A rare unreported complication following transcatheter correction of sinus venosus defect

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ABSTRACT

Transcatheter correction of superior sinus venosus defects using covered stent is increasingly reported in the literature and provides an alternative option to surgery in appropriately selected adults. Being a new intervention, meticulous attention to procedural techniques and precise surveillance imaging modalities are vital to detect and avoid potential early and late complications. This report highlights the occurrence of a residual interatrial communication following covered stent placement and large subclinical asymptomatic nonocclusive thrombus formation at the right atrial end of the stent. The management of both these complications is also highlighted in this report.

Keywords: Covered stent exclusion, residual shunt, superior vena cava, thrombus, transesophageal echocardiography, warfarin

INTRODUCTION

Transcatheter closure of sinus venosus defect (SVD) using covered stent is an emerging surgical alternative in adults. Preprocedural imaging, techniques, antiplatelet medications, and postprocedural imaging protocols vary between different units practicing this new evolving intervention.[1-5] Small residual leaks were reported in 9%–17% at 3–6-month follow-up from two large studies, although only one case was considered hemodynamically significant.[1,2,6] Transesophageal echocardiography (TEE) is more likely to detect residual leaks compared to transthoracic echocardiography (TTE).[6] Device closure of residual leak in SVD after covered stent placement was reported once.[7] Antiplatelets are routinely administered for 6 months following atrial septal interventions to prevent thrombus formation. Thrombus formation in the vicinity of the large covered stent after SVD intervention is not reported so far. A case of residual leak due to the lack of opposition of the lower end of the covered stent to the atrial septum, additionally complicated by a large asymptomatic thrombus, was successfully managed by oral anticoagulation followed by device closure of the residual leak.

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CASE REPORT

A 44-year-old male without comorbidities was evaluated for exertional dyspnea and diagnosed to have SVD with right heart enlargement. Computed tomography showed bilateral superior vena cava (SVC) and a single trunk of the right upper pulmonary vein (RUPV) draining into the right SVC. He opted for transcatheter closure of the SVD after detailed counseling and heart team discussions. There was no history of any medical illness, including thrombotic diseases.

During cardiac catheterization, the left-to-right shunt ratio was 2.84, and the mean pulmonary artery pressure

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was 28 mmHg. Interrogation with a 24 mm × 60 mm Z-MED Balloon (NuMED Inc, Hopkinton, NY) across the cavoatrial junction showed complete closure of the SVD with unobstructed redirection of the RUPV to the left atrium. Since the length of the cavoatrial junction that needed to be stented was around 7 cm to provide a sufficient anchor, two overlapping covered AndraStent XXL (Andramed GmbH, Reutlingen, Germany) with the lengths of 53 mm and 47 mm were mounted on a 24 mm × 75 mm BIB balloon (NuMED Inc, Hopkinton, NY) and deployed [Figure 1]. A small residual leak was noted at the caudal end that persisted despite a postdilatation of the lower end using a 26 mm balloon. Further dilations were not done in anticipation that the residual leaks might reduce with right atrial negative remodeling leading to improved opposition of the septum to the stent. He remained asymptomatic on the 6-month follow-up on regular aspirin and clopidogrel prophylaxis.

A routine TEE performed at 6 months according to the institutional protocol showed a small 6-mm residual leak at the right posterior end of the stent and a large 22 mm × 14 mm thrombus attached to the lower end in the vicinity of the residual flow. The SVC and RUPV flows were unobstructed. This thrombus was not detected in TTE amid the stent-metal artifacts [Figure 2]. The thrombus resolved completely on TEE after monitored warfarin therapy for 6 months. Investigations excluded thrombophilic illnesses. As the small residual defect persisting after 1 year was suspected to be a contributor to thrombus formation, informed consent was obtained for its evaluation and closure.

