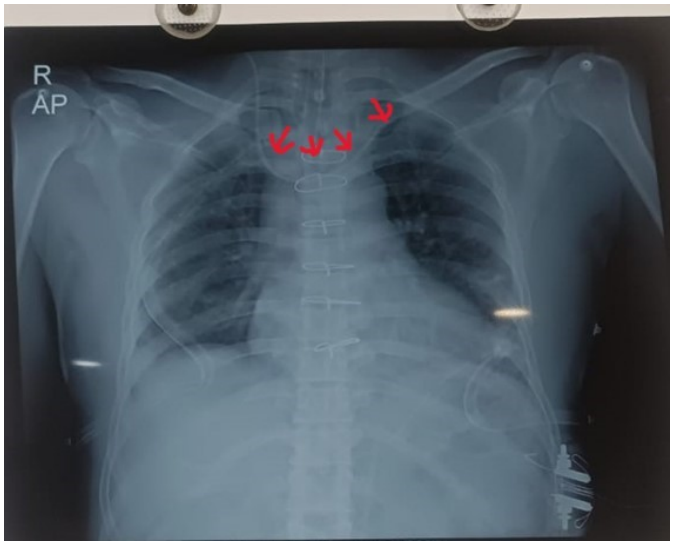

Figure-1. Chest X-Ray , AP view shows that the CVP catheter from RIJV has entered the left innominate vein, the course is followed by the red arrows. The lung fields and cardiac shadow appears to be normal. In addition, sternum closure with steel wires can also be observed.

CVP- central venous pressure, RIJV- right internal jugular vein

Discussion

The central venous catheter (CVC) insertion is one of the most frequently performed invasive monitoring, not only in anaesthesiology and intensive care units but also in various specialities from oncology to emergency medicine. It is most essential part of monitoring in the patients undergoing various cardiac surgical procedures. Despite the level of skill of the operator and the use of ultrasound guidance, CVC placement can result in CVC malposition.[7] In the presented patient, a rare malposition occurred in the contralateral innominate vein from the RIJV – CVC, despite the first attempt insertion by the expert cardiac anaesthesiologist and free blood flow in all the three ports on aspiration, and also non- significant high pressure and bright colour of the blood.

Normally, the tip of CVP catheter is placed, where the superior vena cava and right atrium merge and parallel with the long axis of the vein, such that the tip does not abut the vein or heart wall at an acute angle.[8] On chest X-ray, it seems to be 2 cm proximal to the pericardial line.[9] The incidence of malposition from the IJV have been reported as 5.3%.[3] Another less common complication with CVC is malposition of the catheter tip in an incorrect location and it has been reported in approximately 7% of cases.[7] Unusual malpositioning of a central venous pressure (CVP) line inserted via the right internal jugular vein are known as the catheter tip ending up in a vein other than the superior vena cava or right atrium, entering the ipsilateral or contralateral subclavian vein or the internal jugular vein itself or Axillary Vein.[8] However, other less frequent malpositions are the azygos vein, left superior intercostal vein, and even the left atrium, and vertebral vein and left internal mammary vein.[10,11] Some authors have reported A CVC inserted via the left IJV is noted to have taken an abnormal course in the anomalous pulmonary vein draining into the left innominate vein.[8]

In the author's experience, the carotid placement is also observed particularly when RIJV route is adopted by inexperienced operator using improper landmarks and patient positioning, but it's uncommonly reported in the literature. Inadvertent carotid cannulation as a complication of the IJV catheterization, have been reported in less than 1% of cases but has devastating consequences like bleeding, hematoma, thrombus, cerebral infarct and air embolism.[12,13]

There are some factors contributing to the malposition like head excessive rotation to the left, deep insertion of the needle, or improper guidance during insertion, Incorrect manipulation of the catheter or guidewire, and the Congenital variations in venous anatomy leading to the catheter taking an unintended path. The acquired abnormalities such as stenosis or thrombosis of the central veins can be problematic and can present as a failure to pass a guidewire or catheter or complications after such attempts and malpositioning.

Some authors have suggested that it could be most commonly because of the change in the orientation of the J tip of the guide wire during the procedure. Though, final position of the catheter tip depends upon the course the guide wire takes. [14]

Routinely guidewire length of approximately 15 cm is used during RIJV route, some authors have reported that excessive length of the guide wire insertion can cause malposition and more than 20 cm, the chances of malposition are as high as 45% requiring repositioning.[15]

Studies have shown that ECG monitoring while performing the procedure can place the CVC tip in correct position in 92% of cases while monitoring change in configuration of p wave. In our case ECG monitoring was done throughout the procedure which didn't show any change in pattern.

Confirmation of the malposition done by the chest X-ray is a gold standard method. In addition, ultrasound or TEE or ECG changes, real time X-ray imaging, even assessment by the typical CVP wave forms including a,c,v wave and x and y descent are also confirmatory. The arterial malposition in carotid artery can be confirmed by brightness of the colour (red) and unusual high pressure, but anomalous pulmonary venous drainage in the SVC and RA should be excluded before consider-

ing the bright arterial blood. If there is any doubt about the position of the needle tip, then connecting a pressure transducer to the needle should help to determine if placement is within the vein or arterial system before inserting the guidewire. In addition, depending upon the malposition, other complications such as pleural effusion, pulmonary edema, or cardiac tamponade may occur. In patients undergoing cardiac surgery and requiring opening of the RA, the surgical confirmation either by palpation in SVC or visualized in the RA, and saline injection test are definite confirmation of the correct CVP line position.

Conclusion

This single case report suggests that CVP catheter inserted via RIJV can develop malposition in the contralateral innominate vein, even if it is inserted by the experience cardiac anaesthetist in the first attempt. Innominate malposition can present even with free blood flow in all the three ports on aspiration and displaying the CVP value and waveform tracing. The medications and fluid therapy used through the CVP line remain effective and the catheter in the LIV may remain without doing any harm to the patient. It should only be removed when it's no more required in the postoperative management of the cardiac surgical patients, as per the institutional protocol.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest

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