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**(Mitral Valve Disease )**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

{ يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ }

صدق الله العظيم

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## Abstract

Mitral valve disease is a frequent cause of heart failure and death. Emerging evidence indicates that the mitral valve is not a passive structure, but even in adult life remains dynamic and accessible for treatment. This concept motivates efforts to reduce the clinical progression of mitral valve disease through early detection and modification of underlying mechanisms. Discoveries of genetic mutations causing mitral valve elongation and prolapse have revealed that growth factor signaling and cell migration pathways are regulated by structural molecules in ways that can be modified to limit progression from developmental defects to valve degeneration with clinical complications. Mitral valve enlargement can determine left ventricular outflow tract obstruction in hypertrophic cardiomyopathy, and might be stimulated by potentially modifiable biological valvular–ventricular interactions. Mitral valve plasticity also allows adaptive growth in response to ventricular remodeling. However, adverse cellular and mechanobiological processes create relative leaflet deficiency in the ischemic setting, leading to mitral regurgitation with increased heart failure and mortality. Our approach, which bridges clinicians and basic scientists, enables the correlation of observed disease with cellular and molecular mechanisms, leading to the discovery of new opportunities for improving the natural history of mitral valve disease.

# Introduction

Worldwide, rheumatic disease is the most common cause of valve disease with an estimated prevalence of 15.6–19.6 million . However, in industrially developed countries, the estimated population prevalence of moderate or severe mitral valve disease is 1.8% . Here, mitral stenosis (MS) is uncommon and mitral regurgitation (MR) is usually caused by prolapse or occurs secondary to left ventricular disease, and Mitral valve prolapse

## **Mitral valve regurgitation**

Regurgitation occurs when blood leaks from the valve and flows backward into your left atrium when the left ventricle compresses.

## **Mitral valve stenosis**

Stenosis occurs when the valve opening becomes narrow. This means that not enough blood can pass into your left ventricle.

## **Mitral valve prolapse**

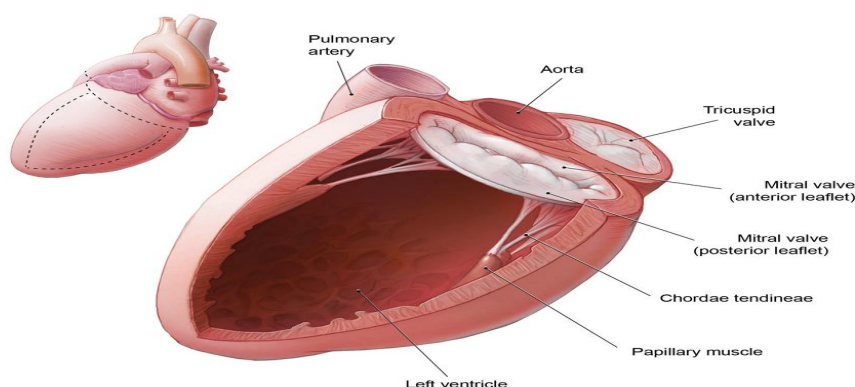
Prolapse occurs when the flaps on the valve bulge instead of closing tightly. This might prevent the valve from closing completely, and regurgitation — the backward flow of blood — may occur.

## Anatomy of mitral valve

The mitral valve connects the left atrium (LA) and the left ventricle (LV). The mitral valve opens during diastole to allow the blood flow from the LA to the LV. During ventricular systole, the mitral valve closes and prevents backflow to the LA. The normal function of the mitral valve depends on its 6 components, which are (1) the left atrial wall, (2) the annulus, (3) the leaflets, (4) the chordae tendineae, (5) the papillary muscles, and (6) the left ventricular wall (see the image below).

It is also known as the bicuspid valve or left atrioventricular valve, is a valve with two flaps in the heart that lies between the left atrium and the left ventricle. Mitral valve and tricuspid valve are known collectively as the atrioventricular valves because they lie between the atria and the ventricles of the heart.

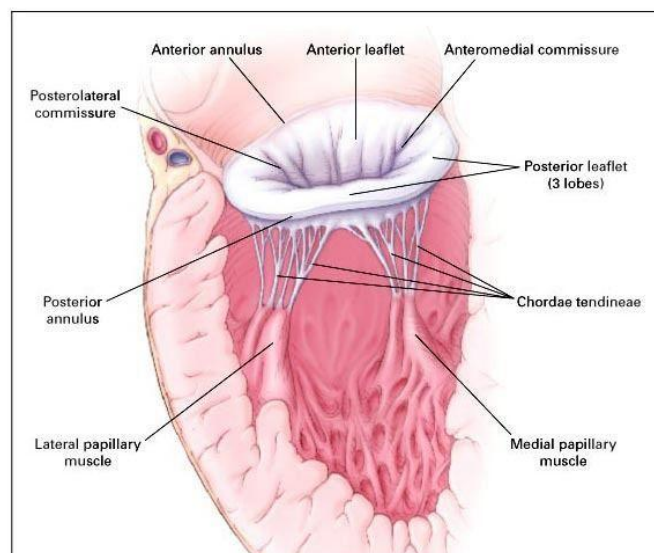
Figure 1: Components of Mitral Valve Apparatus



# Mitral regurgitation

is a condition in which your heart's mitral valve doesn't close tightly, allowing blood to flow backward in your heart. If the mitral valve regurgitation is significant, blood can't move through your heart or to the rest of your body as efficiently, making you feel tired or out of breath.

