Vascular Disease
Surgical Vascular Problems

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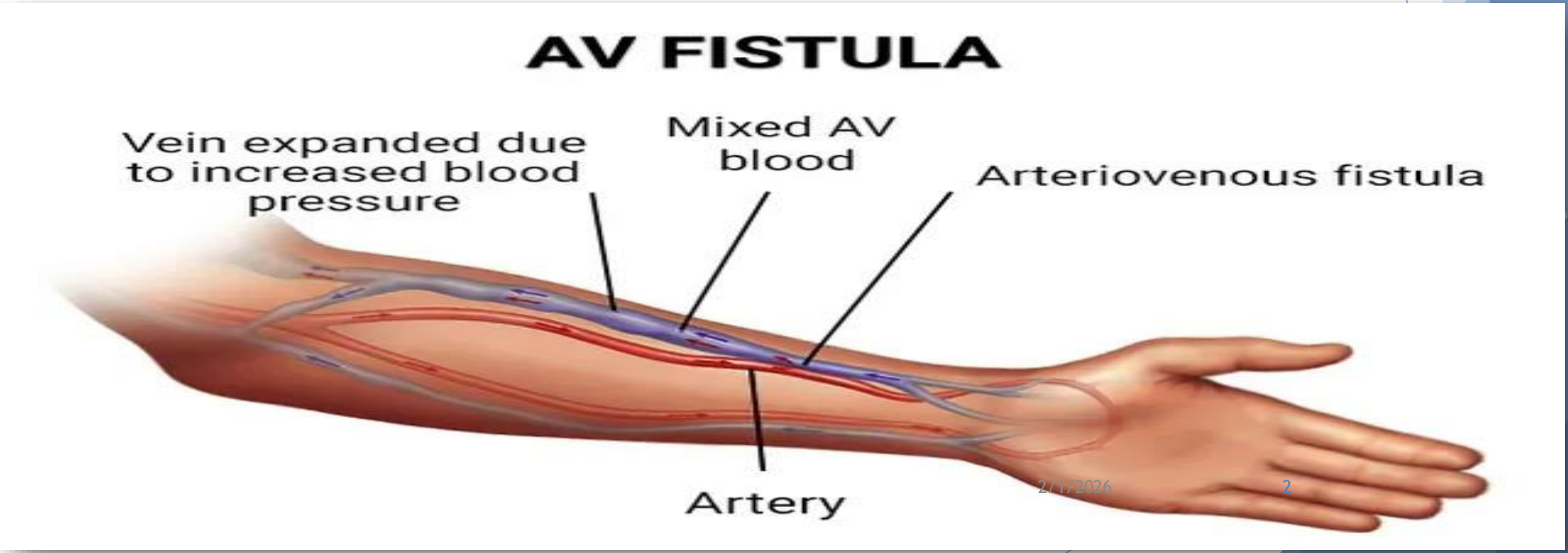
Lecture time : 50-60 min

Arteriovenous fistulas

Definition: *A connection, other than the capillary bed, between the arterial and venous systems.*



Classification

Etiology

Congenital

- *Single fistulas*
- *Multiple fistulas (arteriovenous malformations)*
- *Hemangiomas*

Aquired

Single fistulas

- *Surgical*
- *Pathologic*
- *Aneurysm*
- *Iatrogenic*

Tumors associated communications

- *Vascular tumors, such as angiosarcoma, glomus tumor, or hemangiopericytoma.*
- *Tumors associated with shunting, such as hepatoma or hypernephroma.*

Classification (complexity , size)

🟦 **Simple AVF** Single artery → single vein, Short communication

🟥 **Complex AVF,** Multiple arterial feeders and venous drainage , Often part of AV malformation (AVM)

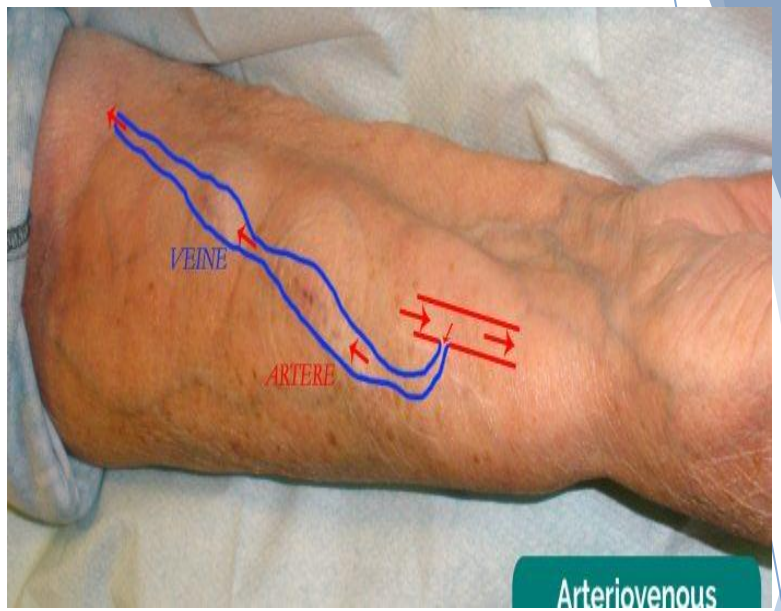
🔥 **High-flow fistula** , Large shunt : Can cause:

- High-output heart failure
- Distal ischemia (steal syndrome)
- Venous hypertension

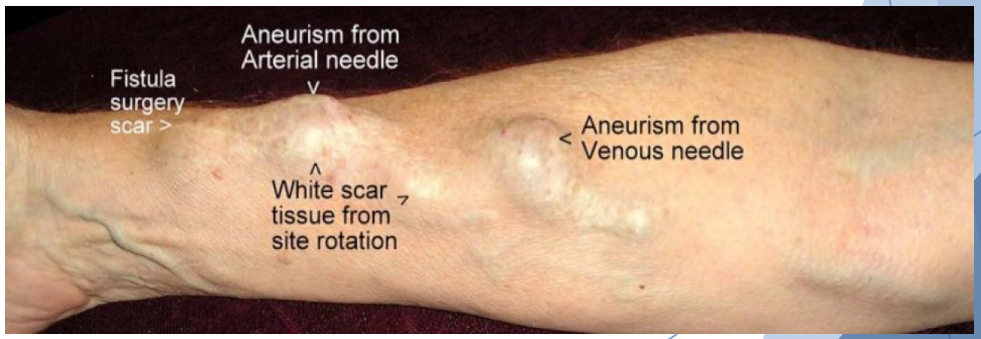
💧 **Low-flow fistula :** Small shunt May be asymptomatic

Clinical Examination of an Arteriovenous Fistula

- **1) Inspection:** Look carefully at **both limbs** and compare.



👀 **Skin & Veins** Dilated, tortuous superficial veins , Shiny, thin skin ,Edema ,Hyperpigmentation ,Ulceration (chronic venous hypertension)



👀 **Fistula Site :** Surgical scar (dialysis AVF), Swelling / pulsatile mass Signs of infection: Redness,Discharge Warmth 👀 **Distal Limb** Pallor or cyanosis (steal syndrome) ,Muscle wasting ,Gangrene (late)

On examination

Tachycardia

Wide pulse pressure

Elevated JVP

Bruit over the site of AVF

Thrill over the site of AVF

The site of AVF may be aneurysmal (pulsatile mass)

Diminished pulse rate with occlusion of AVF (Branham's or Nicoladoni's sign)

This is performed when arteriovenous fistula is suspected.
A pressure on the artery proximal to the fistula will cause reduction in the size of swelling, disappearance of bruit, fall in PR.

The distal pulse of affected limb may be diminished or absent

The involved limb may be oedematous

Long standing venous hypertension may lead to development of stasis dermatitis, varicosities and venous ulcers in the affected limb

The patient may present rarely with congestive heart failure

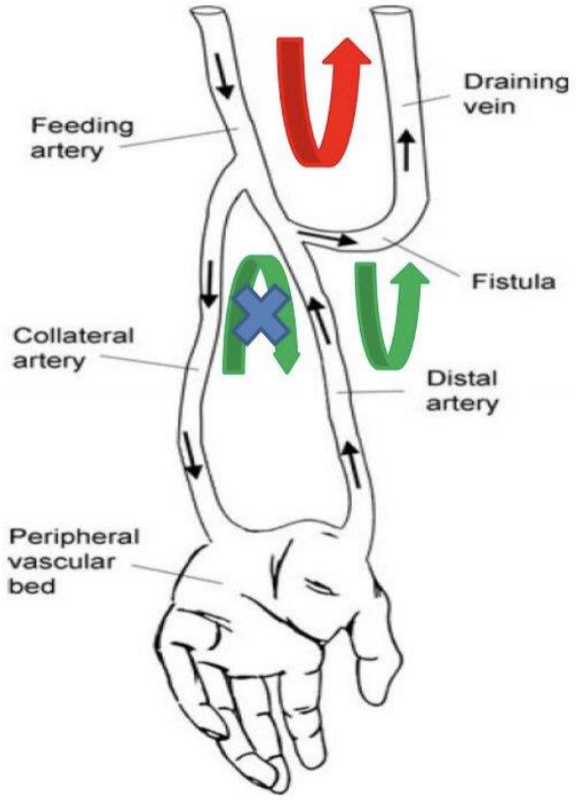
Steel syndrome

Pathogenesis of DASS

- Caused by drop in distal perfusion pressure due to:

– preferential flow or diversion of arterial blood – 'stealing' – into the AV access

