



A SERIES OF CENTRAL VENOUS CATHETER MALPOSITION IN CANCER PATIENTS – A RARE YET STILL FREQUENT PHENOMENON

Anaesthesiology

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ABSTRACT

Introduction: Central venous catheterization though a relatively safe and simple procedure has its own share of complications. One of the frequently occurring complications is catheter malposition seen in nearly 5% of cases. Causes of malposition are multifactorial and varied. In this article, we highlighted a few cases of catheter malposition in our experience. **Cases summary:** Seven cases are described in this article out of which six were inserted blindly and one using ultrasound. Four catheters were malpositioned in the right internal jugular vein, two in contralateral subclavian vein and one in the right internal mammary vein. All of them were diagnosed in routine chest X rays. No complications were seen. **Conclusion:** Catheter malposition is a common complication which can happen to anyone regardless of the experience of the providers. Malposition can lead to many serious problems hence it should not be neglected and once it occurs steps must be taken to properly diagnose and treat it or remove it accordingly.

KEYWORDS

catheterization, central venous, complication

INTRODUCTION

Central venous catheterization is a common, simple, relatively inexpensive method for assessment of a patient's circulating blood volume, cardiac status and vasomotor tone, especially in critically ill patients and in major surgical procedures like cardiothoracic surgery, neurosurgery and oncosurgery. In the operation theatre and ICU (Intensive Care Unit) central venous catheterization is used for measurement of right atrium pressure in patients requiring a cardiopulmonary bypass circuit or in conditions where large amounts of volume or blood loss are expected. It is also used for blood product infusion and vasopressor drug administration. In cancer patients, central venous catheterization plays a pivotal role for placement of chemoport for administration of chemotherapeutic agents, for delivering potentially irritant drugs and for palliative (parenteral nutritional) support. Other usage include pulmonary artery catheter placement, implantation of an atrial pacemaker, or right heart mechanical assist devices and access for haemodialysis[1].

There are four main types of CVCs (central venous catheters): 1) non tunneled devices 2) peripherally inserted central catheters 3) tunneled devices 4) implantable ports. Most commonly catheters are inserted via wire guidance (i.e., Seldinger technique).

Even though it is a relatively safe procedure, multiple complications can be encountered both during the placement and maintenance of the catheter.

Infection, haematoma, and pneumothorax are the most common complications[2]. Less commonly, chylothorax, vein and nerve damage and thrombosis may be seen.

Malposition of the catheter is also a frequently encountered occurrence, reported to be around 3 to 4% in literature[3]. Malposition may lead to problems like extravasation of infusate, unrecognized arterial placement, mediastinal haemorrhage, folding of the catheter and sometimes even fatal events like cardiac tamponade, air embolism and arrhythmia[4]. Studies have shown that placing the CVC tip in a vessel other than the superior vena cava increases the risks of catheter wedging, erosion or perforation of vessel walls, local venous thrombosis, catheter dysfunction, and cranial retrograde injection.

During subclavian catheterization the most common misplacement seen is in the ipsilateral internal jugular vein (60%)[5].

There are multiple causes of malposition like needle bevel

orientation[6], difficult body habitus (e.g., obesity or large breasts), position change from supine to upright, breathing movements and congenital and acquired variations in the venous anatomy[3,7].

A chest radiography is traditionally used to diagnose the malposition of the catheter[8].

In this study, we reviewed seven cases in our institute where the tip of CVC was malpositioned after placement and attempted to highlight the precipitating factors, causes, diagnosis and management of each case.

Description Of Cases:

Case 1 - A 59 year old male patient of cancer oesophagus posted for minimally invasive esophagectomy was routinely given central venous catheter in right subclavian vein using modified Seldinger's technique for intra operative fluid management and post operative parenteral nutrition support. CVC insertion was successful in the second attempt as there was kinking of the guidewire during first attempt at insertion. No resistance was felt in the second attempt and no change in P wave in ECG (Electrocardiogram) was seen in the monitor after inserting up to 15 cm. There were no complications post insertion. It was diagnosed post operatively in the ICU on post operative day 1, when routine CXR (Chest X Ray) was done. In the CXR, the tip of CVC was turned cephalad towards right internal jugular vein (IJV) (Figure 1). The catheter was left in place and utilised for 5 days as there was no complication.



