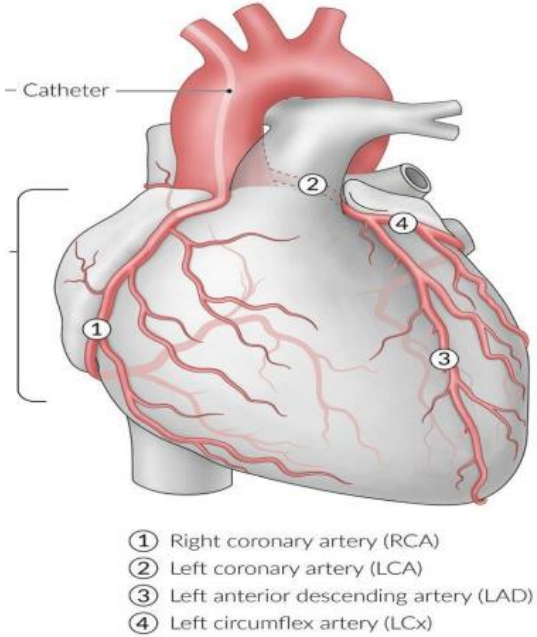
Cardiothoracic Surgery

Done by: Dena Kofahi

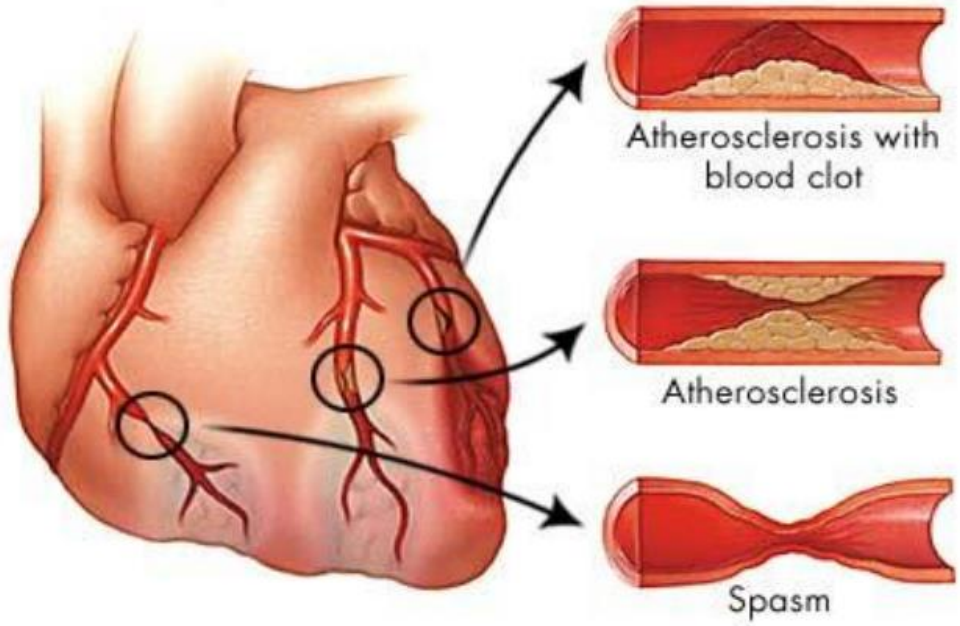
A slightly more detailed version of these slides (perhaps more useful for the final) can be found with the link

Coronary Artery Disease

Ischemic Heart Disease

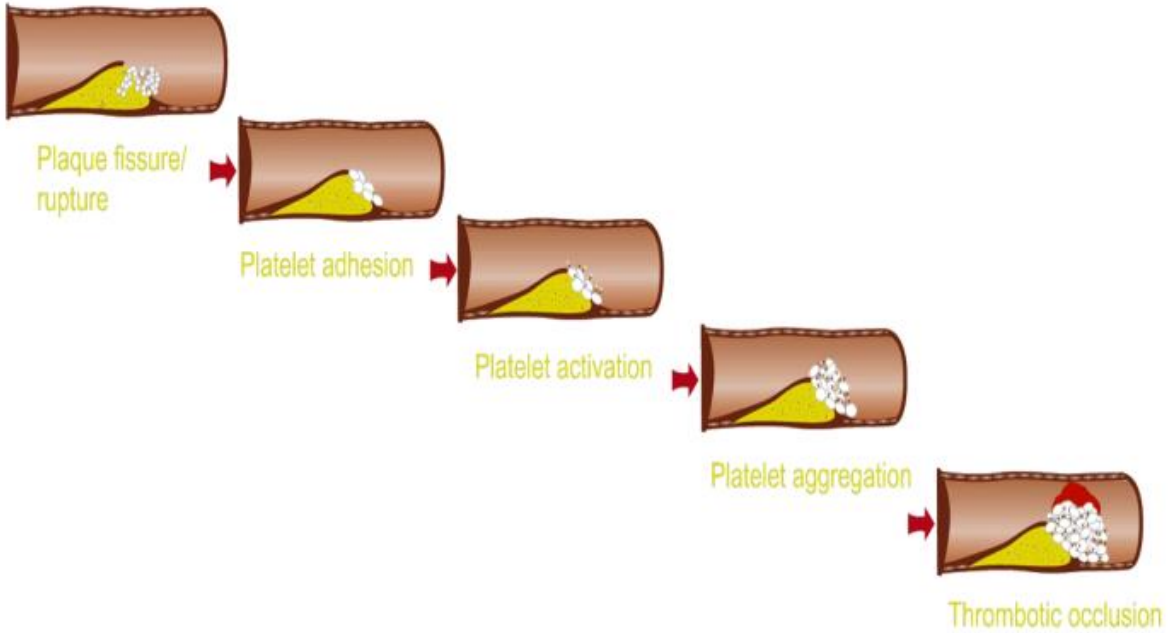


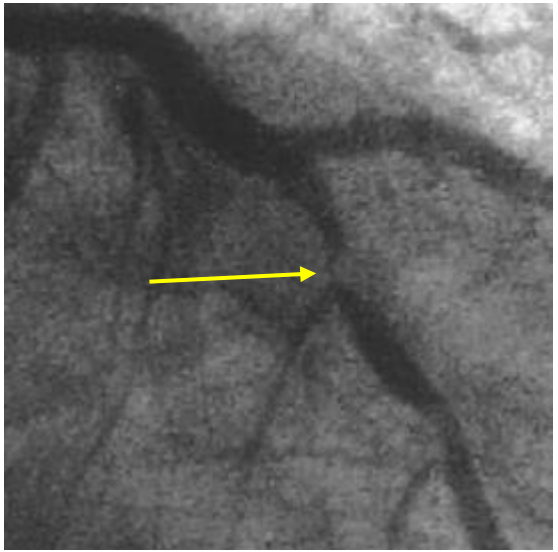
① Right coronary artery (RCA)
② Left coronary artery (LCA)
③ Left anterior descending artery (LAD)
④ Left circumflex artery (LCx)



- Results from the imbalance between oxygen demand and supply.
- Most common cause: Atherosclerosis

Atherosclerosis





- Uncontrollable risk factors: Gender, family history, race, age
- Controllable risk factors: HTN, high cholesterol, smoking, obesity, diabetes, physical activity

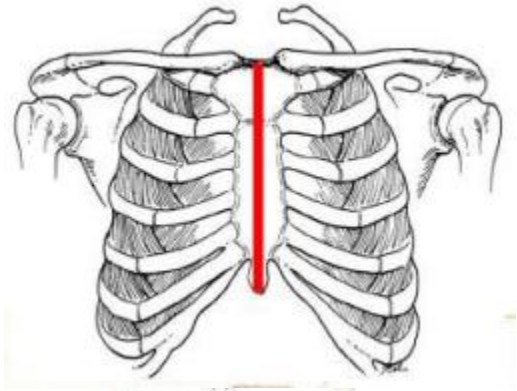
Coronary Artery Bypass Grafting (CABG)

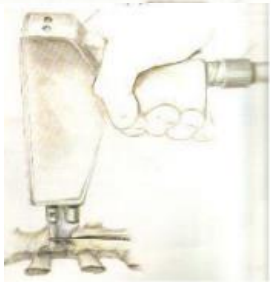
Indications:

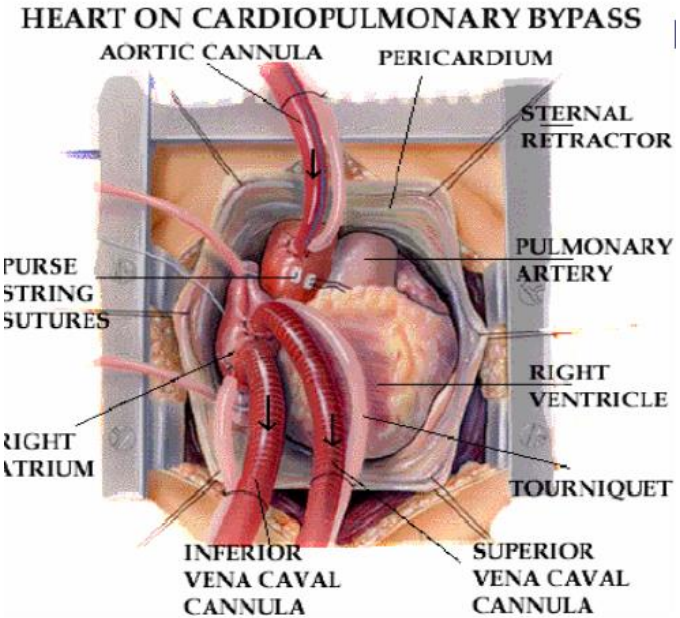
- Triple vessel disease (LAD, left circumflex, RCA)
- Left main coronary artery disease
- Failed medical therapy of unstable angina
- Complications of PTCA (stenting) - Thrombosis, dissection, or perforation of a coronary artery
- Life threatening complications of MI - Free wall rupture, severe mitral regurgitation due to papillary rupture, VSD
- Anomalies of the coronary arteries

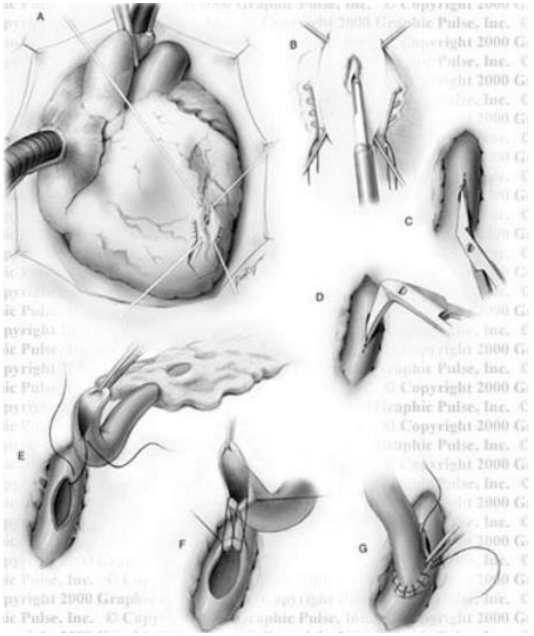
Image: Narrowing of left main artery

Coronary Artery Bypass Grafting (CABG)



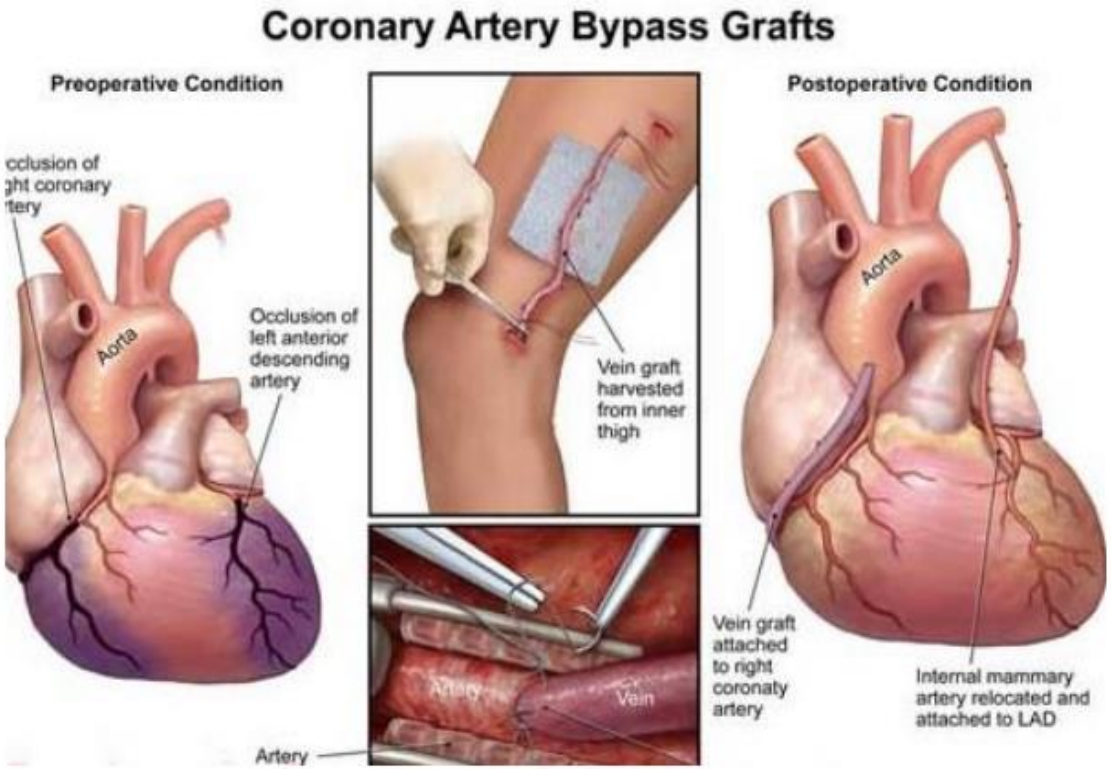






CABG involves median sternotomy, cardiopulmonary bypass, cardioplegic arrest (with a potassium rich solution) and placement of a graft.

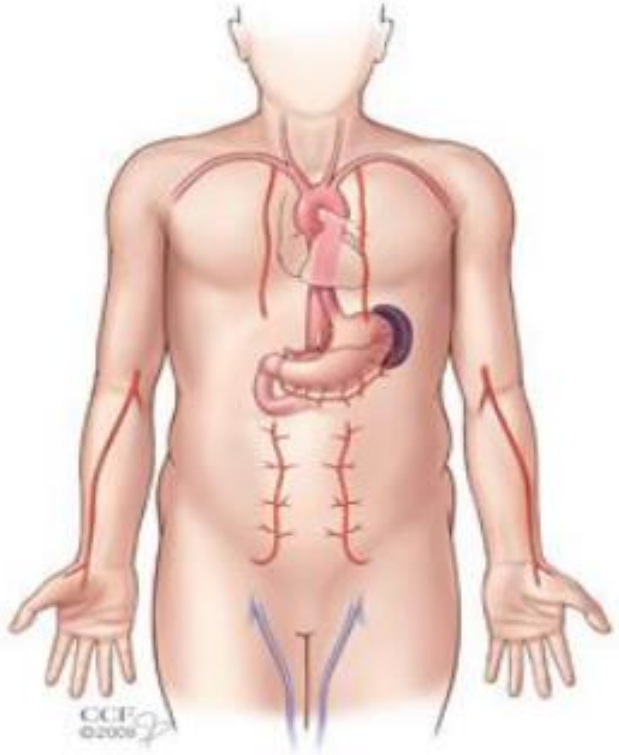
Coronary Artery Bypass Grafting (CABG)



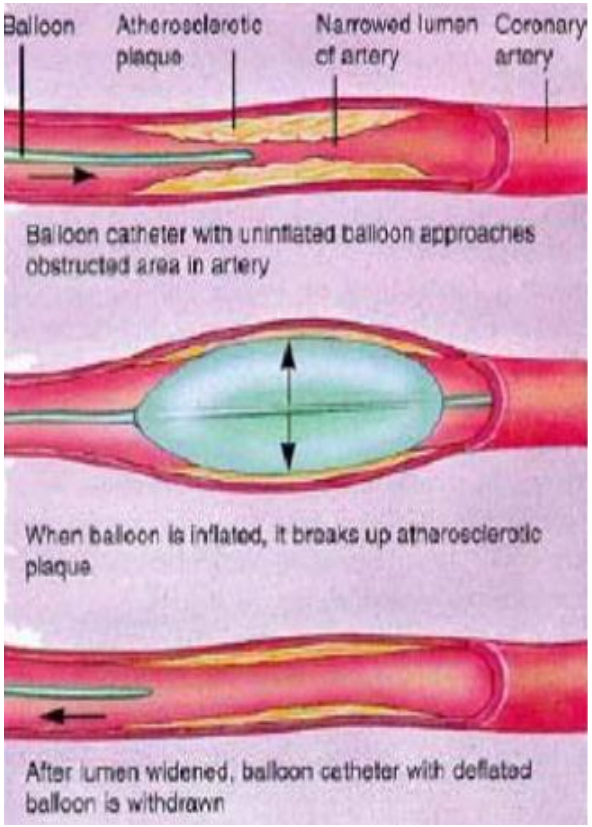
Conduits for CABG

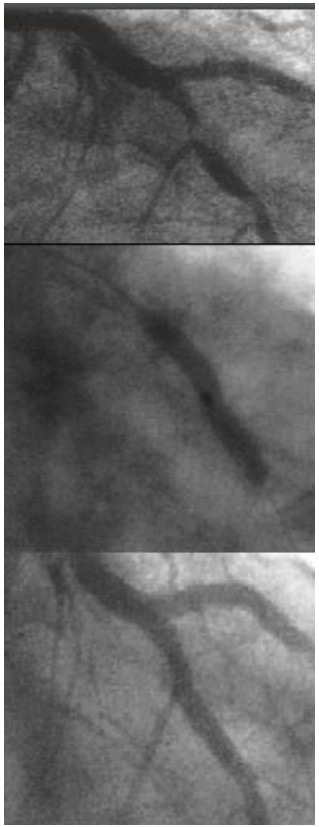
- Internal mammary artery
- Inferior hypogastric artery
- Gastroepiploic artery
- Radial artery
- Saphenous vein

The left internal mammary artery is the best conduit for LAD.

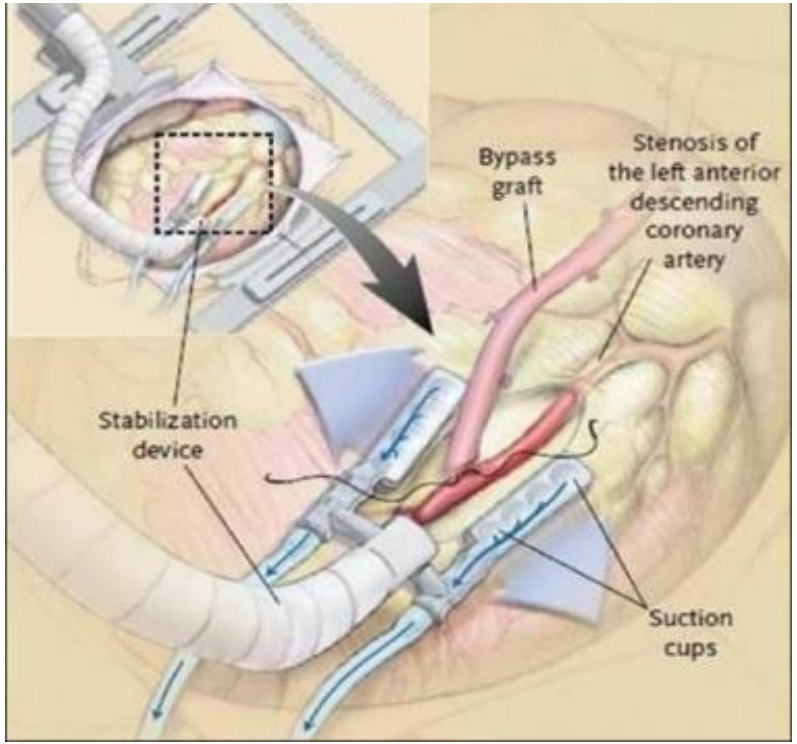


Percutaneous Transluminal Coronary Angioplasty (PTCA)





Off-Pump Coronary Artery Bypass



A procedure to allow bypass surgery to occur without stopping the heart.

Chronic Lower Limb Ischemia

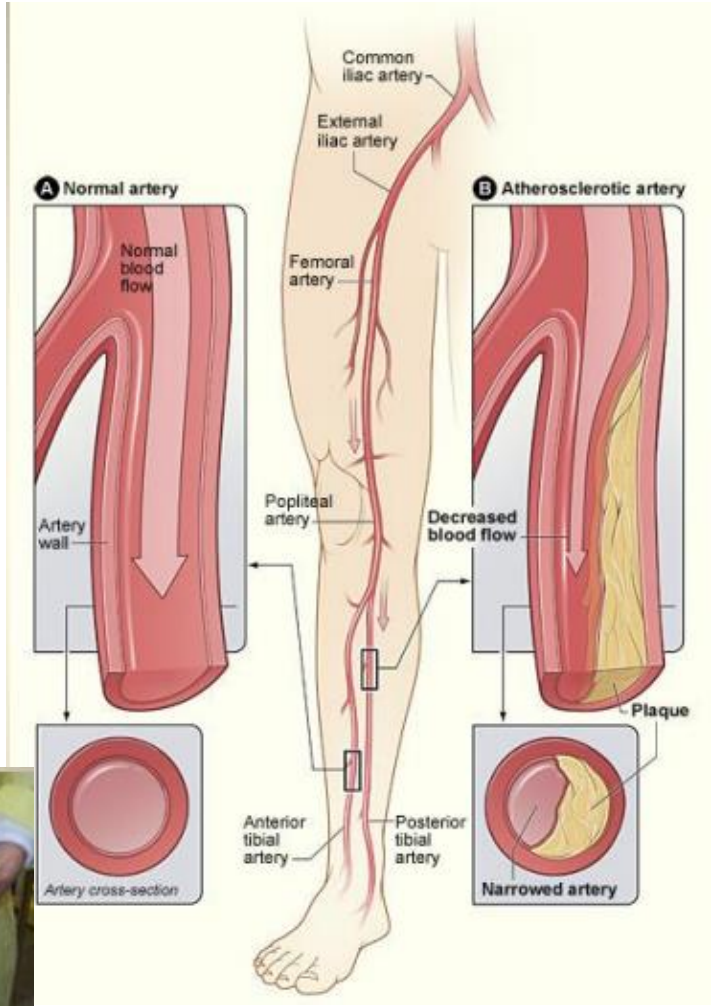
Chronic lower limb ischemia occurs due to the decrease in arterial blood supply to the tissues due to partial occlusion of the arteries.

