Great Vessel Laceration during Central Venous Catheter Insertion

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The Morbidity and Mortality section of this issue will diverge slightly from the typical presentation to discuss a non-interventional radiology complication that yields insight into a fundamental concept of nearly every procedure in interventional radiology. This error is closely related to the How I Do It case in this issue. As discussed earlier per Newton's third law, objects tend to travel in a straight line unless diverted by something else. In some instances, a curved course leads to unwanted complications, particularly if real-time imaging is unavailable or not used.

CASE REPORT

A 67-year-old woman underwent bedside catheter insertion by the general surgery service. The left subclavian vein was punctured using Seldinger technique and venous blood aspirated. A guide wire was passed through the needle into the vein. The tract was then serially dilated and a dual lumen temporary catheter was inserted over the guide wire. The surgeon noted difficulty aspirating blood from the catheter and obtained a postprocedure chest radiograph (Fig. 1A). The catheter appeared to be closely apposed to the expected position of the right lateral wall of the superior vena cava but there were no other findings to suggest a procedural complication. The catheter was used for infusion of total parenteral nutrition. The patient began experiencing respiratory distress the following day and a portable chest radiograph (Fig. 1B) was obtained, revealing new bilateral pleural effusions. Contrast was injected into the catheter and revealed that the catheter tip was in an extravascular location. The patient was taken for urgent thoracotomy and a laceration of the superior vena cava was found and repaired. She made an uneventful recovery.

DISCUSSION

When targeting any lesion, a straight, short course is always desirable. Unfortunately, in many instances such as in this case, straight access to a target may be difficult or impossible. When a curved course is encountered, a catheter may be used to direct a guide wire and the guide wire is subsequently used to "guide" the catheter along a curved course. The attributes of both the wire and catheter are important to facilitate passage along the intended trajectory. Wires differ by rigidity, coefficient of friction, diameter, and length of floppy tip. Smaller, less rigid guide wires are usually most atraumatic for catheterization but lack stiffness and size to guide larger catheters to desired targets. If a course is unusually circuitous, guide wire and/or catheter passage may be impossible even under the best conditions.

In this example, it is likely that the position of the guide wire was too high in the superior vena cava during the initial catheter placement. If only the floppy distal end of the wire was in the superior vena cava (Fig. 2A), as serial dilation and/or catheter insertion was performed, the dilator and/or catheter tip continued on a straight line along the course of the brachiocephalic vein instead of turning caudally down the superior vena cava. The result was perforation of the vein at the confluence (Fig. 2B). This complication can also occur with a properly positioned guide wire if the wire is not held stationary during catheter advancement. Again, the catheter and guide wire combination continues on a straight course through the lateral wall of the superior vena cava. Perforation may not be recognized during of the procedure as the catheter may be inserted through the venous rent and at least partially occlude the laceration. This is particularly true for bedside catheter insertions where the tip of the wire cannot be monitored. In general, catheters inserted in the subclavian veins or

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Figure 1 Venous laceration. (A) Chest radiograph obtained after bedside central venous catheter insertion shows tip of the catheter at the lateral wall of the superior vena cava. (B) Chest radiograph obtained 24 hours after catheter placement shows new bilateral pleural effusions and mediastinal widening.

left internal jugular vein are most susceptible to this problem because the confluence of veins may occur at an acute angle to the superior vena cava. Conversely, catheters inserted via the right internal jugular vein are less prone to this complication as the course of the catheter is relatively straight from puncture site to desired tip position.

The best way for interventional radiologists to prevent this complication is to use fluoroscopy during central venous catheter insertion. A rigid guide wire should be carefully advanced through the heart and positioned with its tip in the inferior vena cava

(Fig. 2C). When fluoroscopy is available during placement, great vessel laceration should be exceedingly rare. Dilation and/or peel-away sheath insertion should be performed over a rigid guide wire such as an Amplatz Superstiff wire (Boston Scientific, Natick, MA). It is critical to observe sheath and dilator insertion under fluoroscopy. It is also important to either position the sheath and/or catheter proximal to the venous confluence (best for temporary catheters) or ensure the dilator portion and catheter passes smoothly along the course of the guide wire into the superior vena cava (best for permanent catheters).

Figure 2 Mechanism of venous laceration. (A) Catheter is directed toward the lateral wall of the superior vena cava. (B) Catheter and guide wire perforate lateral wall of superior vena cava.