
بسم الله الرحمن الرحيم
علی خمسه

Diseases of Aorta

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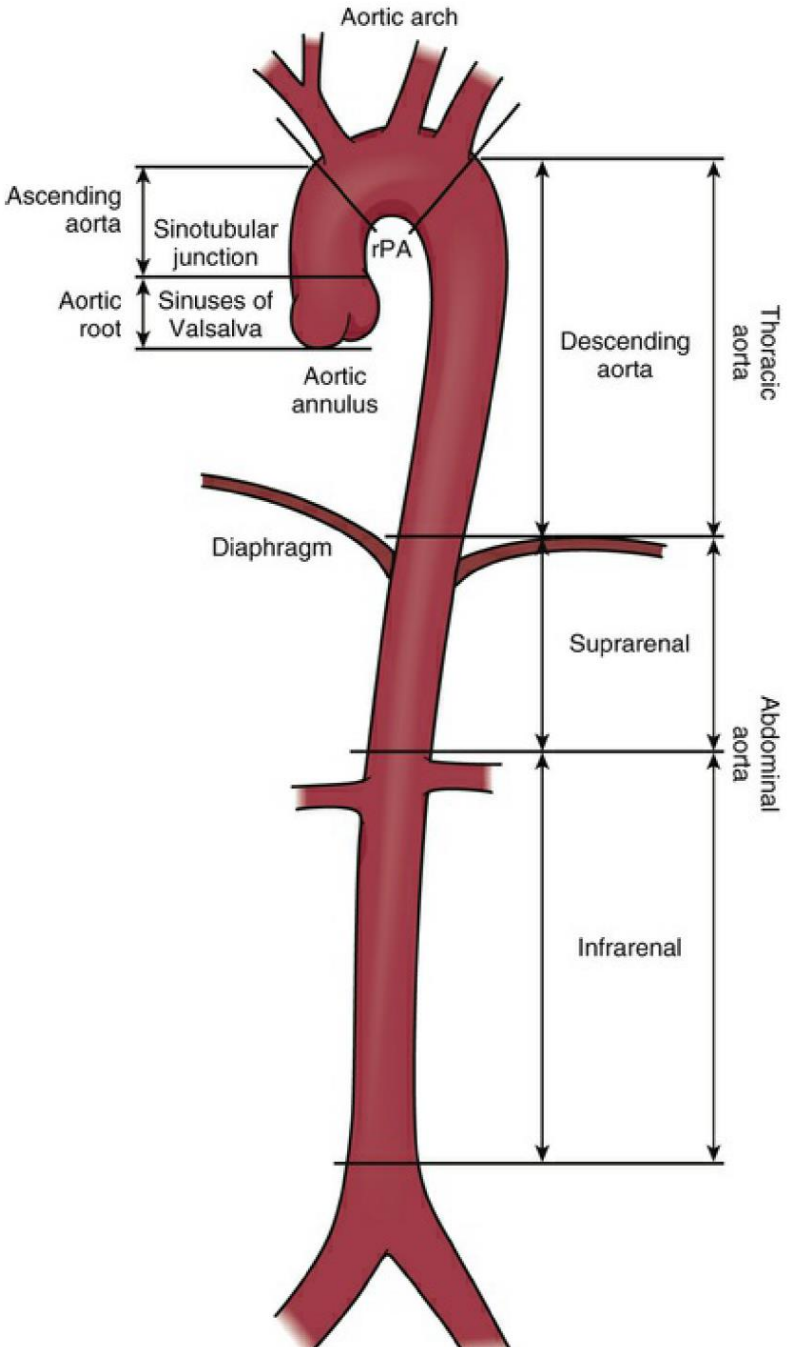
THE NORMAL AORTA


Aortic arch
Ascending aorta
Sinotubular junction
rPA
Aortic root
Sinuses of Valsalva
Aortic annulus
Descending aorta
Thoracic aorta
Diaphragm
Suprarenal
Abdominal aorta
Infrarenal

The aortic bifurcation typically occurs at the level of the umbilicus and the fourth lumbar (L4) vertebral body.

Unexplained Severe Pain?

THINK AORTA

Aortic Dissection is an emergency that is often fatal when missed

CT Scan for a definitive diagnosis

Symptoms

- Pain is the #1 symptom
- Neck, back, chest or abdomen
- Numbness or weakness in any limbs
- History of collapse

Pain characteristics can be:

- Maximal in seconds
- Migratory & transient
- Pain can be sharp, tearing, ripping

Patient Risk Factors

- Hypertension
- Aortic aneurysm
- Bicuspid aortic valve
- Familial aortic disease
- Marfans and other connective tissue disorders

Physical Examination

- Pulse deficit or vascular signs
- Neurological signs of stroke or paraplegia

Diagnostic Warning

- Chest x-ray, ECG, ultrasound & blood tests can be normal

Aortic Dissection Awareness UK in collaboration with:

Heart Research UK
Society for Cardiothoracic Surgery in Great Britain and Ireland
The Royal College of Emergency Medicine

www.thinkaorta.org

AORTIC DISSECTION

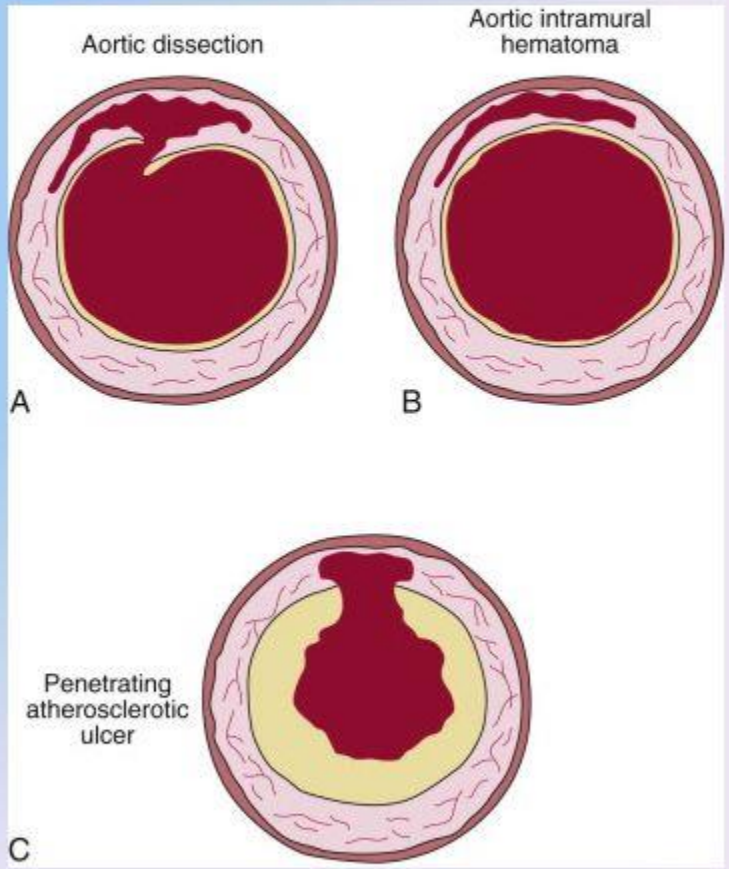
- Acute aortic syndromes include
  - classic aortic dissection,
  - aortic intramural hematoma (IMH),
  - and penetrating atherosclerotic ulcer (PAU)

- In classic aortic dissection, an intimal flap exists between the two lumina (true and false lumina).

- In 5% to 10% of acute dissection cases in Western series, bleeding in the aortic wall occurs without evidence of an intimal tear or dissection flap. This variant of aortic dissection is known as an aortic IMH.

- PAUs also lead to acute aortic syndromes.

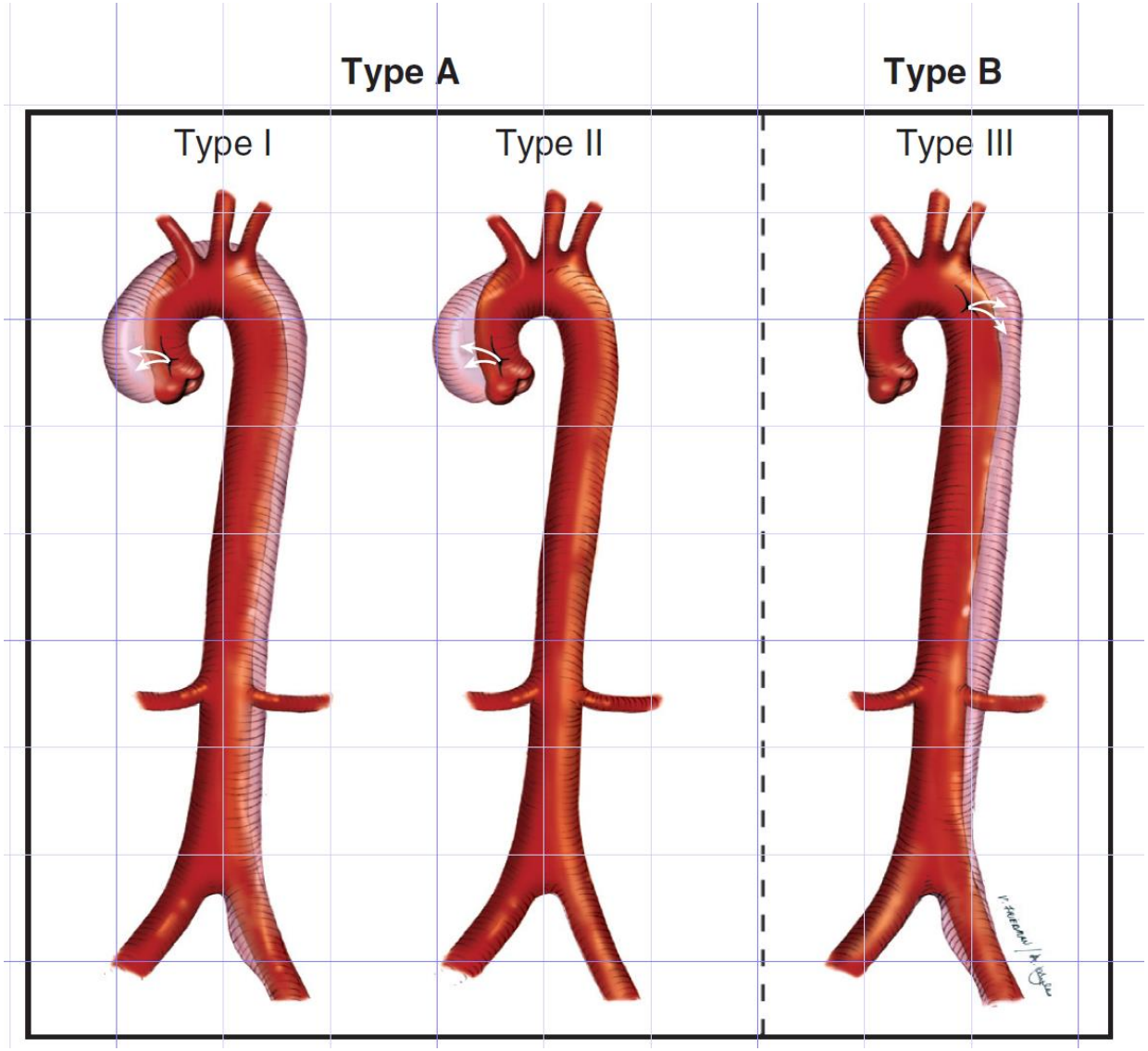
- Acute aortic syndromes consist of 3 interrelated conditions with similar clinical characteristics
- Aortic dissection
- Intramural hematoma
- Penetrating aortic ulcer



- Aortic dissections usually propagate in an antegrade direction because of the pressure wave from the aortic blood, but they occasionally extend in a retrograde direction.

