Cardiology in the Young

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Successful percutaneous closure of a recurrent aorto-left ventricular tunnel with an Amplatzer Vascular Plug II

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Brief Report

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Abstract

Aorto-left ventricular tunnel is an extremely rare CHD clinically impressing as aortic regurgitation. This is usually corrected surgically, sometimes by percutaneous catheter intervention. Recurrent aorto-left ventricular tunnel has been reported occasionally. Reports of percutaneous closure of such recurrent aorto-left ventricular tunnels are rare. We hereby describe successful closure of a recurrent aorto-left ventricular tunnel with an Amplatzer Vascular Plug II.

Aorto-left ventricular tunnel is an extremely rare congenital paravalvular communication between the ascending aorta and the left ventricle bypassing the aortic valve and causing diastolic runoff from the aorta to the left ventricle.[1,2] Whilst an aorto-ventricular tunnel is a Congenital Heart Disease, a ruptured sinus of valsalva is possibly an acquired heart disease and can connect the aorta with any cardiac chamber where the most frequently seen connection is between right coronary sinus and right atrium. Whilst a coronary fistula, which can have the same haemodynamic effects, originates at one of the coronary ostia, the aorto-left ventricular tunnel has no connection with the coronary artery system. Aorto-left ventricular tunnel tends to pass through the intracardiac myocardium to reach the ventricle. Most frequently, treatment consists of surgical closure at the time of diagnosis, depending on the haemodynamic relevance. However, residual and recurrent tunnel as well as valvar aortic regurgitation are known complications.[3,4] Only a few case reports describe transcatheter device closure.[4,5,6] We describe an uncommon case of recurrent aorto-left ventricular tunnel after initial surgical closure, treated percutaneously.

Case report

An 11-year-old boy, who underwent surgical closure of aorta-left ventricle tunnel 2 years ago, presented with increasing breathlessness for the last three months, exertional palpitations, and was restricted in his activities since the primary surgical closure of the tunnel.

On clinical examination, a to-and-fro murmur was heard at the right upper sternal border, and a hyper-dynamic apex was palpable. On ECG, left ventricular dominance was notable. Chest X-ray showed cardiac enlargement. Transthoracic echocardiography revealed recurrence of the aorto-left ventricular tunnel as well as a dilated aortic root with mild central aortic regurgitation (Fig 1) and significant left ventricular and atrial dilatation.

After multidisciplinary discussion, percutaneous closure was planned. Should this be not successful, surgery was stand-by as backup.

Transoesophageal echocardiography showed a tunnel originating from the right aortic sinus, with a diameter of 5 mm at the aortic end, and 7 mm at the left ventricular end. The tunnel was distinct from the right coronary ostium (Fig 2). It measured almost 20 mm in length. The recurrent aorto-left ventricular tunnel appeared at the site of the previous aorto-left ventricular tunnel. This was a haemodynamically significant aorto-left ventricular tunnel causing symptoms.

Angiography with individual coronary injections confirmed that there was no connection of the tunnel with any of the coronary arteries. Aortic root injection delineated the aorto-left ventricular tunnel in complete length (Fig 3). It was crossed retrogradely with a 4F JR-catheter (Cordis, Miami Lakes, USA) over an 0.035 Amplatzer extra stiff wire (Boston Scientific, Marlborough, Massachusetts, USA), and the course was further delineated with individual hand injections, whilst concomitant right coronary injections clearly demonstrated separate origins of the two structures.

Under fluoroscopic and transoesophageal echocardiography guidance, a 10 mm Amplatzer Vascular Plug II (Abbott, Chicago, United States of America) was retrogradely deployed