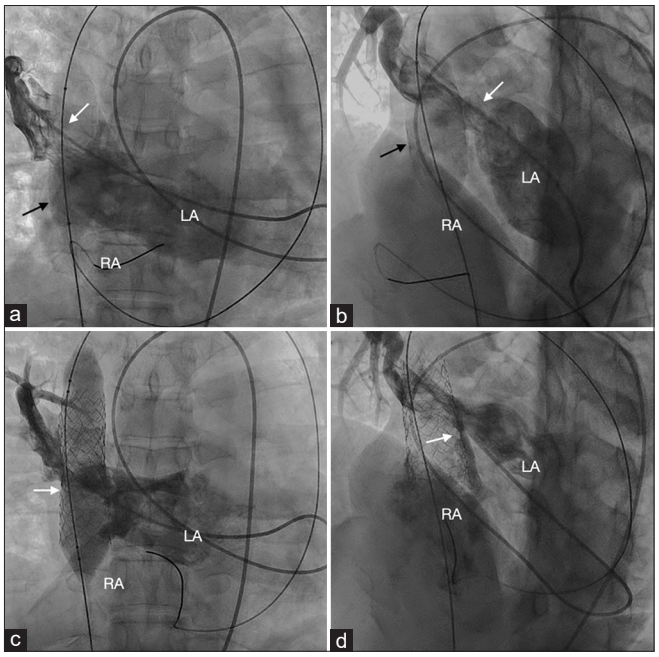

Figure 1: Balloon interrogation of the superior cavoatrial junction in posteroanterior (a) and hepatoclavicular (b) projection with a long balloon (black arrow) showing rerouting (white arrow) of the RUPV to the LA. An arterial catheter was retrogradely advanced into the RUPV through the left ventricle to monitor pressures and perform angiography. There were no residual flows following covered stent deployment with an inflated balloon, (c) but after balloon removal, there were small residual flows. (d) The stiff guidewire from the RA through the cavoatrial junction was advanced through a bridging innominate vein to the left superior venacaval and coronary sinus for stability. RA: Right atrium, LA: Left atrium, RUPV: Right upper pulmonary vein. White arrow shows rerouting of pulmonary vein

During the second catheterization, the lower stent end was dilated up to 30 mm without any significant improvement in the residual leak. Intraprocedural TEE showed that the defect measured 8 mm × 6 mm and was confined to around 10% of the stent circumference. Closure with a device was planned with care to prevent device protrusion into the pulmonary vein orifice. The defect was crossed from the right atrium, and the RUPV was cannulated using a Judkins right coronary catheter. It was exchanged over a Super Stiff wire to 8F Mullins Sheath (Cook Medical, Limerick, Ireland). A 14 mm/12 mm Konar-MF Ventricular septal defect (VSD) occluder (LifeTech scientific, Shenzhen, PRC) was deployed under TEE guidance, with the left disc flush with the anterior wall of the RUPV. The device was released after confirming the lack of residual shunt and obstruction to the RUPV [Figure 3]. Warfarin was continued for another 6 months before a repeat TEE, and computed tomography confirmed the total seal of the residual leak with unobstructed RUPV. Warfarin was stopped, and aspirin was continued after 1 year of follow-up.

DISCUSSION

Covered stent exclusion of the SVD is increasingly reported in adults.[1,2,6] Meticulous imaging is essential

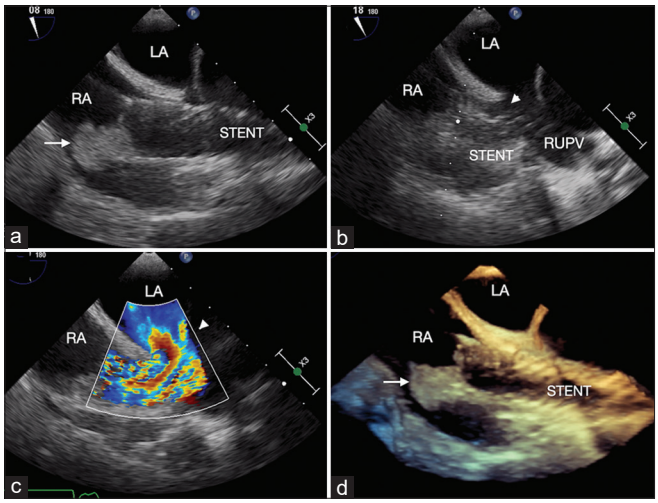

Figure 2: Bicaval view on transesophageal echocardiography (a) showing a thrombus at the right lower end of the covered stent in the RA. A rightward sweep (b) demonstrates a small residual defect (small arrow) with color flows (c). Three-dimensional echocardiogram (d) shows the thrombus in the RA and the smooth surface of the LA. RA: Right atrium, LA: Left atrium. White arrow indicate the thrombus