– retrograde flow through the distal artery into the AV access



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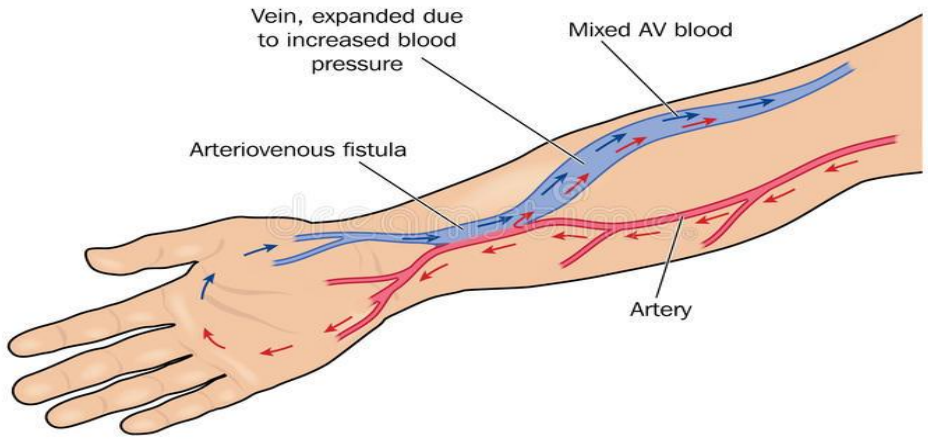
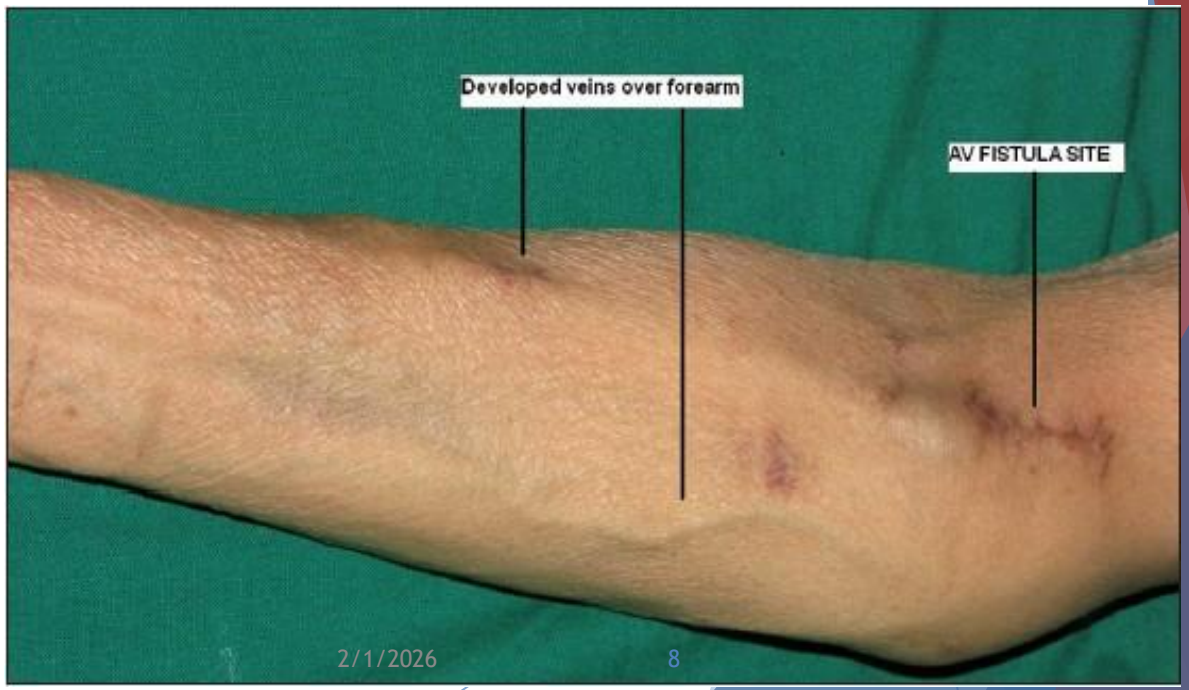
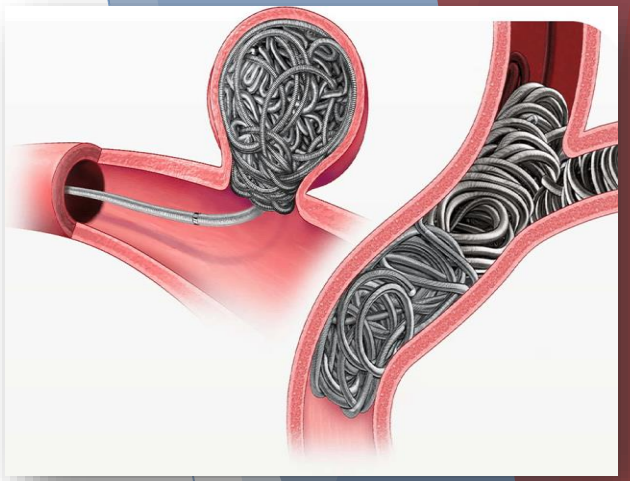
Arteriovenous fistulas

Investigation
Angiography
Duplex scanning
CTA
MRA
Cardiac Assessment (Large AVF)





Treatment:



1) Conservative / Observation Small

- Asymptomatic , Stable , Includes: Surveillance ultrasound ,Limb protection, Avoid cannulation trauma

2) Medical Management

- Treat heart failure (diuretics, vasodilators) , Antibiotics if infected , Anticoagulation → case-specific, Analgesia

3) Endovascular Treatment ⭐Often first choice for pathologic AVF.

- Coil embolization, Vascular plugs, Glue / Onyx, Covered stent, Balloon occlusion

Surgical Treatment Indications: surgery

- Failure of endovascular
- Infection
- Aneurysm
- Limb ischemia
- High-output heart failure
- Rupture risk

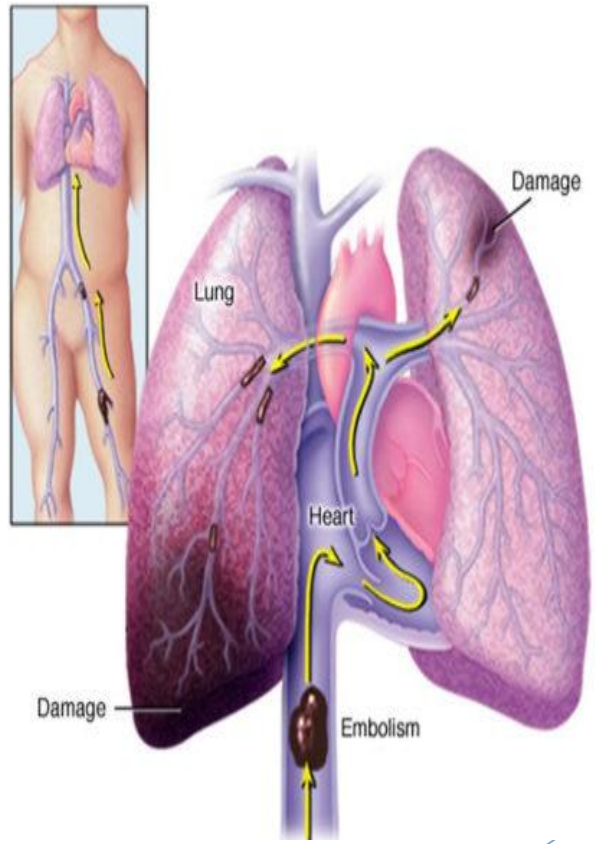
Surgical Options: (Ligation ,Resection + repair, Interposition graft,Banding / flow reduction ,DRIL procedure (for steal)

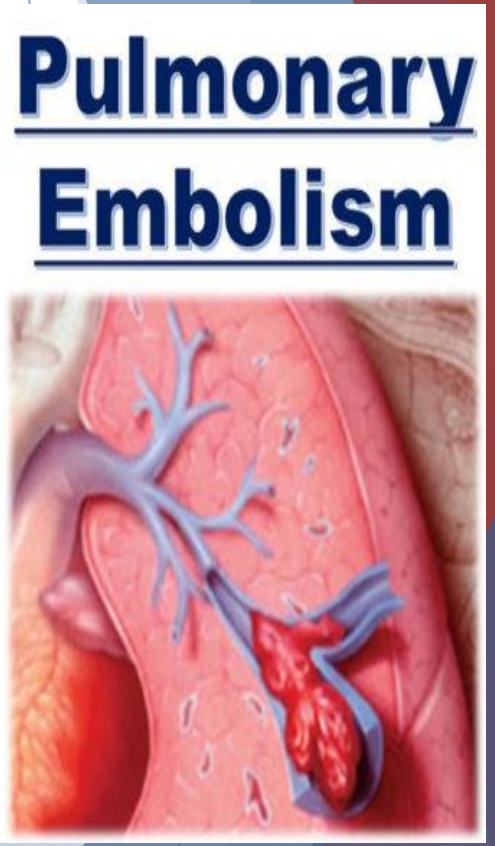
What Do you think are the Red flags need urgent management

- No thrill
- Infection
- Ischemic fingers
- Rapid enlargement
- Venous hypertension

Pulmonary embolism

Definition: *It refers to obstruction of pulmonary artery or one of it's branches by a substance (clot, fat, amniotic fluid, air, etc…) transferred from elsewhere of the body. The most common cause of pulmonary embolism is DVT of the lower limbs.*





Classification

I. By Hemodynamic Severity : This is the **most important classification clinically.**

- **High-Risk (Massive) PE (**Sustained hypotension (SBP < 90 mmHg or drop ≥ 40 mmHg for ≥ 15 min), Shock or cardiac arrest
- **Intermediate-Risk (Submassive) PE :** Hemodynamically stable **but** evidence of right-ventricular (RV) strain.
- **Low-Risk PE (**Normal blood pressure, No RV dysfunction, Normal biomarkers

II. By Anatomical Location(Based on CT pulmonary angiography) :

Saddle PE – at bifurcation of main pulmonary artery

Central PE – main or lobar arteries

Segmental PE

Subsegmental PE

III. By Time Course

Acute PE – sudden onset
Subacute PE – days to weeks

Chronic PE – organized thrombus → may cause CTEPH

Patients who are being admitted for surgery may be graded as low, moderate or high risk for pulmonary embolism and VTE

TABLE 62.5 Modified Wells criteria for predicting pulmonary embolism (PE).

