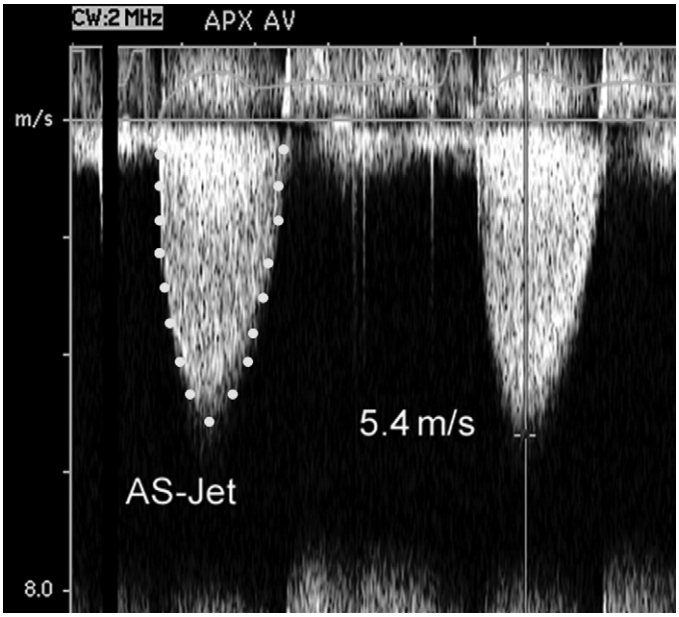

Figure 2 Continuous-wave Doppler of severe aortic stenosis jet showing measurement of maximum velocity and tracing of the velocity curve to calculate mean pressure gradient.

which varies with stenosis severity and flow rate. The mean transaortic gradient is easily measured with current echocardiography systems and provides useful information for clinical decision-making.

Transaortic pressure gradient (ΔP) is calculated from velocity (v) using the Bernoulli equation as:

$$\Delta P = 4v^2$$

The maximum gradient is calculated from maximum velocity:

$$\Delta P_{max} = 4v^2_{max}$$

and the mean gradient is calculated by averaging the instantaneous gradients over the ejection period, a function included in most clinical instrument measurement packages using the traced velocity curve. Note that the mean gradient requires averaging of instantaneous mean gradients and cannot be calculated from the mean velocity.

This clinical equation has been derived from the more complex Bernoulli equation by assuming that viscous losses and acceleration effects are negligible and by using an approximation for the constant that relates to the mass density of blood, a conversion factor for measurement units.

In addition, the simplified Bernoulli equation assumes that the proximal velocity can be ignored, a reasonable assumption when velocity is <1 m/s because squaring a number <1 makes it even smaller. When the proximal velocity is over 1.5 m/s or the aortic velocity is <3.0 m/s, the proximal velocity should be included in the Bernoulli equation so that

$$\Delta P = 4(v^2_{max} - v^2_{proximal})$$

when calculating maximum gradients. It is more problematic to include proximal velocity in mean gradient calculations as each point on the ejection curve for the proximal and jet velocities would need to be matched and this approach is not used clinically. In this situation, maximum velocity and gradient should be used to grade stenosis severity.

Table 3 Recommendations for classification of AS severity

	Aortic sclerosis	Mild	Moderate	Severe
Aortic jet velocity (m/s)	≤2.5 m/s	2.6–2.9	3.0–4.0	>4.0
Mean gradient (mmHg)	–	<20 (<30[a])	20–40[b] (30–50[a])	>40[b] (>50[a])
AVA (cm^2)	–	>1.5	1.0–1.5	<1.0
Indexed AVA (cm^2/m^2)		>0.85	0.60–0.85	<0.6
Velocity ratio		>0.50	0.25–0.50	<0.25

[a]ESC Guidelines.
[b]AHA/ACC Guidelines.

B.1.2. Mean transaortic pressure gradient. The difference in pressure between the left ventricular (LV) and aorta in systole, or transvalvular aortic gradient, is another standard measure of stenosis severity.[8–10] Gradients are calculated from velocity information, and peak gradient obtained from the peak velocity does therefore not add additional information as compared with peak velocity. However, the calculation of the mean gradient, the average gradient across the valve occurring during the entire systole, has potential advantages and should be reported. Although there is overall good correlation between peak gradient and mean gradient, the relationship between peak and mean gradient depends on the shape of the velocity curve,