

CASE REPORT



Amidst COVID-19 pandemic: the catastrophic sequelae of an inadvertent carotid artery insertion during central venous catheter placement – a case report

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ABSTRACT

Introduction: Central venous catheter (CVC) placement is one of the most commonly performed procedures in the intensive care unit for the institution of high-risk medications and nutrients. Despite the frequent use of ultrasound, inadvertent placement of CVC into the carotid artery is still possible. It carries significant morbidity due to the incidence of bleeding, arteriovenous fistula, and stroke.

Methods: We present a case of accidental placement of CVC into the right carotid artery, which led to the right-sided temporoparietal stroke.

Case Summary: A 71-year-old male was admitted to hospital with symptoms of cough, fatigue, and shortness of breath. He was diagnosed with coronavirus disease-19 and did require mechanical ventilation due to progressive hypoxic respiratory failure. The patient developed distributive shock and underwent CVC placement at the day of admission. On the 24th day of intubation, the patient was unable to move his left upper and lower extremities. Computed tomography (CT) head revealed showed a large temporoparietal stroke. CT Angiogram of head and neck revealed a misplaced CVC within the right common carotid artery. He was transferred to the Neuro ICU at our hospital where the patient underwent catheter removal and carotid artery sheath placement followed by dual antiplatelet therapy. Although the patient survived, he still required long-term facility placement due to the stroke.

Conclusion: We reiterate that an experienced clinician must perform the CVC placement with ultrasound guidance and verify its placement with multiple confirmation techniques afterwards. Providers must manage unintentional carotid artery placement promptly to prevent long-term sequelae associated with it.

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1. Introduction

Central venous catheter (CVC) plays an integral role in managing critically ill patients, allowing administration of life-supporting medications and nutritional support that would otherwise be unsafe through a peripheral line. It also enables the measurement of critical hemodynamic parameters. Unfortunately, CVC placement is not entirely risk-free; more than 15% of patients who receive CVC face complications from the procedure [1]. These complications include mechanical complications (hematoma, airway compromise, pneumothorax, etc.), infection, and thrombosis. They can lead to an increased hospital stay, hospital cost, need for further intervention, and overall mortality rate [2]. Here, we present a case of mechanical complication that happened due to CVC placement into the carotid artery.

2. Case presentation

A 71-year-old male with a past medical history of hypertension, obstructive sleep apnea, and coronary artery disease presented with complaints of cough, fatigue, and shortness of breath. He was hypoxic on room air requiring supplemental oxygen through a non-rebreather mask. The patient tested positive for Coronavirus Disease-19 (COVID-19). He continued to develop progressively worsening hypoxic respiratory failure, requiring intubation and mechanical ventilation. A CVC was placed and he was treated with antibiotics, remdesivir, dexamethasone, and convalescent plasma. He required vasopressor support for distributive shock.

On the 24th day of intubation, while undergoing daily spontaneous awakening and breathing trials, the patient's neurologic exam revealed an inability to move his left upper and lower extremities. His com-



Figure 1. Non-contrast CT scan of the head showing large right sided hypoattenuation in the temporoparietal region, consistent with large right temporoparietal infarction with associated mass effect and mild subfalcine shift.



Figure 2. CT-angiography of the head and neck showing a catheter within the right internal carotid artery.

puted tomography (CT) head showed a large hypoattenuation area in the right temporoparietal hemisphere, consistent with large right temporoparietal stroke with minimal subfalcine shift (Figure 1).

Additionally, his CT Angiogram of head and neck revealed a catheter within the right common carotid artery (RCA) (Figure 2).

On retrospective chart review, the catheter was found to have been in place for 24 days since the day of intubation. Chest X-ray performed after the line placement showed a CVC with its tip lying within the neck and not extending into the superior vena cava (Figure 3).

The CVC had been used to administer multiple medications, including vasopressor agents.

He was transferred to the Neuro ICU at our hospital for a higher level of care and further neurologic evaluation. Upon arrival to neurologic ICU, the team discontinued the use of the right RCA CVC. He was started on medical management for the right temporoparietal stroke with aspirin and statin. Neurointensivist obtained alternative access via right femoral CVC, and a multidisciplinary discussion was initiated to determine the safest approach to remove the misplaced CVC. Patient undergoing vascular intervention for catheter removal would require temporary anticoagulation. After discussion with neurology, it was felt that the risk of bleeding is

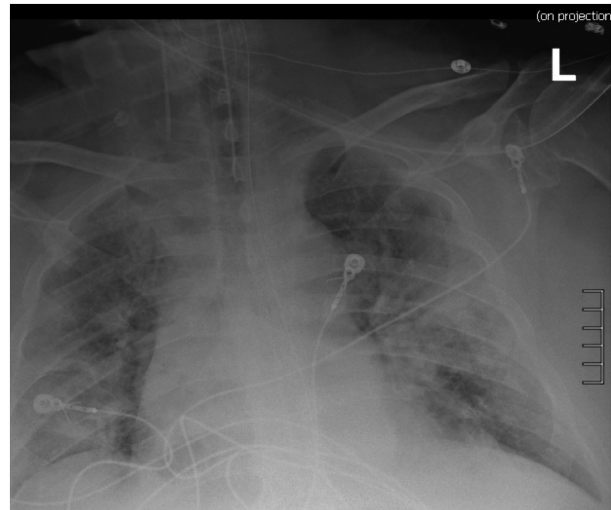


Figure 3. Chest X-ray following supposed right IJ CVC placement, with tip of catheter thought to be within the internal jugular vein. In reality, this catheter was located within the right common carotid artery with its tip near the bifurcation of the carotid artery and brachiocephalic arteries.