Peripheral Vascular Disease

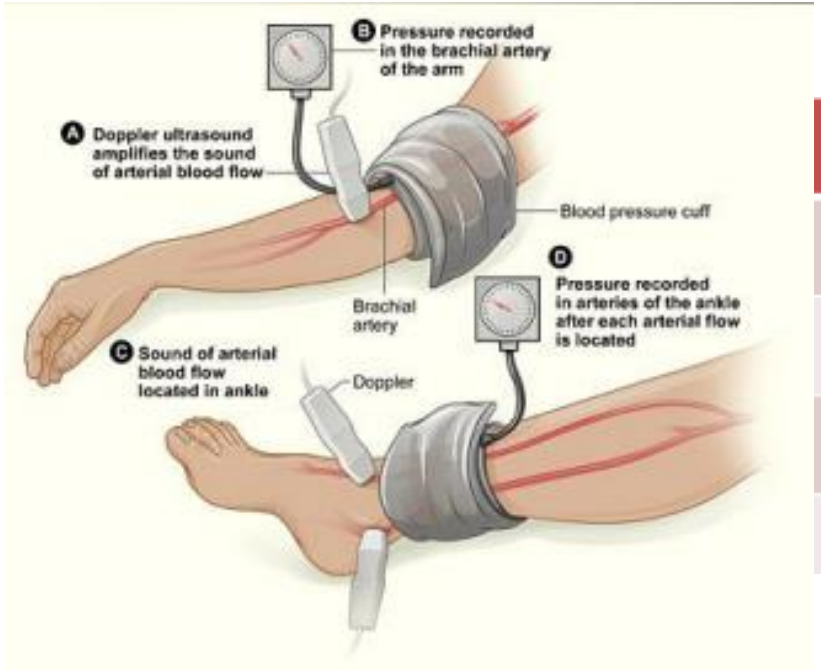
- PVD is occlusive disease of the arteries of the lower extremity.
- Most common cause: Atherosclerosis
- Diagnosing PVD: Ankle-brachial pressure index (ABPI). An ABPI of <0.9 is diagnostic.
- History: Intermittent claudication, night pain, cold limb, non-healing ulcer. Many patients are asymptomatic
- Pulses must be checked.

Signs of critical stenosis (>60%), with impending acute limb ischemia:

- Rest pain
- Ischemic ulceration
- Gangrene



ABPI



ABI	Clinical Correlation
>0.9	Normal Limb
0.5-0.9	Intermittent Claudication
<0.4	Rest Pain
<0.15	Gangrene

An ABPI >1.25 indicates a falsely elevated ABPI, which can be seen in patients with diabetes and renal failure. These patients have calcified arterial walls, which makes the blood pressure seem higher than it actually is.

Interventions

Catheter-Based Revascularization

- Indications:
  - Lifestyle disabling intermittent claudication
  - Severe arterial insufficiency associated with tissue loss that may not heal without revascularization
  - Critical limb ischemia that jeopardizes viability of the lower limb.

Surgical Revascularization

- Indications:
  - Ischemic pain at rest
  - Actual tissue necrosis - Ischemic ulceration or frank gangrene (indicates advanced ischemia and threatened limb loss)
  - Claudication that jeopardies the livelihood of a patient or significantly impairs the desired lifestyle of an otherwise low risk patient.
- Complications
  - Early: post-op hemorrhage, acute occlusion of graft, and post-op organ ischemia
  - Late: failure, graft occlusion, pseudoaneurysm, infection, and aortoenteric fistula

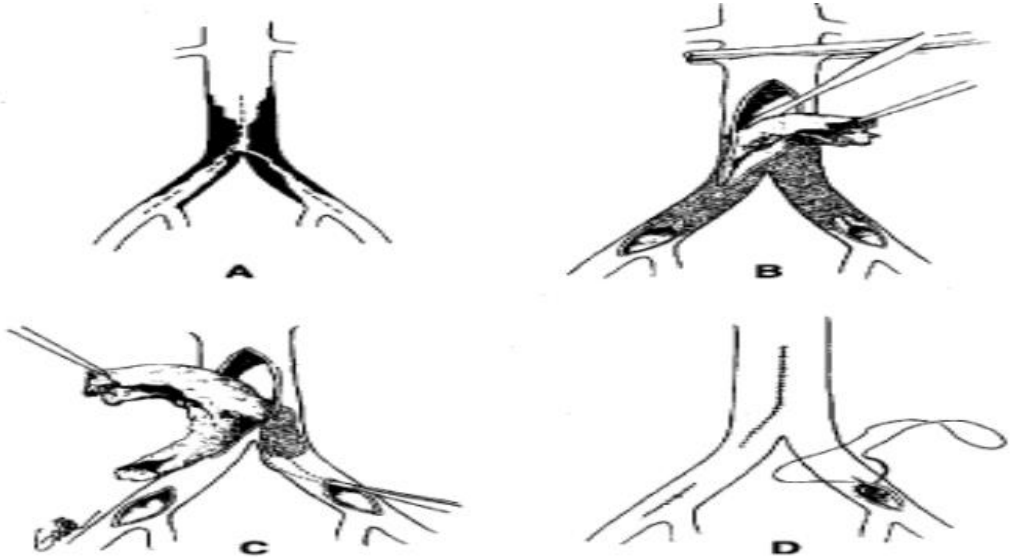
Catheter-Based Revascularization

A: Short occlusion of the left popliteal artery.

B: The occlusion was treated by percutaneous transluminal angioplasty, in which a balloon catheter is passed through the occlusion over a guidewire and inflated.

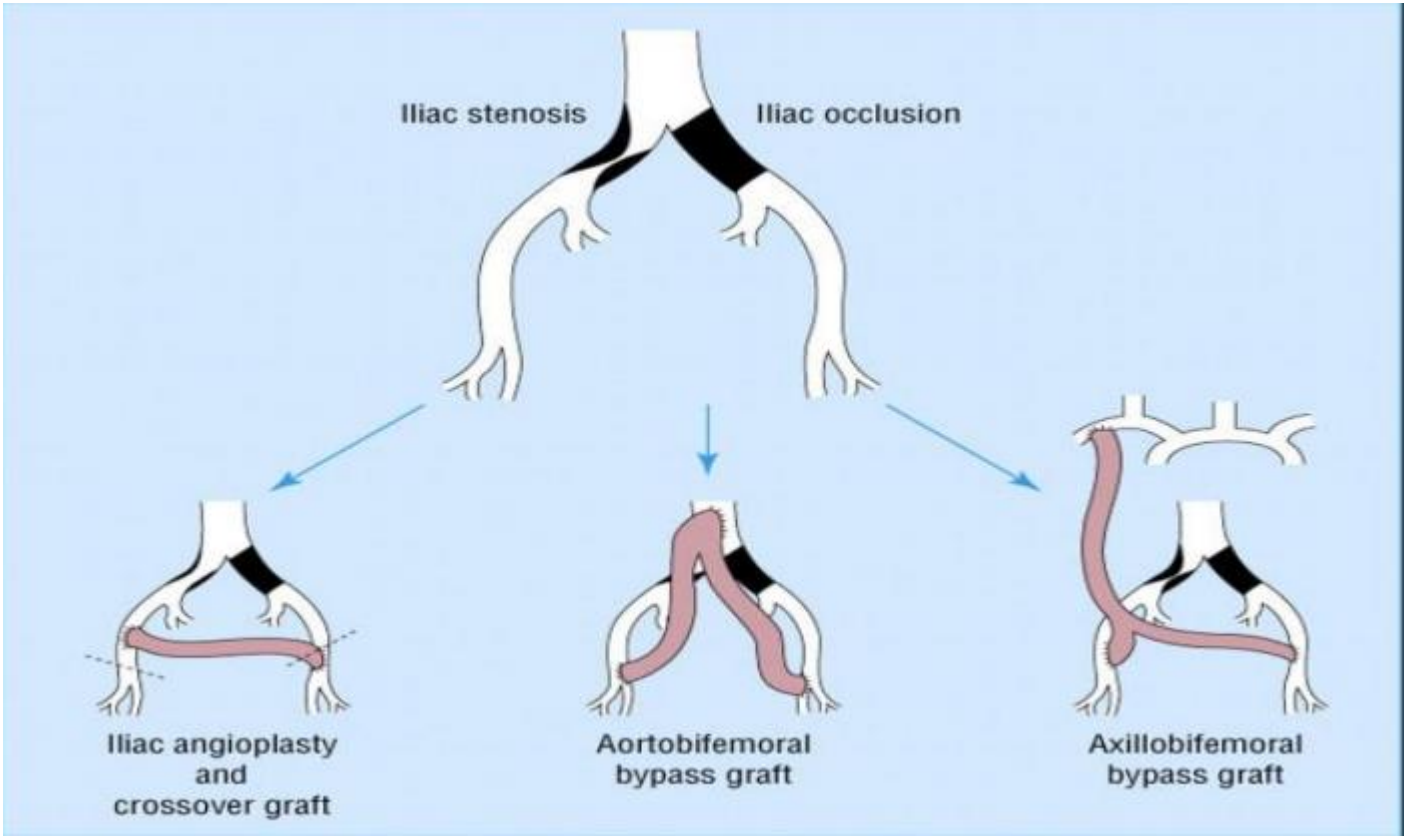
C: Post dilation the artery is patent.

Surgical Procedures - Aortoiliac Endarterectomy

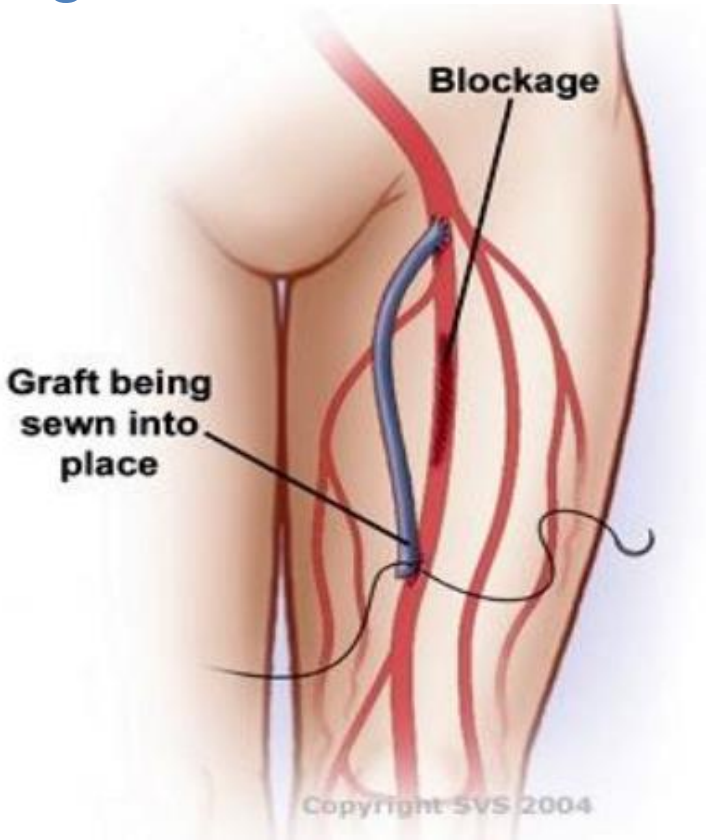


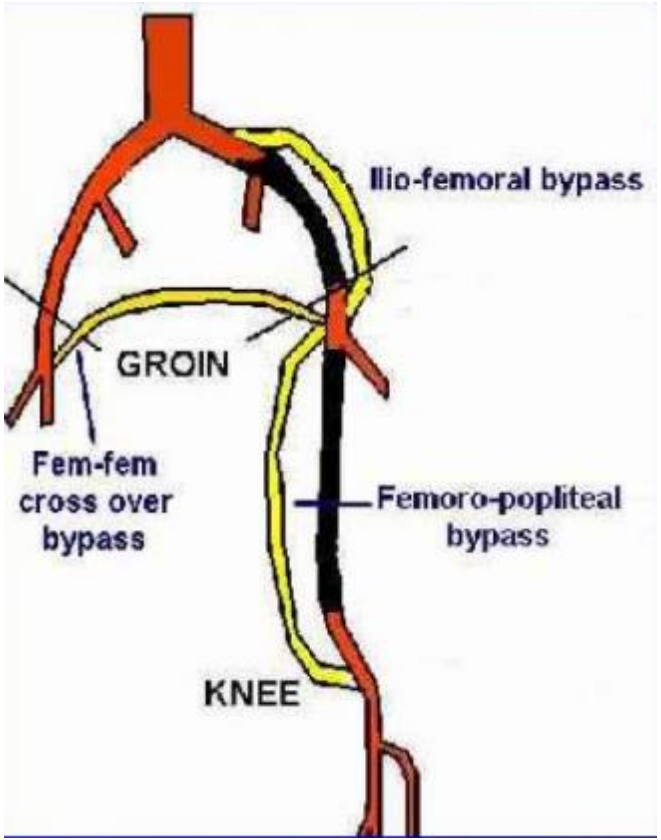
In this case, occlusive disease is limited to the distal aorta and common iliac arteries. The atheromatous material is removed from the aorta and iliac vessels.

Surgical Procedures - Bypass Surgery



Surgical Procedures - Femoropopliteal Bypass





Surgical Procedures - Femorodistal Bypass

These grafts originate from the femoral artery at the groin and take blood to one of the 3 calf blood vessels (anterior and posterior tibial arteries and peroneal artery).

Treatment - Amputation

Indications:

- Unreconstructable peripheral vascular disease,
- Fixed flexion deformities
- Extensive tissue loss

Acute Limb Ischemia

Acute limb ischemia occurs when there is an abrupt interruption of blood flow to an extremity. It may be due to thrombosis of a pre-existing stenotic arterial segment, an embolus, or trauma.

Acute Limb Ischemia

The 6 P's of Acute Limb Ischemia:

- Pain
- Pulselessness
- Pallor
- Paresthesias
- Paralysis
- Perishing cold

Clinical features	Embolus	Thrombosis
Severity	Complete ischaemia (no collaterals)	Incomplete ischaemia (collaterals)
Onset	Seconds or minutes	Hours or days
Limb	Leg 3:1 arm	Leg 10:1 arm
Multiple sites	Up to 15%	Rare
Embolic source	Present (usually AF)	Absent
Previous claudication	Absent	Present
Palpation of artery	Soft; tender	Hard/calcified
Bruits	Absent	Present
Contralateral leg pulses	Present	Absent
Diagnosis	Clinical	Angiography
Management	Embolectomy, warfarin	Medical, bypass, thrombolysis
Prognosis	Loss of life > loss of limb	Loss of limb > loss of life

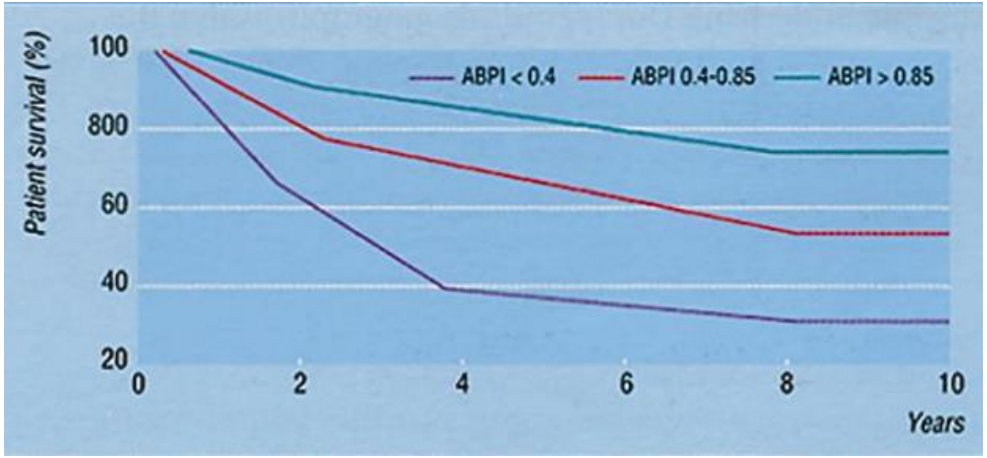
Rutherford Classification of Acute Limb Ischemia

	Viable (I)*	Marginally threatened (IIa)*	Immediately threatened (IIb)*	Nonviable (III)*
Pain	Mild	Moderate	Severe	Variable
Capillary refill	Intact	Delayed	Delayed	Absent
Motor deficit	None	None	Partial	Complete, paralysis (rigor)
Sensory deficit	None	None or minimal (toes)	More than toes	Complete, anesthetic
Arterial Doppler	Audible	Inaudible	Inaudible	Inaudible
Venous Doppler	Audible	Audible	Audible	Inaudible
Treatment	Urgent evaluation	Urgent revascularization	Emergency revascularization	Amputation

Paralysis, paresthesia, and muscle tenderness are the cardinal signs of complete acute ischemia. The limb must be revascularized within 4-6 hours if it is to be saved.

Acute Limb Ischemia

Mottling is bluish or purplish discoloration of the limb due to deoxygenated blood filling the skin. It occurs several hours after the acute ischemia begins.



Correlation between patient survival and ABPI

Acute Limb Ischemia

Dried gangrenous toes with blistering. Irreversible ischemia

Blackish discoloration and irreversible ischemia. The border between the ischemic and viable segments is the line of demarcation

Arteriography

Embolic Occlusion

The artery is normal until there is a sudden cut off due to an embolus. Absence of collaterals.

Thrombotic Occlusion

The artery above the occlusion is atherosclerotic and extensive collaterals are present.

Management

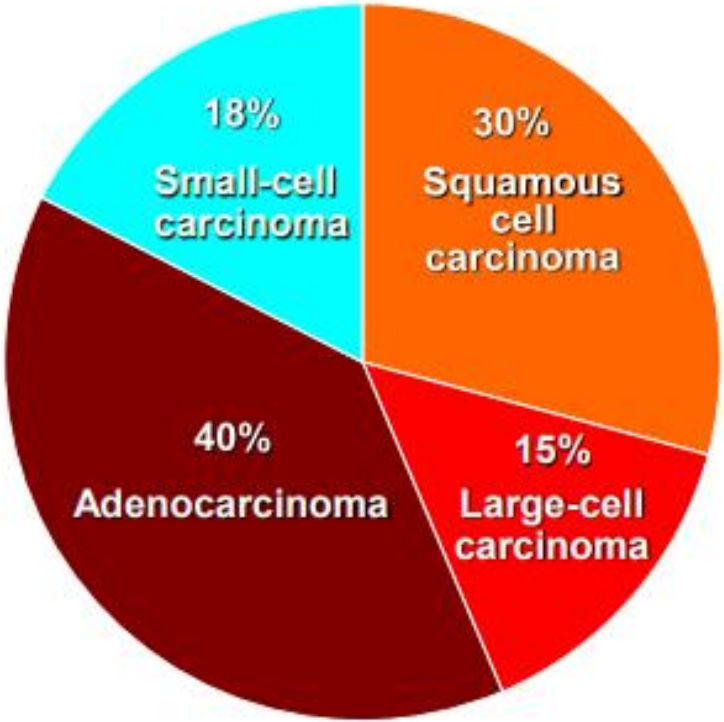
- Cardiac evaluation
- IV fluids
- IV heparin
- Treatment may include surgery and thrombolytics (ex: streptokinase, Rt-PA).

Depending on the state of the limb, medical treatment or surgery can be attempted to restore blood flow within 6 hours, or, if the limb is nonviable, amputation occurs.

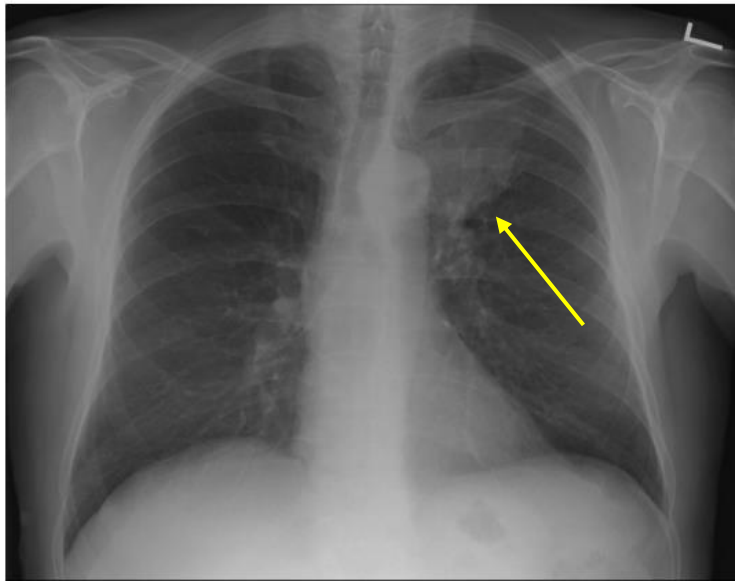
Fasciotomy should always be considered after successful reperfusion to avoid compartment syndrome