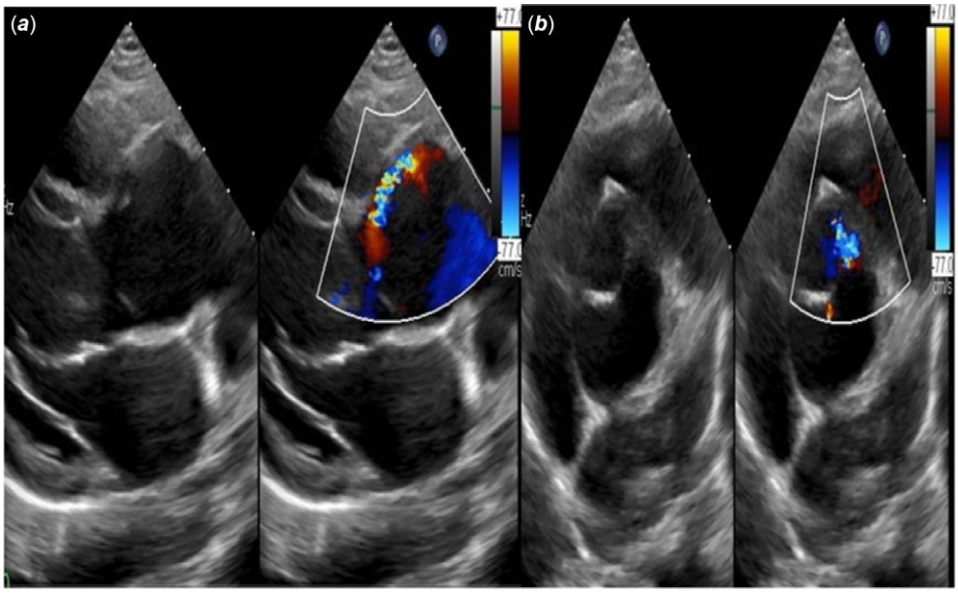

Figure 1. Transthoracic echocardiography depicting the aorto-left ventricular tunnel.

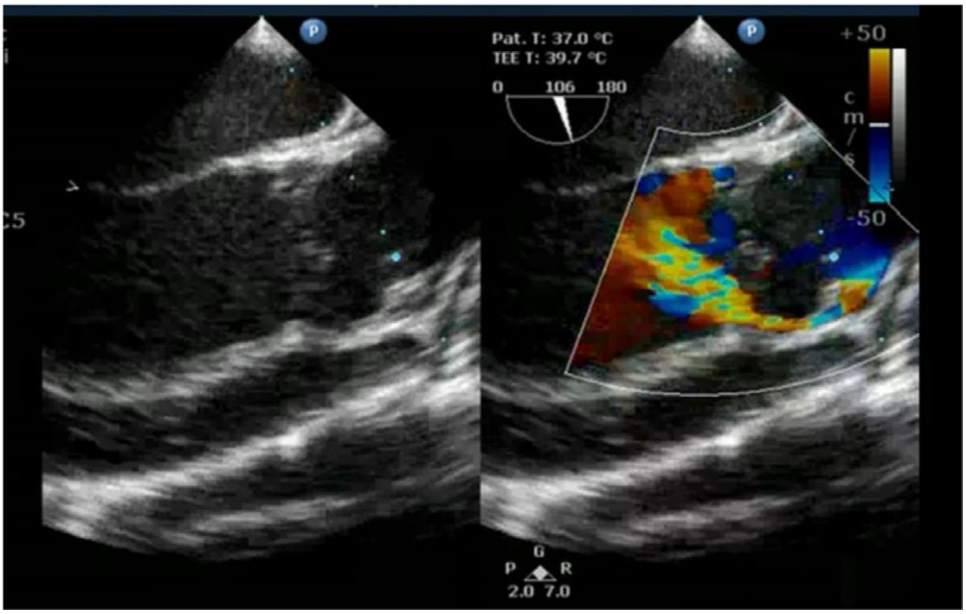

Figure 2. Transoesophageal echocardiography showing complete length of aorto-left ventricular tunnel with diastolic runoff from aorta to the ventricle.

through a 7F Amplatzer TorqVue sheath (Abbott, Chicago, United States of America) covering the aortic origin with one of the disks with the body and second disk within the tunnel. With repeat angiograms, we paid meticulous attention to the coronary ostia, which turned out to be far away from the tunnel. The ostium of the right coronary had no direct relation to the aorto-left ventricular tunnel. The distance between the tunnel and the ostium was 10 mm.

Angiography confirmed uninterrupted right coronary flow (Fig 4). After release, the Amplatzer Vascular Plug II was stable within the tunnel. His pre-procedure aortic blood pressure was 124/50 mmHg which improved to 130/80 mmHg post-procedure. Pre-procedure LVEDP of 10mmHg decreased to 8 mmHg post-procedure. PA pressures recorded were 26/14 mmHg with mean of 18 mmHg.

