

"Navigating Danger: Emergency Thoracotomy For Superior Vena Cava Injury During Dialysis Access In An Elderly Patient"

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Abstract

Superior vena cava (SVC) injury is a rare but life-threatening complication during the insertion of central venous catheters, especially in elderly patients with multiple comorbidities. We report a case of an 81-year-old woman with a complex medical history, including diabetes mellitus, hypertension, dyslipidemia, and end-stage renal disease (ESRD), who suffered an SVC injury during the placement of a PermCath for hemodialysis. The patient was initially admitted with fever and altered sensorium, requiring urgent dialysis. A femoral catheter was initially used, but a more permanent solution was sought. During the placement of the PermCath, the patient developed hypotension and shock, necessitating immediate transfer to the intensive care unit (ICU). Imaging revealed a severe right hemothorax and active bleeding from a perforation of the SVC. Emergency right exploratory thoracotomy was performed, revealing a 2 cm laceration at the insertion of the azygous vein into the SVC and a linear laceration of the right lower lung lobe. Both injuries were repaired, and the patient was stabilized. She recovered well postoperatively and was discharged on the fifth postoperative day. This case underscores the importance of early recognition and prompt surgical intervention in managing SVC injuries during central venous catheterization.

Keywords: SVC Injury, Hemodialysis catheter, Iatrogenic injury

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I. Introduction

Central venous catheter (CVC) insertion is a common procedure in the management of patients requiring long-term vascular access, particularly for hemodialysis in those with end-stage renal disease (ESRD) [1]. Despite being a routine procedure, CVC insertion carries a risk of serious complications, including pneumothorax, hemothorax, cardiac tamponade, and vascular injury [2]. Among these, injury to the superior vena cava (SVC) is exceedingly rare but poses a significant risk of morbidity and mortality due to the potential for massive hemorrhage and rapid hemodynamic deterioration [3, 4].

The incidence of SVC perforation during CVC placement is not well-documented but is considered rare. Factors contributing to this complication may include the patient's age, comorbid conditions, anatomical variations, and the skill and experience of the operator [5]. In particular, elderly patients with comorbidities such as diabetes, hypertension, and dyslipidemia, as seen in this case, are at increased risk of both technical challenges and poor outcomes following vascular injuries [6].

In this report, we present the case of an 81-year-old woman with ESRD who suffered an SVC injury during the placement of a PermCath for hemodialysis. We discuss the clinical presentation, management, and outcomes, and we review the literature on similar cases to provide recommendations for preventing and managing such complications.

II. Case Report

An 81-year-old woman with a long-standing history of diabetes mellitus, hypertension, and dyslipidemia was diagnosed with chronic kidney disease five years ago, which progressed to end-stage renal disease (ESRD). An arteriovenous fistula (AVF) was created in September 2023, but it failed to mature adequately. In December 2023, the patient presented to the hospital with fever and altered sensorium, and urgent dialysis was required. A femoral catheter was initially placed for dialysis, but due to its temporary nature and the need for long-term vascular access, a decision was made to place a PermCath.

During the PermCath insertion, the patient suddenly became hypotensive. The procedure was halted, and the patient was immediately transferred to the intensive care unit (ICU) for further management. Upon arrival in the ICU, she was found to be in shock, requiring norepinephrine support at a rate of 0.3 mcg/kg/min to maintain her blood pressure. Arterial blood gas (ABG) analysis revealed metabolic acidosis (lactate 4.20 mmol/L) and

hyperkalemia. The patient received two units of packed red blood cells (PCV) and four units of fresh frozen plasma (FFP).

Despite these interventions, the patient's condition remained critical. A CT angiography of the chest was performed, which revealed a severe right hemothorax with active bleeding near the tip of the central venous catheter. The catheter was found to have perforated the SVC, with the distal tip located posteriorly outside the SVC before entering the right atrium. A large collection of contrast media indicative of fresh bleeding was seen around the catheter tip. The right lung's middle and lower lobes were collapsed, with mild left pleural effusion noted.

