Thoracic Aortic Aneurysm

Thoracic aortic aneurysm is a dilatation of the thoracic aorta, involving any of the ascending aorta, arch, and descending aorta. Open repair of the thoracoabdominal aorta is widely regarded as the most challenging surgical procedure in terms of overall anesthetic and perioperative management.

ANESTHETIC CONSIDERATIONS:

1. Elective vs. emergency case
2. High morbidity and mortality
3. Potential for OLV
4. Potential for large fluid shifts and hemodynamic instability
5. Potential for massive blood loss, transfusion, and coagulopathy
6. Risk of rupture with hemodynamic changes on induction
7. Hemodynamic and metabolic consequences of aortic cross-clamp and unclamp physiology
8. Associated Co-morbidities: CAD, PVD, CVA, DM, CKD, smoking, HTN, dyslipidemia
9. Ischemic complications and post-operative organ dysfunction (myocardial ischemia, renal failure, hepatic ischemia and coagulopathy, bowel infarction, and paraplegia)
10. Hypothermia
11. Post-operative disposition: ICU and pain management

ANESTHETIC GOALS:

9. Maintain stable hemodynamics throughout perioperative period using invasive monitoring and vasoactive medications
10. Be prepared for lung isolation with DLT or bronchial blocker strategies
11. Be prepared for massive blood loss with blood, products, rapid infuser, cell saver
12. Anticipate and treat hypertensive and hypotensive responses to cross-clamp changes
13. Preserve myocardial function: reduce afterload, normalize preload, and maintain cardiac output
14. Maintain favourable myocardial oxygen supply / demand relationship
15. Minimize risk of post-operative ventilatory failure
16. Organ protection strategies
17. Ensure normothermia and adequate post-operative pain control (regional vs PCA)

HISTORY

- Details of aneurysm (anatomy, level, size, symptoms)
- Exercise tolerance/ functional capacity (> 4METs?)
- Active cardiac conditions (unstable coronary syndromes – unstable or severe angina, recent MI, decompensated heart failure, significant arrhythmias, and severe valvular disease)
- Assess for co-existing comorbidities (CAD, DM, HTN, PVD, smoking, COPD, stroke, renal insufficiency) and preoperative organ dysfunction
- Half of patients asymptomatic, and diagnosed by incidental findings
- Symptomatic thoracic aneurysm - typically reflect impingement of the aneurysm on adjacent structures
    - Hoarseness results from stretching of the left recurrent laryngeal nerve
    - Stridor is due to compression of the trachea
    - Dysphagia is due to compression of the esophagus
    - Dyspnea results from compression of the lungs - of particular importance if positional with mediastinal mass type effects of large aneurysms or contained ruptures
    - Plethora and edema result from compression of the superior vena cava
    - History of chronic back pain
- Aortic dissection:
    - Acute, severe, sharp pain in the anterior chest, the neck, or between the shoulder blades- the pain may migrate as the dissection advances along the aorta
- AMPLE history, Anesthetic history, Surgical history
- Contraindications to neuraxial techniques
- Contraindications to TEE (esophageal or cervical spine disease)

PHYSICAL

- Vitals
- Airway assessment for (patency and) ease of intubation
- Targeted cardipulmonary exam with particular attention to evidence of heart failure, LV and RV dysfunction, distal perfusion
- Brief neurologic examination for preoperative deficits and carotid bruit
- Patients with ascending aortic aneurysms associated with dilation of the aortic valve annulus may present with signs of aortic regurgitation and congestive heart failure
- Signs and symptoms of aortic dissection:
    - Often appear as if they are in shock (vasoconstricted), yet the systemic blood pressure may be quite elevated
    - Diminution or absence of peripheral pulses due to occlusion of branches of the aorta
    - Neurologic complications of aortic dissection may include stroke caused by occlusion of a carotid artery, ischemic peripheral neuropathy associated with ischemia of an arm or a leg, and paraparesis or paraplegia due to impairment of the blood supply to the spinal cord
    - Signs and symptoms of myocardial infarction may reflect occlusion of a coronary artery
    - Abdominal pain and lactic acidosis may indicate gastrointestinal ischemia
    - Renal artery obstruction is manifested by an increase in serum creatinine concentration
    - Look for symptoms of cardiac tamponade due to retrograde dissection into the sinus of Valsalva with rupture into the pericardial space (JVD, distant heart sounds, hypotension, pulsus paradoxus)