Figure 1 – Tip Misplacement In Right Internal Jugular Vein

Case 2 - A 37 year old female of ASA (American Society of Anaesthesiology) class II (asthmatic), who underwent left thoraco abdominal oesophagogastrectomy was routinely given right subclavian CVC by blind/ modified Seldinger's technique for fluid and parenteral nutrition support. CVC insertion was done in single attempt with resistance felt during insertion of the guide wire. Here also the guide wire was kinked after insertion. No P wave changes were noticed after inserting up to 13 cm. There was no complications post insertion. Routine CXR done in the ICU showed the tip of CVC turned cephalad towards right IJV (Figure 2). Catheter was removed after 6 days.



Figure 2: Tip Misplacement In Right Internal Jugular Vein

Case 3 - A 57 year old ASA II male (hypertensive), who was posted for total minimally invasive esophagectomy, was given right subclavian vein CVC after induction of general anaesthesia (GA) by blind/ Seldinger's technique. The insertion was done in double attempt as there was resistance during the insertion of the catheter post dilation. No P wave changes were seen after inserting up to 15cm. CXR showed CVC turned towards cephalad direction towards right IJV. There were no complications post insertion. (Figure 3)

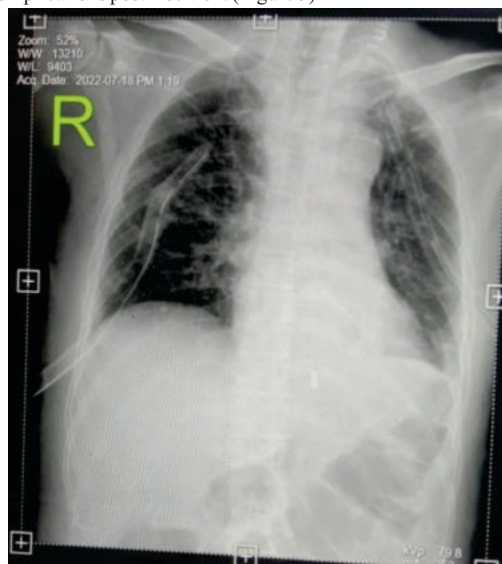


Figure 3: Tip misplacement in right internal jugular vein

Case 4 - A 34 year old female of ASA II (jaundice), who underwent right extended hepatectomy with CBD (common bile duct) excision with left hepaticojejunostomy and jejunoejejunostomy was given right subclavian CVC after GA for intra and post operative fluid management as well as for central venous pressure monitoring intraoperatively. The CVC was inserted in second attempt as there was resistance during the insertion of the catheter post dilation and after guide wire insertion. During the second attempt no changes in P wave were seen even on insertion till 15 cm. On routine post operative CXR done in the ICU on day 1, the tip of the catheter was in the contralateral subclavian vein. (Figure 4). No complications were seen.

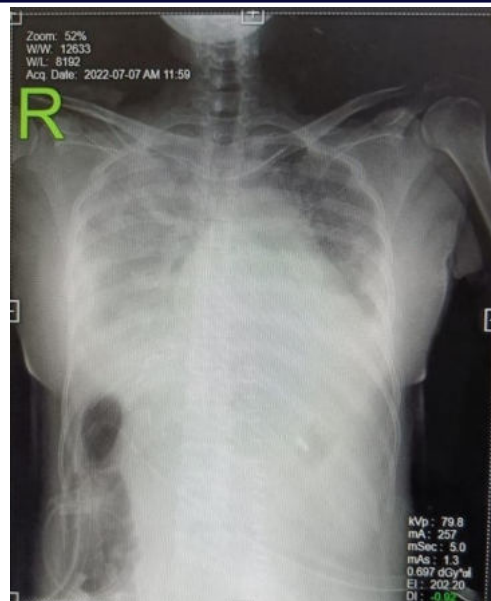


Figure 4: Tip in contralateral subclavian vein

Case 5 - A 12 year old male child with non metastatic osteosarcoma of right tibia on chemotherapy needed central line for palliative care and parenteral nutritional support. Insertion was done in single attempt using ultrasound and but there was resistance both during the insertion of guide wire as well as the catheter. There was no p wave changes in paediatric ECG on the monitor on inserting up to 13 cm. CXR was done immediately and it was seen that the tip of the CVC was in the right internal mammary vessels. (Figure 5) However no complications was seen as such.