Post-interventional transoesophageal echocardiography revealed stable device in situ and no residual leak across the tunnel. Only trivial central aortic regurgitation was seen (Fig 5). Directly after the procedure, there was only trivial flow through the device, which was not visible anymore on transthoracic echocardiography before discharge and on further follow-up. Further transthoracic echocardiography confirmed stable device position without any residual shunt. The procedure was performed under Inj Heparin (100 Units/kg) dose to maintain ACT between 160—180 ms. Total duration of the procedure was 45 minutes. The patient was discharged 48 hours after the procedure in good clinical condition. He received oral anti-platelet treatment with a single agent (Tablet acetylsalicylic acid, 3 to 5 mg/kg/day) for six months post-procedure. The patient was clinically asymptomatic at one-year follow-up with unchanged device position. Aortic regurgitation

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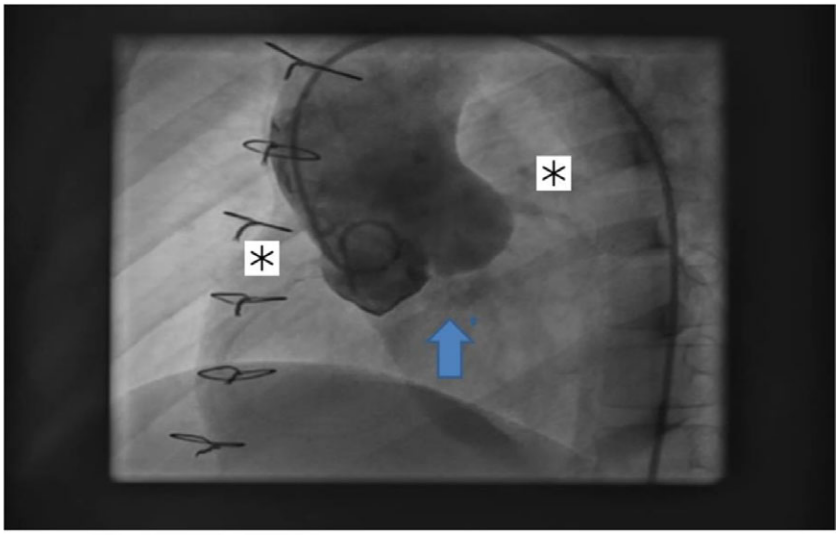

Figure 3. Aortic root injection in LAO/Cranial (65/25 degrees) projection showing aorto-left ventricular tunnel (arrow), with the origin of both right and left coronary arteries separate from the tunnel (asterixis).

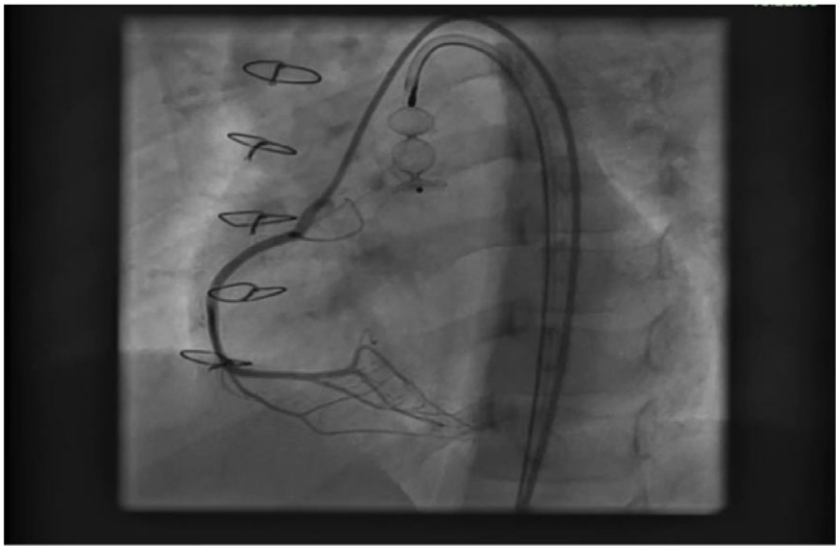

Figure 4. LAO/Cranial (70/30 degrees) projection reveals the origin of the right coronary artery away from Amplatzer Vascular Plug II deployed across the aorto-left ventricular tunnel.

was even less than pre-interventionally and was considered trivial. He did not need any physical restrictions anymore.

Discussion

First described by Levy et al.,[1] aorto-left ventricular tunnel is an abnormal extracardiac connection between the ascending aorta, typically just above the right coronary sinus of Valsalva, that enters the left ventricular cavity bypassing the aortic valve. Diastolic run-off into the left ventricle can cause significant volume overload. Haemodynamically, this shows all features of significant aortic valve regurgitation. Hovaguimian et al.[7] classified the defects into four categories: 1. Simple tunnel with a slit-like opening at aortic end, 2. an oval opening at aortic end with large extracardiac aneurysm of tunnel, with or without aortic valve incompetence, 3. intracardiac aneurysm of tunnel with or without right ventricular outflow obstruction, 4. a combination of types 2 and 3 with aneurysmatic configuration both intra- and extracardially. Having a slit-like aortic origin of the tunnel, our patient was classified as type 1, even if this classification is for native and not post-operative tunnels.