Lung Cancer

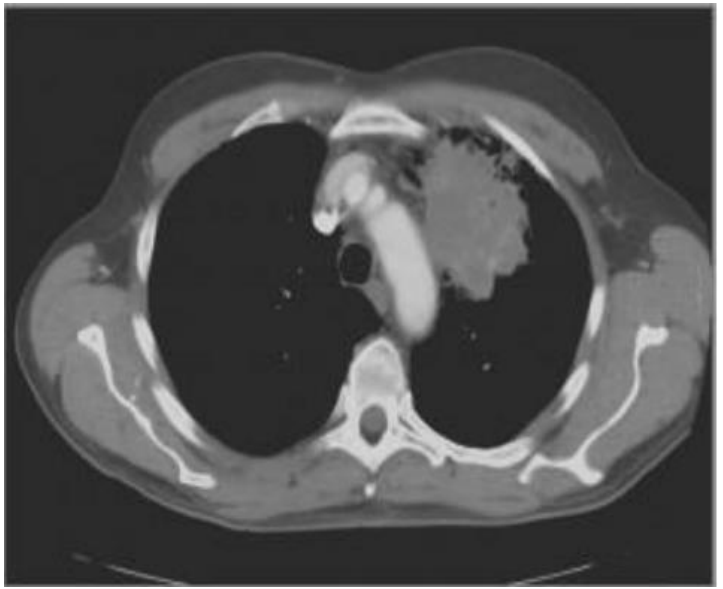
Incidence of Major Histological Types



Lung Cancer

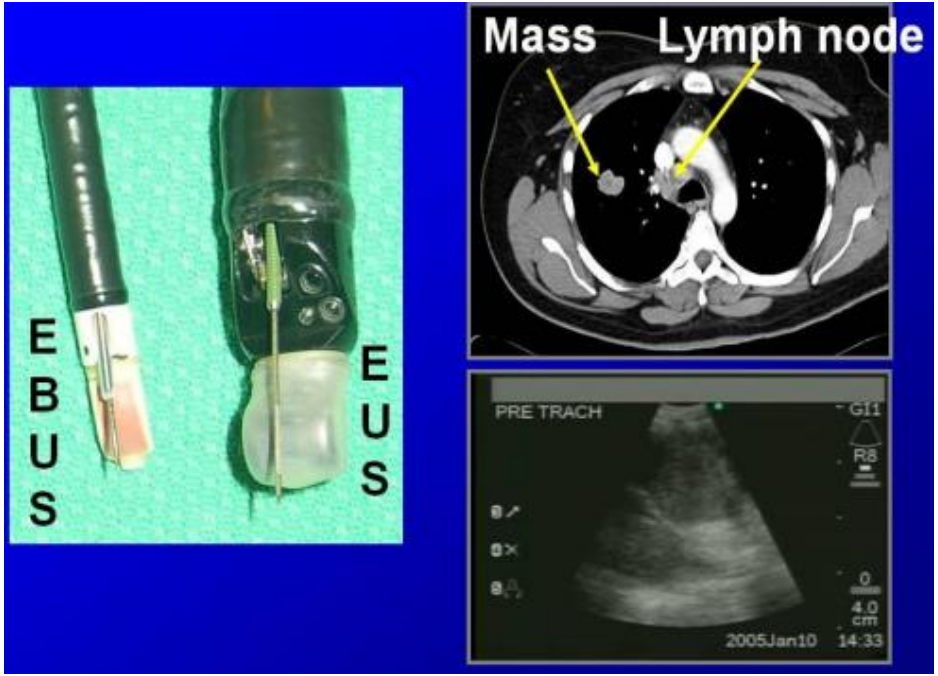


A highly suspicious irregular mass



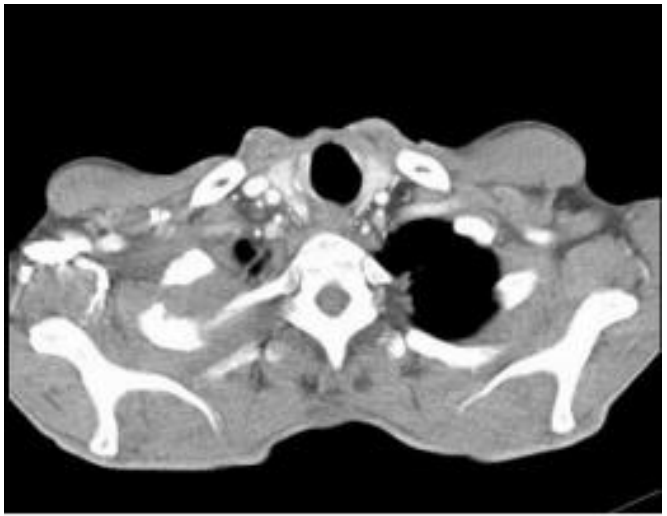
Irregular mass in left upper lobe

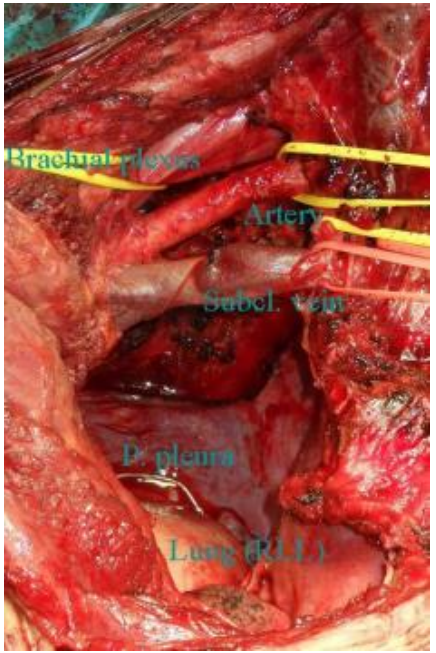
Endobronchial Ultrasound



Allows for US guided biopsy

Pancoast Tumor

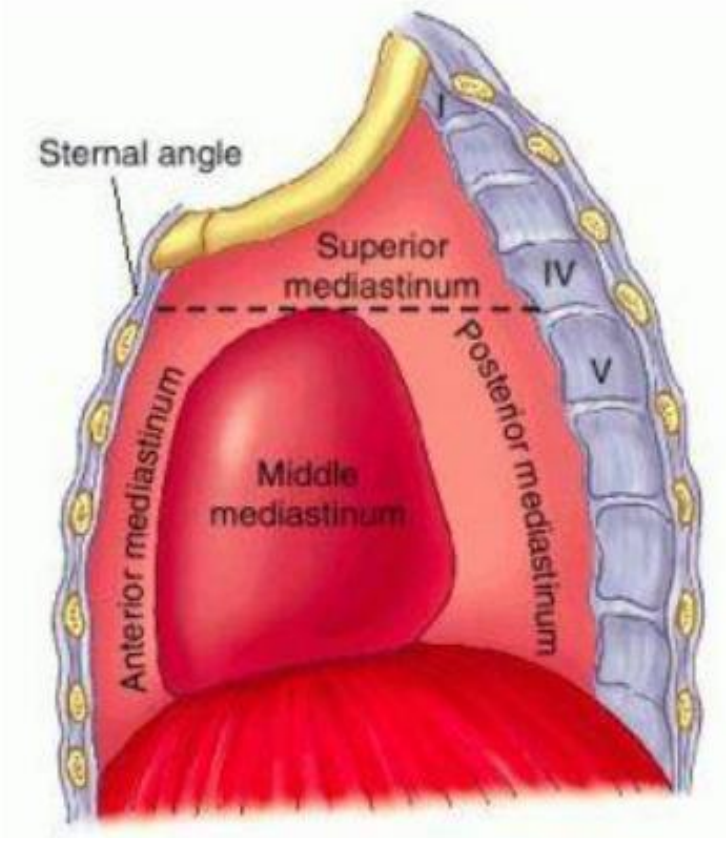




A pancoast tumor is a lung tumor localized in the pulmonary apex with invasion of pleural and adjacent structures. It has clear signs and symptoms. For example, invasion of the brachial plexus can lead to pain in the upper extremity.

Mediastinal Masses

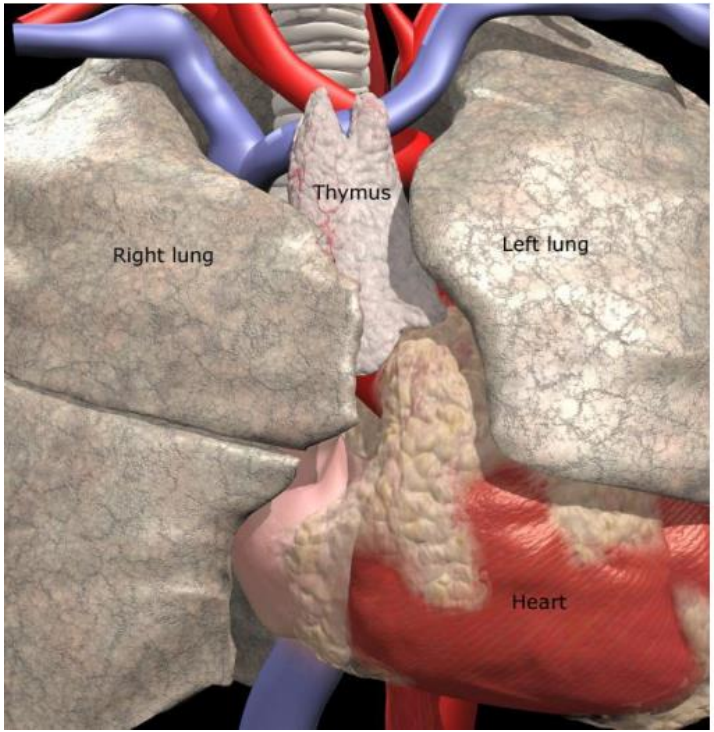
Divisions of the Mediastinum



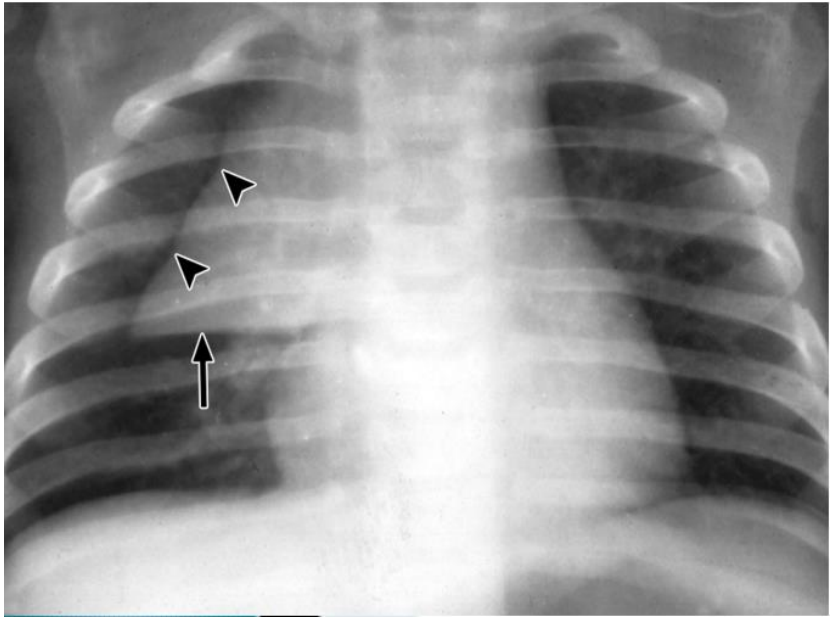
Thymus

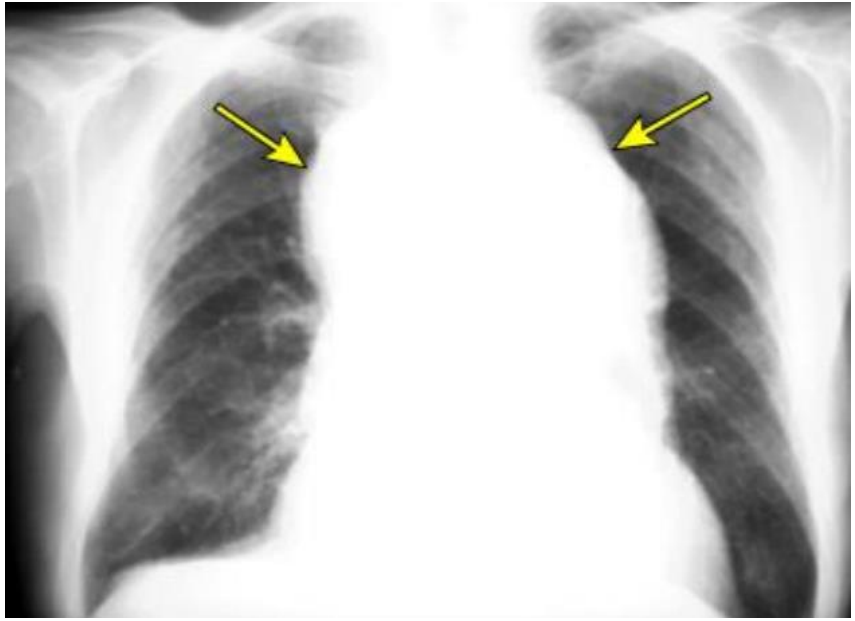
Thymic lesions account for approximately one half of all anterior mediastinal masses.

The most commonly associated paraneoplastic syndrome for a thymoma is myasthenia gravis.

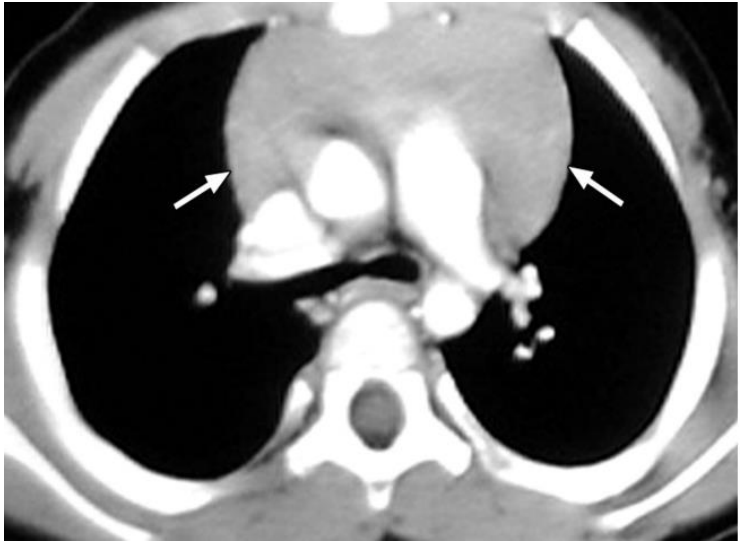


Widened Mediastinum





Mediastinal Masses



Mass present around the heart.

Mass with necrosis (short arrow).
Sign of malignant features.

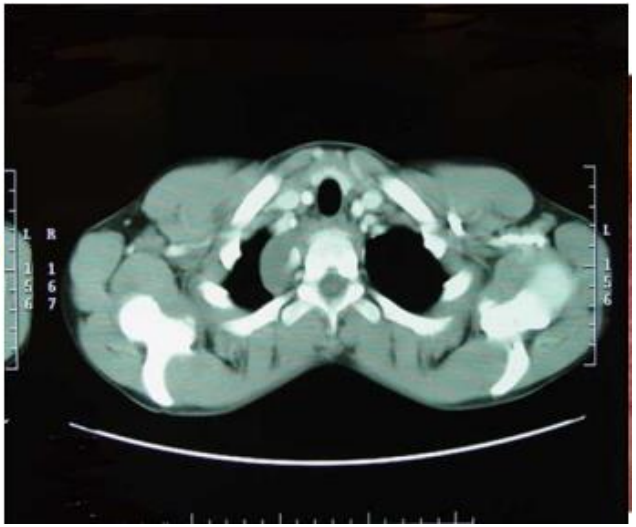
Contrast Esophagram

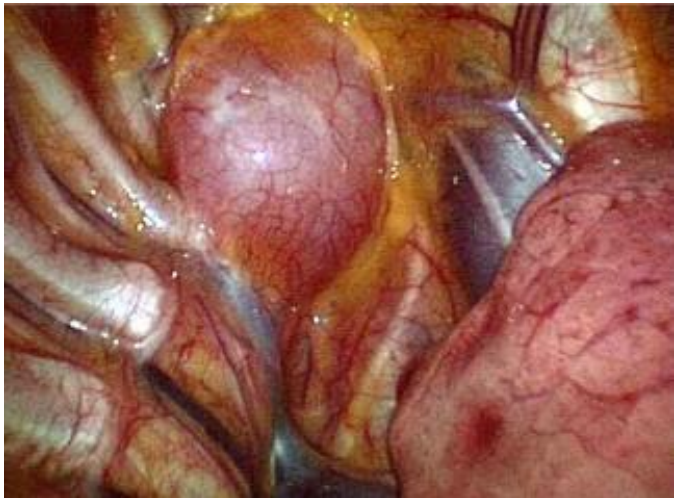
The contrast esophagram shows a mass compressing on the esophagus and causing dysphagia.

The dysphagia is due to the mediastinal mass effect. Direct involvement or compression of normal mediastinal structures by a nearby mass causes a wide range of symptoms such as:

- Hemoptysis
- Cough
- Stridor
- SOB
- Pain
- Hoarseness (involvement or compression of recurrent laryngeal nerve)
- SVC syndrome

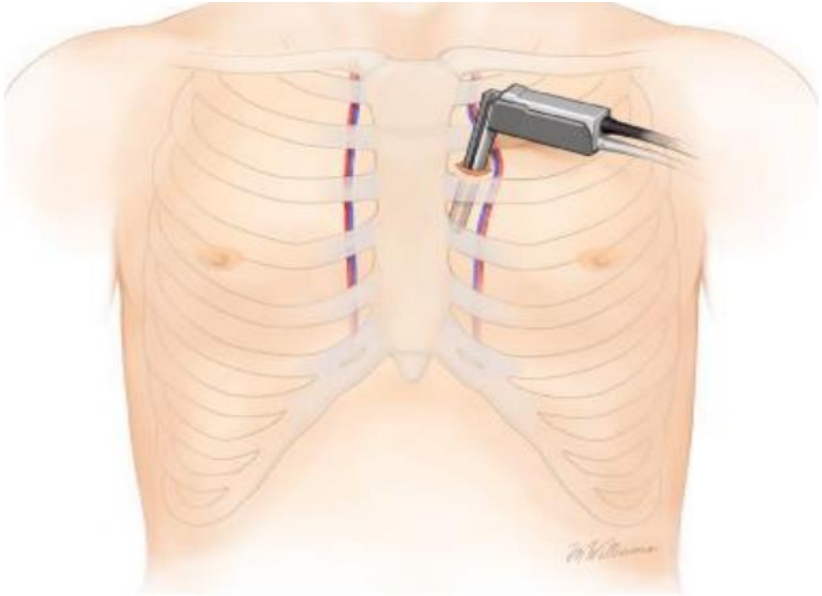
Posterior Mediastinum



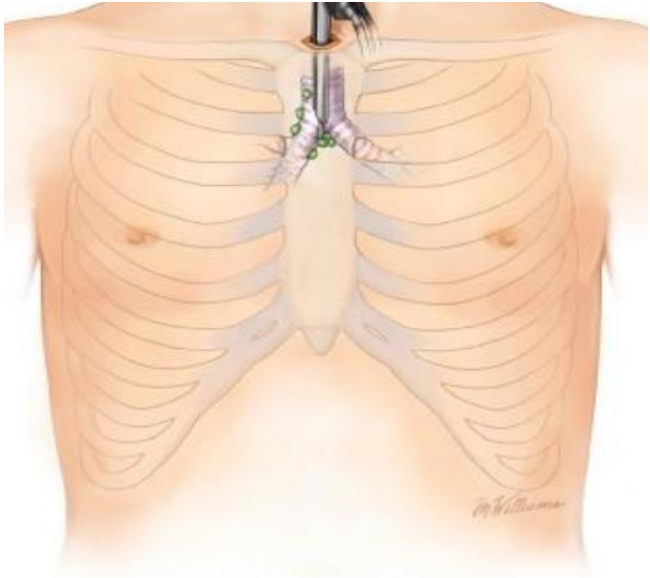


Neurogenic tumors represent more than 60% of posterior mediastinal masses.

Incisions

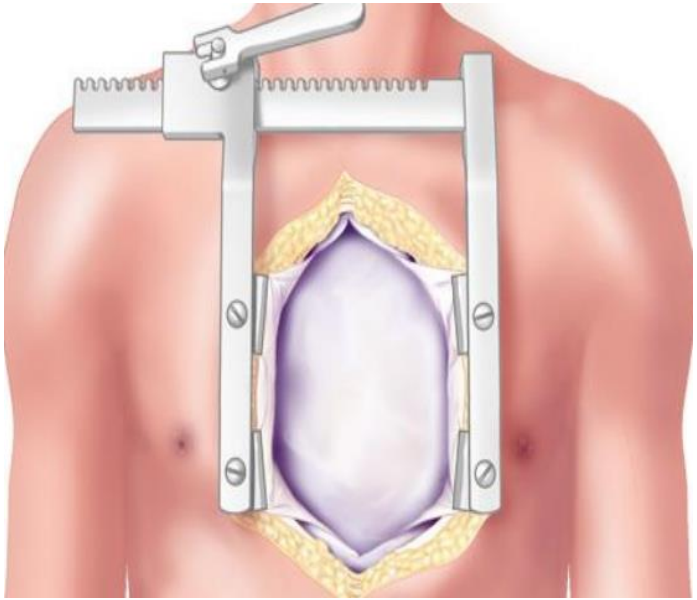


A small incision is made (mediastinostomy) to allow a scope to enter and take a biopsy.

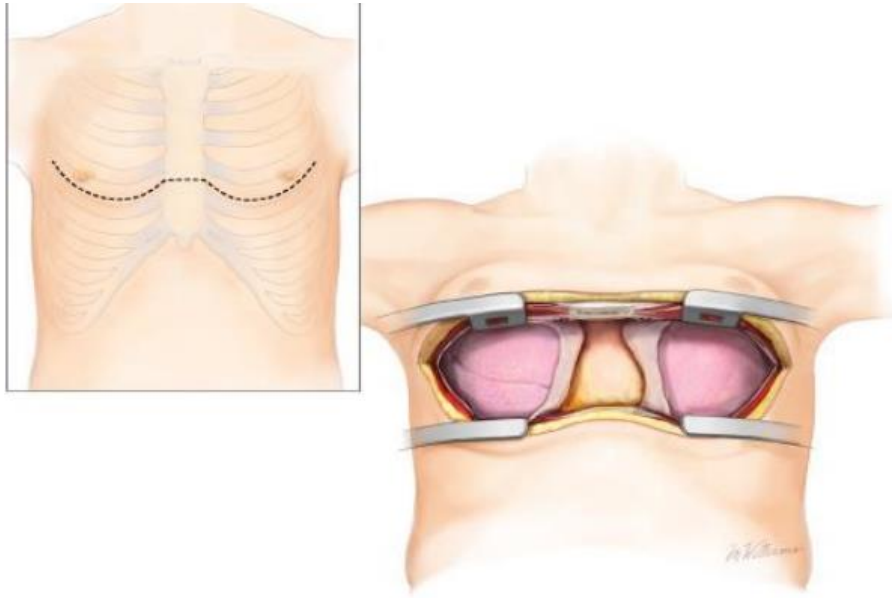


Upper mediastinoscopy allows the scope to enter from the suprasternal notch to take a biopsy from any mass in the ant or sup mediastinum.

Incisions



A median sternotomy is done to remove tumors from the anterior or middle mediastinum.



A transverse thoracostomy is done for masses present on both sides of the chest.

Lateral Decubitis Position

Video assisted thoracoscopy

A posterolateral thoracotomy can be done for posterior and middle mediastinal masses.

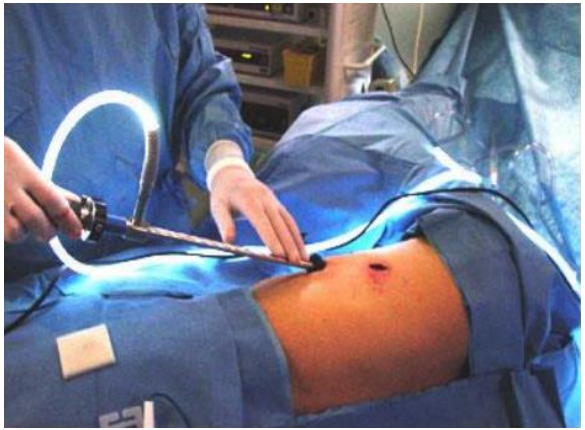
Surgical Lung Infections

Empyema

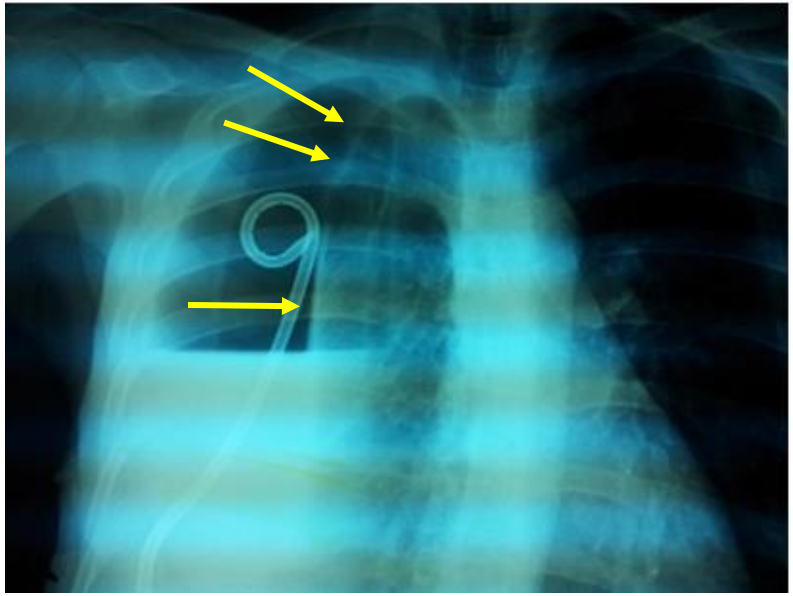
- Empyema is the invasion of the pleural space by bacteria which results in an accumulation of pus.
- Most common cause: Parapneumonic (secondary to pneumonia)
- Clinical Presentation: Pleuritic chest pain, fever, SOB, tachycardia. If a patient has pneumonia and was given antibiotics and does not improve within 7-10 days consider complications such as empyema.

