CLINICAL VIGNETTE

Transcatheter Aortic Valve Replacement in a Patient with Marfan Syndrome and Prior Aortic Valve Repair within a Hemashield Graft

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A 27-year old female with past medical history of Marfan syndrome presented with subacute, progressively worsening dyspnea on exertion. She was diagnosed with Marfan syndrome in childhood based on phenotypic features and mitral valve prolapse. She was diagnosed with severe mitral regurgitation at the age of 17. At that time, she had an aortic root of 3.7 cm (Z-score 2.7) and underwent successful mitral valve repair, and, due to her desire to bear children in the future, she also underwent concomitant valve-sparing aortic root replacement (VSARR) (David V procedure) with a Hemashield graft, a collagen-impregnated woven vascular graft. Her post-operative course was complicated by pericardial effusion requiring pericardiocentesis.

At age 24, she developed severe aortic regurgitation (AR) and underwent aortic valve repair. The surgical notes from this redo-sternotomy noted "severe" adhesions encountered during dissection. Her post-operative course was complicated by the development of atrial fibrillation and flutter requiring two cardioversions.

At age 27, the patient began to report exertional dyspnea. Trans-thoracic echocardiography (TTE) revealed severe AR, with 20mm aortic annulus, and severe calcification and degeneration of all three aortic cusps (Figure 1).

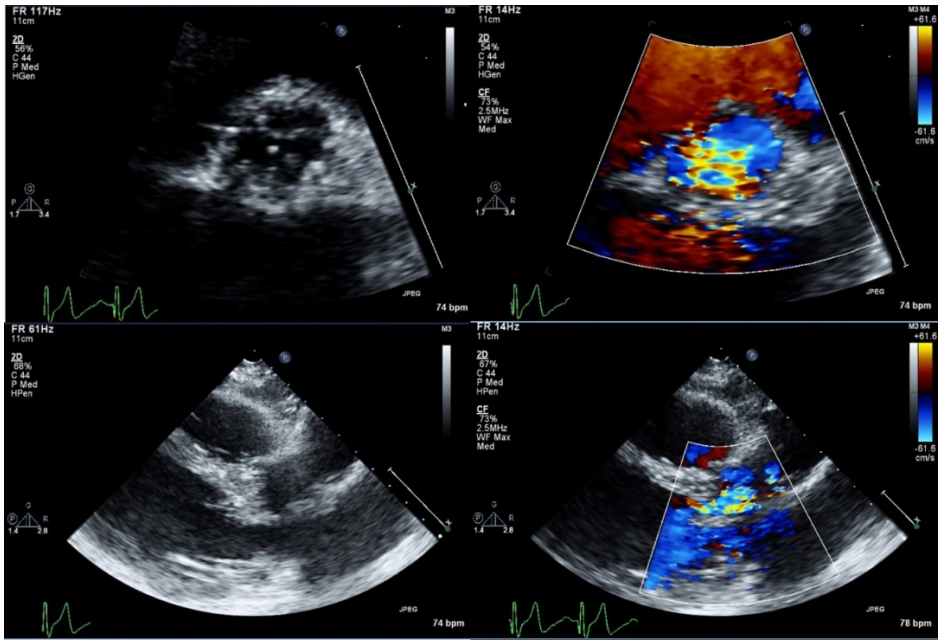

Figure 1: Transthoracic echocardiographic images obtained pre-TAVR. Top Left: Parasternal short axis. Top Right: Parasternal short axis with color showing AR. Bottom Left: Parasternal long axis. Bottom Right: Parasternal long axis with color showing AR.

The patient was extensively counseled on the risks and benefits of a surgical aortic valve replacement (SAVR). She was referred to two tertiary care centers given the complexity. The patient strongly desired a transcatheter aortic valve replacement (TAVR) to avoid a third sternotomy. One tertiary care center declined to offer TAVR given her prior Hemashield aortic graft, with potential increased risk of peri-procedural aortic root rupture. She was eventually offered TAVR at another tertiary care center.

A 26-mm Edwards Sapien Ultra (Edwards LifeSciences, Irvine, CA, USA) was deployed across the aortic valve in standard fashion. After valve deployment, the patient had trace AR on fluoroscopy.

The post-TAVR TTE showed aortic valve peak velocity of 2.5m/s and pressure gradient of 13mmHg with trace AR (Figure 2).

