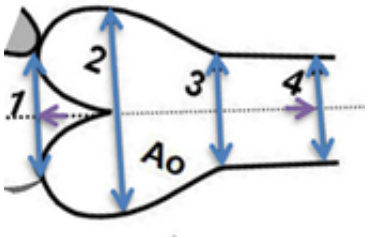
Aortic Valve 1

Aortic root measurements

Measurements should be inner-edge to inner edge measured at end-systole (ASE guidelines). More recent BSE guidelines recommend indexing all values to patient height which might lead to confusion when communicating with the surgical team.



Measured Value	Males (ASE)	Females (ASE)
Aortic Annulus (1)	2.6 +- 0.3	2.3 +- 0.2
Sinus of Valsalva (2)	3.4 +- 0.3	3.0 +- 0.3
STJ (3)	2.9 +- 0.3	2.6 +- 0.3
Proximal ascending aorta (4)	3.0 +- 0.4	2.7 +- 0.4

Aortic Stenosis

Continuity Equation: AVA = [LVOT CSA x LVOT VTI] / AV VTI

Low Flow AS defintion: AVA <1cm2, LVEF% <40%, mean gradient <30-40mmHg

Avoiding patient: prosthesis mismatch: Patient BSA x 0.85 = minimum EOA of implanted prosthesis (see reverse)

AS Severity	***Peak velocity (m/sec)***	***Mean gradient (mmHg)***	***AVA (cm^2)***	***Dimensionless Index***
Mild	2-2.9	<20	>1.5	>0.5
Moderate	3-4	20-40	1-1.5	0.25-0.5
Severe	>4	>40	<1	<0.25

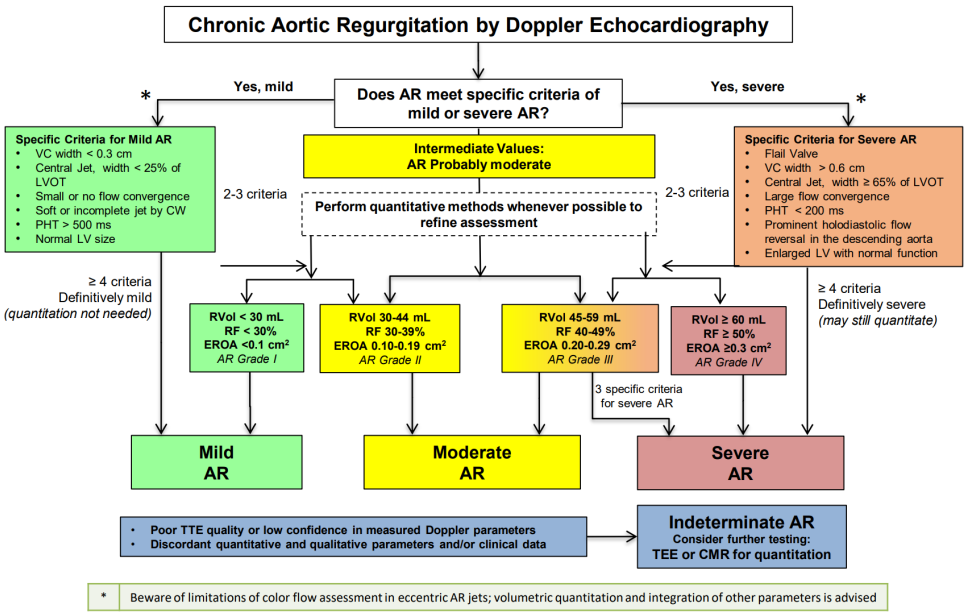
Aortic Regurgitation

AR Severity	***R-Vol (mls)***	***R-Fraction %***	***EROA (cm^2)***	***VCW (mm)***	***PHT***	***LVOT : Jet width***	***LV size***	***Holodiastolic flow descending aorta?***
Mild	<30	<30%	<0.1	<3	>500	<25%	Normal	No
Mild - mod	30-44	30-39%	0.1-0.19	-	-	-	Normal	No
Mod - severe	45-59	40-49%	0.2-0.3	-	-	-	-	-
Severe	>60	>50%	>0.3	>6	<200	>65%	Dilated	Yes

