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Keywords

Trans esophageal echocardiogram; Sinus rhythm; Mitral regurgitation; Mitral valve; Cardio version

Case Report

Conversion of Atrial Fibrillation to Sinus Rhythm results in Significant Improvement in Functional Mitral and Tricuspid Regurgitation

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Abstract**Background**

Both mitral regurgitation (MR) and tricuspid regurgitation (TR) frequently exist in patients with Atrial Fibrillation (AF). But whether valvular regurgitation causes AF or vice versa is unclear.

Atrial fibrillation is the most common rhythm disturbance diagnosed in clinical practice. As the population ages Atrial Fibrillation (AF) is predicted to affect 6-12 million people in the United States by 2050¹. The main focus on the clinical complications of AF has included: stroke, Heart Failure (HF) and sudden Cardiac Death (SCD). The occurrence of Valvular regurgitation in patients with AF has been less studied. There are a few studies which have evaluated improvement of functional mitral valve regurgitation with a rhythm control strategy^{2, 3}, there is some evidence that tricuspid regurgitation may be associated with AF⁴, but to the best of our knowledge there has been no study performed to evaluate response of tricuspid regurgitation to a rhythm control strategy.

Primary MR/TR is when the leaflets or the sub valvular apparatus are structurally abnormal causing leaf let malcoaptation. Functional valvular regurgitation occurs when the leaflets or the sub valvular apparatus are structurally normal and leaf let malcoaptation is related to global or regional ventricular remodeling that displaces the papillary muscles, tethers the leaflets, or by reduction in ventricular closing forces. We were interested in whether restoration of Sinus Rhythm (SR) could result in reverse remodeling in the patients with AF and functional valvular regurgitation.

Objective

To evaluate the effect of a rhythm control strategy involving AF ablation on mitral or tricuspid regurgitation which is at least moderate in severity?

Methods

Patients with moderate or severe, mitral or tricuspid regurgitation and atrial fibrillation at our center underwent a rhythm control strategy

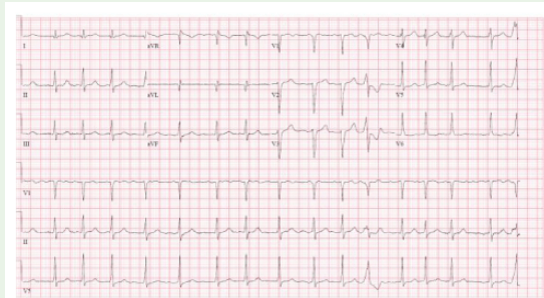


Figure 1: ECG: Atrial fibrillation

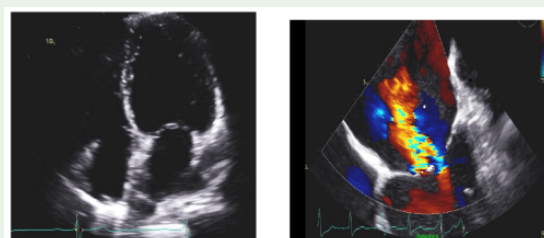


Figure 2: TTE with apical 4-chamber view demonstrating MV annular dilation and esophageal TEE view with severe mitral regurgitation

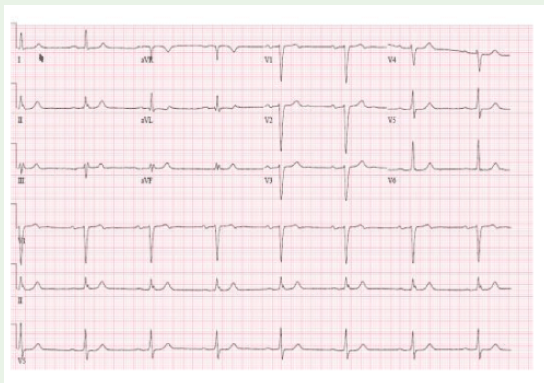


Figure 3: ECG: Sinus Rhythm

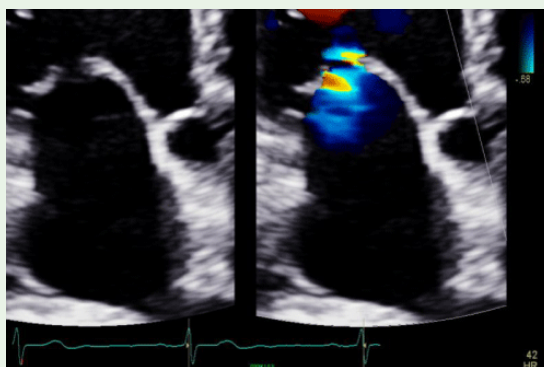


Figure 4: In SR with decreased MV annulus dimension and mild MR

with an ablation procedure. Anti-arrhythmic drugs were used at the discretion of the treating physician. The severities of mitral

or tricuspid regurgitation were assessed using the 2017 American Society of Echocardiography guidelines.

