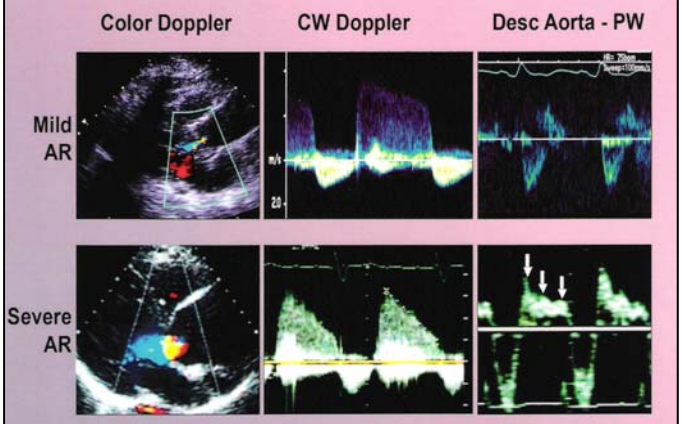
Aortic Valve

Central AR Jet

Eccentric AR Jet

Central and eccentric aortic regurgitation (AR) jets. VC = vena contracta; LA = left atrium; LV = left ventricle.



Color Doppler, continuous wave, and pulsed wave (PW) Doppler recording of flow in the descending aorta in mild and severe aortic regurgitation (AR). Arrows: holodiastolic flow reversal in the descending (desc) aorta.

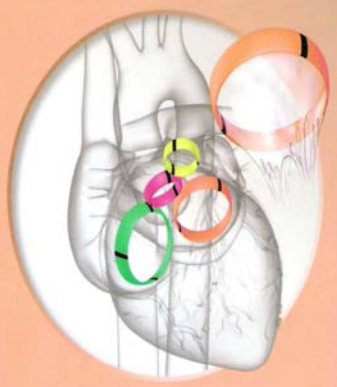
Aortic Valve

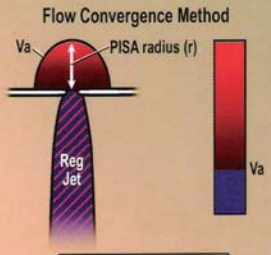
Grading of Aortic Regurgitation Severity

	Mild	Moderate		Severe
Specific Signs for AR severity	• Central Jet, width <25% of LVOT • Vena contracta < 0.3 cm[1] • No or brief early diastolic flow reversal in descending aorta	Signs of AR>mild present but no criteria for severe AR		• Central Jet, width ≥65% of LVOT • Vena contracta > 0.6 cm
Supportive Signs	• Pressure half-time > 500 ms • Normal LV size[2]	Intermediate values		• Pressure half-time <200 ms • Holodiastolic aortic flow reversal in descending aorta • Moderate or greater LV enlargement [3]
Quantitative Parameters				
RVol, 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

1 At a Nyquist limit of 50-60 cm/s.
2 LV size applied only to chronic lesions.
3 In the absence of other etiologies of LV dilatation
AR = aortic regurgitation; EROA = effective regurgitant orifice area;
LV = left ventricle; LVOT = left ventricular outflow tract;
R Vol = regurgitant volume;
RF = regurgitant fraction.

Mitral Valve



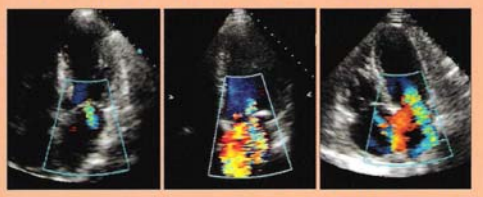


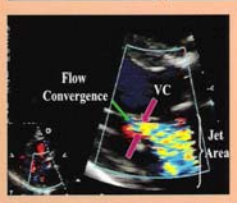
$$\text{Reg Flow} = 2\pi r^2 \times Va$$

$$\text{EROA} = \text{Reg Flow} / PKV_{Reg}$$

Flow convergence or proximal isovelocity surface area (PISA) method for quantitation of regurgitation from the apical views. Va = aliasing velocity; PkVReg = peak velocity of the regurgitant jet by CW Doppler. Reg flow = regurgitant flow; EROA = effective regurgitant orifice area; Reg jet = regurgitation jet.

