Transcatheter Closure of Postoperative Residual VSD and Acquired Left Ventricle-to-Right Atrium Shunt with Using Two Different Devices

Cilsal Erman, Tanıdır İbrahim Cansaran, Yucu Bekir, Sahin Murat and Guzeltas Alper

INTRODUCTION

In the childhood, ventricular septal defects are successfully closed with the transcatheter method using various devices. Some of these devices are frequently used as on-label and some as off-label. We herein describe a patient in whom two different devices [KONAR-MF (multi-functional) ventricular septal defects (VSD) device (Lifetech, Shenzhen, China) and Amplatzer Duct Occluder II; St. Jude Medical, Saint Paul, Minnesota, United States of America] were successfully used to close a residual perimembranous ventricular septal defect with a ventricular septal aneurysm and left ventricle to right atrium (LV-RA) shunt.

CASE

A 16-year-old male was admitted to our outpatient clinic for follow-up. His medical history revealed an operation due to VSD repair in another center when he was four years old and an irregular follow up. On the physical examination, except for normal heart sounds a 3/6 pansystolic murmur heard from the margin of the left sternum. Transthoracic echocardiography revealed a patch on the outlet interventricular septum and an aneurysm of that patch with an acquired LV-RA shunt in addition to the residual defect with LV-RV shunt. Due to the dilation of left heart chambers with +2 z score, cardiac catheterization was planned under general anesthesia with the consent from his parents. After sheaths were placed in the right femoral vein and left femoral artery, 50 U/kg heparin was administered iv infusion and additional doses were administered to keep the activated clotting time (ACT) value around 200. Left ventricular angiography showed a VSD with a left ventricular side of 6 mm, a ventricular septal aneurysm restricting its passage to the right ventricle with a right ventricular side of 5.5 mm. It was observed that there was LV-RA communication in addition to VSD (Figure 1A). After the evaluation with transesophageal echocardiography, it was planned to close the large defect of VSD and LV-RV shunt with a device. After passing the defect from the arterial side with a 0.035 hydrophilic guidewire through a 5-F JR4 catheter, VSD was crossed from the LV into the pulmonary artery. After exchanging the delivery sheath with the catheter, the selected 10/8 MFO Konar device is prepared and positioned in the defect with retrograde approach. Despite such different deployment techniques, angiographic and echocardiographic evaluation demonstrated large residual shunt around the device, so then antegrade approach was planned. The defect was crossed from the arterial side and an arteriovenous circuit was performed by using the snare method A 6-F delivery sheath was passed through the femoral vein through the defect and advanced to the left ventricle. MFO Konar device with a 10/8 size was advanced through the delivery sheath, and the first two discs were opened in the septal aneurysm and the last disc was opened on the right ventricle side (Figure 1B). After evaluation with left ventricular angiography and transesophageal echocardiography, it was found that the LV-RA shunt was still present and it was decided to close this second defect with another device before the first device was released. Therefore, the defect was passed...
through a 5F JR4 catheter retrogradely with a 0.035" hydrophilic guidewire and placed in the right superior vena cava. The G4 ADO-II device, which was decided to be used according to echocardiographic measurements, was loaded into the system and placed appropriately into the defect by advancing the 5F delivery sheath retrograde over the guidewire to the right atrium (Figure 1C). After it was observed that the passage through the defects significantly decreased with the contrast agent injections and that there was no increase in the aortic insufficiency than observed before the procedure, both devices were released simultaneously by making sure that there was no rhythm problem. After both devices were released, contrast material injections and echocardiographic evaluation showed mild residual from both devices, except for mild LV-RA shunt and mild aortic regurgitation (Figure 1D). He was discharged from the hospital 24 hours after the procedure uneventfully. Oral aspirin (5 mg/kg daily) was prescribed for 6 months. During the 6-month follow-up, it was observed that there was trace aortic valve insufficiency and regression in dilatation in the left heart chambers.

DISCUSSION

VSD are the most common form of congenital heart disease (CHD) and can be seen in isolated and other structural defects. It is seen in about 40% of CHD. These surgically repairable defects can also be suitable for percutaneous closure except doubly committed or supracristal defects. Transcatheter closure of defects in perimembranous and muscular localization is widespread, it has also some advantages over the surgical method. On the other hand, postoperative residual VSDs may encounter some difficulties in transcatheter closure, and there is the possibility of encountering more than one problem that should be considered in terms of the use of appropriate technique for the operator in terms of the anatomical structure of the defect and the stabilization of the device and device selection. Among the factors affecting the incidence of postoperative residual VSD, VSD localization is at the top and its frequency varies between 5-25%.

In the series of W.P. Zhou and F. Li et al., it was reported that postoperative closure of residual VSDs was successfully performed in 12 patients without residual VSD and newly developed valve insufficiency. Also, Koakou and Colleagues, who published a series of six diseases, stated that these defects could be closed with different devices as transcatheter with a less invasive method. Today, these interventions can be performed safely and successfully by using many different label and off label devices.

In addition, it was reported that the LV-RA shunt which was defined by Gerbode in 1958, can be congenital and acquired. It is known that Gerbode defects, which are rarely encountered congenitally, occur due to predisposing causes such as cardiac surgery, infective endocarditis, trauma, and myocardial infarction. Acquired LV-RA defect is a rare type of VSD and may result from complications of cardiac surgery such as valve replacements or closure of VSD, trauma, myocardial infarction or endocarditis. The incidence of LV-RA communications is 0.08% of all catheterized congenital defects. Acquired LV-RA defects are more common in males. Anatomically, the defect may be above (type I), below the tricuspid valve (type II) or a combination of these two (type III).
They mentioned transcatheter closure of this communication should be assessed as an option with excellent results. A recent systematic review by Yuan et al. investigated that 51% of 234 patients were etiologically iatrogenic, 36% were infective, 9% were traumatic, and 6% were due to ischemic causes.⁵

In our case after the initial attempt to occlude the main defect left ventricular angiography and transesophageal echocardiography showed us LV-RA shunt was significant, the retention disc could not close it. Although in some cases generally accepted option is using a larger device could have detrimental effect on these procedures by increasing the incidence of complications. Therefore, we decided to use the second device for the LV-RA communication. The technique of simultaneously releasing the devices after closing two separate defects during the procedure plays an important role in postoperative residual VSD closure with LV-RA shunt.⁶ Although Konar-MF device is not symmetrical, having a twin-screw hub is an important feature that provides the advantage of the antegrade and retrograde approach. In this report, we present the transcatheter closure of a patient with postoperative residual VSD and LV-RA communication, as with two separate devices.

The transcatheter closure seems more suitable for centers that are able to handle with complex transcatheter procedures. In these experienced hands, a transcatheter procedure with a shorter hospital stay would be even safer than surgery.⁴

**LEARNING POINTS**

1. LV-RA defect is a rare type of ventricular septal defects and the diagnosis could be challenging if there is also additional residual defect and it is hemodynamically significant.

2. Patients with heart failure symptoms or left heart chamber dilation should be closed surgically or with percutaneous method. Re-operation is a known major risk and these communications could be closed with transcatheter approach with a less invasive and safer method.

3. Some problems are more likely to occur in patients undergoing transcatheter closure of postoperative residual VSDs. Although it is very important to demonstrate the anatomical structure of the defect and the stabilization of device and device selection, sometimes the use of a second device may be appropriate in these patients. Another important detail is the technique of simultaneously releasing the devices.

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**DECLARATION OF CONFLICTS OF INTEREST**

The authors declare that there are no conflicts of interest.

**REFERENCES**


