

# Chapter 72

## Approach to Aortic Dissection in the ICU



### 72.1 Introduction

Aortic dissection, the most common of the acute aortic syndrome, is a life-threatening condition that demands prompt diagnosis and management in the intensive care unit (ICU). It occurs when a tear in the intimal layer of the aorta allows blood to enter the medial layer, creating a false lumen that compromises blood flow and weakens the vessel wall. This can result in catastrophic complications such as aortic rupture, aortic regurgitation, myocardial ischemia, cardiac tamponade, acute stroke, malperfusion of critical organs, or death. Early identification and treatment are crucial to improve patient outcomes [1] [Ref: Algorithm 72.1].

### 72.2 Definition

Aortic dissection is defined as acute if it is during the first 2 weeks after symptom onset or chronic if it is beyond the second week. It has also been divided into four temporal types by the International Registry of Acute Aortic Dissection (IRAD): hyperacute (<24 h), acute (2–7 d), subacute (8–30 d), and chronic (>30 d).

In similar lines the Society of Thoracic Surgeons and Society for Vascular Surgery have also categorized aortic dissection into four temporal types: hyperacute (<24 h), acute (1–14 d), subacute (15–90 d), and chronic (>90 d).

## 72.3 Risk Stratification

### 72.3.1 Classification Systems

Aortic dissections are classified to guide management strategies and predict outcomes. The two primary classification systems are the Stanford and DeBakey systems.

#### Stanford Classification:

- Type A: Involves the ascending aorta and may extend to the arch and descending aorta
- Type B: Involves only the descending aorta distal to the left subclavian artery, without involvement of the ascending aorta

#### DeBakey Classification:

- Type I: Originates in the ascending aorta, involves the arch, and often extends beyond the arch distally
- Type II: Confined to the ascending aorta
- Type III: Originates in the descending aorta and extends distally (type IIIa is limited to the thoracic aorta; type IIIb extends below the diaphragm)

Including both classifications provides additional granularity, particularly useful in surgical planning and prognostication.

### 72.3.2 Risk Factors and Genetic Predispositions

Identifying risk factors is essential for clinical suspicion and early diagnosis.

- Hypertension: The most common risk factor, contributing to intimal tearing due to increased shear stress.
- Genetic Predispositions:
  - Marfan Syndrome: A connective tissue disorder caused by mutations in the FBN1 gene, leading to cystic medial necrosis and weakening of the aortic wall.
  - Loeys-Dietz Syndrome and Ehlers-Danlos Syndrome Type IV: Other connective tissue disorders associated with aortic dissection.
- Bicuspid Aortic Valve (BAV): Patients with BAV have a higher incidence of aortopathy due to abnormal aortic wall stress.
- Familial Thoracic Aortic Aneurysm and Dissection (FTAAD): Genetic mutations (e.g., in ACTA2, MYH11 genes) increase susceptibility.

Understanding these predispositions is crucial, as the ACC/AHA guidelines recommend lower thresholds for surgical intervention in patients with these conditions due to their higher risk of dissection at smaller aortic diameters.

## 72.4 Management

### 72.4.1 Consider Other Differential Diagnoses

- Description: Rule out other life-threatening causes of acute chest or back pain, such as myocardial infarction, pulmonary embolism, or acute pericarditis.
- Rationale: Misdiagnosis can delay critical treatment. Clinical signs such as tearing pain, malperfusion, or syncope may increase suspicion of aortic dissection, but an electrocardiogram (ECG), cardiac biomarkers, chest X-ray, and D-dimer can help exclude alternative diagnoses.
- Key Consideration: Initiating anticoagulation in suspected acute coronary syndrome (ACS) without recognizing aortic dissection could worsen the condition, potentially leading to fatal hemorrhage.

