Endovascular SA and IMA Repair After Iatrogenic Injury

A case report of simultaneous inadvertent injury to both the subclavian and internal mammary arteries treated with endovascular techniques.

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Central venous catheter placement is a common procedure in critically ill patients, but the procedure is still often performed without ultrasound guidance, introducing the risk of arterial injury. However, even with ultrasound guidance, arterial injury can occur. The reported incidence of arterial puncture during central venous catheter placement is between 2% and 9.3%.[1-4] Most arterial punctures are recognized immediately because of the bright red, pulsatile backflow of blood from the access needle or the catheter. However, problems such as distal emboli, brachial plexus injury, pseudoaneurysm formation, vessel rupture, and/or frank bleeding might occur, particularly when the arterial puncture is not recognized, or if there is placement of large dilators or central venous catheters into the artery.[4] Although surgery was the treatment of choice in the past for managing this complication, with recent technical and device advancements, most cases can now be treated with endovascular techniques.

CASE REPORT

A 49-year-old man with a history of alcoholic cirrhosis and polysubstance dependence presented to the emergency room with drug overdose and seizure. The patient was intubated, and a right subclavian line was inserted at the bedside without ultrasound guidance. After the line was placed, it was discovered that it was intra-arterial, probably in the right subclavian artery (SA). Blood-gas analysis confirmed arterial placement. This procedure also resulted in a right pneumothorax for which a chest tube was placed.

A computed tomographic (CT) angiogram of the chest showed entry of the central line into the SA proxi-

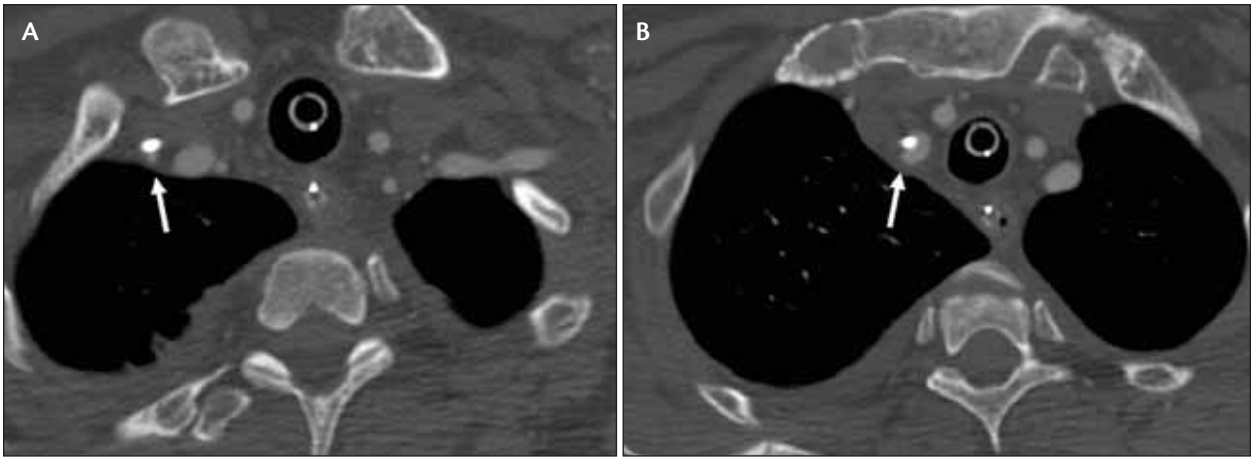

Figure 1. CT angiogram of the chest shows a central line passing along the anterior surface of the right internal mammary artery (IMA) (A) and entering the right SA (B).