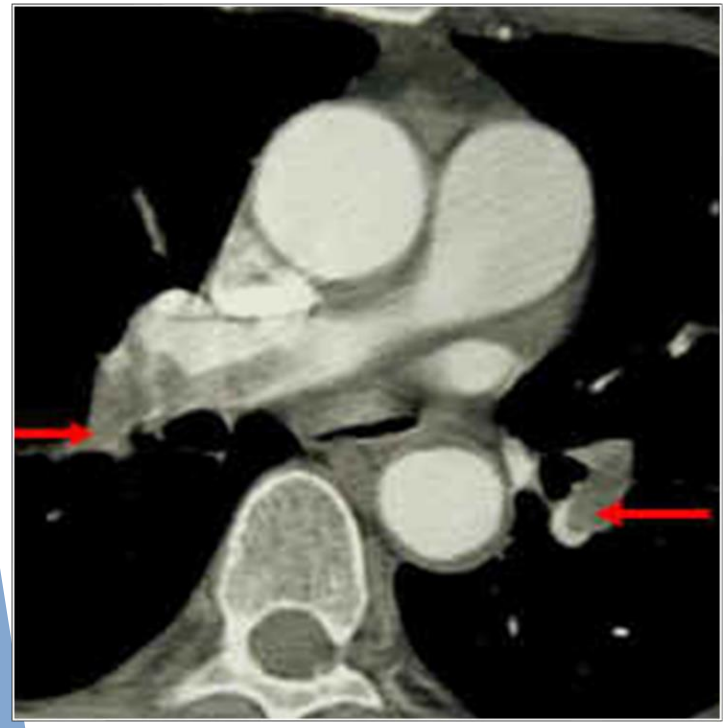
Variable	Score
Clinical signs and symptoms of DVT (minimum of leg swelling and pain on palpation of deep veins)	3
Alternative diagnosis less likely than PE	3
Heart rate >100 bpm	1.5
Immobilisation >3 days or surgery within past 4 weeks	1.5
Previous DVT or PE	1.5
Haemoptysis	1
Malignancy (treatment or palliation within past 6 months)	1

A score of <4 means PE is unlikely (12.4%); >4 is suggestive of PE (37.1%).

TABLE 62.6 Low-, medium- and high-risk patient groups for venous thromboembolism.

Low
• Minor surgery <30 minutes; any age; no risk factors
• Major surgery >30 minutes; age <40; no other risk factors
• Minor trauma or medical illness
Medium
• Major surgery; age 40+ or other risk factors
• Major medical illness: heart/lung disease, cancer, inflammatory bowel disease
• Major trauma/burns
• Minor surgery, trauma, medical illness in patient with previous DVT, PE or thrombophilia
High
• Major orthopaedic surgery or fracture of pelvis, hip, lower limb. Major abdominal/pelvic surgery for cancer
• Major surgery, trauma, medical illness in patient with DVT, PE or thrombophilia
• Lower limb paralysis (e.g. stroke, paraplegia)
• Major lower limb amputation

Acute



The clinical presentation

- *Dyspnea, tachypnea, and chest pain*
- *anxiety, hypotension, hemoptysis, or cyanosis may occur.*
- *Physical examination may include signs of right ventricular dysfunction such as enlarged neck veins, and an accentuated second pulmonary sound and pleural friction rub.*

Investigation

ECG

- It may be normal
- sinus tachycardia,
- $S_1Q_3T_3$ pattern, right ventricular strain pattern, right bundle branch block, and T-wave inversion in (V_1-V_4).

Chest x-ray

- It may be normal.
- oligemia.
- Pleural effusion

Arterial Blood Gases

- Hypoxemia & hypocapnia

D-dimer enzyme-linked immunosorbent assay

Ventilation-perfusion lung scan

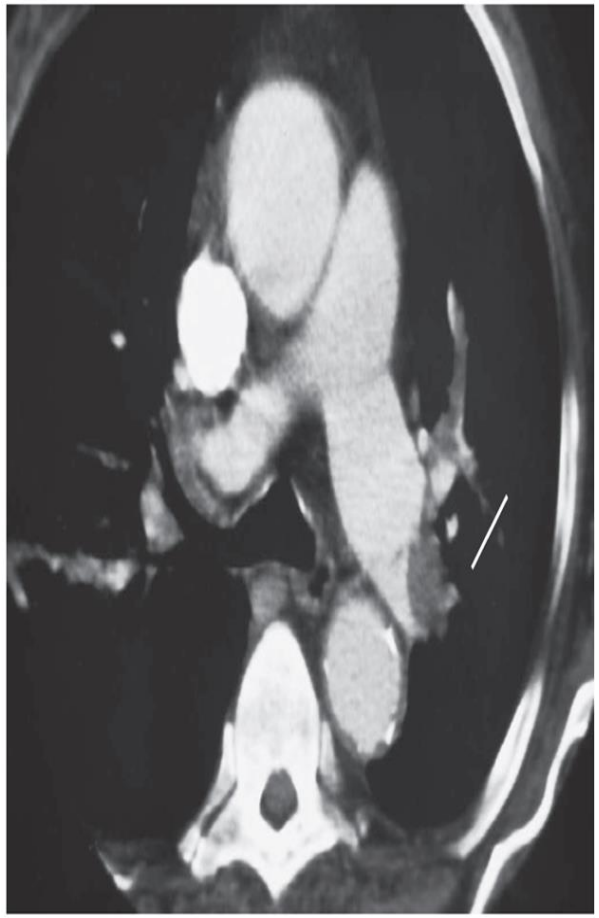


Figure 62.35 A computed tomography pulmonary angiogram showing pulmonary emboli as filling defects (arrow) in the pulmonary artery.

Echocardiography

CT-pulmonary angiography

Pulmonary angiogram

Ultrasound study & Impedance plethysmography of the lower extremities.

Treatment

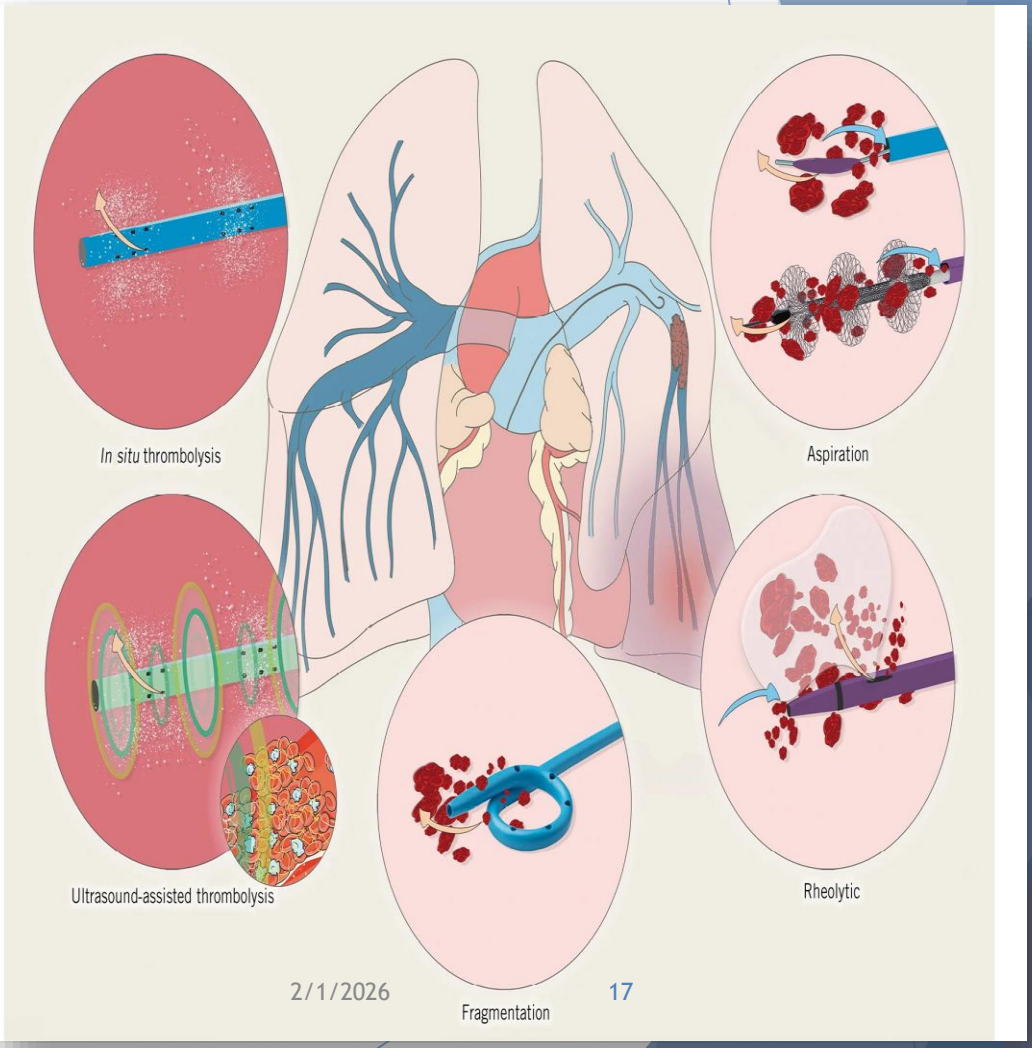
Heparin is the mainstay of treatment for pulmonary embolus. A bolus of heparin of 5000 to 10,000 units is given IV and followed by a continuous infusion of heparin (18 U/kg/hr) & oral warfarin is started at the same time. After about 5 days, heparin is stopped and warfarin is continued with an INR of 2-3.

