B.1.3. Pressure half-time (Level 1 Recommendation). $T_{1/2}$ is defined as the time interval in milliseconds between the maximum mitral gradient in early diastole and the time point where the gradient is half the maximum initial value. The decline of the velocity of diastolic transmitral blood flow is inversely proportional to valve area (cm^2), and MVA is derived using the empirical formula:[53]

$$MVA = 220/T_{1/2}$$

$T_{1/2}$ is obtained by tracing the deceleration slope of the E-wave on Doppler spectral display of transmitral flow and valve area is automatically calculated by the integrated software of currently used echo machines (Figure 9). The Doppler signal used is the same as for the measurement of mitral gradient. As for gradient tracing, attention should be paid to the quality of the contour of the Doppler flow, in particular the deceleration slope. The deceleration slope is sometimes bimodal, the decline of mitral flow velocity being more rapid in early diastole than during the following part of the E-wave. In these cases, it is recommended that the deceleration slope in mid-diastole rather than the early deceleration slope be traced (Figure 10).[54] In the rare patients with a concave shape of the tracing, $T_{1/2}$ measurement may not be feasible. In patients with atrial fibrillation, tracing should avoid mitral flow from short diastoles and average different cardiac cycles.

Table 9 Recommendations for classification of mitral stenosis severity

	Mild	Moderate	Severe
Specific findings			
Valve area (cm^2)	>1.5	1.0–1.5	<1.0
Supportive findings			
Mean gradient (mmHg)[a]	<5	5–10	>10
Pulmonary artery pressure (mmHg)	<30	30–50	>50

[a]At heart rates between 60 and 80 bpm and in sinus rhythm.

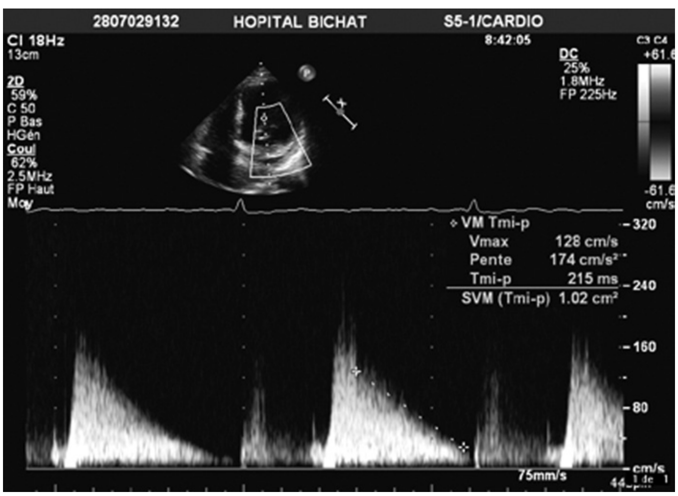

Figure 9 Estimation of mitral valve area using the pressure half-time method in a patient with mitral stenosis in atrial fibrillation. Valve area is 1.02 cm^2.

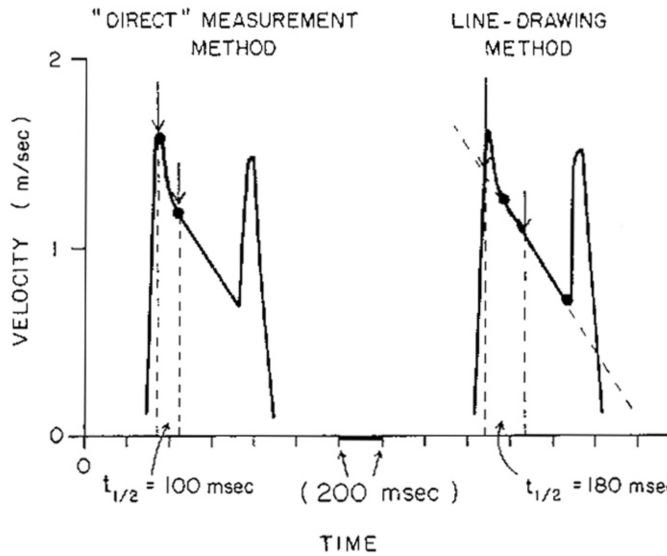

Figure 10 Determination of Doppler pressure half-time ($T_{1/2}$) with a bimodal, non-linear decreasing slope of the E-wave. The deceleration slope should not be traced from the early part (left), but using the extrapolation of the linear mid-portion of the mitral velocity profile (right). (Reproduced from Gonzalez *et al.*[54]).

The $T_{1/2}$ method is widely used because it is easy to perform, but its limitations should be kept in mind since different factors influence the relationship between $T_{1/2}$ and MVA.

The relationship between the decrease of mean gradient and MVA has been described and empirically validated using initially catheterization data and then Doppler data. However, fluid dynamics principles applied to simulations using mathematical models and in vitro modelling of transmitral valve flow consistently showed that LV diastolic filling rate, which is reflected by the deceleration slope of the E-wave, depends on MVA but also on mitral pressure gradient in early diastole, left atrial compliance, and LV diastolic func tion (relaxation and compliance).[53,55] The empirically deter mined constant of 220 is in fact proportional to the product of net compliance, i.e. the combined compliance of left atrium and LV, and the square root of maximum transmitral gradient in a model that does not take into account active relaxation of LV.[56] The increase in mean gradient is frequently compensated by a decreased compliance, and this may explain the rather good correlation between $T_{1/2}$ and other measurements of MVA in most series.

However, there are individual variations, in particular when gradient and compliance are subject to important and abrupt changes. This situation occurs immediately after balloon mitral commissurotomy where there may be important discrepancies between the decrease in mitral gradient and the increase in net compliance.[56] Outside the context of intervention, rapid decrease of mitral velocity flow, i.e. short $T_{1/2}$ can be observed despite severe MS in patients who have a particularly low left atrial compliance.[57] $T_{1/2}$ is also shortened in patients who have associated severe AR. The role of impaired LV diastolic function is more difficult to assess because of complex and competing interactions between active relaxation and compliance as regards their impact on diastolic transmitral flow.[58] Early diastolic deceleration time is prolonged when LV relaxation is impaired, while it tends to be shortened in case of decreased LV compliance.[59] Impaired LV diastolic function is a likely explanation of the lower reliability of $T_{1/2}$ to assess MVA in the elderly.[60] This concerns patients with rheumatic MS and, even more, patients with degenerative calcific MS which is a disease of the elderly often associated with AS and hypertension and, thus, impaired diastolic function. Hence, the use of $T_{1/2}$ in degenerative calcific MS may be unreliable and should be avoided.