Results

30 patients with moderate or severe mitral regurgitation underwent a rhythm control strategy with ablation procedure. 90% of patients (27/30) showed an improvement in the severity of regurgitation with 6 patients demonstrating a decrease in mitral regurgitation from severe to mild and 21 patients from moderate to mild. There were 19 patients with moderate or severe tricuspid regurgitation. 15/19 (79%) patients improved. 4 patients improved their tricuspid regurgitation from severe to mild. 11 patients improved their TR from moderate to mild. None of the patients showed a worsening of either mitral or tricuspid regurgitation from baseline. All patients who had improvement in their valvular regurgitation also showed an improvement in their functional capacity.

Conclusion

Restoration of sinus rhythm significantly improved valvular regurgitation and functional capacity in a majority of patients without any valvular interventions suggesting a pathophysiologic role of atrial fibrillation in development of valvular regurgitation.

Five Clinical Cases

Case 1: MM

Clinical presentation: 67-year-old male presents with heart failure (HF) manifest as severe shortness of breath at rest.

Blood pressure 100/70 and irregularly irregular rhythm with heart rate = 97 bpm. Elevated JVP. 3/6 mitral regurgitation murmur, Bibasilar rales, and no peripheral edema. (Figure 1)

Echocardiogram: Increased LV cavity size, mitral annular dilation, and severe functional mitral regurgitation. LVEF = 25 (Figure 2)

Cine 1: Atrial fibrillation (AF) with ventricular response (VR) between 105-112 bpm

Trans Esophageal Echocardiogram (TEE) esophageal view demonstrating Mitral Valve (MV) annulus dilation

With severe, central (functional) Mitral Regurgitation (MR) with color flow

a) Cardio version: Successful cardio version from atrial fibrillation to sinus rhythm (Figure 3).

b) Repeat Echocardiogram: Mild increase in LV size and with LVEF = 40%. Mild mitral regurgitation (Figure 4).

Cine 2: Sinus rhythm (SR) with VR approximately 42 bpm. Transthoracic echocardiogram (TTE) demonstrating mild (central) MR with color flow

a) Coronary status: Normal nuclear perfusions scan

b) Ablation: Pulmonary Vein Isolation, Cavo Tricuspid isthmus



Figure 5: ECG: Atrial Fibrillation

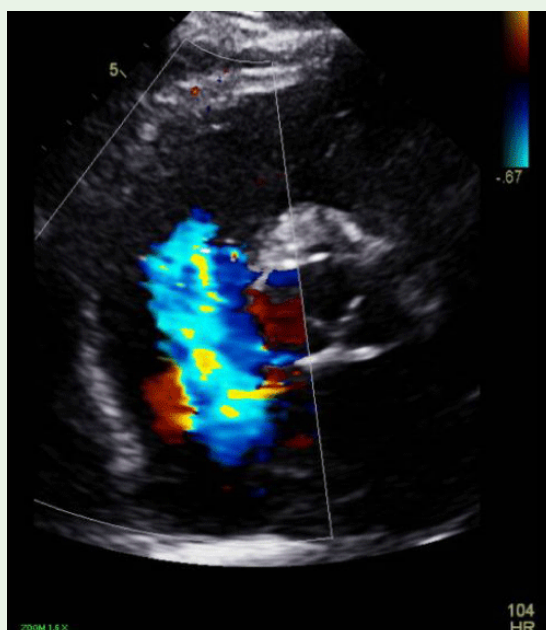


Figure 6: Parasternal short-axis view at the AV level revealing severe TR

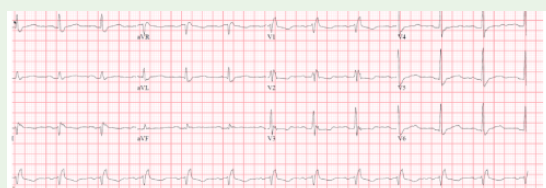


Figure 7: ECG

ablation.

c) Clinical follows up: Class 1 functional status

Case 2: PA

Clinical presentation: 77 -year-old male presents with heart failure (HF) manifest as exertional shortness of breath with rapid heart rate.

Blood pressure 120/80 and irregularly irregular rhythm with heart rate = 110 bpm. Elevated JVP, 2/6 murmur right sternal border 4th ICS, Elevated JVP, ascites, and (2+) peripheral edema (Figure5).