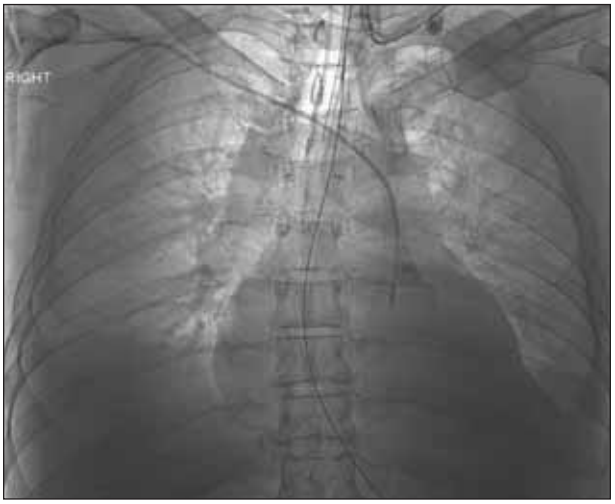

Figure 2. Chest x-ray showing a central line placed into the right SA.

mal to the origin of the vertebral artery (VA). The line passed along the anterior surface of the right IMA (Figures 1 and 2). After discussion of treatment options, the patient was referred for angiography. Catheterization of the innominate artery from the femoral approach was performed. Angiography confirmed intra-arterial placement of the central line, with the entry site between the origin of the right VA and the right common carotid artery (CCA) (Figure 3). The decision was made to place a covered stent across the entry site in the SA. A covered balloon-expandable stent (iCast, Atrium Medical Corporation, Hudson, NH) was advanced through the femoral access and positioned across the entry site. The central line was removed over a safety guidewire while the stent was deployed in the SA across the entry site. The purpose of the safety wire was to maintain access in case the stent deployment failed to control the bleeding, so a dilator could be advanced to tamponade the bleeding while the next step was planned (Figure 4).

A follow-up angiogram showed persistent contrast extravasation from an injury to the right IMA that also appeared to be related to the central line. This was confirmed by catheterization of the IMA (Figure 5). Next, a microcatheter (Progreat, Terumo Interventional Systems, Somerset, NJ) was negotiated distal to the extravasation site. Multiple coils were deployed in the IMA (detachable hydrogel Azur coils, Terumo Interventional Systems), distal then proximal to the extravasation site, to prevent back bleeding. A follow-up angiogram showed complete occlusion of the IMA and patency of the SA, VA, and CCA, with no contrast extravasation (Figure 6).

Figure 3. A right subclavian angiogram shows the central line traversing the right IMA (black arrowhead) and the right SA (black arrow) just proximal to the right VA (white arrow).

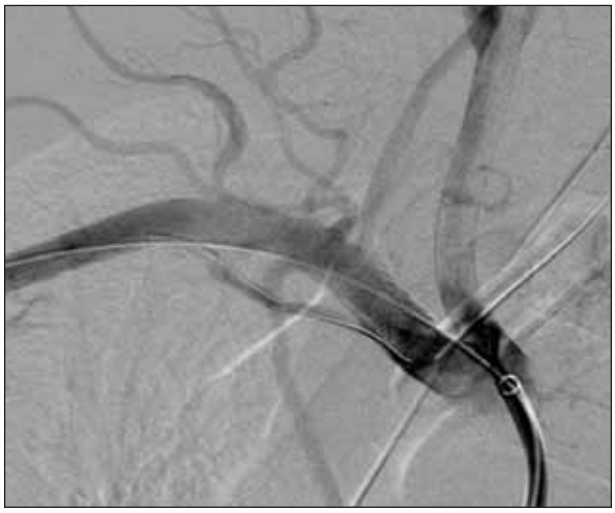

Figure 4. An angiogram after central line removal over a guidewire and covered stent deployment in the proximal SA shows persistent contrast filling of the tract, with the IMA as a potential source of extravasation.

After 48 hours, the patient was extubated. He had no neurological deficits, was clinically stable, and was discharged home.

DISCUSSION

Early recognition and treatment of inadvertent SA injuries during central catheter placement is crucial. A variety of endovascular devices and techniques have

Figure 5. Selective catheterization of the right IMA shows contrast extravasation (arrow).

