Aortic Dissection in the Hospital Setting

Definition and Epidemiology

- Aortic dissection is a life-threatening condition characterized by a tear in the aortic intima, allowing blood to enter the media and create a false lumen. It is classified as Stanford Type A (involving ascending aorta) or Type B (distal to left subclavian artery).
- Prevalence ~2-4 per 100,000 person-years; Type A is more common (60-70% of cases). Mortality is high (50% within 48h for untreated Type A).
- Risk Factors Hypertension (70-80% of cases), connective tissue disorders, bicuspid aortic valve, smoking, male sex (2:1 ratio).
- Rare Demographics Cocaine users (vasospasm-induced), pregnancy (third trimester), iatrogenic cases post-cardiac surgery.

Pathophysiology

- Mechanisms An intimal tear, often triggered by shear stress from hypertension or weakened aortic media (e.g., Marfan syndrome), allows blood to dissect into the media, forming a false lumen. Propagation depends on pulse pressure and aortic wall integrity.
- Effects False lumen expansion compresses the true lumen, impairing organ perfusion (e.g., coronary, cerebral, renal). Rupture into pericardium or pleura causes tamponade or hemothorax.
- Molecular Pathways Cystic medial degeneration (loss of elastin, collagen) in connective tissue disorders; TGF-β dysregulation in Marfan syndrome. Hypertension induces MMP-2/9 activation, degrading aortic matrix.
- Key Pathway Intimal tear → False lumen formation → Aortic wall stress → Propagation or rupture → Organ ischemia or tamponade.

Causes

Category	Common Causes	Rare Causes	Notes
Degenerative	Hypertension, atherosclerosis	Syphilis, aortitis (Takayasu)	HTN: Most common trigger; syphilis causes endarteritis
Connective Tissue	Marfan syndrome, Ehlers-Danlos	Loeys-Dietz, Turner syndrome	Marfan: Fibrillin-1 mutation, TGF-β dysregulation

Category	Common Causes	Rare Causes	Notes
Congenital	Bicuspid aortic valve, coarctation	Familial thoracic aortic aneurysm	Bicuspid valve: 5-10% of cases
Traumatic	Blunt chest trauma (MVA)	Iatrogenic (coronary angiography)	Trauma: Deceleration injury at ligamentum arteriosum
Drug-Related	Cocaine, amphetamines	Energy drinks (vasospasm)	Cocaine: Acute HTN, vasospasm

Clinical Presentation

- Symptoms
  - Sudden, severe “tearing” chest pain (80-90%), radiating to back
  - Syncope (10%, Type A with tamponade or stroke)
  - Dyspnea (heart failure, aortic regurgitation)
  - Rare Neurologic deficits (stroke, spinal ischemia), abdominal pain (mesenteric ischemia)
- Exam
  - Pulse deficit (unequal pulses, 20-30% of Type A)
  - Aortic regurgitation murmur (50% of Type A, diastolic at right sternal border)
  - Hypertension (70% Type B) or hypotension (20% Type A, tamponade)
  - Rare Horner syndrome (carotid dissection), vocal cord paralysis (left recurrent laryngeal nerve)
- Red Flags
  - Shock (SBP <90 mmHg), new murmur, focal neurologic deficits, pulse asymmetry

Labs and Studies

- Labs
  - D-dimer >500 ng/mL (sensitivity 95%, non-specific), peaks within 6h
  - CBC Anemia (rupture), leukocytosis (stress response)
  - CMP Elevated Cr (renal ischemia), lactate >2 mmol/L (organ hypoperfusion)
  - Advanced Troponin (coronary occlusion), miRNA-23a (research biomarker)
- Imaging
  - CT Angiography (CTA) Gold standard; sensitivity 98%, shows false lumen, entry tear, branch vessel involvement
  - Transesophageal Echo (TEE) Bedside option; 95% sensitivity, ideal for unstable patients or Type A
  - MRI Angiography High specificity (99%), limited by time; used for follow-up or pregnancy

    - CXR Widened mediastinum (60-80%), abnormal aortic contour, not diagnostic
    - Advanced Intravascular ultrasound (IVUS) for intraoperative assessment, PET-CT for aortitis
- Other
    - EKG Ischemia (10%, coronary occlusion), low voltage (tamponade)
    - Transthoracic Echo (TTE) Pericardial effusion, aortic root dilation

Diagnosis

- Criteria
    - Acute chest pain (tearing, radiating) + imaging confirmation (CTA/TEE showing false lumen or intimal flap).
- Differential
    - Myocardial infarction, pulmonary embolism, esophageal rupture, pericarditis, pneumothorax.
- Flowsheet
    - Step 1 Stabilize ABCs Hypotension → Fluids, blood; suspect tamponade or rupture
    - Step 2 History/Exam Tearing pain, pulse deficit, new murmur; assess for malperfusion (neuro, renal)
    - Step 3 Labs D-dimer, troponin, lactate to guide urgency; rule out ACS
    - Step 4 Imaging CTA (first-line), TEE if unstable, MRI if pregnancy or contrast allergy
    - Step 5 Classify Stanford Type A (ascending) vs. Type B (distal); assess complications (tamponade, AR)

