



Acquired heart Disease surgery

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Duration: 50–60 minutes

GUESS WHO



Diego Maradona died on November 25, 2020, at the age of 60. His death was caused by a heart attack (cardiac arrest)

Prevalence of ischemic heart disease

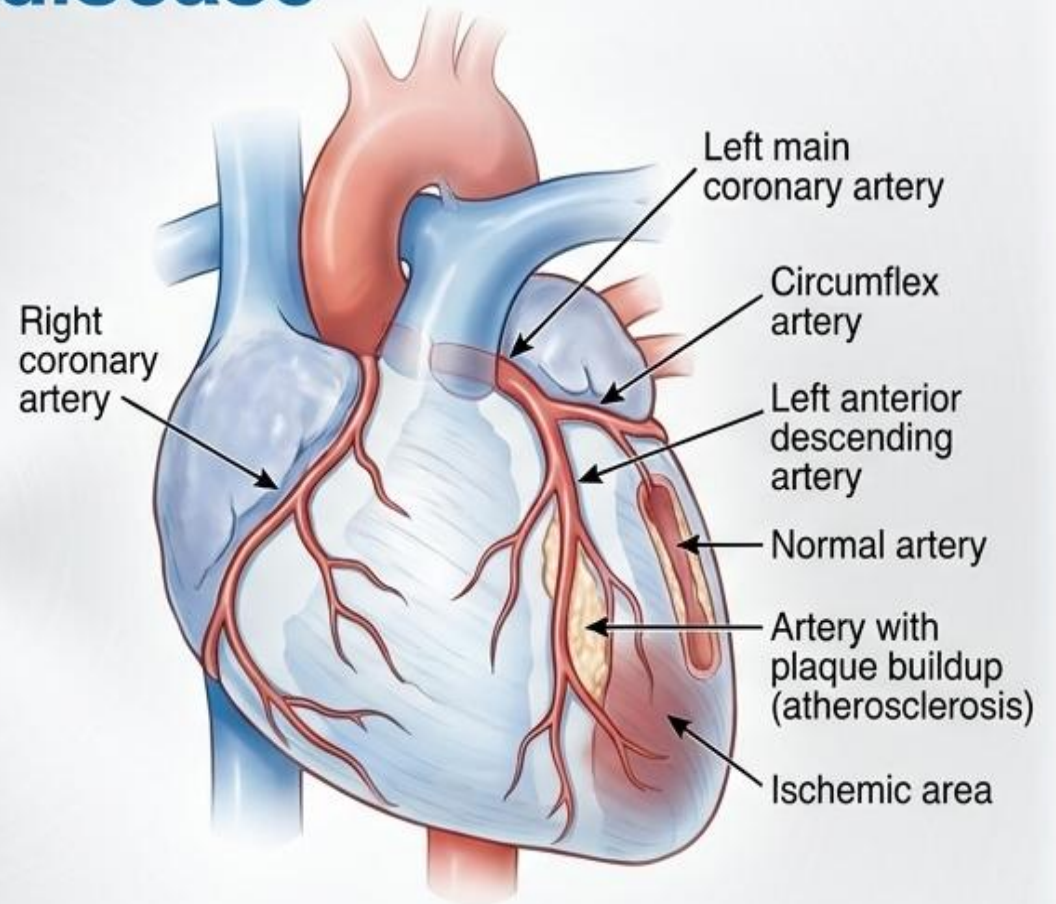
In 2021, there were approximately
8.99 million deaths globally
due to IHD

Mortality rate for IHD in 2021 was about
108.73 per 100,000 population.

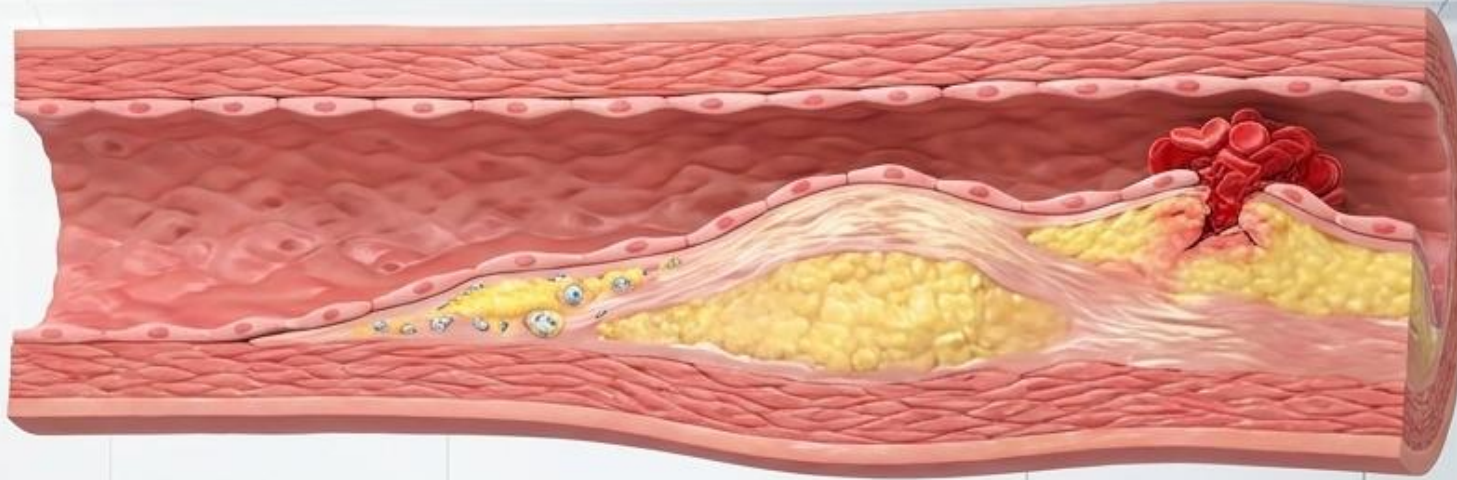
We might expect **9–10 million**
global deaths from IHD in 2025

Clinical Checkpoint

*Why are these numbers
rising despite advances in
modern medicine?*



Pathophysiology of Atherosclerosis

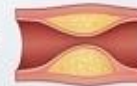


Ages 10-14



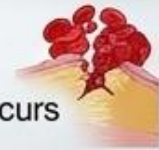
The first evidence of atherosclerosis can be found in children aged 10-14 years. It appears as a yellow streak running along the major arteries. The streak consists of smooth muscle cells, which are filled with cholesterol, and foam cells.

Adulthood



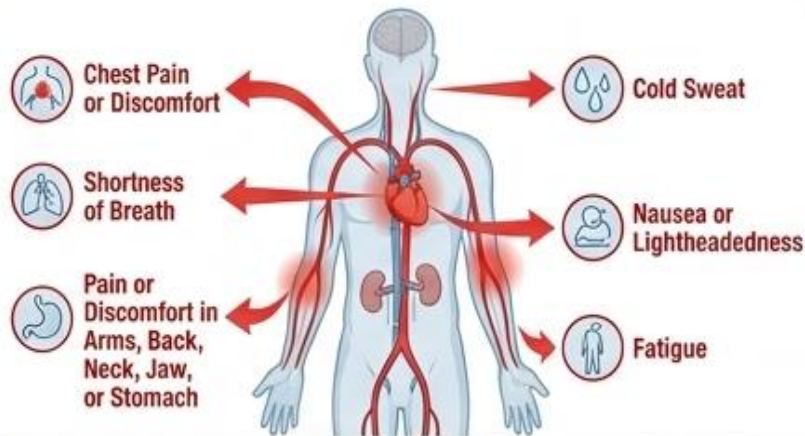
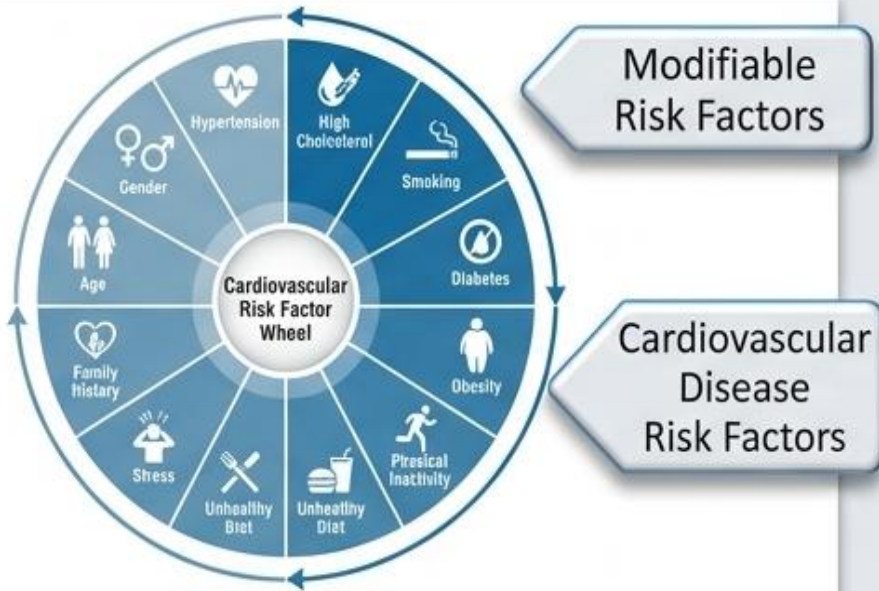
Fibrous plaque develops and projects into the vessel lumen, causing narrowing that, in turn, can lead to ischemia or infarction.

Critical Event



Complicated lesion. This occurs when the fibrous plaque **ruptures**, provoking activation of the coagulation cascade and the formation of thrombus.

