

# Recognizing aortic dissection: *A race against time*

To save the patient's life, the healthcare team must be able to identify this perilous condition in mere moments.

By Rose M. Coughlin, MSN, RN, CNS-BC

**IT CAN STRIKE** without warning, causing death before the victim makes it to the hospital. In fact, about 40% of victims die immediately. Despite recent medical advances, overall mortality is 27% even among those lucky enough to reach the emergency department.

The true incidence of aortic dissection is hard to gauge, as many cases go unnoticed, are misdiagnosed, or cause immediate death. By some estimates, it strikes 5 to 30 of every million Americans every year. Roughly 2,000 new cases are diagnosed annually in the United States—but the number of undiagnosed cases is at least 10 times higher.

Being male, black, and older than age 40 increases the risk. Aortic dissection is about two to five times more common in males. Its incidence is higher in blacks than in whites, and lower in Asians. Roughly 75% of dissections strike between ages 40 and 70, peaking between ages 50 and 65.

With mortality culminating so soon after symptom onset, rapid recognition may be the patient's only hope. Healthcare providers must be able to recognize early

signs and symptoms to prevent delays in diagnosis and treatment.

## Inside the aorta

Understanding the aorta's anatomy is crucial to appreciating what a patient with aortic dissection is up against. The two main segments of the aorta are the thoracic aorta and abdominal aorta. (See *Anatomy of the aorta*.)

## How a dissection occurs

An aneurysm results from increased pressure, dilation, and thinning of the aortic wall. As elastic fibers in

the media (the aorta's thick middle layer) are damaged and the vessel wall weakens, bulging develops. This, in turn, widens the wall beyond its normal diameter of 2 to 3.5 cm. If the wall continues to widen, a tear arises in the intima (the aorta's thin inner layer). Blood passes through the tear, separating the intima from the surrounding media and creating a false lumen. The dissection may extend distally and proximally to the initial tear, which may cause severe blood loss, nerve damage, stroke, myocardial infarction (MI), and death. (See *A developing dissection*.)

Approximately 65% of dissections originate within the ascending aorta, 20% within the descending aorta, 10% within the aortic arch, and the remainder within the abdominal aorta.

## Classifications of dissection

An aortic dissection can be either acute or chronic. In acute dissection, symptoms have been present for less than 2 weeks; in chronic dissection, for 2 weeks or longer.

Another way to classify aortic dissection is by using either the Stanford or DeBakey classification system. The Stanford system is based on the site of the intimal tear; the DeBakey system, on the dissection's anatomic location. The Stanford system is more commonly used. (See *Classifying aortic dissections*.)

## Causes of aortic dissection

Hypertension is present in roughly two-thirds of aortic dissections. However, persons younger than age 40 with dissection are less likely to have hypertension and more likely to have a bicuspid aortic valve or a connective tissue disease (such as Marfan syndrome) or to have had previous aortic surgery. Approximately half of aortic dissections in women younger than age 40 occur during the third trimester of pregnancy. (See *Predisposing factors for aortic dissection*.)



## LEARNING OBJECTIVES

1. Describe the classifications of aortic dissection.
2. List the signs and symptoms of aortic dissection.
3. Discuss surgical and medical treatment of aortic dissection.
4. Explain the follow-up care needed for patients who've had aortic dissections.

---

## Anatomy of the aorta

### Recognizing signs and symptoms

Aortic dissection can cause a wide variety of presentations, depending on the area of the aorta affected. About 85% of patients experience intense chest pain of abrupt onset. Commonly, the pain migrates away from the original location as the dissection extends along the aorta. However, dissection is painless in about 10% of patients—especially those with Marfan syndrome or those in whom the dissection has caused neurologic complications.