Treatment

- General Principles
    - Reduce aortic wall stress (HR, BP), prevent propagation, and address complications (rupture, malperfusion).
    - Supportive Care
    - IV Access Large-bore lines for resuscitation
    - Pain Control Morphine 2-4 mg IV q5-10min PRN (avoid NSAIDs)
    - Monitoring Telemetry, arterial line (BP q5min), neuro checks q1h
- Specific Therapies
    - Type A (Ascending) Emergency surgery (aortic root replacement, graft); mortality 20-30% without surgery

    - Type B (Uncomplicated) Medical management; beta-blocker (esmolol 50-200 mcg/kg/min IV, target HR <60), nitroprusside (0.5-2 mcg/kg/min, SBP 100-120 mmHg)
    - Type B (Complicated) Thoracic endovascular aortic repair (TEVAR) for malperfusion, rupture; open surgery if TEVAR unavailable
    - Rare Causes Cocaine-induced (benzodiazepines for HTN), aortitis (steroids post-infection control)
    - Advanced Fenestration (percutaneous false lumen decompression), branched stent grafts for arch dissection
- Management of Complications
    - Tamponade Pericardiocentesis (avoid if stable, delays surgery)
    - Coronary Occlusion PCI or CABG intra-op
    - Malperfusion Endovascular stenting or surgical bypass
- Monitoring
    - CTA/MRI q6-12 months for Type B (chronic phase)
    - BP control lifelong (SBP <120 mmHg, ACEi or ARB)

Complications

- Acute
    - Aortic Rupture Hemothorax, tamponade (mortality >50%)
    - Malperfusion Syndromes Coronary (MI), cerebral (stroke), renal (AKI), mesenteric (ischemia)
    - Aortic Regurgitation Acute heart failure, cardiogenic shock
- Long-Term
    - Aneurysm Formation Chronic false lumen expansion (20-40% of Type B)
    - Recurrent Dissection 5-10% within 10 years
    - Rare End-organ fibrosis (chronic ischemia), paraplegia (spinal artery occlusion)

Clinical Scenarios

Case 1 Acute Type A Dissection

- Presentation 55 y/o M with hypertension presents with sudden tearing chest pain radiating to back, syncope. Vitals BP 160/90 left arm, 100/60 right arm, HR 110, RR 20. Exam Pulse deficit, diastolic murmur.
- Labs/Studies CTA Ascending aorta dissection, pericardial effusion. D-dimer 2000 ng/mL, troponin 0.5 ng/mL.
- Interpretation Type A dissection with aortic regurgitation, high rupture risk.

- Management Esmolol 100 mcg/kg/min IV, nitroprusside 1 mcg/kg/min, urgent cardiothoracic surgery consult. TEE intra-op confirms AR. Aortic root replacement performed. ICU monitoring post-op.

Case 2 Uncomplicated Type B Dissection

- Presentation 65 y/o F with smoking history presents with severe back pain for 4h. Vitals BP 180/100, HR 90, RR 18. Exam No pulse deficit, normal cardiac exam.
- Labs/Studies CTA Distal aortic dissection (beyond left subclavian). D-dimer 800 ng/mL, Cr 1.2 mg/dL.
- Interpretation Uncomplicated Type B dissection.
- Management Labetalol 10-20 mg IV q10min (target SBP <120, HR <60), transition to metoprolol 50 mg PO BID. Admit to telemetry. CTA follow-up in 48h. Discharge with BP control plan.

Case 3 Cocaine-Induced Dissection (Rare)

- Presentation 40 y/o M with cocaine use presents with chest pain, agitation. Vitals BP 220/130, HR 120, RR 22. Exam Equal pulses, no murmur, diaphoresis.
- Labs/Studies CTA Type B dissection, no malperfusion. Urine drug screen positive for cocaine. Lactate 3 mmol/L.
- Interpretation Cocaine-induced Type B dissection, hypertensive crisis.
- Management Lorazepam 2 mg IV q15min for agitation, nitroglycerin 5-20 mcg/min IV (avoid beta-blockers initially). Vascular surgery consult for TEVAR if progression. Addiction counseling referral.

Expert Tips

- Use CTA over TEE in stable patients; TEE is faster for unstable Type A but requires sedation
- Avoid beta-blockers alone in cocaine-induced dissection; reflex tachycardia worsens shear stress
- Suspect dissection in young patients with chest pain and connective tissue disorder stigmata (e.g., lens dislocation in Marfan)
- Monitor for malperfusion hourly; lactate >4 mmol/L or rising Cr signals urgent intervention
- Consider Loeys-Dietz syndrome in recurrent dissections; genetic testing (TGFBR1/2) guides surveillance
- Pitfall Misdiagnosing as ACS; pulse deficit or widened mediastinum on CXR prompts CTA
- Advanced Intraoperative IVUS improves stent placement; miRNA panels (e.g., miR-29) may predict progression

Key Pearls

- Tearing chest pain with pulse deficit or new murmur is dissection until proven otherwise
- CTA is diagnostic gold standard; D-dimer >500 ng/mL supports but does not confirm
- Type A requires emergent surgery; Type B is often medical unless complicated
- Control HR (<60) and BP (<120 mmHg) to reduce aortic stress
- Rare causes like cocaine or Loeys-Dietz require tailored management

References

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