Can a routine, bedside procedure result in a catastrophe? A clinical paradigm of severe complications following attempts to catheterize the subclavian vein

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Abstract:

Introduction: Central venous catheterization is a routine clinical procedure but possible complications, although rare, can be potentially serious.

Case description: We report a rare case of two concurrent left subclavian artery pseudoaneurysms, secondary to a complicated left subclavian vein catheterization. The first became apparent at the time of catheter removal and was treated by percutaneous thrombin injection while the second became obvious only 7-days later, after causing compressive symptoms and was successfully repaired with endovascular-stenting. This case was further complicated by myocardial ischemia resulting from manipulation of a patent internal mammary artery which was serving as a graft during a previous coronary bypass.

Conclusions: Catheter malposition during central vein cannulation may occasionally cause serious adverse events. Cardiac complications should be anticipated in case a patent internal mammary artery supplies oxygenated blood to the coronary circulation. A wide range of endovascular modalities can be used to successfully treat these lesions.

INTRODUCTION

Central venous cannulation is an essential, routine bedside procedure performed in hospitalized patients for various reasons.[1] Accidental arterial puncture occurs in 5% and subclavian artery pseudoaneurysm is a rare clinical entity with only few cases reported.[2-6] Traditional open repair of these lesions remains a safe treatment option but the site of arterial injury is difficult to expose, while comorbidities make surgical correction challenging for critically ill patients. Endovascular repair with covered stents, percutaneous closure devices and pseudoaneurysm embolization has been reported to offer good results when selected appropriately.[4-7]

We present a case of two concurrent left subclavian artery pseudoaneurysms, after an attempted left subclavian vein (SCV) catheterization. These were successfully repaired with thrombin injection and endovascular stenting in two time points.

CASE DESCRIPTION

A 75-year-old patient with a background history of myasthenia gravis, coronal artery bypass grafting (CABG), synthetic aortic valve replacement, diabetes mellitus and peripheral arterial disease presented in Vascular Surgery Department with foot gangrene. During his hospitalization, SCV catheterization without ultrasound guidance was attempted on the left neck side for hemodynamic monitoring and fluid administration. After multiple attempts, a temporary 7-French triple-lumen catheter was inadvertently positioned in the left subclavian artery. Subsequently, the patient was transferred to the Interventional Radiology Unit for catheter removal under fluoroscopic control.

Through the left brachial artery a 0.035" stiff hydrophilic guidewire was advanced into the origin of the left subclavian artery. A 5-French diagnostic catheter was introduced and diagnostic digital subtraction angiography (DSA) was performed. DSA revealed a small-sized pseudoaneurysm originating from the left subclavian artery measured approximately 1.2x0.7cm with a neck length of 3mm and width of 2mm, in close proximity with left vertebral (LVA) and internal mammary arteries (LIMA). The tip of the triple-lumen catheter was in direct contact with the false sac.(Figure 1) Left common carotid artery, LVA and LIMA remained intact. Due to the close proximity of the arterial injury to the origin of LVA and LIMA, deployment of a stent-graft would carry the risk of their coverage which would be particularly insecure, especially taking into account the patent IMA that was serving as a coronary artery bypass graft. Alternatively, 2000 IU of thrombin were injected into the lumen of the false aneurysm, though the triple-lumen catheter. The narrow neck of the pseudoaneurysm and the fact that the tip of the catheter was inside the false sac, made the lesion amenable to such a manipulation. The pseudoaneurysm immediately thrombosed without any compromise of the arterial branches. (Figure 2)

