

in cardiac output or venous return to the heart increases the mitral valve gradient and increases LA and pulm venous pressures. Pulm edema occurs when the pulm venous pressure is >pulm capillary oncotic pressure.

- Elevated left atrial pressure leads to pulm venous Htn, left atrial dilation, left atrial thrombosis, AFIB, pulm Htn, RV failure, and tricuspid regurgitation.
- Symptoms of mitral stenosis can be elicited by conditions (fluid overload, exercise, pregnancy, sepsis, operation) that demand an increase in cardiac output or diastolic blood flow across the mitral valve.
- Deformity of the mitral valve apparatus may cause mitral stenosis in combination with mitral regurgitation or LV dysfunction.

Etiology

- Congenital heart disease (rare).
- Mitral valve repair with restrictive ring annuloplasty (rare).
- Acquired mitral stenosis is sequela of rheumatic carditis developing after group A streptococcal pharyngitis.
- Rheumatic carditis produces exudative and inflammatory lesions that lead to fibrosis, calcification, thickening, and commissural fusion of the mitral valve apparatus.
- Acquired prosthetic mitral stenosis from structural valvular deterioration after bioprosthetic mitral valve replacement or mechanical prosthetic valve dysfunction after mechanical mitral valve replacement.

Usual Treatment

- Anticoagulation to decrease risk of thromboembolic events in pts with AFIB, prior embolic event, or left atrial thrombus
- Digoxin, beta-blockers, or calcium channel blockers to control ventricular rate in pts with AFIB
- Diuretic therapy for symptomatic pulm edema, CHF, or RV failure
- Percutaneous balloon valvotomy in pts without extensive valve calcification, leaflet restriction, leaflet thickening, moderate-severe mitral regurgitation, left atrial thrombus, or involvement of the subvalvular apparatus
- Mitral valve replacement, repair, or open valvotomy in pts with symptomatic severe MS and MVA ≤ 1.5 cm²
- Transcatheter valve-in-valve mitral valve replacement in high-risk surgical pts with bioprosthetic mitral stenosis

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Mitral stenosis AFIB Pulm Htn	DOE, NYHA class Chest pain or tightness Palpitations DOE	Diastolic murmur Irregular pulse Sternal heave Prominent S ₂	ECHO Cardiac cath ECG CXR
RESP	Pulm edema	DOE Orthopnea Paroxysmal nocturnal dyspnea Hemoptysis	Tachypnea Rales Wheezes	CXR
GI	Cardiac cirrhosis		Hepatomegaly	LFTs
RENAL	Fluid retention Diuretic therapy	Dependent edema	Pedal edema	Serum lytes
CNS	Embolic stroke	Neurologic deficits, TIAs	Focal neurologic deficits	Head CT scan, TEE
HEME	Bleeding	Anticoagulation therapy	Ecchymosis	INR, PT, PTT

Key References: Nishimura RA, Otto CM, Bonow RO, et al.: 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines, *Circulation* 129(23):e521–e643, 2014; Weiner MM, Vahl TP, Kahn RA: Case scenario: cesarean section complicated by rheumatic mitral stenosis, *Anesthesiology* 114(4):949–957, 2011.

Perioperative Implications

Preoperative Preparation

- Determine if pt is a candidate for percutaneous balloon valvotomy.
- Optimize fluid status of pts in CHF.
- Control ventricular rate in pts with AFIB.
- Replete K⁺ in pts with hypokalemia on digoxin therapy.
- Antibiotic prophylaxis for infectious endocarditis according to guidelines.
- Keep pt calm using reassurance, anxiolytics, and analgesics.
- Assess the risk of bleeding in anticoagulated pts and correct the prolonged PT (INR) with FFP if necessary.

Monitoring

- ECG to detect paroxysmal AFIB or flutter.
- Consider arterial catheter for continuous BP monitoring and ABG sampling.

- Consider CVP line, PA catheter, or TEE to measure pulm artery pressure, assess RV function, and guide intravascular volume management when large fluid shifts are anticipated.

