

Endovascular coil embolization and stenting for the treatment of iatrogenic right internal mammary artery injury: A case report

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Abstract

A 54-year-old Chinese woman presented with a 10-year history of repeated paroxysmal palpitations. She was diagnosed with paroxysmal supraventricular tachycardia by 12-lead electrocardiogram and was advised to undergo catheter-based radiofrequency ablation. During the procedure, a rare complication occurred that was diagnosed as a right internal mammary artery penetrating injury. After appropriate emergency treatment with arterial embolization and membrane-covered stent implantation, the patient was out of immediate danger of haemorrhaging. Follow-up computed tomography angiography of the subclavian artery at 3 months after she was discharged from hospital revealed stent-graft patency with no evidence of in-stent thrombosis or stent stenosis. No problems were observed at the 6-month follow-up visit.

Keywords

Catheter ablation, internal mammary injury

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Introduction

Injury to the internal mammary artery during subclavian venous access is uncommon. This case report describes a patient who experienced a penetrating injury to the right internal mammary artery when she was undergoing a routine interventional procedure for paroxysmal supraventricular tachycardia (PSVT).

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Case report

A 54-year-old Chinese woman presented to the Department of Cardiology, First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, Zhejiang Province, China in December 2015 with a 10-year history of repeated paroxysmal palpitations. She was diagnosed with PSVT by 12-lead electrocardiogram when she had been palpitating for hours. She was advised to undergo catheter-based radiofrequency ablation, which has a superior efficacy and safety profile.¹

Right subclavian venous access is standard practice and frequently used in our centre. After central venous catheterization in this approach using a standard 18G needle, the surgeon had difficulty pushing the electrode wire to the coronary vein sinus. At the same time, the patient complained of pain in her chest, but her physical signs were stable.

Subsequent angiography showed that the distal tip of the sheath did not follow the path of the precava, but pursued a more vertical course, which indicated that the sheath was in the right internal mammary artery (RIMA) (Figure 1). The RIMA had been inadvertently punctured during the insertion of the sheath, which if pulled out inappropriately could result in severe complications such as excessive bleeding, haemothorax, and even death. To address this problem, a 10*40 mm Abbott balloon (Abbott Vascular, Santa Clara, CA, USA) was placed in the aorta bifurcation of the subclavian artery via a 6F right femoral arterial sheath to block the blood flow if necessary. Subclavian approach angiography investigated the extravasation of contrast medium in the RIMA while slowly withdrawing the sheath. To seal the perforation, embolotherapy was performed distally and proximally to the laceration of the RIMA with a Cook Spring medical coil (Cook Spring Company, Sarasota, FL, USA)

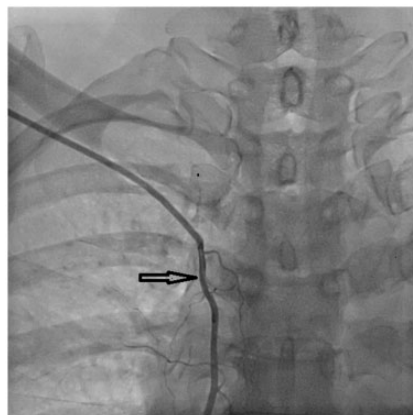


Figure 1. Selective subclavian angiogram showing the catheter sheath puncturing the right internal mammary artery (arrow) in a 54-year-old woman during subclavian vein catheterization undertaken as part of a catheter-based radiofrequency ablation for paroxysmal supraventricular tachycardia.

via a microcatheter. The main reason for this procedure was to prevent retrograde ‘backdoor’ bleeding. RIMA angiography demonstrated an incomplete sealing of the artery lumen. Then a horizontal 10*50 mm preprocessed fenestrated GORE® VIABAHN® endoprosthesis (W.L.Gore & Associates, Inc., Flagstaff, AZ, USA) was employed at the subclavian artery to cover the RIMA origin using an 11F right femoral arterial sheath. After stent deployment, angiography showed the RIMA was completely sealed, and the subclavian artery remained widely patent (Figure 2). While slowly extubating the sheath, angiography showed that the contrast medium followed the path of the superior vena cava (Figure 3), which confirmed the inadvertent cannulation of the subclavian vein.

