CLINICAL VIGNETTE

Recurrent Severe Bioprosthetic Tricuspid Valve Stenosis Treated with Transcatheter Valve Replacement

Pooja Desai, MD[1], Jamil Aboulhosn, MD[2] and Samuel Daneshvar, MD[3]

[1]Department of Internal Medicine, UCLA Medical Center, Los Angeles, CA
[2]Ahmanson/UCLA Adult Congenital Heart Disease Center, Los Angeles, CA
[3]Division of Cardiology, Santa Monica-UCLA Medical Center, Los Angeles, CA

Background

Tricuspid bioprosthetic valves are at risk of re-stenosis and have typically been repaired surgically. We present a case of successful valve-in-valve repair in a patient with high surgical risk.

Case

A 54-year old man presented with progressive fatigue and lower extremity swelling. The patient had prior intravenous drug use, with native tricuspid valve endocarditis with surgical replacement with a bioprosthetic valve 32 years prior. Following this initial surgery, he developed recurrent tricuspid stenosis requiring redo sternotomies with tricuspid valve replacements 5 and 15 years post primary replacement. He also had hepatitis C, liver cirrhosis, atrial fibrillation. His medications included warfarin.

Transthoracic echocardiogram was notable for severely dilated right atrium and tricuspid stenosis of the valve replacement. There was a peak velocity of 2.3 m/s, mean transvalvular gradient of 15 mmHg and pressure half-time of 456 ms (Table 1[1], Figure 1). Due to concern for bioprosthesis failure, he was transferred to a tertiary care center for further evaluation. Cardiac catheterization revealed severely elevated right-sided filling pressures (right atrial pressure of 25 mmHg), moderately elevated left-sided filling pressures (wedge pressure of 22 mmHg), severe tricuspid bioprosthesis stenosis with transvalvular mean gradient of 9.2 mmHg, and calculated tricuspid valvular area of 1.5 cm^2. Given the patient's high surgical risk with three prior sternotomities and hepatic dysfunction, the decision was made to pursue percutaneous transcatheter tricuspid valve-in-valve replacement rather than a fourth sternotomy/ replacement. He underwent successful balloon angioplasty and transcatheter tricuspid valve replacement with a 29mm Sapien3 valve with resolution of tricuspid regurgitation and tricuspid stenosis.Transvalvular mean gradient improved from 9.2 to 2.7 mmHg, and tricuspid valve area improved from 1.5 cm^2 to 4.0 cm^2 (Figures 2-4). His severe tricuspid valve stenosis immediately resolved with improved forward flow as indicated by mean pulmonary artery pressures that increased from 35/19 mmHg to 55/25 mmHg, normal transpulmonary gradient of 6 mmHg, wedge pressure that increased from 22 to 30 mmHg, and systolic blood pressure that increased from 98 mmHg to 130 mmHg (Table 2[1,2], Figure 4).

Discussion

Tricuspid valve disease and its ensuing management is not as well characterized relative to aortic and mitral valve disease. The management of complications of bioprosthetic valve dysfunction are even less well-characterized. Severe tricuspid valve stenosis (of either native or bioprosthetic valve) is defined by a calculated valve area of <1cm^2, mean valvular gradient of 5mmHg or above, or both.[3] Symptomatic patients present with signs of right heart failure- including debilitating edema and cardiac ascites, as our patient struggled with prior to repair. Currently, the American College of Cardiology/American Heart Association 2014 guidelines carry a class Ic recommenddation that repeat valve replacement is indicated in severe symptomatic prosthetic valve stenosis. In 2017, reflecting increasing reports of successful percutaneous replacement, the guidelines were updated to include a IIa recommendation that a transcatheter valve-in-valve procedure is reasonable if the patient is determined to be high surgical risk.[4] Severe infectious endocarditis necessitates surgical repair, but studies have demonstrated lower survivability of tricuspid prostheses and significant rates of re-stenosis. Cases of successful percutaneous valve-in-valve tricuspid replacement are increasingly reported,[5] and given our patient's significant surgical comorbidities, this avenue was pursued. Percutaneous therapies allow more therapeutic options for high surgical risk patients. The relief of tricuspid stenosis and improvement in cardiac preload and output may unmask pulmonary hypertension and elevated ventricular filling pressures as it did in this case. Interventionalists, general cardiologists, and internists alike should consider the risk of bioprosthesis failure in patients with tricuspid valve replacements, and should be aware of percutaneous replacement cases in their preoperative risk evaluation.