Management:

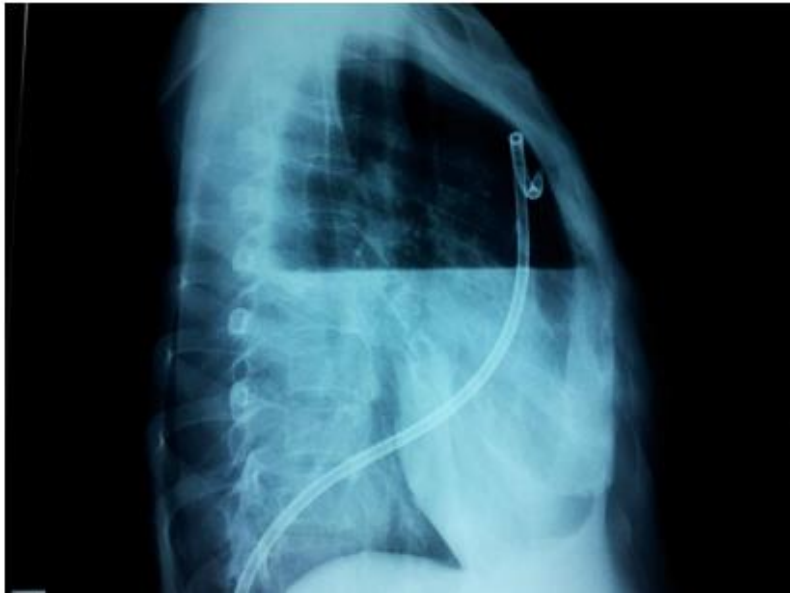
- Antibiotics
- Stage 1: Thoracocentesis, otherwise chest tube drainage
- Obliteration of the empyema cavity
- Surgery: Thoracoscopy or decortication through thoracotomy



Empyema

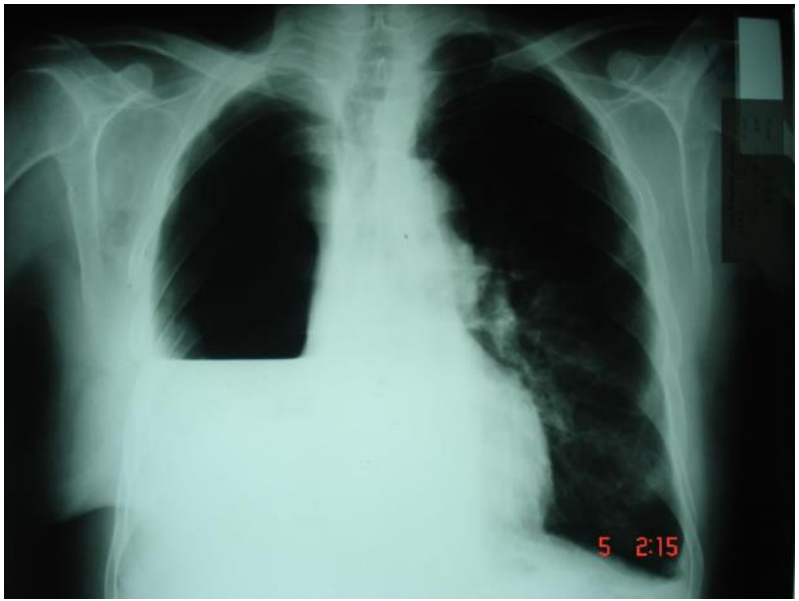


Notice how the yellow arrows indicate the outline of the collapsed lung. Additionally, the pleura is thickened due to inflammation.

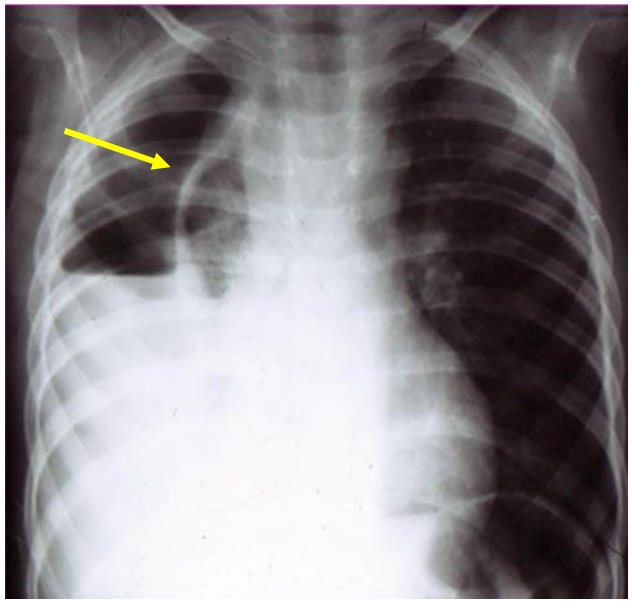


Here, as in the picture of the left, an air fluid level is present. This is typical for empyema.

Empyema

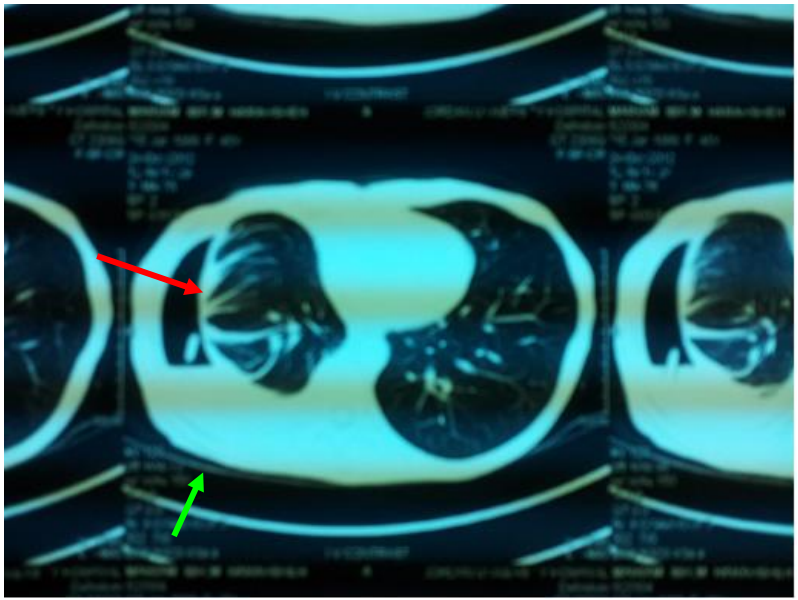


Complete collapse of the right lung and an air fluid level present.

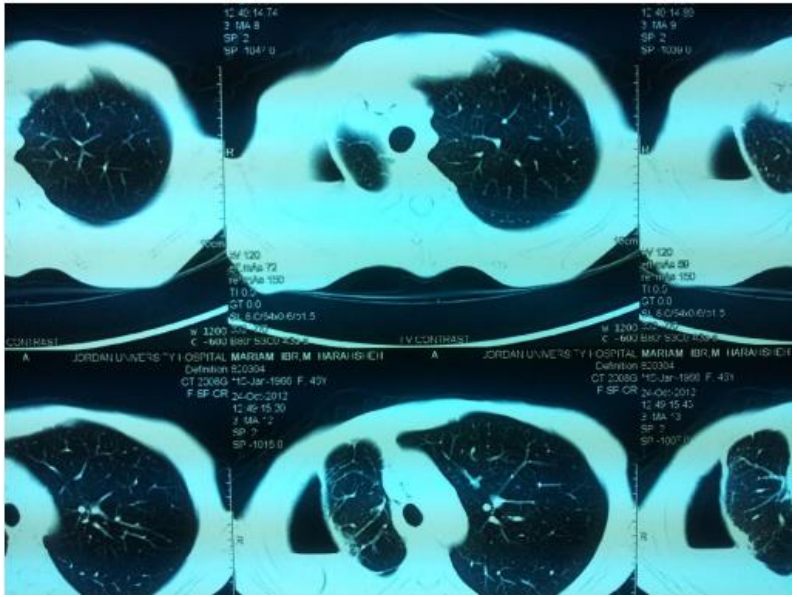


Notice the inflamed, thickened pleura of the collapsed lung.

Empyema - CT



Red Arrow: Collapsed lung and thickened pleural membrane
Green arrow: Notice how the right side inflates less than the left (reduced chest excursion)



The reduced chest excursion is clear here on the infected side.

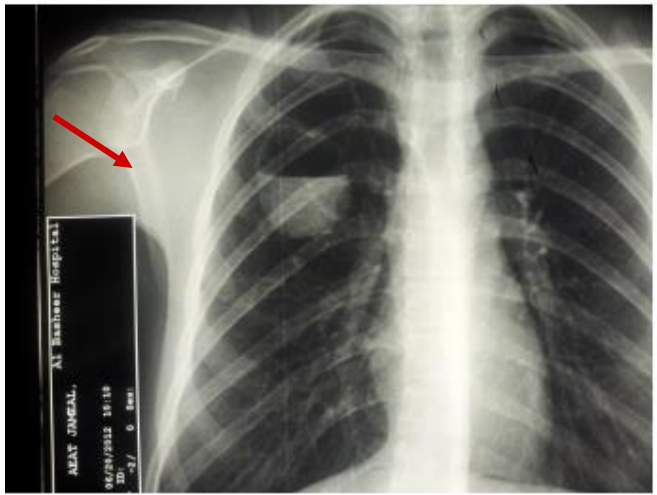
Underwater Seal

This shows the typical pus in empyema. It has thick density and a foul smell.

Lung Abscess

- A lung abscess is a subacute pulmonary infection in which the CXR shows a cavity within the lung parenchyma.
- Symptoms: Fever (intermittent), night sweats, chills, and purulent, foul smelling sputum.
- Signs: Tachypnea, consolidation, and local chest wall tenderness
- Notice the air fluid level enclosed within the lung parenchyma
- Most common cause of primary lung abscess: aspiration (so anything that increases the risk of aspiration, like alcohol abuse or epilepsy is a risk factor)

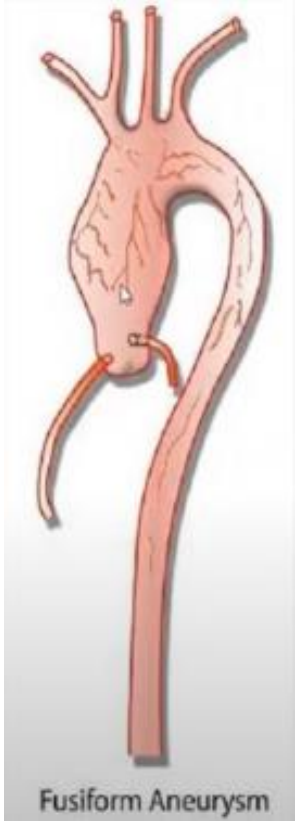
Notice the air fluid level enclosed within the lung parenchyma.

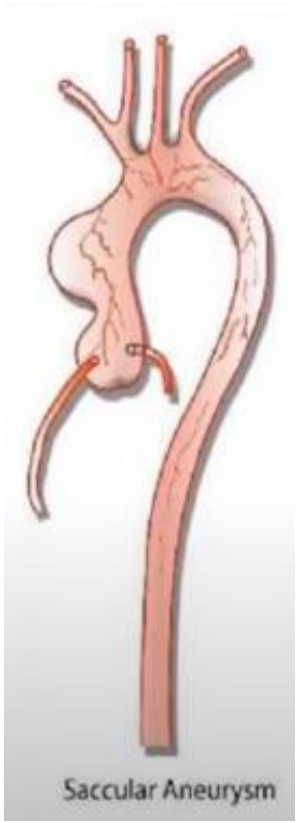


Aortic Aneurysms and Dissections

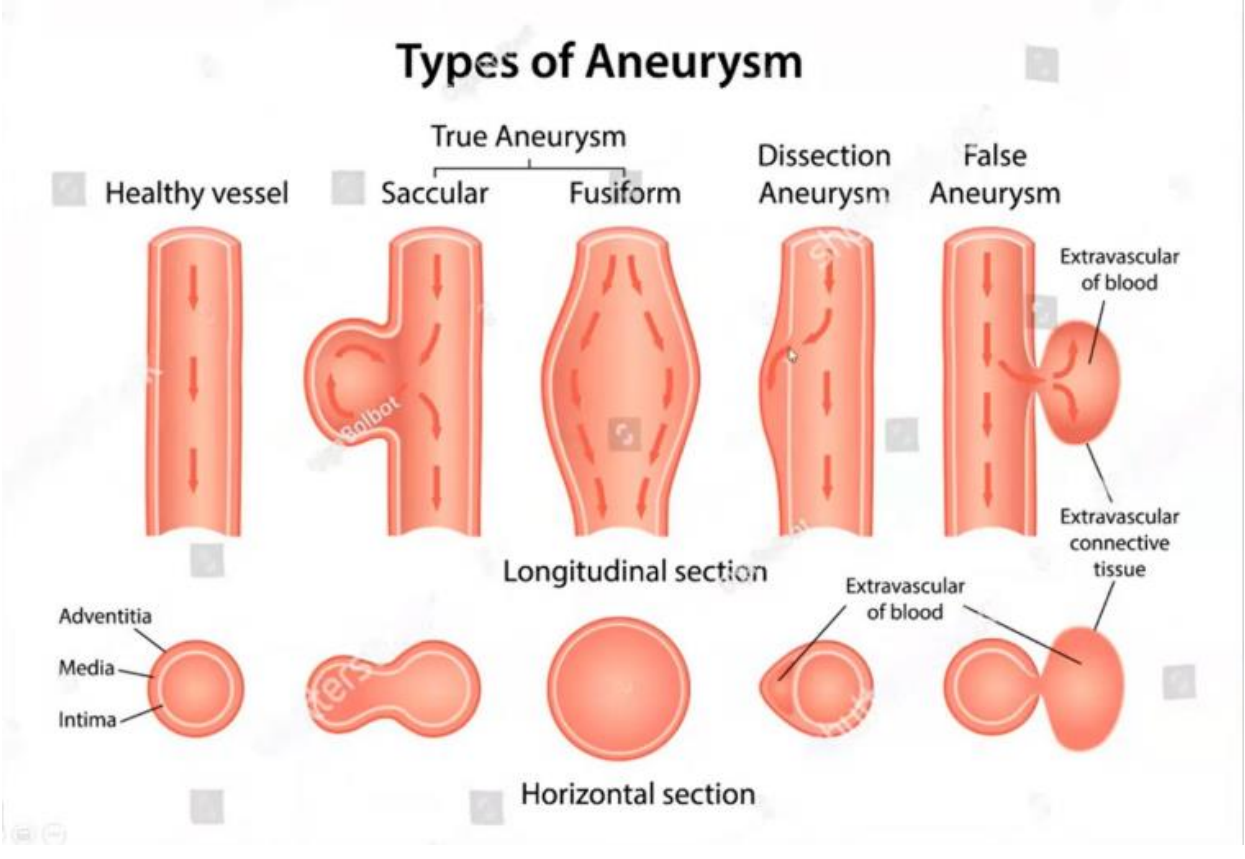
Aortic Aneurysm

- A true aneurysm is enlargement of the inner lumen caused by vessel wall expansion.
- An aortic aneurysm is present when the diameter exceeds 4 cm or exceeds 1.5 times the normal diameter.
- There are two types:
  - Saccular
  - Fusiform





Aortic Aneurysm



Aortic Aneurysm

- Most people with thoracic aortic aneurysms (TAAs) have no symptoms.
- Aneurysms of the aortic root may lead to leakage of the aortic valve, so a murmur may be heard.

Causes of Thoracic Aortic Aneurysm (TAA)

Table 1. Causes of TAA.

Acquired	Degenerative • Age • Hypertension • Smoking Autoimmune (inflammatory) • Takayasu's arteritis • Giant cell arteritis Infectious • Syphilis Traumatic
Genetic	Connective tissue disorders • Marfan syndrome • Loeys–Dietz syndrome • Ehlers–Danlos syndrome Familial TAA syndrome
Congenital	Bicuspid aortic valve

TAA - X-Ray

TAA. This huge aneurysm of the aortic arch and descending thoracic aorta was an incidental finding on this chest radiograph

Chest X-ray (postero-anterior projection) showing that the descending thoracic aorta is extremely dilated and tortuous.

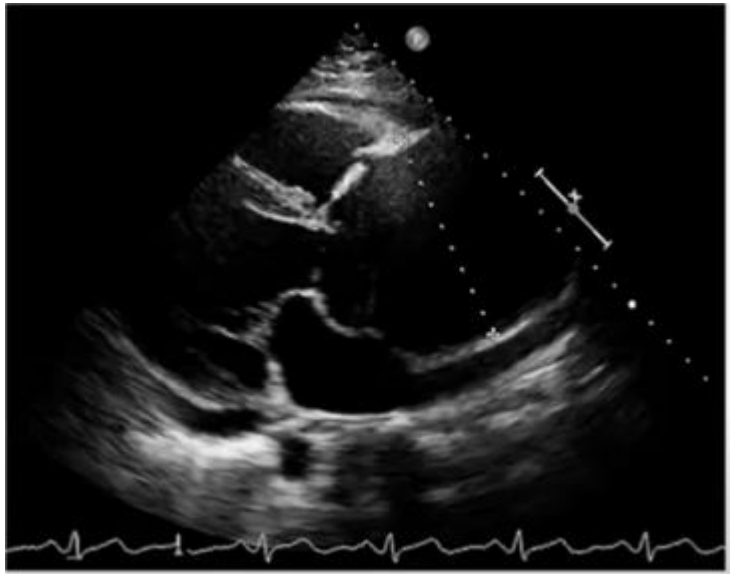
CXR shows widened mediastinum

TAA

- Left: CT - can measure maximal diameter
- MRA is the imaging test of choice for diagnosing and measuring TAAs.

TAA - Echo

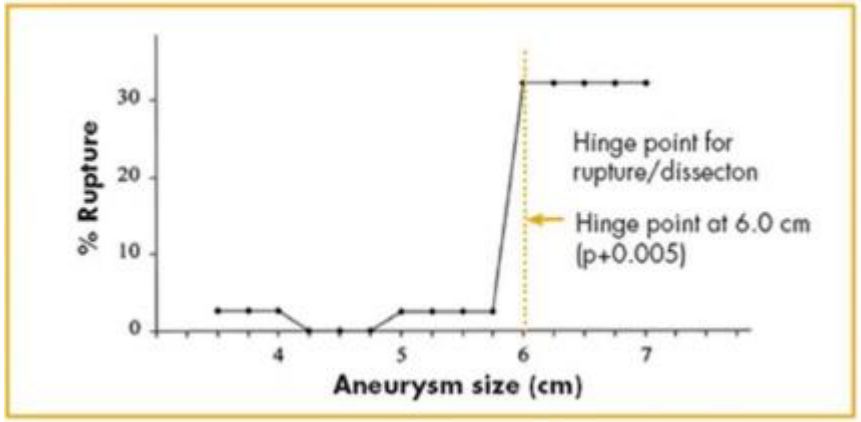
- Notice the dilated lumen of the aorta (dotted line)
- Overall, an echo is useful to look at the aortic root, but it may miss aneurysms farther away from the heart in the ascending aorta and aortic arch.



Risk of Rupture or Dissection

The annual risk of rupture or dissection:

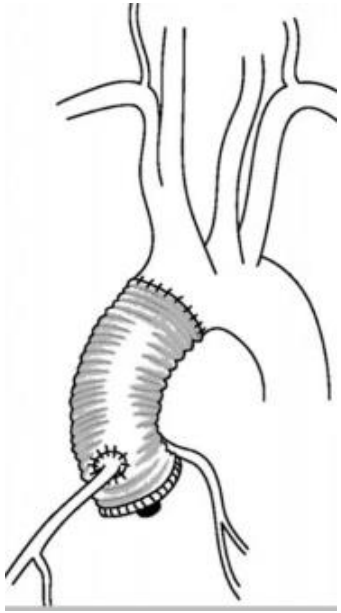
- 2% for TAAs <5 cm in diameter
- 3% for TAAs 5-5.9 cm
- 7% for TAAs >6 cm



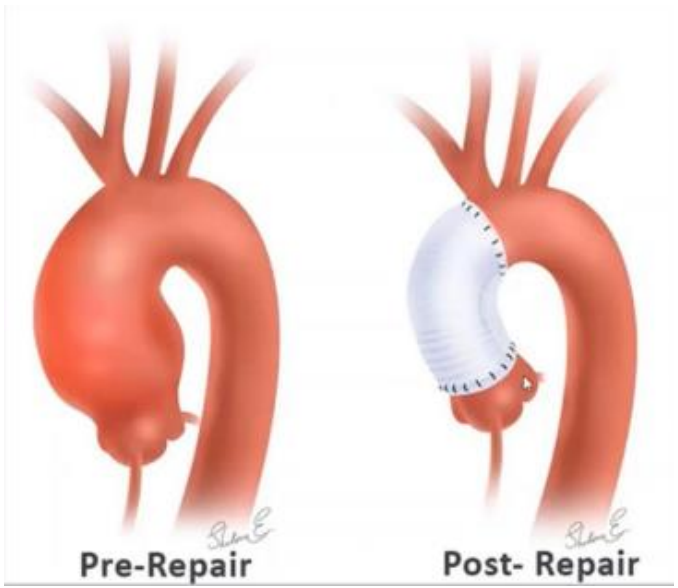
Surgery is recommended for TAAs greater than or equal to 5.5 cm in most cases. For cases like Marfan's syndrome, Loeys-Dietz syndrome, and bicuspid aortic valve, the threshold is lower.

Notice in the graph at the hinge point the risk of rupture increases greatly.

Aneurysm - Surgical Treatment

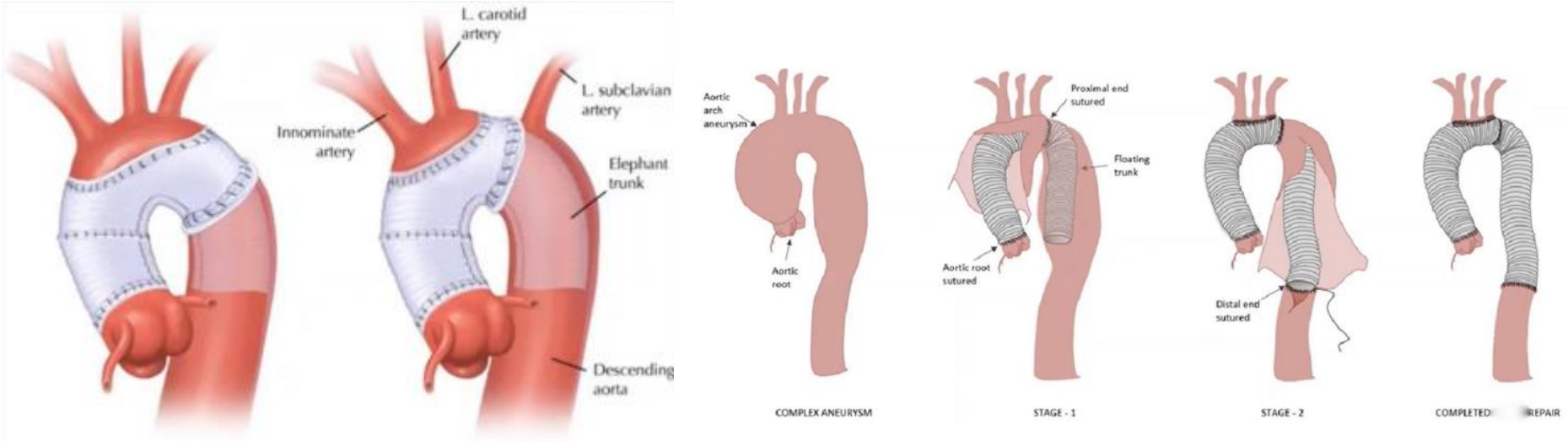


Composite valve and graft replacement



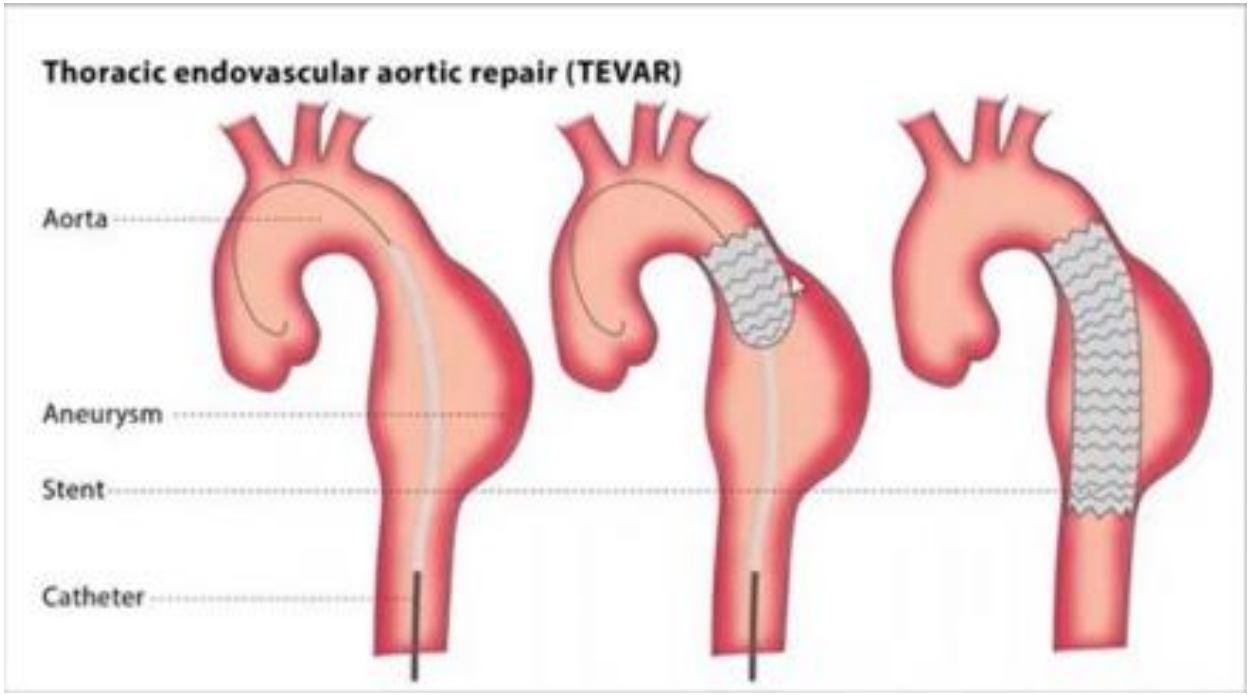
Supracoronary replacement was done. Here, the root of the coronary artery is left alone.

