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CASE REPORT

A Case of Misdirected Subclavian Central Venous Catheter into Ipsilateral Internal Jugular Vein in the Critical Care Unit

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ABSTRACT

Background: Central venous catheter (CVC) malposition is a recognized complication of subclavian venous catheterization, with misdirection into the ipsilateral internal jugular vein (IJV) being one of the more commonly encountered mal-positions. Prompt recognition and correction of such misplacements are crucial to prevent complications such as thromboembolism, vascular injury or impaired catheter function.

Objective: To report a case of inadvertent malposition of a subclavian central venous catheter into the ipsilateral internal jugular vein in a critically ill patient and its subsequent successful repositioning.

Case Presentation: A 32-year-old female patient presented to the general surgery outpatient department of our hospital with complaints of acute abdominal pain, vomiting and discharge from an abdominal wound. After relevant work-up and optimisation, she underwent an exploratory laparotomy for suspected perforation peritonitis with peritoneal lavage and primary jejunal repair. Postoperatively, she was shifted to the critical care unit and required total parenteral nutrition (TPN). A right subclavian vein catheterization was done for central venous access and the catheter fixed at 12cm mark at skin. Post-insertion chest radiograph revealed mal-positioning of the catheter tip into the right internal jugular vein. The catheter was subsequently withdrawn to 10cm and 8cm at skin, successively, guided by

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chest radiographs and finally fixed at 8cm at skin which revealed catheter tip at the junction of subclavian vein and internal jugular vein.

KEYWORDS

• Central Venous Catheterization • Internal Jugular Vein • Subclavian Vein • Catheter Malposition • Critical Care

INTRODUCTION

Central venous catheterization is a vital procedure in critical care, commonly performed via the subclavian vein to ensure reliable vascular access. However, Central venous catheter (CVC) malposition is a recognized complication of subclavian venous catheterization, with misdirection into the ipsilateral internal jugular vein (IJV) being one of the more commonly encountered mal-positions. Such mal-positions can compromise catheter function and increase the risk of thromboembolism, vascular injury and infusion related complications. Early recognition and prompt corrective measures are crucial to ensuring optimal catheter placement and preventing adverse outcomes.

CASE PRESENTATION

A 32-year-old female patient, weighing 45 kg and measuring 152 cm in height, presented to the general surgery outpatient department with a primary complaint of intermittent abdominal pain persisting for four months. Additionally, she reported urinary leakage from a vesico-cutaneous fistula and episodes of vomiting over the past two days. Imaging studies confirmed the presence of gallstone disease, and she was scheduled for either open or laparoscopic cholecystectomy with incisional hernia repair with excision of vesico-cutaneous fistula.

Her medical history was unremarkable, with no history of any chronic illness. Surgically, she had undergone a lower segment cesarean section (LSCS) seven years ago, followed by open mesh hernioplasty for an incisional hernia five years prior alongwith treatment with anti-tubercular drugs for abdominal Koch's All preoperative laboratory investigations were within normal limits and she was accepted for the surgery under ASA physical status class I with a detailed preoperative counseling and informed written consent.

Intraoperatively, under ASTM standard monitoring, combined spinal-epidural anesthesia was administered at the L3-L4 interspace, using 3mL of 0.5% hyperbaric bupivacaine for spinal anesthesia. An epidural catheter was placed for peri-operative pain management. The procedure was completed without complications, and the patient was transferred to the post-anesthesia care unit in a haemodynamically stable condition.

On postoperative day three, the patient developed pyrexia along with persistent abdominal pain and discomfort. Given her recent history of open cholecystectomy with vesico-cutaneous fistula excision, an ultrasound of the abdomen was performed which revealed the presence of free intra-peritoneal air under the diaphragm, raising a strong suspicion of perforation peritonitis. The patient was promptly taken for an emergency exploratory laparotomy under general anesthesia.Intraoperative findings confirmed jejunal perforation, necessitating a primary repair of the jejunal defect with thorough peritoneal lavage. The procedure was completed uneventfully, and the patient was shifted to the intensive care unit (ICU) for close monitoring.

