

Guidewire Complication with Central Line Placement

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Central venous catheter (CVC) placement is a common procedure. The US Food and Drug Administration has estimated that 5 to 6 million CVCs are placed annually in the United States.¹ The versatility of CVCs and the convenience of placing them have made CVCs an integral part of medical treatment today. However, placement of CVCs is not innocuous. Numerous complications may occur, with varying frequency and severity. The overall rate of noninfectious complications of subclavian CVC placement is 5%.^{2,3} Complications that may arise acutely when placing a CVC are listed in the **Table**. In many cases, these complications are readily apparent. Some rarer complications, such as those involving guidewire insertion or removal, often are not immediately apparent. Guidewires have been reported to cause cardiac perforation and tamponade, arrhythmia, entrapment or dislodgment of medical devices, and even death.⁴⁻⁷ A common element in these cases of guidewire-induced complications is the relative lack of acute signs or symptoms. We report a case in which the guidewire perforated the right subclavian vein, requiring a median sternotomy for removal. The potential mechanisms of this complication, as well as possible contributory factors, are discussed. Strategies for reducing the potential for guidewire perforation are reviewed.

CASE PRESENTATION

Patient Presentation

A 39-year-old man presented with swelling, redness, and irritation around a mass in his left inguinal region. He was sent for referral, where a biopsy of the lesion revealed well-differentiated squamous cell carcinoma. On admission, examination of the left inguinal area revealed an 11.5 × 5.5-cm erythematous, friable, fungating mass with a sinus tract draining purulent material. Above the mass, a 1.5 × 1.5-cm tender lymph node was palpated. The other physical examination findings were within normal limits.

CVC Placement Procedure

The operators (2 residents with minimal and moderate experience, respectively, placing CVCs) obtained consent from the patient for placing a CVC. The most common risks and benefits of the procedure were discussed with the patient. Because the indications for central venous access were the initiation of chemotherapy and the infusion of intravenous fluids and antibiotics, a triple-lumen catheter was chosen. The right subclavian area was selected for an infraclavicular approach for placement. The patient was lowered in the Trendelenburg position, and a rolled towel was placed between the shoulder blades. The area was prepared with a povidone-iodine solution and draped in a sterile fashion. Two finger-breadths below the distal third of the clavicle, a skin wheal was made with a 25-ga needle using 1% lidocaine. A 22-ga, 1.5-in finder's needle was used to anesthetize deeper subcutaneous tissues. This same needle was used to identify the location of the right subclavian vein by the presence of free aspiration of dark red blood. An 18-ga, 2.5-in introducer needle was inserted (bevel up) at the same position and angle as the finder's needle. It was passed approximately three quarters the length of the needle aiming at the sternal notch. As the needle was passed, free aspiration of dark red blood was noted. The needle was secured, the syringe was removed, and a J-tipped guidewire (0.81-mm diameter × 45-cm length) was inserted into the hub of the needle. After approximately 10 cm of the guidewire had been inserted, the operator noted resistance with advancement. The wire was removed, the syringe was reattached, and dark red blood was again easily aspirated. The wire was re-introduced, and this time, 15 to 20 cm of wire

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Table. Acute Complications of Central Venous Catheter Placement

Arrhythmia
Arterial puncture
Cardiac tamponade/perforation
Hemothorax
Improper catheter tip position
Perforation of great vessel by guidewire or dilator
Pneumothorax
Thoracic duct injury
Venous air embolism

passed freely through the needle. The tissue dilator was passed and removed over the wire without difficulty. As approximately 10 cm of the triple lumen catheter (7.0 Fr × 16 cm) was placed over the guidewire, the patient complained of severe tearing pain in his right chest.

A prompt examination confirmed bilateral, equal breath sounds, a present right radial pulse, normal respiratory rate, and an oxygen saturation of 96%. There was no subcutaneous emphysema and no evidence of hematoma, venous congestion, or limb ischemia. The procedure was aborted. The catheter was removed over the guidewire without difficulty. Multiple attempts to remove the guidewire were unsuccessful because of resistance and worsening pain reported by the patient. An immediate chest radiograph was ordered, as was a cardiothoracic surgery consultation.

The chest radiograph revealed that the guidewire was in the right infraclavicular area, with multiple coils and possibly a knot at the junction of the right clavicle and sternum (**Figure 1**). Emergent computed tomography of the chest was done. Findings suggested that the guidewire perforated the posterior wall of the right subclavian vein and had coiled upon itself in an area between the right subclavian vein and the superior vena cava (**Figure 2**).

Surgical Removal of the Guidewire

Because attempts to remove the guidewire peripherally were unsuccessful and there was a question of a knot in the guidewire, a decision to remove the guidewire surgically via median sternotomy was made. Findings at surgery revealed no blood or clot in the pericardium and a normal-appearing heart. The guidewire had perforated the posterior wall of the right subclavian vein and looped upon itself 3 to 4 times in an area between the subclavian vein and the