Thrombolytics (streptokinase or urokinase)

Pulmonary embolectomy

Other measures (O_2 , inotropes, I.V. fluid, analgesia, etc…) may be added.

Monitoring in intensive care unit.



Surgical Indications for Pulmonary Embolism

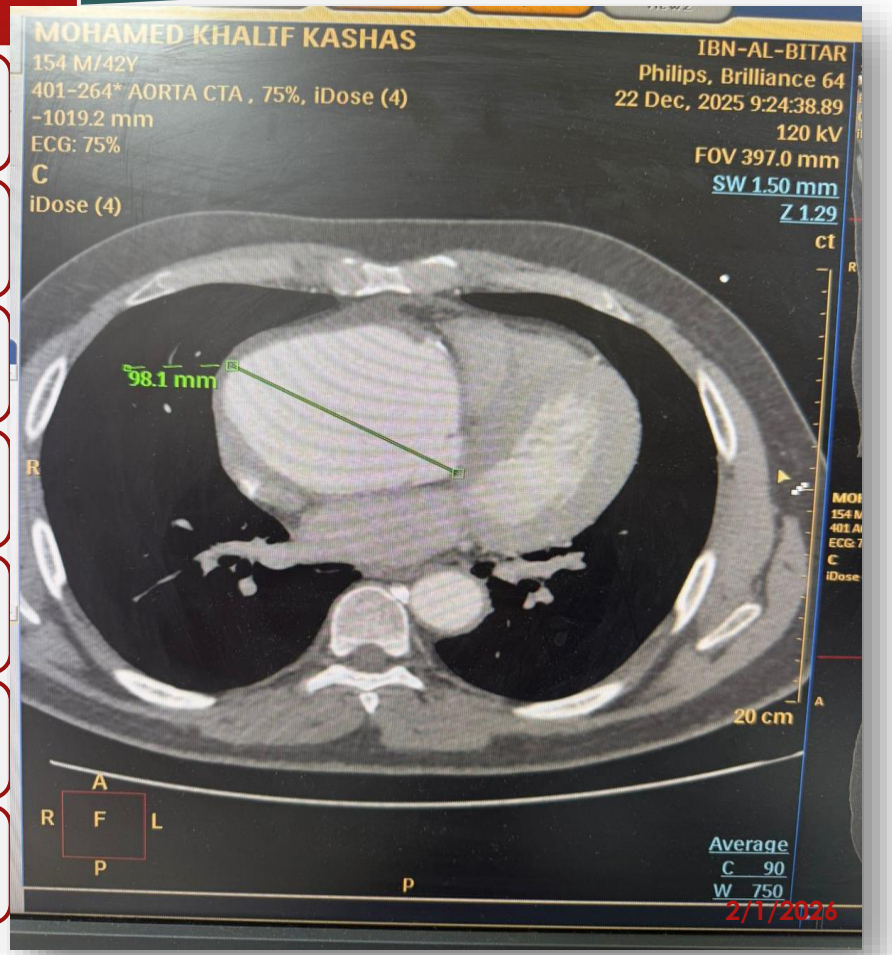
Massive PE with hemodynamic instability	•Shock or sustained hypotension •Cardiac arrest •Severe acute right-ventricular failure
Contraindication to systemic thrombolysis	•Recent major surgery •Intracranial hemorrhage or recent stroke •Active major bleeding •Brain tumor or vascular malformation
Failure of thrombolytic therapy	• Persistent shock • Ongoing hypoxia • Worsening RV dysfunction despite treatment
Failure or unavailability of catheter-directed therapy	• Clinical deterioration despite percutaneous intervention • No immediate catheter capability in an unstable patient
Right-heart thrombus ("clot in transit")	• Mobile thrombus in right atrium or ventricle • High risk of imminent embolization
Intermediate-high-risk (submassive) PE with rapid deterioration	• Rising vasopressor requirement • Escalating oxygen/ventilatory needs • Progressive RV failure
Large central or saddle embolus with severe RV dysfunction	• Especially if thrombolysis is unsafe

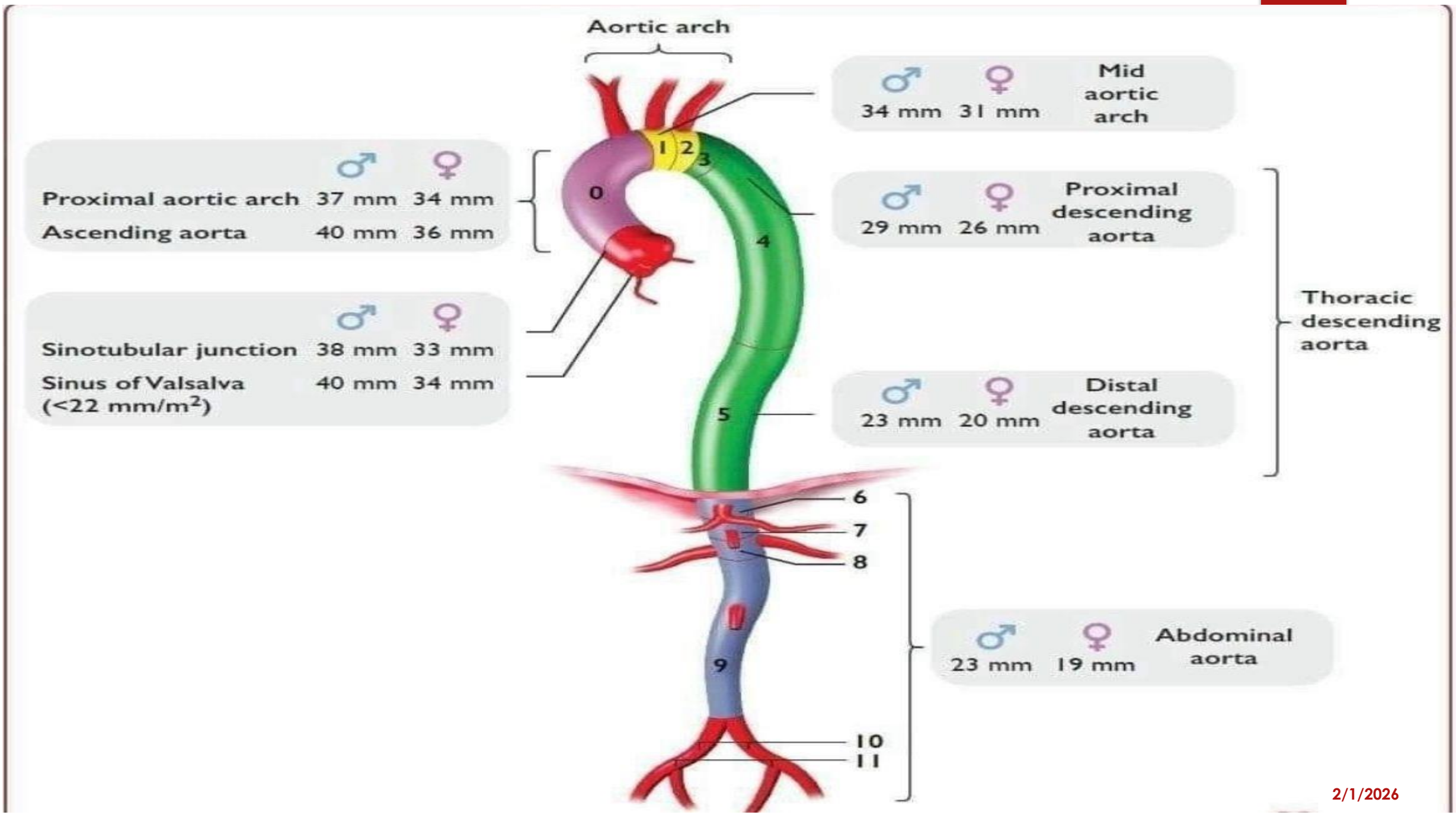
Thoracic Aortic Aneurysms

Definition *It is defined as a permanent, localized dilatation of the thoracic aorta to greater than 1.5 times its normal diameter.*