Due to inadequate oral intake and elevated metabolic demands, a triple-lumen 7.5 French central venous catheter (CVC) was placed in the right subclavian vein (Infra clavicular approach) using the Modified Seldinger's technique (and fixed at 12cm mark at the skin) to facilitate total parenteral nutrition (TPN) administration, ensuring optimal nutritional support and gut healing. A routine post-procedure chest X-ray (*Figure 1*) was performed to confirm correct catheter placement and rule out complications such as pneumothorax or hemothorax. However, the imaging revealed malpositioning of the catheter tip into the ipsilateral internal jugular vein (IJV). To ensure accurate catheter placement and minimize complications, the central line was carefully repositioned. Guided by 2 successive chest

X-rays, catheter was first withdrawn to 10cm mark and then till 8cm mark at skin, which confirmed optimal catheter positioning at the junction of IJV and subclavian vein, allowing safe administration of TPN and intravenous medications. Figure 2 and Figure 3.

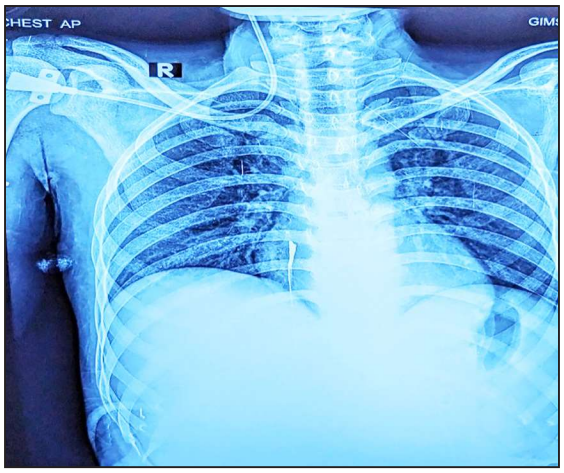

Figure 1: Migration of subclavian vein catheter tip into ipsilateral internal jugular vein (12 cm mark at skin)

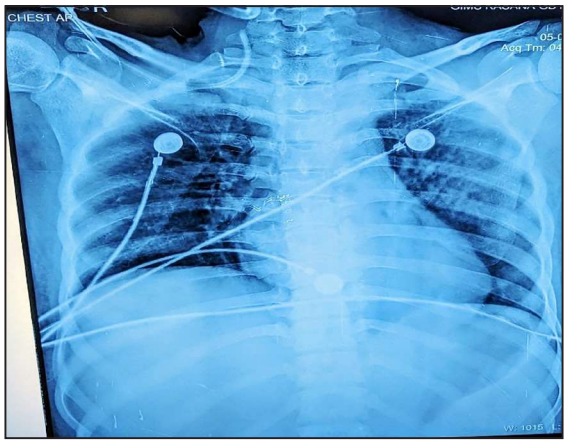

Figure 2: Repositioning of migrated subclavian vein catheter tip to 10cm mark at skin

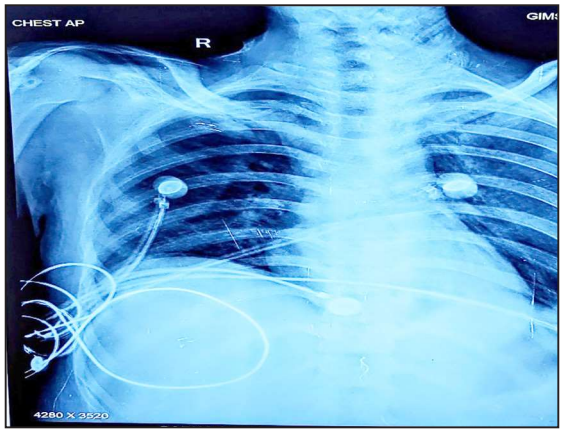

Figure 3: Correct and Final repositioning of migrated subclavian vein catheter tip to 8cm mark at skin

DISCUSSION

Central venous catheterization is the placement of a catheter in such a manner that its tip is positioned within the proximal third of the superior vena cava, the right atrium or the inferior vena cava. It is indicated for access for administration of drugs or extracorporeal blood circuits and haemodynamic monitoring, total parenteral nutrition, and optimizing the management of patients in the intensive care unit (ICU).[1] When inserting a central venous catheter, appropriate preparation and asepsis, positioning of the patient and the use of ultrasound should be considered.