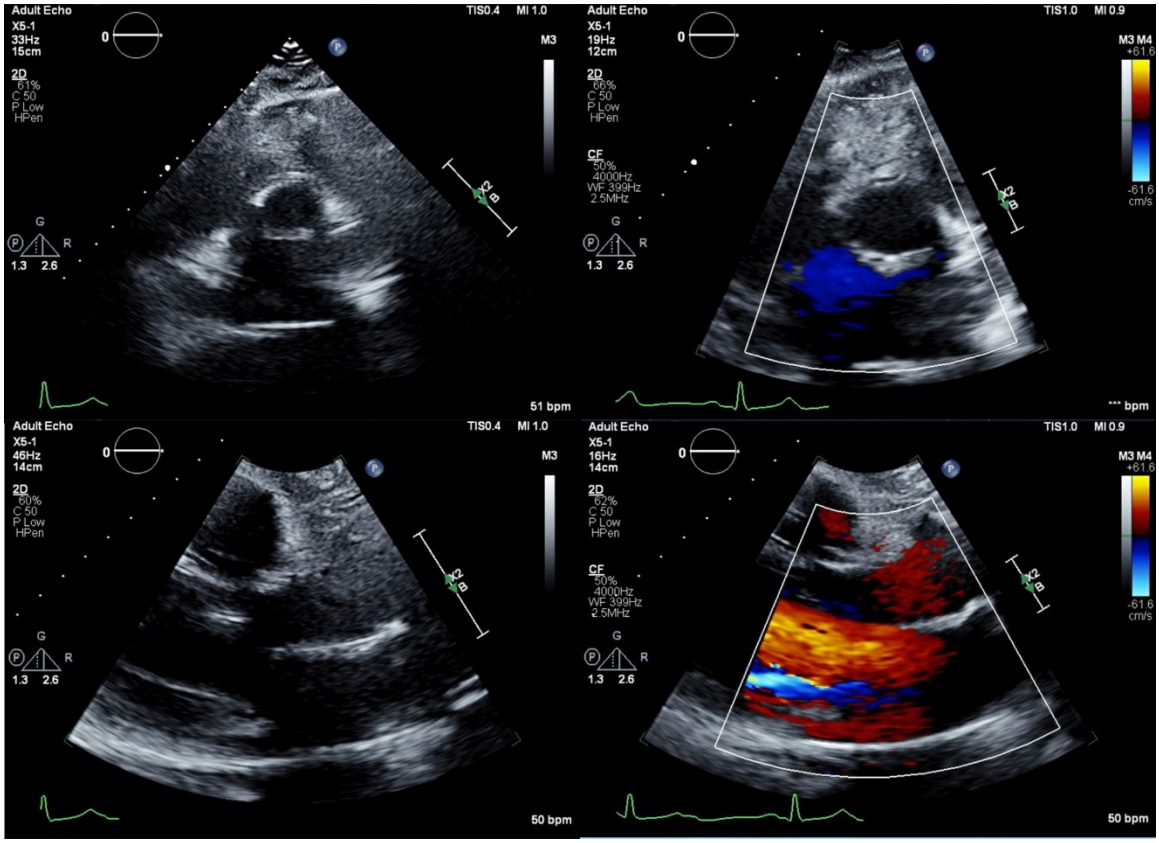

Figure 2: Transthoracic echocardiographic images obtained post-TAVR. Top Left: Parasternal short axis. Top Right: Parasternal short axis with color showing no AR. Bottom Left: Parasternal long axis. Bottom Right: Parasternal long axis with color showing no AR.

Her post-procedural course was complicated by high grade atrioventricular block requiring dual chamber permanent pace-maker placement. At three months follow-up after TAVR, she reported improved functional capacity.

Discussion

This case illustrates the cardiovascular care of a patient with Marfan syndrome, a novel use of TAVR in native valve AR within a Hemashield graft, and the shared decision-making care model.

Marfan syndrome is a connective tissue disease associated with cardiovascular, ocular and skeletal complications.[1] With an incidence of approximately 2-3 per 10,000 it is one of the more common connective tissue disorders.[2] Some cardiovascular manifestations require surgical care and can include mitral valve prolapse, aortic aneurysms, aortic dissection, and AR. These patients undergo annual cardiovascular screening from an early age, and carry a high burden of cardiovascular disease throughout their lifetime.[3] Therefore, internal medicine doctors should be familiar with their care.

