

## Case Report

## Progressive Heart Failure in a Patient After Coronary Artery Bypass Grafting

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**Key words:**

**Endocarditis, native valves, pacemaker, prosthetic valves.**

A 60-year-old man suffered progressive heart failure caused by restrictive cardiomyopathy after coronary artery bypass grafting. The cardiomyopathy was due to cardiac amyloidosis coexisting with coronary artery disease. Repeated echocardiographic assessment of cardiac structure and function was crucial for diagnosis.

**A**myloidosis is a term that refers to extracellular tissue fibrillary depositions (amyloid). Amyloid fibrils are insoluble polymers composed of low molecular weight subunits of a variety of proteins. The latter are derived from soluble precursors, many of which circulate as constituents of plasma. Amyloid is deposited in many tissues and organs, including the heart. Cardiac infiltration can lead to restrictive type myocardial diastolic dysfunction (restrictive cardiomyopathy), with a particularly poor prognosis.

Here we present the case of a man who suffered from exertional dyspnoea after coronary artery bypass grafting (CABG) for left main coronary artery disease. The symptoms were at first attributed to a significant quantity of pericardial fluid that accumulated soon after surgery. Ultrasonographic findings indicative of restrictive cardiomyopathy were followed by all the appropriate laboratory tests, which finally established the diagnosis of cardiac amyloidosis.

### Case description

A 60-year-old hypertensive man suffering from effort angina underwent coronary angiography and a 70% obstruction of the left main coronary artery was revealed. On

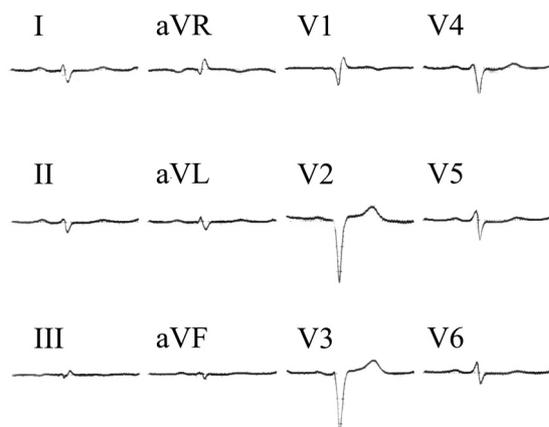
ventriculography, left ventricular contractility was normal, without segmental wall motion abnormalities. Transthoracic cardiac echocardiography (TTE) demonstrated diastolic dysfunction with delayed relaxation pattern, a thickened interventricular septum (12 mm) and a posterior wall in the normal range (8 mm). The patient also complained of palpitations and a burst of non-sustained ventricular tachycardia was recorded on the 24-hour Holter ECG. He underwent CABG fifteen days later with the left internal mammary artery to the left anterior descending coronary artery and the right internal mammary artery as aorta-to-ramus intermedius graft. Soon after surgery he developed exertional dyspnoea (New York Heart Association class I to II), and two episodes of atrial flutter occurred and were cardioverted to sinus rhythm. However, the dyspnoea persisted and TTE was repeated two months later, revealing a large pericardial effusion, whose drainage via pericardiocentesis failed to relieve the symptoms. For this reason, and mainly because of an episode of wide QRS complex tachycardia with a rate of 180 beats per minute, the patient was readmitted to hospital 20 days later. The tachycardia terminated spontaneously and a new episode of atrial flutter alternating with atrial fibrillation occurred during his stay in hospital; the latter was

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10 mm/mV 25 mm/s Average



**Figure 1.** Patient's ECG on readmission.

cardioverted to sinus rhythm. TTE showed diastolic dysfunction of the left ventricle (LV) with a restrictive pattern on Doppler examination, systolic dysfunction (the ejection fraction was estimated at 40%) and a remarkable increase in myocardial wall thickness. The interventricular septum (IVS) and the posterior wall of the LV were each 16 mm. These findings aroused suspicion about the presence of an infiltrative disorder of the myocardium.

Testing for monoclonal proteins by serum and urine protein immunoelectrophoresis and immunofixation revealed the presence of monoclonal kappa light chains (paraprotein k) in serum and urine, an indication of the presence of a monoclonal population of plasma cells. On biopsy, the bone marrow contained 12-13% plasma cells producing monoclonal kappa light chains C $\kappa$ (k). These findings, along with the presence of AL amyloid depositions on gingiva biopsy specimens, established

the diagnosis of AL amyloidosis as the cause of the restrictive cardiomyopathy.