Preinduction/Induction

- Cautious administration of drugs that decrease myocardial contractility, increase HR, or cause vasodilation.
- Hypoventilation and hypoxia may worsen pulm Htn and RV failure.
- Positive inotropic drugs may precipitate pulm edema.

Maintenance

- Control fluid administration.

Extubation/Postoperative Period

- Provide adequate analgesia.
- Increased risk of postop resp failure.

Adjuvants

- Consider regional anesthesia or periop epidural anesthesia and analgesia, especially for labor and delivery in the pregnant pt with mitral stenosis.
- Inhaled NO or epoprostenol for RV failure associated with pulm Htn.

Anticipated Problems/Concerns

- Pts have a limited ability to increase their cardiac output.
- Acute pulm edema is precipitated by increased cardiac output, increased HR, pregnancy, anxiety, fluid overload, exercise, and postop mobilization of sequestered (third space) interstitial and extracellular fluid.
- Bleeding in anticoagulated pts.

Mitral Valve Prolapse

Jessica L. Brodt | Albert T. Cheung

Risk

- Believed to be most common form of valvular heart disease, with an incidence of 2–3% in the general population. MVP is a progressive disease that begins in middle age and affects both men and women.
- Most common cause of chronic primary MR.
- Disease severity varies widely. Complications related to the disease are a consequence of arrhythmias,

infective endocarditis, and progressive severity of MR with associated LV dysfunction.

Perioperative Risks

- Acute HF or exacerbation of chronic HF as a consequence of MR
- Embolic stroke
- Arrhythmias
- Sudden cardiac death

Worry About

- Severity of MR
- Severity of associated LV dysfunction and HF
- AFIB, embolic stroke, sudden cardiac death
- Associated conditions: Marfan syndrome; Ehlers-Danlos syndrome, osteogenesis imperfecta, pseudoxanthoma elasticum, aneurysms-osteoarthritis syndrome, or hypertrophic cardiomyopathy

Overview

- Severity of disease varies widely based on the clinical and diagnostic criteria used to establish the diagnosis.
- MVP is defined by echocardiography as isolated prolapse of the mitral valve leaflets ≥ 2 mm beyond the mitral valve annular plane into the LA during systole. The myxomatous degeneration causing MVP is characterized by leaflet thickening, leaflet redundancy, chordal elongation, or chordal rupture. MRI may demonstrate scarring or fibrosis of the papillary muscle or inferobasal segments of the LV
- Structural changes lead to weakness and deformity of the valve apparatus. Annular dilation, stretching of leaflets and chordal elongation impair leaflet coaptation causing progression of MR.
- Fibrosis or scarring of the valve apparatus may increase the risk of ventricular arrhythmias or sudden cardiac death.
- Rupture of weakened chordae results in a flail leaflet and produces acute severe MR.

- Chronic MR causes progressive atrial dilation, eccentric LV hypertrophy, HF, and AF.
- MVP syndrome is MVP associated with a spectrum of nonspecific symptoms, including atypical chest pain, palpitations, exertional dyspnea, exercise intolerance, syncope, anxiety, lean body habitus, electrocardiographic repolarization abnormalities, and sudden cardiac death. A pathophysiologic link between genetics and the molecular biology of disease expression for MVP and its syndromes has yet to be fully defined.
- Onset of HF symptoms, LV dysfunction (ejection fraction $< 50\%$ or end-systolic diameter > 40 mm) and pulm Htn worsen pt prognosis. AF, left atrial enlargement, leaflet thickening (> 5 mm), flail segments, and age > 50 y is associated with worsening disease.

Etiology

- Familial (autosomal dominant, genetics not completely defined) or sporadic occurrence.
- Inherited connective tissue disorders.

- Myxomatous degeneration caused by dysregulation of collagen and elastin matrix protein synthesis and degradation.

