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Successful Balloon Valvuloplasty of Pacemaker Lead- Induced Tricuspid Stenosis

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Abstract

A young adult, pacemaker dependent patient, presents with new onset systemic desaturation and oxygen requirement. He is diagnosed with severe tricuspid valve stenosis, secondary to leaflet adhesion to the transvenous ventricular lead traversing the valve and resulting in right to left atrial level shunting. This report describes successful tricuspid balloon valvuloplasty under TEE guidance.

Keywords

Pacemaker lead; Tricuspid stenosis; Tricuspid valve balloon valvuloplasty

Abbreviations

TV: Tricuspid Valve; TVBV: Tricuspid Balloon Valvuloplasty; TR: Tricuspid Regurgitation; RA: Right Atrium; RV: Right Ventricle; TEE: Transesophageal Echocardiogram; TTE: Transthoracic Echocardiogram

Introduction

The etiology of Tricuspid valve stenosis can be congenital, rheumatic or secondary to degeneration of a previously placed bioprosthesis. Rare cases have described a transvenous pacemaker lead causing mechanical irritation of the leaflets and potentially leading to fibrosis, calcification, endocarditis or thrombus resulting in stenosis [1]. It is also possible that a valve leaflet could rupture during lead placement and lead to subsequent valvar changes [2]. These cases have demonstrated severe stenosis with no significant regurgitation [2], unlike in cases of rheumatic carditis. There have been scattered case reports of the efficacy and success of balloon valvuloplasty of the TV [1, 2, 3].

Case Presentation

The patient is a 29 year old male, with a history of atrioventricular septal defect who is status post complete surgical repair at the age of 6 months. He subsequently developed severe mitral regurgitation and at 15 years of age underwent mitral valvuloplasty. The procedure was complicated by complete heart block and a dual chamber transvenous pacemaker was implanted. The atrial and ventricular leads were subsequently replaced in 2009. Within a year following lead replacement, he was noted to have asymptomatic moderate tricuspid valve stenosis without insufficiency and a mean gradient of 12 mmHg by TEE. This remained stable over the next 5 years.

Several months prior to the current presentation, the patient had developed atrial flutter and warfarin was initiated. A TTE and TEE were performed and demonstrated moderate mitral regurgitation and moderate tricuspid valve stenosis with a mean gradient of 12 mmHg and trace regurgitation. An incidental retrocardiac mass was also noted and was determined to be benign on biopsy.

Four months later, the patient presented to an outside emergency department with abdominal discomfort and fatigue. Further investigation demonstrated a severely elevated INR of 10 and a retroperitoneal bleed. The patient was transferred to our center and treated with Vitamin K and subsequent stabilization. At that time, the patient was also noted to be hypoxicand requiring significant supplemental oxygen to maintain a saturation >90%.There was no history suggestive of endocarditis.

Repeat TTE revealed the transvenous pacing lead traversing the TV (Figure 1) with severe tricuspid valve stenosis with a mean gradient of 27 mmHg by TTE and 13mmHg by TEE respectively (Figure 2) with moderate right to left atrial level shunting during agitated saline injection. Theatrial level shunt was a new finding and possibly secondary to patch dehiscence in the presence of severely elevated right atrial pressures or a stretched patent foramen ovale. The tricuspid valve stenosis was felt to be secondary to adherence of the transvenous pacing lead and the medial tricuspid valve leafletresulting in diminished diastolic excursion. Cardiac device check revealed a low RV lead impedance of 100 ohms. The patient's heart rate during all imaging studies is consistently 60bpm which is the lower rate limit of his VVI pacer.