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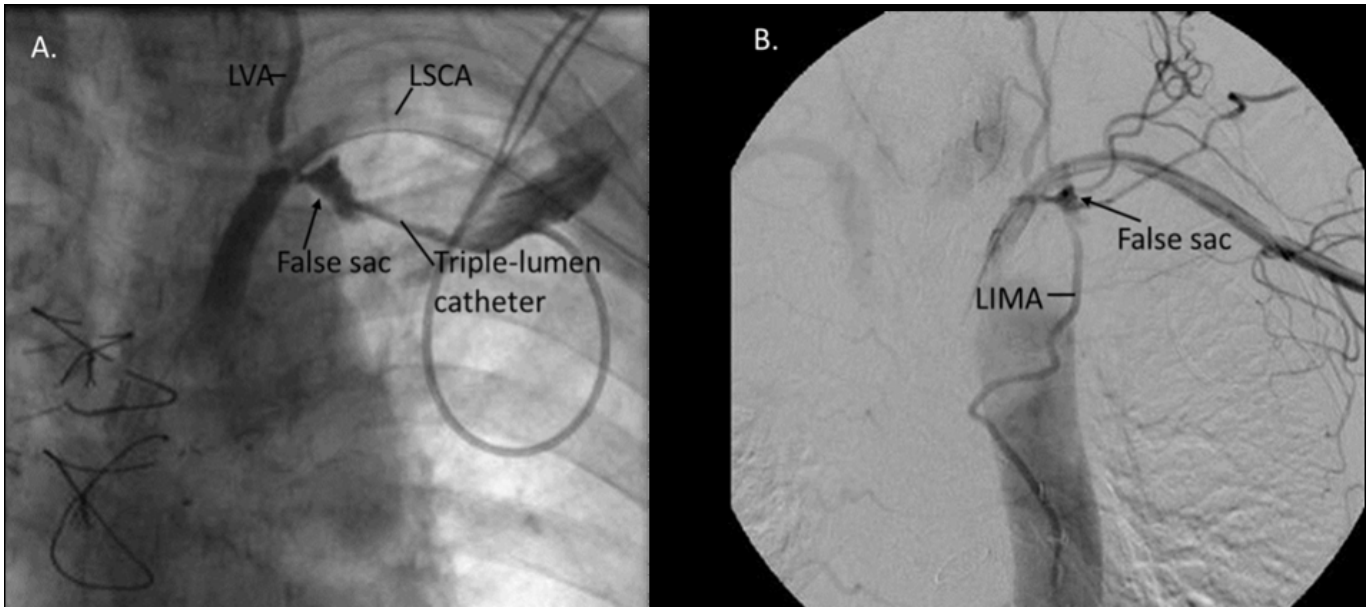

Figure 1: Angiography through triple-lumen catheter (fig A) and diagnostic catheter (fig B). Pseudoaneurysm mass (false sac) measured approximately 12x7 mm with a neck of 3mm length and 2 mm of width, that originated from left subclavian artery, found to be in a direct contact with the triple-lumen catheter. Left vertebral and internal mammary arteries remain intact.

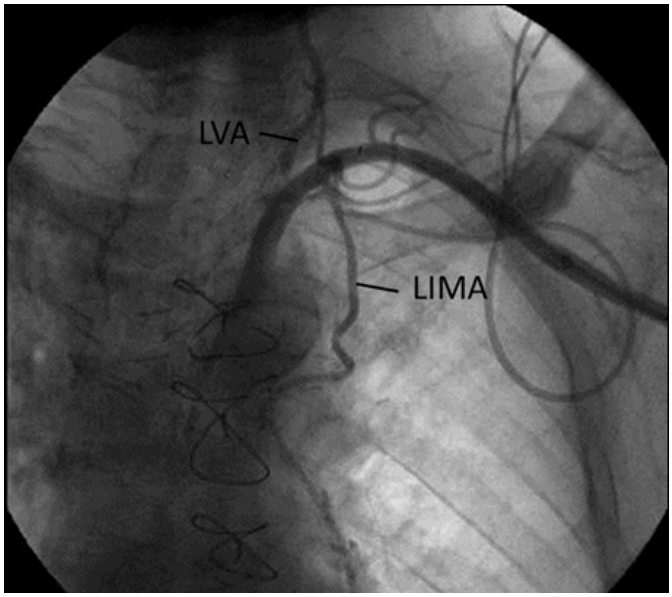

Figure 2. Post-thrombin injection. Diagnostic subtraction angiography shows immediately thrombosed aneurysmal sac, without any compromise of the left vertebral and internal mammary arteries.