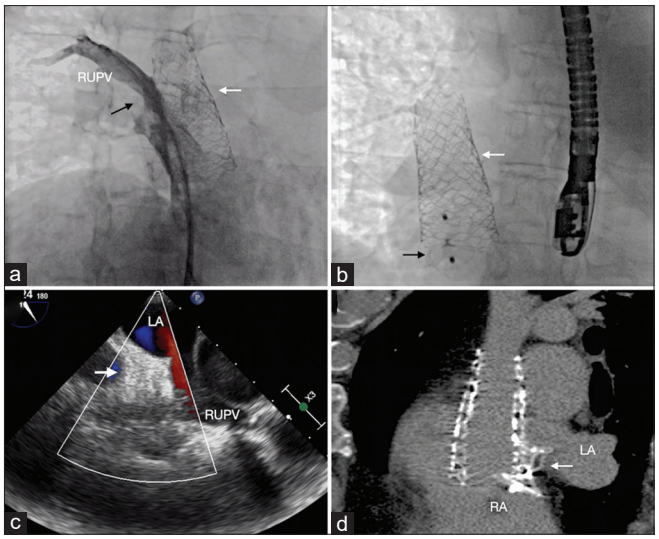

Figure 3: Angiogram from Mullins Sheath (a) across the residual defect (black arrow) into the RUPV shows the residual flow on the right end of the stent (white arrow). Konar MF device (b) across the defect closed the residual flow (c) and demonstrated laminar RUPV flow to the LA on transesophageal echocardiogram. Computed tomography after 6 months (d) shows the device position (arrow) in relation to the covered stent and RA. RA: Right atrium, LA: Left atrium, RUPV: Right upper pulmonary vein. White arrow indicates Konar MF device

to detect late complications. Small insignificant residual leaks seen during intraprocedural TEE in 60% of patients reduced to 24% during predischarge TTE, suggesting that TEE was superior in identifying residual leaks.[2] Follow-up TEE evaluation at 3–6 months identified insignificant residual leaks <3 mm in 16% of patients.[1] The progressive decline of residual leaks was attributed to negative right atrial remodeling promoting opposition of the covered stent to the atrial septum.[2] There was one previous report, where two patients were managed with device closure for the residual leak.[7]

Antiplatelet strategies following SVD closure often included aspirin and clopidogrel for 6 months.[8] Although thrombotic occlusion was not reported in the larger stents used in this procedure, antiplatelets were routinely followed after most atrial septal interventions. Without the use of advanced imaging tools like TEE in the follow-up surveillance, subclinical asymptomatic thrombus would remain undetected.[9] Early thrombus identification would aid in appropriate management. We could only speculate the reason for thrombus formation in this case, despite strict adherence to dual antiplatelet therapy. A watershed zone between the two streams of blood in different directions, one from the residual interatrial leak and the other from SVC flows through the stent lumen could have contributed to the thrombus formation at the hanging end of the stent. Monitored warfarin therapy after diagnosis resulted in a complete thrombus resolution. A recent report used routine anticoagulation for 6 months after SVD closure.[10] In this emerging new intervention, a routine transesophageal echocardiographic follow-up is recommended in patients with small residual flows to look for thrombus formation in the vicinity of the flows.

Residual leak after SVD closure could result from failure of the opposition of the lower end of the stent to the atrial septum and fabric breach. Insignificant leaks <3–4 mm measured on color Doppler would justify only expectant management. Significant leaks persisting beyond 6–12 months with right heart dilatation would merit an intervention. Strategies would depend on the location of the leak. Residual leaks from caudal extension beyond the lower end of the stent as well as fabric tears would warrant additional covered stents. Localized leaks from the lack of opposition of the stent to the atrial septum would be managed with stent dilation using larger balloons. If leaks persist, they can be addressed by low-profile double-disc devices such as Amplatzer Duct Occluder II (Abbott, Plymouth, MN) or Konar MF device.[7] Protrusion into the lumen of the RUPV should be avoided during deployment using TEE guidance.

CONCLUSIONS

Residual leaks and thrombus formation over covered stents are potential late complications after transcatheter SVD closure. Small residual leaks and subclinical thrombosis might be missed due to suboptimal TTE images. Meticulous postprocedural TEE imaging is mandatory to identify them. The recent surge in interest in this intervention as a surgical alternative should be matched by postprocedural surveillance imaging protocols. Significant residual leaks could be addressed by additional interventions.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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