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Case Report

Successful Endovascular Treatment of Inadvertent Subclavian Artery Cannulation in a Patient with Multiple Sclerosis and Coagulopathy in Two Simple Steps

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SUMMARY

Inadvertent cannulation of the subclavian artery is a rare complication when choosing the subclavian vein as the site of central venous catheter insertion. Its management is based on patient factors and the site of arterial puncture. In this case report, inadvertent subclavian artery cannulation was successfully treated in an immunocompromised patient with coagulopathy by using a percutaneous vascular closure device after temporary balloon tamponade.

1. Introduction

The subclavian vein is the most frequently chosen site for central venous catheter insertion because of the low infection rate compared with the rate associated with the jugular and femoral veins, especially for immunocompromised patients.[1] However, inadvertent subclavian artery cannulation could lead to life-threatening complications.[2] The treatment choice includes surgical repair, endovascular therapy, or combined methods.[3] The treatment choice is limited in patients with coagulopathy. We report the successful endovascular treatment of inadvertent subclavian artery cannulation in a patient with multiple sclerosis and subsequent coagulopathy after pneumonia and sepsis.

2. Case report

A 67-year-old woman with a history of relapsing-remitting type of multiple sclerosis was admitted to our intensive care unit because of progressive worsening of dyspnea in 1 week. During admission, cytomegalovirus (CMV) pneumonia was diagnosed based on the positive CMV-IgM result and bronchoscopic biopsy. Ganciclovir was then prescribed. During hospitalization, her platelet level was initially 93,000/μL at admission and decreased to 45,000/μL on the 10th admission day, which was possibly caused by sepsis and was the side effect of drugs. After the 11th admission day, her respiratory distress worsened, and acute kidney injury occurred. Her vital signs were as follows: respiratory rate: 30 times/minute, pulse rate: 96 beats/minute, and blood pressure: 102/74 mmHg. Central venous catheter insertion was planned for central pressure monitoring and medication administration. However, a 7-Fr central venous catheter was unintentionally inserted into the subclavian artery. Rapid progression of right pleural effusion was noted, and hemothorax was highly suspected (Figure 1A, B). Her blood pressure decreased to 74/34 mmHg. Surgical intervention was not considered because of coagulopathy and concomitant unstable hemodynamic status.

Angiography was performed and revealed that the tip of catheter was proximal to the right carotid artery, and the insertion site was near the orifice of the vertebral artery and the right carotid artery (Figure 2A). One 0.035-cm wire was then advanced to the ascending aorta through the central catheter. One 10 × 40-mm balloon catheter (Mustang®; Boston Scientific Co., MA, USA) was inserted through the right brachial artery and was inflated in the right subclavian artery (Figure 2B). The central catheter was removed, and the wound was successfully closed using a vascular closure tool (7-Fr Angio-Seal® device; St. Jude Medical, St. Paul, MN, USA). After deflation of the balloon catheter, follow-up angiography was performed and confirmed no contrast outside the right subclavian artery lumen, and the flow in the carotid artery and vertebral artery was adequate (Figure 2C and D). One day after the procedure, no active bleeding or subcutaneous hematoma at the puncture site was detected (Figure 3). Chest X-ray showed improvement on the next day (Figure 1C). However, the patient eventually died because of

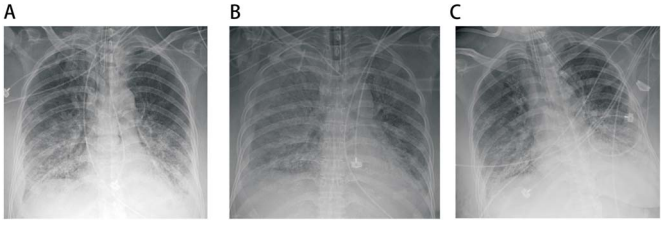

Figure 1. (A) Chest X-ray before central venous catheter placement. (B) Six hours after inadvertent subclavian artery cannulation. Increased pleural effusion amount on the right side; hemothorax was highly suspected. (C) 1 day after successfully removal of the central venous catheter. Improved right side pleural effusion was noted.

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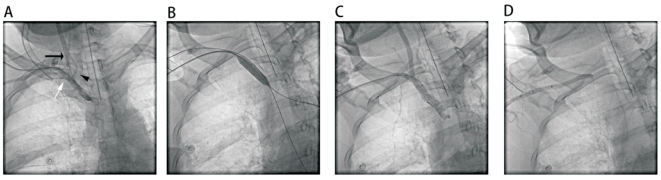

Figure 2. (A) Angiography showing that the insertion site (white arrow) of the central venous catheter was near the orifice of the right vertebral artery (arrowhead) and the right carotid artery (arrow). (B) Transient 10 × 40-mm balloon catheter inflation at the insertion site. Removal of the catheter was performed simultaneously. (C, D) After removal of the catheter, a vascular closure device was applied. Follow-up angiography showed no obstruction of the right carotid and right vertebral artery. No extravasation at the right subclavian artery was observed.