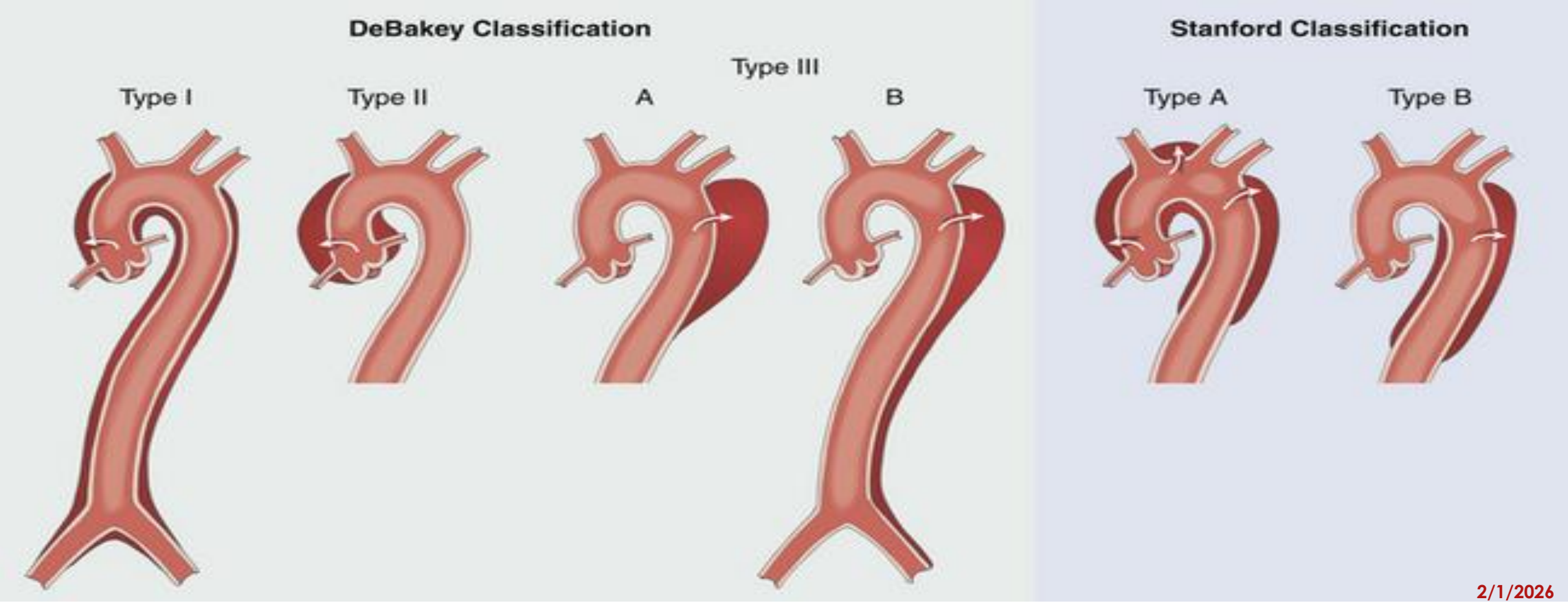
Etiology:

- *Nonspecific medial degeneration*
- *Aortic dissection*
- *Genetic disorders : Marfan syndrome , Ehlers-Danlos syndrome*
- *Post stenotic dilatation*
- Infection : *Aortitis , Takayasu's arteritis , Giant cell arteritis, Rheumatoid aortitis*
- Trauma
- *Other risk factors include increasing age, hypertension, smoking, male gender, atherosclerosis & family history of aneurysm*




Aortic arch
♂ ♀
Proximal aortic arch 37 mm 34 mm
Ascending aorta 40 mm 36 mm
♂ ♀
Sinotubular junction 38 mm 33 mm
Sinus of Valsalva (<22 mm/m²) 40 mm 34 mm
0
1
2
3
4
5
6
7
8
9
10
11
♂ ♀
34 mm 31 mm
Mid aortic arch
♂ ♀
29 mm 26 mm
Proximal descending aorta
♂ ♀
23 mm 20 mm
Distal descending aorta
Thoracic descending aorta
♂ ♀
23 mm 19 mm
Abdominal aorta

Thoracic Aortic Dissection



Thoracic Aortic Aneurysms

- **Clinical features:**

Asymptomatic

Mild & chronic pain

Symptoms related to compression of the superior vena cava

Cough, wheezing, stridor, pneumonitis or hemoptysis

Dysphagia and hematemesis

GI bleeding. Jaundice

Aortic Valve Regurgitation

Distal Embolization of atheromatous plaque and mural thrombus.

Rupture

Thoracic Aortic Aneurysms

Investigations

- CXR
- Echocardiography
- Computed Tomography

- MRA
- Aortography and Cardiac Catheterization
- Abdominal Ultrasonography

Thoracic Aortic Aneurysm Chest X-Ray

- Widened mediastinum
- Abnormal or enlarged aortic contour
- Prominent aortic knuckle (aortic knob)
- Loss of normal aortic silhouette
- Tracheal deviation (often to the right with arch aneurysm)
- Left main bronchus depression
- Cardiomegaly (if associated with aortic regurgitation)

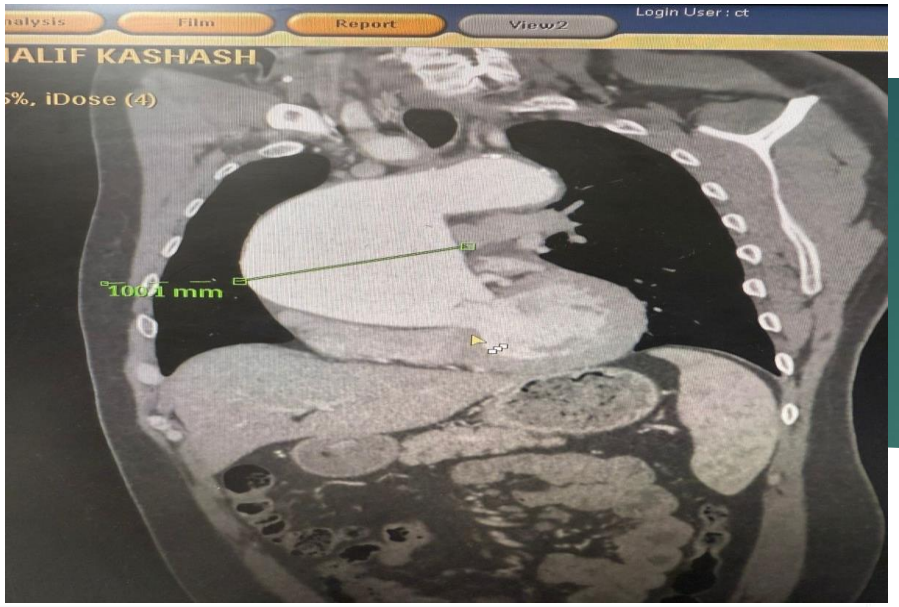
Original image by James Heilman, MD / CC BY-SA 4.0

Widened Mediastinum

Convex tracheal displacement

Ascending Aorta = Right Sided Bulge

Descending Aorta = Left Sided Bulge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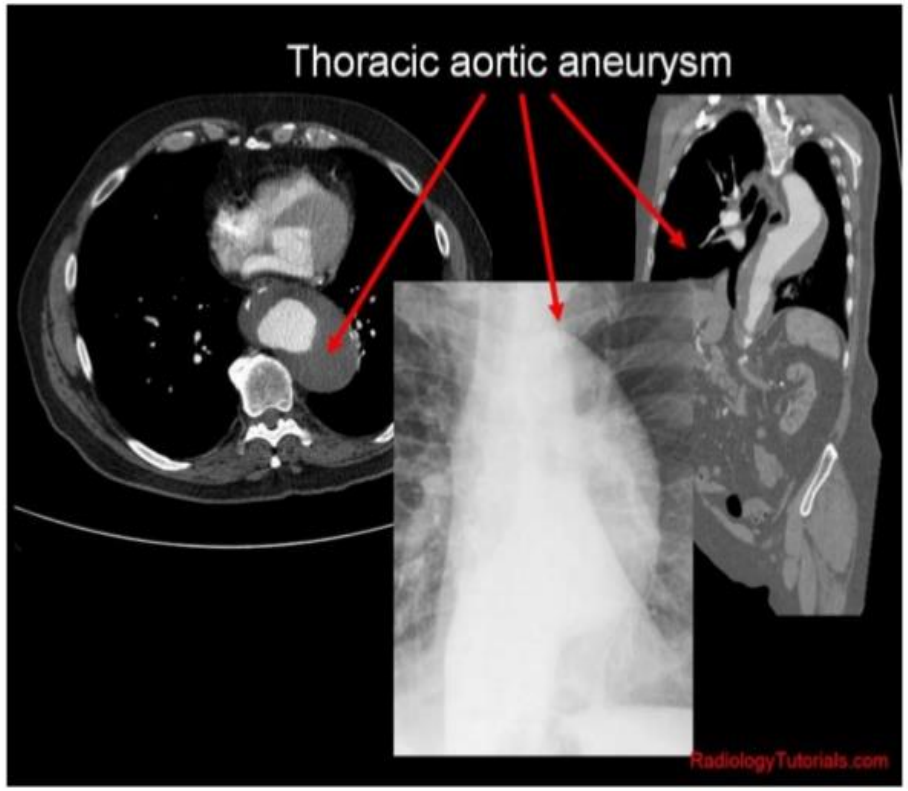
iDose (4)


