Stages of Progression of VHD

Stage	Definition	Description
A	At risk	**Patients with risk factors** for the development of VHD
B	Progressive	Patients with progressive VHD (**mild-to-moderate severity and asymptomatic**)
C	**Asymptomatic severe**	Asymptomatic patients who have reached the criteria for severe VHD C1: Asymptomatic patients with severe VHD in whom the LV or RV remains compensated C2: Asymptomatic patients who have severe VHD, with decompensation of the LV or RV
D	**Symptomatic severe**	Patients who have developed symptoms as a result of VHD

Diagnostic Testing – Diagnosis and Follow-Up

Recommendations	COR	LOE
TTE is recommended in the initial evaluation of patients with known or suspected VHD to confirm the diagnosis, establish etiology, determine severity, assess hemodynamic consequences, determine prognosis, and evaluate for timing of intervention	I	B
TTE is recommended in patients with known VHD with any change in symptoms or physical examination findings	I	C
Periodic monitoring with TTE is recommended in asymptomatic patients with known VHD at intervals depending on valve lesion, severity, ventricular size, and ventricular function	I	C

Diagnostic Testing – Diagnosis and Follow-Up

Recommendations	COR	LOE
Cardiac catheterization for hemodynamic assessment is recommended in symptomatic patients when noninvasive tests are inconclusive or when there is a discrepancy between the findings on noninvasive testing and physical examination regarding severity of the valve lesion	I	C
Exercise testing is reasonable in selected patients with asymptomatic severe VHD to 1) confirm the absence of symptoms, or 2) 2) assess the hemodynamic response to exercise, or 3) 3) determine prognosis	IIa	B

Frequency of Echocardiograms in Asymptomatic Patients With VHD and Normal Left Ventricular Function

Stage	Valve Lesion			
Stage	Aortic Stenosis	Aortic Regurgitation	Mitral Stenosis	Mitral Regurgitation
Progressive (stage B)	Mild: Every 3–5 y Moderate: Every 1–2 y	Mild: Every 3-5 y Moderate: Every 1-2 y	Every 3–5 y (MVA >1.5 cm^2)	Mild: Every 3-5 y Moderate: Every 1-2 y
Severe (stage C)	Every 1 y (V_{max} ≥4 m/s)	Every 1 y Dilating LV–more frequent	Every 1–2 y (MVA 1.0–1.5 cm^2) Every 1 y (MVA <1 cm^2)	Every 6 months to 1 y Dilating LV–more frequent

Basic Principles of Medical Therapy

Recommendations	COR	LOE
Secondary prevention of RhF is indicated in patients with RhHD, specifically mitral stenosis	I	C
Prophylaxis against IE is reasonable for the following patients at highest risk for adverse outcomes from IE prior to dental procedures that involve manipulation of gingival tissue, manipulation of the periapical region of teeth, or perforation of the oral mucosa: • Patients with prosthetic cardiac valves; • Patients with previous IE; • Cardiac transplant recipients with valve regurgitation due to a structurally abnormal valve; or *(continued on next page)*	IIa	B

The Heart Valve Team and Heart Valve Centers of Excellence

Recommendations	COR	LOE
Patients with severe VHD should be evaluated by a multidisciplinary Heart Valve Team when intervention is considered	I	C
Consultation with or referral to a Heart Valve Center of Excellence is reasonable when discussing treatment options for 1) asymptomatic patients with severe VHD, 2) patients who may benefit from valve repair versus valve replacement, or 3) patients with multiple comorbidities for whom valve intervention is considered	IIa	C

Helping Cardiovascular Professionals Learn, Advance, Heal

American Heart Association.