Suspect dissection if a patient presents with signs and symptoms of acute MI (AMI) but lacks classic electrocardiographic (ECG) changes of MI. Unlike AMI, pain from an aortic dissection comes on suddenly. Anterior chest pain that mimics AMI pain usually is associated with aortic arch or aortic root dissection. Dissection interrupts blood flow to the coronary arteries (most often the right coronary artery), leading to inferior-wall MI. Signs and symptoms of cardiac tamponade—including muffled or distant heart sounds, hypotension, jugular venous distention, and pulsus paradoxus—must be recognized early for the patient to have a chance of surviving. (See *Presentation based on dissection type*.)

### Blood pressure changes

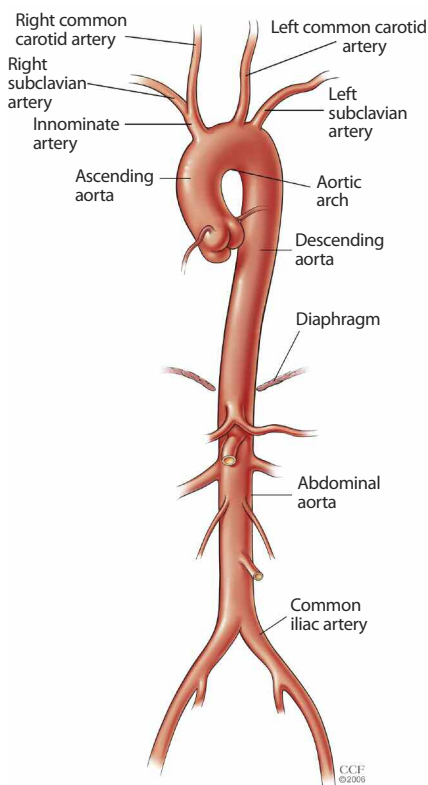
At presentation, hypertension is likely with Stanford type B dissections. On the other hand, hypotension is most common with type A dissection, and can result from cardiac tamponade or aortic regurgitation. Variations in pulse, blood pressure, or both are a significant finding stemming from impaired blood flow to an organ or limb secondary to dissection. A blood pressure differential of more than 20 mm Hg between the right and left arms strongly suggests aortic dissection.

### Neurologic and respiratory deficits

The most common neurologic

The aorta has two main segments—thoracic and abdominal.

- The *thoracic aorta* is composed of the ascending aorta, aortic arch, and descending aorta, which lies above the diaphragm. The ascending aorta is the most vulnerable part of the aorta, as branches from the aortic arch supply blood to the head and upper body. Dissections here are almost twice as common as those of the descending aorta. The descending aorta ends at the diaphragm; its branches supply blood to the distal spinal cord.
- The *abdominal aorta* begins at the diaphragm and ends at the visceral vessels (celiac artery, superior and inferior mesenteric arteries, and renal arteries).



deficits in aortic dissection are syncope and altered mental status, seen in about 20% of patients. Syncope commonly signals such complications as cardiac tamponade, disrupted blood flow to cerebral vessels, or cerebral baroreceptor activation. Peripheral nerve ischemia may cause tingling or numbness of the extremities. Laryngeal nerve compression may lead to coughing, hoarseness, or voice loss. Heart failure or pressure on the trachea,

main bronchus, or lungs may cause dyspnea.

### Diagnostic studies

Prompt diagnosis of aortic dissection requires a high index of suspicion. The healthcare team must rapidly identify the dissection, pinpoint its location, establish its classification, and determine if the patient needs emergency surgical repair.

### Electrocardiography

A 12-lead ECG should always be done to help differentiate aortic dissection from AMI. In dissection, expect the 12-lead ECG to be normal or to show nonspecific ST-segment or T-wave changes. If the dissection interrupts blood flow to the right coronary artery (as in a Stanford type A dissection), expect ST-segment elevation in the inferior leads.

### Chest X-ray

Typically, a chest X-ray reveals mediastinal widening and possibly pleural effusion, cardiomegaly, or heart failure if severe aortic regurgitation is present. However, in more than 10% of documented acute aortic dissections, the chest X-ray is normal.