- The two major classification schemes for aortic dissection
  the DeBakey classification and
  the Stanford classification

are based on the location of the dissection


Type A
Type B
Type I
Type II
Type III

- Aortic dissection may occur in the setting of a BAV that functions “normally” and, importantly, may occur years after BAV replacement.

- Aortic dissection is rarely described during late pregnancy or in the early postpartum period

Clinical Manifestations

- The most common symptom of acute aortic dissection is pain, which occurs in up to 96% of cases.

- Pain in the neck, throat, jaw, or head predicts involvement of the ascending aorta (and often the great vessels), whereas pain in the back, abdomen, or lower extremities usually indicates descending aortic involvement.

- Painless aortic dissection occurs in 6% of patients and is more common in those with
  diabetes,
  previous aortic aneurysm,
  and prior cardiac surgery.
- "Painless" aortic dissections are complicated by
  - syncope in approximately 33%,
  - by heart failure in 20%,
  - and by stroke in 11%

  and are associated with an increased mortality rate

- Acute MI related to involvement of the dissection flap in the ostium

of a coronary artery occurs in 1% to 2% of patients with acute type A aortic dissection.

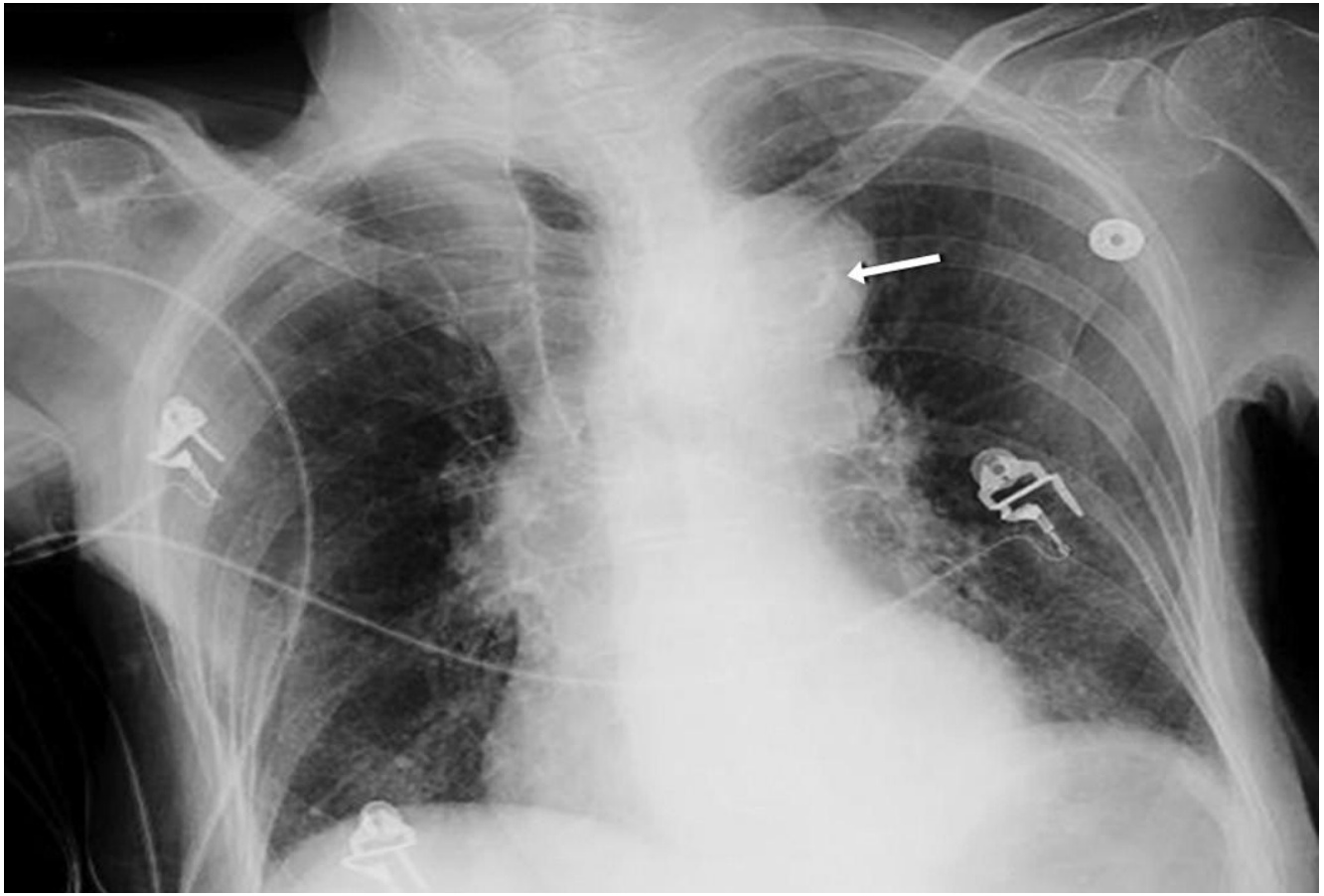
- It most commonly involves the right coronary artery and leads to acute inferior MI.

