Table 1 Qualitative and quantitative parameters useful in grading mitral regurgitation severity

	Mild	Moderate	Severe
Structural parameters			
LA size	Normal*	Normal or dilated	Usually dilated**
LV size	Normal*	Normal or dilated	Usually dilated**
Mitral leaflets or support apparatus	Normal or abnormal	Normal or abnormal	Abnormal/ Flail leaflet/ Ruptured papillary muscle
Doppler parameters			
Color flow jet area[ζ]	Small, central jet (usually < 4 cm^2 or $< 20\%$ of LA area)	Variable	Large central jet (usually > 10 cm^2 or $> 40\%$ of LA area) or variable size wall-impinging jet swirling in LA
Mitral inflow –PW	A wave dominant[Φ]	Variable	E wave dominant[Φ] (E usually 1.2 m/s)
Jet density –CW	Incomplete or faint	Dense	Dense
Jet contour –CW	Parabolic	Usually parabolic	Early peaking–triangular
Pulmonary vein flow	Systolic dominance[§]	Systolic blunting[§]	Systolic flow reversal†
Quantitative parameters[Ψ]			
VC width (cm)	< 0.3	0.3-0.69	≥ 0.7
R Vol (ml/beat)	< 30	30-44 45-59	≥ 60
RF (%)	< 30	30-39 40-49	≥ 50
EROA (cm^2)	< 0.20	0.20-0.29 0.30-0.39	≥ 0.40

CW, Continuous wave; *LA*, left atrium; *EROA*, effective regurgitant orifice area; *LV*, left ventricle; *PW*, pulsed wave; *RF*, regurgitant fraction; *R Vol*, regurgitant volume; *VC*, vena contracta.

* Unless there are other reasons for LA or LV dilation. Normal 2D measurements: LV minor axis ≤ 2.8 cm/m^2, LV end-diastolic volume ≤ 82 ml/m^2, maximal LA antero-posterior diameter ≤ 2 cm/m^2, maximal LA volume ≤ 36 ml/m^2 (2,33,35).

** Exception: acute mitral regurgitation.

[ζ] At a Nyquist limit of 50–60 cm/s.

† Pulmonary venous systolic flow reversal is specific but not sensitive for severe MR.

[Φ] Usually above 50 years of age or in conditions of impaired relaxation, in the absence of mitral stenosis or other causes of elevated LA pressure.

[§] Unless other reasons for systolic blunting (eg. atrial fibrillation, elevated left atrial pressure).

[Ψ] Quantitative parameters can help sub-classify the moderate regurgitation group into mild-to-moderate and moderate-to-severe.

Vena contracta. The vena contracta should be imaged in high-resolution, zoom views for the largest obtainable proximal jet size for measurements. The examiner must search in multiple planes perpendicular to the commissural line (such as the parasternal long-axis view), whenever possible (Figure 1). The width of the neck or narrowest portion of the jet is then measured. The regurgitant orifice in MR may not be circular, and is often elongated along the mitral coaptation line. The two-chamber view, which is oriented parallel to the line of leaflet coaptation,

