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CASE REPORT
Other

Degenerated BioBentall graft with failing stentless bioprosthesis and dissection of the aortic conduit treated with a bail-out valve in valve procedure: a case report

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Background The Bentall procedure is commonly performed to treat combined aortic valve and ascending aorta disease requiring surgical correction. Although the technique has been shown to provide favourable long-term outcomes, both the valvular prosthesis and the aortic conduit can go through structural degeneration. Increasing use of the biological prosthesis opened to percutaneous treatment of valvular deterioration according to a valve-in-valve (ViV) technique. On the contrary, damages of the tube graft are normally referred to repeated surgical operation.

Case summary In the present case, a patient with a biological Bentall graft was diagnosed with severely deteriorated stentless aortic prosthesis and dissection of the conduit arising from a tube wall tear closely located to the valvular plane. The attempted redo surgery was technically unfeasible because of severe mediastinal adhesions; therefore, a ViV procedure with a balloon expandable transcatheter heart valve was performed in order to contemporarily treat the valve prothesis dysfunction and the aortic tube dissection. No procedure-related complications occurred and subsequent aortic computed tomography angiography showed the sealing of the graft wall false lumen.

Discussion Surgical reintervention remains the treatment of choice for degeneration of a previous Bentall surgery, especially when damages of the aortic conduit exist. Nevertheless, when surgery has to be discarded, ViV can be a reliable option as a bail-out strategy to deal with combined aortic valve dysfunction and tube dissection.

Keywords BioValsava degeneration • Valve-in-valve coronary occlusion • Valve-in-valve paravalvular leak • Case report

ESC Curriculum 2.4 Cardiac computed tomography • 4.1 Aortic regurgitation • 4.2 Aortic stenosis • 7.4 Percutaneous cardiovascular post-procedure • 9.1 Aortic disease

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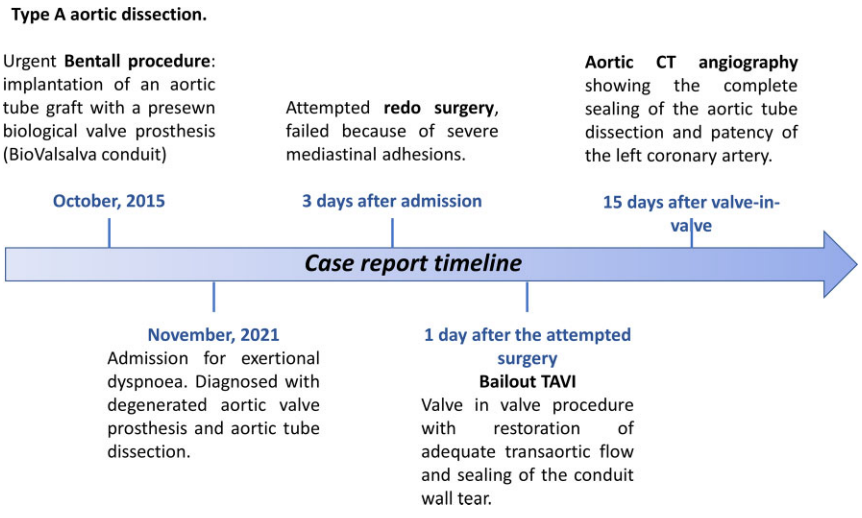
Learning points

- Dissection of the prosthetic wall of an ascending aortic graft is an unusual finding, and it generally requires surgical reintervention in order to avoid a pseudoaneurysm formation.
- In the case of a previous Bentall surgery with combined degeneration of a biological valve prosthesis and dissection of the aortic conduit with a wall tear closely located to the valvular plane, transaortic aortic valve replacement (valve in valve procedure) can be a bailout option to deal with both issues if surgical reintervention is not feasible.
- Careful computed tomography-guided planning of the procedure is mandatory in order to assess the risk of coronary obstruction, in order to define the ideal valve implantation depth, and in the eventual need for pre-deployment coronary protection.