- If coronary angiography is performed in a patient with ST-segment elevation MI and no culprit lesion is found, aortic dissection should be excluded.

Laboratory Findings

- The most common abnormality seen on a chest radiograph in a patient with aortic dissection is
  - an abnormal aortic contour or widening of the aortic silhouette, which appears in 80% to 90% of cases (83% of type A; 72% of type B).

- If calcification of the aortic knob occurs, one may detect separation of the intimal calcification from the outer aortic soft tissuen border by more than 0.5 to 1.0 cm—the “calcium sign”



- Pleural effusions occur in approximately 20% of dissections.

- Even though most patients with aortic dissection will have abnormal findings on a chest radiograph, 12% to 15% have chest radiographs with normal findings.

- Thus normal chest radiograph results cannot exclude the presence of an aortic dissection.

- The electrocardiographic findings in patients with aortic dissection

are nonspecific but may indicate acute complications such as myocardial ischemia or infarction related to coronary artery involvement

- or low-voltage QRS complexes (or rarely, acute pericarditis) related to hemopericardium.

- Acute MI occurs in 1% to 2% of patients with type A dissections. The presence of acute coronary ischemia is particularly dangerous because it may lead the clinician away from the evaluation of dissection.

- Even though the D-dimer level may assist clinicians in their diagnostic approach, normal D-dimer levels have been associated with
  - aortic dissection and a thrombosed false lumen,
  - as well as with aortic IMH
  - and PAU.

- Additionally, patients may initially be seen longer than 24 hours after symptom onset, which affects D-dimer levels.

- Although a negative D-dimer result in low-suspicion patients may be useful, ……

- ……the negative likelihood ratio provided by the D-dimer assay is not sufficient in high-risk individuals and cannot “rule out” the disease in these patients.

- The recent thoracic aortic disease guideline writing committee did not recommend D-dimer screening for all patients being evaluated for aortic dissection

Diagnostic Techniques

- Diagnostic methods available to diagnose aortic dissection include
  - contrast-enhanced CT,
  - MRI,
  - TTE and TEE,
  - and aortography.

- TEE, helical CT, and MRI have very high diagnostic accuracy for suspected aortic dissection

- contrast-enhanced CT and TEE being the most commonly performed.

- Contrast-enhanced CT is highly accurate in diagnosing aortic dissection, with a sensitivity and specificity of 98% to 100%

- Many patients undergo multiple studies. If the probability of dissection

is very high and initial testing is negative or nondiagnostic, a second diagnostic test should be performed.

- TTE has a sensitivity of 77% to 80% and a specificity of 93% to 96%

for the identification of proximal aortic dissection,……

- …….. but it is much less sensitive (31% to 55%) than other modalities for the diagnosis of distal aortic dissection.

- TEE is highly accurate in the evaluation and diagnosis of acute aortic

dissection (sensitivity, ≈98%; specificity, ≈95%), but its accuracy is

operator dependent.

Management

- Initial medical management includes
  - stabilizing the patient,
  - Controlling pain,
  - lowering blood pressure,
  - and reducing the rate of rise in the force (dP/dt) of left ventricular contraction with beta blockers.

- Reduction of systolic blood pressure to levels of approximately 100 to 120 mm Hg or the lowest level appropriate for adequate perfusion is recommended.

- Beta blockers should be administered even if the patient does not have systolic hypertension, with a goal of attaining a heart rate of 60 beats/min or lower.

- When beta blockers are contraindicated, one may consider the calcium channel–blocking agents verapamil or diltiazem.

- Sodium nitroprusside leads to rapid reduction of blood pressure,

but it also may result in an increase in dP/dt—thus it must be used together with a beta blocker in the setting of acute aortic dissection.

Definitive Therapy

- Definitive therapy for acute aortic dissection includes emergency surgery for patients with acute ascending aortic dissection who are considered surgical candidates.

- Uncomplicated acute type B dissection requiring only medical therapy had a very low mortality rate of 1.2% in some series.

- Medical therapy provides an outcome superior to that of initial surgical therapy for uncomplicated type B aortic dissection.

TABLE 57-7 Indications for Surgical, Endovascular, and Medical Therapy for Acute Aortic Dissection

Surgical Therapy
Acute type A aortic dissection Retrograde dissection into the ascending aorta
Endovascular and/or Surgical Therapy
Acute type B aortic dissection complicated by Visceral ischemia Limb ischemia Rupture or impending rupture Aneurysmal dilation Refractory pain
Medical Therapy
Uncomplicated type B aortic dissection Uncomplicated isolated arch dissection

- Typical indications for surgical—or more commonly, endovascular—intervention in patients with type B aortic dissection include complications such as
  - visceral or limb ischemia
  - aortic rupture or impending rupture
  - rapid expansion of the aortic diameter
  - uncontrollable pain,
  - or retrograde extension of the dissection into the ascending aorta.

- The preferred therapy for most complications currently includes endovascular therapy.

- Many advocate initial medical therapy for primary arch dissections that do not involve the ascending aorta,……..
- …….whereas others recommend emergency surgery for some primary

arch dissections, especially if aneurysmal enlargement is present.

- Type B dissections that extend retrogradely into the transverse arch have been managed variably. Initial medical therapy is recommended for most.

    - Rapid aortic expansion and aneurysmal enlargement greater than 5.5 cm are also indications for TEVAR.