Aneurysm - Surgical Treatment



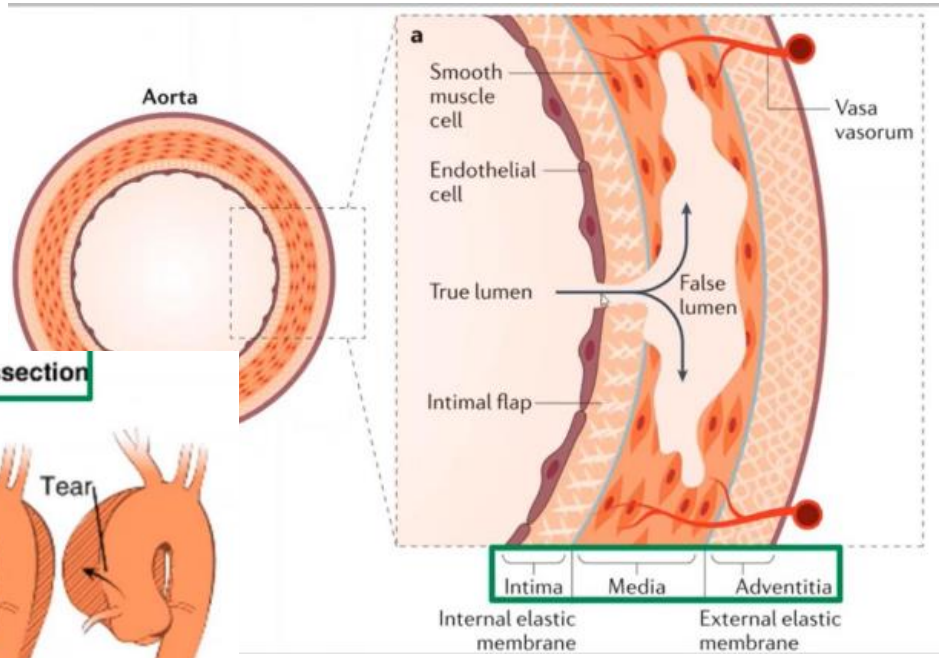
The elephant trunk procedure is done for complex aneurysms (involving the ascending aorta/aortic arch and descending aorta). The ascending aorta/arch is repaired through a sternotomy and excess graft material (the “elephant trunk”) is placed in the descending aorta. In the second stage, the graft can be reached through a left thoracotomy to repair the descending aorta.

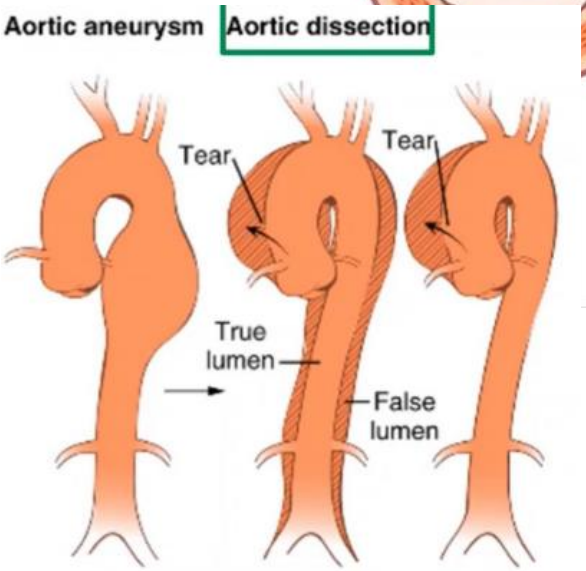
Aneurysm - Surgical Treatment



Aortic Dissection

- Aortic dissection is a tear in the wall of the aorta.
- The tear involves the inner and middle layers of the aortic wall with propagation of a false lumen within the middle layer.
- Immediate death following a short period of symptoms, or no symptoms, occurs in an overwhelmingly high percentage of patients (some reports as high as 40%).





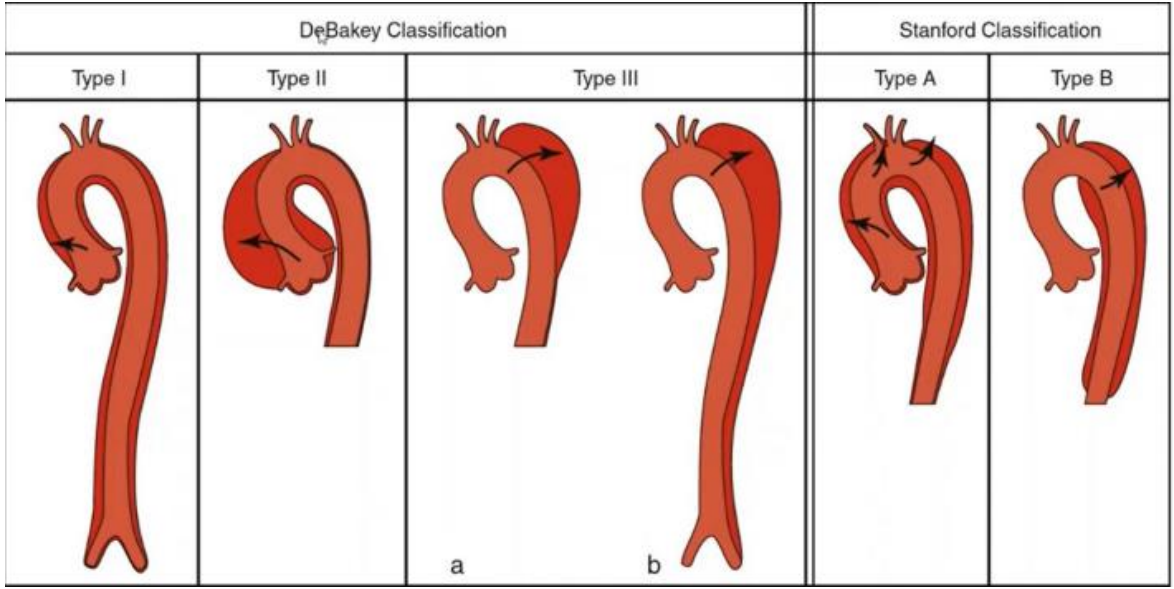
Classification - Aortic Dissection

Stanford Classification:

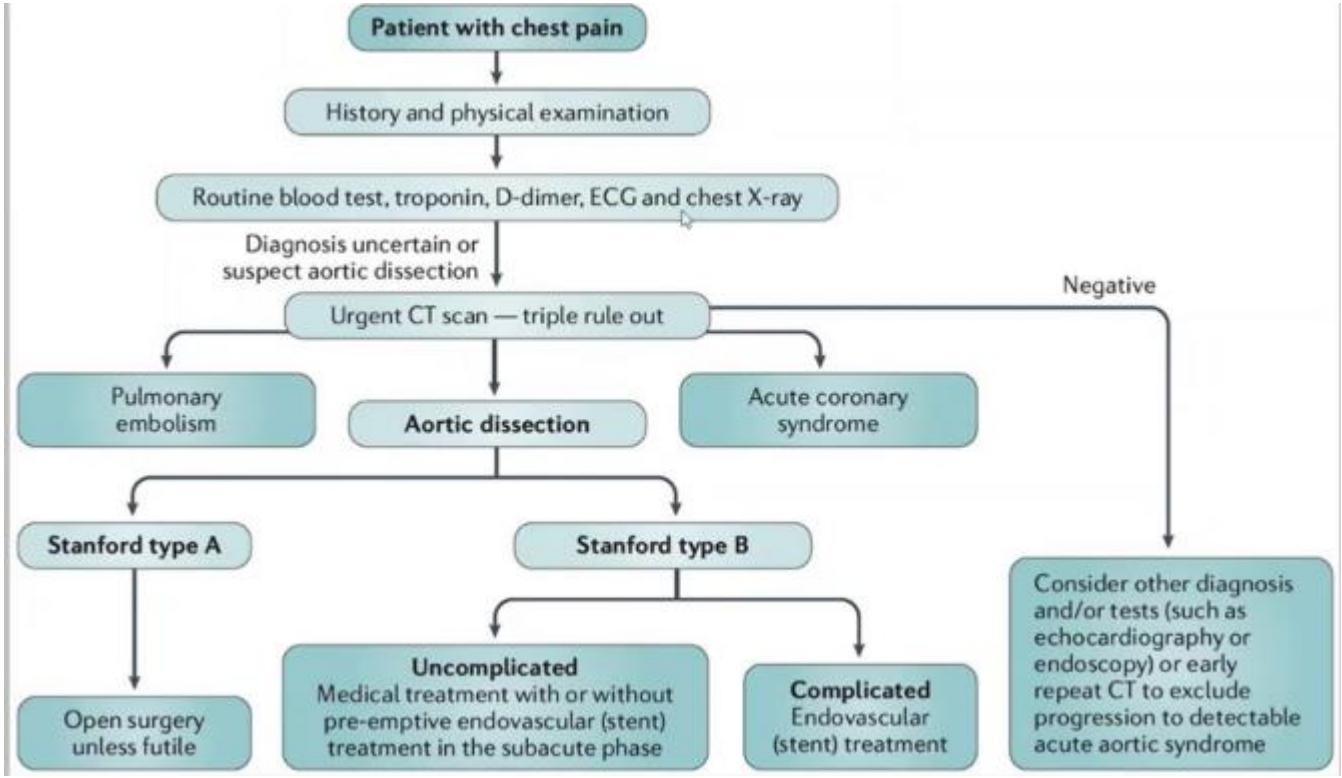
- Type A: Ascending aorta involved
- Type B: All other dissections

DeBakey Classification:

- Type I: All of the aorta
- Type II: Ascending aorta only
- Type III: Descending aorta only

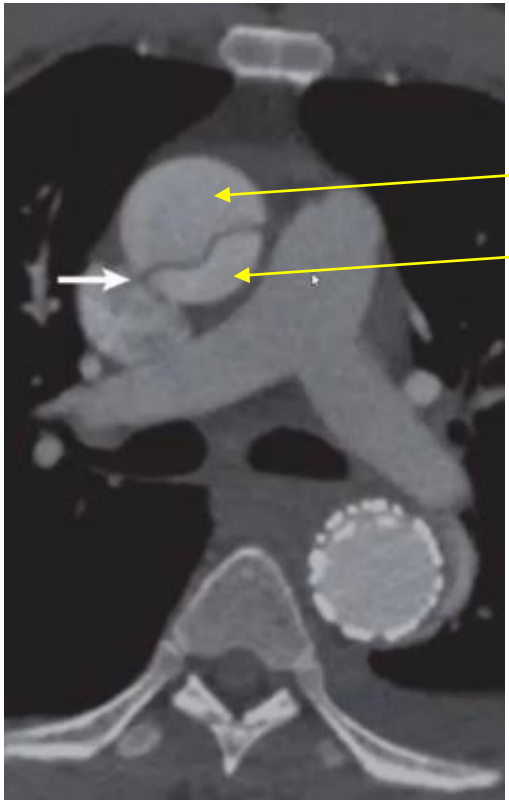


Aortic Dissection



Aortic Dissection - Imaging

The white arrow shows the flap



One of the lumens (yellow arrows) is the true lumen and the other is the false lumen.

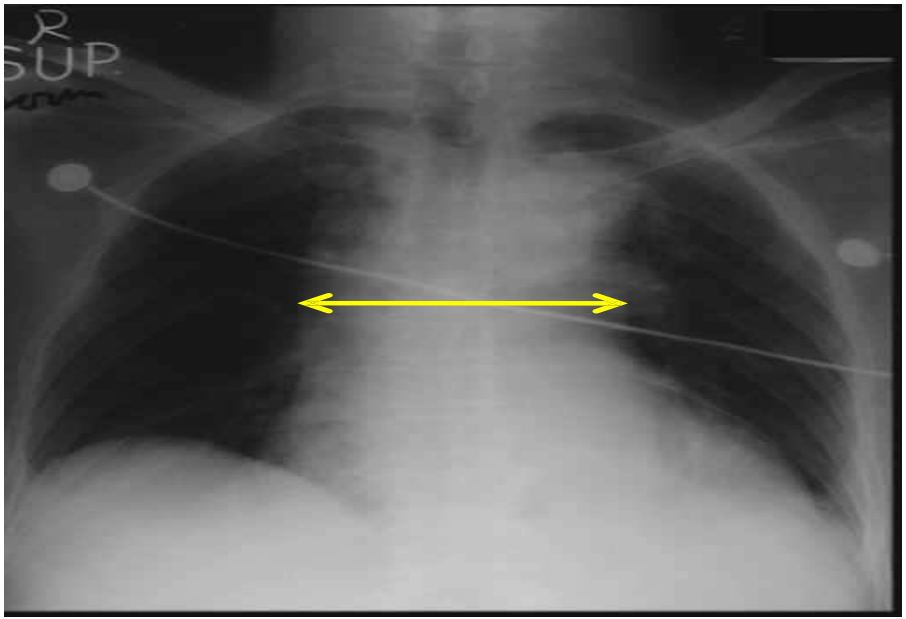
Aortic Dissection

- Double-barrel aorta.
- X-ray findings :

-Widened mediastinum.

- Pleural effusion.

- Aortography : definitive gold standard but time consuming.
- ttt : Stanford type A (surgical)/ Stanford type B (medical 'control BP' unless complicated by rupture or significant occlusions).



Vascular Injuries

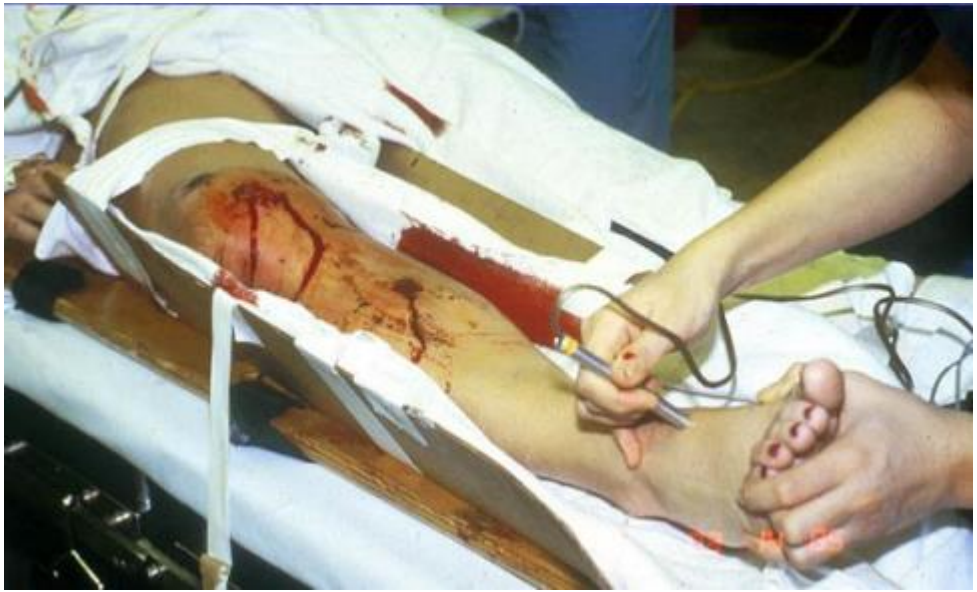
Hard and Soft Signs of Vascular Injury

Hard signs	Soft signs
Active arterial (pulsatile) bleeding	Minor bleeding
Pulseless/ ischemia	Injury in proximity to major vessel
Expanding pulsatile hematoma	Small to moderate size hematoma
Bruit or thrill	Associated nerve injury
	ABI < 0.9
Operation Mandatory	***Further W/U***

If any hard signs are present the patient needs urgent surgery with no need for further investigations.

Doppler U/S

- Determines the presence or absence of arterial supply.
- Presence of signal does not exclude arterial injury as there may be collaterals present. (check ABPI)



Duplex U/S

- Provides signal (like doppler) + image
- More accurate than doppler

CT Angiography

- Diagnostic study of choice
- Indications:
  - Hemodynamic stability
  - Uncertain diagnosis (soft signs, PVD)
  - Unclear location (multiple wounds, fractures, gunshot wounds)

CT Angiography

Figure 3. Upper-extremity arteriogram after gunshot wound to the arm with fracture of radius and cutoff of radial artery just below the bifurcation of the brachial artery.

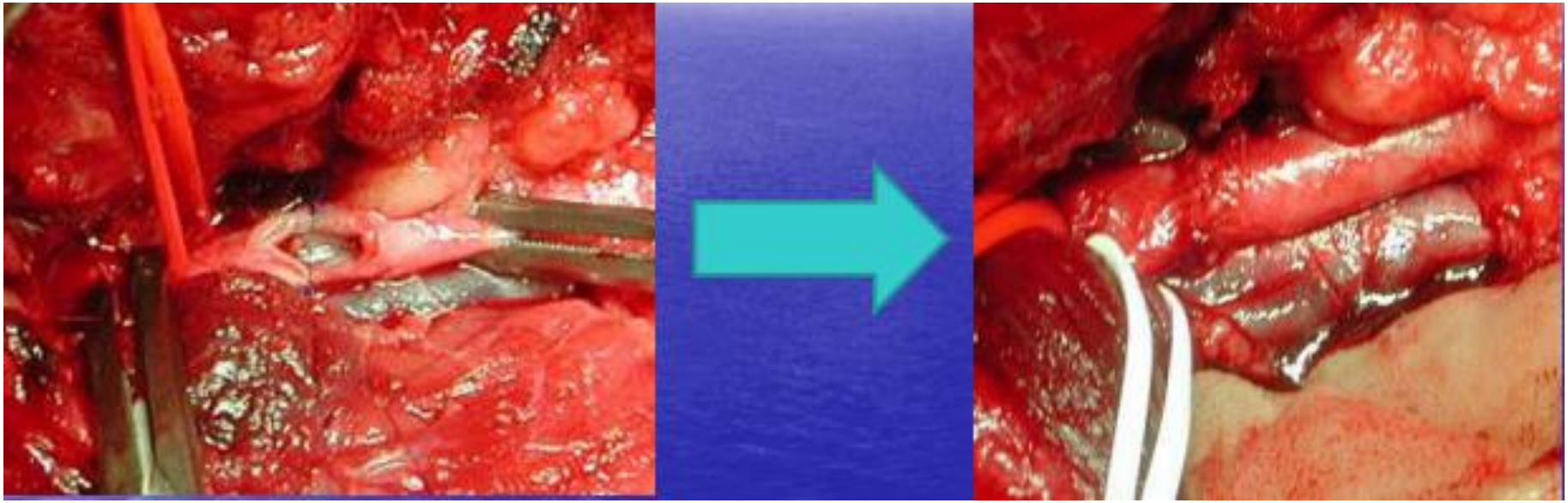
Notice the cutoff of the radial artery

Hematoma in the left subclavian artery

Immediate Treatment of Vascular Injury

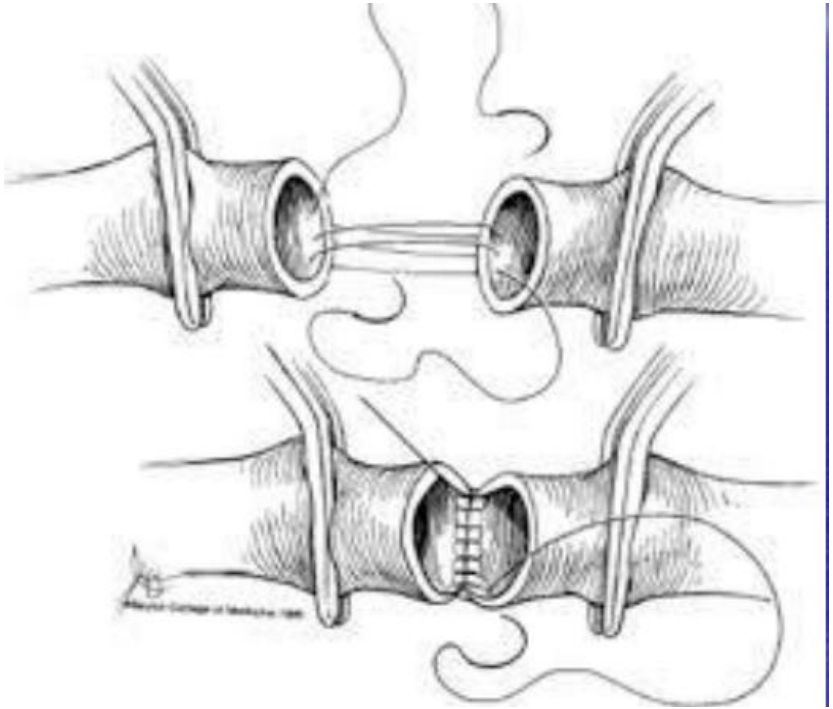
- Control bleeding (compression)
- Replace volume loss
- Cover wounds
- Reduce fractures/dislocations
- Splint

Arterial Repair - Tension Free Primary Repair



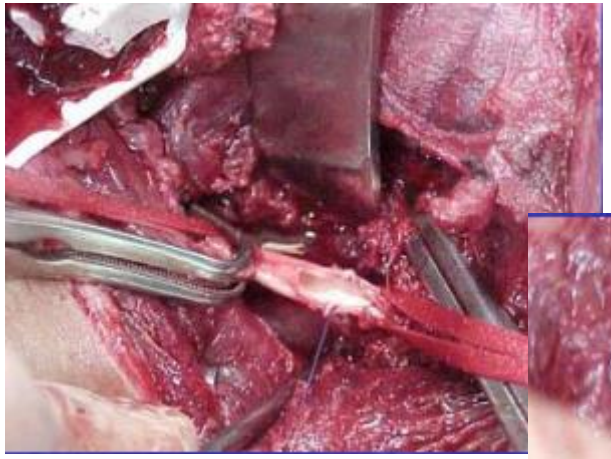
Suture repair can be done for defects less than 1-2 cm

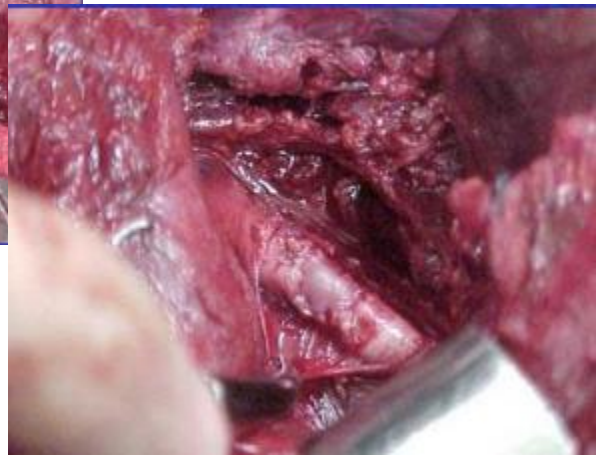
Direct Arterial Repair



End to end anastomosis of the artery by suturing if the injury is small.