### 72.4.2 Assess Symptoms of Aortic Dissection

- Key Question: Does the patient have sudden, severe chest or back pain with a “tearing” or “ripping” quality or signs of malperfusion?
- Description: Classic symptoms include acute, severe pain radiating to the back, abdomen, or legs, and malperfusion syndromes such as limb ischemia, renal failure, mesenteric ischemia, or neurological deficits.
- Rationale: These symptoms are characteristic of aortic dissection and should prompt immediate evaluation. Absence of typical pain does not exclude the diagnosis, especially in patients with risk factors [2].

### 72.4.3 Evaluate Risk Factors

- Key Risk Factors: Hypertension, connective tissue disorders (e.g., Marfan syndrome), bicuspid aortic valve, familial history of aortic disease, previous cardiac surgery, or a history of aortic aneurysm.

### 72.4.4 Perform Advanced Imaging

- Bedside Transesophageal Echocardiography (TEE):
- When Indicated: Immediate bedside TEE is the preferred diagnostic modality as it allows rapid, detailed visualization of the proximal aorta, aortic valve, and pericardial space, and can confirm the diagnosis without requiring patient transport.
- Aortic diameter measurements should be obtained perpendicular to the long axis of the aorta at specified segmental locations, with measurements also taken at the locations of any abnormalities.

- Computed Tomography Angiography (CTA):
  - CTA of the chest, abdomen, and pelvis is the gold standard for diagnosing aortic dissection as it provides high-resolution, three-dimensional imaging of the entire aorta, allowing precise localization of the dissection, evaluation of branch vessel involvement, and differentiation between Type A and Type B dissections. However, it requires iodinated contrast and radiation exposure. Thus, one must ensure that the renal function is adequate.
- Magnetic Resonance Imaging (MRI):
  - MRI is an alternative for patients with contraindications to iodinated contrast or when radiation exposure is a concern. Drawbacks of MRI are limited availability, longer scan times, and contraindications in patients with certain implants or unstable conditions.
- 4D Flow MRI:
  - Provides time-resolved, three-dimensional imaging of blood flow dynamics within the aorta as it offers insights into flow patterns that may contribute to dissection progression or aneurysm formation.
- Automated Aortic Measurement Systems:
  - Utilize artificial intelligence algorithms to assess aortic dimensions accurately. It enhances detection of subtle changes in aortic size, aiding in early diagnosis and surveillance.

It is neither specific nor sensitive to diagnose aortic dissection. However, there are some findings that may raise suspicion. Mediastinal widening, disruption of the normally distinct contour of the aortic knob, “Calcium sign,” which appears as a separation of the intimal calcification from the aortic wall of >5 mm, double density appearance within the aorta, tracheal deviation to the right, and deviation of the nasogastric tube to the right are few findings that are suggestive of aortic dissection.

#### **72.4.5 Classify the Dissection**

- Stanford and DeBakey Classifications: Use both systems to determine the extent and location of the dissection.

### **72.5 Aortic Dissection Risk Scoring System**

Acute aortic dissection risk scoring systems (e.g., aortic dissection detection risk score [AAD-RS] or aorta simplified score [AORTAs]) can aid in the diagnostic evaluation of patients presenting with aortic dissection.

**Table 72.1** Acute aortic dissection detection risk score (ADD-RS) components

| High-risk conditions                               | High-risk pain features  | High-risk examination features                        |
|--|--|---|
| Marfan syndrome or other connective tissue disease | Chest, back, or abdominal pain described as:                     | Pulse deficit or systolic blood pressure differential |
| Family history of aortic disease                   | Abrupt onset, severe in intensity, ripping or tearing in quality | Focal neurologic deficit (with pain)                  |
| Known aortic valve disease                         |  | Murmur of aortic regurgitation (new, with pain)       |
| Recent aortic manipulation                         |  | Hypotension or shock state                            |
| Known thoracic aortic aneurysm                     |  |   |

**Table 72.2** AORTAs simplified pretest probability score for aortic dissection

| Clinical item      | Points |
|--------------------|--------|
| Hypotension/shock  | 2      |
| Aneurysm           | 1      |
| Pulse deficit      | 1      |
| Neurologic deficit | 1      |
| Severe pain        | 1      |
| Sudden-onset pain  | 1      |

AAD-RS: For each risk category, 1 point is assigned if  $\geq 1$  risk factors are present. Consequently, the total ADD-RS will range from 0 to 3. An ADD-RS of 0 points is low risk; 1 point is moderate risk; and 2 to 3 points is high risk (Table 72.1).