LV Dilation Criteria

LV in diastole	Diameter (mm) Males	Diameter (mm) Females	Diameter/BSA cm/m^2 (ASE / ESC)
Normal	37-56	35-51	2.2-3.1
Mild	57-61	52-55	3.2-3.4
Moderate	61-65	56-59	3.5-3.6
Severe	> 65	>59	>3.7

Aortic Valve 2

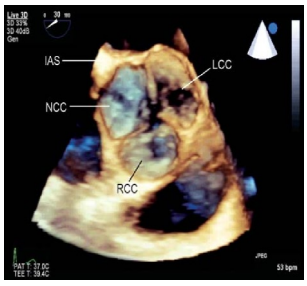


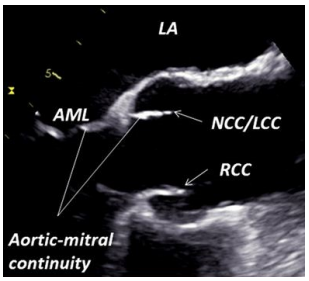
Perceval sutureless valve criteria

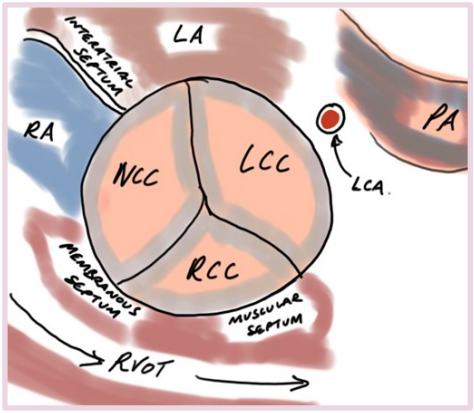
1. Tricuspid Valve (bicuspid contraindicated)
2. Aortic annulus <27mm
3. STJ < 35mm
4. STJ : Annulus <1.3
5. Aortic root height (annulus to STJ) > 21mm
6. No evidence of aortic dissection

Post-AVR assessment

1. Assessment for paravalvular leak—record in reference to the clock face
2. Rocking or loose prosthesis (for sutureless valves)
3. New valve AVA, PG and MG.
4. Patient-Prosthesis Mismatch = EOA <0.65cm^2/m^2







Epic Aortic Valve (FDA data)

Valve Size	21mm	23mm	25mm	27mm	29mm
MG (mmHg)	19.1 (+- 8.2)	13.9 (+-6)	12.1 (+-5.1)	11.4 (+- 4.1)	7.5 (+- 3.3)
EOA (cm^2)	1.0 (+-0.3)	1.4 (+-0.5)	1.5 (+- 0.5)	1.6 (+-0.4)	2.4 (+-1.1)
No. studied	*46*	*118*	*121*	*35*	*10*

Perceval Sutureless Aortic Valve (FDA data)

Valve Size	Small (21mm)	Medium (23mm)	Large (25mm)	X-Large (27mm)
MG (mmHg)	10.1 (+- 4.2)	9.4 (+-5.5)	8.5 (+-4.6)	9.7 (+- 4.7)
EOA (cm^2)	1.3 (+-0.3)	1.5 (+-0.4)	1.5 (+-0.4)	1.6 (+- 0.4)
No. studied	*31*	*131*	*123*	*15*

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Mitral Valve 1

Mitral Valve measurements

Annulus—short axis (MOLAX) <36mm

Annulus—Long axis (MO-Comm) <46mm

C-sept—Normal <25mm (in systole with MV closed)

