Transcatheter Repair of Iatrogenic Aortic Perforation Complicating Transseptal Puncture for a Catheter Ablation of Atrial Arrhythmia

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Aortic root perforation is a potentially life-threatening complication that may occur during transseptal puncture and requires immediate repair. We present a 71-year-old man who was admitted for catheter ablation of persistent atypical atrial flutter. Fluoroscopic-guided transseptal puncture was performed to gain access to the left atrium. An unrecognized puncture of the aortic root by Brockenbrough needle and inadvertent advancement of Mullins sheath resulted in aortic root perforation. We decided to seal the hole transcatheterly with an occluder device. Severe aortic regurgitation (AR) was noted by transesophageal echocardiography after deployment of a 6 mm Amplatzer septal occluder (ASO). Thereafter, we switched to a 6/4-mm Amplatzer duct occluder (ADO) and only minimal AR was noted after deployment. This is because the diameter of the left atrial disc of ASO is larger than the diameter of the retention skirt of ADO to interfere with the movement of aortic valve leaflet. During 6 months of echocardiographic follow-up, the ADO remained in place and no residual shunt was observed.

Key Words: Aortic perforation • Transcatheter repair • Transseptal puncture

INTRODUCTION

Aortic perforation is one of the potentially life-threatening complications that may occur during transseptal puncture and needs to be repaired immediately. Here we reported a 71-year-old man who received fluoroscopic-guided transseptal puncture to gain access to the left atrium for the catheter ablation of persistent atypical atrial flutter. Aortic root perforation complicated the procedure. Open heart surgical repair has been the primary option to treat such complication in the past.[1] We decided to seal the hole transcatheterly with an Amplatzer closure device. This is the first case in our institution to treat such complication by transcatheter device closure.

CASE REPORT

A 71-year-old man was admitted for catheter ablation of persistent atypical atrial flutter. He had undergone cardiac surgery for coronary artery bypass graft and bio-prosthetic mitral valve replacement approximately 5 months earlier. Fluoroscopic-guided transseptal puncture was performed via the right femoral vein to gain access to the left atrium (LA) for catheter ablation. A Decapolar catheter and a 4 Fr pigtail catheter were placed in the coronary sinus and the aortic root, respectively, as anatomic landmarks. The procedure was complicated by an unrecognized puncture of the aortic root by Brockenbrough needle followed by inadvertent advancement of a 8 Fr Mullins sheath

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(Medtronic, Minneapolis, MN, USA). A subsequent test injection of contrast medium through the Mullins sheath showed the left coronary arteries (Figure 1A). The Mullins sheath was left in place and transesophageal echocardiography (TEE) was done immediately; this revealed the aortic perforation at the level of the aortic sinus, just above the non-coronary cusp (NCC) of the aortic valve (Figure 1B). Although referral for open heart surgical repair is the primary option in such a scenario, it is possible to treat this nowadays with a closure device in the era of transcatheter therapy. Thereafter, we decided to seal the hole transcatheterly instead of surgically. Amplatzer guidewire (AGA Medical, Plymouth, MN, USA) was introduced into the aorta through the Mullins sheath and then the Mullins sheath was exchanged for a 8 Fr 45° curve Amplatzer TorqVue delivery sheath (AGA Medical, Plymouth, MN, USA), under the guidance of fluoroscopy and TEE (Figure 1C). As the outer diameter of a 8 Fr sheath is 3.45 mm and the aortic wall is elastic, we selected a 6 mm Amplatzer occluder device to plug the hole. Then, we advanced and deployed a 6 mm Amplatzer septal occluder (ASO) (AGA Medical, Plymouth, MN, USA) to seal the aortic root perforation under the guidance of fluoroscopy and TEE (Figure 2A). But, TEE revealed severe aortic regurgitation (Figure 2B) and the movement of NCC was interfered with by the LA disc of the ASO. This is because the diameter of the LA disc of a 6 mm ASO is 18 mm, and the distance from the perforation to the aortic leaflet was just about 6 mm (Figure 1A). So, we withdrew the ASO and deployed a 6/4-mm Amplatzer duct occluder (ADO) (AGA Medical, Plymouth, MN, USA) (Figure 2C) which has a diameter of 4 mm at the venous end, 6 mm at the arterial end and a retention skirt diameter of 10 mm. Subsequent TEE showed no residual shunt and no aortic regurgitation (Figure 2D) since the diameter of the retention skirt of ADO is much smaller than the diameter of the LA disc of ASO to interfere with the movement of the aortic valve. Then, we released the ADO device. During six months of echocardiographic follow-up, the ADO device remained in place and no residual shunt was observed.