Some case reports mention concomitant aortic valve atresia, or additional congenital abnormalities such as aortic or pulmonary valve dysplasia with or without stenosis, right ventricular outflow obstruction, or involvement of coronary ostia.[4] Our patient had aorto-left ventricular tunnel without other congenital cardiac abnormalities.

This diagnosis, even for asymptomatic cases, is always considered an indication for closure; either surgically[7] or percutaneously, even if the latter has not been performed frequently.[3,5,6] Surgical techniques involve closure of either the aortic origin alone or the ventricular end as well. As per the operative notes of this child, double patch closure from Aortic end was done. It seems that the risk of recurrence is higher if single end closure has been performed, as happened in our patient.[7]

To our recent knowledge, percutaneous closure of a recurrent aorto-left ventricular tunnel has only been reported once before.[4] In our patient, the device used for closure filled the tunnel

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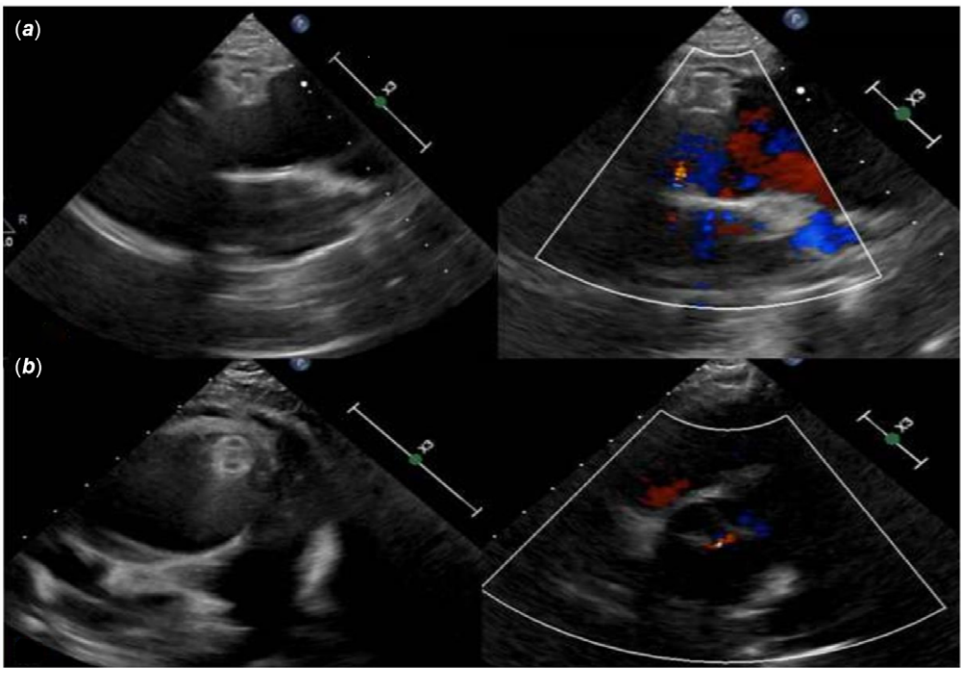

Figure 5. Transthoracic echocardiography (post-device). (*a*) Parasternal long-axis view shows Amplatzer Vascular Plug II in situ; (*b*) parasternal short-axis view, trace aortic regurgitation.

completely and added to the stability of the aortic valve annulus. Thus, on follow-up there was even less aortic regurgitation.

The choice of the device for percutaneous closure was guided by the anatomy and location of the defect. We did not have microvascular plugs available. Furthermore, the maximum diameter of a vessel closable with these is 9 mm. The microvascular plug has no disc that may make such a device more prone to migration. The Amplatzer Vascular Plug II was chosen in view of disks at both ends, one of which we placed in the aortic origin, whilst the cylindrical body filled the length of the tunnel. The disk at aortic as well as ventricular ends of the aorto-left ventricular tunnel prevented migration of the device. As in a previously published case report,[6] oversizing of 100% from the narrowest segment measurement was considered to minimise the risk of embolisation; hence, for our patient a 10 mm Amplatzer Vascular Plug II was selected. Our case demonstrates that percutaneous treatment of recurrent aorto-left ventricular tunnel can be performed safely with good mid-term results.

Conclusion

Post-operative recurrent aorto-left ventricular tunnel can be closed percutaneously with good immediate and mid-term results. Due to its design, Amplatzer Vascular Plug II appears to be a good choice for closing these tunnel-shaped defects. The device can add to stability of the aortic valve annulus.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S1047951122002785

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Conflicts of interest. None.

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