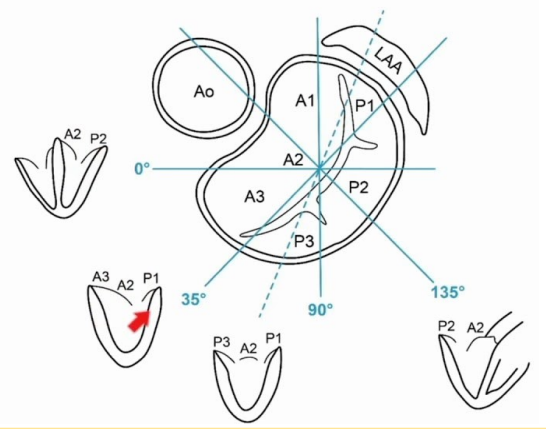
AML length (MOLAX) <36mm = normal

AML:PML ratio <1.5 (suggests larger PML)

Tenting height <10mm (increased suggests restriction)

Tenting area <25mm (increased suggests restriction)

Leaflet thickness <5mm

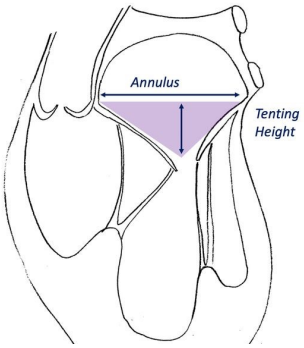


Mitral Regurgitation Assessment

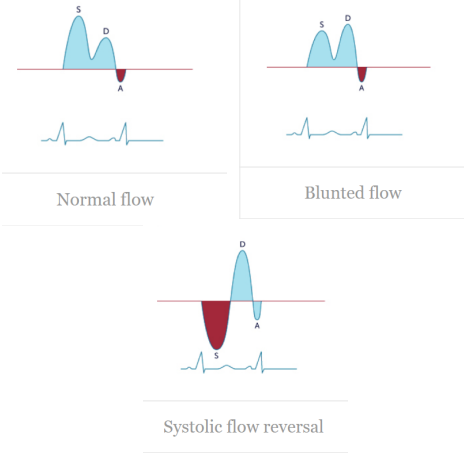
Billowing = body of the leaflet moves above the coaptation line but the tip remains below
Prolapsing = body and tip move above the coaptation line. (Elongation of the chordae)
Flail = Excessive wobbling of the leaflet way above the coaptation line (Ruptured chordae)

Predictors for difficult repair:

1. Severe central jet
2. Annulus >50mm
3. Lesions in >3 areas
4. Severe calcification
5. Coaptation distance >1cm
6. Tenting area >2.5cm^2
7. Postero-lateral angle >45^o



Pulmonary venous doppler profiles



Quantitative Measurements

1. Vena Contracta Width

Mild—<3mm Severe >7mm

2. PISA Method

EROA = $2\pi r^2$ x NL / V_{MR}

"PISA for pinheads" = Set NL to 40cm/sec, assumes MR velocity of 5m/sec.
PISA radius >10mm = severe