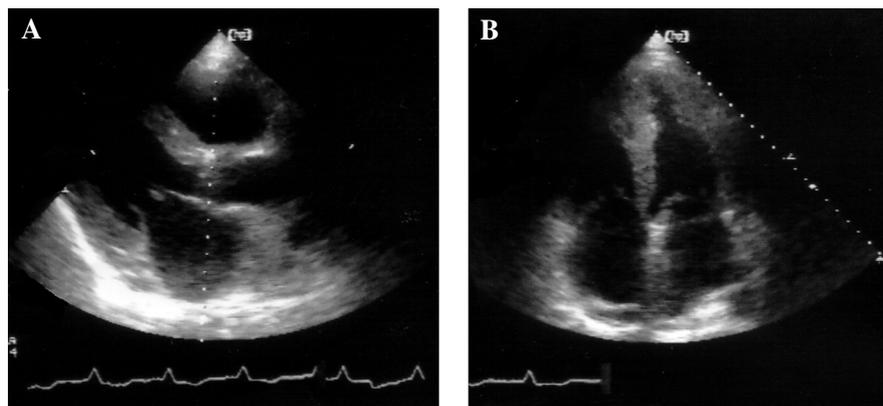
Despite therapy with prednisone and the alkylating agent melphalan, the exertional dyspnoea deteriorated and peripheral oedema appeared. Five months later, the patient was admitted to hospital with the clinical manifestations and the echocardiographic findings of end-stage cardiac amyloidosis.

On physical examination, the arterial pulse was small, the systolic and diastolic arterial pressures were 90 mmHg and 70 mmHg, respectively, and the heart rate 90 beats per minute (signs of peripheral circulatory insufficiency). With the patient's head in the middle position at 45°, inspection of the neck disclosed signs of restrictive pattern diastolic dysfunction, such as increased height of internal jugular venous pulse above the sternal angle, which fell significantly during diastole, Kussmaul's sign and sustained hepatojugular reflux from applying pressure over the upper abdomen. The liver was enlarged without tenderness and of soft consistency on palpation. There was also ankle oedema and the skin had normal appearance and temperature.

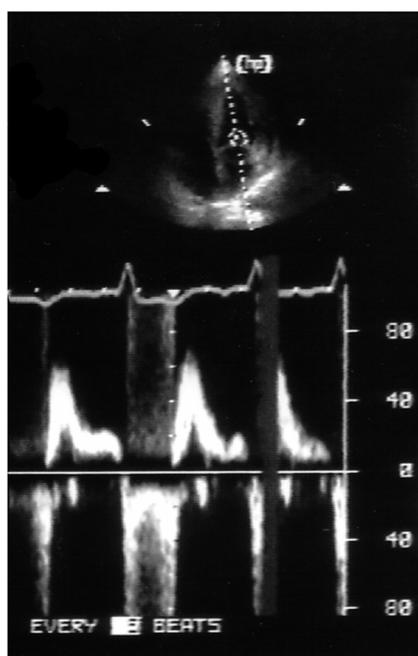
On cardiac auscultation we noticed an accentuated first and second heart sound and a discrete third heart sound, while chest examination revealed audible rales in the lower one third of both lung fields.

The ECG showed sinus rhythm, incomplete right bundle branch block and low amplitude R waves with poor progression in the right precordial leads (Figure 1). On the chest roentgenogram, the size of the cardiac silhouette was normal, the opacity of pulmonary vasculature was prominent in the lower lobes and in the left anterior oblique projection left atrial chamber protrusion was observed.

TTE (Figures 2a, b) disclosed a greater thickening of the posterior LV wall (17 mm) and IVS (18



**Figure 2.** A: Transthoracic echocardiogram, parasternal long-axis view. Note the dilated left atrium and right ventricle and the thickened IVS and posterior left ventricular wall. B: Transthoracic echocardiogram, apical four-chamber view. The IVS and mitral valve are thickened. The atria and right ventricle are dilated but the left ventricle is of normal size. The myocardial wall echogenicity has a uniform speckled appearance (granular sparkling).



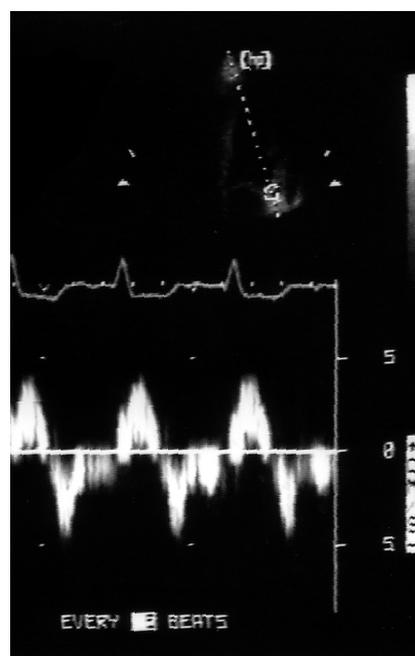
**Figure 3.** Evaluation of diastolic transmitral blood flow on pulsed wave Doppler. Note the restrictive diastolic filling pattern with the ratio of peak early filling velocity to late diastolic atrial filling velocity (E/A) greater than 2.