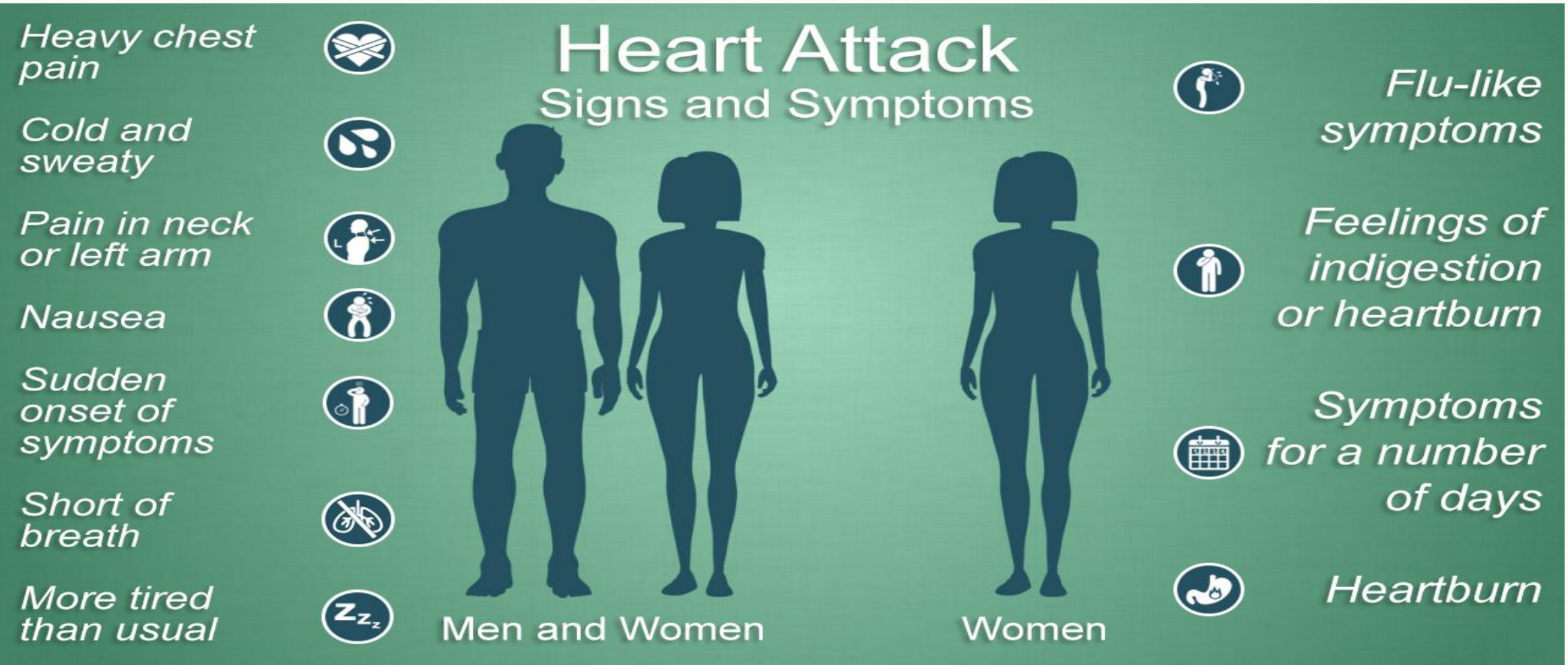
Symptoms, Signs, & Risk Factors



Clinical Case

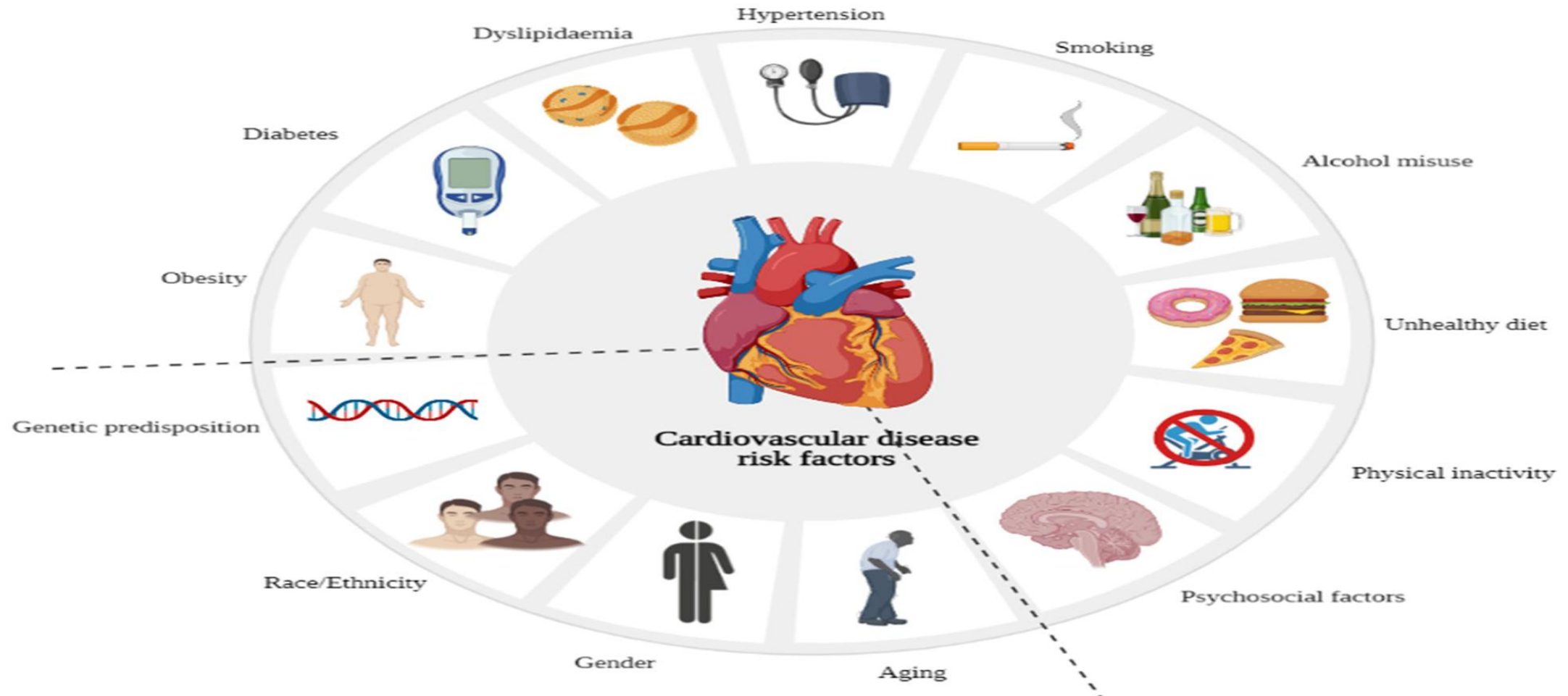
Diego Maradona died on November 25, 2020, at the age of 60. His death was caused by a heart attack (cardiac arrest)

Symptoms and signs



Risk factors

Modifiable risk factors



Clinical Checkpoint: Methods of Diagnosis

NON-INVASIVE METHODS OF DIAGNOSIS

- ✓ Resting electrocardiography
- ✓ Troponin and cardiac isoenzymes
- ✓ Exercise tolerance testing
- ✓ Echocardiography
- ✓ Radionuclide studies and cardiac magnetic resonance imaging
- ✓ Positron emission tomography
- ✓ Computed tomography

INVASIVE METHODS OF DIAGNOSIS

Coronary angiography

- Gold standard for imaging coronary anatomy
- Demonstrates extent, severity and location of stenosis
- Evaluates suitability for surgery

Chronic Coronary Syndrome



Profile: Predictable exertional angina or dyspnea.



Assessment Focus: Symptoms, ischemia, LV function, and coronary anatomy.



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- **Pathways:** Optimal medical therapy, PCI, or CABG.

Acute Coronary Syndrome



Profile: Acute plaque disruption causing unstable angina, NSTEMI, or STEMI.



Priorities: ECG, troponin, stabilization, urgent reperfusion.



Priorities: ECG, troponin, stabilization, urgent reperfusion.



Surgical Trigger: CABG selected for specific anatomy or when PCI is unsuitable/fails.



Medical Therapy

- Risk-factor control, lipid lowering, anti-anginal therapy, diabetes/BP control.
- **Role:** Baseline requirement; antiplatelet therapy when indicated.



PCI

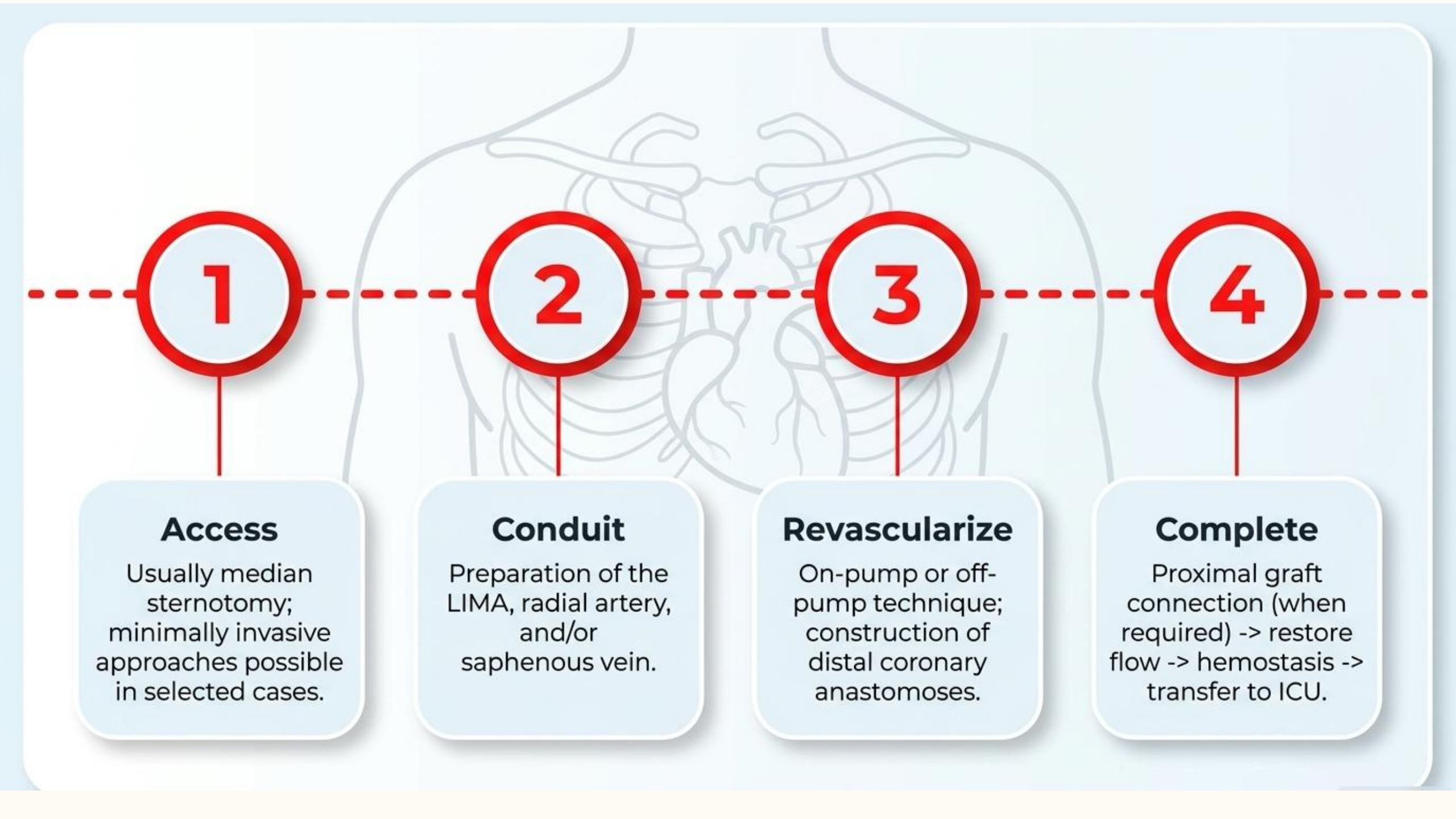
- **Invasiveness:** Less invasive, rapid recovery.
- **Target:** Suitable focal coronary anatomy.
- **Limitation:** May require repeat revascularization in complex disease.



CABG

- **Target:** Selected complex multivessel or left-main disease.
- **Advantage:** Highly durable revascularization.
- **Crucial Detail:** LIMA-LAD is the key graft.

The Revascularization Equation: Strategy is individualized based on Anatomy + Ischemia + LV Function + Comorbidity + Feasibility + Heart Team.



1

Access

Usually median sternotomy; minimally invasive approaches possible in selected cases.

2

Conduit

Preparation of the LIMA, radial artery, and/or saphenous vein.

3

Revascularize

On-pump or off-pump technique; construction of distal coronary anastomoses.

4

Complete

Proximal graft connection (when required) -> restore flow -> hemostasis -> transfer to ICU.

Case 1 Profile

62-year-old male. 