### Blood tests

When the dissection extends to the coronary arteries and causes myocardial ischemia, cardiac biomarkers are elevated. Elevated blood urea nitrogen and creatinine levels indicate renal artery involvement. Low hemoglobin and hematocrit suggest the dissection is leaking or has ruptured. Expect the physician to order blood typing and crossmatching, anticipating the need to transfuse packed red blood cells.

### Imaging studies

Goals of imaging studies are to confirm the diagnosis, determine extent and classification of the dissection, and find evidence of bleeding. Most patients require more than one imaging study. Choice of imaging studies varies

## Presentation based on dissection type

Patient presentation may vary according to whether the aortic dissection involves the ascending or descending aorta.

### Stanford type A (DeBakey types I and II)

- Acute aortic regurgitation (diastolic murmur)
- Acute myocardial ischemia or infarction
- Anterior chest pain (with ascending aortic dissection) radiating to neck, throat or jaw (with aortic arch dissection)
- Cardiac tamponade or sudden cardiac death
- Hemothorax
- Hypotension
- Neurologic deficits (stroke, altered consciousness, syncope)
- Pericardial effusion
- Pulse deficits (carotid, brachial, or femoral)
- Vocal cord paralysis, hoarseness

### Stanford type B (DeBakey type III)

- Diaphoresis
- Hypertension
- Interscapular pain (described as tearing or ripping) radiating to lower back or abdomen
- Lower extremity ischemia, limb paresthesia or paralysis
- Mesenteric ischemia or infarction
- Nausea and vomiting
- Renal insufficiency
- Spinal cord ischemia

among facilities and hinges on availability, operator expertise, and patient stability. Commonly used studies include computerized tomography, magnetic resonance imaging, transesophageal echocardiography, transthoracic echocardiography, and aortography.

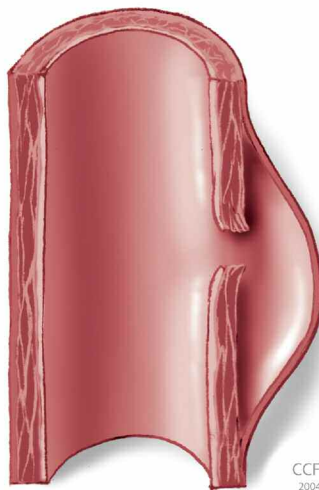
### Preoperative nursing interventions

Immediate patient transfer to the intensive care unit (ICU) is a high priority. Nursing interventions should begin as soon as aortic dissection is suspected, and typically include the following:

- Institute intubation or mechanical ventilation, as ordered, if the patient is hemodynamically unstable.
- Begin continuous cardiac monitoring. Assess for tachycardia and other irregular rhythms.
- Provide continuous blood pressure monitoring with an arterial line; desired systolic pressure is 100 to 120 mm Hg.
- Insert two large-bore I.V. lines.
- Check vital signs every 15 minutes, or according to protocol.
- Observe the patient's mental status and check for neurologic and peripheral vascular changes.
- Measure urine output frequently.

### A developing dissection

This illustration shows bulging of the aortic wall where it has become thin, weak, and dilated.



- Restrict patient activity.
- Provide reassurance and a calm environment.

### Drug therapy

The primary goals of drug therapy are to lower blood pressure (thereby decreasing intimal tearing and dissection extension) and reduce pain and anxiety. In the ICU, pa-

tients typically receive beta blockers (such as propranolol, esmolol, or labetalol), with dosages titrated as needed to reduce heart rate and blood pressure to the lowest level that maintains sufficient blood supply to the vital organs. Most patients can achieve a systolic pressure between 100 and 120 mm Hg and a heart rate of 50 to 60 bpm. If beta blockers are contraindicated, the physician may order calcium channel blockers, such as I.V. verapamil, diltiazem, or nifedipine.