Following informed consent, the patient was taken to the cardiac catheterization lab for balloon tricuspid valvuloplasty.The procedure was performed under general anesthesia via a right internal jugular approach on 80% FiO2 and with TEE guidance to assess the tricuspid valve anatomy and the degree of stenosis/regurgitation following serial balloon dilation. The mixed venous saturation was low at 61% with a systemic saturation of 93% (PO2: 62 torr) resulting in a Qp:Qs < 1 which is secondary to right to left shunting at the atrial level. The right atrial pressure was severely elevated at 22 mmHg with a mean gradient of 17 mmHg across the tricuspid valve. TEE demonstrated a tricuspid valve annular diameter of 20 mm with limited diastolic excursion. The TV was crossed with minimal difficulty with a balloon tipped end-hole catheter and a 0.035 inch floppy tipped Benson wire. Multiple attempts at stabilizing a super stiff Amplatz J wire in the right ventricular apex were unsuccessful. Therefore a 0.035 super stiff, floppy tip Lunderquist wire was placed into the right pulmonary artery to attain stable wire position. Sequential balloon valvuloplasty was then performed utilizing 18mm, 20mm and 22 mm diameter Nucleus balloons (BBraunCorporation) under TEE and fluoroscopic guidance (figure 3). Repeat hemodynamics and echocardiographic evaluation was performed following each balloon dilation and prior to proceeding with the next larger balloon diameter. Following dilation with the 22 mm diameter balloon, the mean gradient across the tricuspid valve decreased to 5 mmHg with mild regurgitation via TEE imaging at which time the procedure was terminated (Figure 4). The patient tolerated the procedure well with a total fluoroscopy time of 23 minutes and procedure time of 145 min.

Following the tricuspid valvuloplasty, patient's clinical condition improved dramatically with resolution of his previous symptoms and he was weaned off O2 supplementation. His systemic saturation in room air was now >95% consistent with a Qp/Qs ratio of 1.0. TTE the following day demonstrated a mean gradient across the tricuspid valve of 15 mmHg, compared to 27 mmHg prior to the

procedure in the presence of moderate tricuspid regurgitation. He was discharged home 4 days later on oral diuretics and Coumadin.At early follow up, the patient remains stable with an oxygen saturation of 98% in room air and significantly decreased systemic venous congestion by physical examination.Most recent transthoracic echocardiogram 3 months later shows a mean gradient of 6 mmHg and at most mild tricuspid regurgitation. A repeat cardiac device check 1 month post tricuspid valvuloplasty revealed the generator to be at end of life and he is scheduled for a generator change. The pacer remains in VVI mode and is functioning normally.

Discussion

TVBV is an alternative method of treating transvenous pacemaker lead- induced tricuspid valve stenosis. Utilizing continuous TEE guidance during the procedure will help avoid over dilation, monitor tricuspid regurgitation following each balloon dilatation and hopefully achieve maximal stenosis relief. A surgical approach would be more appropriate if the leads were fractured, if balloon valvuloplasty wasnot successful in significantly reducing the tricuspid valve gradient or if patient remains symptomatic.

There are only rare cases of this entity described in the available literature and no long term results have been published. Weoffer this approach with documented short term efficacy and obviously it's less invasive than open heart surgery.

Transvenous pacer lead fracture as a result of this procedure, although of theoretical concern, has not been reported.

Conclusion

TVBV is an acceptable method of treating transvenous pacemaker lead- induced tricuspid valve stenosis.