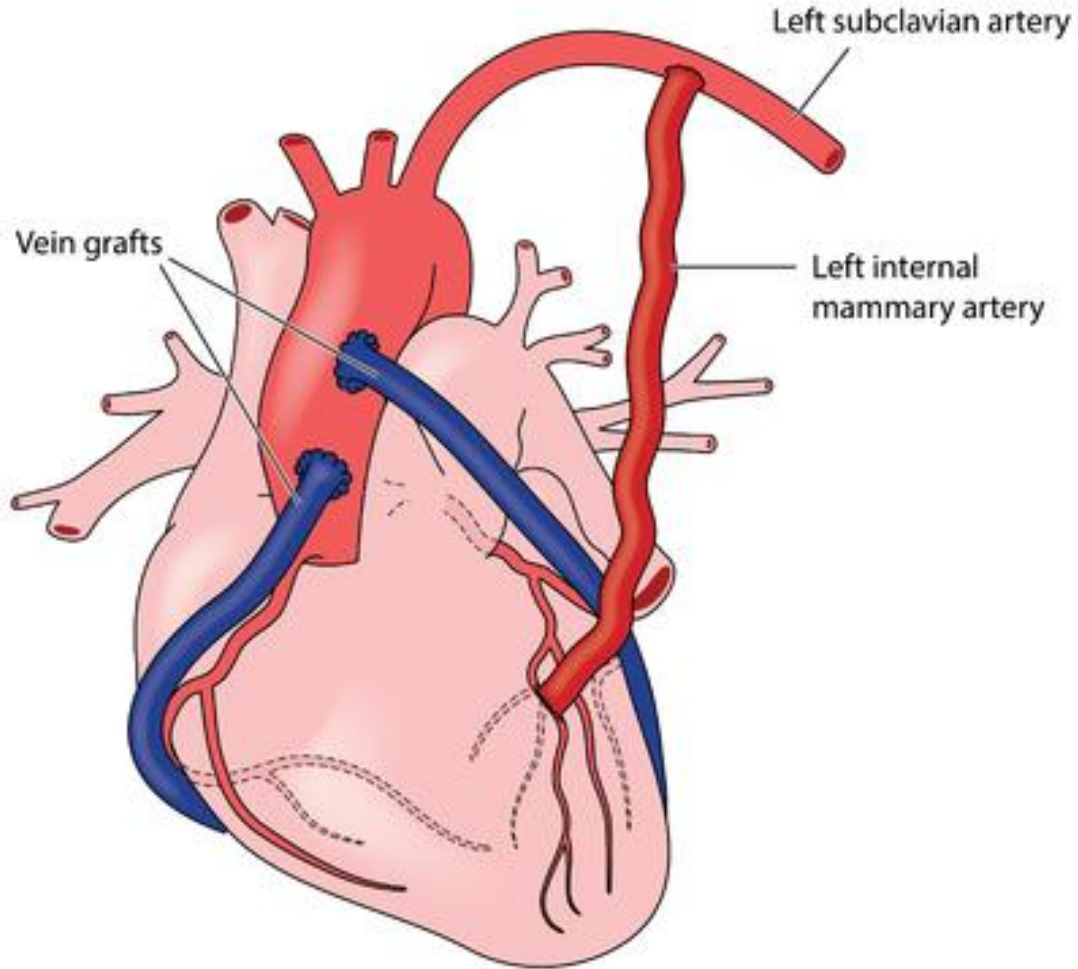
Diabetes and exertional angina despite medical therapy.

Echo: LVEF 50%. 

Angio: Significant multivessel CAD involving the LAD.

What factors guide PCI vs CABG here?

-  ☒ Symptoms/ischemia burden
-  ☒ Coronary complexity
-  ☒ Presence of diabetes (favors CABG)
- ☒ LV function
- ☒ Ability to achieve complete revascularization
-  ☒ Procedural risks
-  ☒ Heart-Team/ patient preference



Indications for surgery

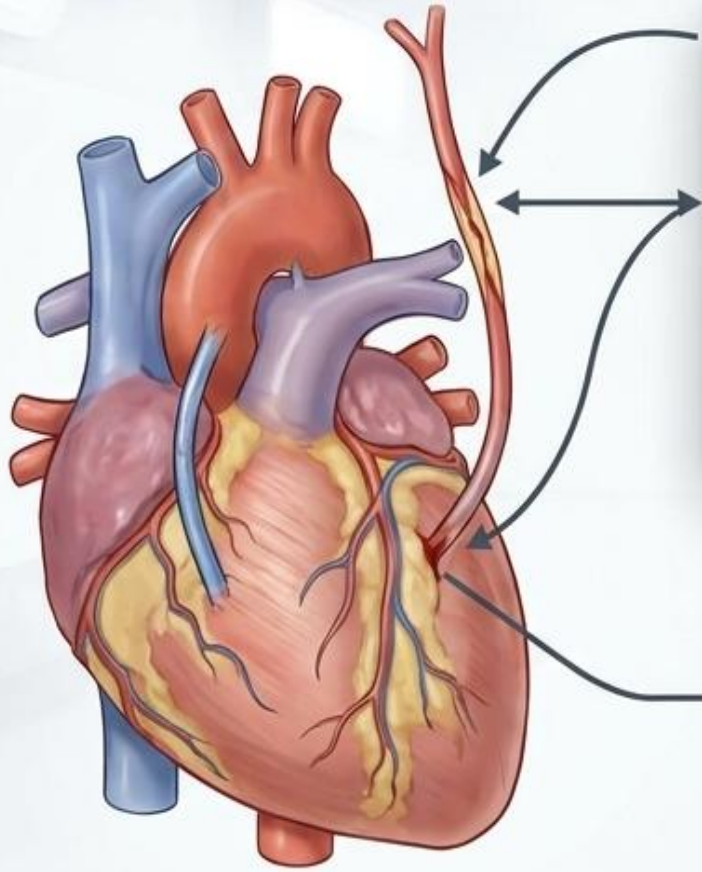
>50% stenosis of the left main stem ('critical left main stem disease')

>50% stenosis of the proximal left anterior interventricular artery

Three main coronary arteries diseased ('triple-vessel disease')

Two-vessel disease including the proximal LAD

Coronary Artery Bypass Grafting (CABG): Indications & Conduits



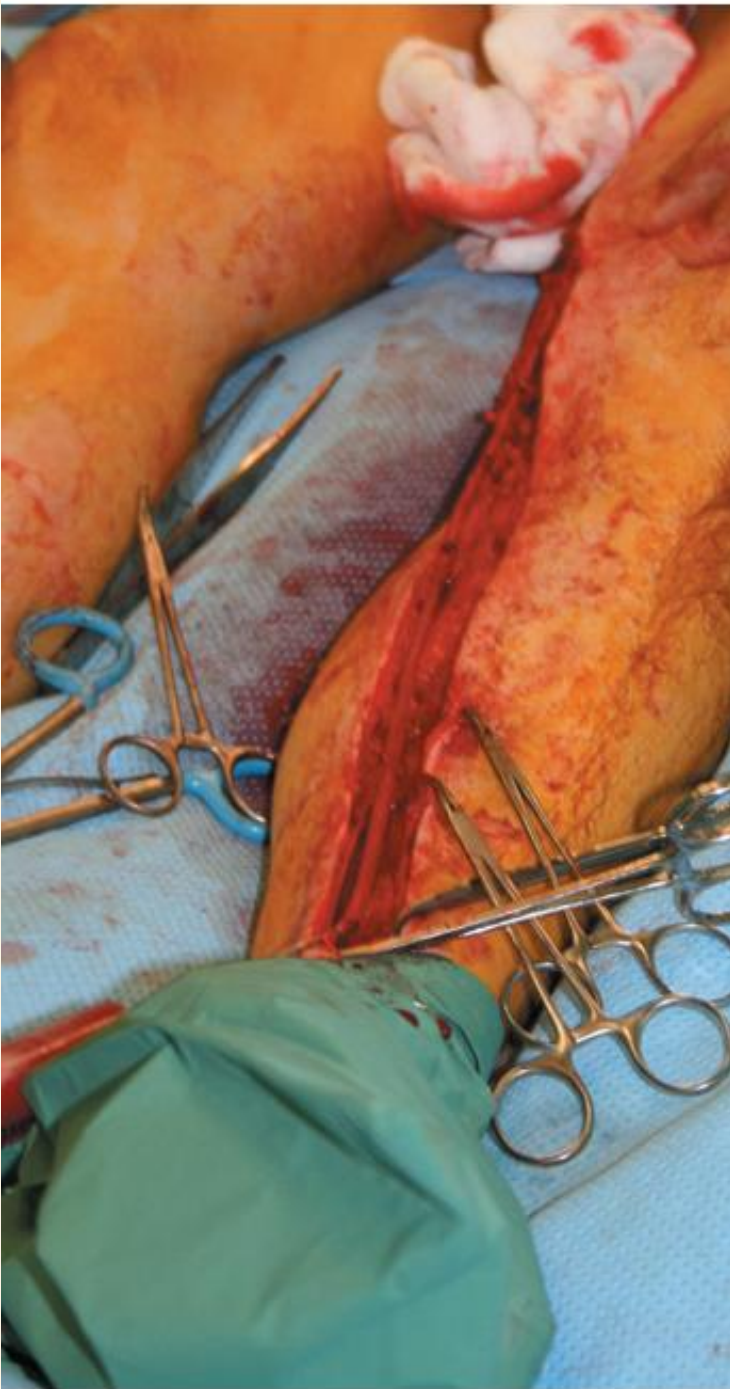
Indications Box

- >50% stenosis of the left main stem
- >50% stenosis of the proximal left anterior interventricular artery
- Three main coronary arteries diseased
- Two-vessel disease including the proximal LAD



Conduit Selection Box

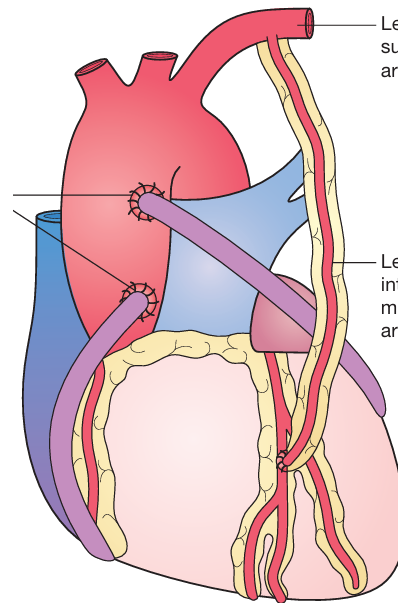
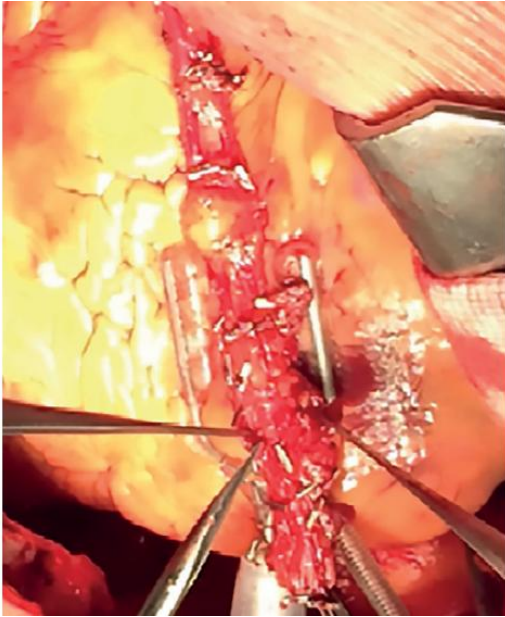
- The long saphenous vein is the most commonly used venous conduit as it is straightforward to harvest... and is easy to handle.
- Alternative vein conduits include the short saphenous vein or upper limb veins such as the cephalic vein; however, these grafts are associated with poorer long-term patency rates.