small from stroke standpoint and he can undergo CVC removal safely following anticoagulation. The approaches discussed included open repair vs placing a covered stent. Open repair was felt less desirable as the catheter on CT Angiogram appeared to enter near the carotid bifurcation, which would require to control the common, internal and external carotid artery

to safely remove the external device. Patient underwent successful placement of covered stent in right common and internal carotid artery, followed by removal of carotid artery catheter.

He was started on dual antiplatelet therapy and was subsequently extubated and discharged to a skilled nursing facility in a medically stable condition. At discharge the patient had mild dysarthria and left sided hemiplegia. The patient remained in skilled nursing facility for 3 months and later on passed away due to cardiogenic shock secondary to myocardial infarction.

3. Discussion

In the USA, physicians insert over 5 million CVCs annually, whereas around 200,000 CVCs are inserted in the National Health Service every year [3,4]. Indications for CVC include extracorporeal therapies like renal replacement therapy and plasmapheresis, hemodynamic monitoring, administration of peripherally incompatible infusions, and inadequate peripheral venous access. Unfortunately, CVC insertion, despite its benefit, is associated with multiple complications, some of which can result in catastrophic morbidity and mortality if not promptly and appropriately managed. Some of the more commonly recognized complications include arterial punctures, pneumothorax, subcutaneous hematoma, hemothorax, and cardiac arrest. According to current literature, arterial injuries have been reported in 3.7–12% of all central venous access procedures and 64% of arterial puncture injuries during CVC placement involved the carotid artery [5,6]. The internal jugular vein catheterization is more likely to be associated with arterial puncture resulting in catastrophic results [1]. The incidence of these complications is inversely related to the use of ultrasound (USG) and the operator's experience [1].

The commonly utilized USG approaches in safe insertion of CVC includes a short-axis/out-of-plane view (ultrasound probe placed transverse to the vessel) and a long-axis/in-plane view (ultrasound probe placed parallel to the vessel). Short-axis view produces a cross-sectional image of the vessel and also offers visualization of surrounding arteries in relation to vein hence limiting unintended arterial puncture [7]. In long axis view the entire needle can be visualized during insertion which reduces puncture of posterior wall of the vessel. Both approaches can be utilized together in real time as well. Initial cross-sectional view can be obtained for structures visualization and as the tip of needle is close to superior wall of vessel, a clockwise probe turn can give a longitudinal view prior to needle entrance into the vessel wall [8]. Alternatively, a combination of short

and long axis view, an oblique view, can also be obtained by placing USG probe at 45 degree to the target vessel, which incorporates advantages of both approaches.

Placement of CVC is a structured multistep approach with following integral components [7]:

- (1) Identification of CVC insertion point and local anatomy via short axis (transverse) and long axis (longitudinal) view.
- (2) Confirm patency of vein using compression USG and color doppler.
- (3) Utilize aseptic technique and real time USG guidance (short-axis, long-axis or oblique view) with constant visualization of needle prior to venous puncture.
- (4) Confirm tip of needle in vessel lumen before advancing guidewire.
- (5) Confirm guidewire location via both short and long axis view.
- (6) After placement of CVC, confirm the actual position of CVC catheter in short and long axis views.

Other modalities that can be used to confirm CVC placement includes pressure waveform transduction, and assessment of the oxygen saturation in aspirated blood from the central line. Despite all measures, arterial insertion can still occur and should be promptly rectified as the risk of complications is increased with a longer duration of the catheter. Once incorrect CVC placement is recognized, incorrectly placed CVC's possible management options include simply removing the catheter and applying pressure ('pull and pressure'), endovascular, and direct surgical repair. The pull and pressure technique can be used for femoral artery cannulation. It is not recommended for catheters more than 7 French in diameter in the subclavian and carotid artery as it could be associated with significantly higher morbidity, including stroke, sudden hematoma expansion causing complex airway management and death [9]. In such cases, endovascular and surgical repair aided by preoperative imaging should be utilized such as seen in our case [6,9]. Patients should be monitored closely after an intervention is performed to detect any focal neurological deficit.

4. Learning objective

- (1) Always confirm placement of CVC placement via multiple techniques such as direct visualization with an ultrasound, intra-luminal pressure measurement, observation of blood color, waveform type and checking oxygen saturation.
- (2) Prompt recognition of carotid artery insertion should be followed by immediate removal to prevent long-term morbidity and mortality

associated with its complications such as stroke.

- (3) Management of complicated carotid artery catheterization must institute a multidisciplinary approach including neurologists, neuro-intensivists, and vascular surgeons.

Disclosure statement

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