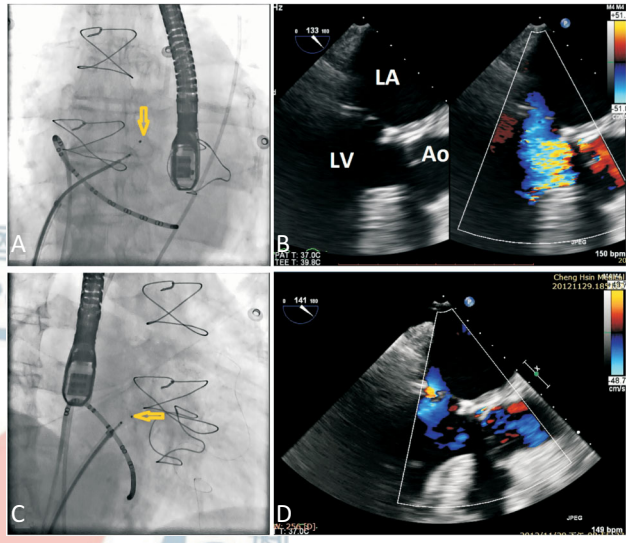

Figure 2. *(A) LAO 8° fluoroscopic projection showed deployment of a 6 mm ASO device (arrow) to seal the aortic perforation. (B) TEE image after deployment of the ASO device revealed severe aortic regurgitation. Ao, aorta; LA, left atrium; LV, left ventricle. (C) Right anterior oblique 25° fluoroscopic projection showed deployment of a 6/4-mm ADO device (arrow) to seal the aortic perforation. (D) TEE image after deployment of the ADO device revealed no aortic regurgitation. ADO, Amplatzer duct occluder; ASO, Amplatzer septal occluder; TEE, transesophageal echocardiography .*

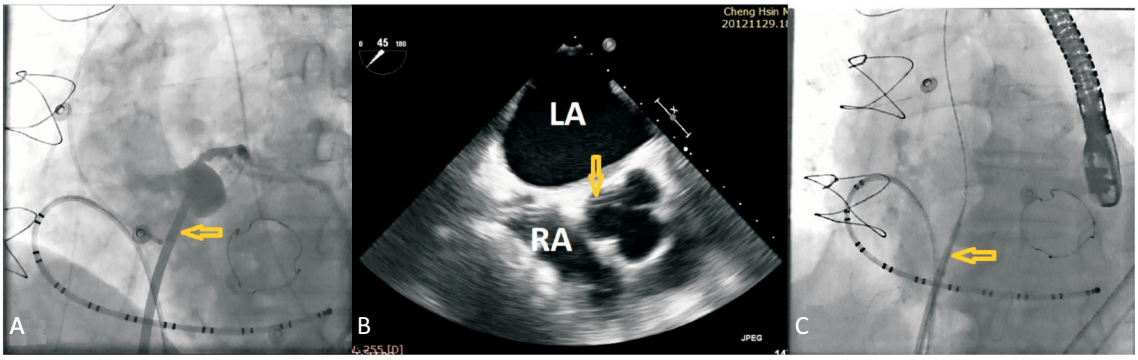

Figure 1. *(A) Left anterior oblique (LAO) 50° fluoroscopic projection while test injection of contrast medium through Mullins sheath (arrow) showed contrast-enhanced left coronary arteries, aortic root and ascending aorta. (B) TEE revealed perforation of aortic wall by Mullins sheath (arrow) into non-coronary aortic sinus. LA, left atrium; RA, right atrium. (C) LAO 30° fluoroscopic projection showed advancement of Amplatzer TorqVue delivery sheath (arrow) over Amplatzer guidewire to cross the aortic perforation. TEE, transesophageal echocardiography.*

DISCUSSION

The transseptal puncture is a routine procedure for interventional cardiologists and cardiac electrophysiologists to access the left atrium for a variety of reasons, including but not limited to catheter ablation, transcatheter mitral valve procedure, transcatheter paravalvular leak closure, transcatheter left atrial appendage occlusion, and left heart hemodynamic assessment.

