Case Report

Percutaneous closure of symptomatic large tricuspid paravalvular regurgitation using two muscular VSD occluders

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1. Introduction

Paravalvular leaks (PVLL) are common following valve replacement surgery. Majority are benign and do not require any active intervention. However, occasionally severe paravalvular regurgitation can produce heart failure and/or hemolysis, needing closure of the defect. It is more commonly associated with aortic and mitral prosthesis, symptomatic tricuspid paravalvular regurgitation being a rare entity. In this report we present the successful percutaneous transcatheter closure of a large paravalvular tricuspid regurgitation in a 59-year old lady with history of multiple previous operations. The elongated crescent-shaped defect was closed using two muscular VSD devices without any residual leak and without hampering the bio-prosthetic tricuspid valve function. Patient had transient complete heart block during the procedure which recovered later. There was marked improvement in the symptomatic status of the patient at discharge (NYHA IV to NYHA II), which was sustained at follow-up.

2. Case report

Our patient, a 59 year old lady, underwent closed mitral valvotomy for Rheumatic mitral stenosis at 24 years of age. 7 years later she underwent mitral valve replacement with Starr Edwards ball and cage mechanical valve for severe mitral re-stenosis. Although not on any secondary prophylaxis, she remained fairly well for nearly 3 decades, until recently, when she developed progressive dyspnea along with features of right heart failure. Subsequently, she underwent tricuspid valve replacement with 29 mm St. Jude Medical biocor bioprosthetic valve for severe low pressure tricuspid regurgitation. Because of transient heart block during the surgery, epicardial right atrial (RA) and RV permanent pacing leads were placed and left sheathed in the right subpectoral pocket. At discharge, mild tricuspid PVLL was noted and patient was advised follow up for the same. In 6 months time our lady returned with symptoms of severe congestive cardiac failure. There was no fever or any history suggestive of recurrence of acute rheumatic fever. Clinical examination revealed markedly elevated venous pressures with prominent V waves, grossly pulsatile liver, pedal edema and ascites. She was also in atrial fibrillation with controlled ventricular rate. Trans-thoracic as well as trans-esophageal echocardiograms were performed which showed severe PVLL through a large defect related to the antero-medial portion (septal...
margin) of the bio-prosthetic tricuspid valve (Fig. 1) suggesting possible suture dehiscence. It was a crescentic defect measuring approximately 12 mm in width and 24 mm in length. The bioprosthetic valve function was normal. The RA was significantly dilated with mild RV dysfunction.

Since the patient had already undergone three previous cardiac surgeries, a redo surgical repair was considered to be associated with high risk (EUROSCORE II-4.89%). To complicate matters, the lady was on high dose Warfarin (target INR: 3–3.5) for the prosthetic mitral valve and recent onset atrial fibrillation. The other viable option was trans-catheter closure of the defect. The pros and cons of each method were discussed in our multidisciplinary heart team meeting. The consensus decision was to do percutaneous device closure.

Accordingly, patient was taken up for device closure under fluoroscopic and transthoracic echocardiography guidance. Under local anesthesia both right and left femoral venous accesses were obtained (in view of possible need for multiple devices). RV angiogram done at the beginning of the procedure showed severe regurgitation across the paravalvular defect. However, the wide regurgitant jet made it difficult to measure the exact size of the defect. The defect was crossed using 6Fr Pigtail catheter and then exchanged for a 10Fr Amplatzer delivery sheath from the right femoral vein access. A second 10Fr Amplatzer sheath was also passed through the defect into the RV from the left femoral venous access. A 16 mm Amplatzer muscular VSD occluder (St. Jude Medical, St. Paul, Minnesota) was then deployed across the defect.

Fig. 1. Transthoracic echocardiogram showing a large tricuspid paravalvular leak (4 chamber view); right atrium massively dilated due to significant regurgitation.

Fig. 2. RV angiogram (AP view) after deployment of the first device shows significant residual leak (white arrows) in-spite of having a large sheath through the defect.

Fig. 3. Two muscular VSD devices deployed interlocked with one another (LAO caudal view); devices are seen on the medial aspect of the tricuspid valve ring (red arrow). Ball and cage mitral prosthesis seen on the left (white arrow).
Subsequent repeat RV angiogram showed significant residual leak. The residual jet measured about 10 mm (Fig. 2). Another 16 mm Lifetech Cera muscular VSD occluder (Lifetech Scientific, Shenzhen, China) was then deployed across the defect interlocking with the previous device (Fig. 3). Echocardiography showed complete abolition of the PVLL and no impediment of bio-prosthetic tricuspid valve function (Fig. 4). Finally the two devices were released one after another under fluoroscopy.