Mild Central MR | **Severe Central MR** | **Severe Eccentric MR**





Examples of: mild regurgitation (MR) with no flow convergence and a small regurgitant jet area; severe central MR, with a prominent flow convergence and a large regurgitant jet area; a severe eccentric MR with a large flow convergence and a wide vena contracta.

Mitral regurgitation jet depicting its 3 components: flow convergence, vena contracta (VC), and jet area in the left atrium.

Mitral Valve

	Mild	Moderate		Severe
Specific Signs of Severity	• Small central jet <4 cm^2 or < 20% of LA area. • Vena contracta width < 0.3 cm • No or minimal flow convergence 1	Signs of MR>mild present but no criteria for severe MR		• Vena contracta width ≥ 0.7cm with large central MR Jet (area > 40% of LA) or with a wall-impinging jet of any size, swirling in LA • Large flow convergence[1] • Systolic reversal in pulmonary veins • Prominent flail MV leaflet or ruptured papillary muscle
Supportive Signs	• Systolic dominant flow in pulmonary veins • A-wave dominant mitral inflow 2 • Soft density, parabolic CW Doppler MR signal • Normal LV size 3	Intermediate signs/findings		• Dense, triangular CW Doppler MR jet • E-wave dominant mitral inflow (E >1.2 m/s) 2 • Enlarged LV and LA size, particularly when normal LV function is present
Quantitative Parameters				
RVol (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

Color Nyquist limit of 50-60 cm/s

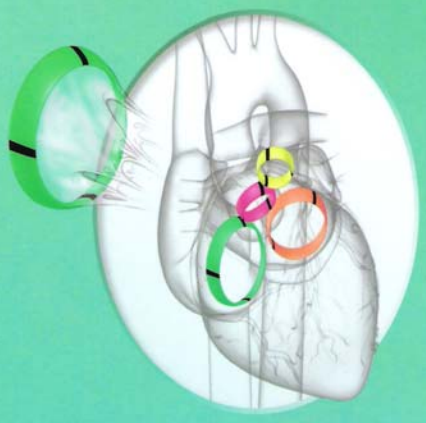
1 Minimal and large flow convergence defined as a flow convergence radius < 0.4 cm and ≥ 0.9 cm for central jets, respectively, with a baseline shift at a Nyquist of 40 cm/s.

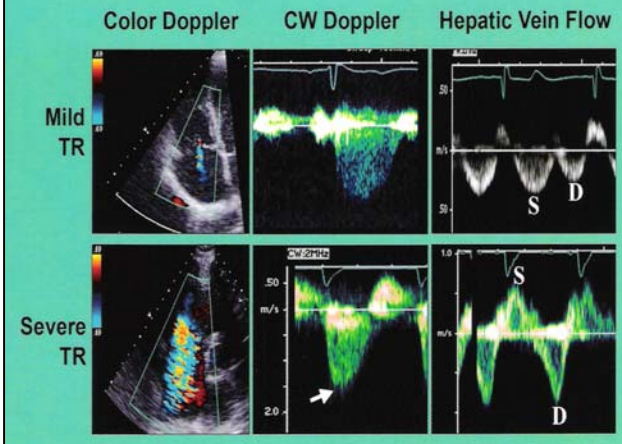
2 Usually above 50 years of age or in conditions of impaired relaxation, in the absence of mitral stenosis or other causes of elevated LA pressure

3 LV size applied only to chronic lesions

CW = continuous wave; EROA = effective regurgitant orifice area; LA = left atrium; LV = left ventricle; MV= mitral valve; MR = mitral regurgitation; R Vol = regurgitant volume; RF = regurgitant fraction.