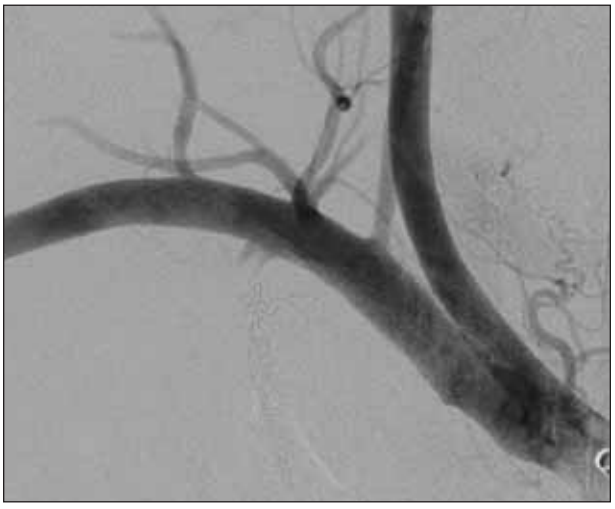

Figure 6. A completion angiogram after coil embolization of the IMA and covered stent placement in the proximal SA shows no contrast extravasation and preservation of flow to the VA.

been described to treat such complications. Each device or treatment option must be tailored to the patient depending on the exact location of the arterial injury. A covered stent, vascular closure device, tract embolization, or gradual downsizing of transarterial catheters can be used.[4] In this case, a covered stent was selected due to the central location of the puncture, where a percutaneous closure device would be difficult to advance and deploy. In addition, the closure device could have further injured the IMA. There are several reports showing success using covered stents to treat SA injuries related to central catheter placement.[1-8] Although its use in this case is off-label, a balloon-expandable covered stent (iCast) provided an ideal option for such an application with the benefit of accurate placement and a variety of sizes, with commercially available stents as short as 16 mm. This small size was crucial because the entry site in this case was between the right VA and the right CCA.

Although there are self-expanding covered stents available, they usually require larger-sized sheaths with limited availability of short lengths and are difficult to deploy with the same accuracy as the balloon-expandable stents. There are no sufficient published data on the need to use anticoagulation during and antiplatelet therapy after covered stent placement for bleeding complications. We believe that using these agents would increase the risk of bleeding, and the benefit of preventing thrombosis of covered stents in this application has not been supported in the literature. However, the argument for anticoagulation or antiplatelet therapy might be valid for smaller-diameter stents (< 5 mm), because our experience shows the risk of thrombosis is higher. The literature also lacks long-term results on patency rates and long-term complications such as stent fractures; these still remain a concern, and follow-up imaging is warranted.

> "Early recognition and treatment of inadvertent SA injuries during central catheter placement is crucial."

This case demonstrates that additional injuries must be considered. These may arise from additional attempts to access the subclavian or jugular vein and can be fatal if left unnoticed.[9] In our case, the patient had a simultaneous injury to the proximal IMA just beyond its origin, which was traversed by the central line. Extravasation was only noted on angiogram after the line was removed and was not seen on CT because of the tamponade effect of the catheter. We prefer coil embolization to treat such injuries. Detachable coils (Azur) were used for the IMA embolization, because there was little proximal landing zone for multiple coils in the proximal IMA. The operators avoided embolization of the SA and maintained patency of the SA.

Preprocedural imaging with CT angiography is essential before removing any line that inadvertently enters an unintended structure or space. CT defines the exact

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vessel entry site, determines the proximity of the catheter-to-branch vessels or other vital structures, and is useful in planning the preferred method of treating the arterial injury. In our case, the CT angiogram showed the arterial entry site into the SA to be central to the origin of the VA and showed a long extravascular course of the catheter, which raised the concern that a closure device may not be able to be deployed safely. In addition, the CT angiogram showed potential traversal of the IMA, which provided another reason against using a closure device.

This case demonstrates the utility of CT angiography in planning a minimally invasive endovascular approach to treating a rare tandem arterial injury during central line placement. ■

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