- On occasion, patients are incidentally discovered to have a chronic type A dissection in an evaluation for aortic regurgitation or a dilated ascending aorta.

- In general, most have advocated surgical treatment for all appropriate candidates with chronic type A dissection, but some have reserved surgery for those

with aneurysmal dilation of the ascending aorta, aortic regurgitation,

or relatively young age.

- Individuals with aortic dissection should undergo evaluation for a genetic disorder,

and all first-degree relatives should be evaluated for TAA disease.

Aortic Intramural Hematoma

- IMH seems to result from primary rupture of the vasa vasorum and subsequent mural hemorrhage, although some debate this theory and state that nonvisualized, small intimal defects underlie IMH.

- When compared with classic aortic dissection, patients with IMH are older and more likely to have descending aortic involvement.

- Given the potential for unpredictable and catastrophic complications, most authorities continue to recommend immediate surgical therapy for type A IMH in patients at reasonable risk and medical management for patients with type B IMH.

- Predictors of resolution of type B IMH have included
  - younger age,
  - smaller aortic diameter (<4 to 4.5 cm),
  - hematoma thickness less than 1 cm,
  - And postoperative use of beta blockers

Penetrating Atherosclerotic Aortic Ulcer

- In PAU, an atherosclerotic lesion penetrates through the internal elastic lamina into the media, often associated with a variable degree of IMH formation.
- PAUs may lead to pseudoaneurysm formation, aortic rupture, or late aneurysm
- PAUs are more common in the thoracic and abdominal aorta than in the arch or ascending aorta.
- Although PAUs may lead to aortic dissection, most patients do not have aortic regurgitation, pulse deficits, or visceral ischemia.
- In general, patients with ascending PAUs undergo surgical resection. Stable patients with type B PAUs may be managed medically, with close follow-up and serial imaging.

Thoracic Aortic Aneurysms

Aortic root or ascending aortic aneurysms are most common (≈60%), followed by

aneurysms of the descending aorta (≈35%) and aortic arch (<10%).

Thoracoabdominal aortic aneurysm refers to descending thoracic aneurysms that extend distally to involve the abdominal aorta.

Cause and Pathogenesis

Causes of TAAs include

- genetically triggered
- degenerative or atherosclerotic
- mechanical
- inflammatory
- and infectious diseases.

Many of the genetic disorders preferentially involve the aortic root and ascending aorta.

risk factors for TAAs:

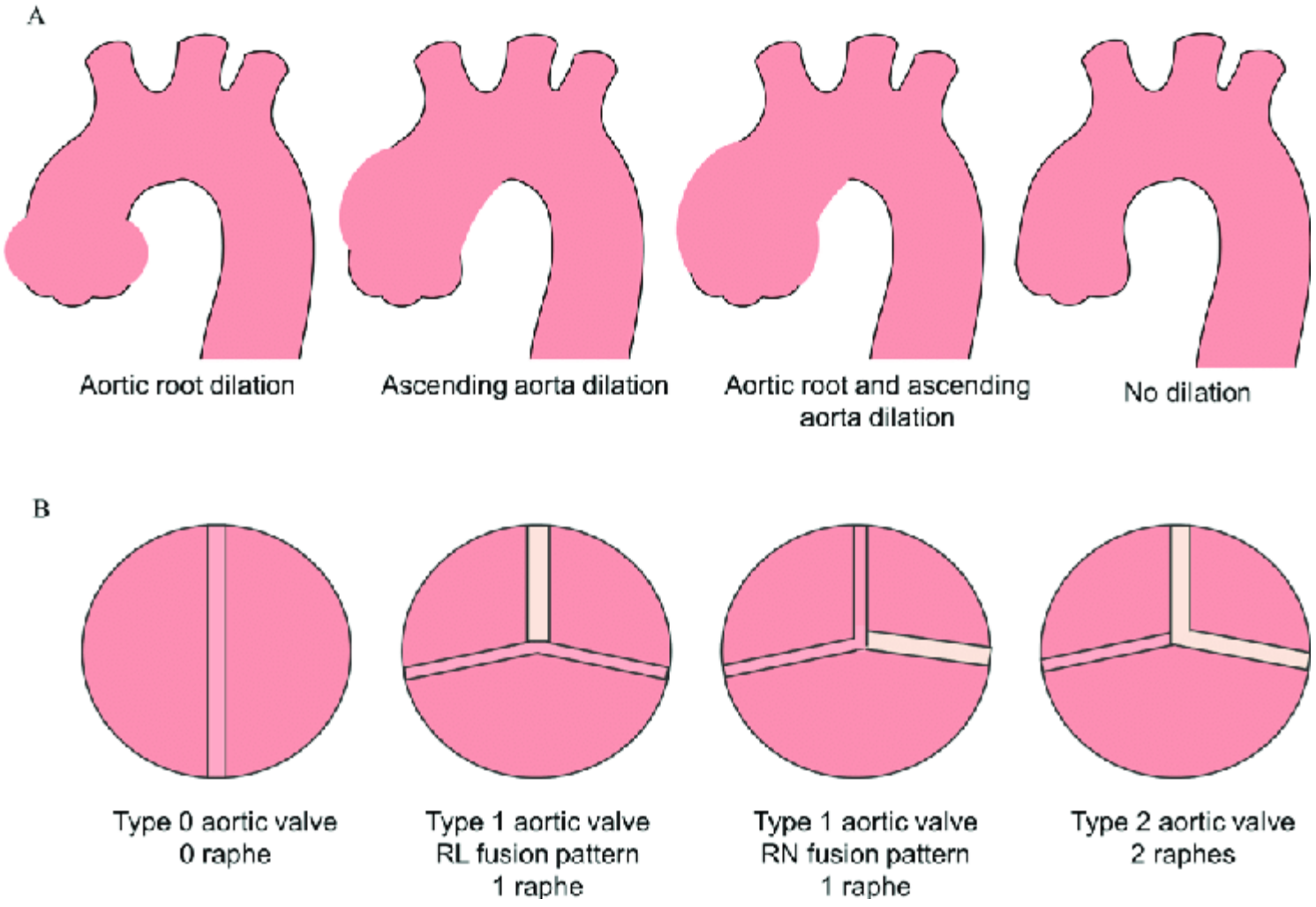
- Smoking
- Hypertension
- Age
- COPD
- Coronary disease
- Family history