Thoracic aortic aneurysm
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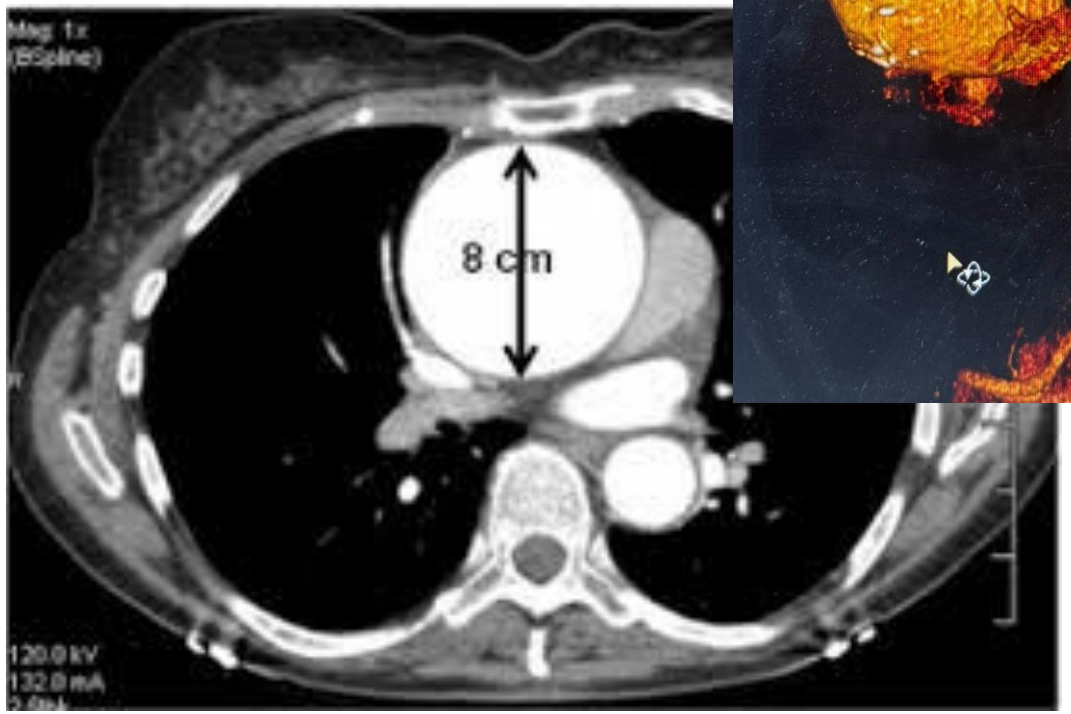
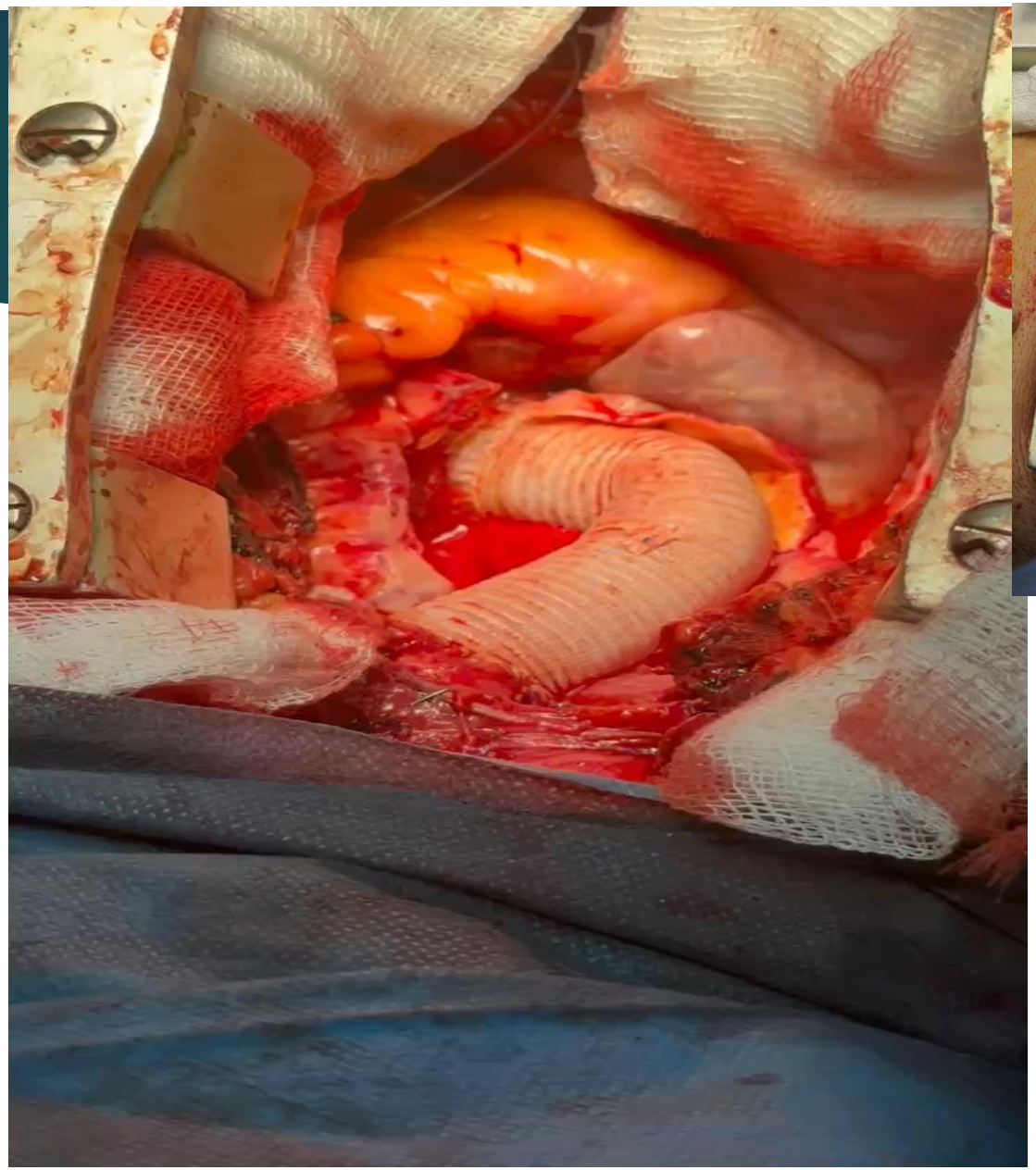

8 cm

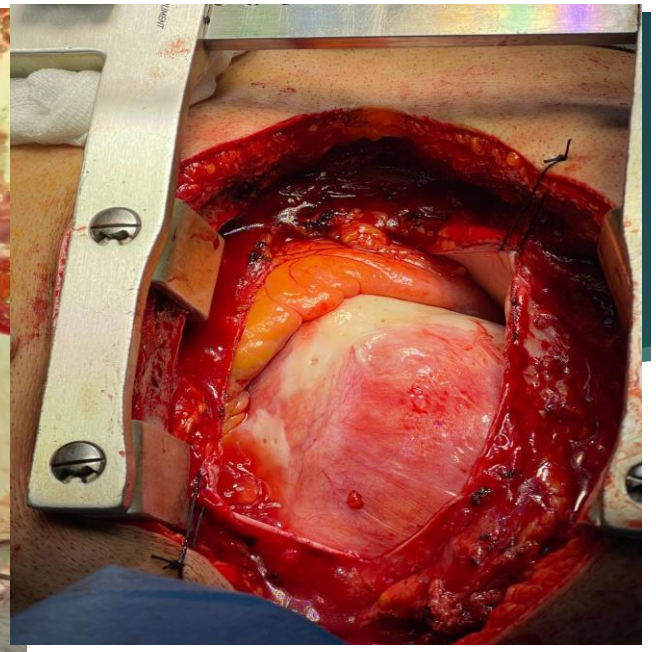
Thoracic Aortic Aneurysms

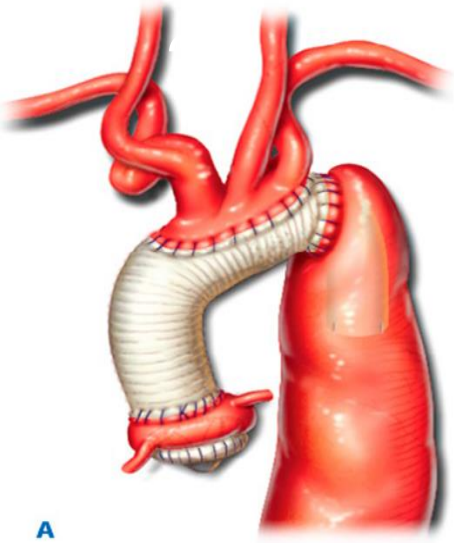
Treatment

Indications for Operation

- *Elective operation in asymptomatic patients is recommended when the diameter of an ascending aortic aneurysm is >5.5 cm, when the diameter of a descending thoracic aortic aneurysm is >6.5 cm, or when the rate of dilatation is >1 cm/year.*
- *In patients with connective tissue disorders, such as Marfan or associated significant aortic valve regurgitation, the threshold for operation is lower.*
- *Symptomatic aneurysms mandate surgery.*
- *- Impending rupture mandates urgent intervention & rupture or superimposed acute dissection is an indication for emergency surgery.*