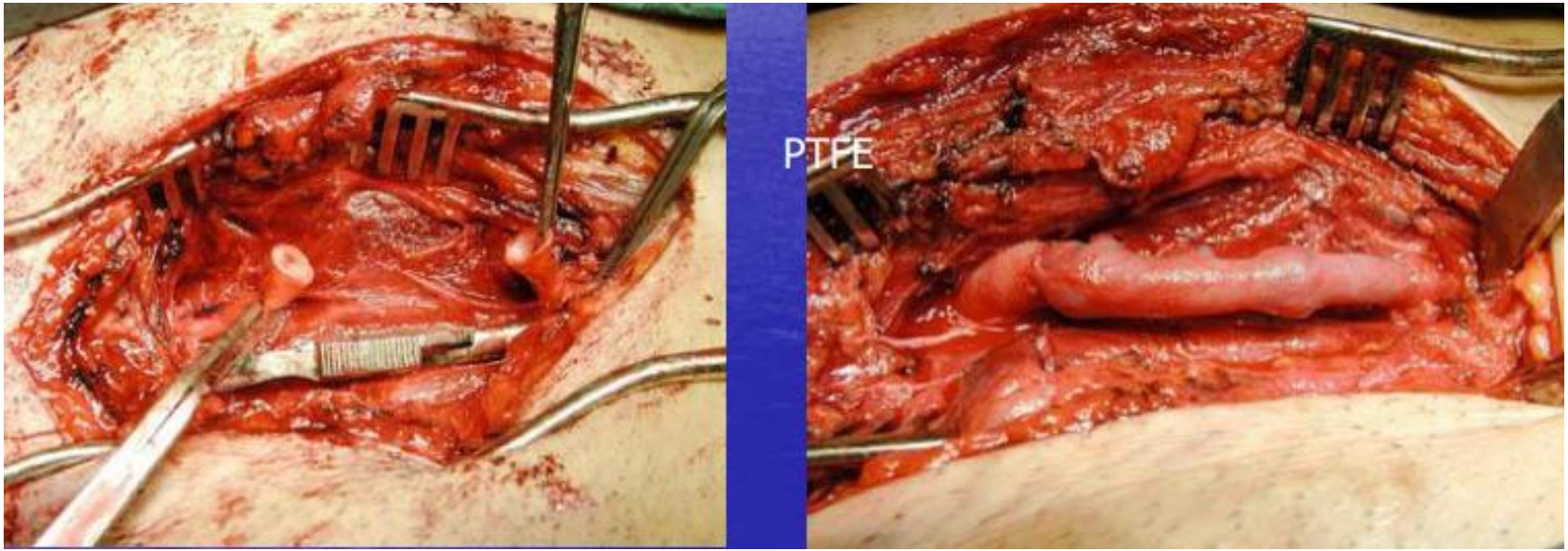
Vein Patch Angioplasty





Knee dislocation can cause popliteal artery injury. Here, the anterior wall of the artery was injured and then repaired by using the saphenous vein to create a patch.

Interposition Graft Repair



For loss of more than 2 cm of an artery, a portion of a vein or synthetic material can be used as a graft. In this case, an interposition autogenous saphenous vein graft was done.

Mangled Injury

A mangled extremity injury involves at least 3 of the 4:

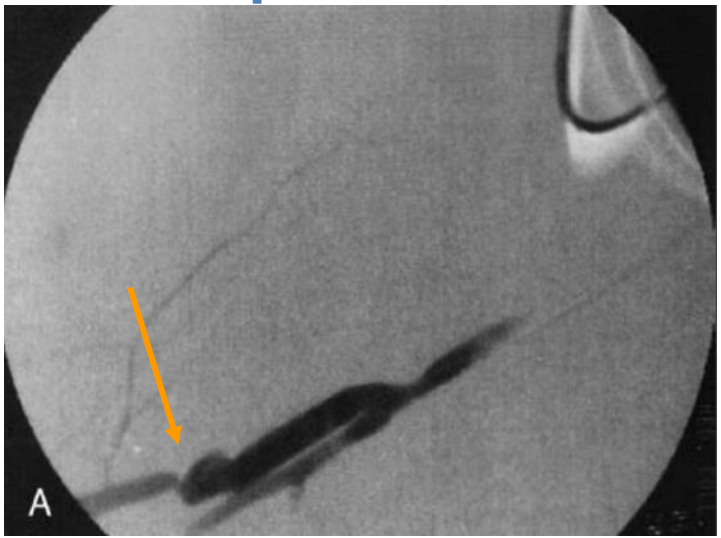
- Bone
- Soft tissue
- Vessels
- Nerves

No vascular intervention can be done, it must be amputated.

Mangled Upper Extremity

Crush to lower leg

Complication of Management - Thrombosis



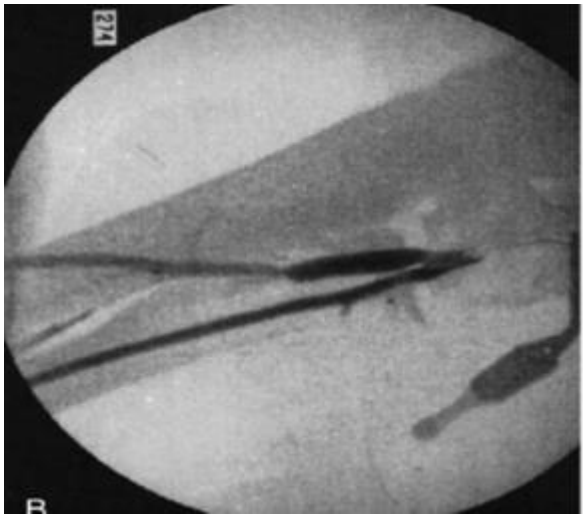


Figure 4. *A*, Completion angiogram after brachial ulnar interposition vein graft. Note the kink in the distal end of the graft secondary to redundancy. *B*, Completion angiogram after revision of the distal anastomosis showing smooth emptying of graft with good runoff by way of the ulnar artery.

The graft used to repair the brachial artery was too long, twisting occurred and thrombosis of the graft happened.

Complication of Management - Stenosis

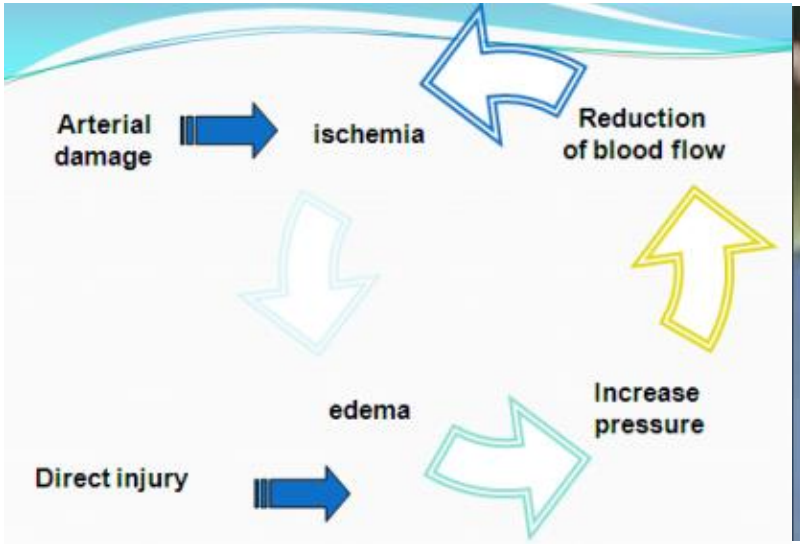
An interposition graft was placed at the junction between the brachial and axillary artery.

As seen, there's tight stenosis. This is often due to tight suture repair.

Figure 12. Arteriogram demonstrating severe stenosis of the proximal anastomosis of an autogenous saphenous vein graft at the right brachial-axillary artery junction which was performed in Vietnam. Although prominent collateral circulation existed between the humeral circumflex and deep brachial arteries, the patient developed discomfort with repetitive motion of his right hand (see Figs. 13 and 14). (*From* Rich NM, Baugh JH, Hughes CW. Significance of complications associated with vascular repairs performed in Vietnam. Arch Surg 100:646–651, 1970; with permission.)

Compartment Syndrome

Compartment syndrome occurs when the muscle swells within the osteofascial compartment. The compartment pressure then exceeds capillary pressure, leading to ischemia. Signs are the same as the 6 P's of acute limb ischemia (with increased pressure)



Fasciotomy

Fasciotomy to fully decompress all involved compartments is the definitive treatment for acute compartment syndrome in the great majority of cases.

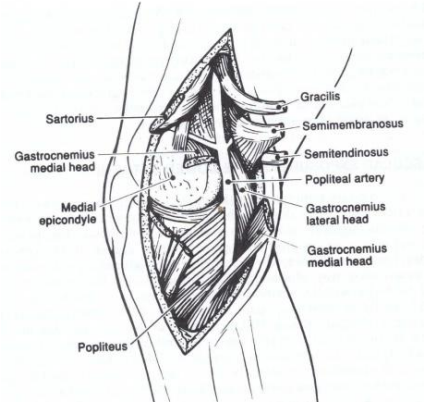
Femoral Artery Repair

The femoral artery is the most commonly injured artery, with most injuries resulting from gunshot wounds.

The left picture shows repair using a synthetic interposition graft while the right uses an autogenous graft with the saphenous vein. Using the saphenous vein is preferable to a synthetic graft because the patency rate is better and the infection rate is less.

Popliteal Artery Repair

- Blunt injury accounts for 20-75% of all cases (such as someone falling off a motorcycle/bike and dislocating their knee).
- Venous grafts have better patency rates than synthetic grafts (flexion/extension damages the graft).



A: Bruises and abrasions on posterior fossa
B: Posterior knee dislocation
C: Angiogram shows complete occlusion of the popliteal artery

Shank Vessels (distal vessels) Repair

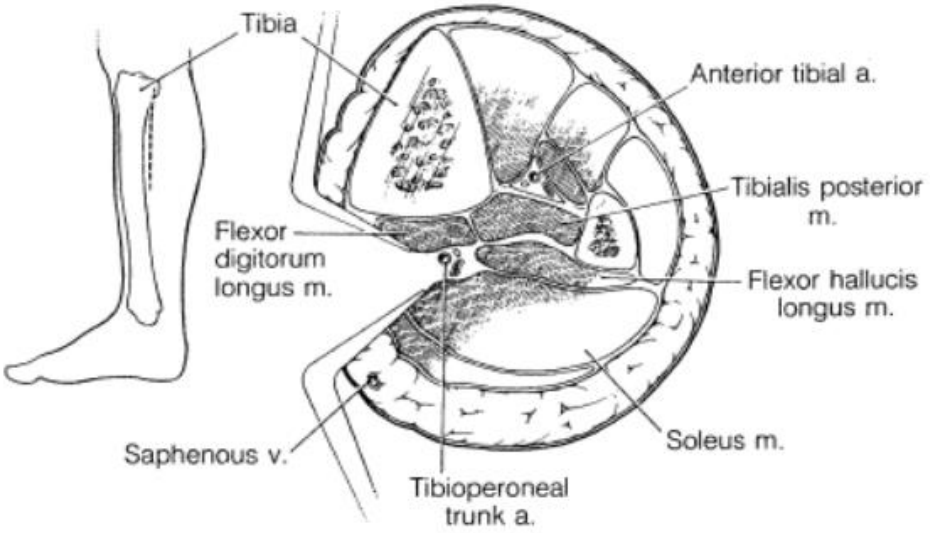


Figure 1. Operative exposure: Tibioperoneal trunk.

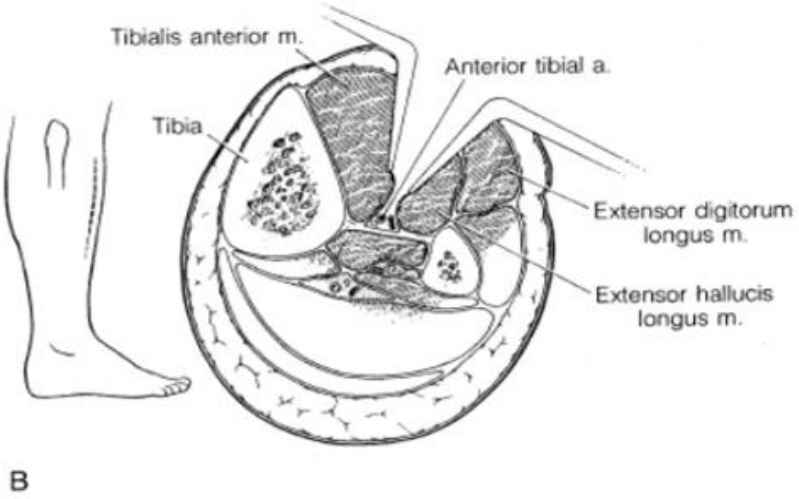
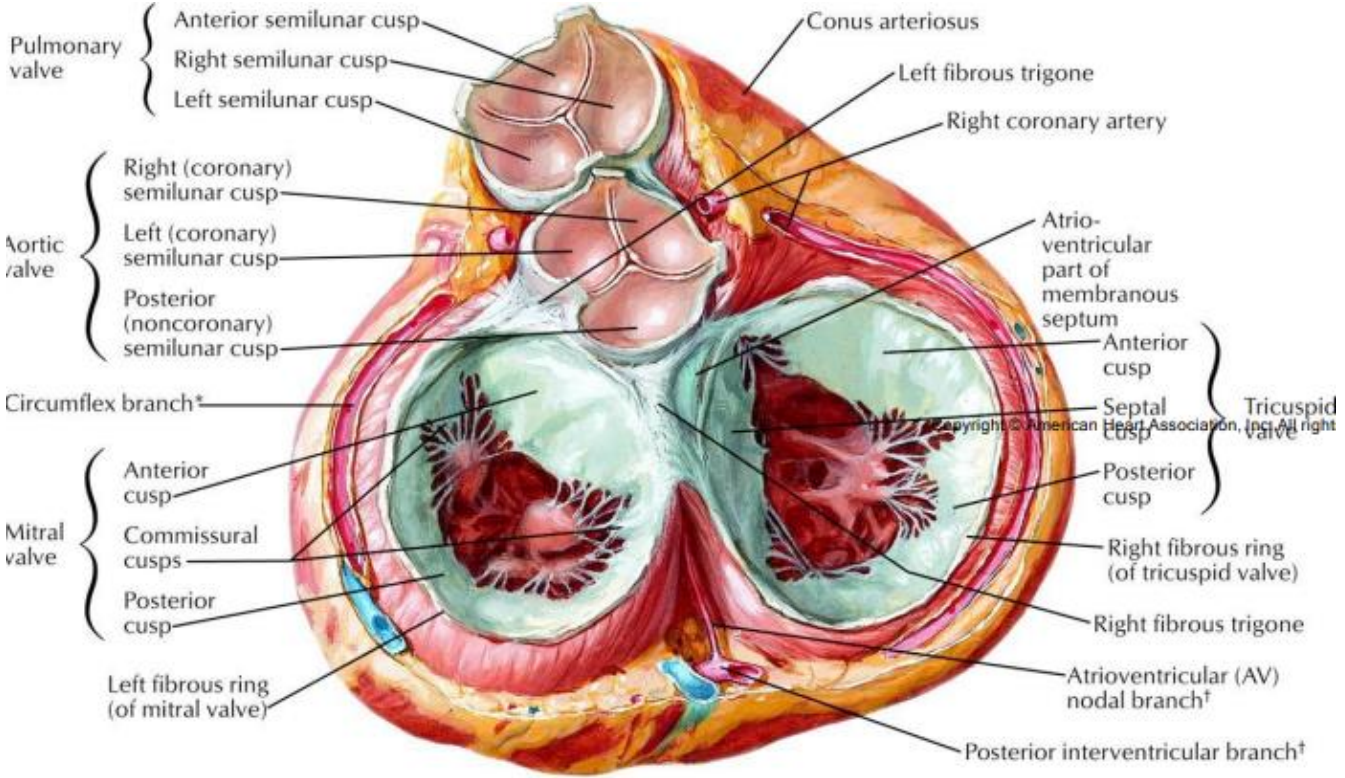


Figure 3. Operative exposures: (Lateral) Shank arteries mid-leg *(A)*, anterior tibial arte
(B).

The images show the area of incision and operative exposure required to reach the posterior tibial or peroneal artery (left) and anterior tibial artery (right)

Valvular Heart Disease

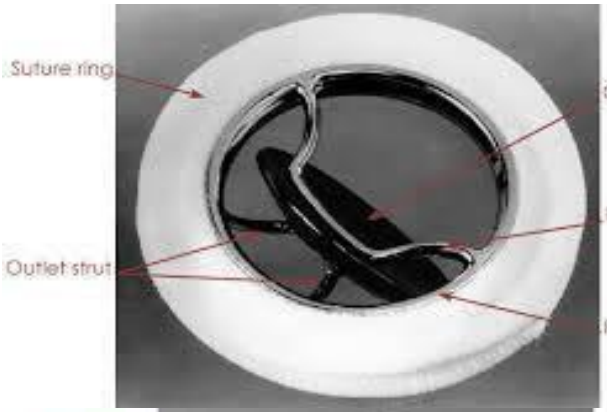
Heart Valves

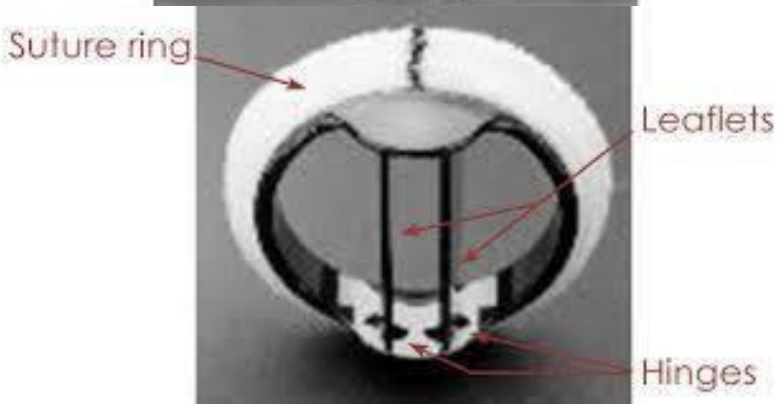


Heart in diastole:
viewed from base with atria removed

Mechanical Prosthetic Valves

Used if the age is < 65 + long life expectancy. Can last for many decades but requires lifelong anticoagulation

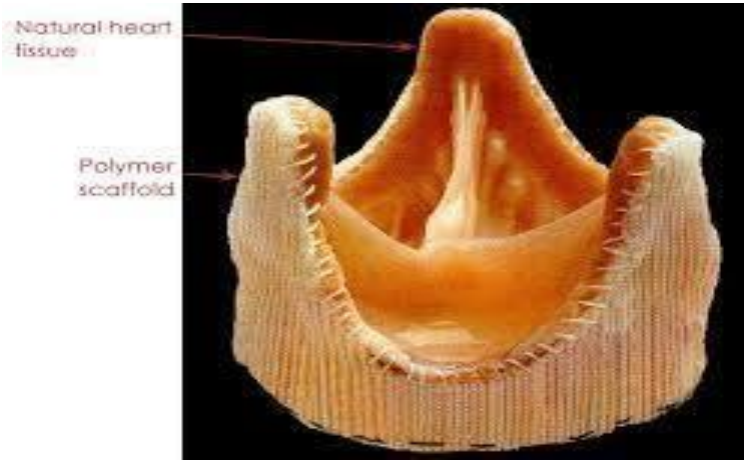




Biological Heart Valves

Used in the following cases:

- Age > 65
- Limited life expectancy (<10 years)
- If coagulation is contraindicated.
- Young women wishing to get pregnant.



Animal tissue valve

Aortic Stenosis

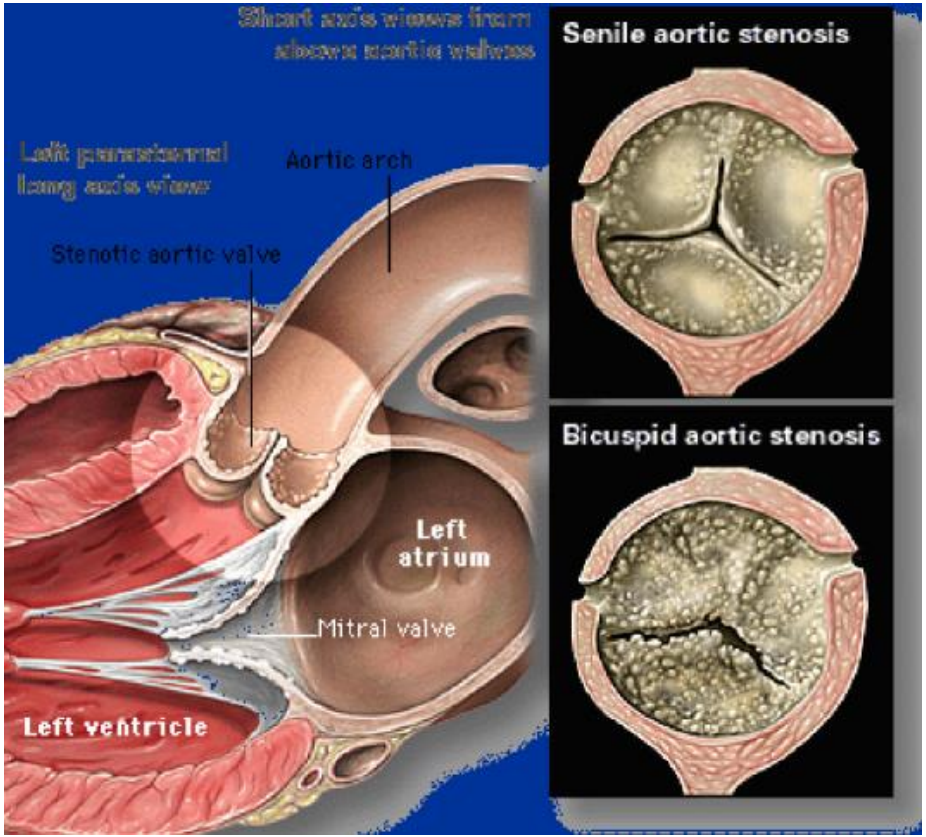
Etiology: Congenital (ex: bicuspid valve) or acquired (rheumatic heart disease, senile degeneration)

Symptoms:

- Exertional dyspnea (due to outflow obstruction, limiting CO increase)
- Angina
- Pul. edema
- Exertional syncope
- Sudden death

Signs of AS:

- Ejection systolic murmur
- Slow rising carotid pulse
- Reduced pulse pressure

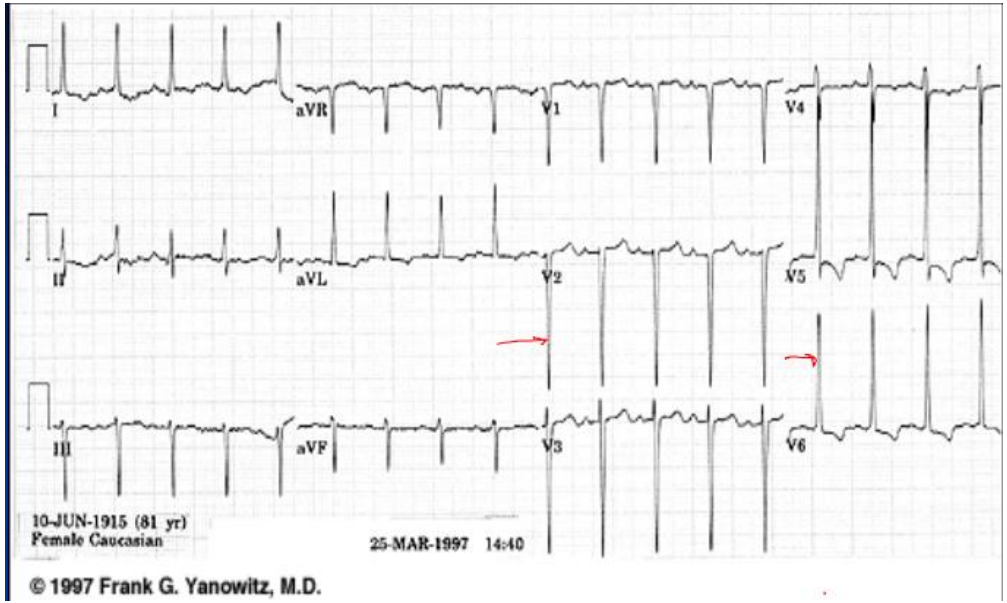


Aortic Stenosis

Calcified tricuspid valve

Calcified bicuspid valve

Aortic Stenosis



- LV hypertrophy (notice the large S in V2, large R in V6)
- LVH is accompanied by strain (slightly wide QRS in some leads)

CXR shows dilated ascending aorta and normal heart size (may dilate at later stages though).