mm) compared with the previous examination. Left ventricular end-systolic and end-diastolic diameters were within normal range (39 mm and 50 mm, respectively), the contractility was mildly reduced (ejection fraction 39%). Both atria were dilated (the left atrium was 55 mm in diameter) and the interatrial septum was thickened. Moreover, the right ventricle was found to be thickened and diffusely hypokinetic. As far as the cardiac valves were concerned, thickening of the valve leaflets, mild aortic and moderate mitral and tricuspid valve regurgitation were observed. The myocardial wall echogenicity had a uniformly speckled appearance (granular sparkling).

There was severe diastolic dysfunction of the LV with a restrictive filling pattern and reduced propagation velocity (32 cm/s) of transmitral blood flow on pulse wave Doppler (Figure 3) and coloured M-Mode, respectively, and reduced mitral annulus velocities (less than 5 cm/s) on tissue Doppler (Figure 4).

Blood count was normal, but there was a mild increase in blood urea nitrogen and in total and direct bilirubin (3.3 mg/dl and 1.61 mg/dl respectively). The value of brain natriuretic peptide was 2480 pg/ml, far above the maximum upper limit of 100 pg/ml.

Although the patient seemed to benefit from the intravenous administration of inotropes and low dos-



**Figure 4.** Blunted diastolic mitral annulus velocities (less than 5 cm/s) on tissue Doppler echocardiogram.

es of furosemid, he died suddenly a few days later of electromechanical dissociation.

## Discussion

Clinical evidence of cardiac involvement is found in 50% of patients with primary amyloidosis, 10% of patients with secondary (AA) amyloidosis and in 5% of those with familial syndromes.<sup>1</sup> Amyloid deposits can also be found in other cardiac locations, such as coronary arteries (clinically manifested as effort angina), heart valves and pericardium.

TTE in this patient initially demonstrated slight thickening of the IVS and left ventricular diastolic dysfunction with a “prolonged relaxation” filling pattern, findings not specific for amyloidosis, which were at first attributed to the patient’s hypertension. The development of rapidly deteriorating, predominantly diastolic heart failure with a left ventricular restrictive filling pattern, along with left ventricular systolic dysfunction and the aforementioned structural abnormalities (especially the inappropriately exaggerated myocardial wall thickening), raised the suspicion of the presence of amyloidosis.<sup>2,9-11</sup>

The “granular sparkling” appearance of the myocardium is a relatively non-specific echocardiographic

finding, since it can also be seen in some other infiltrative (e.g. Pompe's disease) and non-infiltrative disorders (hypertrophic cardiomyopathy, chronic renal failure, left ventricular hypertrophy).<sup>16</sup>

The presence of conduction system disturbances is an important determinant factor of the course and prognosis of the disease. Although the sinus and atrioventricular node are most often infiltrated by amyloid, their function is preserved in most patients, as in this case.<sup>4</sup> Conduction abnormalities of the His-Purkinje system and ventricular myocardium can lead to ventricular arrhythmias, and HV prolongation during electrophysiological study (sometimes not accompanied by QRS prolongation), as well as the presence of late potentials on the signal averaged ECG, have been independently linked to an increased risk of sudden cardiac death due to arrhythmias.<sup>4,5</sup>

The pseudoinfarct pattern, usually demonstrated as a poor increase in R wave amplitude in the right precordial leads, the atrial arrhythmias and mainly the low voltage in all leads, occurring in over 50% of patients, are common ECG abnormalities in cardiac amyloidosis. The voltage to mass ratio has been found in many studies to be particularly sensitive and specific for cardiac amyloidosis, since the combination of increased ventricular mass (measured echocardiographically) with reduced electrocardiographic voltage is unique to this disease.<sup>2,6-8</sup>

Among patients with heart failure due to cardiac amyloidosis, median survival has been reported to be 6-9 months and the presence of disproportionate right ventricular dilatation, as in this case, is associated with particularly poor prognosis.<sup>11,12</sup> The only therapy that may be effective and may extend survival is the long term administration of melphalan and prednisone. Although there is temporary benefit from cardiac transplantation, it has not been performed routinely because of the frequently severe extracardiac amyloid deposition, possible recurrence in the transplant and possible progression to multiple myeloma.<sup>13-15</sup>

We believe that the case described here is interesting because: 1) the constellation of hypertension, coronary disease and complications of CABG delayed the establishment of the correct diagnosis, by justifying the

majority of the echocardiographic findings and clinical manifestations of amyloidosis in the early stages of the disease; 2) TTE was a valuable tool for the diagnosis of cardiac amyloidosis.

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