

Iatrogenic Intramural Hematoma of the Ascending Aorta Complicating Inadvertent Arterial Cannulation during Central Venous Catheter Placement. A Case Report and Review of the Literature

Abstract

Aortic injury during central venous catheter (CVC) insertion is a rare but serious complication. This presentation describes a case of iatrogenic intramural hematoma of the ascending aorta complicating inadvertent arterial cannulation of the right subclavian artery during attempted Port-A-Cath insertion at the right subclavian vein. Various strategies for the prevention and management of aortic injury during CVC placement are discussed. In this case, the hematoma was managed surgically and replacement of the ascending aorta was undertaken under deep hypothermic circulatory arrest.

Keywords: Aorta, central venous catheter, fluoroscopy, intramural hematoma, ultrasound

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Case Report

A 48-year-old Caucasian male with recurrent left tonsillar bed cancer was referred for Port-A-Cath placement for anticipated chemotherapy. The right subclavian vein was selected for placement. A percutaneous gastrostomy tube under general anesthesia was also planned to be placed as a combined procedure.

After induction of general anesthesia, the right subclavian vein was accessed at first attempt as noted by the return of dark nonpulsatile blood. Patient's oxygen saturation at that time was 100% as displayed on the monitor screen. Mild resistance was initially encountered at advancing the guidewire which seemed to take a wide course before reaching the right side of the mediastinum as seen under fluoroscopy. An 8 Fr Peel-Apart sheath introducer with a dilator was then inserted. Some technical difficulties were encountered upon passing the catheter which was described as the catheter getting buckled as seen under fluoroscopy, which was eventually overcome with catheter manipulation.

Upon completion of the procedure, poor blood return from the port was noted. Under fluoroscopy, the catheter appeared to take an irregular course, crossing the mediastinum

to the left of the midline [Figure 1], before descending inferiorly to the right side of the mediastinum. Arterial placement was suspected and confirmed with arterial blood gas analysis of a blood sample drawn from the port. The catheter and port were removed intact. Firm pressure was applied around the clavicle for several minutes. No visible or palpable hematoma was noticed after the pressure was released.

Another attempt at placement, again at right subclavian vein, was undertaken and the vein was ultimately cannulated uneventfully.

Vascular surgery was consulted and a chest radiograph was obtained which revealed mild widening of the mediastinum. Computed tomographic (CT) angiography of the chest with and without contrast was then undertaken for further delineation which revealed mild intimal irregularity of the right subclavian artery [Figure 2] with central dissection of the right subclavian and innominate arteries extending as intramural hematoma of the ascending aorta [Figure 3] up to the aortic valve. Also present was moderate mediastinal hematoma without active bleeding. The patient remained hemodynamically stable and neurologically intact.

Cardiothoracic surgery was consulted, and the pros and cons of surgical versus

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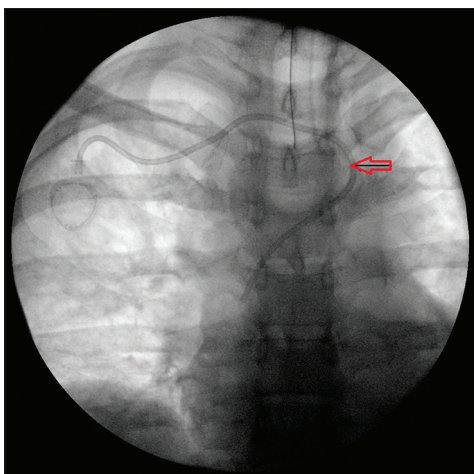


Figure 1: Initial placement of Port-A-Cath (red arrow) as seen under fluoroscopy. Note the wide course of the catheter to the left before descending into the right chest

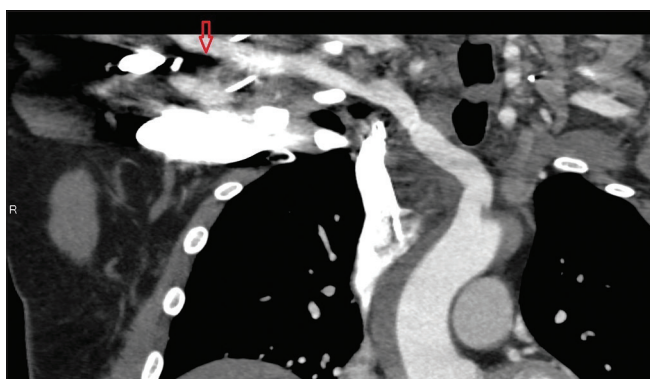


Figure 2: Intimal irregularity (red arrow) of right subclavian artery as seen on CT angiography



Figure 3: Intramural hematoma (red arrow) of the ascending aorta as seen on CT angiography

conservative management options were discussed with the patient. The decision was made to proceed with surgical repair of the aortic injury, which was accomplished by replacing the ascending aorta with an interposition graft under deep hypothermic circulatory arrest. Reportedly, no

intimal tear was found during surgery, though the presence of an aortic wall thrombus was described. The patient recovered uneventfully and was discharged home to follow up as scheduled.