Aortic Stenosis

Aortic valve area (cm2)	Mean gradient(mmhg)	severity
>1.5	<25	mild
1-1.5	25-45	moderate
<1	>45	severe
<0.7	>70	critical

Above is the ECHO criteria for the assessment of aortic stenosis. Surgical replacement is indicated for severe AS.

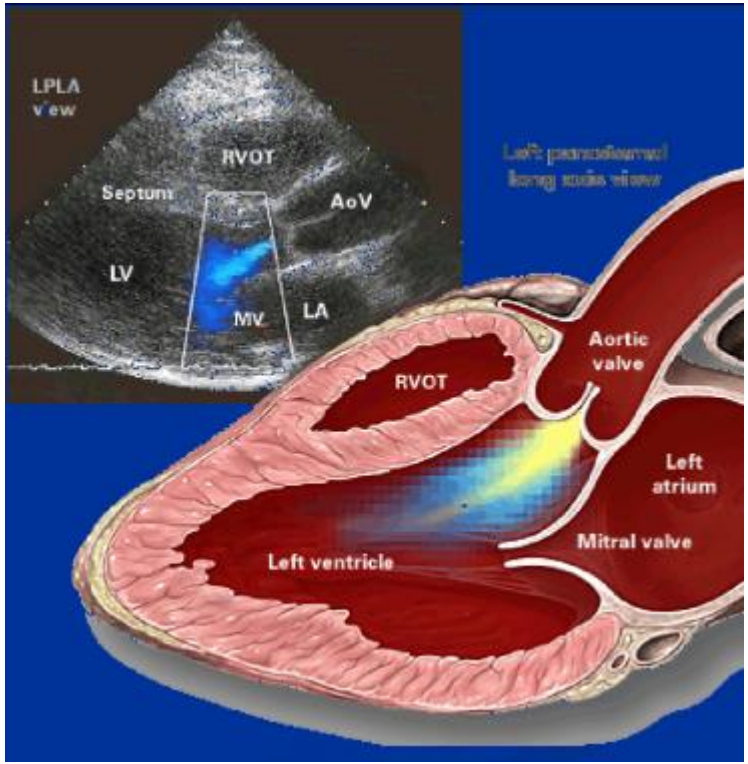
Aortic Regurgitation

Etiology

- Congenital - Bicuspid valve or disproportionate cusps
- Acquired
  - Rheumatic Disease
  - Infective endocarditis
  - Trauma
  - Aortic dilatation (Marfan's, atheroma, ankylosing spondylitis)

Pathophysiology

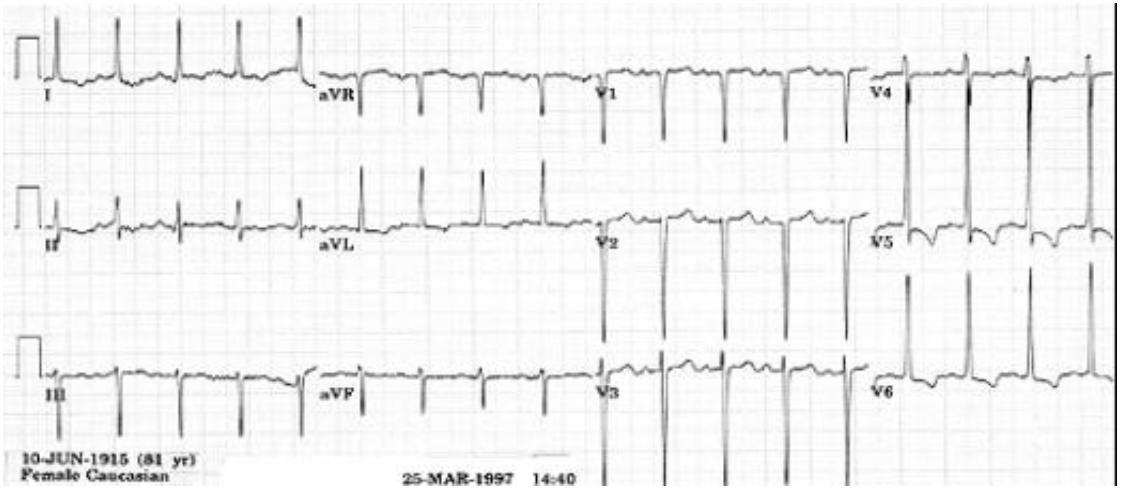
- LV dilatation and hypertrophy
- Stroke output doubled or tripled
- Acute AR: Pressure rapidly increases and LV can't adapt so the pressure is transmitted to the LA and pul. vasculature leading to pul. edema and congestion



Aortic Regurgitation

Symptoms

- Mild Regurgitation
  - Asymptomatic
  - Palpitations
- Severe Regurgitation
  - Symptoms of HF
  - Angina



Signs

- Large volume or ‘collapsing’ pulse
- Bounding peripheral pulses
- Early diastolic murmur
- Systolic murmur of increased stroke volume

ECG: LV hypertrophy (notice the large S in V2, large R in V6), left atrial enlargement and left axis deviation.

Aortic Regurgitation

CXR

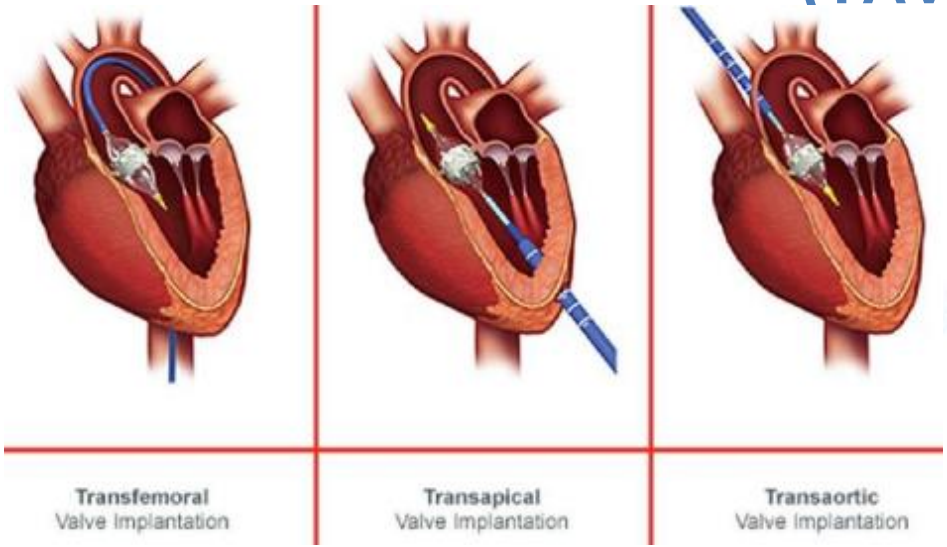
- Enlarged thoracic aorta
- Cardiomegaly

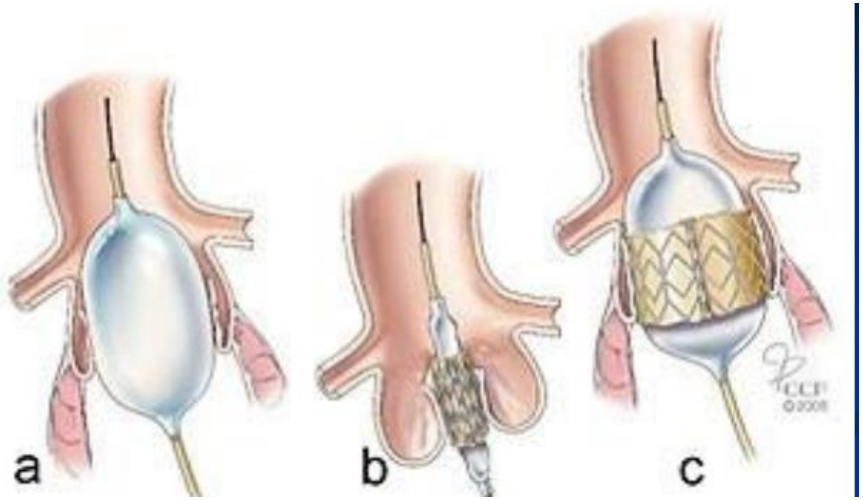
Medical Treatment: Vasodilator therapy for asymptomatic patients with chronic severe AR and dilated but normal LV function (according to IM: therapy is not needed if there is no systemic HTN)

Indications for Surgery (AVR):

- Symptomatic AR
- Evidence of LV systolic dysfunction (EF <0.50)
- Severe LV dilatation

Transcatheter Aortic Valve Intervention (TAVI)





- Percutaneous valve replacement
- Reasonable alternative to surgical AVR in patients at high surgical risk

Mitral Stenosis

Etiology: The most common cause of acquired MS is rheumatic heart disease.

Pathophysiology and Symptoms

- Increased LA pressure leads to LA dilatation and pulmonary HTN
- Severe MS results in decreased cardiac output
- Progressive dyspnea
- Hemoptysis (due to rupture of vessels due to pul HTN)
- Right heart failure symptoms due to pul HTN

Signs

- Atrial arrhythmias including A. fib (due to LA dilatation)
- Loud 1st heart sound, opening snap, mid diastolic murmur
- Signs of raised pulmonary capillary pressure (crepitations, pul. edema, effusions)

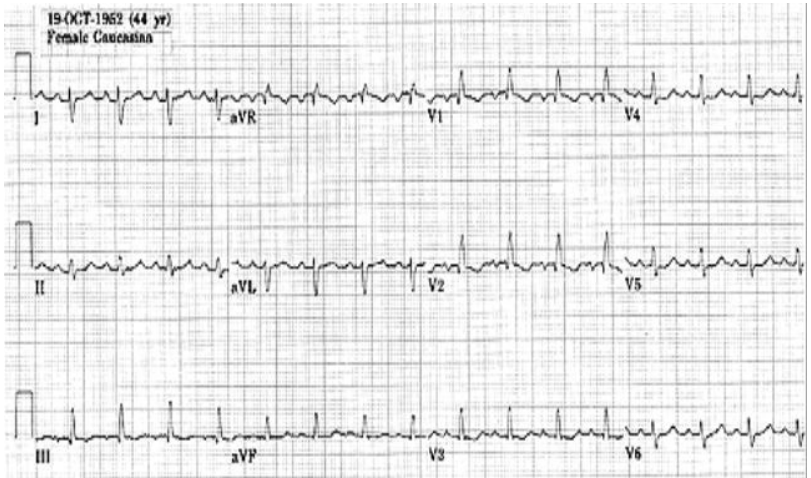
Mitral Stenosis

A calcified valve leads to decreased surface area of the mitral valve opening.

Fish mouth appearance characteristic of rheumatic heart disease

Mitral Stenosis

ECG findings
Left atrial enlargement is illustrated by increased P wave duration in lead II



RV hypertrophy with RV strain

Mitral Stenosis

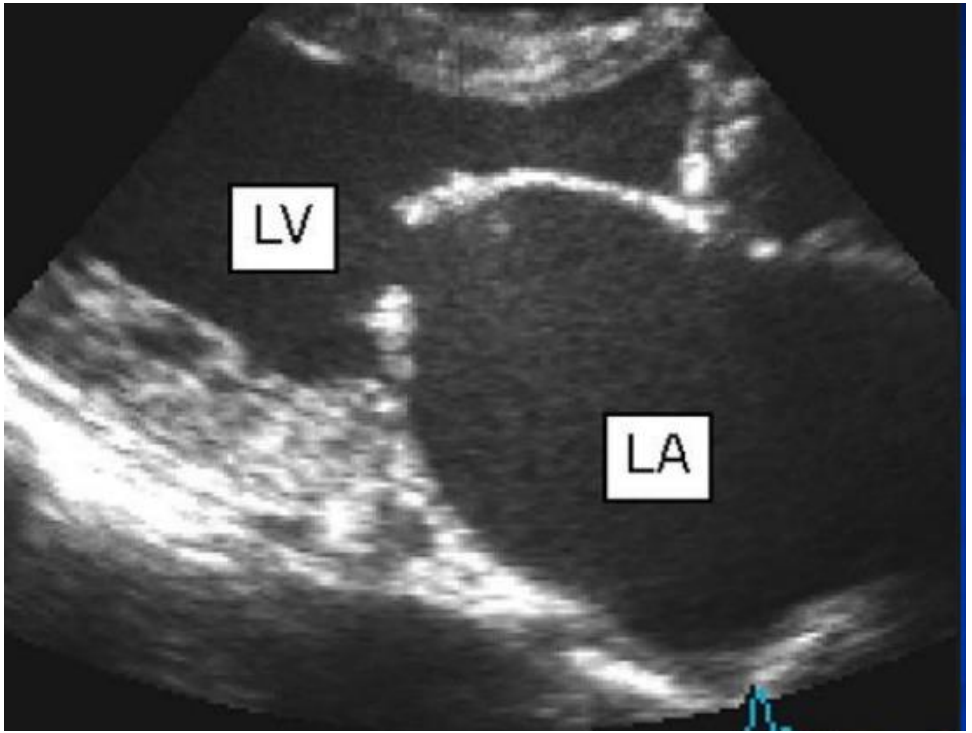
CXR

- Pulmonary HTN
- Mild cardiomegaly
- Enlargement of the left atrium (arrow) and pulmonary artery.
- Enlargement of the left atrium causes straightening of the left heart border. (the dip between the aortic knob and LV is lost)

Mitral Stenosis

ECHO

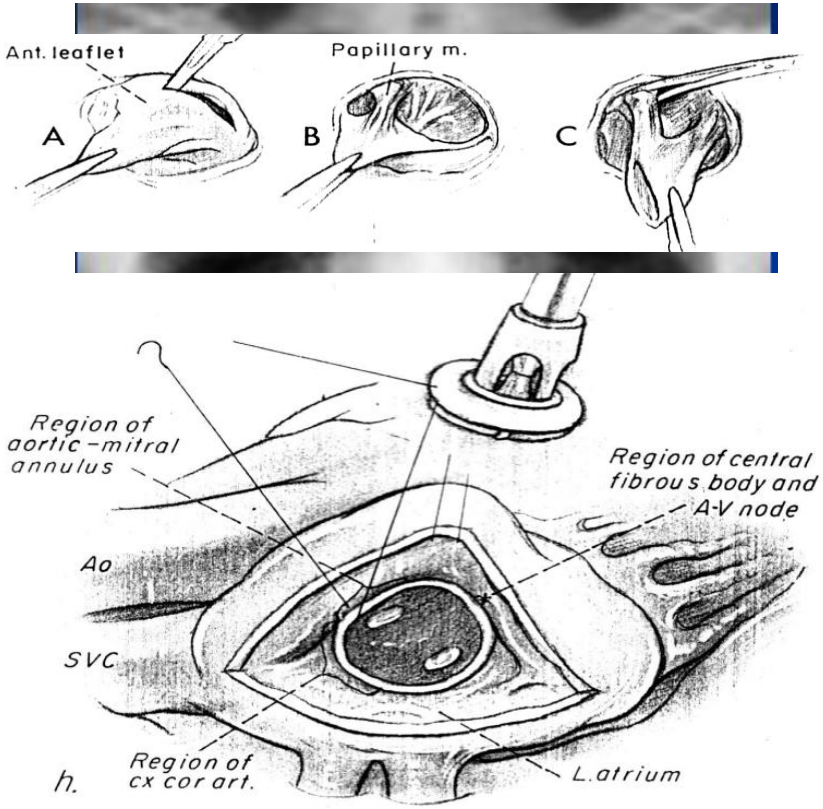
- Thickened immobile cusps
- Reduced valve surface area
- LA dilatation
- Reduced rate of diastolic filling



Mitral Stenosis

Treatment

- Medical
  - Diuretics may be of benefit for patients with signs or symptoms of HF
  - Treatment of tachyarrhythmias (ex: ablation of atrial fibrillation or flutter circuits)
- Percutaneous mitral balloon valvuloplasty
  - Indications similar to those for surgery
- Surgery
  - Mitral valvotomy and valve replacement
  - Fused chordae tendineae and papillary muscles can be divided to relieve subvalvular stenosis
  - Indications:
    - Symptomatic MS not responding to treatment, especially if there are peripheral emboli.
    - Mitral valve area less than 1 cm^2.



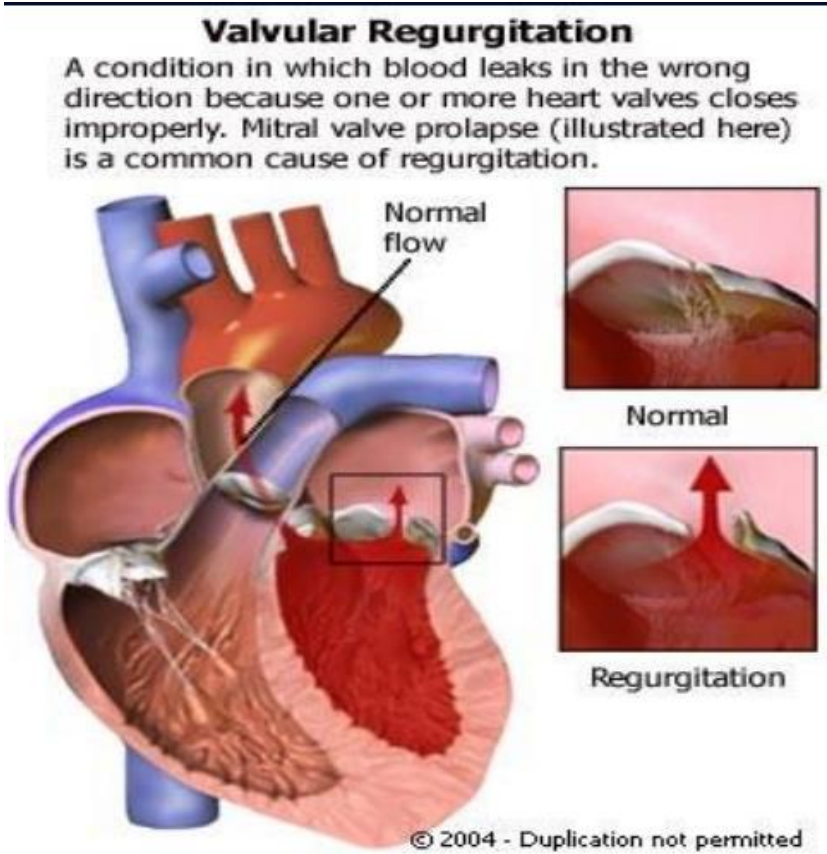
Mitral Regurgitation

Etiology

- Acute MR
  - Ruptured chordae or papillary muscle due to acute MI or trauma
  - Perforation of mitral valve leaflet
  - Acute failure of a prosthetic valve
- Chronic MR
  - Mitral valve prolapse
  - Rheumatic heart disease
  - CTD
  - Malfunctioning prosthetic valve

Pathophysiology

- In chronic MVR, the distensibility of the LA and LV are increased over time (i.e. dilatation occurs)



Mitral Regurgitation

Symptoms of acute MR are due to acute pulmonary edema and reduced CO (hypotension, tachycardia, rales).

Chronic MR Symptoms

- Exertional and nocturnal dyspnea
- Palpitations (AF, atrial flutter, increased stroke volume)
- Symptoms of pulmonary edema and diminished CO
- Symptoms of right sided HF

Signs

- Atrial arrhythmias including A. fib and flutter
- Cardiomegaly - displaced hyperdynamic apex beats
- Apical systolic murmur
- Signs of raised pulm capillary pressure (crepitations, pul edema, effusions)
- Signs of pul. HTN

Mitral Regurgitation

CXR

- Marked cardiomegaly
- Pulmonary venous HTN
- LA enlargement
- Straightening of left heart border

Additional Pictures

A cervical rib is an extra rib that forms above the first rib from the base of the neck. The presence of a **cervical rib** can cause a form of thoracic outlet syndrome due to compression of the lower trunk of the brachial plexus or subclavian artery.

The patient may complain of paresthesias & numbness in his neck, shoulder, arm, and hand. 90% of cases are in the ulnar distribution. Weakness manifested by difficulty grasping or holding a pen is a result of arterial and or neural compression. The hand is usually cold.

Tension pneumothorax

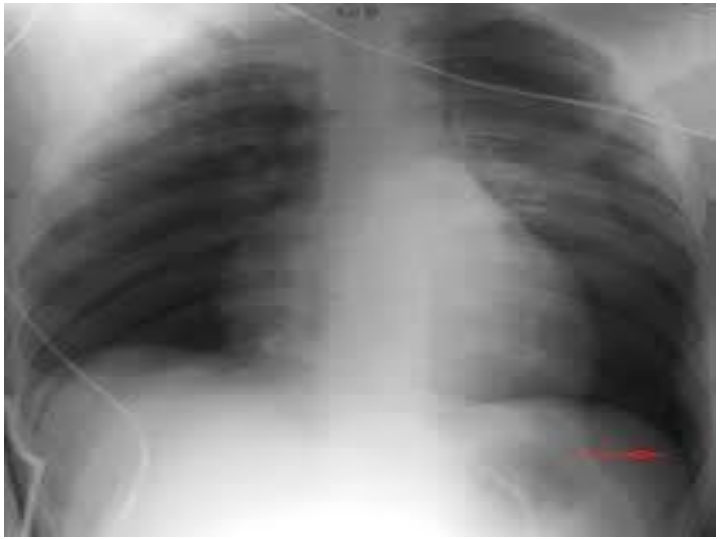
Chest X-ray

Findings :

- Massive left pneumothorax.
- Complete left lung collapse.
- Shift of mediastinum to right.
- Depression of left diaphragm.

ttt : rapid thoracostomy incision or immediate decompression by **needle thoracostomy in the 2nd intercostal space** midclavicular line followed by chest tube.