Genetically Triggered Thoracic Aortic Aneurysm Diseases

- Many disorders of the thoracic aorta have an underlying genetic trigger, some of which are associated with widespread syndromic features and others with thoracic aortic disease alone.

- These disorders are associated with abnormalities in the aortic media, vascular SMCs, or contractile proteins, and many lead to overactivation of signaling pathways and downstream mediators.

- Such disorders include MFS, LDS, vEDS, familial thoracic aortic aneurysm and dissection syndrome (FTAA/D), bicuspid aortic valve (BAV) disease, Turner syndrome (TS), and the aortopathy assoociated with many congenital heart diseases.


A
Aortic root dilation
Ascending aorta dilation
Aortic root and ascending aorta dilation
No dilation
B
Type 0 aortic valve
0 raphe
Type 1 aortic valve
RL fusion pattern
1 raphe
Type 1 aortic valve
RN fusion pattern
1 raphe
Type 2 aortic valve
2 raphes

- BAVs and ascending aortic aneurysm may be familial and associated with risk for aortic dissection and may be inherited as an autosomal dominant disorder with variable expressivity and incomplete penetrance

- First degree relatives of a patient with BAV disease may have aortic dilation and/or abnormal aortic elastic properties, even in the absence of BAV disease.

- All family members should undergo evaluation for BAVs and ascending aortic aneurysm

Clinical Manifestations

- Most patients with a TAA are asymptomatic, and the aneurysm is discovered incidentally on chest radiography, echocardiography, CT, or MRI.

- Findings on physical examination such as aortic regurgitation may lead to further imaging and diagnosis of TAA.

- Symptoms of TAAs are usually related to a local mass effect, progressive aortic regurgitation, heart failure from aortic root dilation, or systemic embolization

as a result of mural thrombus or atheroembolism.

- Obstruction of the superior vena cava or innominate vein may be due to ascending aorta or arch aneurysms.

- TAAs may compress the trachea, bronchus, or esophagus and lead to symptoms.

- Persistent chest or back pain may occur because of a direct mass effect from the TAA, with compression of intrathoracic structures or erosion into adjacent bones.

- TTE is an excellent modality for imaging the aortic root and can be used to visualize TAAs involving the sinuses of Valsalva and often the proximal ascending aorta, aortic arch, and proximal descending aorta.

- Although TTE does not thoroughly characterize aortic arch and descending TAAs, TEE can image most of the thoracic aorta and has become widely used for detection of aortic dissection.

- CTA and contrast-enhanced MRI are highly accurate in the evaluation and follow-up of patients undergoing endovascular TAA therapy.

- Importantly, the echocardiogram generally measures the internal diameter, whereas CT and/or MRI measure the external diameter of the aorta, which is expected to be 0.2 to 0.4 cm larger than the internal diameter

Natural History

- Many factors influence the natural history of TAAs.
- Genetically triggered TAAs have been differently from atherosclerotic aneurysms.
- The location and size of the TAA also affect its rate of growth and likelihood of rupture or dissection.
- Surgery is recommended when the TAA reaches a certain size threshold in appropriate candidates.
- Endovascular therapy is changing the approach to management in operative candidates who were previously considered high risk.

- In general, surgical replacement of the aorta should be performed

when the ascending aortic diameter reaches 5.5 cm and,……

- ……. in the setting of
  - BAV aneurysm,
  - MFS,
  - and familial TAA syndromes,

when it reaches 5 cm.

- In adults with LDS, surgery is recommended when the aortic root measures 4.2 cm by TEE or 4.4 to 4.6 cm by CT or MRI.

- although some experts recommend surgery in patients with LDS once the aortic root is larger than 4 cm.

- In TS, prophylactic surgery should be considered when the ascending aorta is 3.5 cm or larger or 2.5 cm/m2 or larger.