EROA <0.2cm = mild,

0.2-0.4 = moderate

> 0.4 = severe

3. Regurgitant Volume—RVol = EROA x VTI_{MR}

4. Regurgitant % - R% = RVol / RVol + SV (from LVOT)

Semi-Quantitative Measures

1. Pulmonary venous flow patterns

Peak S-velocity 50-80cm/sec. Peak D-velocity 40-70cm/sec

S>D = Normal

S-blunting = moderate MR

S-wave reversal = severe MR likely

2. LA dilatation—[Difficult to measure with TOE]

Pre-op TTE LAVI >34cm/m2 = Increased mortality risk

3. Tricuspid Regurgitation

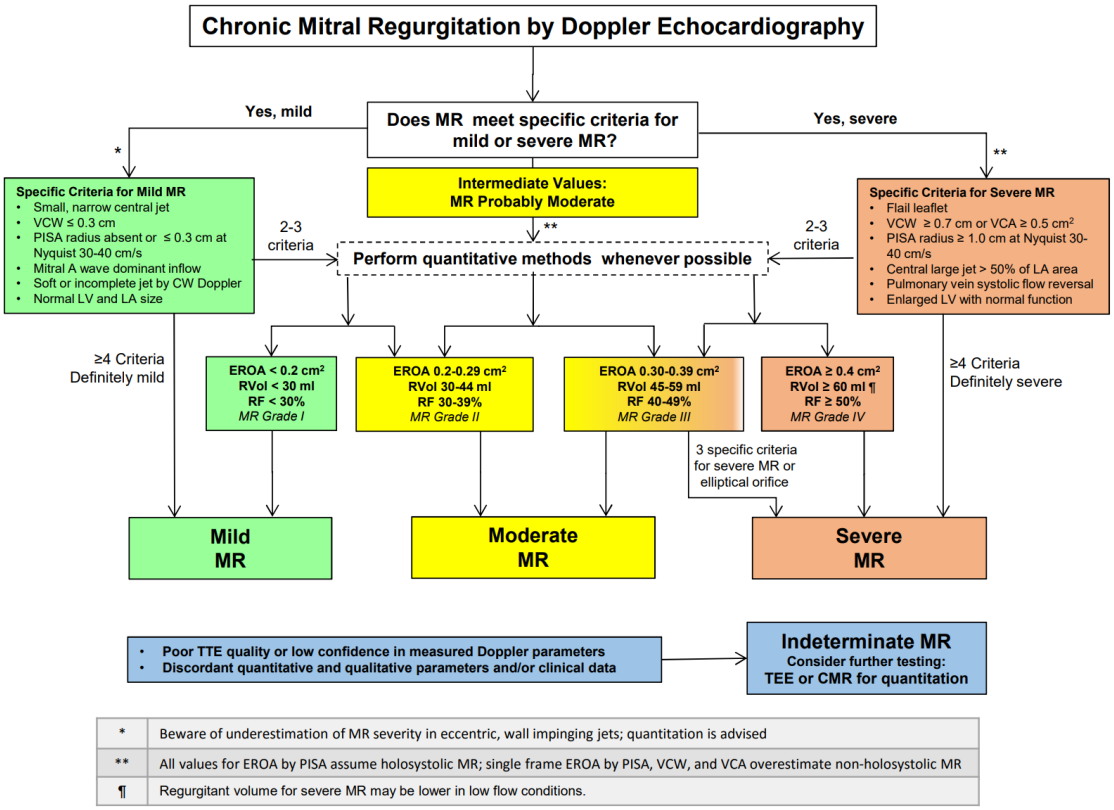
TR jet velocity >2.8m/sec suggests raised PA pressures secondary to high LA pressure from severe MR (non-specific finding though)

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Mitral Valve 2

SAM Risk Assessment

1. C-Sept <25mm
2. Septal bulge >15mm
3. AML:PML ratio <1.5 (coaptation point shifted towards LVOT)



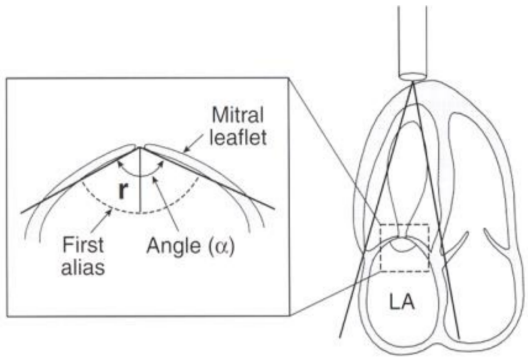
*	Beware of underestimation of MR severity in eccentric, wall impinging jets; quantitation is advised
**	All values for EROA by PISA assume holosystolic MR; single frame EROA by PISA, VCW, and VCA overestimate non-holosystolic MR
¶	Regurgitant volume for severe MR may be lower in low flow conditions.