Selection of conduit

- **Venous grafts**

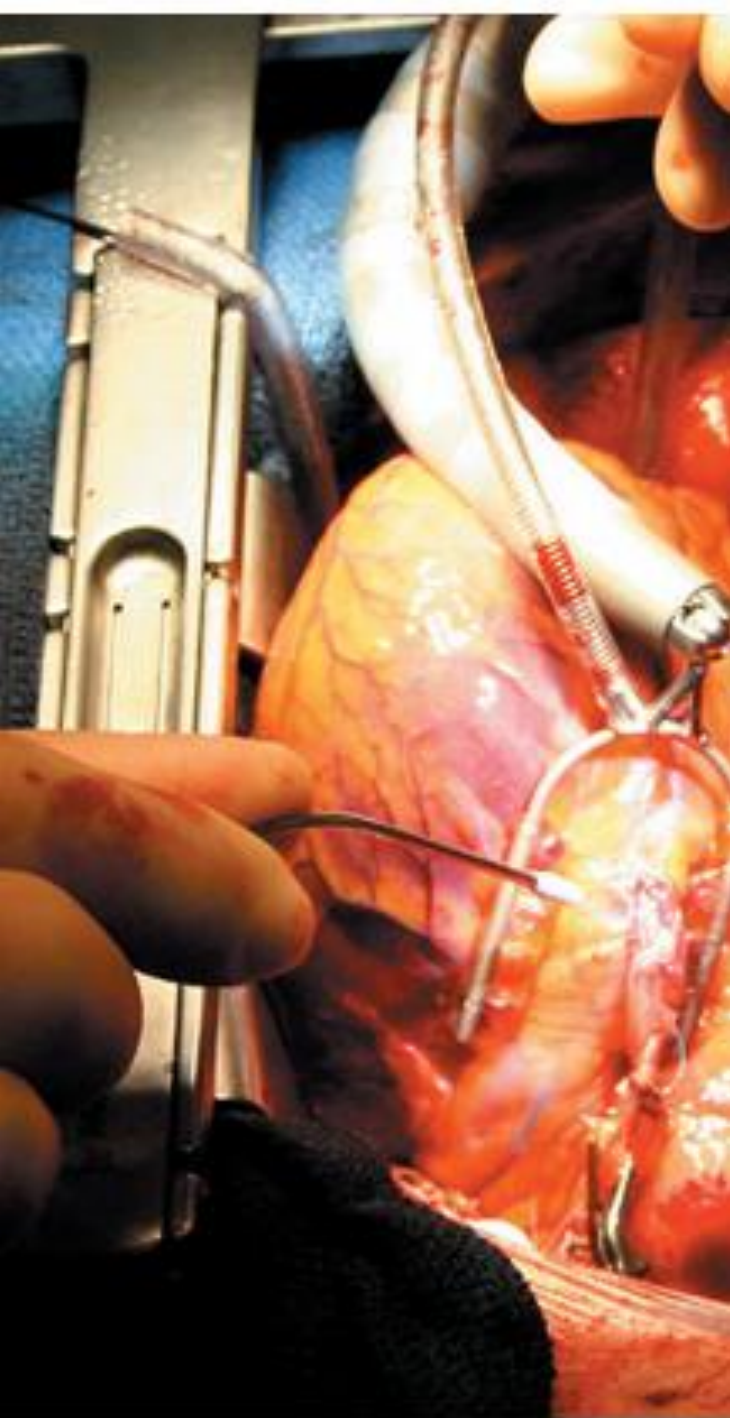
- ❑ The long saphenous vein is the most commonly used venous conduit as it is straightforward to harvest, provides good length and is easy to handle. Historical studies showed a limited long term patency rate for long saphenous vein grafts (50–60% at 10 years). However, recent studies suggest that early postoperative use of lipid-lowering agents and antiplatelet agents such as low-dose aspirin can improve vein graft long-term patency.
- ❑ Alternative vein conduits include the short saphenous vein or upper limb veins such as the cephalic vein; however, these grafts are associated with poorer long-term patency rates.



Completed coronary artery bypass grafts.

Arterial grafts

- ❑ The left internal mammary artery (LIMA), or internal thoracic artery, has become the conduit of choice for LAD grafting. Evidence from the mid-1980s to the present day suggests a 10-year patency rate of >95%, with a lower reoperation rate.
- ❑ The use of the radial artery as an alternative arterial bypass graft has undergone a recent revival. This has been driven by the belief that total arterial revascularization (avoiding venous conduits) might improve long-term results of coronary surgery. Different studies have demonstrated excellent patency rates at 1 and 5 years with this strategy.



Postoperative complications



Bleeding Significant bleeding occurs in approximately 2–3% of patients.



Arrhythmias The most common postoperative arrhythmia is atrial fibrillation (AF). 30–60% of patients



Poor cardiac output state Myocardial function typically declines in the first few hours following cardiac surgery



Neurological dysfunction Stroke occurs in approximately 2% of patients following CABG



Wound infection Significant deep wound infection resulting in sternal dehiscence and mediastinitis occurs in around 0.5–2% of patients.



Mortality In the UK, the mortality rate for patients undergoing CABG is 1–3%.
M

Coronary Artery Bypass Surgery Outcomes

Mortality

1–3%

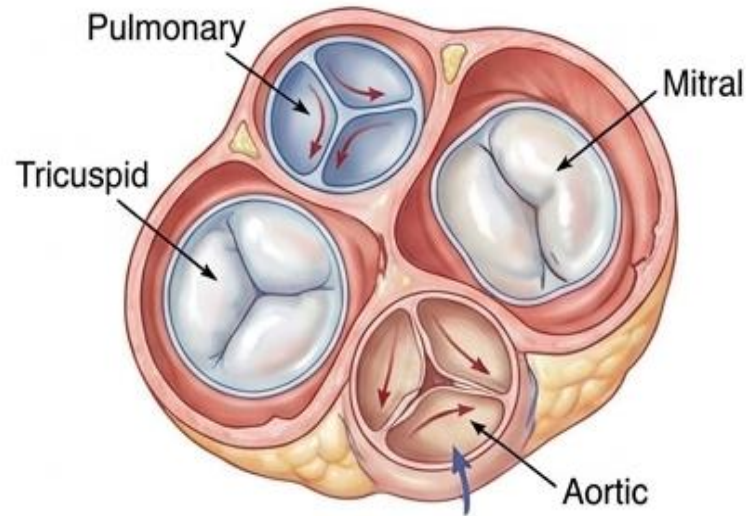
Survival Rates

- >95% at 1 year
- 90% at 5 years
- 75% at 10 years

Angina

Improved in
>90% at 1 year
80% at 5 years
60% at 10 years

Transition to Valvular Heart Disease



Heart valves serve to maintain pressure gradients between cardiac chambers, thus ensuring a unidirectional flow of blood.

Historical Note:

The first prosthetic valve replacement was performed by Dwight Harken, who replaced an aortic valve, followed by a mitral valve replacement by Starr a year later.

Prosthetic Valves Comparison Matrix

Mechanical Valves



Traits:

- Can be used in any age group
- Extremely durable but **thrombogenic**
- Patients require systemic anticoagulation, usually with warfarin.

Bioprosthetic / Biological Valves



Traits:

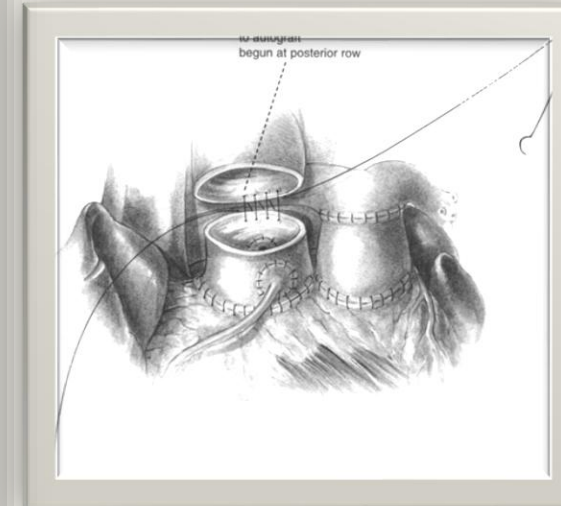
- Types:
 - cadaveric homograft
 - autografts
 - heterografts (prepared from animal tissues)
- Decreasing pressure gradients and minimizing turbulence
- Limited durability of 10–15 years

Clinical Decision

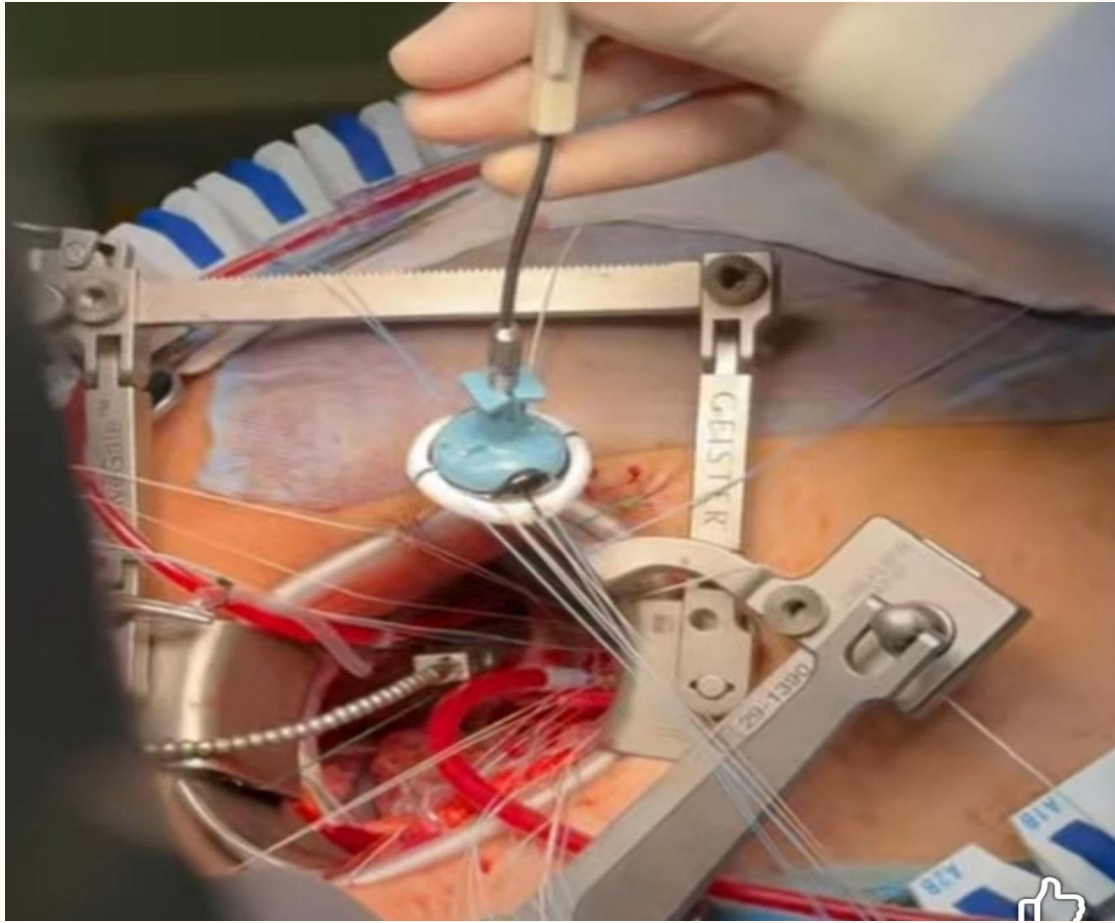
Which valve would you choose for a 30-year-old vs. an 80-year-old patient?