Introduction

The Bentall procedure can be considered as the gold standard for the treatment of combined aortic valve and ascending aortic disease requiring surgical replacement. Today, the so-called 'BioBentall' (an aortic conduit pre-sewn with a biological prosthesis) is usually the preferred solution, mainly because of freedom from lifelong anticoagulation following the intervention. The Biovalsava conduit (Vascutek Terumo, Renfrewshire Scotland) is an example of BioBentall prosthesis made by a three-layered polyester aortic tube pre-sewn with a stentless aortic valve (Elan, Vascutek, Terumo).[1] Long-term outcomes of isolated aortic valve replacement and Bentall procedure were similar, and reintervention is mostly due to valve deterioration.[2] At this regard, percutaneous valve-in-valve (ViV) procedure for degenerated prostheses emerged to be feasible (even with a Bentall aortic conduit), although associated with unique technical challenges and risks, especially an increased incidence of coronary obstruction.[3,4] On the contrary, complications related to the aortic conduit (e.g. endocarditis, pseudoaneurysm) normally require a surgical redo.

Timeline



Case report

A 67-year-old man was referred to our centre for exertional dyspnoea developed during the last couple of months (NYHA class IIb). His daily medical therapy included only Cardioaspirin and Valsartan. He underwent urgent Bentall procedure for type A dissection 6 years before and a BioValsalva conduit with a 25 mm sized valve was implanted. At the admission, physical examination did not show any signs of heart failure but a moderate systo-diastolic murmur was clearly detected; transthoracic echocardiography showed a degenerated aortic prosthesis with severe stenosis (transvalvular mean gradient 45 mmHg) and moderate-to-severe regurgitation consequent to a paravalvular leak, as confirmed by transoesophageal echocardiography (*Figure 1*, see Supplementary material online, Video). To assess the feasibility of percutaneous VIV, we performed an aortic computed tomography (CT) angiography (according to the transaortic aortic valve replacement—TAVI—protocol), which showed a dissection of the three-layered aortic graft arising from the valvular plane (*Figure 2*). After patient's evaluation by local Institutional Valvular Team, despite the possible feasibility of transfemoral TAVI, considering the relatively young age of the patient and the concerns of possible evolution of the graft dissection to a life-threatening pseudoaneurysm, it was decided to perform a second Bentall procedure. Pre-interventional coronary angiography showed a chronic occlusion of the right coronary ostium with good retrograde collateral circulation (Rentrop grade 3) and a viable left coronary artery. After median sternotomy, before cardiopulmonary bypass, surgical inspection showed extensive mediastinal adhesions to the polyester conduit, and the redo intervention

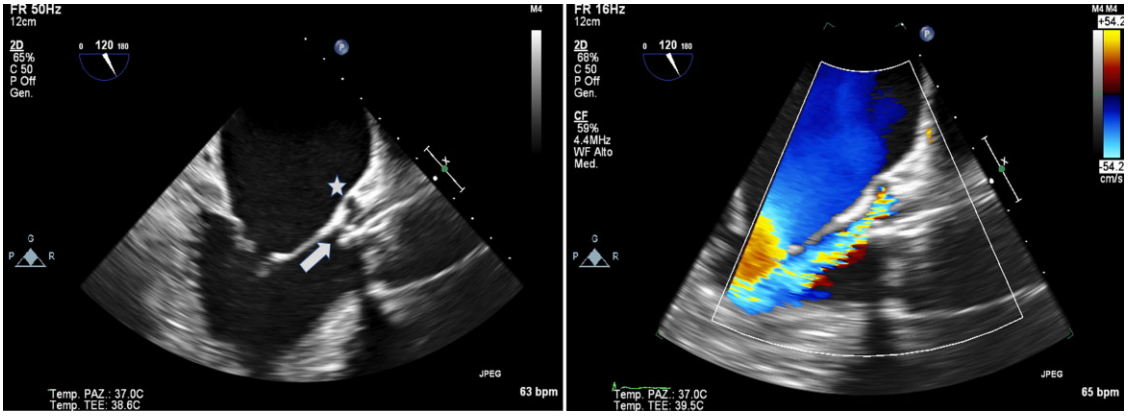


Figure 1 Transoesophageal echocardiography showing a moderate to severe aortic regurgitation due to a paravalvular leak. Arrow indicates the site of the partial bioprosthetic detachment from the graft causing the leak. Star indicates the likely site of the graft wall tear.