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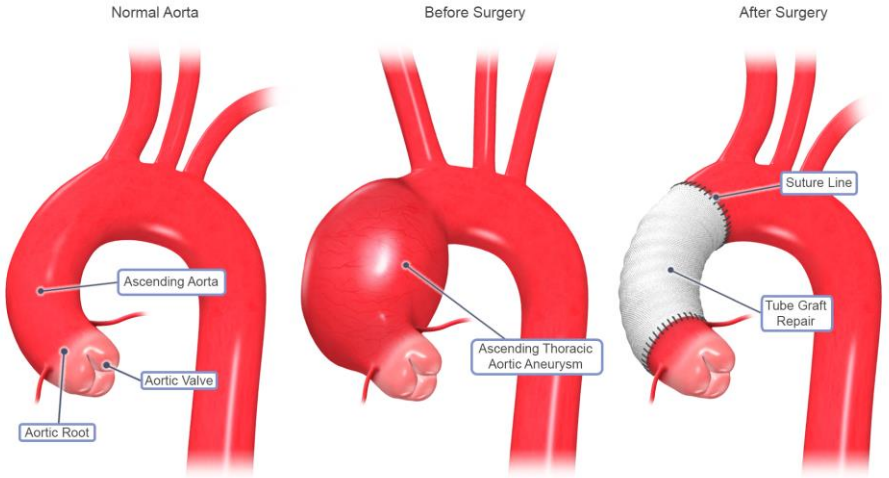
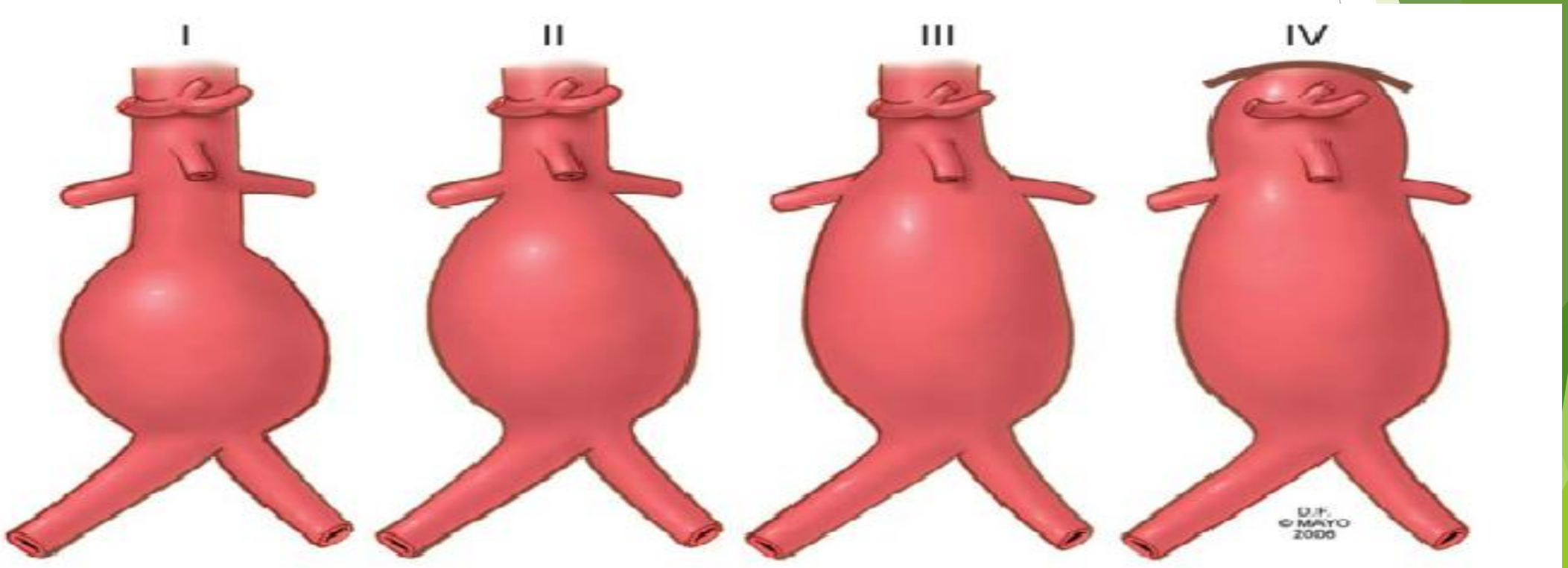

Normal Aorta
Before Surgery
After Surgery
Ascending Aorta
Aortic Valve
Aortic Root
Ascending Thoracic Aortic Aneurysm
Suture Line
Tube Graft Repair

Abdominal Aortic Aneurysm



- **Classification of abdominal aortic aneurysms:** infrarenal (I), juxtarenal (II), pararenal (III), and suprarenal (IV).

Abdominal Aortic Aneurysm

Etiology

- *Abdominal aortic aneurysms are caused by atherosclerosis in 95% of cases. Rarely, trauma, syphilis, mycotic infection, or Marfan's syndrome may be responsible.*

Risk Factors

- *Age.*
- *Gender. Male gender*
- *Race. White males are two to three times more likely to develop AAA than black males.*
- *Tobacco use.*
- *A family history of aneurysmal disease.*
- *Atherosclerosis.*
- *Hypertension.*
- *Chronic Chlamydia pneumoniae infection*
- *COPD*

Abdominal Aortic Aneurysm

CLINICAL MANIFESTATIONS

- *Most AAAs are asymptomatic.*
- *early satiety, or nausea and vomiting. Chronic vague abdominal or back pain is the most common symptom, Acutely expanding aneurysms produce severe, deep back pain or abdominal pain radiating to the back. This may be associated with tenderness to palpation of the aneurysm. This presentation usually signifies impending rupture, and urgent evaluation and treatment is required.*

COMPLICATIONS

- ***Rupture***
- ***Thrombo-embolism***
- ***Infection***
- ***Spinal erosion***
- ***Chronic consumption coagulopathy***
- ***Arteriovenous fistula***
- ***Aortoenteric fistula***
- ***Concomitant cholelithiasis***

Abdominal Aortic Aneurysm

Investigations:-

- Plain abdominal radiography
- Eggshell pattern of calcification
- Abdominal ultrasound
- Computed tomography (CT) scan
- Magnetic resonance imaging (MRI)
- Magnetic resonance angiography (MRA)
- Angiography

Abdominal Aortic Aneurysm

- ***Treatment:-***

Observation may be indicated for those who are asymptomatic with a small sized AAA less than 5.5 cm in diameter for males & less than 5 cm in diameter for women with slow rate of expansion of the AAA.

Abdominal Aortic Aneurysm

Indications for Repair

A-Elective repair is indicated in:-

- *AAAs with a diameter of 5.5 cm or greater in men.*
- *AAAs that expand at a rate of more than 1 cm/year or that are symptomatic.*
- *AAAs with a diameter of 4.5-5.4 cm if that is the patient's preference.*
- *AAAs with a diameter of 4.5 to 5.0 cm in women.*
- *Atypical aneurysms (dissecting, pseudoaneurysms, mycotic, saccular, and penetrating ulcers).*

B- Urgent repair is indicated for symptomatic AAA & for those with expansion at a rate of more than 1 cm/year

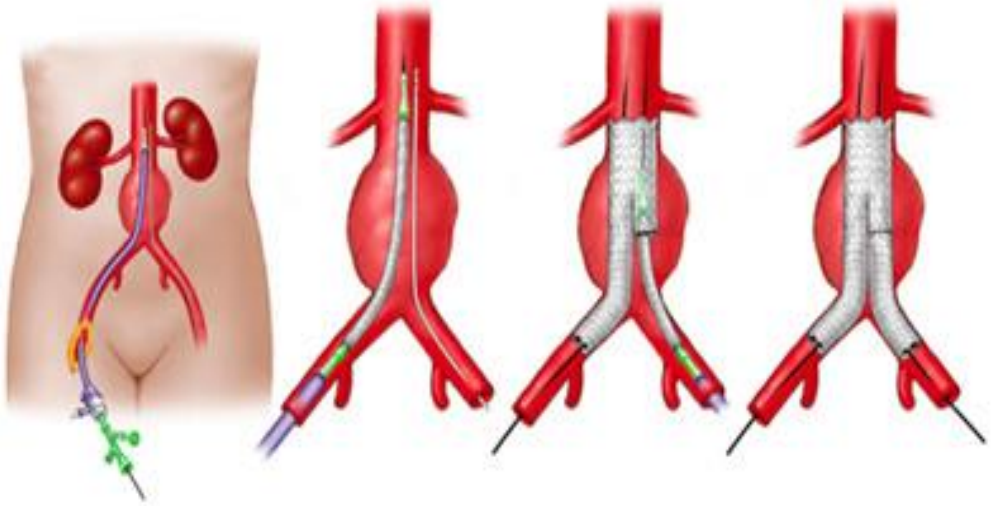
C- Emergency surgery is indicated for ruptured AAA

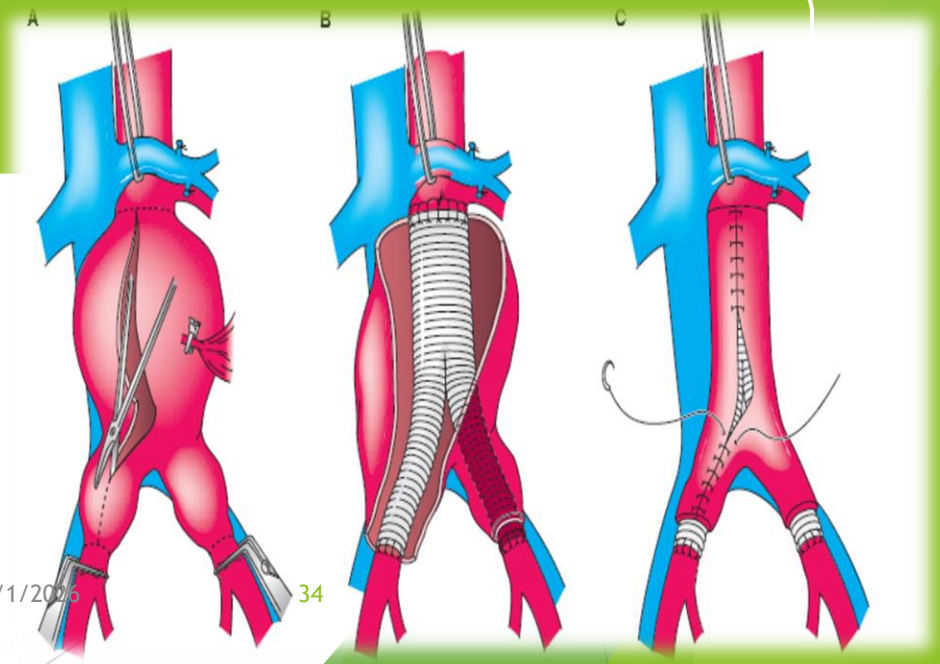
Abdominal Aortic Aneurysm

Surgical Repair of Abdominal Aortic Aneurysm

- Transperitoneal approach
- Retroperitoneal Approach

Endocasvcular Repair (EVAR)





Carotid Artery Occlusive Disease

About 30% to 60% of all ischemic strokes are related to atherosclerotic carotid bifurcation occlusive disease.