Mitral Stenosis Assessment

MVA = 220/Pressure half-time

MVA = 759 / Decceleration time

Grade	Mean pressure mmHg	Pressure half time (msec)	Valve area (MVA)
Mild	<5	<139	1.6-2.0
Moderate	6-10	140-219	1.0-1.5
Severe	>10	>219	<1.0



$$PISA = \frac{\alpha}{180} \times \text{hemispheric area}$$

Left Ventricle

LV Dimensions

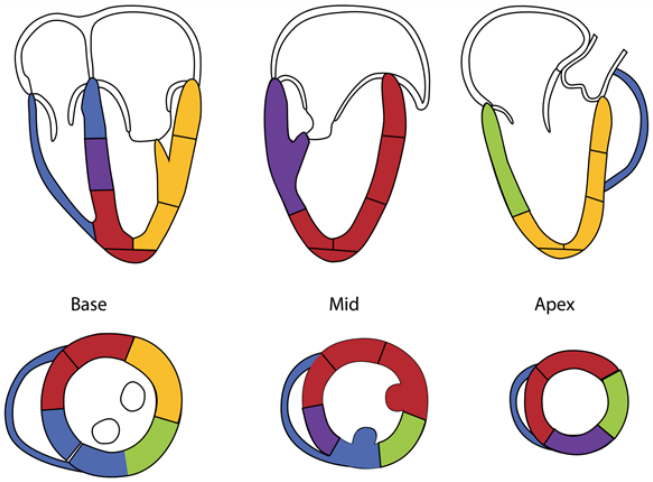
LV in diastole	*Diameter (mm) Males*	*Diameter (mm) Females*	*Diameter/BSA cm/m^2 (ASE / ESC)*
Normal	37-56	35-51	2.2-3.1
Mild	57-61	52-55	3.2-3.4
Moderate	61-65	56-59	3.5-3.6
Severe	> 65	>59	>3.7

LV in systole	*Diameter (mm) Males*	*Diameter (mm) Females*	*LVESV/BSA (mls/m^2) (ASE / ESC)*
Normal	22-41	20-37	12-30
Mild	41-45	38-42	31-36
Moderate	46-50	43-46	37-42
Severe	>50	>46	>43

LV volumes **Males**	*LVEDV (mls)*	*LVESV (mls)*	*LVEDV/BSA (mls/m^2)*	*LVESV/BSA (mls/m^2)*
Normal	53-156	15-62	30-79	9-31
Mild			80-91	32-36
Moderate			92-103	37-42
Severe			>103	>42

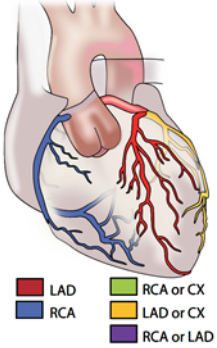
LV Volumes **Females**	*LVEDV (mls)*	*LVESV (mls)*	*LVEDV/BSA (mls/m^2)*	*LVESV/BSA (mls/m^2)*
Normal	46-121	13-47	29-70	8-27
Mild			71-81	28-32
Moderate			82-91	33-37
Severe			>91	>37

LV Anatomy



Scoring:
0: Not visualized
1: Normokinesia
2: Hypokinesia
3. Akinesia
4. Dyskinesia
5. Aneurysmatic





1. basal anterior
2. basal anteroseptal
3. basal inferoseptal
4. basal inferior
5. basal inferolateral
6. basal anterolateral
7. mid anterior
8. mid anteroseptal
9. mid inferoseptal
10. mid inferior
11. mid inferolateral
12. mid anterolateral
13. apical anterior
14. apical septal
15. apical inferior
16. apical lateral
17. apex