Bioprosthetic (biological) valves

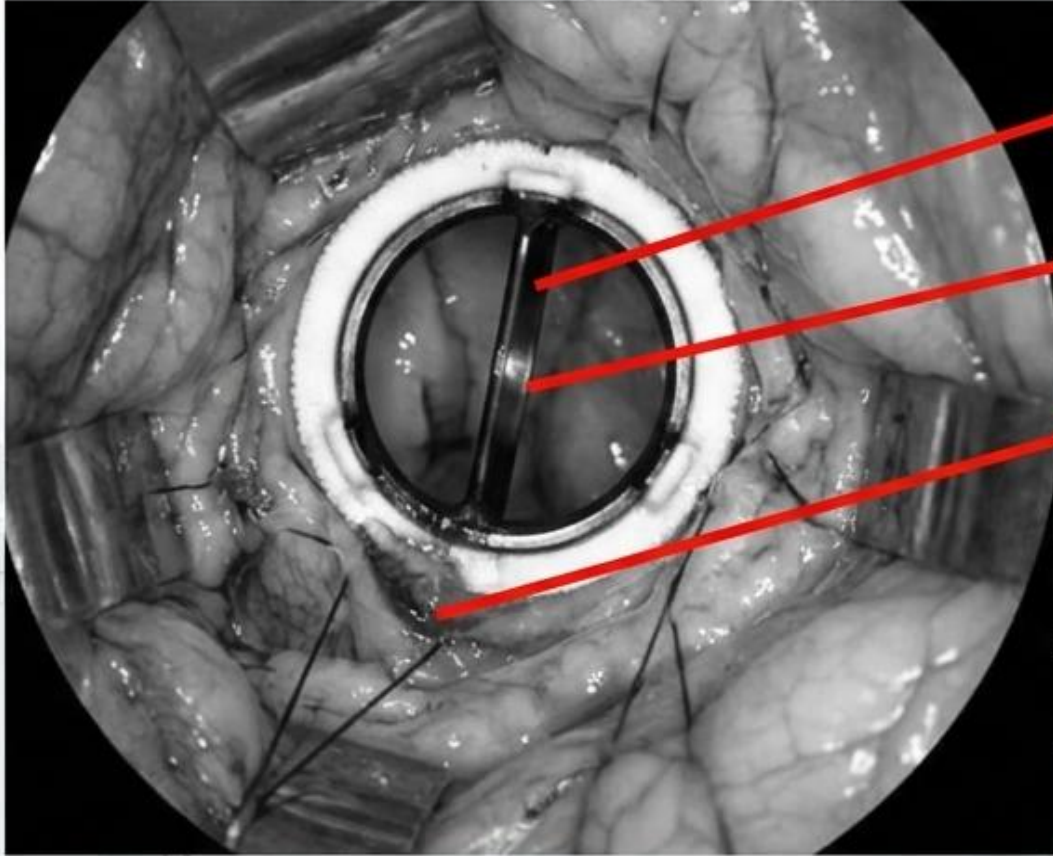
- cadaveric homograft (or allograft) valves
- autografts, a patient's own valve;
- most commonly, heterografts (or xenografts) prepared from animal tissues.
- All have three semilunar leaflets with central flow, so decreasing pressure gradients and minimizing turbulence .
- Heterograft 'tissue' valves are the most commonly used valves and can be stented with a limited durability of 10–15 years



Minimal cardiac surgery



Prosthetic Valve Dysfunction and Complications



Structural valve failure

Paravalvular leak

Thrombosis and
thromboembolism

Thrombus formation is the most common complication of a mechanical valve.

Heart Failure

Severe acute valve regurgitation, obstruction, or fistula causing hemodynamic compromise

Uncontrolled Infection

Persistent infection, abscess, destructive lesions, or difficult-to-eradicate organisms

Embolic Prevention

Selected patients with large/high-risk vegetations and high embolic risk

Surgery is NOT simply delayed until antibiotics are completed. Timing is dictated by indication, clinical stability, and complications.

Prosthetic valve dysfunction and complications



Mechanical Valve

- ⚙️ Very durable.
- 💧 Requires lifelong vitamin-K antagonist (Warfarin) anticoagulation. Subtherapeutic INR = thrombosis/embolism; Supratherapeutic INR = bleeding.
- 🕒 Must consider age, pregnancy plans, and adherence.

Bioprosthetic Valve

- ✅ No lifelong anticoagulation required **solely** for the valve in many patients.
- ⌚ Limitation: Structural valve degeneration occurs over time.
- 💡 Favored when anticoagulation is undesirable; future valve-in-valve options influence planning.



Warning: DOACs are NOT substitutes for warfarin in patients with mechanical heart valves! Bridging/interruption depends on specific thrombotic and procedural bleeding risks.

Mitral valve disease (Mitral regurgitation)

TABLE 59.4 Causes of mitral regurgitation.

Degenerative causes	Ventricular causes	Autoimmune and infective causes	Other causes
Barlow's disease (myxomatous degeneration)	Transient ischaemia and dynamic regurgitation	Infective endocarditis	Trauma (rarely)
Calcification of the leaflets or annulus	Myocardial infarction resulting in papillary muscle rupture	Rheumatic fever (post-streptococcal throat infection)	Congenital defects such as isolated mitral cleft
Marfan/Ehlers–Danlos syndromes and other connective tissue disorders	Cardiomyopathy and annular dilatation		Associated with certain medications (those containing ergotamine)
			Radiotherapy

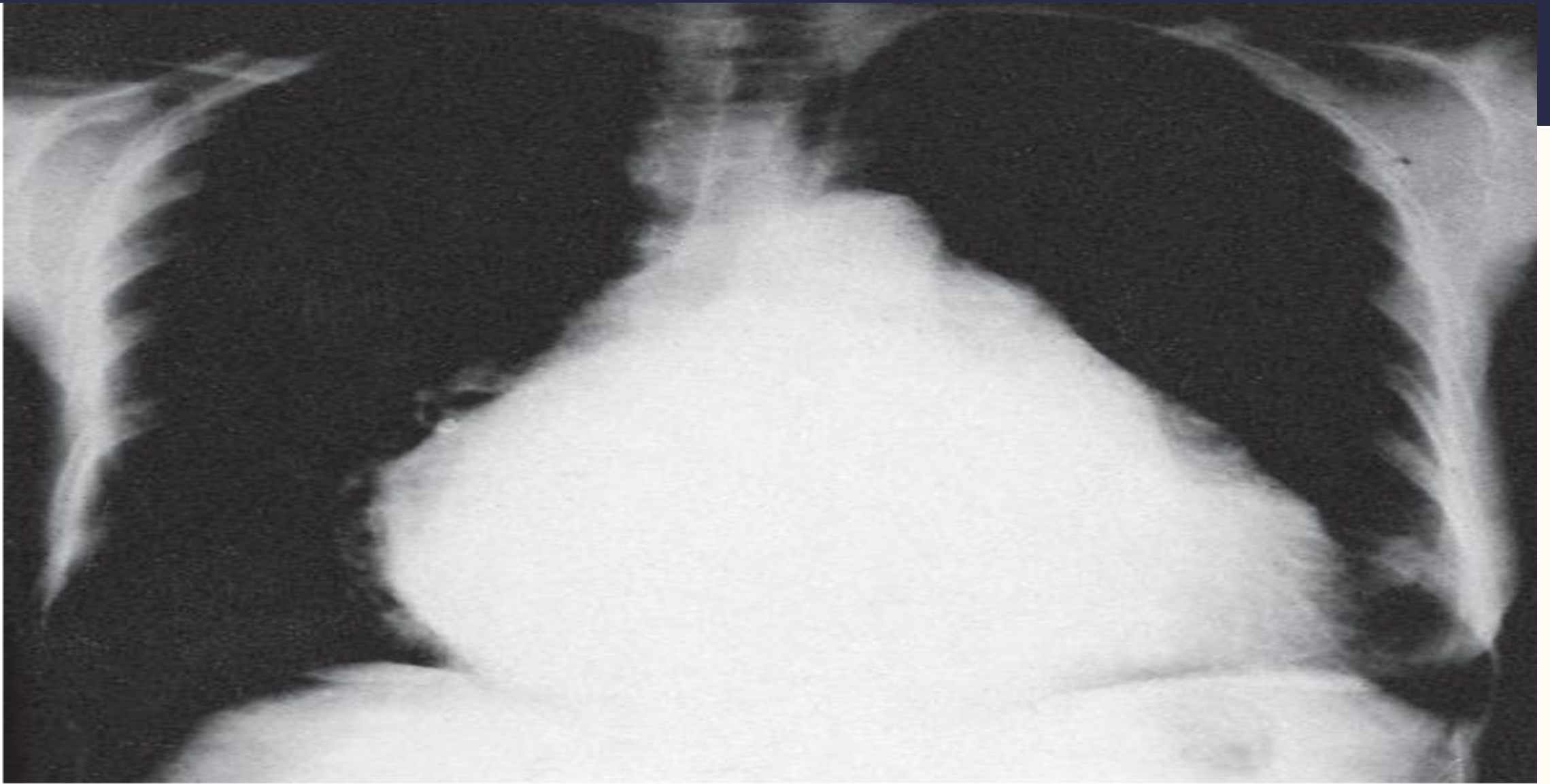


Figure 59.14 Chest radiograph of longstanding mitral stenosis showing a massive left atrium.

Mitral Stenosis (MS)

✓ Symptomatic severe MS (valve area $\leq 1.5 \text{ cm}^2$):

- If **valve is suitable**, do **balloon valvotomy**
- If **valve not suitable**, do **surgical commissurotomy** or **valve replacement**
- ✓ **Asymptomatic but:**
 - **Pulmonary hypertension** ($>50 \text{ mmHg}$)
 - **New atrial fibrillation**
 - **Severe MS** and patient is **undergoing another heart surgery**

Causes of mitral valve disease

Stenosis

- Rheumatic heart disease (common)
- Calcification of valve or chordae tendinae
- Congenital (rare)

Regurgitation

- Rheumatic heart disease
- Valve prolapse
- Left ventricular dilatation or hypertrophy
- Ischaemia
- Bacterial endocarditis

Indications for Mitral Valve Surgery (Simplified)

Chronic MR

-  Symptomatic (shortness of breath, fatigue) and severe MR, with heart function still good (LVEF >30%).
-  Asymptomatic but: Heart function starts to decline (LVEF <60%) Left ventricle becomes enlarged (LVESD $\geq$ 40 mm) New atrial fibrillation appears Pulmonary hypertension develops (pulmonary artery pressure >50 mmHg)
 -  During another heart surgery (e.g., CABG or aortic valve surgery) if MR is severe.
- Acute MR
- Emergency surgery if caused by: Papillary muscle rupture (after MI) Chordae tendineae rupture Infective endocarditis and patient develops pulmonary edema or shock.