Stages of Primary Mitral Regurgitation (PrMR)

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
A	**At risk of MR**	• Mild MVP with normal coaptation • Mild valve thickening and leaflet restriction	• No MR jet or small central jet area <20% LA on Doppler • Small vena contracta <0.3 cm	• None	• None
B	**Progressive MR**	• Severe MVP with normal coaptation • Rheumatic valve changes with leaflet restriction and loss of central coaptation • Prior IE	• Central jet MR 20%–40% LA or late systolic eccentric jet MR • Vena contracta <0.7 cm • Regurgitant volume <60 cc • Regurgitant fraction <50% • ERO <0.40 cm^2 • Angiographic grade 1–2+	• Mild LA enlargement • No LV enlargement • Normal pulmonary pressure	• None

Helping Cardiovascular Professionals Learn, Advance, Heal

American Heart Association.

Stages of PrMR (cont.)

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
C	**Asymptomatic severe MR**	• Severe MVP with loss of coaptation or flail leaflet • Rheumatic valve changes with leaflet restriction and loss of central coaptation • Prior IE • Thickening of leaflets with radiation heart disease	• Central jet MR >40% LA or holosystolic eccentric jet MR • Vena contracta ≥0.7 cm • Regurgitant volume ≥60 cc • Regurgitant fraction ≥50% • ERO ≥0.40 cm^2 • Angiographic grade 3–4+	• Moderate or severe LA enlargement • LV enlargement • PH **may be** present at rest or with exercise • **C1**: LVEF >60% and LVESD <40 mm • **C2**: LVEF ≤60% and LVESD ≥40 mm	• None

Stages of PrMR (cont.)

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
D	**Symptomatic severe MR**	• Severe MVP with loss of coaptation or flail leaflet • Rheumatic valve changes with leaflet restriction and loss of central coaptation • Prior IE • Thickening of leaflets with radiation heart disease	• Central jet MR >40% LA or holosystolic eccentric jet MR • Vena contracta ≥0.7 cm • Regurgitant volume ≥60 cc • Regurgitant fraction ≥50% • ERO ≥0.40 cm^2 • Angiographic grade 3–4+	• Moderate or severe LA enlargement • LV enlargement • PH **present**	• Decreased exercise tolerance • Exertional dyspnea

Helping Cardiovascular Professionals Learn, Advance, Heal.

American Heart Association.

Chronic PrMR: Diagnosis & Follow-Up

Recommendations	COR	LOE
TTE is indicated for baseline evaluation of LV size and function, RV function and LA size, PAP, and mechanism and severity of primary MR (stages A to D) in any patient suspected of having chronic primary MR	I	B
CMR is indicated in patients with chronic primary MR to assess LV and RV volumes, function, or MR severity and when these issues are not satisfactorily addressed by TTE	I	B

Helping Cardiovascular Professionals Learn, Advance, Heal.

American Heart Association.

Chronic PrMR: Diagnosis & Follow-Up (cont.)

Recommendations	COR	LOE
Intraoperative TEE is indicated to establish the anatomic basis for chronic primary MR (stages C and D) and to guide repair	I	B
TEE is indicated for evaluation of patients with chronic primary MR (stages B to D) in whom noninvasive imaging provides nondiagnostic information about severity of MR, mechanism of MR, and/or status of LV function	I	C

Helping Cardiovascular Professionals Learn, Advance, Heal.

American Heart Association.

Chronic PrMR: Diagnosis and Follow-Up (cont.)

Recommendations	COR	LOE
Exercise hemodynamics with either Doppler echocardiography or cardiac catheterization is reasonable in symptomatic patients with chronic primary MR where there is a discrepancy between symptoms and the severity of MR at rest (stages B and C)	IIa	B
Exercise treadmill testing can be useful in patients with chronic primary MR to establish symptom status and exercise tolerance (stages B and C)	IIa	C

Chronic PrMR: Medical Therapy

Recommendations	COR	LOE
Medical therapy for systolic dysfunction is reasonable in symptomatic patients with chronic primary MR (stage D) and LVEF less than 60% in whom surgery is not contemplated	IIa	B
Vasodilator therapy is not indicated for normotensive asymptomatic patients with chronic primary MR (stages B and C1) and normal systolic LV function	III: No Benefit	B

Chronic PrMR: Intervention

Recommendations	COR	LOE
MV surgery is recommended for symptomatic patients with chronic severe primary MR (stage D) and LVEF >30%	I	B
MV surgery is recommended for asymptomatic patients with chronic severe primary MR and LV dysfunction (LVEF 30%–60% and/or LVESD ≥40 mm, stage C2)	I	B
MV repair is recommended in preference to MVR when surgical treatment is indicated for patients with chronic severe primary MR limited to the posterior leaflet	I	B

Helping Cardiovascular Professionals Learn, Advance, Heal.