The patient tolerated the procedure well. No severe complications such as haemothorax or pneumothorax occurred. Low molecular weight heparin (4000 U/0.4 ml) was administered hypodermically every 12 hours for 3 days after the procedure;

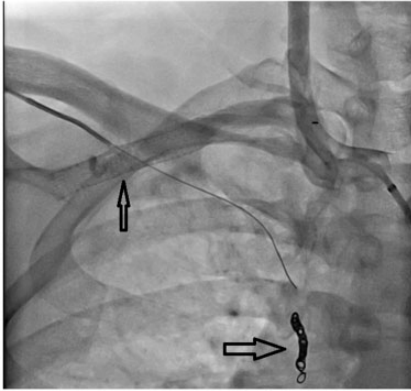


Figure 2. Angiogram obtained after membrane covered stent (vertical arrow) implantation in the subclavian artery showing adequate patency and successful sealing of the distal internal mammary artery with a Cook Spring medical coil (horizontal arrow) in a 54-year-old woman during subclavian vein catheterization undertaken as part of a catheter-based radiofrequency ablation for paroxysmal supraventricular tachycardia.

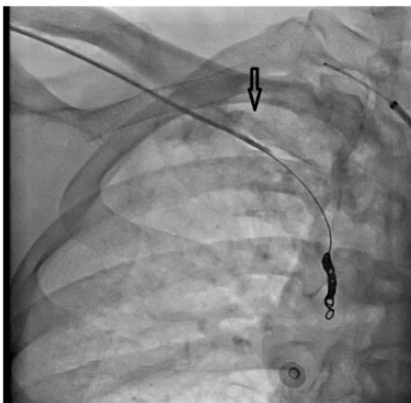


Figure 3. Angiography demonstrating radiopaque contrast medium (arrow) flowing into the superior vena cava in a 54-year-old woman during subclavian vein catheterization undertaken as part of a catheter-based radiofrequency ablation for paroxysmal supraventricular tachycardia.

and 100 mg/day aspirin for 3 months was recommended to the patient. Computed tomography angiography (CTA) of the subclavian artery 3 months later showed



Figure 4. Posterior computed tomography angiography view at 3 months after the procedure revealing a patent endograft in the right subclavian artery in a 54-year-old woman during subclavian vein catheterization undertaken as part of a catheter-based radiofrequency ablation for paroxysmal supraventricular tachycardia. The colour version of this figure is available at: <http://imr.sagepub.com>.

no in-stent thrombosis or stent stenosis (Figure 4); and no problems were observed at the 6-month follow-up visit.

Discussion

Subclavian venous catheterization is an alternative endovascular route for catheter ablation. The most common vascular injury is inadvertent puncture or cannulation of the subclavian artery and the rate of occurrence of this complication ranges from 1–11%.² Injury to the internal mammary artery during subclavian vein approach cannulation is infrequent,^{2–9} of which arteriovenous fistulas or pseudoaneurysms have been reported in a few publications.

In the current case, the reason for the RIMA injury may be as follows. When the conduct wire was advancing, the needle maybe not have been well fixed, as it sloped downward and deep into the RIMA. Coincidentally, the end of needle was blocked by the arterial wall, so blood did not spray into the injector. After placing the conduct wire, the conventional protocol would have been to push its distal tip

into the inferior vena cava, so that it would either pass through the inferior caval valve or curve along the wall of the right atrium when meeting the atrial systole. However, the surgeon neglected to undertake this procedure and they also did not order a cardiac lateral position film, which would have resulted in the conduct wire being immediately retracted.

The gold standard for assessing vessel injury is digital subtraction angiography, which has a sensitivity in excess of 99% and specificity of 100%, compared with CTA that has a 99.7% sensitivity and 100% specificity.⁷ Most centres use CTA as a preoperative imaging examination to diagnose the extent of vessel-related disease and design the treatment plan. In this current case, CTA was also used for the comprehensive assessment of the RIMA injury.