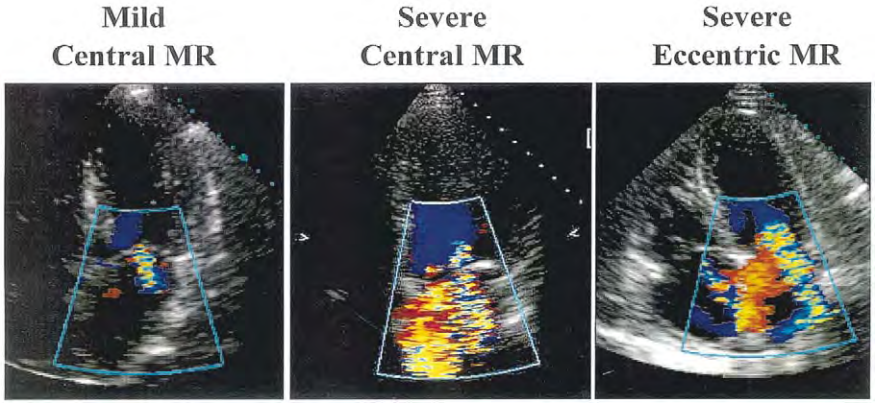

Figure 3 Examples of color flow recordings of different mitral regurgitation (*MR*) lesions from the apical window. The case of mild regurgitation has no flow convergence, a small regurgitant jet area, in contrast to that of severe central MR, which shows a prominent flow convergence and a large regurgitant jet area. The example with severe eccentric MR has a small jet area impinging on the wall of the left atrium but a large flow convergence and a wide vena contracta.

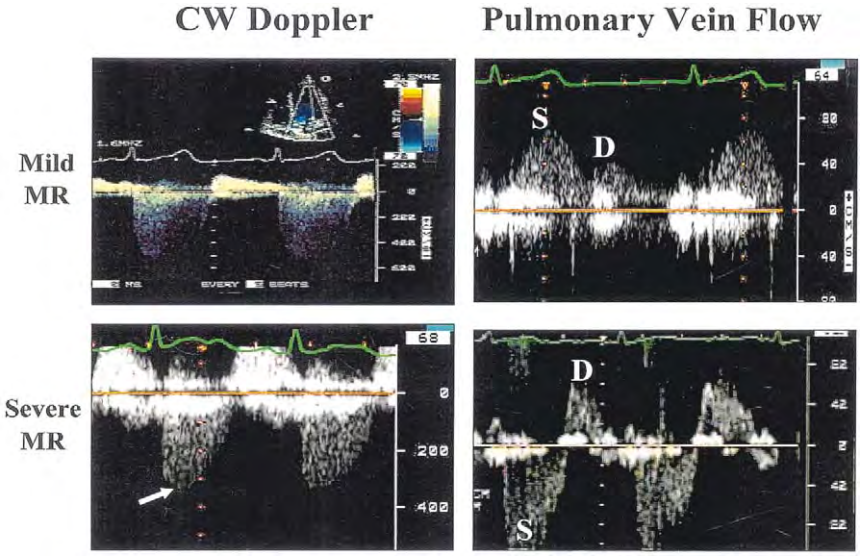

Figure 4 Example of findings of continuous wave (*CW*) Doppler recordings and pulmonary vein flow by pulsed Doppler in a case with mild and another with severe mitral regurgitation (*MR*). In mild MR, spectral recording of the jet has a soft density with a parabolic, rounded contour of the regurgitant velocity whereas in severe MR, the jet is dense with a triangular, early peaking of the velocity (*arrow*). Pulmonary vein flow is normal in mild MR with predominance of systolic flow (*S*). In contrast, the case with severe MR displays systolic flow reversal. *D*, Diastolic flow velocity.

generally shows a wide vena contracta even in mild MR, and should not be used to measure the vena contracta. Although the size of the vena contracta is independent of flow rate and driving pressure for a fixed orifice,[5] the regurgitant orifice in MR is often dynamic and therefore the vena contracta may change with hemodynamics or during systole.[6]

Several studies have shown that the width of the vena contracta is accurate in assessing the severity of MR, either by transthoracic or transesophageal echocardiography.[41-45] The width of the vena contracta in long-axis views and its cross-sectional area in short-axis views can be standardized from the parasternal views.[44] A vena contracta < 0.3 cm usually denotes mild MR where as the cut-off for severe MR has ranged between 0.6 to 0.8 cm.[43-45] Although intermediate values tend to correlate well with moderate MR, there is enough overlap that another method should be used for confirmation. A particular strength of the vena contracta method is

that it works equally well for central and eccentric jets. In fact, in eccentric jets of severe MR, the width of the vena contracta along with flow convergence alerts the echocardiographer to the severity of regurgitation by color Doppler (Figure 3). In patients with multiple MR jets, the respective widths of the vena contracta are not additive, but their cross sectional areas can be.[44] In the future, three-dimensional imaging of the vena contracta should improve the accuracy of measuring EROA by this technique.