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Case Report
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Diastolic Regurgitation at Inflow Valve (Mitral and Tricuspid) in Second Degree Atrioventricular Block

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Abstract

Mitral regurgitation during diastole is not uncommon among patients with atrioventricular (AV) block, severe aortic regurgitation, and cardiomyopathies (restrictive, and dilated). It results because of atrial contraction which followed by asynchronized ventricular contraction leading into reversal of atrioventricular pressure gradient during atrial diastole. Here, we report a case of diastolic mitral regurgitation and tricuspid regurgitation in a 69-year old patient who presented with syncope with second degree AV block. Careful analysis of echocardiogram with online electrocardiogram serves as an important tool to delineate the timing of bilateral inflow valvular regurgitation.

Keywords: Diastolic mitral regurgitation; Diastolic tricuspid regurgitation; Second degree Atrio-ventricular block

Introduction

The effective and complete mitral valve closure at the end of diastole is a complex phenomenon requiring an appropriately timed ventricular systole. Diastolic MR is commonly observed during AV block, when atrial contraction is not followed by adequately synchronized LV contraction. Under these conditions, the AV pressure gradient reverses during atrial relaxation (ventricular pressures higher than atrial), resulting in diastolic MR in the presence of an incompletely closed mitral valve. It may be accompanied by systolic mitral regurgitation as well as diastolic tricuspid regurgitation [1]. Sometimes benign though, it assumes importance during selection of pacing mode during pacemaker implantation, and cardiac resynchronization therapy to achieve optimal cardiac output.

Case Report

A 69-year old man was admitted with history of dyspnoea and multiple episodes of syncope. He was smoker and, hypertensive (ramipril 10 mg and hydrochlorthiazide 12.5 mg daily). His blood pressure and heart rate were 138/92 mmHg and 38/min respectively. Physical examination was unremarkable. Electrocardiogram revealed 2:1 atrioventricular block (Mobitz type-II second degree). On admission, his complete haemogram and electrolytes were normal. 2-D transrthoracic echocardiography was performed VIVID7 (GE, USA) which demonstrated normal chamber dimensions, valvular echo, Ejection Fraction (EF), and normal diastolic profile. Color Doppler interrogation revealed systolic mitral regurgitation and Dastolic Mitral Regurgitation (DMR) with Mid-Diastolic (MDMR) and End Diastolic component (EDMR) (Figure 1 and 2). Every dropped P-wave was being followed by a MDMR and EDMR (Figure 1 and 3). Another interesting finding was diastolic tricuspid regurgitation with similar components with peak velocity of 1 m/sec and systolic tricuspid regurgitation with peak velocity of 3 m/sec. The gradient across the tricuspid valve was 36 mmHg (Figure 4). Surprisingly, V-A gradient was higher across the tricuspid valve compared to mitral valve. Permanent pacemaker implantation (DDDR, St. Jude, USA) was done next day and patient was discharged in stable condition and is in regular follow up since then.

Discussion

Isovolumetric contraction during cardiac cycle leads to closure of the atrio-ventricular valves as ventricular pressure exceeds that of the atrial pressure. However, effective and complete mitral valve closure at the end of diastole is a complex phenomenon. Normally, atrial contraction transiently increases the left atrial diastolic pressure above that of the LV diastolic pressure (LVEDP) and results in wide opening of the mitral valve at end diastole. Toward the end of atrial contraction, there is an abrupt cessation of forward flow leading to a transient zone of negative pressure behind the mitral valve and the formation of eddy currents behind the leaflets that precipitates closure of the mitral valve. The LA then relaxes as LV pressure rises during phase of isovolumetric

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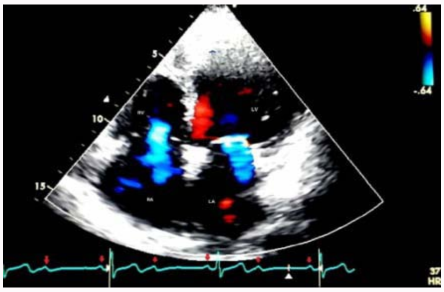

Figure 1: Diastolic mitral and tricuspid regurgitation with mid diastolic component (red arrow-P wave, white arrowhead- mid diastolic phase of cardiac cycle).