INVESTIGATIONS

- Labs:
    - CBC, INR, PTT, lytes, BUN, creatinine, LFTs
    - Crossmatch for blood
- Cardiac:

- EKG
- TTE: assess ascending aorta and valvular pathology, biventricular function, R/O tamponade/pericardial effusion
- Non-invasive testing eg. MIBI depending on functional capacity, presence of active cardiac conditions and clinical cardiac risk factors
  - High risk surgery (>5% cardiac risk, as per 2007 AHA guidelines)
  - Patients often have co-existing "clinical risk factors" (heart disease, CHF, CVD, DM, renal insufficiency)

- Respiratory
  - PFT and ABG as dictated by history and coexisting respiratory diseases, to predict risk of post-operative respiratory failure
- Imaging
  - CXR may show a widening mediastinum diagnostic of a thoracic aortic aneurysm; however, enlargement of the ascending aorta may be confined to the retrosternal area so the aortic silhouette can appear normal
  - In aortic dissection, CXR may show acutely widened mediastinum or hemothorax
  - CT or MRI for diagnosis and aneurysm anatomy
  - Angiography of the aorta to define the complete extent of the dissection and the location of all compromised aortic branches
  - In acute aortic dissection, the diagnosis is most rapidly and safely made using transesophageal echocardiography with color Doppler imaging
  - Carotid dopplers for stenosis and/or angiography of the brachiocephalic and intracranial arteries may be performed preoperatively in patients with a history of stroke or transient ischemic attacks

OPTIMIZATION

- Consult cardiology as needed
  - Medically optimize patients with heart failure or significant aortic regurgitation
  - A preoperative percutaneous coronary intervention or coronary artery bypass grafting may be indicated in some patients with ischemic heart disease
- Consult pulmonary as needed
  - Medically optimize pre-operative respiratory function to minimize risk of post-op failure
  - Reversible airway obstruction and pulmonary infection should be treated with bronchodilators, antibiotics, and chest physiotherapy
  - Smoking cessation
- Consult nephrology as needed if preoperative renal dysfunction is present
  - Preoperative hydration and avoidance of hypovolemia, hypotension, low cardiac output, and nephrotoxic drugs during the perioperative period are important in decreasing the likelihood of postoperative renal failure
- Consult vascular/neurosurgery as needed
  - Patients with severe stenosis of one or both common or internal carotid arteries could be considered for carotid endarterectomy before elective surgery on the thoracic aorta
- For elective repair, optimize volume status, correct anemia (Miller: maintain Hb>9.0 g/dL), optimize coagulation
- Before the day of surgery, the anesthesiologist and vascular surgeon should discuss the following issues: extent of the aneurysm and technique of surgical repair, plans for distal aortic perfusion, monitoring for spinal cord ischemia, renal and spinal cord protection, hemodynamic monitoring, and ventilation strategy
- Consider **Endovascular thoracoabdominal aortic aneurysm repair** (endoTAAR)
  - Has been advocated as an alternative to open surgery, as complications may be lower with endovascular approaches, with blood loss averaging 500 mL and 1 day in the ICU for uncomplicated cases
  - May be particularly useful in the elderly or in those with co-existing medical conditions that would significantly increase the risk of conventional operative treatment
  - Currently, endovascular aneurysm repair of the intrathoracic aorta has been focused on the descending thoracic aorta, that is, the portion distal to the left subclavian artery
  - The thoracic aorta poses several unique challenges to endovascular repair compared to endovascular repair of the abdominal aorta
    - The hemodynamic forces are significantly more severe and place greater mechanical demands on thoracic endografts (may increase incidence of device migration, kinking, and late structural failure)
    - Greater flexibility is required of thoracic devices to conform to the natural curvature of the proximal descending aorta and to lesions with tortuous morphology
    - Because larger devices are necessary to accommodate the diameter of the thoracic aorta, arterial access is more problematic
    - As with conventional open thoracic aneurysm repair, paraplegia remains a potential complication of the endovascular approach despite the absence of aortic cross-clamping
  - Current reported experience with thoracic stent grafting demonstrates successful deployment in 87% of cases, 30-day mortality of 2% to 5% for elective cases, and paraplegia and endoleak rates of 4% to 9%