Complications occur in approximately 1% of transseptal puncture cases and include aortic root puncture, stroke/transient ischaemic attack, pericardial effusion/tamponade, right/left atrial wall puncture, pleuritic chest pain, transient ST elevation of inferior leads, persistence of atrial septal defect and death.[2] Guidance by TEE or intracardiac echocardiography may reduce this small incidence of complications even further, but it is not routinely used due to cost constraints.

In this case, distorted anatomy and thicker atrial septum caused inadvertent puncture of the aortic root with the Brockenbrough needle, and further advancement of the Mullin sheath resulted in perforation of the aortic root. Although the puncture was guided only by fluoroscopy, the complications could be avoided if some precautions are taken. It is very important to confirm that the tip of the needle is in the left atrium after the initial puncture, before further advancing the dilator or sheath. Measurement of the pressure from the needle can differentiate between the left atrial pressure and the aortic pressure prior to advancing the sheath. If only the needle enters the aorta, there is a general perception that it can be safely withdrawn without causing undue complications. But if the sheath is advanced into the aorta, it is imperative not to withdraw the sheath, otherwise catastrophic complications may ensue.

In the literature, relatively few similar cases have been previously reported.[3] Amplatzer closure devices have been more commonly used to seal the intracardiac shunt or heart perforation. It appears that ADO was the most frequently used device to seal ruptured sinus of Valsalva aneurysm,[4-6] and ASO was the most often used device to seal iatrogenic heart perforation in one series of cases.[7] Which device should be used in which circumstance depends on the relative structures of the defect and the device. In this case we initially used ASO, but the LA disc of the device interfered with the movement of aortic valve causing significant aortic regurgitation. So, we changed to the 6/4 mm ADO. We learned from this case that an ADO device having a smaller disc is a preferred device to avoid interference with the movement of the aortic valve if a perforation is adjacent to the aortic valve.

In conclusion, although open heart surgical repair is the primary option to treat such complication in the past decades, percutaneous repair of iatrogenic aortic perforation with a closure device seems to be a safe and effective method nowadays.

REFERENCES

1. Park JH, Na MH, Lee JH. Ascending aortic puncture during percutaneous balloon mitral valvuloplasty. *Heart* 2006;92:1772.
2. Earley MJ. How to perform a transseptal puncture. *Heart* 2009; 95:85-92.
3. Hartono B, Razakjr OA, Munawar M. Amplatzer septal occluder sealed the complicating aortic root perforation during transseptal procedure. *JACC Cardiovasc Interv* 2012;5:450-1.
4. Kerkar PG, Lanjewar CP, Mishra N, et al. Transcatheter closure of ruptured sinus of Valsalva aneurysm using the Amplatzer duct occluder: immediate results and mid-term follow-up. *Eur Heart J* 2010;31:2881-7.
5. Sivadasanpillai H, Valaparambil A, Sivasubramonian S, et al. Percutaneous closure of ruptured sinus of Valsalva aneurysms: intermediate term follow-up results. *EuroIntervention* 2010;6: 214-9.
6. Dobarro D, Sánchez Recalde A, Martín Reyes R. Severe aortic regurgitation after the closure of a ruptured congenital aneurysm of sinus of Valsalva with an Amplatzer device. *EuroIntervention* 2010;6:426-7.
7. Stolt V, Cook S, Räber L, et al. Amplatzer septal occluder to treat iatrogenic cardiac perforations. *Catheter Cardiovasc Interv* 2012; 79:263-70.