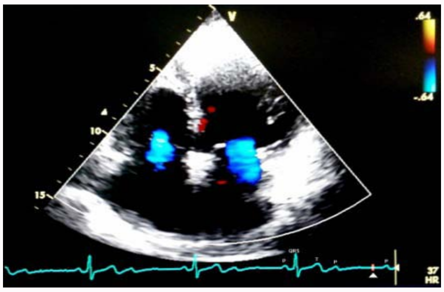

Figure 2: Diastolic mitral and tricuspid regurgitation with end-diastolic component (white arrowhead: end-diastolic phase of cardiac cycle).

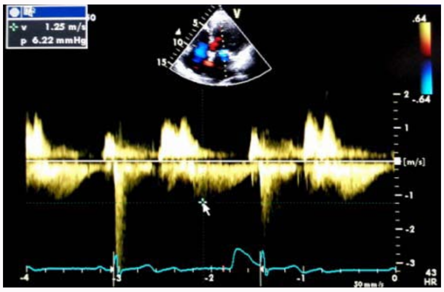

Figure 3: Diastolic mitral regurgitation on colour Doppler interrogation showing low velocity mid component.

contraction leading to closure of the mitral leaflets and therefore, an effective and appropriately timed ventricular systole is prerequisite for isovolumetric contraction and effective closure of the mitral valve.

Diastolic AV valve regurgitation is commonly observed during AV block, severe aortic regurgitation, restrictive cardiomyopathy, and dilated cardiomyopathy with severe left ventricular dysfunction [1-3]. It is outcome of atrial contraction which is not followed by adequately synchronized ventricular contraction which results into reversal of AV pressure gradient during atrial diastole (ventricular pressures higher than atrial), leading to diastolic AV regurgitation because AV valves are incompletely closed. Restrictive cardiomyopathy may cause significant elevation of LV end-diastolic pressures (LVEDP) leading to diastolic AV regurgitation. At the end of isovolumetric relaxation phase of cardiac cycle, LVEDP falls below atrial pressure which initiates phase of passive filling. When LVEDP remains persistently elevated above atrial pressure, it will not allow the AV valve to close and rather may cause regurgitation. This is typically observed in case of acute severe AR. Diastolic MR has not been studied quantitatively.

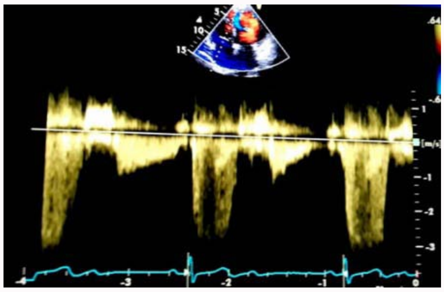

Figure 4: Diastolic tricuspid regurgitation with low jet velocity and systolic tricuspid regurgitation with high velocity jet on colour Doppler interrogation.

Since, the diastolic ventriculoatrial pressure gradient is usually low, diastolic regurgitant volume is also small despite a large regurgitant orifice of the incompletely closed mitral valve. This is the reason it fails to produce any murmur clinically. If it encountered in case of AV block, it highlights the significance of adequately timed AV synchrony in optimal diastolic filling of the failing ventricle [4,5]. Dual-chamber pacing (DDD/DDDR) at a shorter AV interval or dual sensing and ventricular pacing (VDDR) may improve LV filling dynamics by optimization of mechanical atrial and ventricular synchrony, prolongation of the effective LV diastolic filling period, and elimination of diastolic MR. This will not be the case with single chamber pacemaker (VVI/VVIR). The combination of these effects may lower LV filling pressures and elevate cardiac output, thus offering an additional therapeutic option in a subset of patients of AV block with LV dysfunction.

Although this phenomenon has been described previously, this patient's echocardiographic findings were remarkable because the combination of diastolic tricuspid regurgitation as well as diastolic mitral regurgitation. It typically occurs in mid to late diastole in the setting of premature and incomplete closure of the mitral valve and elevated LV diastolic pressure that exceeds LA pressure during ventricular diastole. DMR in the presence of normal LV function may contribute to pulmonary venous hypertension, if a high reverse V-A pressure gradient. This may have been responsible dyspnoea and high pressure tricuspid leak. Our case illustrates the importance of careful analysis of multiple echocardiographic images, and their timings using online ECG in order to delineate DMR, DTR and pulmonary hypertension.

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