Discussion

Complications associated with CVC insertion include pneumothorax, arterial injury, venous perforation, air embolism, infection, nerve injury, hemothorax, and cardiac tamponade.^[1] Arterial injury is a rare complication of CVC insertion. Inadvertent arterial puncture with a small needle during CVC placement ranges from 4.2% to 9.3% in reported series.^[2] Large-bore arterial perforation or cannulation of the carotid or subclavian artery during CVC insertion occurs in 0.1% to 1% of cases.^[3] Aortic injury, including dissection, is an even rarer complication.^[4]

Different mechanisms account for aortic injuries encountered during central venous catheter placement.

In the case described by Tsukashita *et al.*,^[5] iatrogenic type A aortic dissection was caused by an aortic injury during an attempted left subclavian vein cannulation using the supraclavicular approach. Operative findings revealed that the catheter entered the transverse arch between the origins of the left carotid artery and the left subclavian artery and exited the posterior wall of the ascending aorta.

Bas *et al.*^[6] described a case of central venous catheter insertion into the false lumen of a complicated acute type B aortic dissection by direct aortic puncture during endovascular repair of the dissection.

Othman *et al.*^[7] described a case of inadvertent left subclavian artery (and aortic arch cannulation) during attempted placement of left subclavian vein triple lumen venous catheter. The case was complicated by a stroke.

In the case presented here, the aortic injury was likely an extension of the dissection that started at the right subclavian artery as a consequence of direct needle penetration of the arterial wall resulting in an intramural hematoma that spread to the innominate artery and down to the ascending aorta.

Preventing arterial injury requires attention to several details. The traditional method for avoiding arterial puncture is to observe the color and pulsatility of blood coming from the needle hub before placement of the guidewire and catheter. However, the American Society of Anesthesiologist's guideline for CVC placement states that color and pulsatility are not reliable for distinguishing vein from artery.^[8] Ultrasound guidance and pressure monitoring have been suggested as practical and more reliable alternatives.^[9]

Though arterial puncture can usually be identified by pulsatile flow into the syringe and bright red color of the blood, these findings, however, may be absent in patients

with shock and hypoxia. Blood gas analysis may be used to confirm intra-arterial position but it is impractical due to time delay. Emerging data also support the use of ultrasound in infraclavicular subclavian vein access.^[10]

In the case presented here, neither ultrasound guidance nor pressure monitoring was utilized during CVC placement, and absence of pulsatile backflow was misinterpreted as an evidence of proper venous puncture.

Immediate recognition and management of arterial puncture usually prevents subsequent complications. Once an arterial stick is suspected, the needle is immediately withdrawn and direct but nonocclusive pressure applied to the site continuously for 10-15 minutes to prevent hematoma formation. Unrecognized arterial cannulation with subsequent dilation and catheter placement is associated with life-threatening hemorrhage and neurologic complications.^[3] Late recognition of arterial cannulation increases the risk of hemorrhagic complications that may require surgical intervention.

If location of the catheter in the vein versus the artery is unclear, measuring intraluminal pressure with a transducer prior to dilation aids in recognizing arterial puncture.^[11] Simple catheter removal may be considered for inadvertent femoral artery cannulation.^[3] Accidental cannulations of the carotid or subclavian artery by a large-bore catheter (>7 Fr) can cause hemorrhage, stroke, pseudoaneurysm, or death. When the carotid or subclavian artery is cannulated by a large-bore catheter,^[12,13] before catheter removal, clinicians should consult immediately with a vascular surgeon for possible emergent vascular repair of the damaged artery.^[3]

Management of arterial cannulation is a challenge. Removal and manual compression are associated with a higher complication rate when applied to vascular beds other than the femoral artery.

When recognized, and before catheter removal, vascular surgery consult should be undertaken. A multi-disciplinary approach for catheter removal should be pursued. Surgical exploration can be used if the site is easily accessible. Otherwise, endovascular therapy should be considered. Possible approaches include covered stent, balloon tamponade, or vascular closure devices,^[14] and choice of therapy should be individualized.

Conclusion

Although rare, arterial cannulation during attempts to place central venous catheters is a serious complication. Ultrasound and pressure monitoring may prevent it. When recognized, and before catheter removal, vascular surgery consult should be undertaken. A multi-disciplinary approach for catheter removal should be pursued. Options for arterial repair include open surgical repair, mini-invasive percutaneous techniques, or the use of closure devices.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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