ANESTHETIC OPTIONS

- GA +/- thoracic epidural (consider anticoagulation on bypass)
- GA +/- OLV

ANESTHETIC SETUP

- **Monitors and lines:**
  - Standard CAS monitors plus 5-lead EKG, temperature monitoring, peripheral nerve stimulator
  - Large bore IV access proximal to cross-clamp
    - Especially if partial bypass (in contrast to full bypass) is planned because it is difficult or impossible for the perfusionist to administer fluid or blood products into the closed partial bypass circuit
  - Pre-induction arterial line:
    - Right radial artery if cross-clamp proximal to the left subclavian
    - Left radial artery if selective antegrade cerebral perfusion planned via right axillary artery, or repairs involving inominate artery
    - Right femoral artery if distal aortic perfusion planned
    - Monitoring blood pressure both above (right radial artery) and below (femoral artery) the aneurysm permits assessment of cerebral, renal, and spinal cord perfusion pressure during cross-clamping
  - Central line, CVP
  - Pulmonary artery catheter
  - Intraoperative TEE for assessment of left ventricular end-diastolic volume, myocardial ischemia, valvular function, and to determine the size and the extent of the aneurysm.
  - Cerebral oximetry
  - SSEP or MEP monitoring for spinal cord perfusion during cross-clamping

- **Drugs:**
  - Standard emergency meds
  - Vasopressors/ inotropes
  - Vasodilators (e.g. nitroglycerine, nitroprusside) and antihypertensive drugs
  - End-organ protection: glucose monitoring, thiopental for DHCA, mannitol for renal/pulmonary protection
  - Heparin and protamine
  - Antifibrinolytics: tranexamic acid
- **Other:**
  - DLETT and fibreoptic scope to confirm tube placement if OLV planned
  - Blood and FFP immediately available (at least 15 units of each in fridge)
  - Blood conservation: Cell Saver
  - Fluid warmer, forced air warmer (upper body only – lower body warmers increase reperfusion acid load)
  - If CSF drainage is elected, a silastic lumbar drainage catheter
  - Pre-induction thoracic epidural or placed the night before surgery
  - Pads placed pre-op and crash cart available if hypothermia planned

MANAGEMENT OF ANESTHESIA

Induction:

- Induction of general anesthesia should be slow and controlled
- Maintain stable hemodynamics on induction and intubation – avoid hypertension + hypotension
  - Minimize undesirable increases in systemic bp, which could exacerbate an aortic dissection or rupture an aneurysm
- The heart rate should be maintained at or below baseline because myocardial ischemia is often related to the heart rate
- Risk of cardiovascular collapse on induction for ruptured aneurysms- have patient prepped & surgeon present
- Use of a left-sided double-lumen endobronchial tube permits collapse of the left lung, facilitates surgical exposure during resection of a thoracic aneurysm, and to avoid an iatrogenic pulmonary contusion in the left lung
  - Occasionally, a right-sided endobronchial tube may be necessary when the left mainstem bronchus is compressed by a large aneurysm, and the lumen does not accommodate an endobronchial tube

Maintenance:

- Any general anesthetic technique is reasonable as long as vital organ perfusion and function is maintained
  - Usually, balanced anesthesia is provided with a combination of an opioid, a low-dose potent volatile anesthetic, a benzodiazepine, and a long-acting muscle relaxant
  - A total intravenous technique may be optimal if transcranial MEP monitoring is used
  - GA may cause some reduction in cerebral metabolic rate that may be particularly desirable during this surgery
  - Generous exposure of the thoracic and abdominal aorta and its major branches can be obtained with a left thoracoabdominal incision and retroperitoneal dissection
  - Surgical repair of a thoracic aortic aneurysm requires aortic cross-clamping just distal to the left subclavian artery or between the left subclavian artery and the left common carotid artery
- **Cross-clamp physiology and management is discussed in the AAA seminar –please refer to that section**
- **Simple "Clamp-and-Sew" technique:**
  - Descending thoracic and thoracoabdominal aortic surgery can be performed without extracorporeal support (i.e., left heart bypass or cardiopulmonary bypass)
  - Favourable location and extent of aneurysm may be amenable to simple aortic crossclamp
  - The benefits of avoiding the complexity and complications of bypass must be weighed against the risk of vital organ ischemia and complications such as renal failure and paraplegia
    - Clamp time < 20-30 mins are associated with almost no paraplegia, whereas for clamp times between 30-60 mins, incidence of paraplegia increases from 10% to 90% as time progresses
    - Because clamp times are typically in this range or longer, specific adjuncts including epidural cooling for spinal cord protection, regional hypothermia for renal protection, and in-line mesenteric shunting to reduce visceral ischemia, are often used
  - Application of the aortic cross-clamp results in significant proximal hypertension
    - Blood flow to tissues below the aortic cross-clamp is dependent on perfusion pressure rather than on preload and cardiac output
    - Proximal aortic pressures should be maintained as high as the heart can safely withstand unless other modalities (such as temporary shunts or hypothermia) are implemented to perfuse distal organs
    - Maintain MAP near 100 mmHg above the cross-clamp and above 50 mmHg distal to the cross-clamp
    - The use of vasodilators to treat hypertension above the level of the aortic cross-clamp must be balanced against the likelihood of a decrease in perfusion pressure in the tissues below the clamp
      - Nitroprusside may decrease spinal cord perfusion pressure both by decreasing distal aortic pressure and by increasing CSF pressure as a result of cerebral vasodilation
      - Nitroglycerin can be used to normalize preload and cardiac filling and thus reduce ventricular wall tension (Although nitroglycerin does not control proximal hypertension well as a single agent, it is very helpful when used in combination with sodium nitroprusside)
      - Isoflurane can be used if normal myocardial function
- **Clamp with distal aortic perfusion techniques:**
  - Maintaining lower body perfusion with the use of retrograde distal aortic perfusion reduces ischemic injury and improves outcome, provided that the pressure is high enough to perfuse the organs
  - The simplest method of providing distal aortic perfusion is a passive conduit or shunt
    - The heparin-bonded Gott shunt was developed to avoid the need for systemic heparinization and is used to divert flow passively from the left ventricle or proximal descending thoracic aorta to the distal aorta
    - Some centers place a temporary axillary-to-femoral artery graft before thoracotomy to function as a shunt during aortic cross-clamping
    - Intercostal artery reattachment in hopes of preserving blood flow to the anterior spinal cord may also be beneficial
  - Partial bypass, also referred to as left heart bypass or left atrial-to-femoral bypass, is the most commonly used distal aortic perfusion technique
    - This technique allows adjustment of blood flow and usually draws blood from the left atrium and returns blood to the left femoral artery