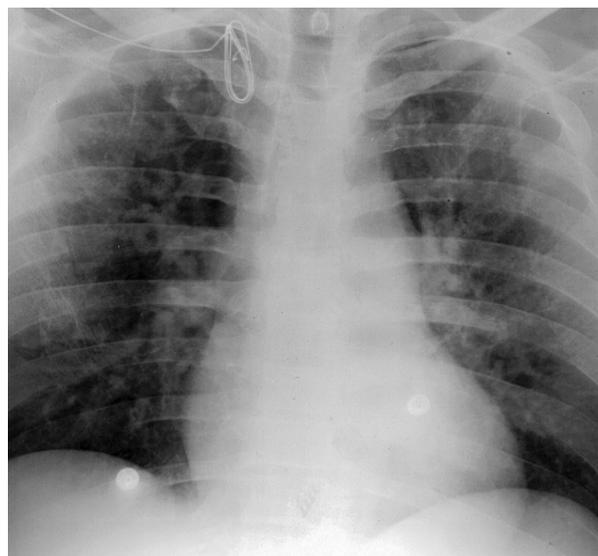


Figure 1. Chest radiograph of the case patient shows the guidewire inserted through the right subclavian vein and looping upon itself near the junction of the right clavicle and sternum.

superior vena cava. The coiled end was clipped and uncoiled. This end measured 18 cm. Examination of the right subclavian vein revealed a 0.1-cm hole in the posterior wall, which did not require oversewing. The remaining wire was removed from the peripheral insertion site. Irrigation and observation of the mediastinum revealed no bleeding. The procedure was completed, and the patient recovered uneventfully and was discharged. He did not start chemotherapy until a later date.

DISCUSSION

We describe a case of a guidewire perforating the right subclavian vein during CVC placement. We hypothesize that the mechanism of injury was direct perforation of the right subclavian vein by a J-tipped guidewire. Two attempts were needed to pass the guidewire. When there was resistance with the first attempt, only the guidewire was removed. The needle was not withdrawn. We speculate that the needle was within the lumen of the right subclavian vein (because reattachment of the syringe and aspiration confirmed venous placement). However, the distal end of the needle was most likely pressed against the posterior wall of the subclavian vein, and the second pass of the guidewire caused direct perforation of the posterior wall of the right subclavian vein. Any resistance with the second passage was not noted or perceived by the operator. The angle the right subclavian vein makes as

it turns to the superior vena cava is sharp, and the selection of this site may have facilitated the direct perforation by the guidewire.

Direct perforation by the dilator was less likely because of the size of the perforation noted at surgery. It is possible that the perforation was caused by the introducer needle. This scenario is less likely, however, because only 1 needle pass was needed to locate the vein, and as best we can determine, the needle was within the lumen at all times (confirmed by second aspiration of dark red blood). As the guidewire perforated the right subclavian vein, it began to coil upon itself as it was advanced. Because the guidewire was tightly coiled in a small space, one would have expected resistance to be noted with passage of the guidewire. It is possible that more experienced operators and/or supervising physicians might have sensed that something wrong was happening during the procedure.

Other published case reports have specifically noted guidewire perforation of the subclavian vein when attempting to place a subclavian CVC.^{8,9} Each of these cases, including the present case, mentioned initial difficulty with passage of the guidewire. This is not uncommon when placing CVCs; however, any resistance should prompt needle withdrawal several millimeters (to ensure that the distal end of the needle is not pressing against the posterior wall of the subclavian vein). If the guidewire cannot be passed easily without resistance, the procedure should be stopped, the needle and guidewire removed as a single unit, and pressure applied. The procedure should then be restarted.¹⁰ Neither of the previous 2 cases report patient pain. Our patient first noted pain when passing the catheter over the guidewire was attempted.

Although this case involves a rare complication during a common procedure, it serves to reinforce several important points regarding the placement of CVCs. First, site selection for CVC placement is important. Placement of the CVC in the left subclavian vein or internal jugular vein may have been safer. Second, consider broadening the risks involved when obtaining consent from a patient for a procedure. Doing so will force one to have a contingency plan for each risk. Third, if there is resistance when trying to retrieve a guidewire, never forcibly remove it. Lastly, embrace the concept that even though CVC placement is common, execution of detail is imperative.

CONCLUSION

CVC placement is an extremely common procedure performed at virtually every institution by a variety of specialists. Guidewire perforation is an uncommon

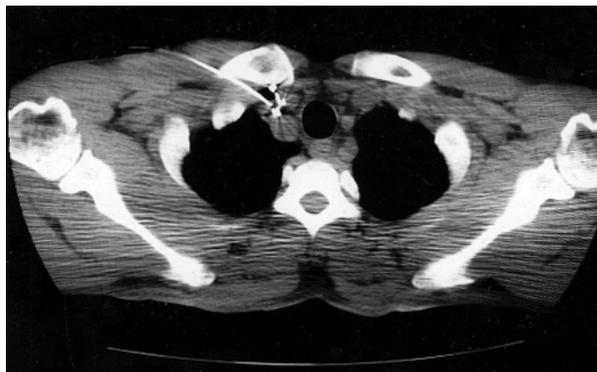


Figure 2. Computed tomography of the case patient's chest shows guidewire perforation through the posterior wall of the right subclavian vein.

complication, but subtle difficulties passing the guidewire or patient-reported discomfort with passage of the guidewire or the catheter should raise the possibility that the guidewire is not where it should be. A review for house staff of CVC placement with special emphasis on needle/guidewire mechanics may help prevent such complications. CVCs often are placed by personnel who are in training; closer supervision by more senior personnel may help identify and prevent similar complications. In the future, such imaging modalities as real time ultrasonography may prove useful for preventing guidewire complications. Enthusiasm for CVCs should be tempered by an awareness of the serious and occasionally fatal complications that occur secondary to the placement of these devices. **HP**

ACKNOWLEDGMENT

The authors would like to formally acknowledge James M. Kaufmann, Ph.D., for his editorial contribution to the manuscript.

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