CASE REPORTS

Accurate assessment of aortic stenosis with intravenous contrast

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Received 10 December 2004; received in revised form 14 February 2005; accepted 6 March 2005
Available online 4 May 2005

KEYWORDS
Aortic stenosis; Contrast agents; Echocardiography

Abstract We came across an interesting case of calcific aortic stenosis in which severity was inaccurately assessed on two-dimensional and Doppler echocardiogram resulting in catheterization. Use of intravenous transpulmonary contrast agent enhanced the Doppler signal enabling better quantification of the transvalvular gradient. Use of contrast in such difficult to image patients is very useful in establishing a correct diagnosis.

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A 69-year-old obese gentleman presented to our accident and emergency department with a week long history of dizziness and breathlessness. Past history included a transient ischemic attack, coronary artery disease, hypertension and hyperlipidemia.

Physical examination revealed tachycardia, an irregular pulse and an ejection systolic murmur over the aortic area. Admitting electrocardiogram showed paroxysmal atrial fibrillation with aberrant conduction which was managed with intravenous amiodarone. There were no acute ST-segment changes and 12 h troponin-I was normal. Echocardiography performed 4 days following admission, when in sinus rhythm showed a hypertrophied and mildly dilated left ventricle with normal systolic function and no regional wall motion abnormalities. The aortic valve was heavily calcified with reduced opening. Poor baseline window prevented acquisition of good left ventricular outflow tract (LVOT) images. Continuous wave Doppler across the aortic valve revealed a poor envelope with a peak velocity of 2.68 ms⁻¹ and a mean gradient of 15.3 mmHg (Fig. 1).

In view of the presenting complaint, previous history of coronary artery disease and the absence of significant aortic valve stenosis the patient proceeded to coronary angiography that showed an insignificant mid-left anterior descending stenosis. The aortic valve was calcified and could not be crossed which suggested more severe stenosis as compared to echocardiographic findings.

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To establish the degree of aortic valve stenosis a repeat echocardiography was performed using a single bolus of intravenous contrast (Optison, Amersham pharmaceuticals, UK). Contrast enhanced continuous wave Doppler unmasked a peak velocity of 4.52 ms$^{-1}$ and a mean gradient of 51.3 mmHg (Fig. 2) across the aortic valve. Subsequently the patient was referred for urgent aortic valve replacement.

Calcific aortic stenosis is common and hemodynamically significant valvular stenosis affects approximately 5% of people aged 75–86 years.\(^1\) Severe symptomatic aortic stenosis carries poor prognosis and the only definitive treatment is aortic valve replacement. Doppler echocardiography is the accepted mode of examination, results of which have shown to correlate well with invasive hemodynamic data.\(^2\)

However, the procedure is time consuming and also because of narrow stream of aortic flow in patients with severe aortic stenosis, there is little assurance that the true maximal velocity has been recorded. Often in such cases invasive measurement also fails because of inability to cross the aortic valve during cardiac catheterization. Furthermore, for the calculation of aortic valve area (AVA) by continuity equation, LVOT diameter and peak velocities of blood flow in the LVOT

\[\text{AVA} = \frac{Q_1^2 \times \pi \times d^2}{2 \times V_1 \times (V_1 - V_2)}\]

Figure 1  Continuous wave Doppler across aortic valve revealed a poor envelope (peak velocity of 2.68 ms$^{-1}$ and mean gradient of 15 mmHg).

Figure 2  Contrast enhanced continuous wave Doppler revealed a clear envelope (peak velocity of 4.52 ms$^{-1}$ and a mean gradient of 51 mmHg).
and across the aortic valve are required. Patient body habitus, presence of sigmoid interventricular septum and aortic valve calcification all interfere with acquisition of satisfactory LVOT images. Use of contrast agent in such patients enables better visualization of the endocardial border and accurate estimation of AVA.

Development of transpulmonary contrast agent which increases the backscatter from blood resulting in improvement of signal to noise ratio have resulted in better spectral and Doppler images. Strengthening of Doppler signal enables better quantification of transvalvular and intraventricular gradients. Contrast enhancement is indicated when the native recordings are noisy and complete envelope of the Doppler spectrum is not obtained. In aortic stenosis several investigators have shown good agreement between the gradient calculated from Doppler measurements and the results of cardiac catheterization. Higher correlations with invasive data and higher sensitivity and specificity are found with contrast Doppler as compared to conventional Doppler. Furthermore, use of contrast agent produces at least modest improvement in reproducibility of LVOT diameter and AVA.

This case illustrates the importance of the use of contrast agent in patients who are difficult to image with poor baseline LVOT images or Doppler studies.

References