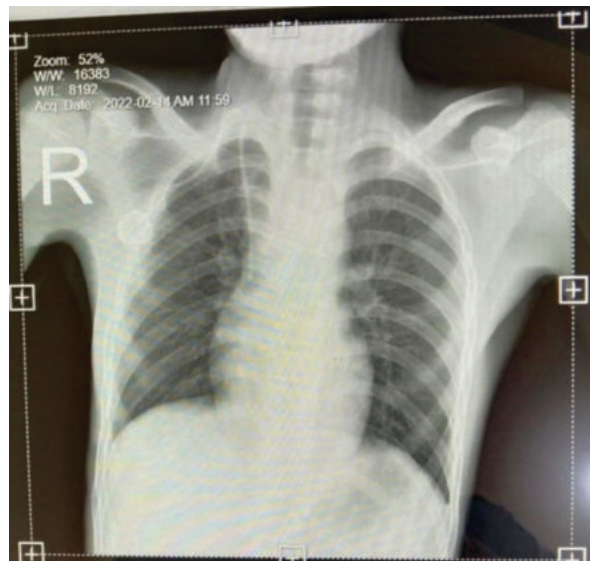


Figure 5: Tip In Right Internal Mammary Vessels

Case 6 - A 35 year old female posted for retroperitoneal mass excision and ileal conduit was given CVC routinely after GA by blind/modified Seldinger's technique for intraoperative fluid management and post operative parenteral nutritional support. The CVC insertion was done in double attempt as there was resistance during the insertion of the catheter post dilation and after guide wire insertion. The diagnosis of misplacement in contralateral subclavian vein was done in post operative day 1 when routine CXR was done in the ICU (Figure 6).

Case 7 - A 66 year old male of ASA II (diabetic & hypertensive), posted for minimally invasive esophagectomy, was given routine CVC in subclavian vein after GA by blind/modified Seldinger's technique. It was inserted in single attempt and there was no resistance felt during the insertion of the catheter. Routine CXR showed CVC going in cephalad direction towards right IJV. (Figure 7). There were no

complications and the catheter was not removed immediately.

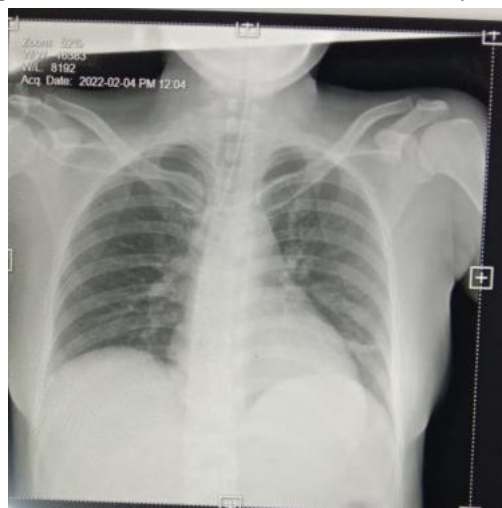


Figure 6: Tip in contralateral subclavian vein

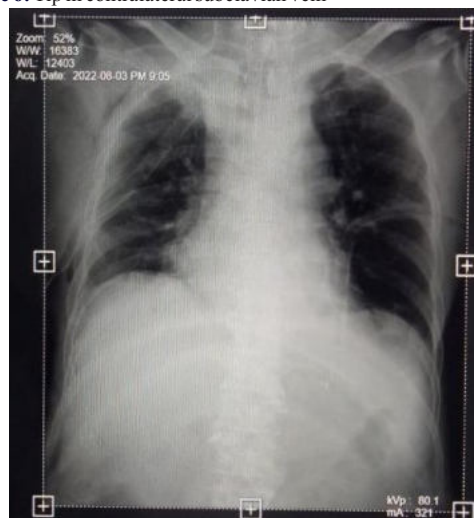


Figure 7: Tip in right internal jugular vein

Summary:

Serial No.	Variable And No Of Cases	
1	Site of insertion	
	Subclavian vein (right)	7
	Internal jugular vein	0
2	Mode of insertion	
	Blind	6
	Ultrasound guided	1
2)	No of attempts	
	1	3
	More than 1	4
3)	Guide wire /dilator changes	
	Yes	6
	No	1
4	Site of malposition	
	Internal jugular vein (right)	4
	Subclavian vein (contralateral)	2
	Others (Internal mammary vessel)	1
4)	Chest X Ray	
	Cephalad	4
	Caudal	1
	Contralateral	2
5)	Complications	
	a) Yes	0
	b) No	7

DISCUSSION

Central venous catheterisation is one of the most commonly done procedures in critically ill patients however it is not devoid of

complications. The most common complications seen are infection (5% to 26%) followed by haematoma (2% to 26%) and pneumothorax (up to 30%)[2].