Table 1: Echocardiographic Parameters Consistent with Tricuspid Valve Stenosis as per ASE Guidelines[1] with Findings found in reported patient

Parameter	Consider Valve Stenosis	Case Patient
Peak Velocity	>1.7 m/s	2.4 m/s
Mean gradient	≥6 mmHg	15 mmHg
Pressure half-time	≥230 ms	456 ms

Table 2: Catheter based data Pre- and Post- Valve-in-Valve Repair of the Bioprosthetic Tricuspid Valve

Metric	Pre-Replacement	Post-Replacement	Reference Values[1,2]
Transvalvular Mean Gradient (mmHg)	9.2	2.7	< 6.0
Tricuspid Valvular Area (cm^2)	1.50	3.97	4.00
Mean pulmonary artery pressure (mmHg)	25	36	13-17
Right pulmonary artery wedge pressure (mmHg)	22	33	6-12

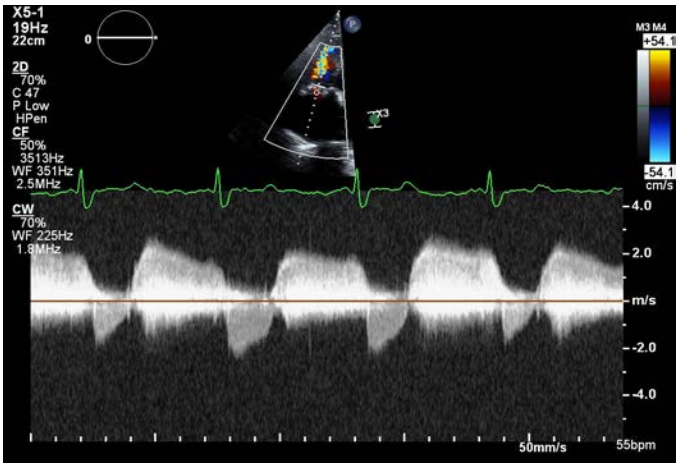

Figure 1: Continuous Wave Doppler of the bioprosthetic tricuspid valve. Note the prolonged diastolic filling time with flattened velocity profile, consistent with valvular stenosis. The mean diastolic gradient is 15 mmHg and pressure-half time is 456 ms.