Management

Surgical Treatment for
ASCENDING THORACIC AORTIC ANEURYSMS

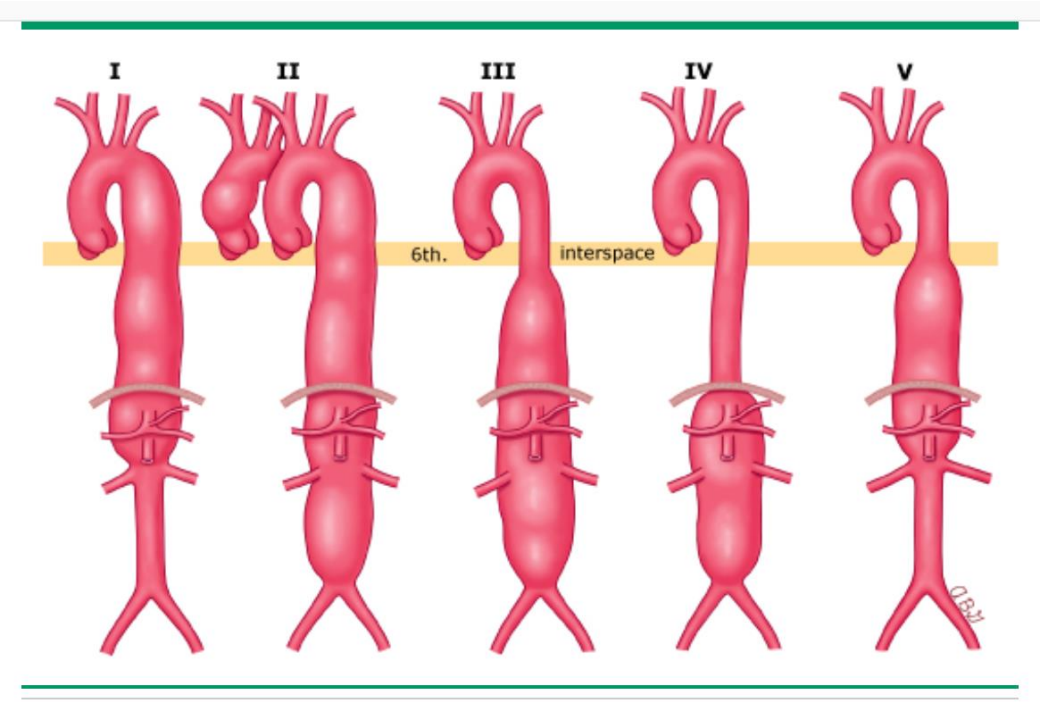
- Treatment of ascending TAAs involves resection and grafting of the ascending aorta with or without concomitant AVR.

- Cardiopulmonary bypass is necessary for the removal of ascending aortic aneurysms, and partial bypass to support the circulation distal to the aneurysm while the aortic site being repaired is crossclamped is often advisable when resecting descending TAAs. TAAs are generally resected and replaced with a prosthetic graft.

DESCENDING THORACIC ANEURYSMS

- Treatment of descending TAAs involves resection and grafting of the aneurysmal segment with a polyester graft.

- The procedures are performed with partial femorofemoral bypass or atriofemoral bypass to maintain retrograde perfusion to critical arterial branches; …….
- ……..they are associated with a perioperative mortality of 10% or less and a paraplegia rate of approximately 2%, depending on the extent of repair.



Type I arises from above the sixth intercostal space, usually near the left subclavian artery, and extends to include the origins of the celiac axis and superior mesenteric arteries. Although the renal arteries can also be involved, the aneurysm does not extend into the infrarenal aortic segment.

Type II aneurysm also arises above the sixth intercostal space, and may include the ascending aorta, but extends distal to include the infrarenal aortic segment, often to the level of the aortic bifurcation.

Type III aneurysm arises in the distal half of the descending thoracic aorta, below the sixth intercostal space, and extends into the abdominal aorta.

Type IV aneurysm generally involves the entire abdominal aorta from the level of the diaphragm to the aortic bifurcation.

Type V aneurysm arises in the distal half of the descending thoracic aorta, below the sixth intercostal space, and extends into the abdominal aorta, but is limited to the visceral segment.

Medical Management

- Treating hypertension and smoking cessation are important tenets of management because they are risk factors for TAAs.
- Home blood pressure monitoring may help confirm adequate control.

- In patients with atherosclerotic TAAs, cholesterol lowering is also recommended.
- Beta blockers are recommended for patients with MFS.

- Even though no randomized trials currently exist to support it,

beta blockers are often recommended in non-MFS patients with TAAs and in patients after aneurysm repair.

- Based on animal model data, when antihypertensive medications are needed, ARBs or ACE inhibitors are recommended.

- Statins, by suppressing the inflammatory pathways involving the reduced form of (NADH/NADPH) oxidase system independent of lipid lowering or by influencing the activity of MMPs and plasminogen activators and their inhibitors, may benefit patients with TAAs.

Thoracic Endovascular Aneurysm Repair (TEVAR)

- Material fatigue and migration of the endovascular graft are rare with the currently available endovascular thoracic devices.

- Endoleaks are the most common complication of endovascular repairs and occur in 10% to 20% of patients.

Abdominal Aortic Aneurysms (AAA)

AAAs are defined by an increase in size of the abdominal aorta to greater than 3.0 cm in diameter.

Most AAAs (>80%) arise in the infrarenal aorta, but up to 10% may involve the pararenal or visceral aorta and some extend into the thoracoabdominal segment.

AAAs are approximately five times more prevalent in men than in women, and their incidence is strongly associated with age, with most occurring in those older than 60 years.

AAAs are also strongly associated with cigarette smoking, with current and former smokers having a fivefold increase in risk in comparison to nonsmokers.

Up to 20% of patients with AAAs describe a family history of aortic aneurysms, thus suggesting the contribution of a heritable component.

Diagnostic Imaging

- Abdominal ultrasound can detect AAAs with high accuracy and a sensitivity and specificity of almost 100% and is preferred over CT in screening for AAAs because it is inexpensive and noninvasive and avoids exposure to radiation and contrast agents.

- Ultrasound also permits serial measurement of AAA size during the follow-up of patients with small AAAs.

- Because ultrasound-derived measurements of AAA diameter are less accurate than those obtained by CT or MRI, many recommend the use of ultrasound for follow-up of small AAAs and use CT or MRI for larger AAAs.