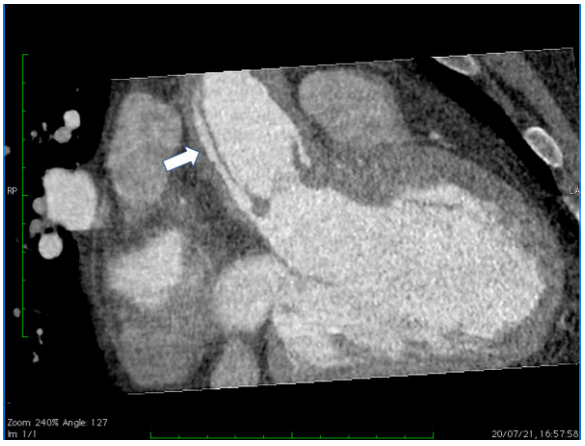


Figure 2 Aortic computed tomography angiography showing dissection of the Dacron conduit, arising from the valvular plane (arrow).

was aborted. At that point, TAVI became the only available option, and CT angiography was carefully revaluated to establish the transcatheter heart valve (THV) size and assess the procedure risk of the left main obstruction (*Figure 3*). Given the absence of severe calcifications of the cusps, the target anchoring plane for the THV was the Dacron sewing ring of the conduit, at the native annulus plane and immediately below the porcine cusps' reflection point. According to product specifications and ViV app,[5] the sewing ring of a 25 mm BioValsalva conduit has an inner diameter (ID) of 25 mm, and the bioprosthetic valve has a true ID of 23 mm and is mounted at the bottom of a conduit with a constant ID of 26 mm. The distance between the sewing ring and the take of the left coronary artery (LCA) was not easily detectable at CT, but it was estimated to be no more than 12 mm. Taking into account the known perivalvular leak and aortic graft wall tear at the site of the valvular insertion, a balloon expandable THV, providing more radial strength than a self-expandable one, was preferred. Finally, considering the Dacron sewing ring size, an Edwards Sapien 3 26 mm was choice, as also suggested by the ViV app; this model has an overall 20 mm

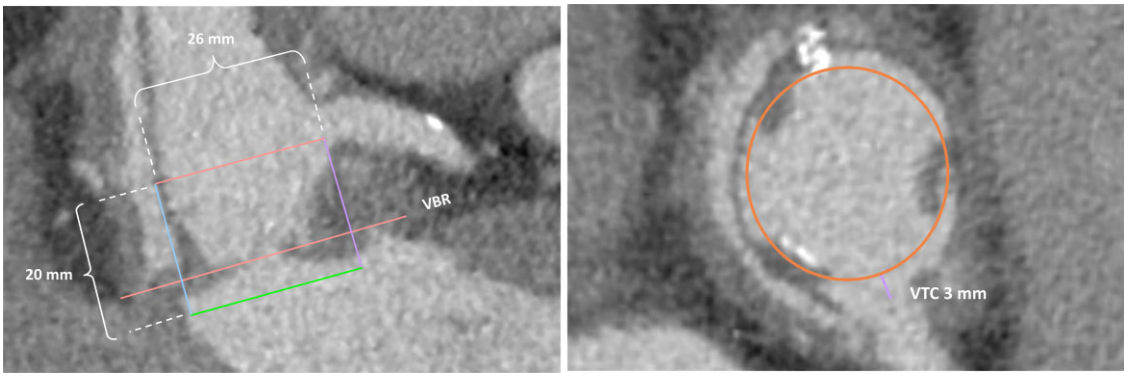


Figure 3 Computed tomography simulation of the transcatheter heart valve implantation. A cylinder with the same dimension of the chosen transcatheter heart valve (Edwards Sapien 3) was projected into the aorta: supposing a 70/30 implantation (see text) and referring to the BioValsalva sewing ring as the virtual basal ring, a concerning valve to coronary distance of 3 mm was obtained.