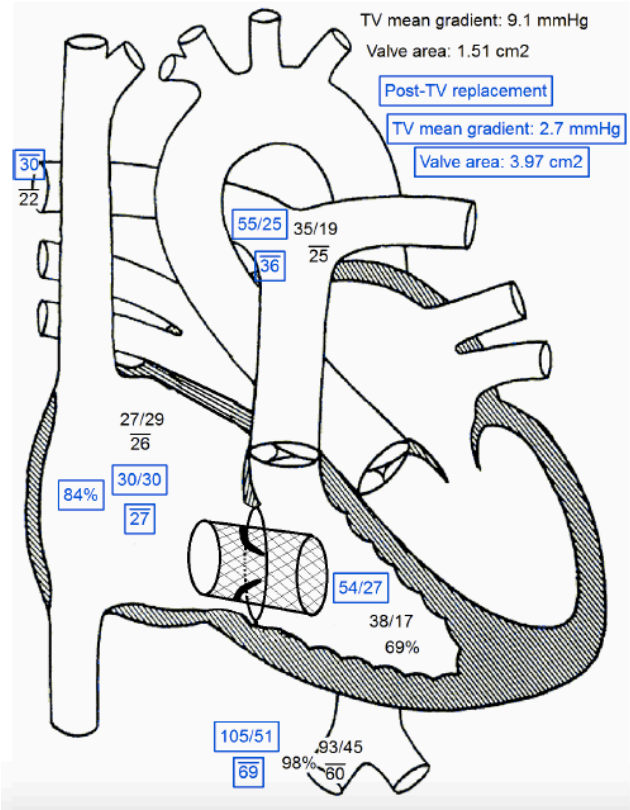

Figure 2: Diagram detailing right atrial, tricuspid, right ventricular, and pulmonary artery pressures and tricuspid valve area post-valve-in-valve tricuspid valve repair.

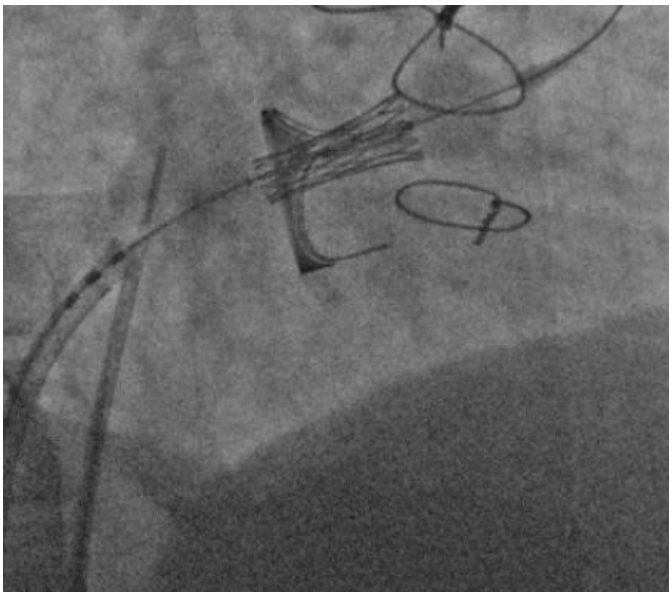

Figure 3: Catherization demonstrating percutaneous deployment of Edwards Sapien3 tricuspid valve in prior Edwards Magna pericardial valve (placed 2010)