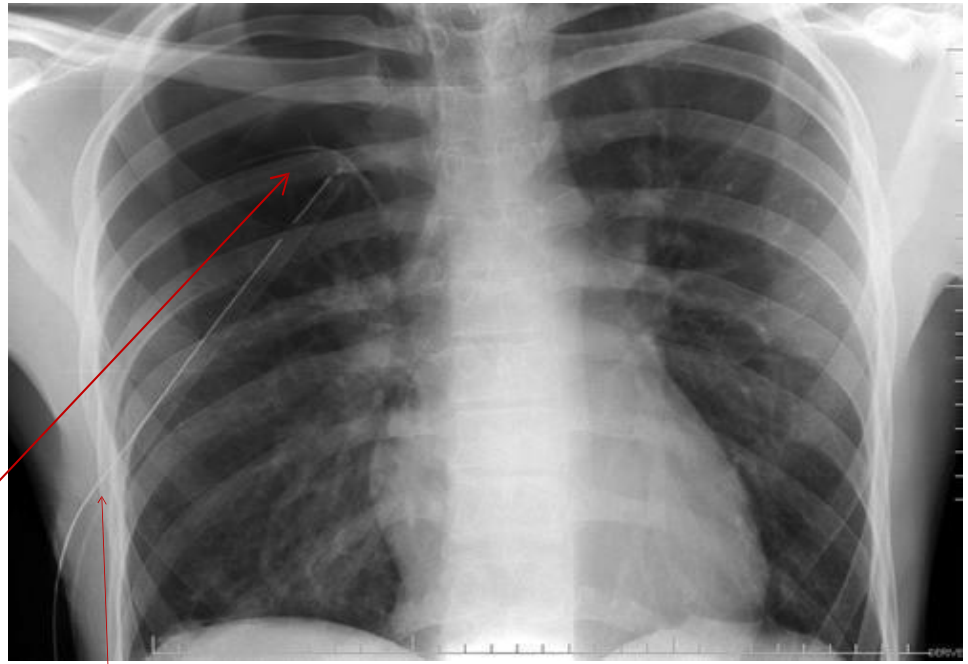
Tension Pneumothorax: The most reliable sign of tension pneumothorax is depression of a hemidiaphragm.



Pneumothorax in a Supine Patient: The ’deep sulcus sign’ (costophrenic angle abnormally deepened) is seen here (arrow) in the left lung base.

This image shows right-sided pneumothorax with a chest tube inserted.

- pneumothorax localizes more towards the apex of the lung.
- Notice that the markings are absent from the apex down to some degree.
- Notice the white line of the pleura.



Chest tube

There is unilateral diaphragmatic paralysis on the right.

we can still see the costodiaphragmatic angle so it is not effusion or hemothorax.

Surgical emphysema

- Subcutaneous emphysema.
- Radiolucent striations outlining pectoralis major due to air surrounding the muscle fiber bundles.
- It is usually benign, and treatment is directed at reversing the underlying cause.

Westermarck's sign : Decreased pulmonary vascular markings on CXR in a patient with pulmonary embolus

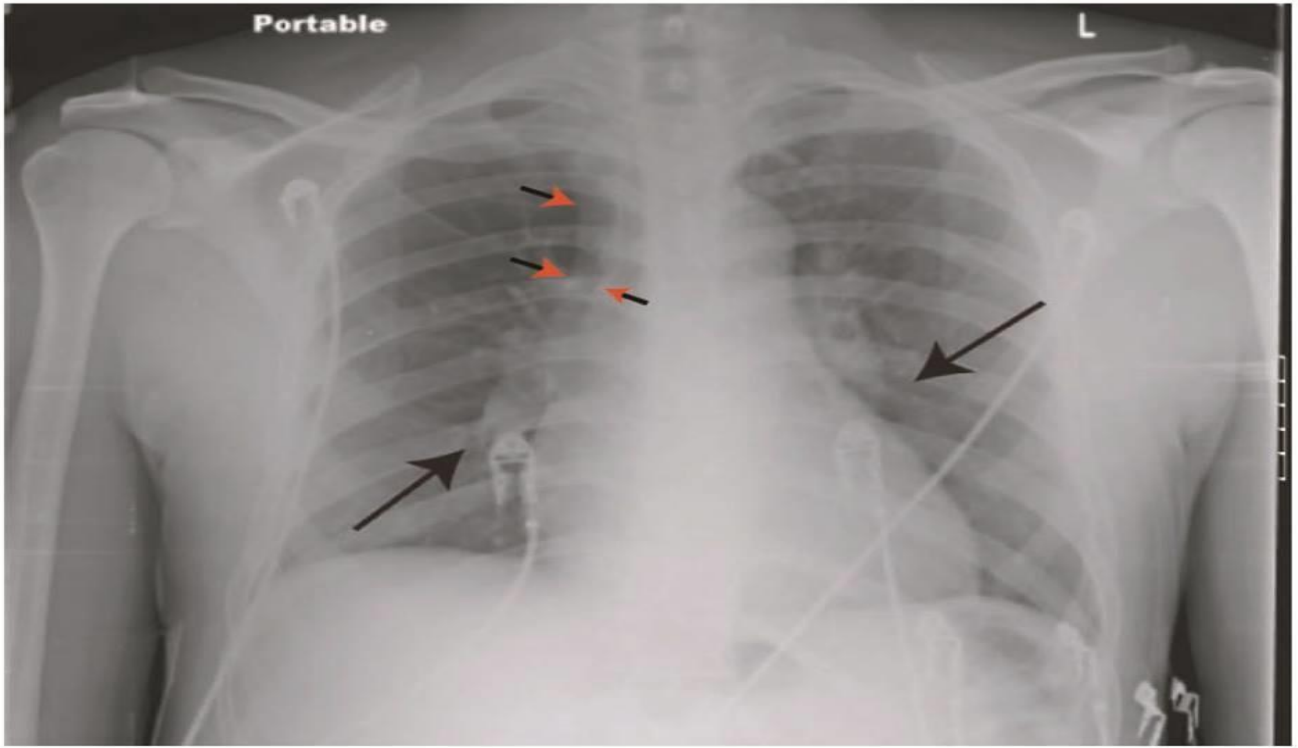
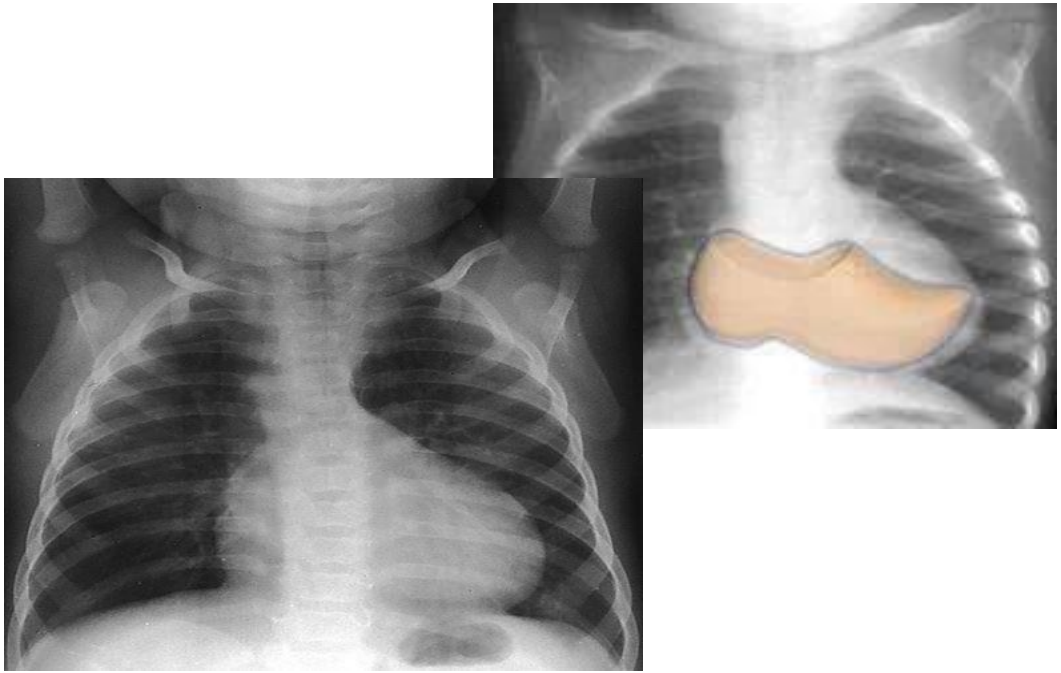


Figure 1. Chest radiograph demonstrating a prominent central pulmonary artery (early Fleishner's Sign, red arrows) and a cut-off of the pulmonary arteries bilaterally (Westermark sign, black arrows).



Tetralogy of Fallot

"boot" shaped heart on chest X-ray.

Transposition of great vessels

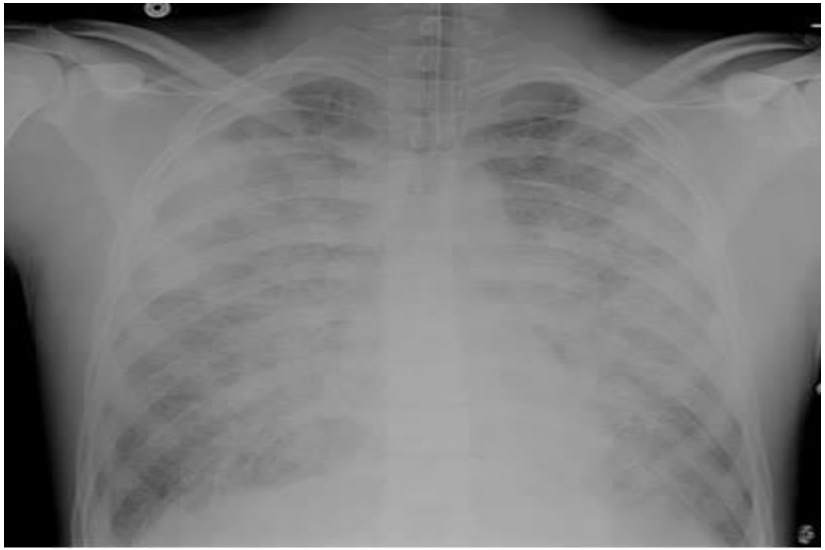
Egg shaped heart

ARDS (bilateral diffuse pulmonary infiltrates)

Other DDx:

1-severe pulmonary edema.
2-pulmonary hemorrhage.
3-pulmonary fibrosis.

(history differentiates between these conditions)



Q: what can you see in the picture??
And give 4 DDx for it ??

A: right (unilateral) lower limb swelling.

DDx:

1. Rupture of a Baker's cyst
2. Cellulitis
3. Lymphatic obstruction (e.g. parasites)
4. DVT

Lymphangiosarcoma

-A complication of long-standing lymphedema, usually in the edematous arm of a post-radical mastectomy patient.

-to prevent it: use elastic compression stockings.

Inferior Vena Cava Filter

Mention 3 indications for its use.

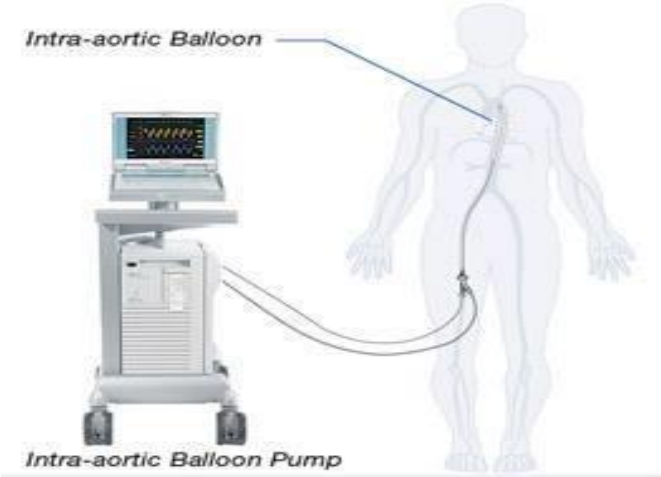
1. Proven venous thromboembolism with contraindication for anticoagulation.
2. Proven VTE with complications of anticoagulation.
3. Recurrent VTE despite adequate anticoagulation.

It is contraindicated to give warfarin.

Intra-aortic balloon pump

The intra-aortic balloon pump (IABP) is a mechanical device increases cardiac output and therefore increases coronary blood flow and myocardial oxygen delivery.

It consists of a cylindrical polyethylene balloon that sits in the aorta, approximately 2 centimeters (0.79 in) from the left subclavian artery and counter pulsates. That is, it actively deflates in systole, increasing forward blood flow by reducing afterload through a vacuum effect. It actively inflates in diastole, increasing blood flow to the coronary arteries via retrograde flow. These actions combine to decrease myocardial oxygen demand and increase myocardial oxygen supply.



Notes :

- The polyethylene balloon has a radiopaque tip.
- We go through the femoral artery up to the tip of the descending aorta distal to the subclavian.
-It increases coronary blood flow by decreasing the afterload.
-The balloon inflates during diastole and deflates during systole.
-Depending upon the patient's hemodynamic status, the balloon is programmed to assist every beat 1:1 or 1:2.
-Linked to an ECG (deflates prior the ending of QRS complex),(inflates in the middle of T wave) or pressure transducer.
-Indications: Cardiogenic shock post-MI, CABG, post cardiothoracic surgery, unstable angina .
-Most important complication is lower limb ischemia. We have to make sure to check the pulse and perfusion .

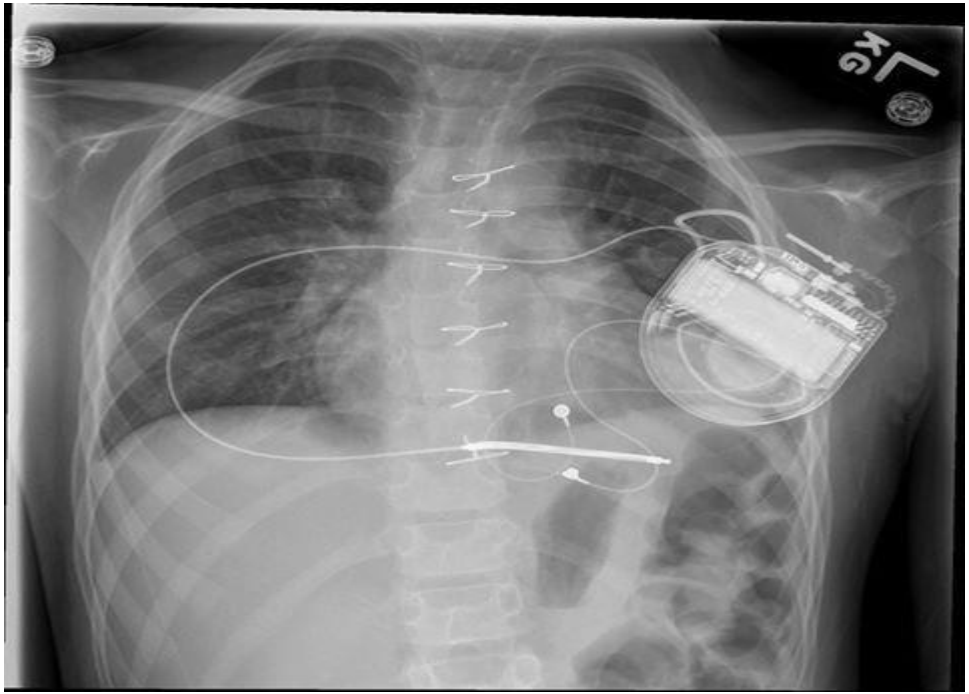
Abdominal x-ray with evidence of the calcified edge of an abdominal aortic aneurysm.

Deep vein thrombosis, or deep venous thrombosis, (DVT) is the formation of a blood clot (thrombus) within a deep vein, predominantly in the legs. Non-specific signs may include pain, swelling, redness, warmness, and engorged superficial veins. Pulmonary embolism, a potentially life-threatening complication, is caused by the detachment (embolization) of a clot that travels to the lungs.

Q: What can you see in this chest X-Ray ?

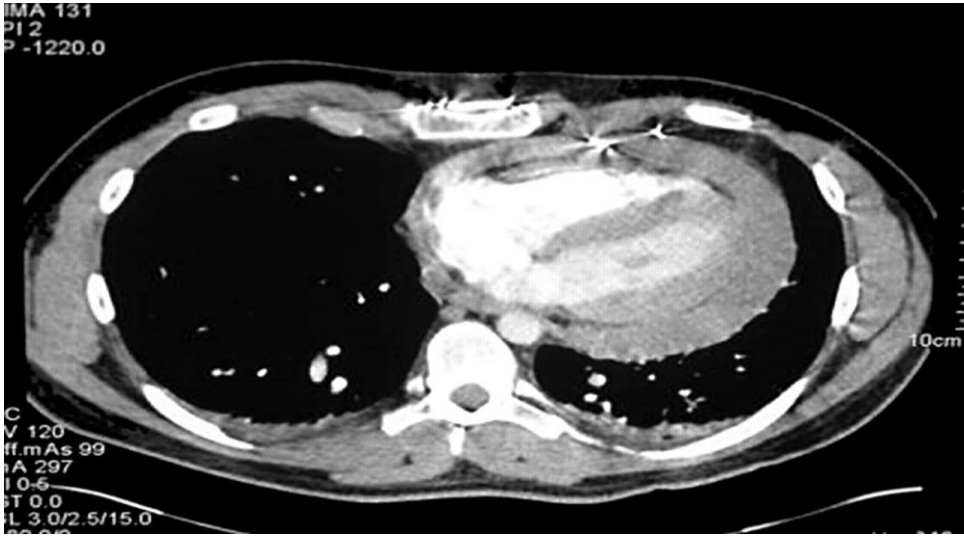
A:

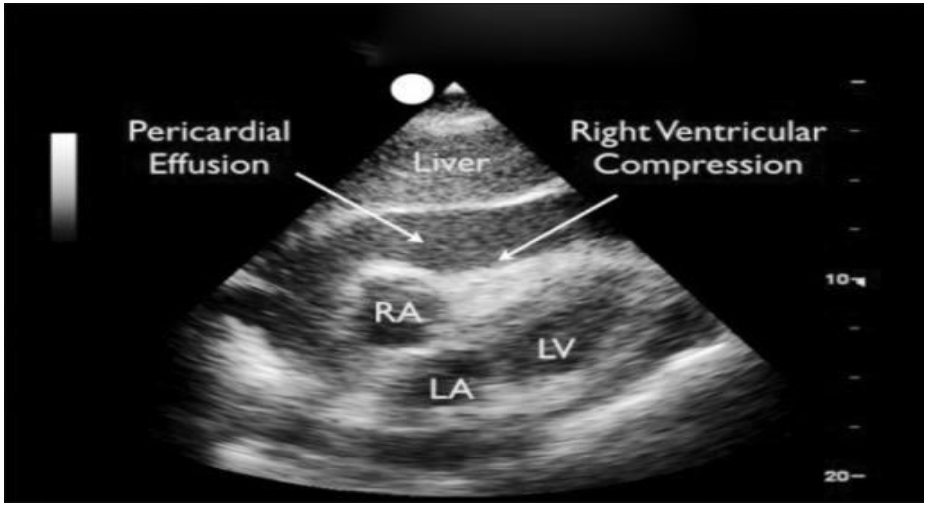
1. Sternal wires in the midline (indicate that the patient underwent sternotomy).
2. Pacemaker.

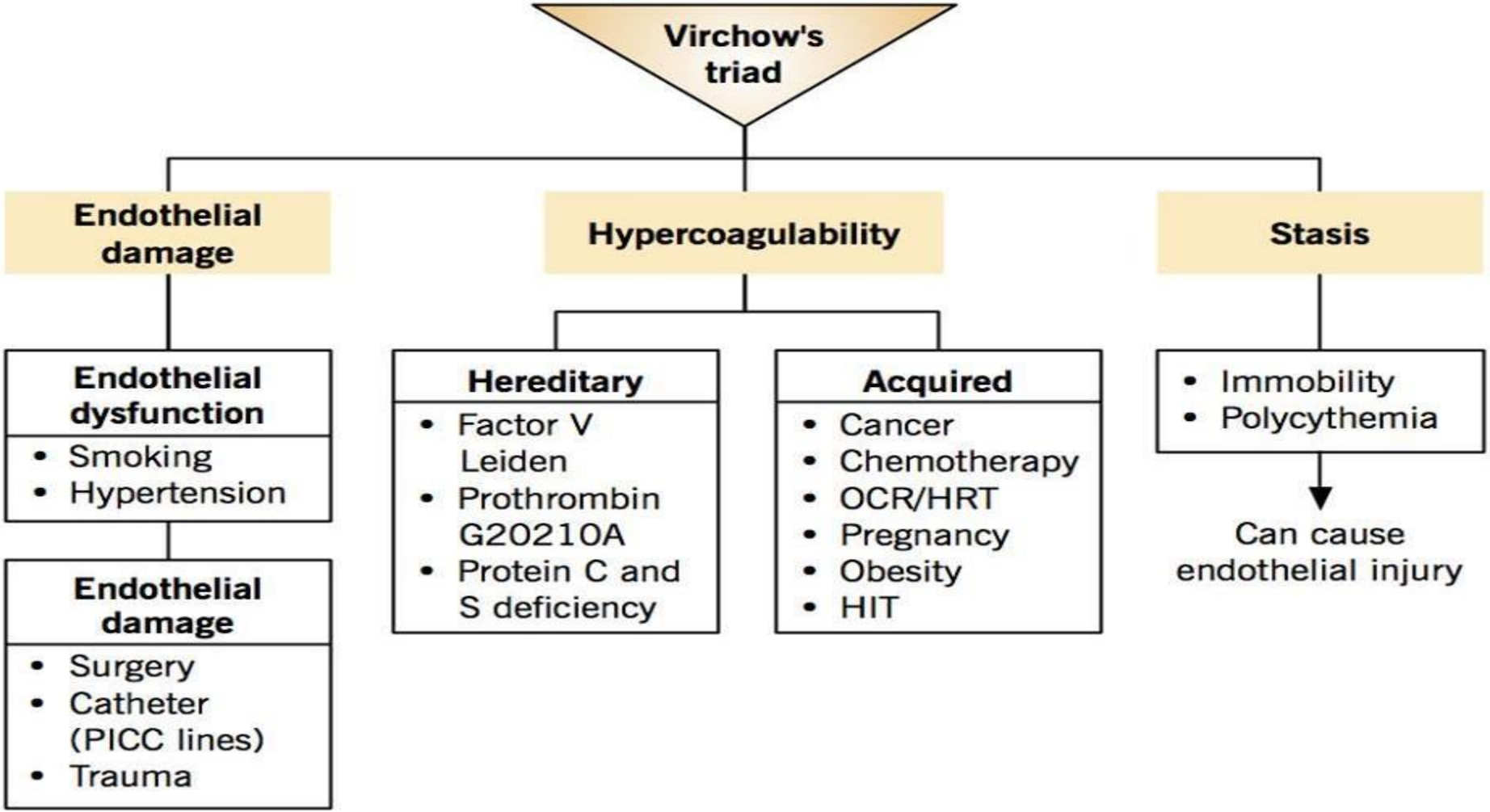


Cardiac tamponade

- Beck’s triad: hypotension/ increased JVP/ muffled heart sounds.
- Pericardial effusion.
- Kussmaul’s sign.
- Treatment: immediate decompression via needle pericardiocentesis.






Virchow's triad
Endothelial damage
Hypercoagulability
Stasis
Endothelial dysfunction
• Smoking
• Hypertension
Endothelial damage
• Surgery
• Catheter (PICC lines)
• Trauma
Hereditary
• Factor V Leiden
• Prothrombin G20210A
• Protein C and S deficiency
Acquired
• Cancer
• Chemotherapy
• OCR/HRT
• Pregnancy
• Obesity
• HIT
• Immobility
• Polycythemia
Can cause endothelial injury