Tricuspid Valve





Jet recordings by color Doppler, continuous wave Doppler, and hepatic vein flow by pulsed Doppler in mild and severe tricuspid regurgitation (TR). Systole = S; Diastole = D.

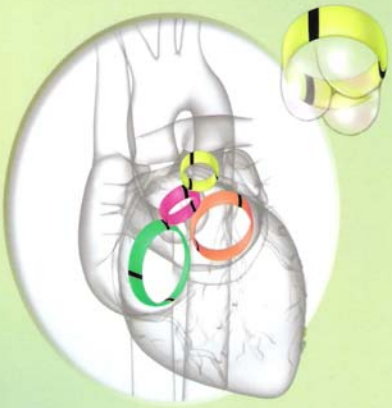
Tricuspid Valve

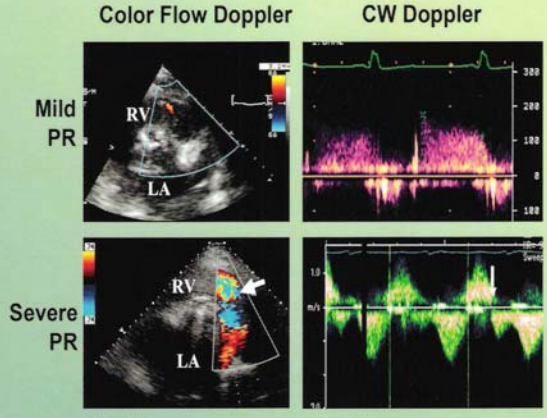
Grading Tricuspid Regurgitation Severity

Parameter	Mild	Moderate	Severe
Tricuspid valve	Usually normal	Normal or abnormal	Abnormal/Flail leaflet/ Poor coaptation
RV/RA/IVC size	Normal[1]	Normal or dilated	Usually dilated[2]
Jet area- central jets (cm^2)[3]	< 5	5-10	>10
VC width (cm)	Not defined	Not defined, but <0.7	>0.7
PISA radius (cm)[4]	<0.5	0.6 – 0.9	>0.9
Jet density and contour –CW	Soft and parabolic	Dense, variable contour	Dense, triangular with early peaking
Hepatic vein flow[5]	Systolic dominance	Systolic blunting	Systolic reversal

1 Unless there are other reasons for RA or RV dilation; 2 Exception: acute TR.
3 At a Nyquist limit of 50-60 cm/s.
4 Baseline shift with Nyquist limit of 28 cm/s.
5 Other conditions may cause systolic blunting (eg. atrial fibrillation, elevated RA pressure).
CW = Continuous wave Doppler; IVC = inferior vena cava; RA = right atrium; RV = right ventricle; VC = vena contracta width.

Pulmonic Valve





Color flow and continuous wave Doppler recording in mild and severe pulmonary regurgitation (PR). Arrow: early termination of PR flow; LA = left atrium; RV = right ventricle.

Pulmonic Valve

Grading Pulmonary Regurgitation Severity

Parameter	Mild	Moderate	Severe
Pulmonic valve	Normal	Normal or abnormal	Abnormal
RV size	Normal[1]	Normal or dilated	Dilated[2]
Jet size by color Doppler	Thin (usually <10 mm in length) with a narrow origin	Intermediate	Usually large, with a wide origin; May be brief in duration
Jet density and deceleration rate –CW[3]	Soft; Slow deceleration	Dense; variable deceleration	Dense; steep deceleration, early termination of diastolic flow
Pulmonic systolic flow compared to systemic flow –PW	Slightly increased	Intermediate	Greatly increased

1 Unless there are other reasons for RV enlargement. 2 Exception: acute PR
3 Steep deceleration is not specific for severe PR
CW = Continuous wave Doppler; PR = pulmonic regurgitation; PW = pulsed wave Doppler; RV = right ventricle.