Trivial MR is shown on colour Doppler in 40% of normal people, while mild or worse MR may be found in approximately one in five people . The mitral apparatus consists of the leaflets, the annulus, chordae, papillary muscle and the adjacent myocardium (Figure 2). Dysfunction of any or all of these can cause MR (Table 1). The prevalence increases with age and is 9.3% aged  $\geq 75$  . MR accounted for 31.5% of cases of valve disease in the Euro Heart Survey .



**Figure 2 Mitral valve anatomy and relation to the ventricular myocardium. MR may arise from any condition which disrupts leaflet coaptation or the structure of left ventricle.**



## Table 1 Causes of mitral regurgitation

### Primary or organic (i.e. involvement of the valve)

Degenerative disease with prolapse

Rheumatic

Endocarditis

Rare: lupus, radiation, the anorectic drugs phentermine and fenfluramine, congenital

Hypertrophic cardiomyopathy can cause mitral regurgitation as a result of both abnormal papillary muscle function and an abnormally long anterior leaflet.

### Secondary or functional

Ischaemic heart disease

Hypertensive heart failure

Dilated cardiomyopathy

End-stage aortic valve disease

## Clinical features (and their causes) in MR

- Dyspnoea (pulmonary venous congestion)
- Fatigue (low cardiac output)
- Palpitation (atrial fibrillation, increased stroke volume)
- Oedema, ascites (right heart failure)

## Signs

- Atrial fibrillation/flutter
- Cardiomegaly: displaced hyperdynamic apex beat
- Apical pansystolic murmur  $\pm$  thrill

- Soft S1, apical S3
- Signs of pulmonary venous congestion (crepitations, pulmonary oedema, effusions)
- Signs of pulmonary hypertension and right heart failure

## Investigations in mitral regurgitation

### ECG

- Left atrial hypertrophy (if not in atrial fibrillation)
- Left ventricular hypertrophy

### Chest X-ray

- Enlarged LA
- Enlarged LV
- Pulmonary venous congestion
- Pulmonary oedema (if acute)

### Echo

- Dilated LA, LV
- Dynamic LV (unless myocardial dysfunction predominates)
- Structural abnormalities of mitral valve (e.g. prolapse)

### Doppler

- Detects and quantifies regurgitation Cardiac catheterisation
- Dilated LA, dilated LV, mitral regurgitation
- Pulmonary hypertension
- Coexisting coronary artery disease

## Medical Therapy

In patients not suitable for surgery,

Medical management of mitral regurgitation

- Diuretics
- Vasodilators, e.g. ACE inhibitors
- Digoxin if atrial fibrillation is present
- Anticoagulants if atrial fibrillation is present

## Mitral stenosis

The vast majority of cases of MS are rheumatic . Rheumatic fever occurs in children aged 5–15 years from the immune response to Group A beta-haemolytic streptococcal pharyngitis. Rheumatic fever is uncommon after one episode of pharyngitis, but occurs in up to 75% after recurrent episodes. Cardiac involvement occurs in 10–40% after the first attack of rheumatic fever, but more frequently after multiple attacks. The development of chronic rheumatic disease depends on the age at the time of the acute episodes and their severity and frequency and is more likely with multiple valve involvement, failure to obtain medical help and lack of secondary prophylaxis. Single valve involvement and MS are more likely in older individuals with less active carditis. Rheumatic heart disease affects the mitral valve in approximately 90% of cases

with isolated MS in about 25% of patients and mixed valve disease, particularly of the aortic valve, in almost 50% .

The mitral valve orifice is normally about 5 cm<sup>2</sup> in diastole and may be reduced to 1 cm<sup>2</sup> in severe mitral stenosis. Patients usually remain asymptomatic until the stenosis is less than 2 cm<sup>2</sup> . Reduced lung compliance, due to chronic pulmonary venous congestion, contributes to breathlessness, and a low cardiac output may cause fatigue. Other conditions which may cause MS include congenital disease, mitral annular calcification, rheumatoid arthritis, SLE and carcinoid syndrome.