Echocardiogram: Remodeled RV cavity with RV enlargement.

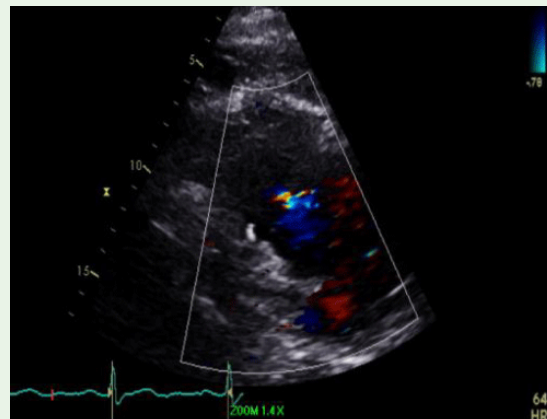


Figure 8: RV inflow view revealing trace TR

Depressed RV function.TV annulus dilation with severe tricuspid regurgitation (Figure6).

Cine 3: AF with VR approximately 100-105 bpm. TTE short-axis view at the level of the aortic valve demonstrating severe tricuspid regurgitation (TR) with color flow

a) Cardio version: to Sinus rhythm

b) Ablation: Pulmonary Vein Isolation and Cavotricuspid isthmus ablation (Figure7).

c) Repeat Echocardiogram: Normal RV size and function with trivial TR (Figure8).

Cine 4: SR with VR = 66 bpm

TTE apical 4-chamber view demonstrating trace TR with color flow

a) Coronary status: Normal coronary arteries with angiography

b) Ablation: Successful

c) Clinical follows up: Class 1 functional status

Case 3: SB

Clinical presentation: 52 -year-old female presents with heart failure (HF) manifest as class 3 shortness of breath with rapid heart rate. Blood pressure 90/60 and irregularly irregular rhythm with

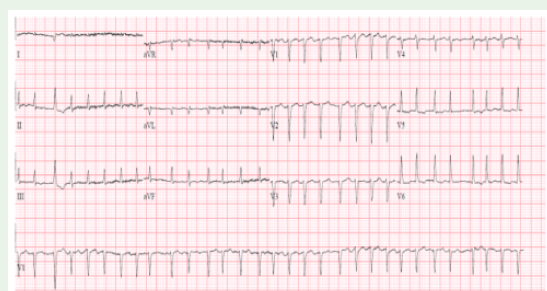


Figure 9: ECG: Atrial fibrillation

Table 1: Reversal of Severe MR with Significant Cardiac

	Echocardiogram in AF (Mean for 6 patients)	Echocardiogram after restoration of sinus rhythm (Mean for 6 patients)	Months (Mean duration)
Severity of mitral regurgitation	Severe	Trace to mild	8 Months
Mitral valve annular diameter	47.3 mm	32 mm	
Left ventricular ejection fraction	19%	58%	
Left atrial volume index	51mL/m ² (Severely enlarged)	38 mL/m ² (Mildly enlarged)	
Left ventricular size	67.5 mm	56.8 mm	
Right ventricular size	Normal to mildly enlarged	Normal size	
RV systolic function (Pulsed Doppler S wave)	9.3 cm/second	19.3 cm/second	
Right atrial size	Moderately enlarged	Normal to mildly enlarged	
Inferior vena cava	Plethoric	Normal	
NYHA functional class	Class IV	Class I- II	

Table 2 : Reversal of Severe TR with Significant Cardiac Remodeling

	Echocardiogram in AF (Mean for 4 patients)	Echocardiogram after restoration of sinus rhythm (Mean for 4 patients)	Months (Mean duration)
Severity of tricuspid regurgitation	Severe	Mild	26.5 months
Tricuspid valve annular diameter	47.5 mm	37.5 mm	
Right atrial size	Severe enlargement	Mild enlargement	
Right ventricular size	Moderate enlargement	Normal size	
Right ventricular systolic function (Pulsed Doppler S wave)	7.25 cm/second	19.25 cm/second	
Left ventricular ejection fraction	31%	58%	
Left atrial volume index	41.25 mL/m ²	35.25 mL/m ²	
Inferior vena cava	Plethoric	Normal	
NYHA Functional Class	Class III- IV	Class I-II	