The development of arterial lesions of the RIMA after inadvertent puncture is extremely rare, with only a few reports documenting such a complication.^{2,3} Therapeutic embolization of abnormal thoracic vessels was first reported in 1974,⁸ whereby tissue adhesive bucrylate was applied to permanently occlude bronchial arteries. Tissue adhesives polymerize so rapidly that the surgeon only has a few seconds to inject them before they form a strong adhesive. They are also not radiopaque, so they are rarely used to treat arterial lesions and the procedure was more experimental at that time.⁹ In 1993, a case of arteriovenous fistula from the RIMA to the subclavian vein was reported, which was successfully treated by embolization using a detachable balloon catheter.¹⁰ In 1999, a report documented the successful treatment of a left IMA to innominate vein fistula using coil embolization.⁴ A series of cases of traumatic injury of the IMA reported in 2002 demonstrated that the lesions in 12 of 18 patients were treated with 0.035 macrocoils and Gelfoam pledgets; and the rate of success was 91.6%.¹¹

A subsequent report in 2009 described five cases of IMA injury that were successfully treated with embolization using microcoils.³ Therefore, nonsurgical occlusion of IMA-associated injury with coil embolization is a straightforward and reliable procedure. In the current case, the distal RIMA was initially embolized with coils to prevent retrograde 'backdoor' bleeding from its branches,¹² then a covered stent graft was used in the right subclavian artery to block the prograde 'frontdoor' bleeding. A previous report of one such case described the use of a covered stent graft in the right subclavian artery to prevent the pseudoaneurysm filling from the RIMA and the subclavian artery.¹³ In the current case, the laceration was thought to be in the proximal RIMA, but because the Cook Spring medical coil can slide up to the distal tip resulting in embolotherapy failure, a covered stent was deployed even without a subclavian artery injury. In addition, the IMA is usually 2–3 mm in diameter, so injury to a vessel of this size can potentially result in blood loss within a few minutes or delayed bleeding, so the surgical team took an aggressive attitude towards sealing the RIMA.¹¹

Inflating a balloon in a proximal artery to transiently block any potential bleeding is an efficient and safe method. In this current case, an unaerated balloon was employed in the opening of the right subclavian artery in order to make sure that the whole procedure was undertaken as securely as possible from the point of view of haemorrhage.¹⁴

Implantation of covered stent grafts, which has been reported to successfully treat iatrogenic complications, especially in carotid artery injury, is a feasible and effective therapy for the accurate and long-term treatment of vascular injury.¹⁵ Disadvantages of this endovascular stent approach are the need for postoperative antiplatelet and anticoagulation therapy

to prevent in-stent thrombosis and restenosis.¹⁶ Since stent implantation has been rarely used in RIMA injury, no consensus agreement yet exists to provide guidance for the need and type of adjunctive anticoagulation or antiplatelet therapy in this situation. More evidence is available from stent grafting of the internal carotid artery, but different antiplatelet or anticoagulation regimes have been used following this procedure. For example, antiplatelet therapy with clopidogrel for 6 weeks after stent graft placement in carotid pseudoaneurysm followed by ongoing warfarin sodium has been suggested.¹⁷ A study by the Cleveland Clinic Carotid Stent Registry suggests that dual therapy with clopidogrel bisulfate plus aspirin is the preferred strategy for patients undergoing carotid artery stenting.¹⁶ Generally, endothelialization is a slow process and it is known to take between 28 and 96 days to complete.¹⁶ The need for high levels of platelet inhibition seems to be most important during the phase of stent endothelialization, during which the exposed stent surface acts as a source of platelet activation.¹⁶ The traumatized vessels are hypercoagulable, and the stent material may delay endothelialization, prolonging the need for anticoagulation.¹¹ In the current case, the subclavian artery was intact, so we recommended administering 4000 U low molecular weight heparin every 12 hours for 3 days postoperation, followed by 100 mg aspirin every day for 3 months. CTA of the right subclavian artery revealed good stent patency and the patient was symptomless at the time of follow-up 6 months later.

Conclusion

Traumatic or iatrogenic injury to the RIMA is uncommon. The current case report describes the successful microcatheter embolization of an iatrogenic RIMA lesion that occurred during subclavian

vein catheterization undertaken as part of a catheter-based radiofrequency ablation for PSVT. The IMA is a well collateralized vessel that maintains communication with anterior intercostal branches, the distal part of superior epigastric artery and the musculophrenic artery, so it can therefore to be sacrificed without risk of ischaemia. Endovascular techniques have provided effective and less invasive management options.^{5,17} Early diagnosis and treatment by selective embolization combined with stent grafting in interventional radiology is the first therapeutic choice and could be life-saving.

Declaration of conflicting interests

The authors declare that there are no conflicts of interest.

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