below the aortic valve (Figure 5). The measurement of vena contracta width is significantly smaller than that of jet width in the LVOT because the jet expands immediately after the vena contracta. Imaging of the vena contracta is obtained similarly from parasternal long-axis views.[61] The vena contracta provides an estimate of the size of the EROA. To appropriately visualize the vena contracta, it is essential to see all 3 components of the regurgitant flow, i.e., the flow convergence, the vena contracta and the jet.[61] Measurement of vena contracta is simple and has a high feasibility both by transthoracic and transesophageal echocardiography. Furthermore, it appears to be more robust than jet width and area in the LVOT for the assessment of AR severity.[61] Limitations of this parameter occur in the presence of multiple jets or jets with irregular shapes, where one diameter may not be reflective of the severity of the AR; a short-axis view however will provide a better appreciation of the regurgitation.[62] The thresholds of vena contracta width associated with severe AR are 0.5 cm as a highly sensitive threshold, 0.7 cm as a highly specific threshold and 0.6 cm as the threshold with the best combination of specificity and sensitivity.[61]

Table 4 Qualitative and quantitative parameters useful in grading aortic regurgitation severity

	Mild	Moderate		Severe
Structural parameters				
LA size	Normal*	Normal or dilated		Usually dilated**
Aortic leaflets	Normal or abnormal	Normal or abnormal		Abnormal/flail, or wide coaptation defect
Doppler parameters				
Jet width in LVOT –Color Flow$^{\zeta}$	Small in central jets	Intermediate		Large in central jets; variable in eccentric jets
Jet density–CW	Incomplete or faint	Dense		Dense
Jet deceleration rate –CW (PHT, ms)$^{\psi}$	Slow > 500	Medium 500-200		Steep < 200
Diastolic flow reversal in descending aorta –PW	Brief, early diastolic reversal	Intermediate		Prominent holodiastolic reversal
Quantitative parameters$^{\varphi}$				
VC width, cm$^{\zeta}$	< 0.3	0.3-0.60		> 0.6
Jet width/LVOT width, %$^{\zeta}$	< 25	25-45	46-64	≥ 65
Jet CSA/LVOT CSA, %$^{\zeta}$	< 5	5-20	21-59	≥ 60
R Vol, ml/beat	< 30	30-44	45-59	≥ 60
RF, %	< 30	30-39	40-49	≥ 50
EROA, cm^2	< 0.10	0.10-0.19	0.20-0.29	≥ 0.30

AR, Aortic regurgitation; *CSA*, cross sectinal area; *CW*, continuous wave Doppler; *EROA*, effective regurgitant orifice area; *LV*, left ventricle; *LVOT*, left ventricular outflow tract; *PHT*, pressure half-time; *PW*, pulsed wave Doppler; *R Vol*, regurgitant volume; *RF*, regurgitant fraction; *VC*, vena contracta.
* Unless there are other reasons for LV dilation. Normal 2D measurements: LV minor axis ≤ 2.8 cm/m^2, LV end-diastolic volume ≤ 82 ml/m^2 (2).
** Exception: would be acute AR, in which chambers have not had time to dilate.
$^{\zeta}$ At a Nyquist limit of 50–60 cm/s.
$^{\psi}$ PHT is shortened with increasing LV diastolic pressure and vasodilator therapy, and may be lengthened in chronic adaptation to severe AR
$^{\varphi}$ Quantitative parameters can sub-classify the moderate regurgitation group into mild-to-moderate and moderate-to-severe regurgitation as shown.

Vena contracta. The vena contracta is defined as the smallest neck of the flow region at the level of the aortic valve, immediately below the flow convergence region. It is different from the jet width discussed above, which is measured in the LVOT,