Coronary Territory

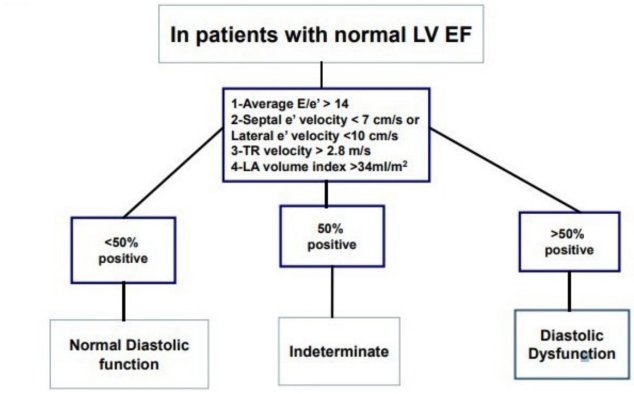
LAD: Segments 1, 7, 8, 9, 13, 14, 15, 16, 17
RCX: Segments 5, 6, 11, 12
RCA: Segments 2, 3, 4, 10

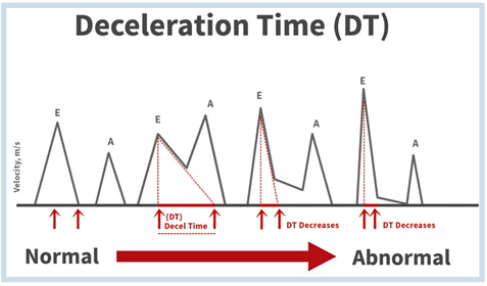
LV Function

Function **Assessment**	*FAC %*	*LVEF% (Simpsons)*
Normal	*25-45%*	>54%
Mild	*20-25%*	45-54%
Moderate	*15-20%*	35-44%
Severe	*<14%*	<35%

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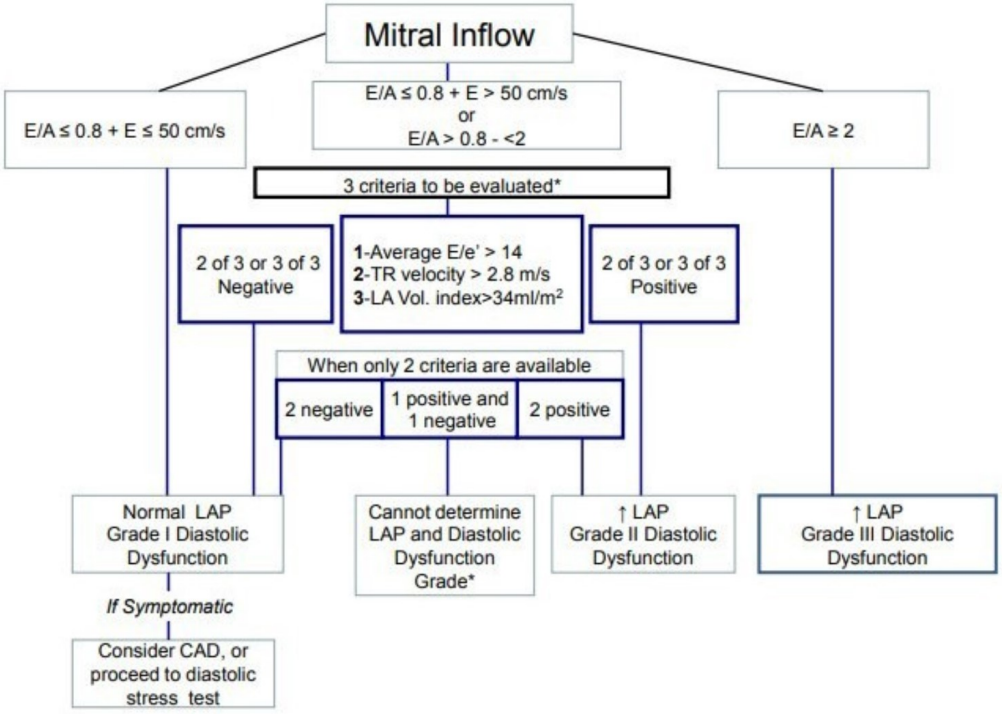
Diastolic Function