During the procedure, after deployment of the first device, patient developed complete heart block. She was hemodynamically stable with a low ventricular rate of 35/min. Atropine injection was given twice and temporary pacing was attempted. However, due to massively dilated RA, it was very difficult to pass the pacing lead into RV across the bio-prosthetic valve. Isoproterenol infusion was started and gradually ventricular rate picked up to 55/min. The rest of the procedure was completed uneventfully. Since the patient already had epicardial leads from the previous surgery permanent pacemaker implantation (Medtronic VVI RELIA RESRO1) was performed using the previously placed leads. However, within 24 h she returned to her basal rhythm of atrial fibrillation with adequate heart rate of 70–80 per minute. At 3 months follow-up all the clinical signs of heart failure had regressed and patient’s symptom status had improved from NYHA class IV to class II.

3. Discussion

Despite major advances in prosthetic valve replacement surgery, clinically significant paravalvular leaks occur in up to 1–5% patients. Surgical re-interventions were the treatment of choice for large defects till few years back. However, such re-do surgeries are usually associated with high risk of perioperative mortality (6–15%). In almost 50% patients the perioperative period is marked by complications such as prolonged ventilation (>48 h), renal failure, arrhythmia, pneumonia, re-exploration, neurologic or gastro-intestinal events.

In the early 1990s, Hourihan et al. reported the first successful percutaneous closure of paravalvular defect in three patients of aortic paravalvular regurgitation using the Rashkind-Cuaso double umbrella device. Although a technically difficult procedure, multiple reports of transcatheter closure of PVLL are now available with overall success rates of 60–80%. Majority of the reports concern mitral and aortic paravalvular leaks, the two most common sites of prosthetic valve implantation. A variety of devices have been used. The choice of device depends on the size, shape, location and complexity of the paravalvular defect. Precise knowledge of the different device characteristics is also crucial in order to select the most appropriate occluder to close a specific paravalvular leak.

Till date, very few reports have been published on the use of occluder devices for correcting tricuspid PVLL. Serdar et al. reported the closure of a large tricuspid PVLL using Amplatzer atrial septal occluder while other reports mention use of Amplatzer duct occluders. Although, no purpose-specific occluder is available for closure, Amplatzer vascular plug III (AVP-III) offers potential advantage because of its oval shape. In spite of its bulky configuration, we chose a muscular VSD occluder because of the large size of the defect. The crescentic shape necessitated the use of two devices to cover the entire defect. The interlocked position of the two devices with one another, helped to increase the stability as well as to eliminate the residual shunt between them. The sizing of the devices was based on echocardiographic measurement of the defect size and angiographic findings. Intra-procedure balloon sizing was avoided as it is technically difficult for such elliptical defects. Moreover, even highly compliant balloons can potentially stretch the defect. To the best of our knowledge this is the first time two muscular VSD occluders have been used to successfully close such a large tricuspid paravalvular defect.

Imaging modalities like 3-D TEE have revolutionized planning and performance of various structural cardiac interventions, and nowadays it is being used in almost all cases of paravalvular leak closure. In our patient standard (2-D) TEE was done as a pre-procedure work-up and the intervention was carried out with transthoracic echocardiography guidance. Exact sizing of the defect was important and it was ascertained by viewing the defect in two orthogonal views. The excellent anatomic delineation of the defect and surrounding structures provided by 3-D TEE would offer advantages in difficult cases. However it is not mandatory for the procedure as evident in our case.

Owing to its anatomic location, tricuspid PVLL closure is probably a technically easier procedure compared to mitral paravalvular defect occlusion. However, as seen in our patient, closure of defects on the antero-medial aspect of the tricuspid prosthesis can be tricky due to proximity to the nodal tissue. As in perimembranous VSD closure, the propensity for heart block

Fig. 4. Echocardiography showing stable position of both devices with no residual shunt.
should always be taken into consideration while planning for device in this area.

4. Conclusion

Percutaneous closure of paravalvular defects is a safe and effective alternative to high risk re-do surgeries. Haemodynamically significant tricuspid PVLL can be corrected successfully using muscular VSD occluders. Because of the large size and crescentic shape of the defects, multiple devices may be often necessary to achieve successful closure.

Conflicts of interest

The authors have none to declare.

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