Figures

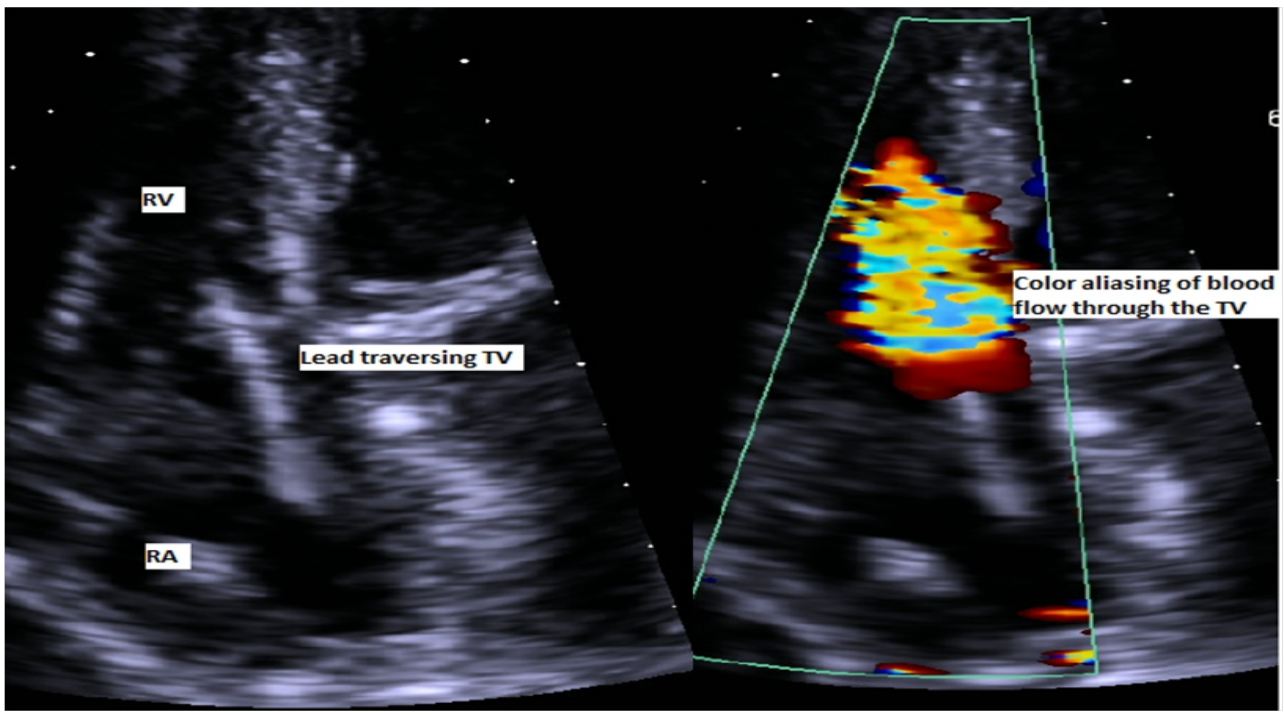

Figure 1: Left panel: 2D image of the TTE with the transvenous pacing lead traversing the tricuspid valve annulus; Right panel: Color aliasing at the level of the tricuspid valve annulus where the transvenous pacing lead traverses the valve indicating stenosis at that level.

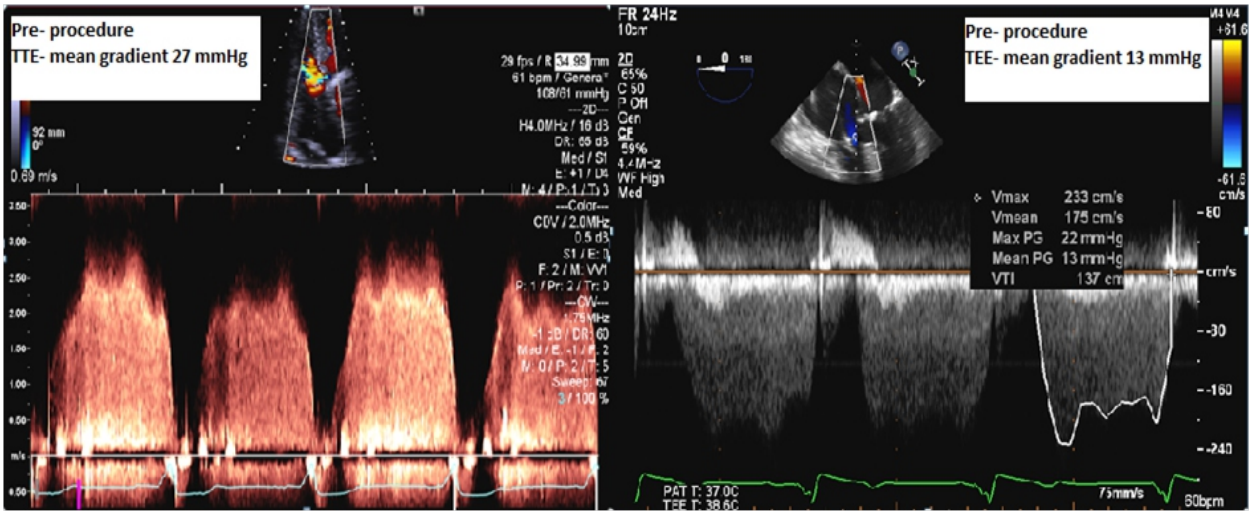

Figure 2: Transthoracic and transesophageal echocardiogram demonstrating severe tricuspid valve stenosis in the presence of trivial insufficiency (mean gradient: 27 mmHg by TTE and 13 mmHg by TEE under general anesthesia).