Natural History

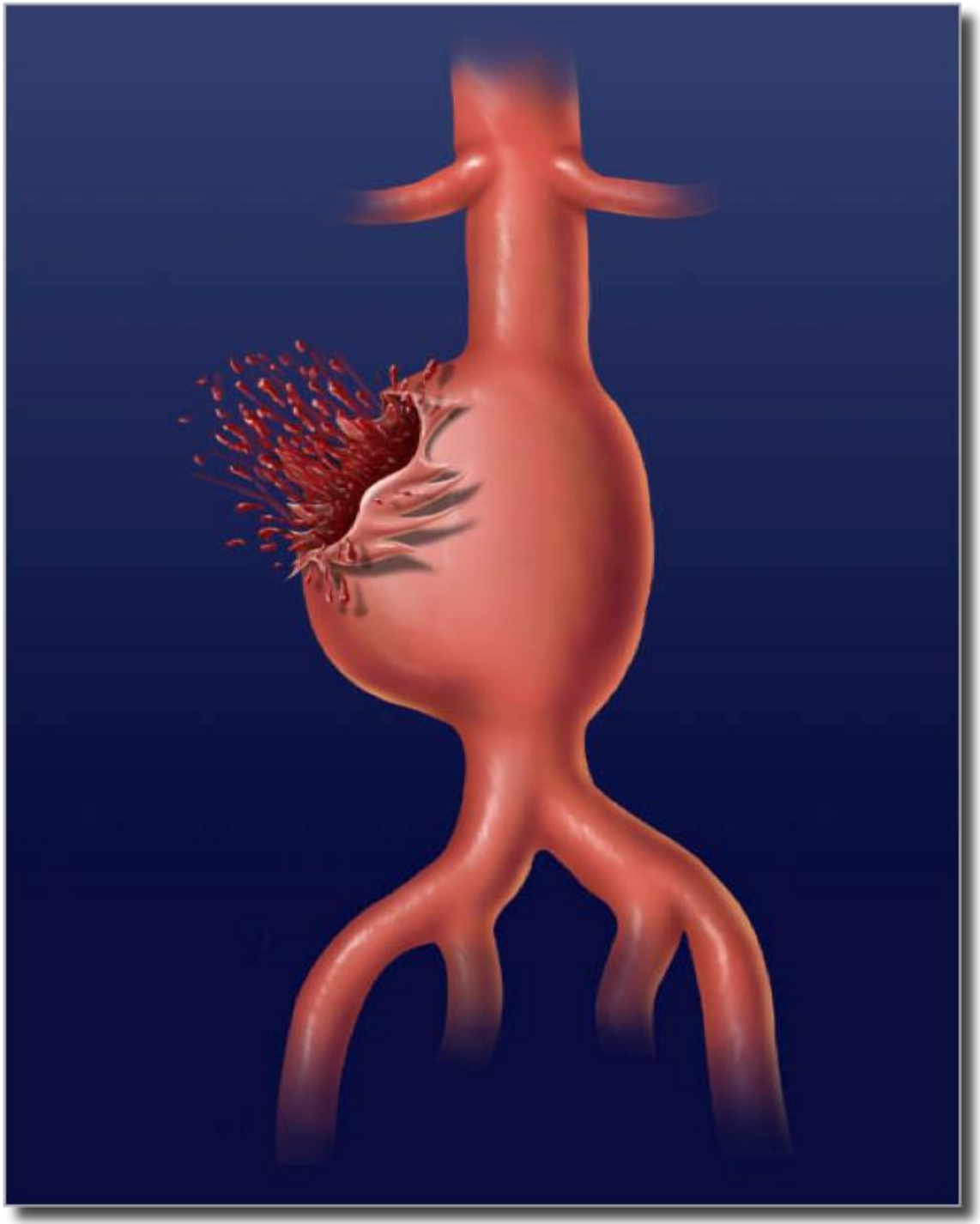
- The natural history of AAAs is gradual expansion over a period of years and eventual rupture.

- The average rate of expansion of AAAs between 3 and 5.5 cm ranges from 0.2 to 0.3 cm/year, increasing as aortic diameter increases.

- Not all AAAs follow a linear or consistent rate of expansion.

- Some patients may have stable AAAs that grow slowly for years, whereas others may have a stable AAA size for many years, followed by a sudden increase within a short period.

Management



Surveillance/Medical Therapy

In general, AAA repair is reserved for asymptomatic aneurysms at least 5.0 to 5.5 cm in diameter.

Symptomatic aneurysms and those with rapid growth (>1 cm/year) require more urgent consideration

In patients with AAAs larger than 4.5 cm, CT is preferred over ultrasound for more accurate measurement of AAA size.

Surveillance of aneurysms until the diameter exceeds 5.5 cm is associated with a low rate of rupture (≈1% per year).

- Several steps are recommended for patients with AAAs to help minimize the risk for expansion of the aneurysm.

- Smoking cessation is important inasmuch as strong evidence has linked ongoing tobacco use with more rapid rates of AAA expansion and rupture.

- Patients with AAAs and coexisting atherosclerotic disease will likely benefit from statin therapy, which might also slow AAA growth.

- Patients with small AAAs should exercise regularly because moderate physical activity does not adversely influence the risk for rupture and may limit AAA growth.

Surgery

- Perioperative medical management to reduce cardiac risk in patients undergoing AAA repair may include
  - continuation of beta blockers
  - statins
  - and/or aspirin.
- AAAs can be treated surgically by OSR or EVAR.
- Selection of the approach depends on the individual anatomy and on secondary factors such as patient age and estimated risks associated with anesthesia and surgery, with most patients currently undergoing EVAR.

Endovascular Abdominal Aortic Aneurysm Repair (EVAR)

Endovascular Abdominal Aortic Aneurysm Repair (EVAR)