The 1st post-procedural day the patient complained about thoracic pain and presented electrocardiographic changes with ST-elevation while troponin level had increased. Myocardial ischemia was diagnosed and he was transferred to the cardiology intensive care unit for further management. This was believed to be a complication resulting from leakage of thrombin into the LIMA.

Seven-days after the percutaneous thrombin injection with the patient having recovered from his cardiac condition, he reported difficulties in breathing and swallowing which were associated with neck swelling. Emergent CT angiography revealed a second pseudoaneurysm measured approximately 5x3x4 cm in the upper side of the chest and neck region, originating from the left subclavian artery, few millimeters away from the origin of the LVA and LIMA and at the opposite side of the previously thrombosed, early pseudoaneurysm which caused a mass effect and mediastinal shift. (Figure 3).The possible mechanism was hypothesized to be the initial arterial puncture which went completely through the subclavian artery.

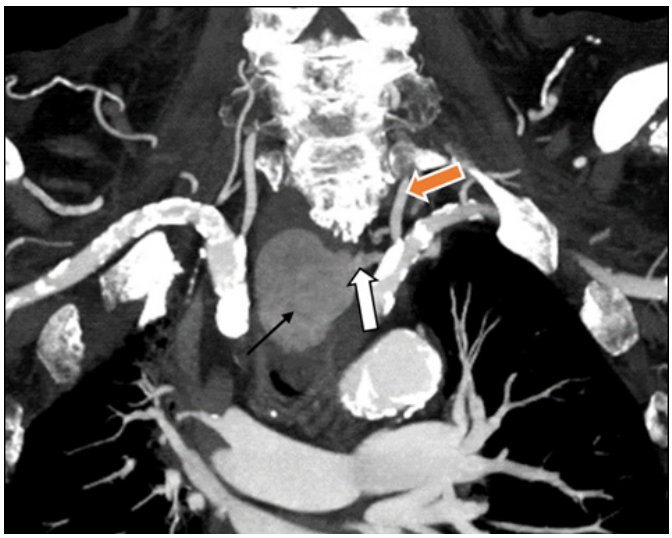

Figure 3. Computer tomography-aortography. Coronal view/MIP reconstruction. A large paravertebral mass (black arrow) at the level of T8 vertebra, causing compression over the trachea and esophagus. The mass found to be in contact with left subclavian artery, few millimiters away from left vertebral (orange arrow) and left internal mammary arteries. Leakage/exavasation of intravenous contrast is demonstrated from the posterior wall of subclavian artery, through a discrete neck of 2cm lengh and 3-4mm width (white arrow) into the paravertebral mass (pseudoaneurysm).

The patient immediately was transferred to the interventional radiology unit for further management. Endovascular subclavian artery stenting was offered and the procedure was performed through the left brachial and left femoral arteries using 5-French and 10-French sheaths, respectively. Through the brachial access, a 0.014" hydrophilic guidewire and 3x15mm balloon catheter was advanced into the LIMA, in order to maintain access if accidentally this had blocked. Through the femoral access, a 0.035'' stiff hydrophilic guidewire and a 5-French diagnostic catheter were advanced into the left subclavian artery and DSA was performed. A 7x40mm balloon expandable covered stent was advanced and positioned to the left subclavian artery immediately proximal to the origin of the LIMA which remained intact. The completion angiography demonstrated the correct position and expansion of the stent-graft. (Figure 4)