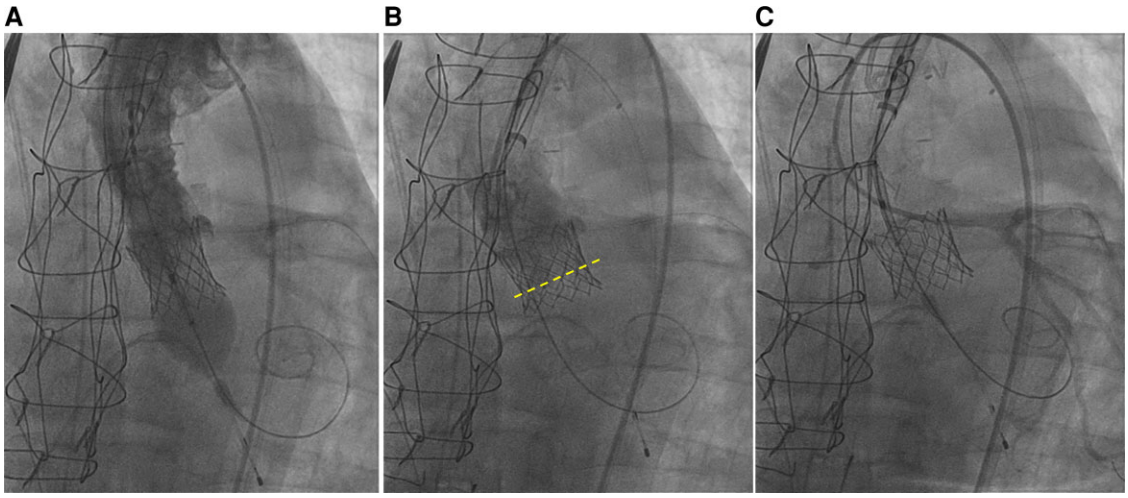


Figure 4 (*A*) Aortic angiography during transcatheter heart valve deployment showing deep implantation: central marker of the valve balloon is located below the cusp's nadir. (*B–C*) Post-deployment angiography confirms deep positioning of the transcatheter heart valve (dotted line passing through the cusps' nadir shows a 70:30 implantation height), without relevant regurgitation and patency of the left main.

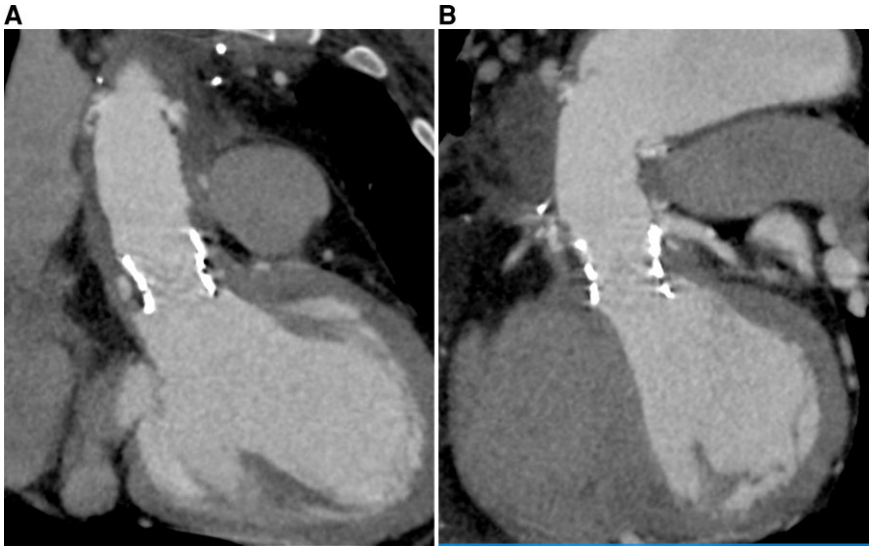


Figure 5 Post-transaortic aortic valve replacement computed tomography angiography showing the graft dissection sealing (A). Computed tomography imaging confirms transcatheter heart valve stent frame position, immediately below the left main ostium (B).

height and simulating a standard 70/30 height deployment (70% of the prosthesis struts above and 30% below the annulus), a virtual cylinder leaning on the sewing ring with a 26 mm diameter and a height of 14 mm was projected into the aorta. The deployment simulation predicted that THV frame would have been in front of left coronary ostium with a concerning valve to coronary distance (VTC) of 3 mm (*Figure 3*). The day after the failed redo surgery, TAVI via transfemoral approach was attempted. The procedure was performed under general anaesthesia following the classical steps. We decided to wire the left anterior descending artery to eventually be ready for the treatment of LCA occlusion. Moreover, because of the relevant paravalvular leak, before advancing the THV through the deteriorated bioprosthesis, transoesophageal echocardiography confirmation of the passage of the wire through the true valve orifice was obtained. During the valve deployment, the Edwards Sapien' central marker was maintained slightly below the virtual line passing through the cusps' nadir (where the target Dacron sewing ring of the BioValsalva was expected to be located) so that a mildly deeper implantation than normal was obtained, reducing the risk of the left main occlusion (*Figure 4A*). Final angiography showed no significant aortic regurgitation and patency of the LCA (*Fig.4B and C*); no conduction disturbances were observed. The patient was rapidly