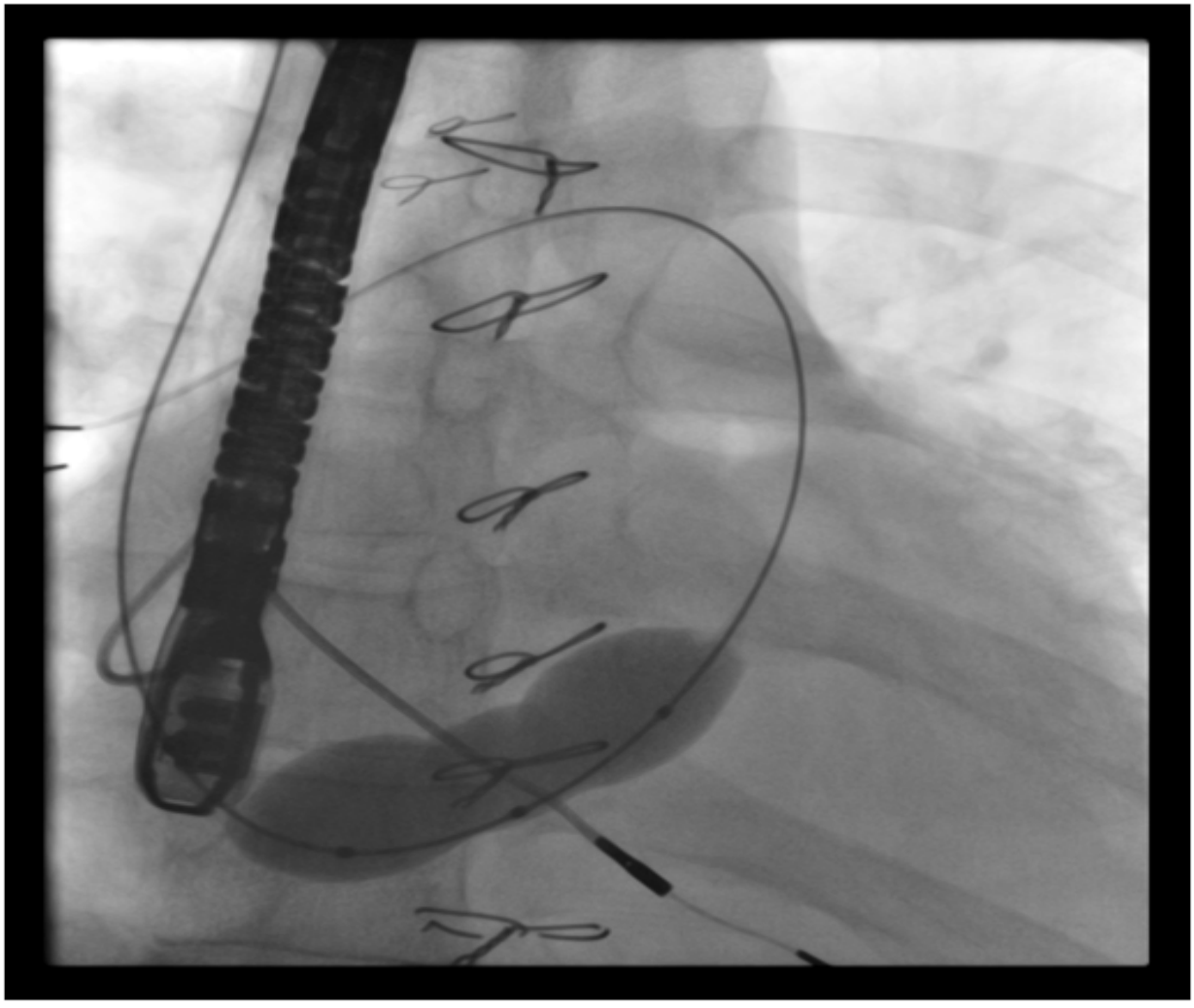

Figure 3: Visualization of the 22 mm diameter Nucleus balloon inflated across the tricuspid valve with the super stiff Lunderquist wire in the right pulmonary artery branch. The transvenous pacer lead and balloon dilation catheter are not parallel with each other during inflation.