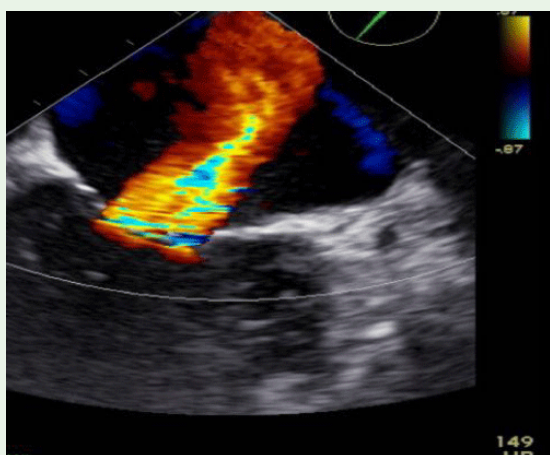


Figure 10: TEE revealing severe mitral regurgitation

heart rate = 150- 180 bpm. Elevated JVP, 3/6 mitral regurgitation, No peripheral edema (Figure 9).

Echocardiogram: Increased LV cavity size, mitral annular dilation with severe functional mitral regurgitation. LVEF = 35% (Figure 10).

Cine5: AF with VR approximately 130 bpm

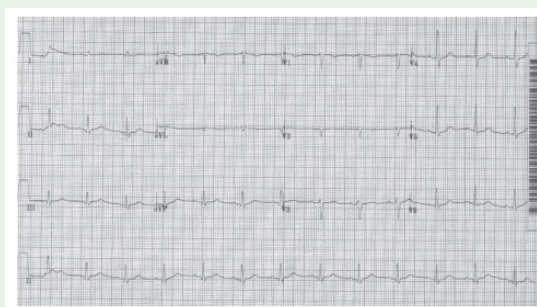


Figure 11: ECG: Sinus Rhythm

TTE apical 4-chamber view revealing annular dilation with severe central MR

a) Cardio version to Sinus rhythm (Figure 11)

b) Repeat Echocardiogram: Normal LV size and function with trivial MR; LVEF = 60% (Figure 12)

Cine 6: SR with VR = 60 bpm

TTE apical 4 chamber view demonstrating trace MR with color flow

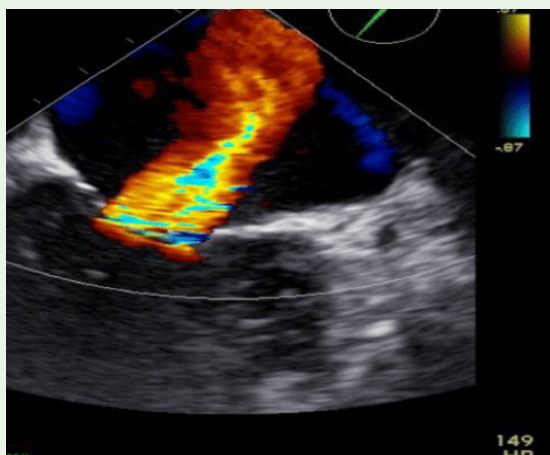


Figure 12: TTE revealing mild mitral regurgitation



Figure 13: ECG: Atrial Fibrillation

- Coronary status: Normal perfusion scans
- Ablation: Pulmonary vein isolation
- Clinical follows up: Class 1 functional status

Case 4: KN

Clinical presentation: 62 -year-old male presents with NYHA Class IV heart failure (HF) symptoms manifest as severe shortness of breath at rest with controlled heart rate. Patient was unable to lie flat.

Blood pressure 130/80 and irregularly irregular rhythm with heart rate = 97-100 bpm. Elevated JVP. 3/6 mitral regurgitation, No peripheral edema (Figure 13)

Echocardiogram: Reveal severely increased LV cavity size, mitral annular dilation with severe functional mitral regurgitation. LVEF = 25% (Figure 14).

Cine 7: AF with VR = 112 bpm

TTE apical 4-chamber view demonstrating severe MR with color flow

- Cardio version to Sinus rhythm
- Ablation: Pulmonary vein isolation (Figure 15).
- Repeat Echocardiogram: Normal LV size and function with

