

to reach a peak toward the middle of ejection, and ends just before aortic valve closure. It is characteristically low-pitched, rough, and rasping in character, and loudest at the base of the heart, most commonly in the second right intercostal space. It is transmitted upward along the carotid arteries. Occasionally it is transmitted downward and to the apex, where it may be confused with the systolic murmur of mitral regurgitation (MR) (Gallavardin effect). In almost all patients with severe obstruction and preserved CO, the murmur is at least grade III/VI. In patients with mild degrees of obstruction or in those with severe stenosis with heart failure and low CO in whom the stroke volume and, therefore, the transvalvular flow rate are reduced, the murmur may be relatively soft and brief.

■ LABORATORY EXAMINATION

ECG In most patients with severe AS, there is LV hypertrophy. In advanced cases, ST-segment depression and T-wave inversion (LV “strain”) in standard leads I and aVL and in the left precordial leads are evident. However, there is no close correlation between the ECG and the hemodynamic severity of obstruction, and the absence of ECG signs of LV hypertrophy does not exclude severe obstruction. Systemic hypertension can coexist and also contribute to the development of hypertrophy.

Echocardiogram The key findings on transthoracic echocardiogram are thickening, calcification, and reduced systolic opening of the valve leaflets and LV hypertrophy. Eccentric closure of the aortic valve cusps is characteristic of congenitally bicuspid valves. Transesophageal echocardiography imaging can display the obstructed orifice extremely well, but it is not routinely required for accurate characterization of AS. The valve gradient and aortic valve area can be estimated by Doppler measurement of the transaortic velocity. Severe AS is defined by a valve area $<1 \text{ cm}^2$, whereas moderate AS is defined by a valve area of $1\text{--}1.5 \text{ cm}^2$ and mild AS by a valve area of $1.5\text{--}2 \text{ cm}^2$. Aortic valve sclerosis, conversely, is accompanied by a jet velocity of $<2.5 \text{ m/s}$ (peak gradient $<25 \text{ mmHg}$). LV dilation and reduced systolic shortening reflect