Aorta Simplified Score (AORTAs) Pretest Probability Assessment Score: The points are summed, and a total score of 0 to 1 point is low-probability of aortic dissection, where a total of  $\geq 2$  points is high probability (Table 72.2).

## 72.6 Management Based on Classification

### 1. Type A Dissection (Ascending Aorta Involved)

- Urgency: Type A dissections are surgical emergencies due to the risk of aortic rupture, pericardial tamponade, acute aortic regurgitation, and coronary artery involvement.
- Treatment:
  - Hemodynamic Stabilization: Arterial line insertion for continuous blood pressure (BP) monitoring.
  - Blood Pressure Control: Target systolic BP  $<120$  mmHg and heart rate 60–80 beats per minute using intravenous beta-blockers (e.g., esmolol, labetalol). If beta-blockers are contraindicated (e.g., acute AR, heart block,

- or bradycardia), consider calcium channel blockers (verapamil/diltiazem). Add intravenous vasodilators if BP is not controlled by beta blockers alone.
- Pain Management: Administer analgesics (e.g., morphine) to reduce sympathetic stimulation. Avoid ketorolac as it may cause hypertension.
  - Surgical Intervention: Type A is associated with high risk of life-threatening complications. Thus, it is prudent to go for surgical intervention if there is a proven or suspicion of Type A dissection. Type A dissection presenting with malperfusion syndrome is an absolute indication for immediate surgical intervention.
    - Emergent Surgery: Open surgical repair involving resection of the intimal tear, obliteration of the false lumen, and restoration of aortic continuity.
    - Considerations: Involvement of the aortic valve or coronary arteries may necessitate additional procedures (e.g., aortic valve replacement, coronary artery bypass grafting).
  - If Surgery Is Not Feasible:
    - Medical Management: Reserved for patients with prohibitive surgical risk; involves strict blood pressure control and close monitoring.
    - Palliative Care: Focuses on symptom management and quality of life when neither surgery nor medical therapy is appropriate.
  - Management in Specific Populations:
    - Pregnant Patients: Requires a multidisciplinary team involving obstetricians, cardiothoracic surgeons, and anesthesiologists. Early surgical intervention during the first and second trimester is often recommended, with consideration of fetal viability and maternal health. In the third trimester, urgent cesarean section followed by aortic surgery is recommended.
2. Type B Dissection (Descending Aorta Only)
- Uncomplicated Type B Dissections:**
- Medical Management:
    - Blood Pressure Control: Achieve target systolic BP <120 mmHg and heart rate 60–80 bpm using intravenous beta-blockers. Vasodilators (e.g., nitroprusside) may be added if blood pressure remains elevated.
    - Monitoring: Close hemodynamic monitoring and serial imaging to assess for complications.
- Complicated Type B Dissections:**
- Indications for Intervention: Evidence of malperfusion syndromes (renal failure, mesenteric ischemia, limb ischemia), aortic rupture, rapid expansion, or persistent/refractory pain.
  - Endovascular Repair (Endovascular stent grafting) and TEVAR (Thoracic endovascular aortic repair).
    - Description: Placement of a stent graft to cover the intimal tear and redirect blood flow into the true lumen.

- Advantages: Less invasive than open surgery, shorter recovery times, and reduced perioperative morbidity and mortality.
  - Considerations: Requires suitable vascular anatomy; long-term durability is still under investigation.
- Surgical Intervention: Open repair may be necessary if TEVAR is contraindicated or not feasible due to anatomical considerations.
- Emerging Recommendations:
  - Early TEVAR: Recent studies suggest benefits of early TEVAR even in uncomplicated Type B dissections to promote aortic remodeling and reduce long-term complications.
- Special Considerations:
  - Pregnant Patients: Management is predominantly medical, balancing maternal and fetal risks. TEVAR is generally avoided due to radiation exposure [3].