If blood pressure remains uncontrolled despite beta blockers, expect the physician to add vasodilators. Nitroprusside sodium is the vasodilator of choice, but shouldn't be used alone because it can cause reflex tachycardia. Titrate the nitroprusside dosage to maintain a mean arterial pressure (MAP) of 65 to 75 mm Hg—but always start beta blocker therapy before nitroprusside.

To control pain (which can contribute to hypertension and tachycardia), expect to administer morphine sulfate.

If the patient is hypotensive, suspect cardiac tamponade, aortic rupture, or MI (or a combination); provide volume replacement, as ordered, and prepare the patient for surgery. Know that in cardiac tamponade, pericardiocentesis should be avoided, as immediate surgery is the therapy of choice. If hypotension persists, norepinephrine and phenylephrine are the preferred vasopressors because of their limited effects on shear force.

### Surgical repair

The death rate for aortic dissection is roughly 1% to 2% per hour until the patient undergoes surgery. For a Stanford type A dissection, emergency surgical repair is the preferred treatment.

Type B dissection usually is managed medically, with drugs given to control blood pressure. However, urgent surgical repair is recommended for complicated type B

## Classifying aortic dissections

The **DeBakey** aortic classification system is based on anatomic location of the dissection.

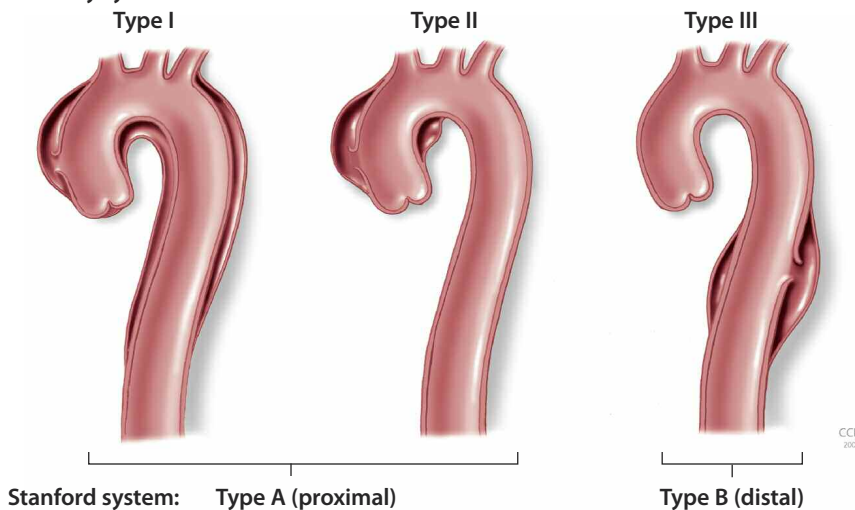
- Type I dissection involves the ascending aorta, aortic arch, and descending aorta.
- Type II is confined to the ascending aorta.
- Type III is confined to the descending aorta distal to the left subclavian artery.

The **Stanford** classification system is based on the site of the intimal tear.

- Type A dissection involves the ascending (proximal) aorta.
- Type B involves the descending (distal) aorta.

Being familiar with these classification systems helps you to understand how presenting symptoms relate to dissection location and to predict which symptoms to expect if the dissection extends. For instance, if the patient has signs and symptoms of an ascending aortic dissection (chest pain, hypotension, cardiac tamponade, or neurologic deficits) and starts to develop renal insufficiency or lower extremity ischemia, suspect that the dissection has extended distally.

**DeBakey system:**



dissections with evidence of increasing aortic diameter, compromise of major aortic branches, impending rupture, persistent pain despite pain-control measures, or bleeding into the pleural cavity.

### Elephant trunk and reimplantation procedures

The so-called elephant trunk procedure is a two-stage open surgery used for extensive aneurysms involving the ascending aorta, aortic arch, and descending aorta. In the first stage, the ascending aorta and aortic arch are replaced, leaving a segment of distal tubular graft in the descending aorta. In 6 weeks to 4 months, the patient returns for the second stage, in which the descending aorta is replaced.

