Transcatheter Closure of Late-Onset Residual Aortopulmonary Septal Defect Using a Muscular Ventricular Septal Occluder

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SUMMARY

Late-onset residual shunt after surgical repair of aortopulmonary septal defect (APSD) is a rare event complicating the management strategy. Surgical reoperation was the treatment of choice traditionally, while associated with increased risk and suffering. We report a case of successful treatment of this type of residual shunt using a transcatheter closure technique with an infrequently used muscular ventricular septal device. (Int Heart J 2014; 55: 89-91)

Key words: Residual shunt, Congenital heart defect, Heart catheterization, Ventricular septal occluder device

Aortopulmonary septal defect (APSD) is a congenital defect caused by anormogenesis of the aortopulmonary septum and is mostly treated with surgery through sternotomy. Late-onset residual shunt after surgical repair of APSD is an extremely rare complication, which warrants immediate intervention. However, surgical reoperation was found to be associated with the risk of hemorrhage as a result of repeated sternotomy and tissue adhesion. Experience with transcatheter closure for this type of defect is also limited. We describe a case of successful transcatheter closure of a late-onset residual defect after repair of aortopulmonary septal defect using a muscular occluder device. This experience with device closure was unique because the shape of the lesion increased the difficulty and the rare device was originally designed for closure of muscular ventricular septal defect (mVSD).

CASE REPORT

An 8-year-old boy was diagnosed with type II distal aortopulmonary septal defect 3 years previously. The defect was surgically repaired with a Dacron patch. Postoperative echocardiography showed no residual shunt. Nine months after the surgery, a 3/6 degree continuous murmur was noted in follow-up. Echocardiography revealed a late-onset residual defect with a continuous left-to-right shunt passing through an approximately 10 mm defect just beside the patch at the aortopulmonary septal level (Figure 1A). The shunt was tube-like with a maximum velocity of 3.7 m/s in Doppler interrogation. No vegetation was noted in the surrounding region and signs of infection were negative for this patient. Computed tomography and its 3D reconstruction displayed a tube-like fistula, which was nearly parallel to the aorta, connecting the ascending aorta and pulmonary artery (Figure 2).

Next, transcatheter closure was attempted in this patient. Cardiac catheterization through the left femoral artery confirmed a 2.5 to 1 left-to-right shunt with a pressure gradient of 56 mmHg, which was well separated from the aortic and pulmonary valves (Figure 3A). An SHSMA (Shanghai Shape Memory Alloy Co., Ltd.; Shanghai, China) mVSD occluder with a 20 mm distal disc diameter, 16 mm proximal disc diameter, 10 mm waist diameter, and 10 mm waist length was selected (Figure 3C). A tract was established by placing a Terumo guide wire (Terumo Co., Japan) from the ascending aorta into the left pulmonary artery through the tube-like defect, and then trapping and pulling the guide wire out through the right femoral vein. A 9F introducer was positioned via the tract. The muscular VSD occluder was then delivered and deployed successfully under fluoroscopic guidance. The distal disc was positioned on the aortic side with the proximal disc in the pulmonary artery (Figure 3B). An aortogram and transesophageal echocardiogram demonstrated good position of the occluder and no residual leak or obstruction of coronary arteries. No ST-segment or T-wave changes were noted on the electrocardiogram. No clinical symptom or heart murmur was detected on subsequent days, and he was discharged after 3 days without complications. During the 6-month follow-up, no residual shunt was detected in his echocardiograms (Figure 1B).

DISCUSSION

A postsurgical residual shunt, especially one whose onset is a long time after surgery, is a rare complication of surgical repair of a congenital cardiovascular defect and largely complicates the management strategy. Surgical reoperation and cardiopulmonary bypass may increase risk and suffering. Transcatheter closure has the obvious advantage of minimal invasion. Residual shunt after surgical repair of APSD is not a
Figure 1. A. Preoperative echocardiogram marked the defect (white arrow). B. At 6-month follow-up, an echocardiogram showed successful closure with no residual leak (black arrow).

Figure 2. Preoperative radiological assessment. A. CT showed a defect with a thick wall (white arrow) connecting the ascending aorta (Ao) and pulmonary arterial trunk (PAT). B. 3D reconstruction showed that the defect was shaped like a long tube (white arrow).

Figure 3. A. Catheter travelled through aorta (Ao). The defect can be clearly seen (white arrow). B. Aortogram showing good fitness of device (black arrow) and little residual shunt. C. The SHSMA mVSD occluder had a 20 mm distal disc diameter, 16 mm proximal disc diameter, 10 mm waist diameter, and 10 mm waist length.
common condition, especially for those with a late-onset shunt. Experience for managing this type of defect is also limited. According to the location of the shunt, we presumed that the residual shunt in this case was associated with partial dehiscence of the Dacron patch. As previously reported, a late-onset dehiscence of a prosthetic patch was sometimes caused by infective endocarditis. However, in this case there was no evidence of infection or vegetation. Hence, loosening of the suture was the most suspicious culprit.

Surgery repair was the traditional treatment option for both primary and residual APSD, but was associated with the expense of cardiopulmonary bypass and bleeding due to diffused adhesion. Transcatheter closure is also attempted in primary APSD when the defect is relatively small and providing adequate space for the margin of the device. Richens and Alekyan separately introduced their initial attempts using an Amplatzer septal occluder for residual APSD. What can be drawn from these limited experiences is that transcatheter closure should be considered only if there is sufficient distance between the defect and valves, with no other associated cardiovascular anomaly present. Similarly, in choosing a closure device, the candidate device should match the shape and margin of the defect.

In our experience, preoperative image evaluation is of paramount importance. Echocardiograms can be used to confirm its existence, and assess the volume and direction of the shunt. Computed tomography and its 3D reconstruction can help to evaluate the feasibility of transcatheter closure and choose suitable devices. Furthermore, the potential disturbance of hemodynamics and coronary blood flow should be assessed before releasing the device. Thus, intraoperative electrocardiogram monitoring might be helpful. The greatest technical difficulty we encountered was the establishment of a tract. In previous reported cases, some interventionists chose the aortic side to create tracts and deploy devices. However, in this case, the fistula was directed inversely from the aortic side. A venous access was preferable for establishing the tract. Preoperative images showed that the septum between the ascending aorta and pulmonary artery was thickened. This explained the unusual shape of the defect, a long tube-like fistula with a thick wall. Therefore, the previously reported devices, like ductal occluders and Amplatzer septal occluders, should be excluded because of their small distal disc or short waist. The SHSMA muscular VSD occluder with a large distal disc and a long and wasp waist corresponding to the shape of the defect was selected and deployed. SHSMA devices are used in treating muscular VSD and perforation of the ventricular septum. However, their adoption in the closure of other congenital heart defects has not been previously reported. This device may not be suitable for usual primary APSD. However, in some cases of a long-tube like defect with a thickened wall, whether it was native or residual, the mVSD device might be a candidate. This experience of closure could be considered a success according to the postoperative and 6-month results.

**Conclusion:** We conclude that the SHSMA muscular VSD occluder can be considered in the closure of residual defects after previous surgical repair of APSD.

**References**