## 72.7 Incorporate Advanced Pharmacological Guidelines

- Beta-Blocker Therapy:
  - Nuances: Select agents with rapid onset and short half-life (e.g., esmolol) for titration; consider nonselective beta-blockers for additional vasodilatory effects.
  - Contraindications: In patients with asthma or severe bradycardia, use calcium channel blockers (e.g., diltiazem) as alternatives.
- Vasodilators:
  - Usage: Add vasodilators (e.g., nitroprusside, nicardipine) if blood pressure remains elevated despite beta-blockade.
  - Monitoring: Watch for reflex tachycardia; beta-blockers should be initiated first to prevent this effect.
- Considerations for Complicated Cases:
  - Malperfusion Syndromes: Inotropes may be necessary to support end-organ perfusion but should be balanced against increased aortic wall stress.

## 72.8 Focus on Complication Mitigation

1. Malperfusion Syndromes
  - Renal Ischemia:
    - Management: Revascularization via TEVAR or surgical fenestration; renal replacement therapy if necessary.

- Limb Ischemia:
  - Management: Surgical or endovascular intervention to restore perfusion; fasciotomy if compartment syndrome develops.
- Mesenteric Ischemia:
  - Management: Emergent intervention due to high mortality; requires prompt revascularization.

## 2. Stroke Prevention

- Risk Factors: Extension of the dissection into carotid arteries or hypotension leading to cerebral hypoperfusion.
- Management: Blood pressure optimization; surgical repair if dissection involves cerebral vessels.

## 3. Aortic Rupture

- Emergency: Immediate surgical or endovascular repair is required.
- Prevention: Strict blood pressure control and timely intervention for high-risk dissections.

## 72.9 New Insights from Recent Guidelines

### 1. Reduced Thresholds for Intervention

- Indexed Aortic Diameter: Intervention thresholds may be lower for patients with smaller body size or genetic predispositions.
- ACC/AHA Recommendations: Surgery may be considered at an aortic diameter of 5.0 cm or even smaller in patients with Marfan syndrome or other high-risk features.