Mitral Valve Disease: Regurgitation vs. Stenosis

Mitral Regurgitation (MR)

Causes of Mitral Regurgitation

Primary	• Myxomatous degeneration (MVP) • Infective endocarditis • Rheumatic heart disease • Congenital anomalies
Secondary (Functional)	• Ischemic heart disease (papillary muscle dysfunction/rupture) • Dilated cardiomyopathy • Hypertrophic cardiomyopathy

Features of MR



Symptoms:

- Dyspnea (exertional, orthopnea, PND)
- Fatigue
- Palpitations
- Right heart failure symptoms (edema, ascites)



Signs:

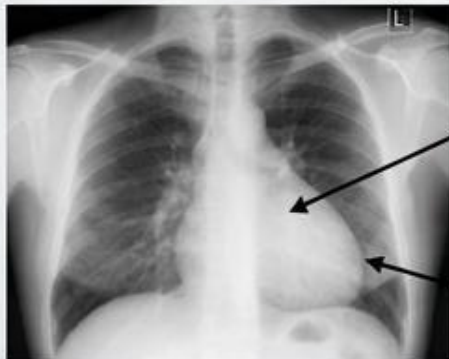
- **Pansystolic murmur** at apex radiating to axilla
- S3 gallop
- Displaced apical impulse
- Signs of pulmonary hypertension
- Signs of right heart failure

Clinical Checkpoint

Surgical Indications: severe symptoms or associated changes in left ventricular function or dimension (e.g. left ventricular end-systolic diameter).

Mitral Stenosis (MS)

Chest X-Ray: Massive Left Atrial Enlargement



Enlarged left atrium

Pulmonary congestion

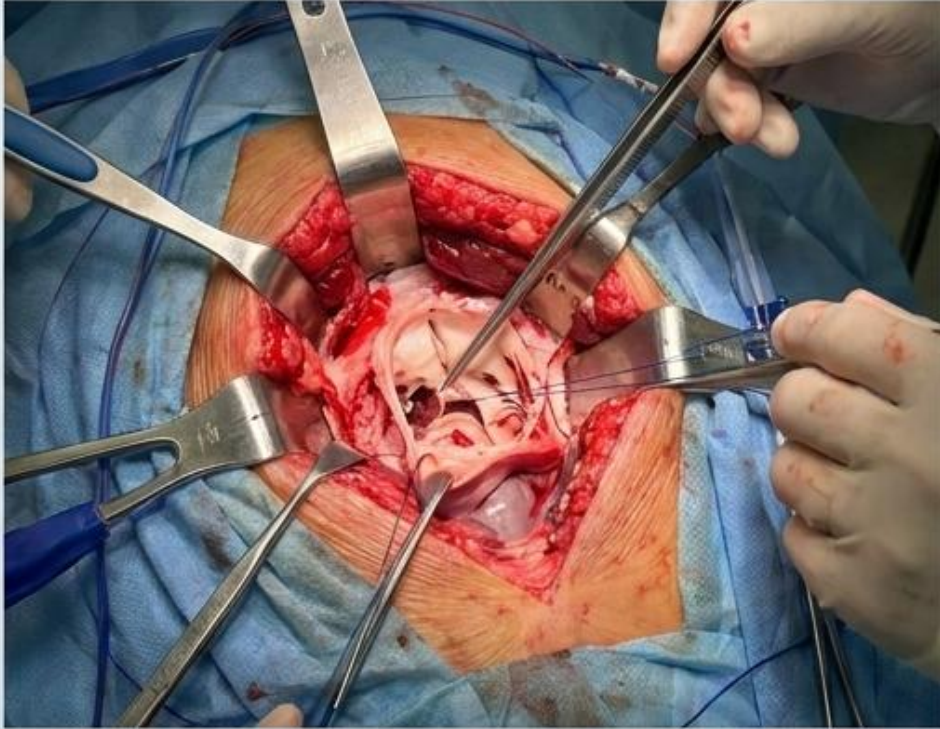
Chest X-Ray: Massive Left Atrial Enlargement

Etiology & Timeline

The most common cause of mitral stenosis worldwide remains **rheumatic fever**. Symptoms of mitral stenosis may manifest years after the acute attack of rheumatic fever. The most common cause of left atrial enlargement, hasive stenosis (symptom is surrouso to al:mitral symptoms and oncorrelated by oreaiminary rehactiers of mitral stenosis progra.

Symptoms of mitral stenosis usually develop more than 10 years after the acute attack.

Mitral Valve Surgical Interventions



Mitral Valve Repair in Progress

Core Operations

1. Mitral valve repair
2. Mitral valve replacement
3. Transcatheter mitral valve repair



Pathological Specimen:
Excised Mitral Valve

Rheumatic
Valve Disease



Bicuspid
Valve



Calcified
Valve
Stenosis



Mitral Valve Morphologies

Indications for surgery in patients with primary mitral

regurgitation include severe symptoms or associated changes in left ventricular function or dimension (e.g. left ventricular end-systolic diameter)

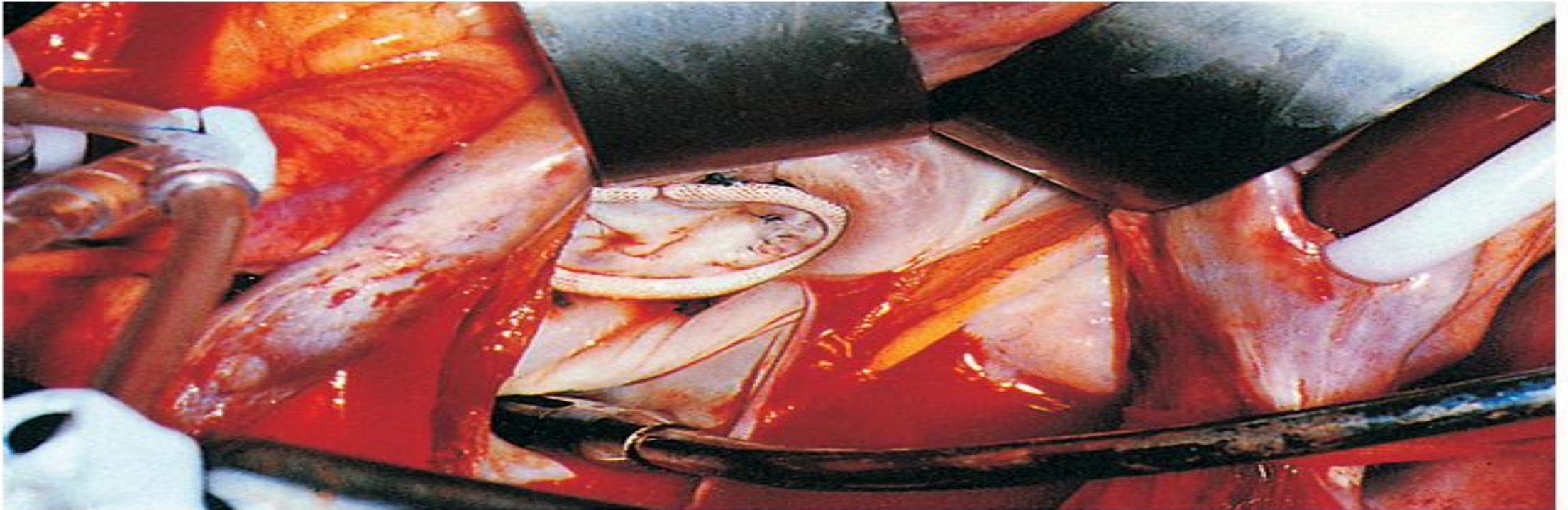
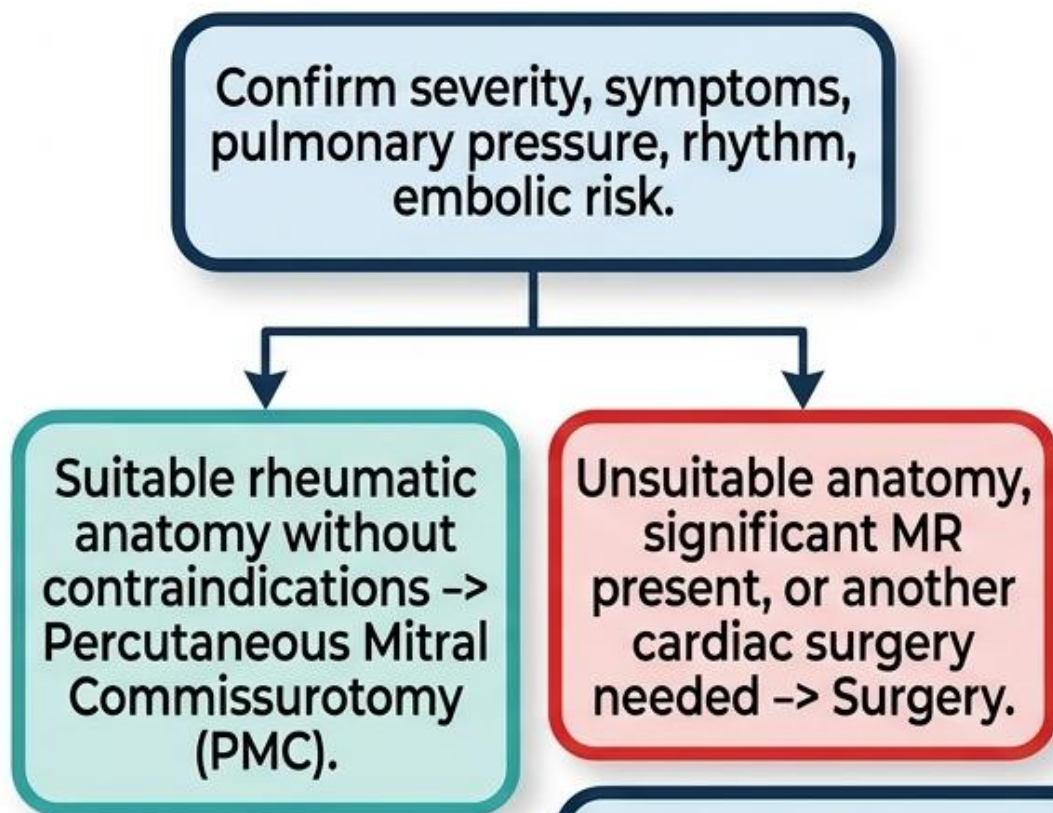


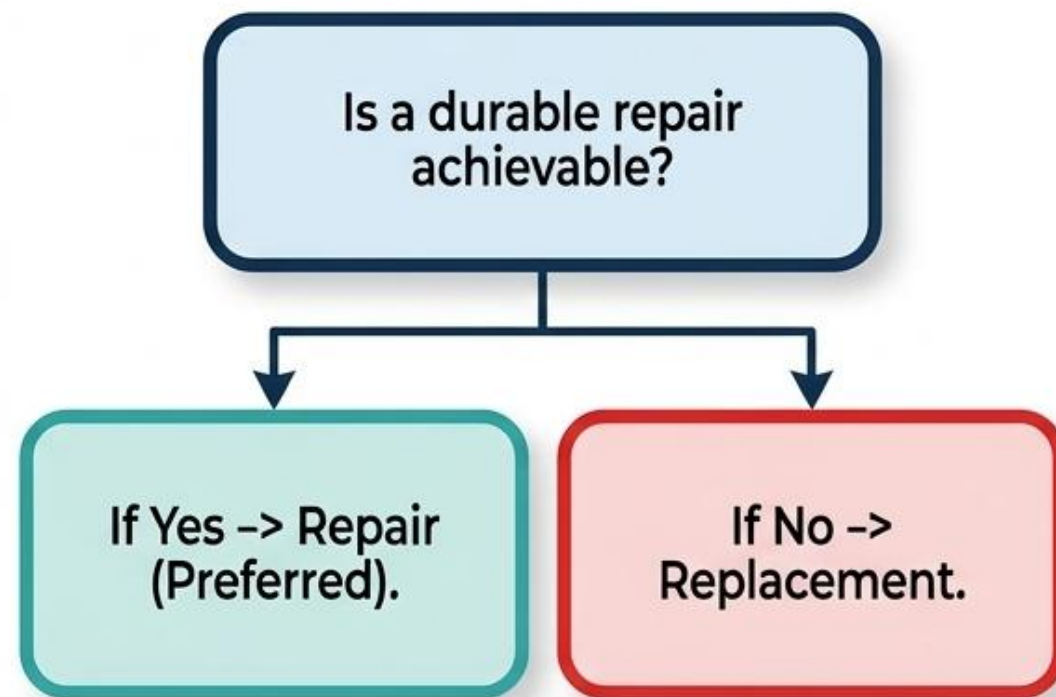
Figure 59.16 Operative view of the mitral valve repair using a Carpentier–Edwards annuloplasty ring (courtesy of A Murday, FRCS).