Pathogenesis & risk factors

The severity of carotid artery atherosclerotic stenosis is divided into three categories according to the luminal diameter reduction: mild (less than 50%), moderate (50 to 69%), and severe (70 to 99%). Severe carotid stenosis is a strong predictor for stroke.

The neurologic deficit occurs due to:-

- *Embolization of either atherosclerotic material or clot.*
- *Thrombosis of the internal carotid artery & it's propagation*

Carotid Artery Occlusive Disease

***Risk factors** include Increasing age, male gender, hypertension, tobacco smoking, diabetes mellitus, homocysteinemia, and hyperlipidemia.*

Clinical presentations

- *It includes three general groups:-*
  - *Asymptomatic lesions --There is no history of cerebral symptoms.*
  - *Lesions producing TIAs.*
  - *Lesions producing cerebral infarction.*

Carotid Artery Occlusive Disease

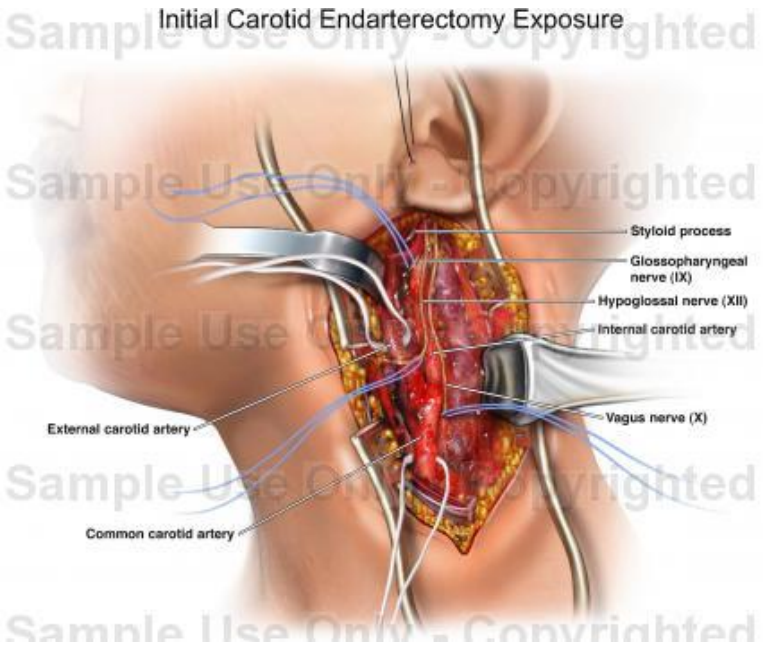
Investigations

- *Duplex ultrasonography. It may be enough to decide for surgery.*
- *MRA. It can differentiate areas of acute ischemia, areas still at risk for ischemia (penumbra), and chronic cerebral ischemic changes.*
- *CT scan. CT scanning of the head should be performed in all patients with cerebral symptoms and to differentiate between an ischemic and a hemorrhagic infarction.*
- *Angiography*
- *CTA*
- *MRA*
- *General investigations include ECG, CXR, and routine laboratory tests.*

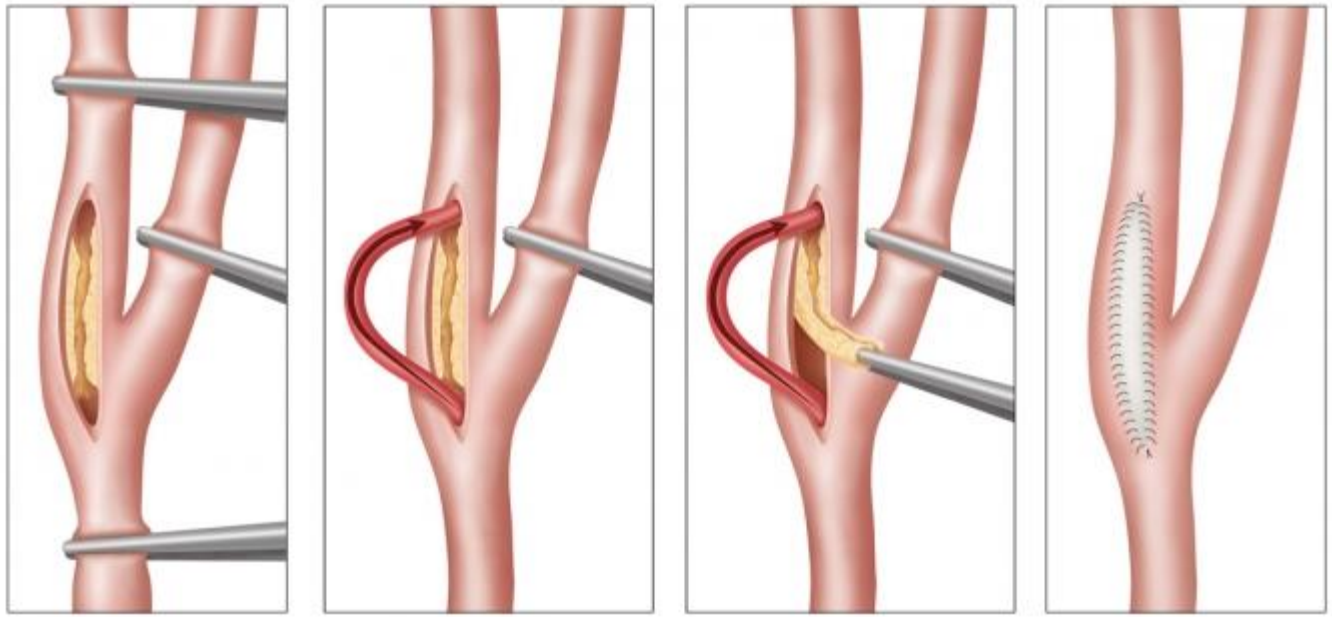
Carotid Artery Occlusive Disease

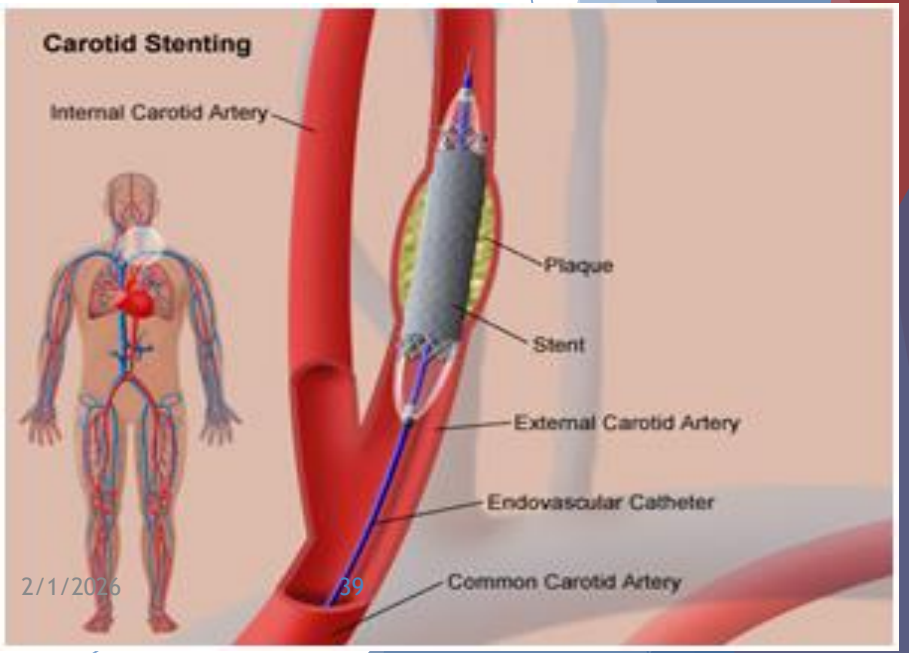
Treatment of Carotid Occlusive Disease

- *Patients with carotid artery occlusive disease need aspirin and/or clopidogrel as prophylactic measures + control of risk factors and the indications for revascularization (endarterectomy or stenting) are as follows:-*
  - ***Symptomatic Carotid Stenosis***
    - *Carotid revascularization is indicated with more than 50% diameter reduction.*
  - ***Asymptomatic Carotid Stenosis***
    - *Carotid revascularization is indicated for asymptomatic carotid arteries with more than 70% diameter reduction.*
  - ***Completely occluded carotid artery***
    - *It is generally not indicated for surgery*



Carotid Endarterectomy VS Carotid artery stent





Thank you