Catheter malposition, a relatively common adverse event occurring in approximately 3% to 14% of cases, can lead to severe complications, including potentially fatal outcomes if not promptly addressed. Catheter malposition may manifest either during initial insertion or later as a result of catheter tip migration. Complications can still arise, some of which can be severe. Traditionally, CVC placements relied on anatomical landmarks for guidance. However, incorporating ultrasound guidance has notably increased the success rate of catheter placements and substantially reduced the relative risk of complications by up to 73%. Subclavian-vein catheterization was associated with a lower risk of bloodstream infection and symptomatic thrombosis and a higher risk of pneumothorax than jugular vein or femoral vein catheterization.[2] Subclavian access is preferred for TPN due to its lower infection risk, but catheter malposition remains a concern.

Studies suggest that for patients undergoing implantable port evaluation, ports placed into the subclavian vein are more likely to demonstrate a radiographic abnormality, as well as having increased likelihood of catheter malposition or fracture, compared to those placed into the internal jugular vein. One potential explanation for this difference may be related to the anatomic differences in the two veins. The subclavian vein originates as a continuation of the axillary vein at the lateral border of the first rib, transverses posterior to the clavicle, and then joins the IJV at the medial border of the anterior scalene muscle to form the brachiocephalic vein. Due to compression between the clavicle and the first rib, catheter pinch-off syndrome can occur, which has been associated with increased fractures and

embolization of the catheter in subclavian ports.[3]

This finding was also shared with a study by Plumhans, et. al, which found significantly lower rates of tip migration in internal jugular ports when compared to the subclavian ports One possible explanation for the increased rate of malpositioning in subclavian ports is that these ports must pass through the pectoralis muscles, which favor catheter movement during Contraction.[4] Furthermore, due to anatomical positioning of the subclavian vein, a more lateral access site may increase the risk of catheter loops or curved catheter courses, resulting in catheter malposition.

Central venous catheter (CVC) misplacement can lead to significant complications; therefore, implementing effective preventive strategies is crucial. Key measures include:

Ultrasound Guidance

Utilizing real-time ultrasound during CVC insertion is considered the gold standard, as it allows direct visualization of the vein, surrounding anatomy, and catheter placement, thereby reducing the risk of misplacement. Studies have demonstrated that ultrasound guidance not only decreases the incidence of catheter malposition but also minimizes complications such as arterial puncture and pneumothorax. Recognition and management of complications is an advantage of ultrasound guided vascular access but ultrasound does not usually allow the path of misplaced central catheters to be accurately determined, nor can it predict whether it is safe to remove them.[5]

Optimal Insertion Site Selection:

Choosing the appropriate insertion site is vital. The internal jugular vein is often preferred due to its straight anatomical course and accessibility, which may reduce the likelihood of catheter misplacement compared to the subclavian vein.Subclavian-vein catheterization was associated with a lower risk of bloodstream infection and symptomatic thrombosis and a higher risk of pneumothorax than jugular-vein or femoral-vein catheterization.[6]

Operator Experience and Training:

Central venous catheter placement has been associated with mechanical complications, some of which can be life-threatening. Recent studies have shown that simulation-based education on ultrasound-guided central venous catheter placement improves puncture success rates.[7]

Proper Patient Positioning:

Proper patient positioning is crucial for successful subclavian vein catheterization, as it enhances vein accessibility and minimizes the risk of complications.[8] Key considerations include:

- Trendelenburg Position: Placing the patient in the Trendelenburg position (head-down tilt of 10 to 20 degrees) promotes venous dilation, facilitating easier cannulation and reducing the risk of air embolism.
- Arm Positioning: Abducting the patient's arm on the side of cannulation to 90 degrees can lift the clavicle, creating additional working space and making vascular structures more superficial, thereby aiding in the procedure.
- Head Positioning: Turning the patient's head to the contralateral side exposes the puncture site and improves vein accessibility, facilitating successful catheter placement.
- Neutral Head and Shoulder Alignment: Maintaining the head and shoulders in a neutral position without retraction is suggested, as retraction can distort subclavian vein anatomy, making cannulation more challenging.

By adhering to these positioning guidelines, clinicians can enhance the success rate of subclavian vein catheterization and minimize potential complications.

Use of Anatomical Landmarks:

While ultrasound guidance is preferred, familiarity with anatomical landmarks remains important, especially in situations where ultrasound is unavailable. Accurate identification of these landmarks aids in proper needle placement and reduces the risk of misplacement.[9]

Guidewire and Catheter Handling:

Careful manipulation of the guidewire and catheter during insertion is crucial. Ensuring that the guidewire advances smoothly within the intended vein before catheter placement helps prevent misplacement. A recent case report highlighted an incident of guidewire

entrapment during CVC insertion, emphasizing the importance of meticulous guidewire handling to avoid such complications.[10]

Pressure Waveform Monitoring:

Monitoring pressure waveforms during central venous catheter (CVC) insertion is a valuable technique to distinguish between venous and arterial placements, thereby identifying potential arterial misplacements. A recent case report highlighted an incident where a CVC was inadvertently placed in an artery, and the arterial placement was confirmed by analyzing the pressure waveform obtained through the catheter transducer. This underscores the importance of pressure waveform monitoring in promptly detecting and correcting such misplacements, thereby preventing associated complications.[11]

Blood Aspiration Confirmation:

Aspirating blood from the catheter after insertion confirms venous placement. The characteristics of the aspirated blood, such as color and flow, can provide immediate feedback on catheter location. The ability to withdraw blood from the catheter does not unequivocally confirm correct placement, as the catheter tip could still be malpositioned despite successful aspiration. Therefore, relying solely on blood aspiration is not recommended for confirming accurate catheter placement. To ensure proper positioning and reduce the risk of complications, it is advisable to use additional verification methods, such as ultrasound guidance during insertion and post-procedural imaging, to confirm the catheter's location.

Post-Procedural Imaging:

Performing a chest X-ray or utilizing other imaging modalities post-insertion is standard practice to verify the catheter tip's position and detect any complications, such as pneumothorax. This step ensures that the catheter is correctly placed within the central venous system.[12]

Implementing these strategies collectively enhances the safety and efficacy of CVC insertions, thereby reducing the incidence of catheter misplacement and associated complications. In the case of actual or suspected complications, early use of ultrasound to identify pleural and pericardial complications can be done but one cannot rely on it to guide management of misplaced catheters, bleeding or other problems.

The catheter point of entry, course and exit from the circulation, need to be identified to guide further management. Definitive diagnostic imaging needs computed tomography (CT) angiography or fluoroscopy with injection of contrast down the catheter to verify its position in the venous system, mediastinum, arterial tree, pleura or pericardium. Urgent referral to the appropriate specialty is vital for favourable outcomes, for example, cardiovascular surgery, cardiology or interventional radiology. Ultrasound guidance for vascular access is now well established. Future investigations should seek to further refine equipment, training and procedures to maximise patient benefits

CONCLUSION

This case highlights the importance of confirming central line placement post-procedure using imaging modalities. Although subclavian access is preferred for TPN due to its lower infection risk, catheter malposition remains a concern. Routine use of ultrasound guidance during central venous catheter placement can enhance accuracy and reduce the incidence of misplacement.

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