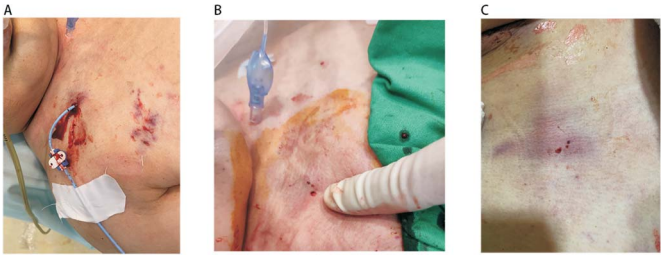

Figure 3. (A) Pulsatile bleeding from the central venous catheter insertion site. Pulsatile movement of the catheter was noted. (B) After applying the vascular closure device, no active bleeding was detected from the puncture site. (C) One day later, no bleeding nor subcutaneous hematoma was observed.

multiple organ failure on the 14th admission day.

3. Discussion

We present a case with multiple sclerosis and severe coagulopathy related to CMV infection and drug side effect complicated with inadvertent subclavian artery cannulation. The vascular complication was successfully treated using a percutaneous vascular closure device after temporary balloon tamponade.

Patients with multiple sclerosis have a shorter expected survival time compared with the general population, and infectious respiratory disease is a leading cause of mortality.[3] Moreover, CMV infection can cause severe thrombocytopenia.[4] With the prescription of ganciclovir, thrombocytopenia could be worsened.[4] Therefore, the patient in the present case was more challenging to treat compared with previous cases.[5,6]

Although the subclavian vein has been suggested as an access site because of the lower infection rate,[1] a higher risk of mechanical complications has been reported compared with the jugular vein and femoral vein.[7] The rate of arterial puncture during the placement of a central venous catheter from the subclavian site has been reported to be 1.5%,[7] and arterial puncture could be life threatening because of massive bleeding from the injured subclavian artery.[8] By performing standardized ultrasound assessment, the vascular anatomy could be evaluated rapidly and the ideal insertion/puncture site with lowest risk of complication occurrence could be identified.[9] From the associated guidelines[1,10] and result of a randomized controlled study,[11] ultrasound guided subclavian vein puncture had significant lower artery puncture rate than anatomical landmark guided venous cannulation. Moreover, the first attempt successful rate is significantly higher by ultrasound-guided technique than by anatomical landmark technique.[12] The standardized ultrasound-guided central venous catheterization provides operator favorable anatomical insight for rapid pre- and post-insertion assessment, which improves clinical outcomes and patient satisfaction.

The pulling/pressure technique for managing inadvertent subclavian artery cannulation can be challenging because of the deep location of the subclavian artery, and this technique may increase the risks of stroke and pseudoaneurysm;[13] thus, surgical intervention is a safe and efficient method of treatment.[14] However, surgery may not be a feasible treatment option in patients with critical illness. Therefore, less invasive treatment with a shorter procedure time would be the first choice. Our patient had an immunocompromised status and was complicated with CMV infection. In this patient, thrombocytopenia caused by sepsis and drugs led to a more complicated situation after subclavian artery cannulation, and the hemodynamic status deteriorated rapidly. Instead of surgical repair, several options of treatment can be considered, such as covered stent deployment,[15] temporary tamponade balloon technique,[16] and vascular closure device application.[17] First, the insertion site of the catheter is near the orifice of major branches, such as the vertebral artery and right carotid artery. With deployment of the covered stent, the risks of occluding the aforementioned vessel and developing stroke are high. Furthermore, the patient presented coagulopathy and thrombocytopenia, which preclude the use of antiplatelet agents after covered stent implantation. Second, during the temporary balloon tamponade technique, the balloon inflation time may be remarkable prolonged to achieve hemostasis because of the severe coagulopathy status. In this patient, combination of balloon tamponade technique and followed by a vascular closure device successfully treat the complication. With temporary balloon tamponade technique, active bleeding during removal of the central venous catheter and preparation of vascular closure devices was stopped effectively via internal compression. Then the vascular closure device application was used for sealing the hole on the subclavian artery rapidly. By performing these 2 techniques sequentially, the active bleeding could be successfully treated in a short time without sacrifice of any major branches near the insertion site. To our best knowledge, this is the first report of successfully management of the inadvertent subclavian artery cannulation with combination of transient internal compression and percutaneous vascular closure device.

A vascular closure device was approved for closure of the femoral artery after intervention procedures were performed through the femoral artery. Case reports have demonstrated the feasibility of percutaneous endovascular repair by using a vascular closure device.[5] The acute successful rate was reported to be 95.7%,[17] and the procedure time was significantly shorter than that of surgical repair.[18] Endovascular repair using a closure device for inadvertent subclavian artery cannulation is a safe method. A large-scale study investigating the feasibility of this minimal invasive therapy for iatrogenic subclavian injury is necessary.

In conclusion, in immunocompromised patients, inadvertent subclavian artery cannulation can considerably affect survival. Under the circumstances of coagulopathy, endovascular repair using a vascular closure device combination with transient balloon tamponade technique and is an effective and safe method for managing this iatrogenic complication.

Conflict of interest

None.

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