American Heart Association.

Chronic PrMR: Intervention (cont.)

Recommendations	COR	LOE
MV repair is recommended in preference to MVR when surgical treatment is indicated for patients with chronic severe primary MR involving the anterior leaflet or both leaflets when a successful and durable repair can be accomplished	I	B
Concomitant MV repair or replacement is indicated in patients with chronic severe primary MR undergoing other cardiac surgery	I	B

Helping Cardiovascular Professionals Learn, Advance, Heal.

American Heart Association.

Chronic PrMR: Intervention (cont.)

Recommendations	COR	LOE
MV repair is reasonable in asymptomatic patients with chronic severe primary MR (stage C1) with preserved LV function (LVEF >60% and LVESD <40 mm) in whom the likelihood of a successful and durable repair without residual MR is >95% with an expected mortality <1% when performed at a Heart Valve Center of Excellence	IIa	B

Helping Cardiovascular Professionals Learn, Advance, Heal

American Heart Association.

Chronic PrMR: Intervention (cont.)

Recommendations	COR	LOE
MV repair is reasonable for asymptomatic patients with chronic severe non-rheumatic primary MR (stage C1) and preserved LV function in whom there is a high likelihood of a successful and durable repair with 1) new onset of AF or 2) resting pulmonary hypertension (PA systolic arterial pressure >50 mm Hg)	IIa	B
Concomitant MV repair is reasonable in patients with chronic moderate primary MR (stage B) undergoing other cardiac surgery	IIa	C

Helping Cardiovascular Professionals Learn, Advance, Heal

American Heart Association.

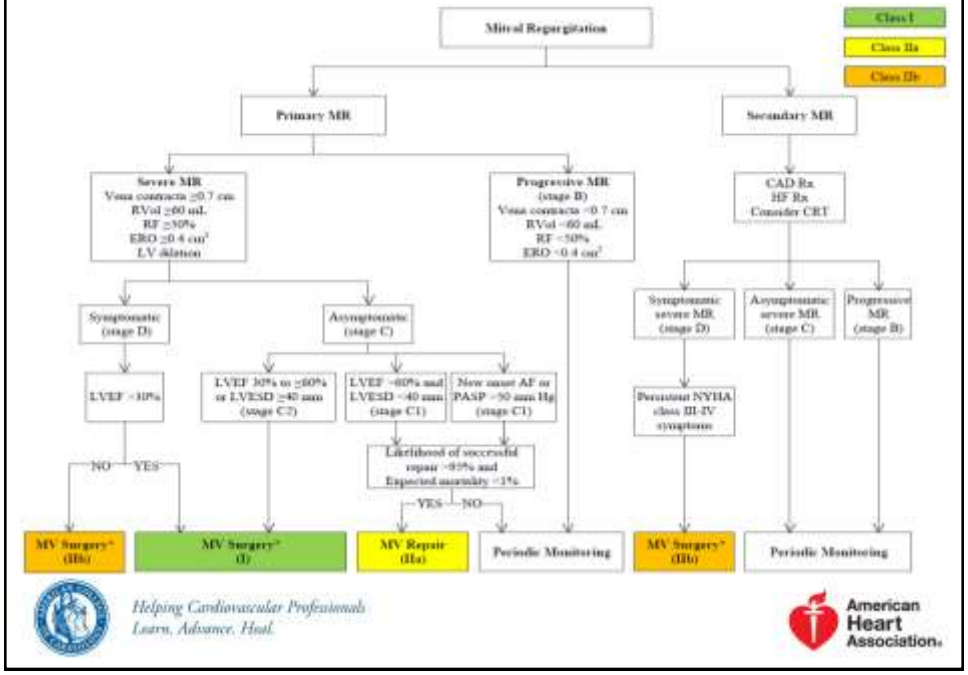
Chronic PrMR: Intervention (cont.)