Cardiothoracic surgery is frequently required. One area of concern has been repeat sternotomies, which are more technically challenging because scar tissue and adhesions from the prior incision make dissection difficult. Redo sternotomy procedures are reported to have higher incidence of cardiac injury, which can include injury to coronary vessels as well as the myocardium.[4-6] Prior to any major intervention, these patients will benefit from shared decision-making to ensure

counseling that maintains a therapeutic alliance with their healthcare teams.

Aortic disease is found in 60-80% of patients and includes aortic dissection, aortic aneurysm, and AR. This is the main determinant of lifespan.[7] Aortic aneurysms are classically asymptomatic, and aortic dissections present similarly to the general population, with severe tearing chest pain and hemodynamic instability. Aortic regurgitation can be clinically silent until very late stage disease, when patients may present with exertional dyspnea, orthopnea, atypical angina, and widened pulse pressure. Around 40-50% of patients with Marfan syndrome experience mitral valve prolapse, presenting with atypical chest pain and palpitations and regurgitation.[8] Mitral regurgitation is often asymptomatic until severe, when left ventricular remodeling occurs. Complaints include dyspnea on exertion, orthopnea, and atrial fibrillation.

Cardiovascular care for these patients involves screening cardiovascular imaging, beta blocker medical therapy, and prophylactic aortic root surgery to prevent aortic dissection. Screening imaging is predominantly with echocardiograms, but there are roles for computed tomography and magnetic resonance imaging.[9] Annual screening is recommended but may occur more frequently in patients with advanced disease. Beta blockers are the main medical therapy and have been shown to slow the progression of aortic root dilatation.[10] Prior to prophylactic aortic root surgery, the majority of patients died by age 45, whereas their current lifespan is similar to the general population.[3] Eventually, open cardiothoracic surgery is common.

This patient suffered many classic cardiovascular issues associated with Marfan syndrome. After her most recent presentation with AR, she was offered SAVR via a third sternotomy. While SAVR is the gold standard for AR, third-time redo sternotomy is an independent risk factor for cardiac injury.[6,11] It is worth noting that cardiac injury during re-sternotomy may not effect mortality and morbidity.[6] The patient experienced complications from her prior surgeries. There has been increasing interest in TAVR as an alternative in carefully selected patients with high surgical risk.[11] Early data on the safety and efficacy of the procedure are promising, but TAVR also poses technical challenges.[12]

In native valve AR it is difficult to properly anchor the prosthetic valve given the lack of a calcified annulus, which may lead to residual valvular insufficiency. There is also substantial danger of annular rupture from over-inflating the prosthetic valve. This patient was known to have severely calcified aortic valve cusps, which provide some structural integrity to anchor the valve. However, this patient had prior VSARR with a Hemashield graft which makes the aortic root more vulnerable to rupture during TAVR. Both aortic root and aortic annular rupture can be disastrous complications.

For this reason, TAVR in native valve AR status post VSARR is an extremely rare procedure. Literature review identified only two cases, with patients aged 56 and 19 years, with bicuspid aortic valves, no aortic valve calcification, and no history of connective tissue disease.[13,14]

Our patient had a very difficult decision balancing two risks. Her care team employed a shared decision-making model to guide the patient through this process. Shared decision making has been defined as a collaborative model of care that allows patients and clinicians to mutually agree on treatment based on patient values and preferences. Multiple studies have shown that shared decision-making decreases both surgical rates and decisional conflict, while increasing the amount of knowledge obtained by the patient and physician trust.[15,16] One review article reported patients uniformly preferring shared decision making, which makes them feel that their health care is more accessible and aligned with their values.[17]

There are many methods of shared decision-making used to elicit patient preferences, including reading materials, videos, and coaching. Discussions and coaching with this patient occurred over several months. Her doctors were willing to listen to, and advocate for, the patient. They actively petitioned her insurance to refer her to tertiary care centers, communicated with her pediatric surgeon, listened to her concerns, and strongly considered her preference of TAVR in a novel setting. This preserved a therapeutic alliance which would allow for future care of this patient with a chronic condition.

Conclusion

Marfan syndrome carries a lifelong burden of cardiovascular disease. Regardless of Marfan status, TAVR may be a reasonable alternative to SAVR for AR in carefully selected and well-informed patients.

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Conflict of Interest **-** The authors declare that there is no conflict of interest.

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