Aortic Aneurysm: Thoracic and Abdominal aortic Aneurysm

An **aneurysm** is a **permanent localized pathologic dilation** of a blood vessel segment exceeding the normal diameter.

An **aortic aneurysm** is a permanent, localized dilation of the aortic wall.

Age-related Changes in Arteries

- Arteries become **stiffer** , **wider** (aneurysm formation), and **longer** (tortuosity) with age.

Pathogenesis & Causes of Aneurysms

Main Mechanism:

- **Degradation or abnormal production of aortic wall structural proteins: collagen and elastin.**
- Most aneurysms arise due to **degenerative disease** — predominantly **atherosclerosis** .

Specific Causes:

- **Structural weakness** and altered **haemodynamic forces** on the vessel wall.
- **Intimal damage** and loss.
- **Reduced elastin and collagen** content in the media and adventitia:
    - **Collagen:** Provides tensile strength (mainly in adventitia).
    - **Elastin:** Provides recoil capacity (mainly in media).

Risk Factors for Aortic Aneurysms

- **Smoking** (strongest modifiable risk factor)
- **Hypertension**
- **Hypercholesterolemia**

Laplace's Law

- Wall tension (T) = Pressure (P) × Radius (r)
- As the **radius increases, wall tension rises** , causing **progressive aneurysm enlargement** and risk of rupture.

Rare Causes of Aneurysms

Cause	Examples/Notes
Congenital	Marfan's syndrome (mutation in **fibrillin-1 gene**), Berry aneurysms (cerebral)

Cause	Examples/Notes
Post-stenotic	Coarctation of the aorta, cervical rib, popliteal artery entrapment syndrome
Traumatic	Gunshot, stab wounds, arterial punctures (often descending thoracic aorta just beyond ligamentum arteriosum)
Inflammatory	Vasculitides such as Takayasu's arteritis, Behcet's disease
Mycotic (infectious)	Infection with Staph, Strep, Salmonella, fungi; often saccular; associated with bacterial endocarditis, syphilis, TB
Pregnancy-associated	Splenic, cerebral, aortic, renal, iliac, coronary aneurysms

Classification of Aortic Aneurysms

1. By wall involvement

- **True aneurysm:** Involves dilation of **all three vessel wall layers** (intima, media, adventitia).
- **False aneurysm (pseudoaneurysm):** Disruption of intima and media; dilated segment lined by adventitia or perivascular tissue and clot; sac formed by compressed surrounding tissue.

2. By gross morphology

- **Fusiform aneurysm:** Spindle-shaped, involves entire circumference ? diffuse dilation.
- **Saccular aneurysm:** Localized outpouching involving a segment of the vessel wall.

3. By location

- **Thoracic aortic aneurysm (TAA):** Ascending, arch, descending thoracic aorta.
- **Abdominal aortic aneurysm (AAA):** Below diaphragm, most commonly infra-renal.
- **Thoracoabdominal aneurysm:** Continuous from thoracic to abdominal aorta.

Epidemiology

Feature	Detail
Most aneurysms (>90%)	Abdominal aorta
Most common segment	Infra-renal abdominal aorta (95%)
Gender ratio	Male:Female = 4:1
Geographic prevalence	More common in Western countries
Prevalence	5% of people >50 years, 15% >80 years
Associated aneurysms	Iliac (30%), Popliteal (10%)

Thoracic Aortic Aneurysm (TAA)

Clinical Features

- Mostly **asymptomatic** , found incidentally.
- Symptoms if compressing adjacent structures:
  - Acute chest pain
  - Dyspnea, cough, hoarseness (due to recurrent laryngeal nerve involvement)
  - Aortic regurgitation ? congestive heart failure (if ascending aorta involved)
  - Superior vena cava compression ? head, neck, upper extremity congestion

Diagnosis

- **Chest X-ray:** Widened mediastinum, tracheal or bronchial displacement.
- **Echocardiography:** Especially transesophageal echo for proximal ascending and descending thoracic aorta.
- **Contrast-enhanced CT, MRI, aortography:** Gold standard for size and branch involvement.
- **Additional:** ECG, ESR, Urea & Electrolytes.

Treatment

- **Medical:**
  - ?-blockers (especially in Marfan's) to reduce shear stress and expansion rate.
  - Control hypertension.
  - Angiotensin receptor blockers (ARBs) may help in Marfan's (reduce TGF-? signaling).
- **Surgical:**
  - Symptomatic aneurysms or ascending aortic diameter ?5.5 cm.
  - Growth >0.5 cm/year.
  - Marfan's syndrome: surgery at 4–5 cm.
  - Degenerative descending thoracic aneurysms: surgery at >6 cm; consider endovascular repair at >5.5 cm.

Abdominal Aortic Aneurysm (AAA)

Anatomy Reminder

- Begins at **T12** , ends at **L4** .
- Relations:
  - Anterior: splenic vein, pancreas, duodenum
  - Right: IVC, azygos vein
  - Left: sympathetic trunk
- Branches:
  - Paired visceral: suprarenal, renal, gonadal arteries
  - Unpaired visceral: celiac trunk, SMA, IMA
  - Paired abdominal wall: subcostal, inferior phrenic, lumbar arteries

Epidemiology & Pathophysiology

- More common in males, incidence increases with age.
    - 90% of AAA >4 cm are atherosclerotic.
- Most are infra-renal.
- Rupture risk correlates with size.

Clinical Features

- Usually asymptomatic, found on routine exam or imaging.
- Palpable, pulsatile, expansile, nontender abdominal mass.
- Expansion may cause:
    - Abdominal or back pain
    - Pulsations felt by patient
    - Chest, lower back, or scrotal pain
- **Rupture:** Acute severe pain, hypotension, requires emergency surgery.