Usual Treatment

- No treatment if asymptomatic or in pts with MVP syndrome without severe MR.
- Medical therapy with ACE inhibitors, beta-blockers, angiotensin receptor antagonists, aldosterone antagonists, and diuretics in pts with significant MR or HF (see Mitral Regurgitation or Heart Failure).
- Antiarrhythmic and anticoagulation therapy in pts with AF (see Atrial Fibrillation).
- Mitral valve repair recommended in pts with symptomatic severe MR or if asymptomatic with moderate LV dysfunction. Valve repair is reasonable in asymptomatic pts with preserved LV size and systolic function if expected mortality rate is $< 1\%$ and likelihood of successful repair $> 95\%$. Mitral valve repair preferable to mitral valve replacement when a successful and durable repair can be achieved

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	MVP MR AFIB Infectious endocarditis	Atypical chest pain DOE CHF NYHA class Palpitations Fever, chills	Mid- and late-apical nonejection systolic clicks Mid- to late-apical systolic murmur Irregular pulse Embolitic phenomena	ECHO ECHO CXR ECG TEE, blood culture Cardiac MRI
CNS	Stroke	Neurologic deficits TIAs	Focal neurologic signs	Head CT scan TEE
MS	Connective tissue disorders		Pectus excavatum Scoliosis Lean stature	

Key References: Dellling FN, Vasan RS: Epidemiology and pathophysiology of mitral valve prolapse. New insights into disease progression, genetics, and molecular basis, *Circulation* 129(21):2158–2170, 2014; Frogel J, Galusca D: Anesthetic considerations for patients with advanced valvular heart disease undergoing noncardiac surgery, *Anesthesiol Clin* 28(1):67–85, 2010.

Perioperative Implications**Preoperative Preparation**

- Assess presence and severity of MR.
- Assess for signs and symptoms of HF.
- Prophylactic antibiotics for endocarditis only indicated in pts with prior episode of IE.

Monitoring

- Routine.
- Consider invasive hemodynamic monitoring for major operations in pts with symptoms, severe MR, and/or LV dysfunction.

Preinduction/Induction/Maintenance

- Avoid Htn and acute increases in sympathetic tone.
- Consider regional anesthesia.

Adjuvants

- Interventions that increase BP, myocardial contractility, preload, or sympathetic tone may increase severity of MVP, MR, or the risk of chordal rupture.
- Antihypertensives, afterload reducing agents, and positive inotropic drugs are effective for increasing cardiac output in pts with significant MR.

Extubation and Postoperative Period

- Avoid Htn and acute increases in sympathetic tone.

Anticipated Problems/Concerns

- Htn and intravascular volume expansion may increase severity of MVP, worsen the degree of MR, and increase the risk of pulm edema and acute exacerbation of HF.
- Presence of severe MR, LV dysfunction, or associated connective tissue disease may alter routine management of pts with isolated MVP (see Mitral Regurgitation).
- Risk of sudden cardiac death among predominantly young females with MVP who have frequent ECG repolarization abnormalities.

Mobitz I (Second-Degree Atrioventricular Block)

James R. Zaidan

Risk

- Occurs after inferior MI or occasionally in trained athletes or in normal, sleeping people.
- Incidence varies based on etiology.

Perioperative Risks

- Without associated heart disease and without symptoms, should not present undue risk during anesthesia (e.g., in trained athletes).
- If occurs secondary to inferior MI, periop risk depends on extent of ischemic area.

Worry About

- Advancing to a higher-degree block if ischemic zone extends to anterior wall.
- Papillary muscle dysfunction may occur.

Overview

- Found usually in presence of CAD.
- Block generally occurs in AV node, resulting in normal QRS complexes.
- ECG reveals progressive lengthening PR intervals at decreasing increments and progressively shortening RR intervals leading to regular atrial rhythm and irregular ventricular rhythm.
- Bradycardia usually responds to atropine.

Etiology

- Acquired, usually with MI
- Increased resting parasympathetic tone relative to resting sympathetic tone

Usual Treatment

- Specific therapy in absence of heart disease not necessary unless pt is symptomatic.
- Treatment of an infarction-related Mobitz I block includes observation and medical therapy with atropine.
- Temporary pacing is necessary only if a medically unresponsive pt is symptomatic.
- Permanent pacing seldom required and considered only in persistently blocked, symptomatic pts.