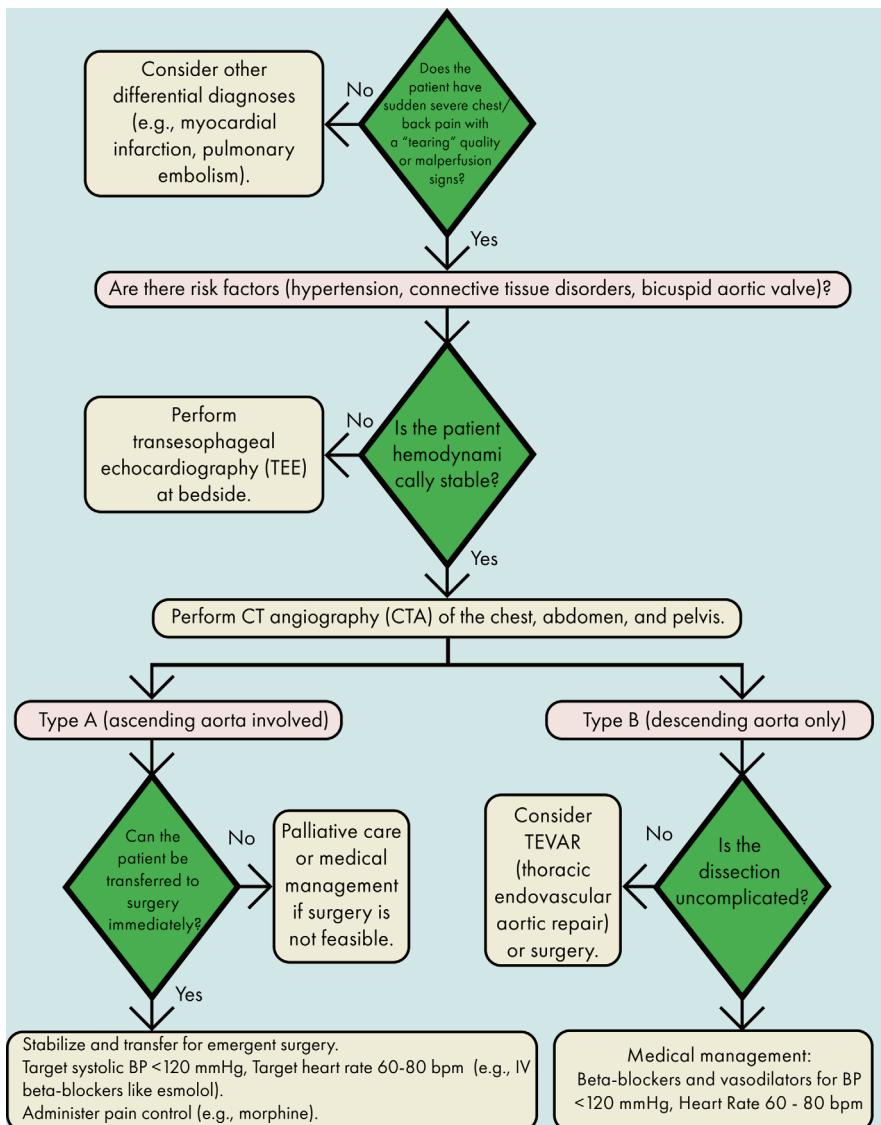
### 2. Acute Aortic Syndrome Spectrum

- Intramural Hematoma:
  - Description: Hemorrhage within the aortic wall without intimal tear.
  - Management: Similar to aortic dissection; Type A requires surgery; Type B may be managed medically or with TEVAR.
- Penetrating Atherosclerotic Ulcer:
  - Description: Ulceration of atherosclerotic plaque penetrating the internal elastic lamina.
  - Management: Depends on symptoms and size; TEVAR may be indicated for symptomatic or enlarging ulcers.

## 72.10 Conclusion

The management of aortic dissection in the ICU demands a structured and comprehensive approach centered on early diagnosis, prompt imaging, accurate classification, and appropriate intervention. Understanding the nuances of risk stratification, including genetic predispositions and the use of both Stanford and DeBakey classification systems, guides clinical decision-making.

Type A dissections require emergent surgical repair due to the high risk of mortality, while Type B dissections may be managed medically or with endovascular techniques depending on the presence of complications. Strict blood pressure control is pivotal in all cases to prevent progression or rupture. Long-term surveillance and management, including regular imaging and blood pressure optimization, are essential to prevent re-dissection and other complications. Incorporating the latest guidelines and leveraging a multidisciplinary team approach enhance patient care and outcomes. By staying abreast of emerging diagnostic tools and evolving management strategies, clinicians can improve the prognosis for patients with this critical condition.

**Algorithm 72.1: Approach to aortic dissection in the ICU**


## Bibliography

1. Isselbacher EM, Preventza O, Hamilton Black J, Augoustides JG, Beck AW, Bolen MA, et al. ACC/AHA guideline for the diagnosis and Management of Aortic Disease: a report of the American Heart Association/American College of Cardiology Joint Committee on clinical practice guidelines. *Circulation.* 2022;146(24):e334–482.
2. Erwin Iii JP, Committee ACCSSO, Cibotti-Sun M, Elma M. Aortic disease guideline-at-a-glance. *J Am Coll Cardiol.* 2022;80(24):2348–52.
3. Force M, Czerny M, Grabenwoger M, Berger T, Aboyans V, Della Corte A, et al. EACTS/STS guidelines for diagnosing and treating acute and chronic syndromes of the aortic organ. *Ann Thorac Surg.* 2024;118(1):5–115.
4. Mazzolai L, Teixido-Tura G, Lanzi S, Boc V, Bossone E, Brodmann M, et al. ESC guidelines for the management of peripheral arterial and aortic diseases. *Eur Heart J.* 2024;45(36):3538–700.

**Part VII**  
**Pulmonary**