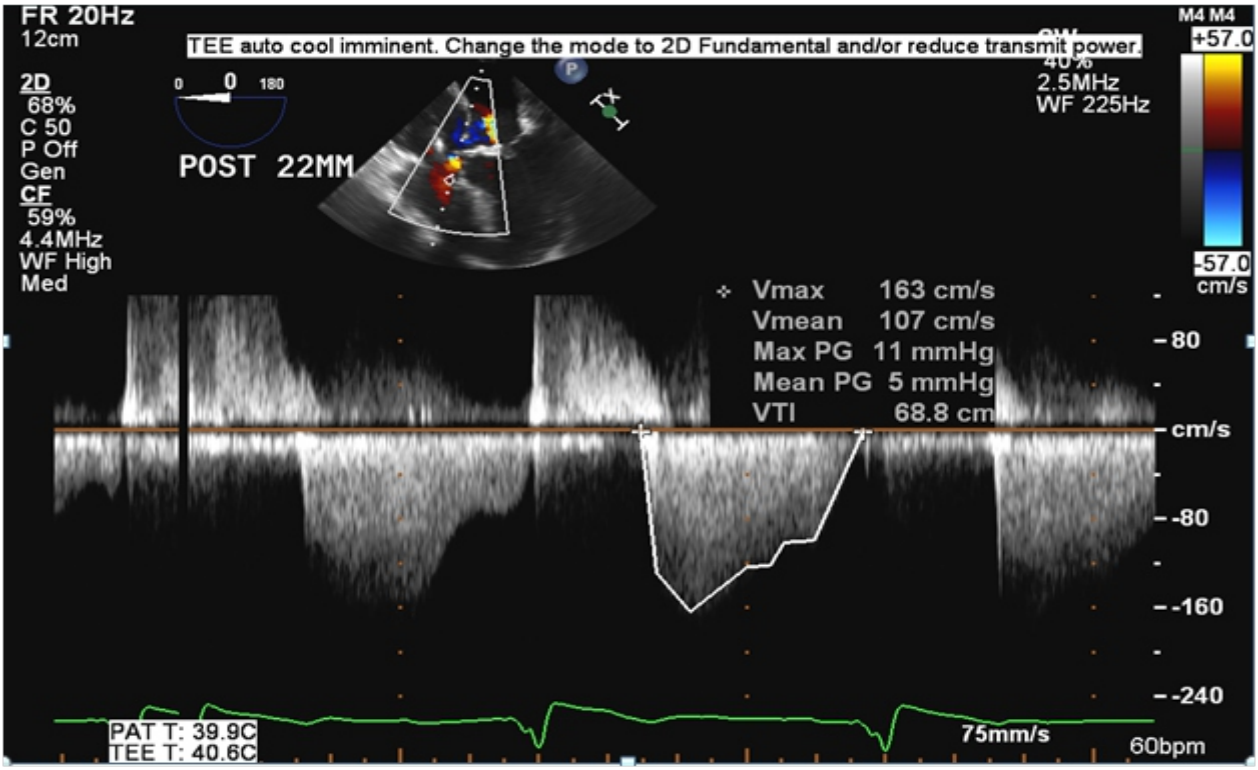

Figure 4: Transesophageal echocardiographic assessment of the tricuspid valve gradient post 22mm diameter balloon valvuloplasty in the presence of at most mild insufficiency (mean gradient: 5 mmHg)

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