### **Clinical features (and their causes) in mitral stenosis Symptoms**

- Breathlessness (pulmonary congestion)
- Fatigue (low cardiac output)
- Oedema, ascites (right heart failure)
- Palpitation (atrial fibrillation)
- Haemoptysis (pulmonary congestion, pulmonary embolism)
- Cough (pulmonary congestion)
- Chest pain (pulmonary hypertension)
- Thromboembolic complications (e.g. stroke, ischaemic limb)

### **Signs**

- Atrial fibrillation
- Mitral facies
- Auscultation

Loud first heart sound, opening snap

Mid-diastolic murmur

- Crepitations, pulmonary oedema, effusions (raised pulmonary capillary pressure)

## Investigations in mitral stenosis

### ECG

- Right ventricular hypertrophy: tall R waves in V1–V3
- P mitrale or atrial fibrillation

### Chest X-ray

- Enlarged LA and appendage
- Signs of pulmonary venous congestion

### ECHO

- Thickened immobile cusps
- Reduced valve area
- Enlarged LA
- Reduced rate of diastolic filling of LV

### Doppler

- Pressure gradient across mitral valve
- Pulmonary artery pressure
- Left ventricular function

### Cardiac catheterisation

- Coronary artery disease
- Pulmonary artery pressure
- Mitral stenosis and regurgitation

# Management

Patients with minor symptoms should be treated medically. Intervention by balloon valvuloplasty, mitral valvotomy or mitral valve replacement should be considered if the patient remains symptomatic despite medical treatment or if pulmonary hypertension develops.

## Medical management

This consists of anticoagulation to reduce the risk of systemic embolism, ventricular rate control (digoxin,  $\beta$ -blockers or rate-limiting calcium antagonists) in atrial fibrillation, and diuretic therapy to control pulmonary congestion. Antibiotic prophylaxis against infective endocarditis is no longer routinely recommended.

## Mitral balloon valvuloplasty and valve replacement

Valvuloplasty is the treatment of choice if specific criteria are fulfilled, although surgical closed or open mitral valvotomy is an acceptable alternative. Patients who have undergone mitral valvuloplasty or valvotomy should be followed up at 1–2-yearly intervals because re-stenosis may occur. Clinical symptoms and signs are a guide to the severity of mitral re-stenosis but Doppler echocardiography provides a more accurate assessment.

### Criteria for mitral valvuloplasty\*

- Significant symptoms
- Isolated mitral stenosis
- No (or trivial) mitral regurgitation
- Mobile, non-calcified valve/subvalve apparatus on echo
- LA free of thrombus

## **mitral valve prolapse**

Mitral valve prolapse, also called MVP, is a condition in which the two valve flaps of the mitral valve don't close smoothly or evenly, but bulge (prolapse) upward into the left atrium. Mitral valve prolapse is also known as click-murmur syndrome, Barlow's syndrome or floppy valve syndrome.

### **What happens during MVP?**

When the heart pumps (contracts) part of one or both flaps collapse backward into the left atrium. In some cases, the prolapsed valve lets a small amount of blood leak backward through the valve, which may cause a heart murmur.

### **Is mitral valve prolapse dangerous?**

In most cases, it's harmless. Most people who have the condition are unaware of it and their health isn't affected. However, in some cases treatment is required.

### **What causes MVP?**

The most common cause of MVP is abnormally stretchy valve leaflets (called myxomatous valve disease). Mitral valve prolapse occurs in around 2% of the population. A person can be born with the genetic risk of developing MVP. It also can be caused by other health problems, such as some connective tissue diseases.

### **How's mitral valve prolapse detected?**

Because most patients with MVP don't have symptoms, a murmur may be detected during a routine physical exam when listening to the heart with a

stethoscope. Common symptoms include bursts of rapid heartbeat (palpitations), chest discomfort and fatigue.

### **Does mitral valve prolapse need to be treated?**

In many instances, having MVP won't impact your health and requires no treatment. Talk with your health care provider about how to prevent complications from MVP based on your level of risk.

If you're prescribed medication, take it as directed. People with an abnormal mitral valve may need mitral valve repair or replacement if:

Symptoms are getting worse

Mitral regurgitation becomes severe

The left ventricle or left atrium of the heart become enlarged

Arrhythmias develop

The heart function gets worse

MVP rarely becomes a serious condition. However, in the most serious cases it can cause abnormal heartbeats (arrhythmias) that may eventually become life-threatening.

When mitral valve prolapse is severe enough to cause significant valve leakage, called "regurgitation," it can lead to serious complications such as heart attack and stroke. This happens because when the valve leaks, it can cause the atrium to enlarge. An enlarged atrium may lead to heart rhythm problems such as atrial fibrillation, which may cause blood clots to form. When clots travel from the heart to the arteries or the brain, it can lead to a stroke or heart attack.



## Conclusion

The assessment of mitral valve disease can be difficult. Patients may slow down to avoid getting symptoms so exercise testing should be considered to confirm that a patient is symptom-free. The LV ejection fraction should be high in the presence of severe MR; if in the low normal range, 50–60%, this suggests reduced contractility. Even moderate secondary (functional) MR increases mortality independent of the effect of LV function. Guidelines advise early surgical referral of patients with repairable mitral valves. However, it is vital that they are seen by a specialist repair surgeon.

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