Mitral Stenosis Intervention



Key Principle: Distinguish symptom control (diuretics/rate control) from definitive relief of valve obstruction.

Mitral Regurgitation Rule



Aortic Valve Disease & Surgical Indications

Pathology & Symptoms

The commonest cause of **aortic stenosis** in adults is an acquired, **degenerative, calcific process** that results in **immobile aortic valve cusps**.

Auscultation reveals a high-pitched early diastolic murmur best heard at the left sternal edge.

Indications for Surgery Checklist

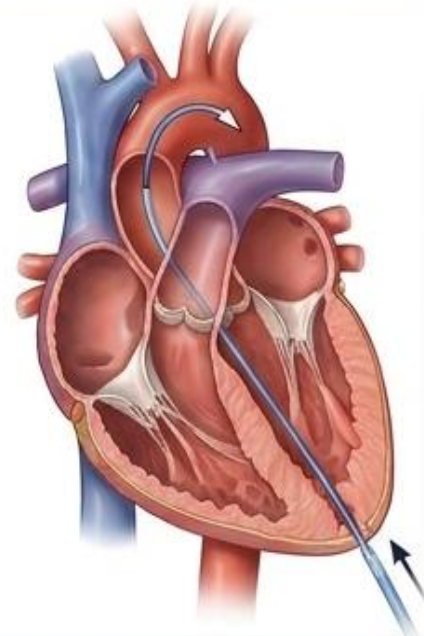
- ✓ Asymptomatic patients with **severe aortic regurgitation** and **left ventricular dysfunction** should also be offered surgery.
- ✓ When there is evidence of **progressive left ventricular dilatation** (left ventricular end-systolic diameter **>50 mm**).
- ✓ Aortic valve replacement is recommended if there is a decrease in systolic function.

Aortic Valve Surgery & TAVI

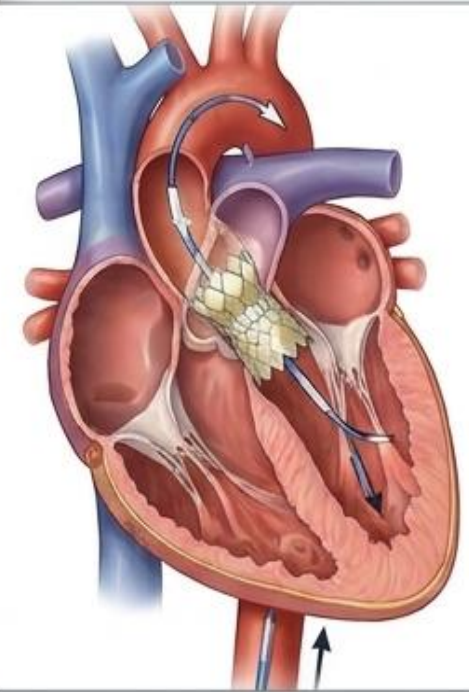


Aortic valve replacement

Transcatheter aortic valve implantation



Transapical approach



Transluminal approach

Symptoms of Aortic Stenosis

- Shortness of breath
- Angina
- Fatigue
- Syncope or pre-syncope
- Other
 - Rapid or irregular heartbeat
 - Palpitations



Sandy
Actual TAVR Patient
Pre-Procedure
Inoperable

The symptoms of aortic disease are commonly misunderstood by patients as 'normal' signs of aging.⁵ Many patients initially appear asymptomatic, but on closer examination up to 37% exhibit symptoms.⁶

TABLE 59.5 Classification of the severity of aortic stenosis.

	Mild	Moderate	Severe
Valve area (cm ²)	>1.5	1.0–1.5	<1.0
Mean gradient (mmHg)	<20	20–40	>40
Velocity (m/s)	2.6–2.9 (<2.5 found in aortic sclerosis)	3.0–4.0	>4.0
Velocity ratio	>0.50	0.25–0.50	<0.25

Indications for surgery

The natural history of symptomatic patients with aortic stenosis is dismal, with 10-year mortality around 80–90%. The risk of sudden death is related to the severity of stenosis.

- Surgery is indicated in asymptomatic patients with severe stenosis and impaired left ventricular function or when the patient is undergoing concomitant procedures such as CABG.
- An abnormal blood pressure response to exercise (low blood pressure) is also a sign that there is limited reserve in asymptomatic patients.

TABLE 59.6 Causes of aortic regurgitation.

Acute aortic regurgitation

Leaflet abnormalities

Infective endocarditis
Prosthetic valve dysfunction
Traumatic leaflet rupture

Aortic wall abnormalities

Aortic wall dissection
Aortic trauma

Chronic aortic regurgitation

Bicuspid aortic valve
Calcific degeneration
Fenfluramine usage (appetite suppressant)

Calcific degeneration
Marfan syndrome, Ehlers–Danlos
Aortic root dilatation
Rheumatoid arthritis, systemic lupus erythematosus, ankylosing spondylitis

Clinical features

asymptomatic until left ventricular failure develops,

exertional dyspnea (predominantly)

angina

A wide pulse pressure due to a reduction in diastolic pressure and a collapsing pulse (water hammer pulse).

visible capillary pulsation of the nail bed (Quincke's sign),

pulsatile head bobbing (de Musset's sign),

visible arterial pulsation in the neck (Corrigan's sign)

a 'pistol shot' sound on auscultating over the femoral artery (Traube's sign)

The apex is displaced laterally and is often visible and hyperdynamic or 'thrusting' in nature because of the left ventricular hypertrophy.

Auscultation reveals a high-pitched early diastolic murmur best heard at the left sternal edge

Indications for surgery

Asymptomatic patients with severe aortic regurgitation and left ventricular dysfunction should also be offered surgery.

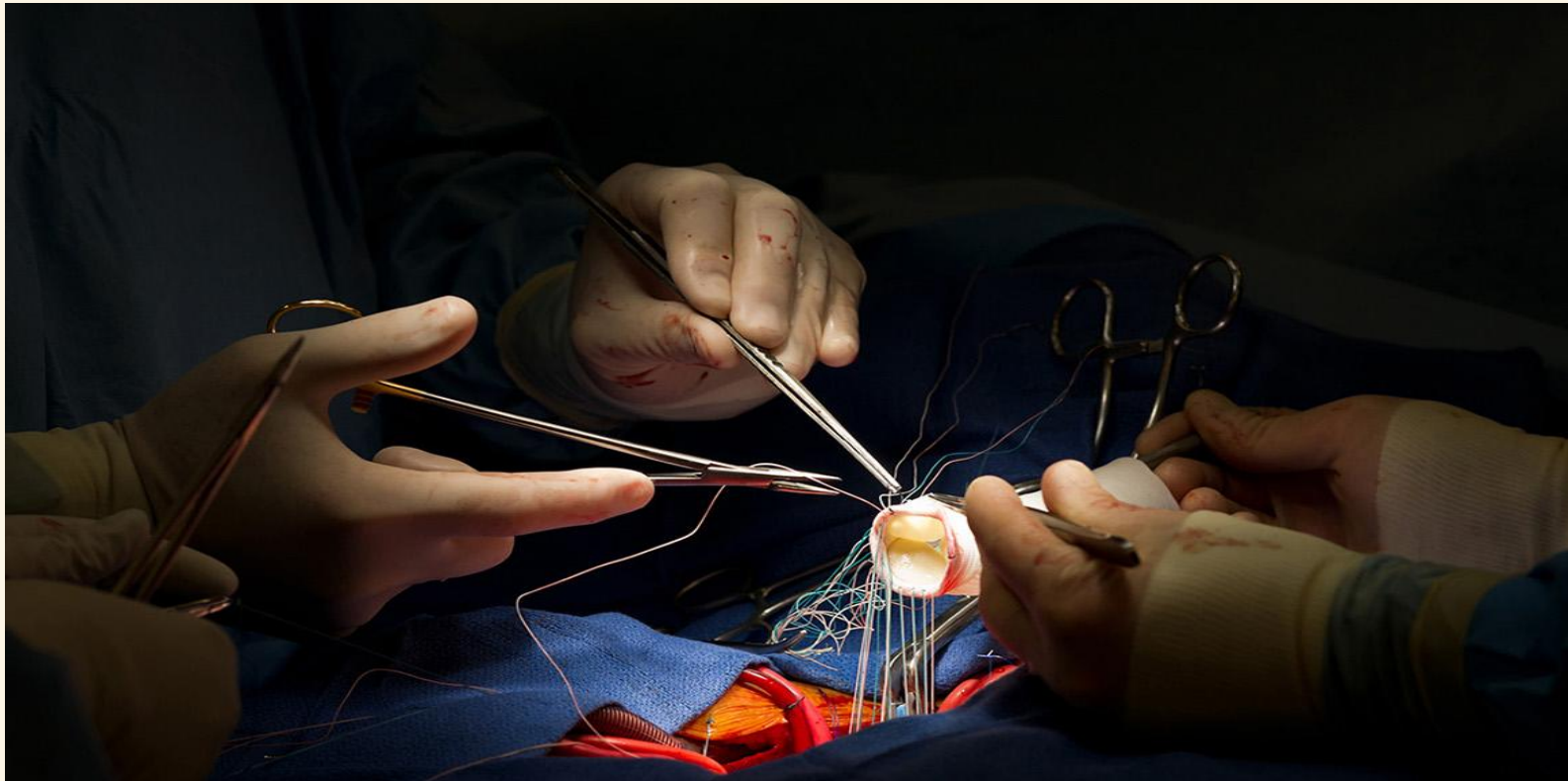
Valve replacement should also be considered in asymptomatic patients with severe regurgitation if they are undergoing cardiac surgery for any other reason,

when there is evidence of progressive left ventricular dilatation (left ventricular end-systolic diameter >50 mm).

Aortic valve replacement is recommended if there is a decrease in systolic function.

Aortic valve surgery

Aortic valve replacement



Case 2 Profile

- ⦿ 78-year-old patient.
- ⦿ Progressive exertional dyspnea and syncope.
- ⦿ **Exam:** Slow-rising pulse, ejection systolic murmur radiating to carotids.
- ⦿ **Echo:** Severe aortic stenosis, preserved LV systolic function.

Does this patient need intervention? SAVR vs TAVI?