Assessment of diastolic function in patients with normal LV EF; Nagueh et al. (J. Am. Soc. Echocardiogr. 2016)

Parameter	*Normal*	*Impaired Relaxation*	*Pseudonormal*	*Restrictive*
LV Relaxation	Normal	Impaired	Impaired	Severely impaired
LAP	Normal	Normal	Elevated	Elevated
e' [lateral annulus]	>10	<8	<8	<8
E-Decelleration time		>150msec		<150msec
E/A Ratio	>0.8	<0.8	0.8-2	>2
E/e' ratio	<10	<10	10-14	>14
Peak TR velocity (m/sec)	<2.8	<2.8	>2.8	>2.8
LAVI	<34	N/A	>34	>34



Right Ventricle

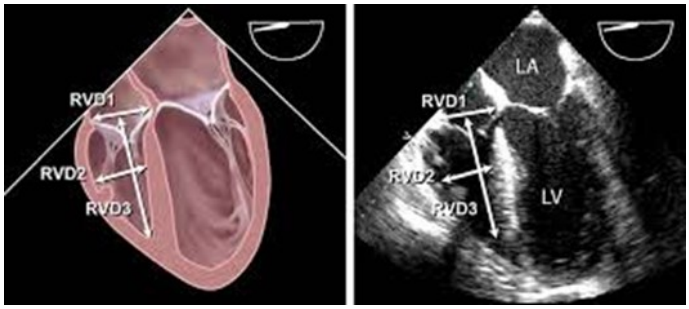
Anatomical Assessment

Parameter	Normal	Mild / abnormal	Moderate	Severe
Comparison to LV	Smaller		Equal to LV	Larger than LV
LV vs RV Apex	2/3 towards LV apex		Equal to LV	Apex displaced to RV
RVD1 (basal)		>41mm		
RVD2 (mid)		>35mm		
RVD3 (longitudinal)		>86mm		
RV volume (diastole)		>25cm^2		
RV Volume (systole)		>14cm^2		

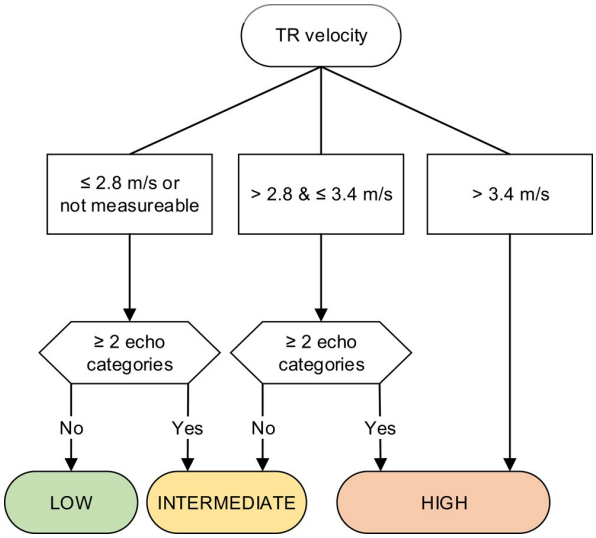
RV Function Assessment

Modality	Normal	Mild / abnormal	Moderate	Severe
RV FAC%	50%	<35%		
RVEF%		<45%		
TAPSE (mm)	>20	<16mm	n/a	n/a
TV S'		<10		
Strain	>20	<20		

RV wall thickness should be <5mm at end diastole adjacent to the tricuspid valve, larger = RVH



Tricuspid Valve



TR Assessment	VCW	EROA	CWD Profile	Hepatic venous flow
Normal	n/a		n/a	
Mild	Not defined		Soft, parabolic	Systolic dominant
Moderate	<7mm		Dense, irregular	Systolic blunted
Severe	>7mm	>0.4cm^2	Dense, triangular	Systolic reversal

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Other values