Recommendations	COR	LOE
MV surgery may be considered in symptomatic patients with chronic severe primary MR and LVEF ≤30% (stage D)	IIb	C
MV repair may be considered in patients with rheumatic mitral valve disease when surgical treatment is indicated if a durable and successful repair is likely or if the reliability of long-term anticoagulation management is questionable	IIb	B

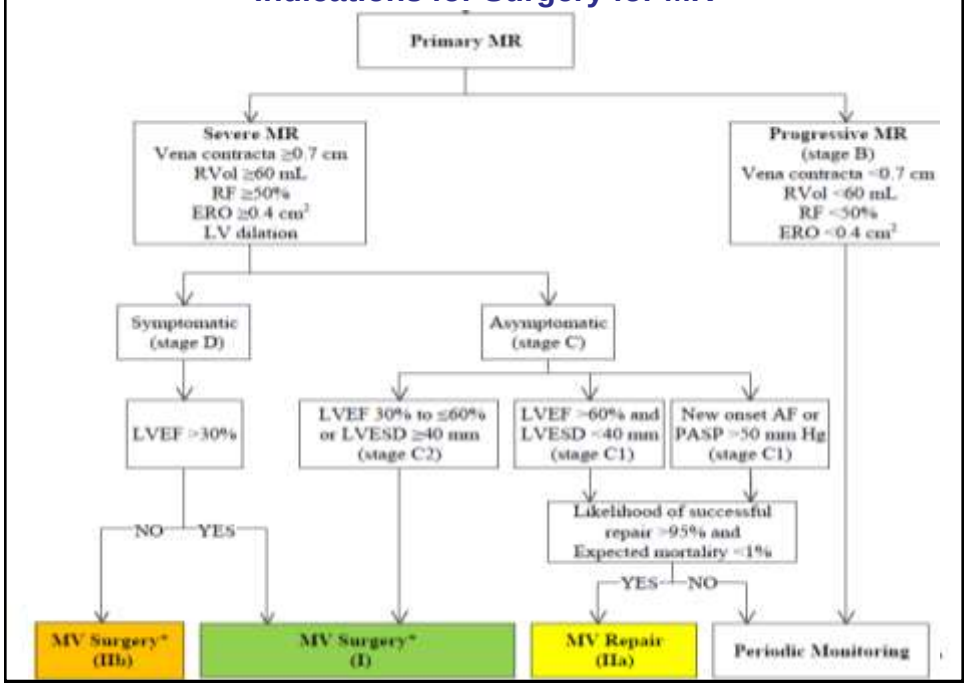
Chronic PrMR: Intervention (cont.)

Recommendations	COR	LOE
Percutaneous MV repair may be considered for severely symptomatic patients (NYHA class III-IV) with chronic severe primary MR (stage D) who have a reasonable life expectancy, but a prohibitive surgical risk because of severe comorbidities	IIb	B
MVR should not be performed for the treatment of isolated severe primary MR limited to less than one half of the posterior leaflet unless MV repair has been attempted and was unsuccessful	III: Harm	B