extubated, and he was discharged three days after the procedure. Post-TAVI echocardiography showed a residual mild aortic stenosis (mean gradient 18 mmHg) and a trivial intra-prosthetic regurgitation. Fifteen days after TAVI, the patient underwent a new aortic CT angiography to assess the evolution of the graft dissection: the contrast enhancement of the false lumen was not detectable anymore and the THV struts were confirmed to be located immediately below the left main stem ostium (*Figure 5*). Six months after the procedure, the patient is free from dyspnoea, flow velocity across the prosthesis is stable (mean gradient 17 mmHg), and no regurgitation can be depicted at transthoracic echocardiography.

Discussion

To our knowledge, this is the first reported case of a degenerated BioBentall prosthesis with combined dysfunction of a stentless aortic valve and dissection of the aortic conduit successfully treated with a ViV procedure. Although THV implantation for degenerated bioprosthesis has been extensively demonstrated to be feasible,[6] in our case the surgical intervention was the first choice mainly because of the concerning delamination of the aortic conduit. Being forced to the percutaneous approach by the failure of the redo surgery, several issues had to be faced. It is known that stentless aortic prosthesis are related to an increased risk of coronary ostia obstruction,[7] and in our case, the concern was strengthened by the short LCA height from the valvular plane and the minimum VTC distance. For this reason, a slightly deeper THV implantation than usual was preferred dealing with the increased risk of paravalvular leak or conduction disturbances.

The real gamble of the whole intervention was the possibility to seal the paravalvular leak and, above all, the Dacron conduit wall tear with a THV implantation. ViV procedure has been shown to be a possible solution to paravalvular bioprostetic leaks,[8] and it can be expected to succeed especially for stentless aortic valves, where a rigid valvular sewing ring lacks. Dissection entry tear was not clearly depicted by CT angiography but the false lumen began from the valvular plane, apparently on the same side of the paravalvular leak (*Figures 1 and 2*). Therefore, we supposed that an adequate THV expansion could have contemporarily closed the delamination entry point of the tube and seal the leak. At this regard, it was necessary to reach a compromise between the necessity of a deep-seated deployment and an adequate apposition of the stent frame to the prosthetic root.

Finally, considering the young age of the patient, doubts about long-term prognosis of a ViV procedure in a similar challenging setting could be fairly arisen. Durability of THV in respect to the surgical replaced ones is still an unsolved question and data are sparse, especially for ViV cases. According to actual evidence and taking into account all the technical issues that has to be managed, the percutaneous approach for a similar case can be considered as a bail-out strategy, only when surgery as to be discarded.

Conclusion

Structural delamination of a Dacron aortic conduit is generally detected as a pseudoaneurysm requiring surgical replacement. True dissection of the prosthetic tube can be interpreted as an earlier stage of the deterioration process that can result to pseudoaneurysm formation. In a similar scenario, when surgical reintervention is deemed unfeasible and the graft wall tear is located close to the valvular plane, TAVI can be a bailout option to seal the false lumen. In the setting of a degenerated Bio-Bentall graft with a deteriorated stentless bioprosthetic valve, TAVI remains a valuable solution, although special cares have to be taken, especially to avoid coronary obstruction.

Lead author biography

Doctor Massimo Fineschi is the Interventional Cardiology Unit Director at the Siena University Hospital (Azienda Ospedaliera Universitaria Senese, Siena, Italy). He completed his medical degree and cardiology residency at the University of Siena and since then he has been working as interventional cardiologist. He developed specific interests for complex coronary interventions, multimodality endovascular imaging techniques and percutaneous structural interventions (TAVI, mitral valve transcatheter edge-to-edge repair, atrial septal defects repair).

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Slide sets: A fully edited slide set detailing these cases and suitable for local presentation is available online as Supplementary data.

Consent: The patient has consented to the submission of the case report to the journal and to the eventual publication. Original signed version of the consent form is available to the Journal Editor if specifically requested. The authors confirm that written consent for submission of the case report including images and associated text has been obtained from the patient in line with COPE guidance.

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