→ Intervention Logic:

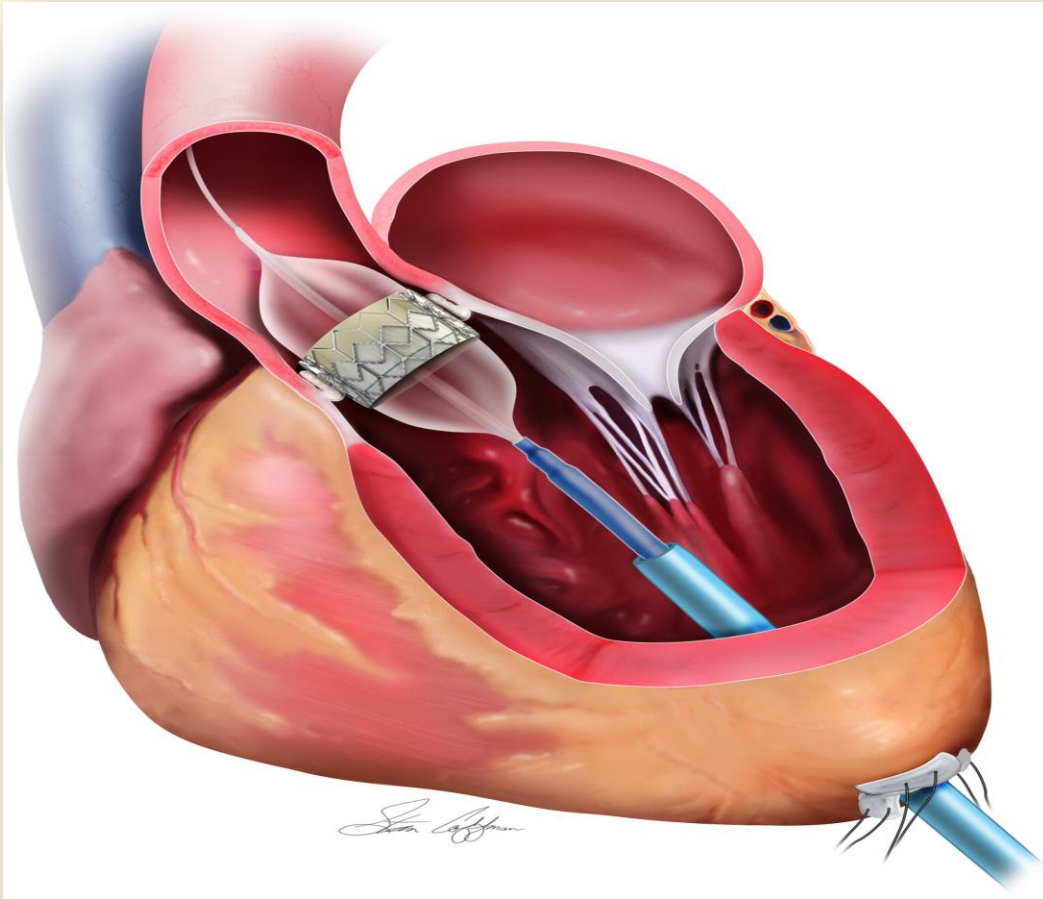
Yes. Symptomatic severe AS requires valve intervention unless benefit is unlikely.

↳ Modality Logic:

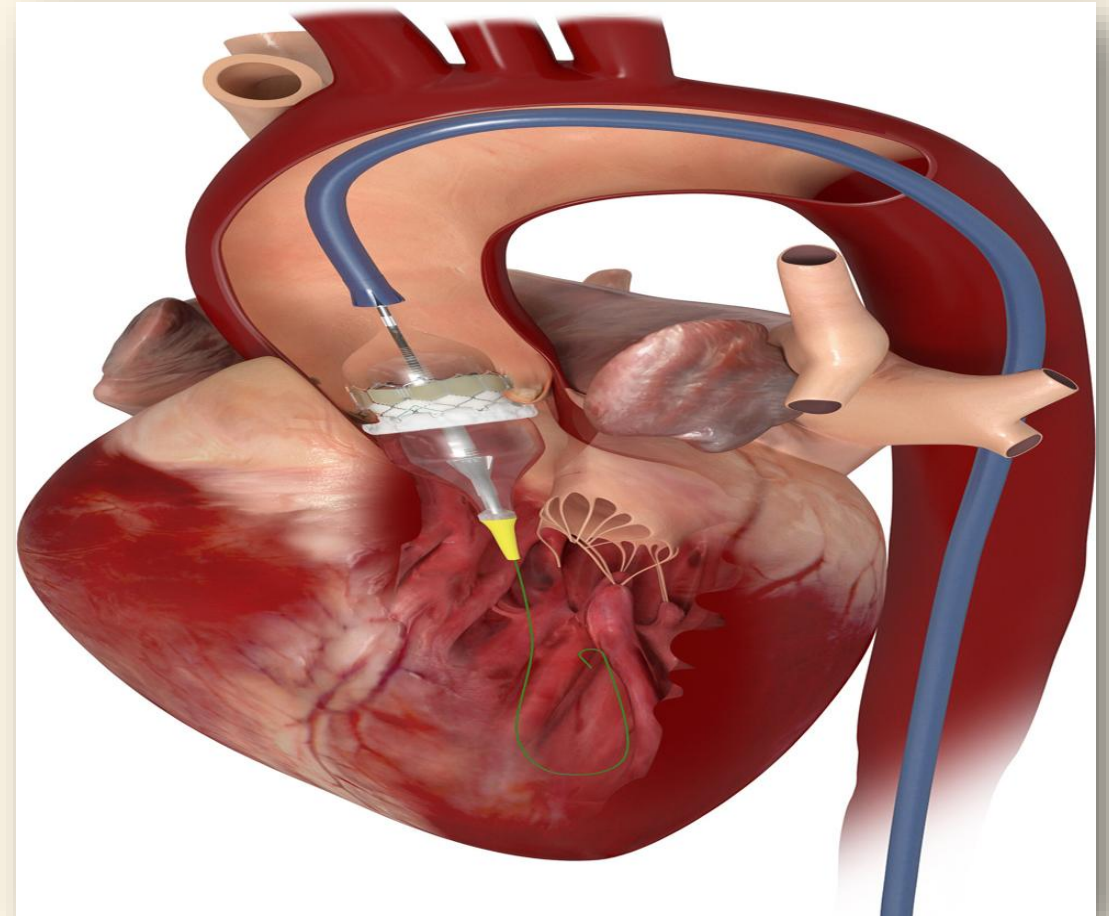
TAVI is heavily favored here due to advanced age (78), pending assessment of anatomy, comorbidity, and surgical risk by the Heart Team.

Transcatheter aortic valve implantation

Transapical approach



Transluminal approach



Surgical AVR (SAVR)

Open surgical replacement.

Allows simultaneous treatment of associated coronary or aortic disease.

Can utilize mechanical or biological prosthesis.

Target: Younger patients, or when concomitant cardiac surgery is required.



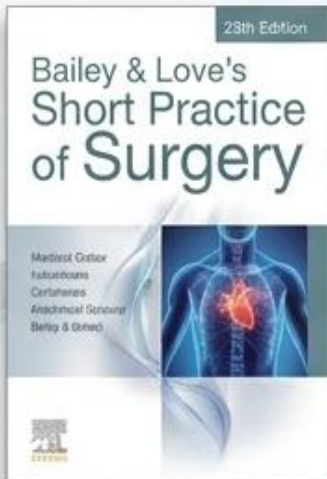
Transcatheter Aortic Valve Implantation (TAVI)

Valve delivered via catheter (usually transfemoral).

Avoids sternotomy and cardiopulmonary bypass.

Target: Older patients, specific surgical-risk groups.

The Frontier: Minimal Cardiac Surgery



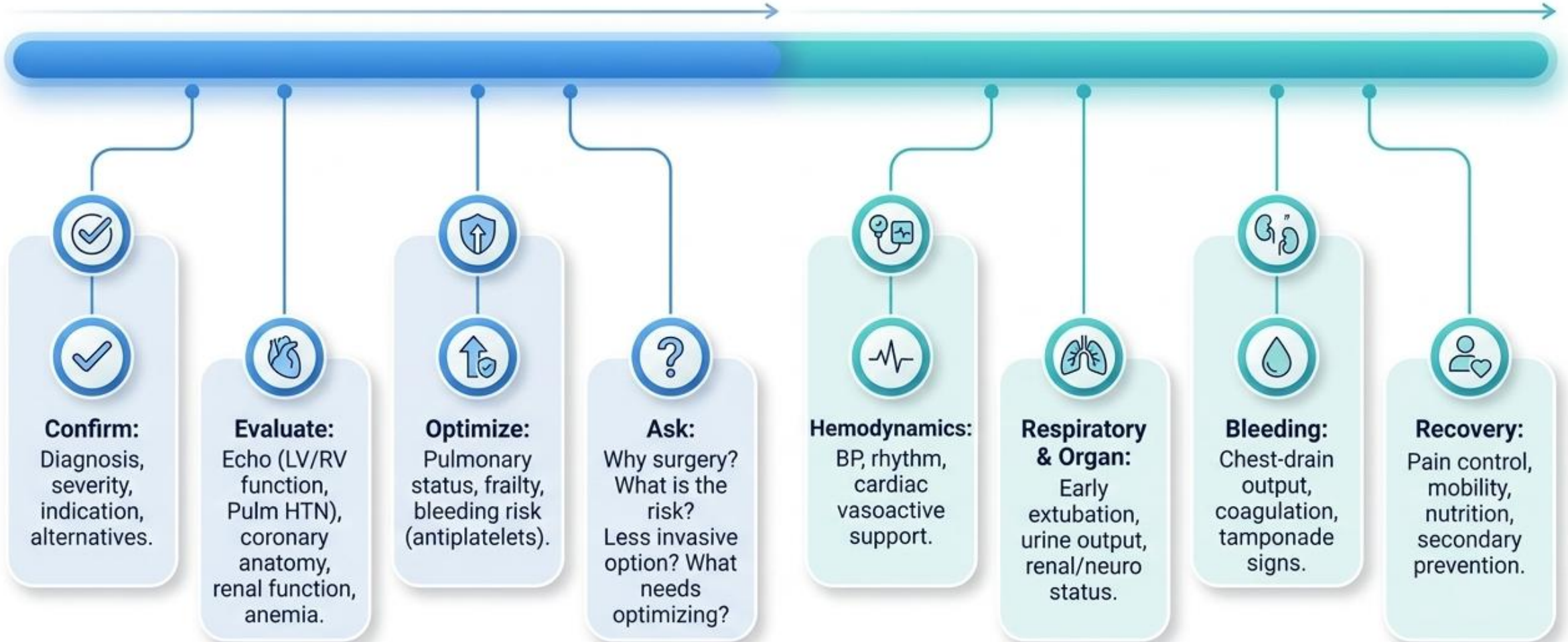
Reference: Bailey & Love's
Short Practice of Surgery,
28th Edition

Final Checkpoint from Dr. Saif Al-Mudhaffar

Based on your anatomical knowledge, identify the exact surgical landmarks and approaches marked on these patients' chests.

PREOPERATIVE ASSESSMENT

EARLY POSTOPERATIVE CARE



5 Take-Home Messages

- 1** Do not treat a murmur — define the valve lesion and severity.
- 2** CABG is not chosen by stenosis % alone; revascularization is individualized.
- 3** Mitral repair is strongly preferred over replacement if durable.
- 4** Mechanical valves are durable but mandate lifelong Warfarin.
- 5** Recognize emergencies: acute MR/AR, endocarditis complications, tamponade.

Quick Review

-  Preferred LAD Conduit? → **LIMA.**
-  Mechanical Valve Anticoagulant? → **Warfarin (Not DOAC).**
-  Symptomatic Severe AS needs? → **Valve Intervention.**
-  Endocarditis Surgical Triggers? → **Heart Failure, Uncontrolled Infection, Embolic Prevention.**
-  Acute papillary muscle rupture post-MI causes? → **Acute severe MR.**

A stack of five wooden blocks is held by two hands at the top. The blocks are arranged vertically, with the text 'THANK YOU FOR YOUR ATTENTION' written on them in a bold, black, sans-serif font. The background is a solid dark blue. The blocks are light-colored wood, and the text is centered on each block. The hands are visible at the top, holding the top block.

THANK

YOU

FOR

YOUR

ATTENTION