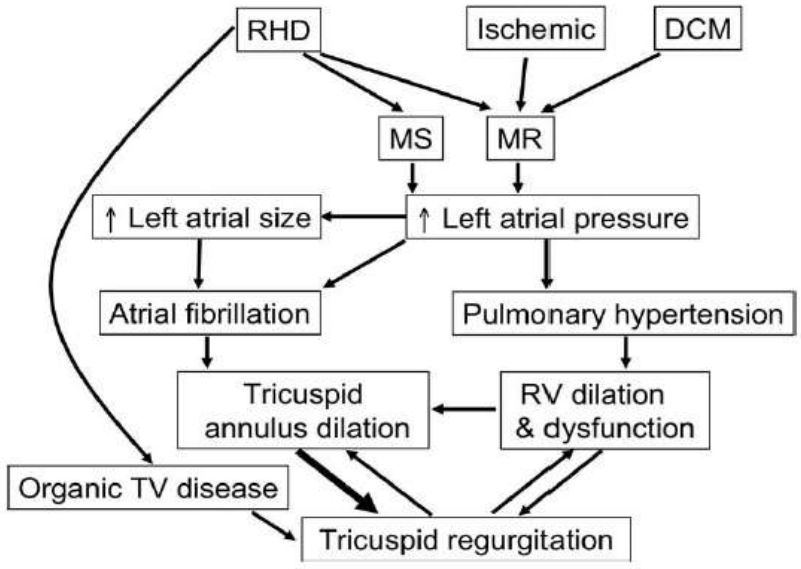
Indications for Surgery for MR



Indications for Surgery for MR



Pathogenesis of TR in MVD



Stages of Tricuspid Regurgitation (TR)

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
A	**At risk of TR**	**Primary** • Mild rheumatic change • Mild prolapse • Other (e.g., IE with vegetation, early carcinoid deposition, radiation) • Intra-annular RV pacemaker or ICD lead • Postcardiac transplant (biopsy-related) **Functional** • Normal • Early annular dilation	• No or trace TR	• None	• None or in relation to other left heart or pulmonary/ pulmonary vascular disease

Stages of TR (cont.)

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
B	**Progressive TR**	**Primary** • Progressive leaflet deterioration/ destruction • Moderate-to-severe prolapse, limited chordal rupture **Functional** • Early annular dilation • Moderate leaflet tethering	**Mild TR** • Central jet area <5 cm^2 • Vena contracta width not defined • CW jet density and contour: soft and parabolic • Hepatic vein flow: systolic dominance **Moderate TR** • Central jet area 5–10 cm^2 • Vena contracta width not defined, but <0.70 cm • CW jet density and contour: dense, variable contour • Hepatic vein flow: systolic blunting	**Mild TR** • RV/RA/IVC size normal **Moderate TR** • No RV enlargement • No or mild RA enlargement • No or mild IVC enlargement with normal respirophasic variation • Normal RA pressure	• None or in relation to other left heart or pulmonary/ pulmonary vascular disease

Stages of TR (cont.)

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
C	**Asymptomatic, severe TR**	**Primary** • Flail or grossly distorted leaflets **Functional** • Severe annular dilation (>40 mm or 21 mm/m^2) • Marked leaflet tethering	• Central jet area >10 cm^2 • Vena contracta width >0.7 cm • CW jet density and contour: dense, triangular with early peak • Hepatic vein flow: systolic reversal	• RV/RA/IVC dilated with decreased IVC respirophasic variation • Elevation RA pressure with “c-V” wave • Diastolic interventricular septal flattening may be present	• None, or in relation to other left heart or pulmonary/ pulmonary vascular disease

Stages of TR (cont.)

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
D	**Symptomatic severe TR**	**Primary** • Flail or grossly distorted leaflets **Functional** • Severe annular dilation (>40 mm or >21 mm/m^2) • Marked leaflet tethering	• Central jet area >10 cm^2 • Vena contracta width >0.70 cm • CW jet density and contour: dense, triangular with early peak • Hepatic vein flow: systolic reversal	• RV/RA/IVC dilated with decreased IVC respirophasic variation • Elevation RA pressure with "c-V" wave • Diastolic interventricular septal flattening • Reduced RV systolic function in late phase	• Fatigue, palpitations, dyspnea, abdominal bloating, anorexia, edema

TR: Diagnosis and Follow-Up

Recommendations	COR	LOE
TTE is indicated to evaluate severity of TR, determine etiology, measure sizes of right-sided chambers and IVC, assess RV systolic function, estimate PASP, and characterize any associated left-sided heart disease	I	C
Invasive measurement of PAP and pulmonary vascular resistance can be useful in patients with TR when clinical and noninvasive data regarding their values are discordant	IIa	C