Other complications include arterial puncture, haemothorax, lymphatic and thoracic duct injury, seepage of drug in the extravascular space, guidewire fracture, catheter damage and malposition.

Malposition of the catheter is a relatively common complication (5.01%) that can make the catheter non functional[3,5]. It can cause serious complications such as cardiac perforation, arrhythmias, thrombosis, extravasation and vessel injury if not detected early[4].

The correct placement of the CVC is at the level of mid-lower superior vena cava to cavo atrial junction. When it doesn't lie in the correct position, malposition happens. It can be of two types, intra caval and extra caval malposition based on the location of the catheter[3]. When the catheter lies outside the vasculature, it is called extra caval malpositioning such as when placed in the mediastinum, pleura, pericardium, trachea, oesophagus or subarachnoid space. In intra caval malpositioning, it lies within the vessels but not in the correct one, such as internal mammary vein, internal jugular vein, azygos vein, axillary vein and intercostal veins.

In this study, we depicted seven cases of CVC malposition all of which were inserted in the right subclavian vein. Six of them were inserted blindly and in only one case ultrasound was used.

Subclavian vein and IJV are the most commonly used sites for cannulation[9]. The IJV has a low incidence of malpositioning however there is no difference in mechanical complication as compared to subclavian vein[4]. The frequency of malposition of subclavian vein catheter has been found to be higher than that of the IJV (5.3% vs. 9.3%, relative risk 0.66 [0.44-0.99]).

The incidence of malpositioning by experienced providers was found to be 6.7% and it was most commonly seen in CVCs inserted via the left internal jugular vein (12%), followed by right subclavian (9.3%), left subclavian (7.3%) and right internal jugular vein (4.3%)[10].

In our study, four catheters were malpositioned in the right internal jugular vein, two in the contralateral subclavian vein and one in the right internal mammary vein. These were all diagnosed by routine CXR.

The exact cause and mechanism of CVC malpositioning is not known. The causes can be divided into anatomical and technical factors. Anatomical factors include congenital anomalies like vessel anatomy, its branches and tortuosity, acute angulations and acquired factors like venous stenosis, thrombosis and obstruction[7]. Anatomical variations can lead the catheter into venous tributaries with a low-resistance path. A common clinically significant congenital variation is persistent left-sided superior vena cava seen in 0.3% to 0.5 % of normal population[3]. External obstruction occurs due to extrinsic compression by a mass most commonly malignancy. Technical factors include kinking of the guidewire and dilators, entry of guide wire into other veins, orientation of the bevel of the needle and use of high pressure during insertion and manipulation of the guide wire or catheter[11]. Certain other factors such as obesity, patient position or movement during respiration can cause migration of the tip of catheter[12,13].

No difference has been found between expertise of junior or senior doctors performing the procedure leading to malpositioning of the catheter[14]. In our study also the operators were all different with different levels of experience yet the problem of malposition occurred equally.

Consequences of malpositioned CVC can range from being asymptomatic to fatal complications including death. CVC placed in the pleural space can cause pneumothorax, haemothorax, injury to thoracic duct or chylothorax. Pericardial placement can lead to pericardial perforation, haemopericardium, cardiac tamponade or fatal ventricular fibrillation. It can cause catheter blockage, vessel injury, thrombosis, embolism, catheter migration and fracture.

Diagnosis Of Malposition

Signs and symptoms include blockage of catheter with negative

aspiration of blood from all the lumens of the catheter, swelling, dyspnoea, chest pain and back pain. In few cases patients remain asymptomatic so a high degree of suspicion is needed. Cross sectional CT (computed tomography) is the best imaging modality to identify the site of catheters[15]. When a CVC gets malpositioned in the right internal mammary vein, no blood is aspirated from the line and the cannulation produces shoulder or arm pain during aspiration and flushing of the catheter.