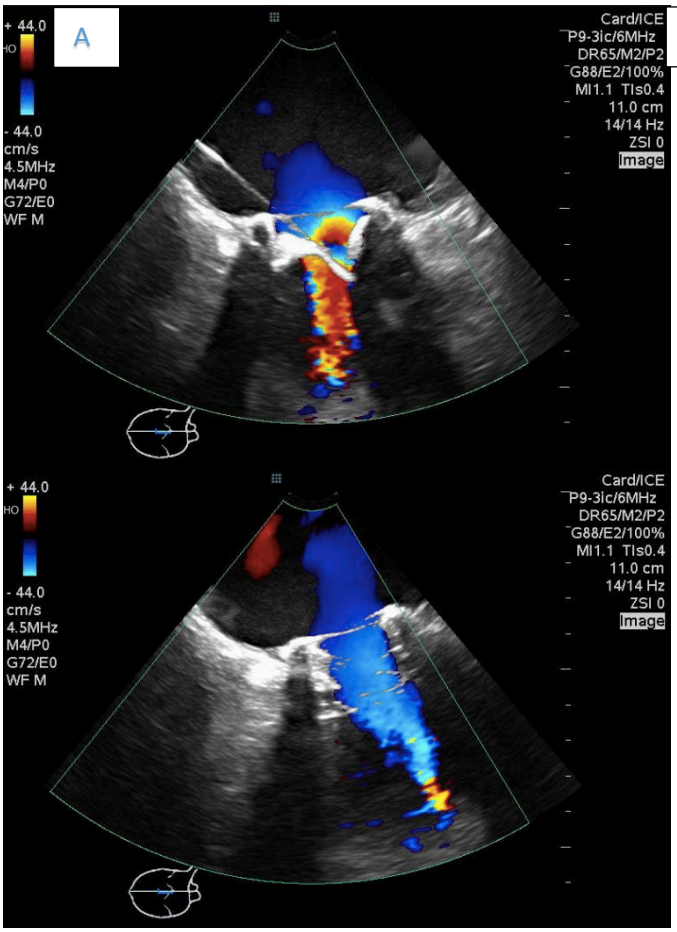

Figure 4: A) Intracardiac echocardiogram reveals moderate tricuspid regurgitation, and severe tricuspid stenosis with limited leaflet mobility. B) Post valve-replacement, no tricuspid regurgitation or perivalvular regurgitation is noted.

REFERENCES

1. **Zoghbi WA, Chambers JB, Dumesnil JG, Foster E, Gottdiener JS, Grayburn PA, Khandheria BK, Levine RA, Marx GR, Miller FA Jr, Nakatani S, Quiñones MA, Rakowski H, Rodriguez LL, Swaminathan M, Waggoner AD, Weissman NJ, Zabalgoitia M; American Society of Echocardiography's Guidelines and Standards Committee; Task Force on Prosthetic Valves; American College of Cardiology Cardiovascular Imaging Committee; Cardiac Imaging Committee of the American Heart Association; European Association of Echocardiography; European Society of Cardiology; Japanese Society of Echocardiography; Canadian Society of Echocardiography; American College of Cardiology Foundation; American Heart Association; European Association of Echocardiography; European Society of Cardiology; Japanese Society of Echocardiography; Canadian Society of Echocardiography**. Recommendations for evaluation of prosthetic valves with echocardiography and doppler ultrasound: a report From the American Society of Echocardiography's Guidelines and Standards Committee and the Task Force on Prosthetic Valves, developed in conjunction with the American College of Cardiology Cardiovascular Imaging Committee, Cardiac Imaging Committee of the American Heart Association, the European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography and the Canadian Society of Echocardiography, endorsed by the American College of Cardiology Foundation, American Heart Association, European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography, and Canadian Society of Echocardiography. *J Am Soc Echocardiogr*. 2009 Sep;22(9):975-1014; quiz 1082-4. doi: 10.1016/j.echo.2009.07.013. PubMed PMID: 19733789.
2. **Kovacs G, Avian A, Olschewski A, Olschewski H**. Zero reference level for right heart catheterisation. *Eur Respir J*. 2013 Dec;42(6):1586-94. doi: 10.1183/09031936.00050713. Epub 2013 Jun 21. PubMed PMID: 23794468.
3. **Aoyagi S, Tomoeda H, Kawano H, Yokose S, Fukunaga S**. Doppler echocardiographic evaluation of prosthetic valves in tricuspid position. *Asian Cardiovasc Thorac Ann*. 2003 Sep;11(3):193-7. PubMed PMID: 14514546.
4. **Nishimura RA, Otto CM, Bonow RO, Carabello BA, Erwin JP 3rd, Fleisher LA, Jneid H, Mack MJ, McLeod CJ, O'Gara PT, Rigolin VH, Sundt TM 3rd, Thompson A**. 2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2017 Jul 11;70(2):252-289. doi: 10.1016/j.jacc.2017.03.011. Epub 2017 Mar 15. PubMed PMID: 28315732.
5. **Rana G, Malhotra R, Sharma A, Kakouros N**. Percutaneous Valvuloplasty for Bioprosthetic Tricuspid Valve Stenosis. *Tex Heart Inst J*. 2017 Feb 1;44(1):43-49. doi: 10.14503/THIJ-15-5408. eCollection 2017 Feb. Review. PubMed PMID: 28265212; PubMed Central PMCID: PMC5317359.