TR: Medical Therapy

Recommendations	COR	LOE
Diuretics can be useful for patients with severe TR and signs of right-sided HF (stage D)	IIa	C
Medical therapies to reduce elevated PAPs and/or pulmonary vascular resistance might be considered in patients with severe functional TR (stages C and D)	IIb	C

TR: Intervention

Recommendations	COR	LOE
Tricuspid valve surgery is recommended for patients with severe TR (stages C and D) undergoing left-sided valve surgery	I	C
Tricuspid valve repair can be beneficial for patients with mild, moderate, or greater functional TR (stage B) at the time of left-sided valve surgery with either 1) tricuspid annular dilation or 2) prior evidence of right HF	IIa	B
Tricuspid valve surgery can be beneficial for patients with symptoms due to severe primary TR that are unresponsive to medical therapy (stage D)	IIa	C

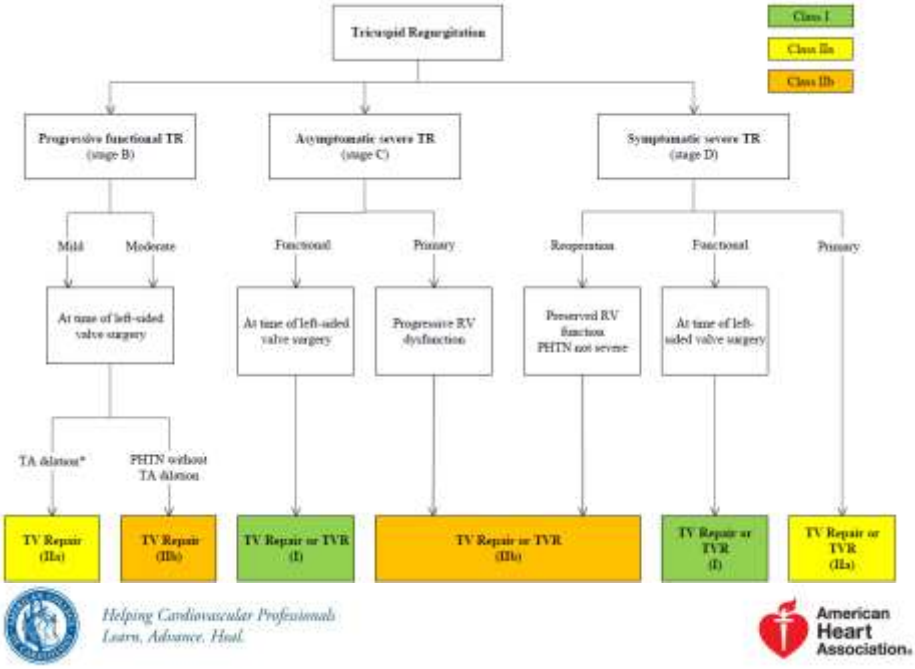
TR: Intervention (cont.)

Recommendations	COR	LOE
Tricuspid valve repair may be considered for patients with moderate functional TR (stage B) and pulmonary artery hypertension at the time of left-sided valve surgery	IIb	C
Tricuspid valve surgery may be considered for asymptomatic or minimally symptomatic patients with severe primary TR (stage C) and progressive degrees of moderate or greater RV dilation and/or systolic dysfunction	IIb	C

TR: Intervention (cont.)

Recommendations	COR	LOE
Reoperation for isolated tricuspid valve repair or replacement may be considered for persistent symptoms due to severe TR (stage D) in patients who have undergone previous left-sided valve surgery and who do not have severe pulmonary hypertension or significant RV systolic dysfunction	IIb	C

Indications for Surgery for TR



Journal of the American College of Cardiology
© 2009 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 53, No. 5, 2009
ISSN 0735-1097/09/$36.00
doi:10.1016/j.jacc.2008.09.048

STATE-OF-THE-ART PAPER

Tricuspid Regurgitation in Mitral Valve Disease

Incidence, Prognostic Implications, Mechanism, and Management

Avinoam Shiran, MD,* Alex Sagie, MD†‡
Haifa, Petah Tikva, and Ramat Aviv, Israel