Prevention

Selecting the vessel - The right side of the circulation should be given first preference for CVC insertion unless those insertion sites are contraindicated as the incidence of malpositioning has been found to be lower in the right side.

Confirming Placement -

In general, the tip of CVC should lie in the long axis of a wide vein with high blood flow, away from both the vessel wall and junctions[3]. To ensure correct placement of catheter tip several techniques like ultrasound or fluoroscopic guided cannulation, continuous ECG monitoring of shape and size of P wave as the catheter is advanced, central venous pressure tracing and routine chest radiography before catheter use have been advocated.

Technique -

During IJV catheterization, orienting the needle bevel medially helps in easy guide wire passage into the superior vena cava. The rate of misplacement was substantially decreased in subclavian venous catheterization when the J-tip was directed caudally[6]. Lateral flexion of the head towards the insertion side narrows the os of the internal jugular vein, preventing the tip from entering the internal jugular circulation[21].

Chest X Ray -

Although most commonly used to ascertain the position of CVC location, correct interpretation of these X rays require knowledge of the normal course and termination of mediastinal vessels related to the CVC[8]. Lateral X rays may be helpful in cases of atypical anterior-posterior chest radiograph. If there is still uncertainty, injecting a small amount of contrast material through the catheter during conventional radiography or CT may be necessary for precise localization[16].

The internal mammary vein originates from the brachiocephalic vein, which overlies the SVC and travels along the posterior aspect of the anterior chest wall. Thus, a catheter tip in the right internal mammary vein may appear to be within the SVC on a standard anterior posterior chest radiograph[16,17]. In our study routine CXRs helped to diagnose the misplacement of catheters.

Ultrasound -

USG guided CVC insertion helps in visualising the exact location of the vein, improves the success rate and decreases complications but it cannot tell us the exact position of the catheter tip[3]. A flush test where the CVC is flushed with 5-10 mL of normal saline and a thrill is felt on palpation or an audible bruit on auscultation is useful for diagnosis[18]. Definite view of bubbles in the right atrium after injection of 10mL of agitated normal saline via the CVC port can help in correct placement of the CVC tip[19]. Significant limitations of this technique includes the inability to visualize the alignment of the catheter, and the presence of any aberrant course.

Treatment

If any malposition is detected it should be repositioned or removed. However, final decision should be taken only after evaluating the risk-benefit scenario and peer discussion.

Insertion of a new catheter may be attempted after partial retrieval and redirecting of the wire guide, which may correct the malpositioning in some cases. However, few studies have suggested that to avoid the stress of removing and replacing a malpositioned CVC, the catheter should be left in place since spontaneous correction may occur within one day[20]. But, no similar observation has been described in adults.

Sometimes, assistance may be needed from interventional radiology or vascular surgery specialists in the removal of the malpositioned CVC especially for catheters cannulated in noncompressible arteries or those centrally visualized but not clearly intravascularly located such as in our case where one was malpositioned in the internal mammary vein.

The infusion of hyperosmolar solutions or vasopressors through the malpositioned CVC increases complications associated with a CVC cannulation and should be avoided before the malpositioning is fixed.

CVC malpositioned in the internal mammary veins is non functional and produces shoulder and arm pain hence should be removed under radiographic monitor with the moderate force.

One author reported a technique where the catheter is first withdrawn under aseptic conditions and then a force is given using jet of saline to straighten the bend in the central line. After straightening the catheter, it was reinserted & repositioned under fluoroscopic guidance till the tip is visualized in SVC. Misplacement into both IJV and subclavian vein can be corrected using this technique[22].

In our cases as there were no complications, we did not remove the central catheters and they were kept in place and used for maximum of seven days except in one case as mentioned already..

CONCLUSION:

Central venous catheter malpositioning is a prevailing complication which can happen to any provider regardless of their experience. Knowing the mechanisms of CVC malpositioning and learning how to prevent, reduce, identify, and correct it could decrease potentially harmful complications. Awareness of signs and symptoms of CVC malpositioning in a patient with apparently adequate CVC placement on plain radiographs and use of imaging techniques should promptly reduce the incidence. In general, repositioning, replacing or removing a malpositioned CVC should be done as soon as possible.

In our study we were fortunate enough not to encounter any damaging complications in all seven cases. However a more comprehensive, extensive and suitable prospective study with more number of cases can be done in the future to properly study the incidences, causes, precipitating factors and management of catheter malposition.

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