Another type of open surgical repair is the modified David's reimplantation procedure. This may be

done for an aneurysm at the aortic root that has caused the aortic valve to leak. This surgery repairs the aneurysm while preserving the patient's own aortic valve.

### Minimally invasive surgery

For some patients, minimally invasive endovascular aneurysm repair (EVAR) may be an option. Usually, two small groin incisions are made, and guidewires are threaded through the femoral artery to position the endovascular stent graft at the aneurysm site. The stent graft creates a new lining in the aneurysm sac and reinforces the weak part of the aorta.

### Postoperative nursing care

Postoperative nursing interventions in the ICU or step-down unit include administering drugs, maintaining target blood pressure and heart rate, monitoring and observa-

tion, preventing skin breakdown, and providing patient teaching.

Expect to give pain medications (such as morphine sulfate) as needed for pain control; beta blockers and vasodilators (such as nitroprusside or nitroglycerin) to control heart rate and blood pressure; and norepinephrine to prevent hypotension. As ordered, maintain systolic pressure between 100 and 120 mm Hg to prevent graft occlusion and reduce pressure on the repaired aorta. Maintain MAP at 65 to 75 mm Hg and heart rate between 50 and 60 bpm.

For the first 2 or 3 days postoperatively, keep the head of the bed lower than 45 degrees and elevate the patient's legs 20 to 30 degrees, to avoid pressure on incision sites.

### Monitoring, observation, and other interventions

Assess the patient's vital signs and peripheral pulses hourly, according to facility protocol. Stay alert for increased abdominal distention and postoperative complications, such as hemorrhage, MI, arrhythmias, heart failure, cardiac tamponade, thromboembolism, renal impairment, pneumonia, cerebral or spinal cord ischemia, and stroke.

Evaluate for signs and symptoms of hypovolemia. Check chest tube drainage and drains; note drainage on dressings, and mark the boundaries. Monitor hourly fluid output, and frequently check the complete blood count for signs of bleeding and blood urea nitrogen and creatinine levels for signs of renal insufficiency.

Monitor skin condition, and take steps to prevent skin breakdown. Increase the patient's activity level gradually, as appropriate. Encourage the patient to use an incentive spirometer and to splint when coughing. Finally, discuss the plan of care with the patient and family.

### Long-term management

Typically, hospital stays range from 2 to 10 days, depending on whether the patient had open surgical re-



## Predisposing factors for aortic dissection

The factors listed below increase the risk for aortic dissection.

- **Atherosclerosis-related conditions:** hypertension, dyslipidemia
- **Chromosomal aberrations:** Turner's syndrome, Noonan's syndrome
- **Deceleration trauma:** motor vehicle accident, fall from heights
- **Hereditary connective tissue disease:** Marfan syndrome, Ehlers-Danlos syndrome
- **Hereditary or acquired aortic structural disease:** previous dissection of an aortic aneurysm, aortic coarctation, bicuspid aortic valve
- **Iatrogenic factors:** catheter- or instrument-based intervention, aortic surgery
- **Inflammatory disease associated with vasculitis:** giant cell arteritis, syphilitic arteritis
- **Other:** pregnancy, smoking, cocaine u

pair or EVAR. Patients who survive through discharge have a 5-year survival rate of up to 80% and a 10-year survival rate of about 50%. In most cases, chronic underlying disease of the aorta predisposed the patient to the dissection—and this disease persists after surgery.

After discharge, long-term management includes aggressive blood-pressure control. For most patients, the blood pressure goal is below 120/80 mm Hg to decrease the force of left ventricular contractions and lower systemic pressure. Beta blockers are preferred; for patients who can't tolerate them, calcium channel blockers may be an alternative. Drugs that reduce lipids may be ordered to help reduce high cholesterol levels.

Patients who've had EVAR require routine surveillance using serial imaging studies for further aneurysm formation, aortic dissection, or aortic valve insufficiency. They should have physician follow-up visits at 1, 3, 6, and 12 months and annually thereafter, including regular imaging evaluations.