        - A centrifugal pump is used and there is no need for full-dose systemic heparin because the circuit is coated with heparin (the typical heparin dose for partial bypass is 100 U/kg)
        - An oxygenator is unnecessary because only the left side of the heart is bypassed
        - Decreased: LV preload, afterload, CO and work of ventricle
        - Perfusion is provided to the distal aorta
        - MAP pre-clamp 80-100 mmHg and post-clamp >60 mHg controlled by intravascular volume, pump speed and vasoactive medications
        - +/- Hypothermia
- **Deep Hypothermic Circulatory Arrest following femoral-femoral Cardiopulmonary Bypass**
    - Complex aneurysms (eg. arch involvement, or revision surgery) involving the aortic arch often require elective cardiopulmonary bypass with an interval of deep hypothermic (15°C) circulatory arrest (DHCA) because cerebral blood flow is transiently interrupted during surgery
    - DHCA may also be necessary whenever the location, extent, or severity of aortic disease precludes placement of a proximal aortic clamp during thoracic or thoracoabdominal aortic repair
    - DHCA eliminates the need for proximal aortic clamping and allows a bloodless field for the proximal aortic anastomosis
    - Deep hypothermia may provide better end-organ and spinal cord function
    - Bypass can be accomplished by cannulation of the femoral artery and the femoral vein (i.e., femoral-femoral bypass)
    - During the interval of DHCA, some centers also use anterograde (i.e., innominate artery) or retrograde (i.e. IJ vein) selective cerebral perfusion with cold oxygenated blood to extend the safe maximum duration of circulatory arrest
        - Without this technique, 45 to 60 minutes is thought to be the safe limit of DHCA, but 90 minutes has been reported with selective cerebral perfusion
    - After completion of the proximal anastomosis and intercostal artery–to-graft anastomoses under DHCA, the aortic graft is cannulated and bypass flow is reestablished to the upper part of the body
    - During a period of hypothermic low bypass flow, the distal anastomoses are completed and then rewarming is initiated
    - Discontinue potent volatiles until rewarming begins
    - Halt the antifibrinolytic, and if protamine is used then monitor ACT appropriately
- **Spinal Cord Protection:** (Table 42-5 Barash)
    - Limitation of cross-clamp duration
        - A brief period of thoracic aortic cross-clamping (<30 minutes) is usually tolerated
        - If cross-clamp time is more than 30 minutes, the risk of spinal cord ischemia is significant
    - Distal circulatory support / Partial circulatory assistance (left atrium-to-femoral artery shunt)
    - Reimplantation of critical intercostal arteries when possible
    - CSF drainage
        - Spinal cord perfusion pressure = Distal mean aortic pressure – (the greater of CSF pressure or CVP)
        - Autoregulation of spinal cord blood flow: blood flow is relatively constant over the range of 50 to 125 mmHg unless patient is hypoxic or hypercarbic
        - CSF pressure often increases (by 10 to 15 mmHg) with cross-clamping of the descending thoracic aorta, which reduces spinal cord perfusion pressure and increases risk of ischemic spinal cord injury
        - CSF drainage is used in the hope of improving the pressure gradient, allowing spinal cord blood flow
            - A silastic lumbar drainage catheter is placed into the intrathecal space at L3-L4 or L4-L5
            - These catheters have a one-way pressure valve that allows drainage only when CSF pressure is greater than 5 to 10 mmHg
        - Complications include headache, meningitis, chronic CSF leak, spinal & epidural haematomas, subdural haematoma (3.5%; RF: high volume CSF drainage)
    - Reduction of spinal cord metabolism by moderate systemic hypothermia (32°C to 34°C)
        - Reduce oxygen requirements by approximately 5% for each degree centigrade
        - Epidural cooling
        - Circulatory arrest
        - Risk of supraventricular & ventricular arrhythmias- be prepared to rewarm slightly or to cardiovert
    - Maintenance of proximal blood pressure during cross-clamping
    - Avoidance of postoperative hypotension
    - Sequential aortic clamping
    - Pharmacotherapy: corticosteroids, barbiturates, naloxone, calcium channel blockers, NMDA antagonists, mannitol, magnesium, vasodilators (adenosine papaverine, prostacyclin), perfluorocarbons, cochicine
    - Intrathecal papaverine, magnesium and other drugs under investigation
    - Enhanced monitoring for spinal cord ischemia
        - SSEPs, MEPs - requires stable anaesthetic levels; best with TIVA & no muscle relaxation
        - Hydrogen-saturated saline
        - Avoidance of hyperglycemia
- **Renal Protection:**
    - Mannitol, Furosemide, Dopamine, Fenoldopam – see AAA seminar
    - Protection: hypothermia reduces kidneys' oxygen requirements
    - Optimization of systemic hemodynamics including circulating blood volume represents the most effective measure for protecting the kidneys from the ischemic effects produced by aortic cross-clamping
- **Managing coagulopathy** secondary to hypothermia, blood transfusion, residual heparin, ischemia of the liver
    - With the early use of fresh frozen plasma and platelets, severe coagulopathy can often be avoided
    - INR, PTT, fibrinogen level, and platelet count should be measured frequently
    - Cryoprecipitate may be necessary to correct coagulopathy, especially when the prothrombin time and partial thromboplastin time are prolonged and hypervolemia prevents the administration of significant volumes of fresh frozen plasma
    - When coagulopathy persists despite these efforts, ε-aminocaproic acid is beneficial as antifibrinolytic therapy, and desmopressin can be given to increase circulating levels of von Willebrand factor and factor VIII
    - Normothermia should be achieved by complete rewarming before separation from bypass, by increasing ambient temperature after separation from bypass, and by forced-air warming over the upper body skin surface

