Illustration of the echocardiographic diagnosis of subaortic membrane stenosis in adults: surgical and live three-dimensional transoesophageal findings

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We report here two cases of patients admitted in our institution for heart failure. The first had been previously diagnosed with severe aortic valve stenosis and was referred for aortic valve replacement. The myocardial and valvular anatomy combined with the Doppler profiles allowed, however, to suggest the diagnosis of a discrete subaortic membrane that was confirmed by surgical findings. In the second case, the use of real-time three-dimensional transoesophageal echocardiography (3D TEE) provided superb 3D visualization quality of the subaortic membrane and allowed assessing the stenosis area using the multiplanar review mode. Hence, the use of live real-time 3D TEE is likely to be key in the spatial assessment of this complex lesion.

Keywords
Subaortic stenosis • Doppler echocardiography • Surgery

Case 1
A 70-year-old woman was referred to our cardiac surgery department for aortic valve replacement. The patient, without any risk factor, presented with acute congestive heart failure 2 months previously and was diagnosed with severe aortic valve stenosis. Left ventricular (LV) hypertrophy was found on echocardiography (EKG). Coronary angiography was unremarkable. Doppler echocardiographic examination was repeated the day prior surgery. Blood pressure was 135/70 mmHg and heart rate was 65 beats/min. LV ejection fraction was normal. Two-dimensional examination of the aortic valve in parasternal view showed a slightly calcified aortic valve associated with a moderate central aortic regurgitation (vena contracta 3 mm) and a well preserved opening of the leaflets (Figure 1A). Continuous wave Doppler recording from the apical view showed an increased aortic jet velocity at 3.1 m.s⁻¹ associated with a ‘rough’ appearance of the systolic velocity curve (Figure 1B). However the outflow area had a mosaic pattern indicative of turbulent and high subaortic flow velocities (Figure 1C and D). Neither systolic anterior motion of the mitral valve nor hypertrophic cardiomyopathy was found. The presence of a subaortic membrane was therefore highly suspected by transthoracic Doppler echocardiography. Intraoperative findings were a thin subaortic membrane (Figure 2) associated with a retraction of the aortic cusps. The membrane was removed and a bioprosthetic aortic valve was inserted.

Case 2
A 65-year-old man with diabetes and chronic kidney disease was referred to our institution for severe dyspnea, leg edema and a systolic murmur. Left ventricular hypertrophy was found on EKG, blood pressure was 140/85 mm Hg and heart rate 65 beats/min. Left ventricular ejection fraction was preserved at 60%. Parasternal and apical (loop) long-axis view demonstrated the presence of a calcified subaortic membrane in the LV outflow tract. A moderate valvular aortic regurgitation was found using Doppler colour flow mapping without any evidence of significant aortic valve stenosis. Continuous wave Doppler in
apical long-axis view demonstrated an increased aortic jet velocity of 4.11 m/s and a mean gradient of 39 mmHg. Pulsed wave Doppler recording of the outflow area showed a mosaic pattern. Live three-dimensional transoesophageal echocardiography (3D TEE) using a fully sampler 3D transducer (Philips IE 33, Handover) improved the spatial assessment of the subaortic membrane (Supplementary data online, Loop 1 and Figure 3). The planimetry of the subaortic membrane was 0.93 cm$^2$ using multiplanar review on a Xcelera workstation with the use of QLab software (Philips Medical Systems, Figure 4). Surgery was denied because of severe comorbidities and frailty.

Discussion

Sub- or supra-valvular aortic stenosis is usually suspected in young adults when the valve anatomy is not clearly stenotic, whereas Doppler examination reveals high transaortic pressure gradient. Supra-valvular aortic obstruction is commonly caused by an hourglass fibrous ring, tubular hypoplasia of the ascending aorta or either less frequently a discrete membrane at the sinotubular junction. Sub-valvular aortic obstruction is usually formed by a thin fibrous or occasionally muscular membrane of the LV outflow tract. Careful high-pulse repetition-frequency Doppler allows localization of the level of obstruction by detection of the site of maximum velocities. Heightened subaortic velocities may be recorded in case of hyperthyroidism, anaemia, arterio-venous fistula or aortic regurgitation but still remains relatively uniform. Underlying obstructive hypertrophic cardiomyopathy associates turbulence in the LV outflow tract, subaortic late-peaking

Figure 1 (A) The preserved opening of the aortic valve (parasternal long-axis view), (B) continuous wave Doppler recording obtained from the apical views displaying aortic regurgitation and mean and peak transaortic gradients at 24 and 39 mmHg, respectively, (C) pulsed Doppler spectra showing high and turbulent velocities in the left ventricle outflow tract and (D) showing mosaic pattern of colour Doppler imaging in the outflow tract of the left ventricle (patient 1).

Figure 2 Intra-operative view from the aorta demonstrating the subaortic membrane (asterisks). Aortic cusps are shown by arrows. The non-coronary cusp is in the forceps, the right coronary cusp is under the retractor (patient 1).
high-velocity curve, LV anatomic change and often systolic anterior motion of the mitral leaflet. Transoesophageal imaging is usually needed to demonstrate the presence of the often subtle membrane. Live real-time 3D TEE may provide such as in this case superb 3D visualization quality of the subaortic membrane. The size of the probe used is similar to that of standard probes making widely acceptable live 3D TEE in clinical practice. Last, multiplanar review of the full volume helped in the present case to assess the area of the subaortic stenosis. Hence, the use of live real-time 3D TEE is likely to be key in the spatial assessment of this complex lesion.

Supplementary data

Supplementary data are available at European Journal of Echocardiography online.

Conflict of interest: none declared.

Reference