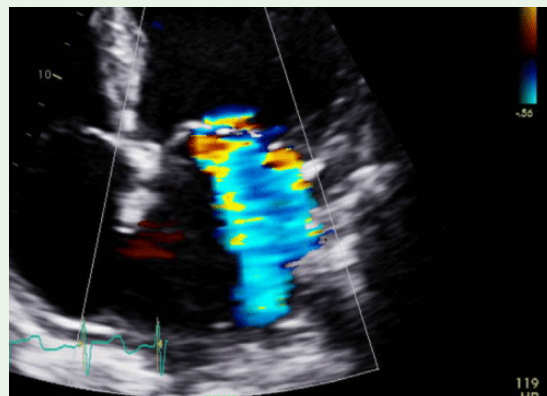


Figure 14: Severe Mitral Regurgitation



Figure 15: ECG: Sinus Rhythm

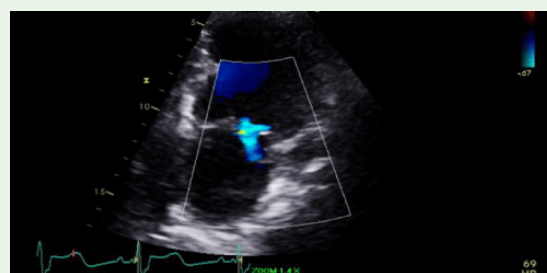


Figure 16: Mild Mitral Regurgitation

mild MR; LVEF = 60% (Figure 16).

Cine 8: SR with VR = 69 bpm

TTE apical 4 chamber view with trace MR with color flow

- Coronary status: Normal coronaries angiographically
- Ablation: Successful
- Clinical follow up: Class 1 functional status

Case 5: ES

Clinical presentation: 67 -year-old female presents with chest pain, heart failure (HF) manifest as class 3 shortness of breath with controlled heart rate. Patient was unable to lie flat.

Blood pressure 110/80 and irregularly irregular rhythm with heart rate = 70 -100 bpm. Elevated JVP. 3/6 mitral regurgitation, No peripheral edema (Figure 17).

Echocardiogram: Increased LV cavity size, mild mitral annular dilation, and severe functional mitral regurgitation. LVEF = 45%



Figure 17: ECG: Atrial Fibrillation

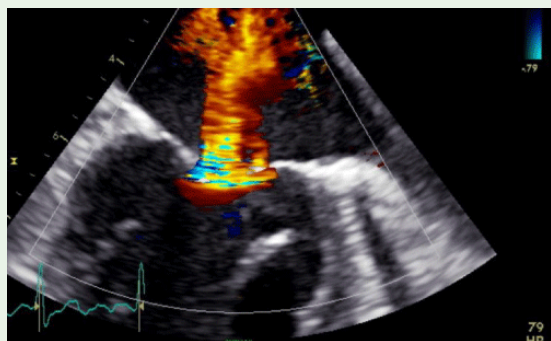


Figure 18: Severe Mitral Regurgitation

(Figure 18).

Cine 9: AF with VR = 90 bpm

TEE demonstrating annular dilation with severe (functional) MR with color flow

a) Cardio version to Sinus rhythm (Figure 19).

b) Repeat Echocardiogram: Normal LV size and function with mild MR; LVEF = 60% (Figure 20).

Cine 10: SR with VR = 50 bpm

TEE demonstrating trace to mild MR with color flow

a) Coronary status: Normal coronaries angiographically

b) Ablation: Pulmonary vein isolation, cavotricuspid isthmus ablation.

c) Clinical follows up: Class 1 functional status

Discussion

This case series generates a hypothesis that restoration of sinus rhythm in patients with atrial fibrillation and significant functional mitral regurgitation results in cardiac remodeling with decreased left ventricle chamber size, LAVI, mitral annular diameter, right atrial and ventricular size with dramatic improvement in left ventricular

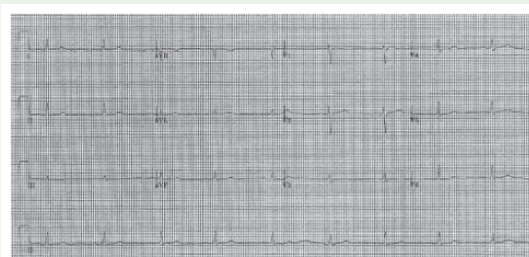


Figure 19: ECG: Sinus Rhythm

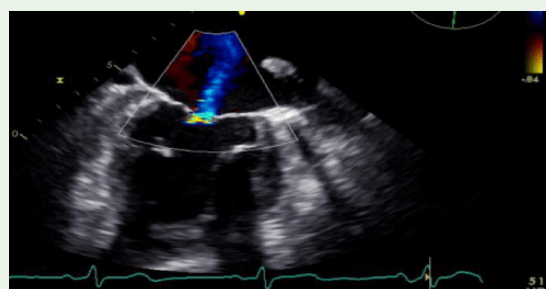


Figure 20: Mild Mitral Regurgitation

ejection fraction. Restoration of sinus rhythm was found to reverse severe Tricuspid regurgitation with a marked improvement in right sided chamber size, function and an improvement in left ventricular ejection fraction. The positive remodeling in sinus rhythm resulted in an improvement in patient functional capacity. These results should lead to further studies to reinforce the findings in this study.

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