

Hammock effect and complete cusp prolapse: Rare mechanisms of Melody valve failure demonstrated by intracardiac echocardiography

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ABSTRACT

Transcatheter pulmonary valve replacement using Melody valve (Medtronic, Minneapolis MN) has significantly increased in the recent decades. Melody valve failures, although rare, can be problematic and require re-intervention. Through intracardiac echocardiography, we present two patients who each had a rare etiology for dysfunction of their Melody valve. Hammock effect, wherein the valve does not oppose the stent and complete cusp failure causing severe regurgitation have not been previously described as causes of Melody valve failure in the absence of endocarditis. Awareness and knowledge of these mechanisms is pivotal in the management of this patient population.

Keywords: Cusp failure, hammock effect, intracardiac echocardiography, melody valve failure, transcatheter pulmonary valve

INTRODUCTION

The use of Melody valves (Medtronic, Minneapolis MN) for percutaneous pulmonary valve implantation has increased in recent years. In this manuscript we report two cases in which intracardiac echocardiography played a pivotal role in identifying unique complications associated with its use in the pediatric population. Both patients underwent successful re-implantation.

CASE REPORT

Patient 1 had a history of truncus arteriosus with initial complete repair as a neonate. At the age of 5 (2003), he underwent truncal valve repair and placement of a 19-mm right ventricle (RV) to pulmonary artery (PA) homograft conduit. He developed progressive conduit stenosis over a 3-year period and underwent RV outflow reconstruction using Gore-Tex on the preexisting homograft without replacement. Subsequently, he developed severe conduit

regurgitation with progressive right ventricular dilation. At the age of 13 (2011), he underwent placement of a 20-mm Melody valve (Medtronic, Minneapolis, MN) in the existing conduit with elimination of pulmonary regurgitation and very mild residual stenosis.

During his follow-up visit at the age of 19 (2017), he was noted to have severe Melody valve regurgitation with RV dilation on his transthoracic echocardiogram. A thorough evaluation for evidence of endocarditis including clinical and laboratory data was negative. Cardiac magnetic resonance imaging revealed severe pulmonary regurgitation with a regurgitant fraction of 56%, RV-indexed end-diastolic volume of 140 cc/m², and low RV ejection fraction of 42%. Subsequently, he underwent an elective cardiac catheterization for the assessment of hemodynamics and possible placement of a second Melody valve. During the procedure, an intracardiac echocardiogram (ICE) was performed that demonstrated complete prolapse of the valve leaflets

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10.4103/apc.APC_143_18

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How to cite this article: Jhaveri S, Prieto L, Suntharos P. Hammock effect and complete cusp prolapse: Rare mechanisms of Melody valve failure demonstrated by intracardiac echocardiography. *Ann Pediatr Card* 2019;12:342-4.

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without any coaptation leading to severe regurgitation. There were no vegetations or masses visualized [Figure 1 and Video 1a and b]. Following this, a Melody valve (TPV22) was successfully placed within the conduit over a 22-mm Ensemble system. At his most recent follow-up 1 year postplacement, his Melody valve function was excellent with no significant stenosis or regurgitation.

Patient 2 was diagnosed with truncus arteriosus at birth and repaired at the age of 3 months. He underwent reoperations for the replacement of his RV-PA conduit at the age of 2 (1983) and 19 (2000), with the latter one being a 20-mm-sized homograft. At the age of 29 (in 2010), given progressive homograft regurgitation and stenosis in the setting of RV dysfunction, he underwent a cardiac catheterization with placement of a Melody valve (TPV22) within his homograft over a 20-mm Ensemble system.

Three years later, he presented with acute right-sided heart failure with pedal edema, hepatomegaly, and limited exercise capacity. His cardiac examination revealed a harsh 3/6 systolic ejection murmur at the right upper sternal border. Transthoracic echocardiogram showed severe Melody valve stenosis with a peak gradient of 80 mmHg due to an unclear mechanism. Endocarditis was excluded based on the negative blood cultures and lack of fevers. A cardiac catheterization with ICE was performed. This showed loss of contact between the valve and the stent with a “hammocking” movement, leading to severe regurgitation and stenosis [Figure 2 and Video 2a and b]. A new Melody valve (TPV22) was placed over a 20-mm Ensemble system within the former one with acute success. Two years from his cardiac catheterization, he continues to have good Melody valve function with mild residual stenosis and no regurgitation.

DISCUSSION

Transcatheter pulmonary valve placement was first performed in humans in 2000 by Dr. Bonhoeffer.^[1] The valve design was subsequently acquired by Medtronic and renamed the Melody Valve. Over the next decade,

it became increasingly used in North America with high success rates. It consists of a harvested bovine jugular venous valve that is sutured into a platinum-iridium stent frame and then crimped onto a delivery balloon Ensemble system.

Callahan *et al.* reported on their experience with bioprosthetic pulmonary valve failures. Of the 14 patients with transcatheter pulmonary valve failures, loss of stent integrity and endocarditis were the primary causes for severe pulmonary stenosis. None of the patients had pure leaflet dysfunction as seen in our report (patient 1).^[2] In a recent study on mid-term outcomes after Melody valve failure, none of the 111 patients with Melody valve placements developed cusp failure at a 7-year follow-up.^[3]

The hammock effect wherein the valve does not maintain contact with the stent was a cause of in-stent stenosis in the early generation of Melody valves. This prompted modification of the design in 2003 to add more sutures at all strut intersections over the entire length and circumference of the venous graft and is not expected with the new generation valves.^[4] In the presence of endocarditis, pus and vegetations can accumulate between the stent and the valve leading to the hammock effect.^[5,6] However, without endocarditis, hammock effect that occurred in patient 2 is not a reported complication.^[3]

In this series, we describe two unique mechanisms of Melody valve failure that resulted in right-sided heart failure. Based on our literature review, these complications have not been previously reported, in the lack of endocarditis. Both patients underwent successful valve-in-valve replacement. This paper highlights the role of intracardiac echocardiography in elucidating these mechanisms of valve failure and raises awareness on unusual etiologies of Melody valve failure.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

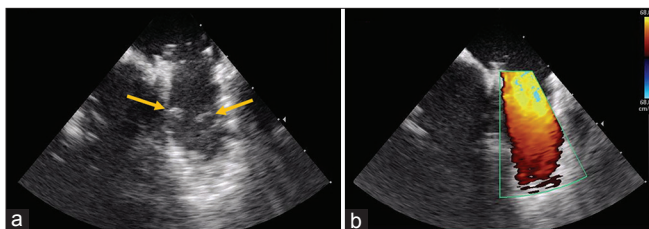


Figure 1: A two-dimensional image (a) and color Doppler (b) obtained through intracardiac echocardiography demonstrating complete lack of coaptation of valve leaflets (arrow) causing severe regurgitation

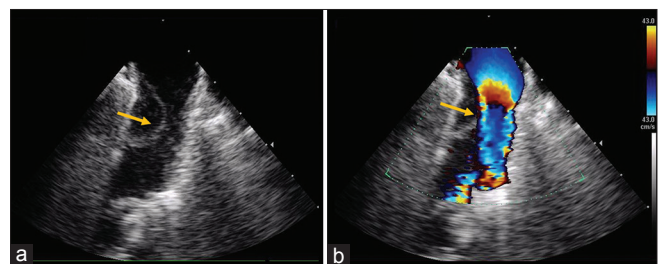


Figure 2: A two-dimensional image (a) demonstrating loss of apposition of the Melody valve and stent causing collapse (arrow) of the valve into the lumen. Color Doppler (b) showing stenosis at the level of the “hammocking” valve

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