Emergence:

- The double-lumen tube is usually changed, if possible, to a single-lumen tube at the completion of surgery to facilitate ICU management of pulmonary hygiene and reduce resistance to breathing during weaning in the postoperative period
    - The airway is often edematous after surgery because edema of the head and neck frequently occur after high cross-clamping (even with distal perfusion), and it may be difficult or impossible to change the double-lumen tube without tube-changing catheters
- Plan for gradual slow emergence ~ 2 hours post-op, although early emergence in stable patients preferable for prompt assessment of neurologic function
- If thoracic epidural is in place, during the immediate postoperative period opioids are preferred over local anesthetics to prevent masking of anterior spinal artery syndrome

DISPOSITION & MONITORING

- Post-op patients require high intensity level of cardiac monitoring in the CVICU
- Extubation should always take place in the CVICU and only after a significant period of hemodynamic and metabolic stability
- The postoperative analgesic regimen should focus on pain control and stable hemodynamics
    - Posterolateral thoracotomy is among the most painful of surgical incisions because major muscles are transected and ribs are removed
    - Pain relief is commonly provided by neuroaxial opioids and/or local anesthetics
- Patients recovering from thoracic aortic aneurysm resection are at risk of developing cardiac, pulmonary, and renal failure during the immediate postoperative period
    - Cerebrovascular accidents may result from air or thrombotic emboli that occur during surgical resection of diseased aorta
        - Patients with co-existing CVD may be more vulnerable to the development of new CNS complications
    - Spinal cord injury may manifest during the immediate postoperative period as paraparesis or flaccid paralysis
        - Delayed appearance of paraplegia (12 hours to 21 days postoperatively) has been associated with postoperative hypotension in patients with severe atherosclerotic disease in whom marginally adequate collateral circulation to the spinal cord is present
    - Systemic HTN is not uncommon and may jeopardize the integrity of the surgical repair and/or predispose to MI
        - The role of pain in the etiology of HTN must be considered
        - Institution of antihypertensive therapy with drugs such as nitroglycerin, nitroprusside, hydralazine, and labetalol may be appropriate
        - Some patients benefit from concomitant administration of β-blockers to attenuate manifestations of a hyperdynamic circulation

