Second diastolic pulmonary venous flow and isolated late diastolic mitral valve regurgitation in first-degree atrioventricular block

Gregor Leibundgut* and Alain M. Bernheim

University Hospital Basel, Basel, Switzerland

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The authors report the case of a 77-year-old male patient with sinus rhythm and a first-degree atrioventricular (AV) block who was referred for echocardiographic follow-up 18 years after aortic valve replacement. Left ventricular systolic function as well as the function of the aortic prosthesis was normal. Systolic mitral regurgitation (MR) was virtually absent, but isolated late diastolic MR was detected by colour Doppler imaging. Coincidental to the occurrence of diastolic MR, a second late diastolic forward flow in the pulmonary veins was observed. Therefore, during the prolonged left atrial relaxation caused by first-degree AV block, the left atrial pressure drops below the pressure in both adjacent chambers in late diastole, resulting in both late diastolic MR and a second diastolic pulmonary venous forward flow.

Keywords
Echocardiography • Atrioventricular block • Diastolic mitral regurgitation • Late diastolic pulmonary venous flow

A 77-year-old male patient was referred to our clinic for echocardiographic follow-up 18 years after receiving a mechanical aortic bileaflet prosthesis for severe aortic regurgitation (AR). The patient presented in good physical condition, complaining only mild and stable exertional shortness of breath. On physical examination, blood pressure was 156/87 mmHg and heart rate was 65 b.p.m. Cardiac examination revealed normal mechanical valve sounds on auscultation. The electrocardiogram showed sinus rhythm with a first-degree atrioventricular (AV) block (PR interval of 260 ms) and a complete left bundle branch block (QRS duration 132 ms).

Transthoracic echocardiogram

Transthoracic echocardiogram showed eccentric hypertrophy of the left ventricle (LV) with normal systolic function (ejection fraction 58%). The mechanical bileaflet aortic valve prosthesis showed unrestricted leaflet motion; the pressure gradients across the prosthesis were slightly elevated (peak gradient 40 mmHg, mean gradient 20 mmHg), but stable compared with the previous examinations. No paravalvular or relevant transvalvular leaks were detected. The mitral valve was normal in appearance. Whereas systolic mitral regurgitation (MR) was virtually absent, isolated late diastolic MR was detected by colour Doppler imaging (Figure 1A and C). Coincidental to the occurrence of diastolic MR, a second late diastolic forward flow (D2) in the pulmonary veins was observed (Figure 1D). Assessment of diastolic function revealed a pseudonormal filling pattern reflecting the combination of a moderately increased left atrial pressure superimposed on a left ventricular relaxation abnormality (Figure 1B and D). The left atrium (LA) was dilated. Right ventricular size and function were normal. A graph of assumptive left atrial, pulmonary venous, and left ventricular pressures corresponding to the observed Doppler recordings is provided in Figure 2 (invasive measurements were not performed in the presented case).

Discussion

Diastolic MR has been described in the setting of severe AR, in heart failure with restrictive ventricular physiology,2 or related to first-degree AV block.3 In our patient, the aortic valve prosthesis did not show relevant regurgitation. The primary mechanism responsible for diastolic MR in our patient was the presence prolonged diastole due to extended relaxation of the LA caused by first-degree AV block. Late diastolic MR might have been additionally facilitated by elevated LV-filling pressure.3 Of note, the prolonged relaxation of the LA not only led to late diastolic reversal of the atrioventricular pressure gradient with subsequent MR, but also resulted in a second diastolic pulmonary venous

* Corresponding author. Tel: +41 61 265 5214, Fax: +41 61 265 4598, Email: kardiologie@mac.com

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Figure 1 Diastolic mitral valve regurgitation shown by colour M-mode, PW-Doppler, and CW-Doppler. Vertical red bars indicate timing of electrical activation of the left atrium (p mitrale). (A) Colour M-mode recording of mitral inflow. White arrows indicate diastolic mitral valve regurgitant jet. (B) PW-Doppler recording of mitral inflow showing pseudonormal filling pattern. There is partial fusion of mitral E- and A-wave resulting from first-degree AV block. (C) CW-Doppler recording across the mitral valve. White arrows indicate late diastolic mitral valve regurgitant jet. Systolic mitral regurgitation is virtually absent. (D) PW-Doppler recording of pulmonary venous flow showing systolic (S) and diastolic (D1) forward flow, short atrial reversal (arrow), followed by a second pulmonary venous flow signal (D2) occurring during prolonged atrial relaxation.
forward flow, occurring after a short atrial flow reversal (Figure 2D). Therefore, in our case, extended relaxation of the LA due to first-degree AV block resulted in simultaneous left atrial inflow from the LV and the pulmonary veins. However, each one of these two findings can appear without the other.

Conflict of interest: none declared.

References

Figure 2 Diagram of left ventricular pressure (LVP), left atrial pressure (LAP), and pulmonary venous pressure (PVP) curves to illustrate the relationship between the pressures present within the different cavities at different time points in analogy to the observed Doppler recordings. Note that the depicted pressure curves are an assumption since no invasive measurements were performed in our patient.