### Patient education

Urge patients to keep all follow-up physician and imaging appointments. Instruct them to call the physician immediately to report signs or symptoms associated with aneurysm or dissection. Teach them about risk factors for dissection. Emphasize the importance of

taking antihypertensives regularly, even if their blood pressure is within normal range. Urge those who smoke to quit, and advise all patients to avoid secondhand smoke.

Recommend a diet low in sodium and cholesterol. Encourage a regular exercise routine to maintain a healthy weight. Also recommend aneurysm screening for at-risk family members—namely, those who smoke, have hypertension, or are elderly.

### Aim for rapid recognition

Whether you work in a primary- or acute-care setting, you can play a crucial role in improving the outcome of patients with aortic dissection. Life-saving interventions are possible only when alert and knowledgeable healthcare providers can instantly read the handwriting on the wall. ★

For additional information on imaging studies and surgical repair of a thoracic aortic dissection, visit [www.AmericanNurseToday.com/journal](http://www.AmericanNurseToday.com/journal).

### Selected references

- Alspach J. *Core Curriculum for Critical Care*. 6th ed. Philadelphia, PA: W.B. Saunders Co.; 2006.
- Erbel R, Alfonso F, Boileau C, et al. Diagnosis and management of aortic dissection. *Eur Heart J*. 2001;22:1642-1681.
- Klein D. Thoracic aortic aneurysms. *J Cardiovasc Nurs*. 2005;20(4):245-250.
- Mancini, M.C. Aortic Dissection. *eMedicine.com*. April 2009. <http://emedicine.medscape.com/article/425118-overview>. Accessed September 7, 2009.
- Soat, M. Aortic aneurysm: Causes, clues, and treatment options. *American Nurse Today*. 2009; 4(7); 7-9.
- Tsai T, Nienaber C, Eagle K. Acute aortic syndromes. *Circulation*. 2005;112:3802-3813.
- Wiesenfarth, J. Aortic dissection. *eMedicine.com*. November 2007. [www.emedicine.com/emerg/topic28.htm](http://www.emedicine.com/emerg/topic28.htm). Accessed February 25, 2008.
- Visit [www.AmericanNurseToday.com/journal](http://www.AmericanNurseToday.com/journal) for a complete list of selected references.

All illustrations courtesy of the Cleveland Clinic, Cleveland, Ohio.

**Rose M. Coughlin was a Clinical Nurse Specialist on the Cardiothoracic Stepdown Units at the Cleveland (Ohio) Clinic when this article was written. The planners and authors of this CNE activity have disclosed no relevant financial relationships with any commercial companies pertaining to this activity.**

## CE POST-TEST — Recognizing aortic dissection: A race against time

### Instructions

To take the post-test for this article and earn contact hour credit, please go to [www.AmericanNurseToday.com](http://www.AmericanNurseToday.com). Simply use your Visa or MasterCard to pay the processing fee. (Online: ANA members \$15; nonmembers \$20.) Once you've successfully passed the post-test and completed the evaluation form, you'll be able to print out your certificate *immediately*.

If you are unable to take the post-test online, complete the print form and mail it to the address at the bottom of the next page. (Mail-in test fee: ANA members \$20; nonmembers \$25.)

### Provider accreditation

The American Nurses Association Center for Continuing Education and Professional

Development is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation. ANA is approved by the California Board of Registered Nursing, Provider Number 6178.

Contact hours: 1.6

Expiration: 12/31/12

Post-test passing score is 75%.

ANA Center for Continuing Education and Professional Development's accredited provider status refers only to CNE activities and does not imply that there is real or implied endorsement of any product, service, or company referred to in this activity nor of any company subsidizing costs related to the activity. This CNE activity does not include any unannounced information about off-label use of a product for a purpose other than that for which it was approved by the Food and Drug Administration (FDA).