A 67-year-old man underwent transthoracic echocardiography for the evaluation of heart failure. The echocardiographic examination demonstrated significant dilatation of all cardiac chambers with marked global left ventricular (LV) systolic dysfunction (LV ejection fraction of 10% to 15%). Color flow imaging revealed a mild-to-moderate degree of mitral regurgitation (MR). Diastolic as well as systolic MR was detected by multiple Doppler modalities (Figures 1 to 3). Diastolic MR resulted from the combination of first-degree atrioventricular (AV) block and severe elevation of LV filling pressures.

Effective ventricular contraction is mandatory for complete mitral valve closure. Diastolic MR is commonly observed during AV block of any degree, 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. Diastolic MR in the absence of AV block may occur secondary to significant elevation of LV end-diastolic filling pressures in the presence of restrictive ventricular hemodynamics or severe aortic regurgitation, primarily acute regurgitation. Diastolic tricuspid regurgitation, which commonly accompanies diastolic MR, may result from similar right-sided pathophysiological mechanisms.

Diastolic MR has not been studied quantitatively. As a result of the low diastolic ventriculoatrial pressure gradient, diastolic regurgitant volume is probably small, despite a potentially large regurgitant orifice of the incompletely closed mitral valve. Diastolic MR due to AV block is, in general, a benign phenomenon devoid of diagnostic or therapeutic clinical implications. However, the presence of diastolic MR in patients with significant LV dysfunction (systolic and diastolic dysfunction), as in the patient described, highlights the significance of adequately timed AV synchrony in optimal diastolic filling of the failing ventricle. In the presence of first-degree AV block and severe LV dysfunction, dual-chamber pacing at a shorter AV interval 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. 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 with severe LV dysfunction.

**Figure 1.** Pulsed-Doppler interrogation of mitral inflow from an apical transducer position. Fusion of mitral E and A waves is evident (arrow) as a result of combination of sinus tachycardia (heart rate of 100 bpm) and first-degree AV block (PR interval of 260 ms). Note that LV filling is extremely abbreviated, to ~20% of total cardiac cycle length. Fused mitral inflow pattern does not allow evaluation of LV diastolic function. Doppler interrogation of pulmonary venous flow (not shown) was consistent with restrictive LV filling dynamics (low systolic and high diastolic velocities).
Figure 2. Color M-mode recording of flow through mitral valve from an apical transducer position. MR (encoded in blue) is clearly evident during majority of cardiac cycle, including second half of diastole (arrow) as well as systole. Fused earlier mitral inflow, corresponding to pulsed-Doppler inflow signal in Figure 1, is encoded in red (arrowhead).

Figure 3. Continuous-wave Doppler recording of transmitral flow from an apical transducer position. A lower-velocity signal of diastolic MR (arrow) precedes systolic regurgitant signal. Similar observations were evident on Doppler interrogation of tricuspid valve (not shown). Also note markedly delayed upstroke of systolic mitral regurgitant signal (arrowheads), representing slow rate of early systolic pressure rise (dP/dt) in failing left ventricle.
Diastolic Mitral Regurgitation
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