

a. Color flow Doppler. Color-Flow imaging directly shows the regurgitant flow through the aortic valve during diastole. The regurgitant flow has 3 components that can be visualized: the flow convergence region in the aorta, the vena contracta through the regurgitant orifice, and the jet direction and size in the left ventricle (Figure 5).

Regurgitant jet size. Imaging of the regurgitant jet is used in all patients with AR because of its simplicity and real time availability.⁵⁸ The length of jet penetration into the left ventricle is an unsatisfactory indicator of AR severity.⁵⁹ The preferred assessment is based on the proximal jet width or cross-sectional area immediately below the aortic valve, within 1 cm of the valve.^{59,60} The parasternal views are preferred over apical views because of better axial resolution. The recommended measurements are those of maximal proximal jet width obtained from the long-axis views and its ratio to the LV outflow tract diameter.⁵⁹ Similarly, the cross-sectional area of the jet from the parasternal short-axis view and its ratio to the LV outflow tract area can also be used.⁵⁹ The criteria to define severe AR are ratios of $\geq 65\%$ for jet width and $\geq 60\%$ for jet area (Table 4) (Figure 6). Although small jets reliably reflect small degrees of AR, there are important limitations to color-flow imaging of regurgitant jet, similar to mitral regurgitation.^{38,40} Jet shape may affect the measurements. If the proximal jet does not have a shape with parallel borders in the LV outflow, it is difficult to know where to measure it. Jet direction is also a confounding variable. Eccentric jets that are directed predominantly to the anterior leaflet of the mitral valve (Figure 5) or the septum tend to occupy a small portion of the proximal outflow tract and may thus appear narrow and underestimate the severity of regurgitation.³⁸ Conversely, central jets tend to expand fully in the outflow tract and may be overestimated. Furthermore, the severity of AR in diffuse jets arising from the entire coaptation line is also poorly evaluated by color-flow imaging. This can be suspected from short axis imaging at the aortic valve. In practice, the assessment of AR based on jet size in the LV outflow is most often based on visual estimation rather than direct quantitative measurement and is used as a gross indicator of the degree of AR.

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 [§]	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) [¶]	Slow > 500	Medium 500-200		Steep < 200
Diastolic flow reversal in descending aorta –PW	Brief, early diastolic reversal	Intermediate		Prominent holodiastolic reversal
Quantitative parameters[°]				
VC width, cm [‡]	< 0.3	0.3-0.60		> 0.6
Jet width/LVOT width, % [‡]	< 25	25-45	46-64	≥ 65
Jet CSA/LVOT CSA, % [‡]	< 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 sectional 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/m², LV end-diastolic volume ≤ 82 ml/m² (2).

** Exception: would be acute AR, in which chambers have not had time to dilate.

[§] At a Nyquist limit of 50–60 cm/s.

[¶] PHT is shortened with increasing LV diastolic pressure and vasodilator therapy, and may be lengthened in chronic adaptation to severe AR

[°] Quantitative parameters can sub-classify the moderate regurgitation group into mild-to-moderate and moderate-to-severe regurgitation as shown.