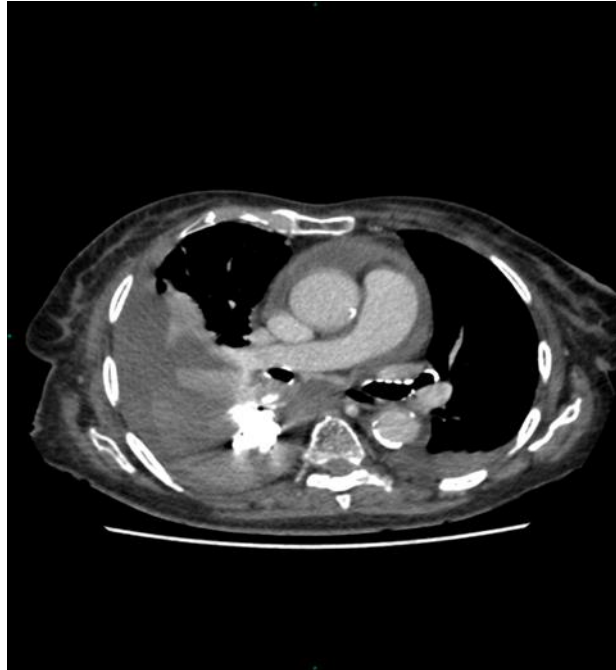


Fig.1 large amount of contrast seen around tip of catheter



Fig.2 catheter seen outside posterior to SVC

An emergency right exploratory thoracotomy was performed. Intraoperative findings included a large hemothorax with 1.8 liters of blood drained from the right hemithorax. A 2 cm laceration was identified at the insertion of the azygous vein into the SVC, and a linear laceration was present in the right lower lung lobe. The SVC injury was repaired using 5/0 Prolene sutures, and the lung laceration was repaired with 4/0 Prolene continuous running sutures. The pleural space was thoroughly washed with 2 liters of saline, and air leakage testing was negative. Two chest tubes were placed in the right pleural cavity, and the wound was closed in layers.

Postoperatively, the patient was extubated on the third postoperative day and gradually advanced to a clear liquid diet. The chest tubes were removed, and she was transferred to the ward on the fourth postoperative day. She was discharged in satisfactory condition on the fifth postoperative day and continues to be followed by nephrology for ongoing hemodialysis.

III. Discussion

Injury to the SVC during CVC placement, while rare, is a serious and potentially fatal complication. The SVC is a thin-walled vessel, and its proximity to the sternum and other thoracic structures makes it vulnerable to injury during catheterization [7]. The risk of SVC injury is further increased in elderly patients due to age-related changes in tissue elasticity and vascular fragility [8]. Additionally, comorbid conditions such as diabetes, hypertension, and dyslipidemia can exacerbate the risk of vascular complications by contributing to atherosclerosis and impaired wound healing [9].

In this case, the patient's advanced age and multiple comorbidities likely contributed to the complexity of the catheterization procedure and the subsequent SVC injury. The initial presentation of hypotension and shock, along with the findings of metabolic acidosis and hyperkalemia, indicated a severe and life-threatening hemorrhage that required immediate surgical intervention. The rapid recognition of the complication and the prompt decision to perform an emergency thoracotomy were crucial in preventing further deterioration and ensuring the patient's survival [10].

The use of imaging, specifically CT angiography, was instrumental in diagnosing the extent of the injury and planning the surgical approach. CT angiography is highly sensitive for detecting vascular injuries and can provide detailed information about the location and severity of the perforation, as well as any associated complications such as hemothorax or lung collapse [11]. In this case, it allowed the surgical team to accurately localize the source of bleeding and plan the repair strategy effectively.

The surgical management of SVC injuries involves direct repair of the laceration using fine non-absorbable sutures, as was done in this case. The choice of suture material and technique is important to ensure hemostasis while minimizing the risk of thrombosis or further injury to the vessel [12]. The addition of chest tube drainage and thorough irrigation of the pleural cavity are also critical steps in managing associated hemothorax and preventing postoperative complications such as infection or re-accumulation of blood [13].

Postoperative care in such cases focuses on monitoring for signs of re-bleeding, infection, and ensuring adequate respiratory function, particularly in patients with compromised lung function due to underlying conditions or intraoperative lung collapse [14]. The successful extubation and uneventful recovery of the patient in this case highlight the importance of meticulous postoperative monitoring and care.

IV. Conclusion And Recommendations

This case illustrates the potential for severe complications during CVC placement, particularly in elderly patients with multiple comorbidities. Early recognition of vascular injuries, prompt surgical intervention, and the use of advanced imaging techniques are essential components of successful management. To reduce the risk of such complications, it is recommended that:

1. **Pre-procedural Planning:** Thorough assessment of patient risk factors, including anatomical variations and comorbidities, should be conducted before CVC insertion.
2. **Operator Experience:** Central venous catheterization, especially in high-risk patients, should be performed by experienced operators or under their direct supervision.
3. **Imaging Guidance:** The use of ultrasound guidance during CVC insertion can reduce the risk of complications and should be standard practice, particularly in challenging cases.
4. **Early Intervention:** In cases of suspected vascular injury, immediate imaging and surgical consultation should be sought to confirm the diagnosis and plan treatment.
5. **Postoperative Monitoring:** Close monitoring in the ICU postoperatively is essential for early detection of complications and ensuring a positive outcome.

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