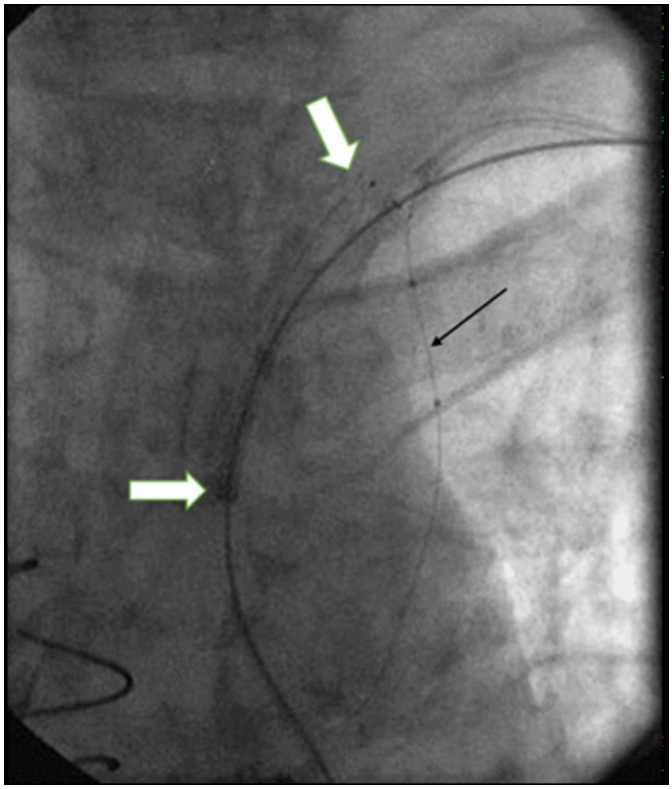

Figure 4: Endovascular repair using covered-stent. The stent-graft 7x40 mm (between white arrows) was positioned in the left subclavian artery, few millimeters from left internal mammary artery. In advance, balloon 3x15mm (black arrow) was advanced over 0.014'' guidewire into the internal mammary artery.

DISCUSSION

Central venous cannulation is a routine clinical procedure, which nevertheless carries specific risks. Various complications have been described which are rare but potentially serious.[8] Although venous puncture using surface anatomic landmarks has been widely practiced, ultrasound guided cannulation has been reported to result in higher success rates and fewer complications.[4]

If arterial cannulation occurs with large catheters (>7 French), it is suggested to keep the CVC in place, and perform a safe removal under direct visualization.[2] Pseudoaneurysms are rare and usually occur immediately after an iatrogenic injury but delayed manifestations are possible.[4-6] Since spontaneous rupture and thrombosis are common risks, immediate correction is recommended.[4] Several options are available, ranging from the traditional open repair to minimal invasive techniques, like balloon occlusion, endovascular stents, percutaneous closure devices, thrombin injection and coil embolization.[4-7] Stent-grafts present a high technical success rate but carry the risk of arterial branch occlusion.[7] Balloon tamponade offers technically feasible and effective hemostasis but prolonged balloon dilatation may lead to limb ischemia, thromboembolism, delayed pseudoaneurysm formation and additional risks for myocardial damage in cases of CABG.[7] Therefore, management of these lesions should be individualized and selected based on imaging evaluation. In our case, close proximity of the pseudoaneurysm with the origin of the LVA and a patent LIMA coronary bypass made hemostatic ballooning or stent-graft insertion insecure and therefore thrombin injection was favored as the safest treatment option.

The delayed presentation of the second pseudoaneurysm underlines the need for continuous monitoring and a high suspicion index. Although not typical, delayed presentation has been previously described.[9] This can be attributed to the continuous slow leakage of a small quantity of blood from the injured vessel. The fact that the patient was anticoagulated due to his prosthetic aortic valve, may have played a role. Another remarkable point is the myocardial ischemia which complicated recovery of our patient after thrombin injection. Such a complication most likely occurred due to the close proximity of the arterial injury to the LIMA origin. This highlights the fact that direct injury of a patent IMA coronary graft is possible during attempts to puncture the SCV. Accordingly it would be reasonable to recommend that the side of the origin of an IMA coronary bypass graft should be preferentially avoided.

Finally, the fact that two concurrent pseudoaneurysms complicated the procedure has not been previously reported and may be explained by a throughout arterial puncture, during attempts for vein cannulation. Thus, if vein cannulation is challenging and unsuccessful after several attempts, a safe strategy would be to abandon the procedure, seek assistance, use real-time ultrasound or try alternative access sites. Aggressive, continuous attempts for cannulation are ill-advised and may result in catastrophic outcomes.

CONCLUSION

Iatrogenic subclavian artery pseudoaneurysms can be safely managed by endovascular means, using a wide range of therapeutic options and a patient- and lesion-specific approach. A high suspicion index is necessary in order not to miss delayed manifestations, while cardiac complications should be anticipated in case a patent IMA bypass graft.

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