COMPLICATIONS

- Mortality 5.2 – 20%
    - Traditional surgery for thoracic aortic aneurysm continues to be associated with higher morbidity and mortality than infrarenal AAAs
    - Risk factors for death include diabetes mellitus, cerebrovascular disease, and renal insufficiency
- Myocardial ischaemia/infarction
- Cerebral ischaemia/infarction
- Spinal cord ischemia (anterior spinal artery syndrome) resulting in paraplegia
    - The incidence of paraplegia is reported to be 0% to 10% for thoracic aneurysm repair, 10% to 20% for thoracoabdominal repair, and as high as 40% for extensive dissecting TAA repair
    - Manifestations of anterior spinal artery syndrome include flaccid paralysis of the lower extremities and bowel and bladder dysfunction; sensation and proprioception are spared
- Acute renal failure (ATN) 3-30%
    - Approximately 6% of patients will require hemodialysis post-op (associated with high mortality of 30% to 60%)
- Pulmonary complications including respiratory failure requiring long term ventilation ~50%
    - 8-14% require tracheostomy
- Shock liver, bowel ischemia

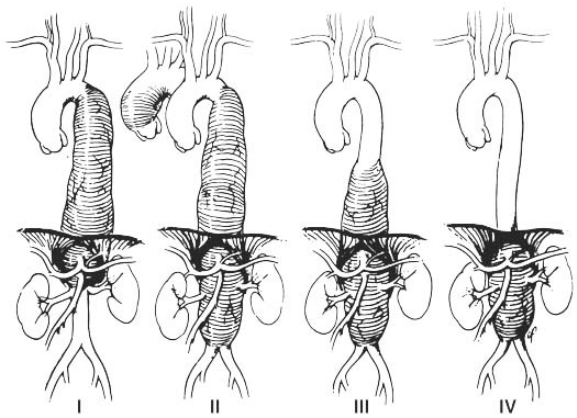
PATHOPHYSIOLOGY

- Risk factors for thoracic aortic aneurysm and dissection: systemic HTN, nonheridetary conditions (manipulation of or surgery on the aorta, blunt trauma and deceleration injury), inherited conditions (Marfan syndrome, Ehlers-Danlos, cystic medial degeneration, Takayasu's arteritis, syphilitic aortitis, bicuspid aortic valve, and nonsyndromic familial aortic dissection)

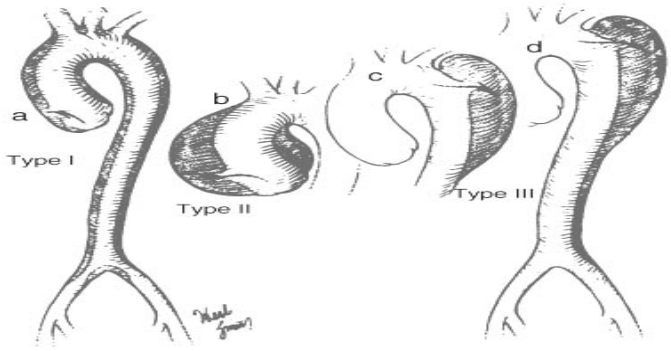
Crawford Classification of Thoracoabdominal aortic aneurysms (degenerative and dissecting)

I: Aneurysms from left subclavian to the diaphragm (all or most of the descending thoracic aorta and the upper abdominal aorta)
II: Aneurysms from left subclavian to below the renal arteries (all or most of the descending thoracic aorta and abdominal aorta)
III: Lower portion of thoracic aorta to below the renal arteries (lower portion of the descending thoracic aorta and most of the abdominal aorta)
IV: Diaphragm to below the renal arteries (all or most of the abdominal aorta, including the visceral segment)

Types II and III are the most difficult to repair since they involve both the thoracic and abdominal segments of the aorta.
Crawford type II are at greatest risk for paraplegia and renal failure.



DeBakey Classification of Aortic Dissection
Type I – starts in the ascending aorta and extends throughout the entire aorta (the intimal tear originates in the ascending aorta and the dissection involves the ascending aorta, arch, and variable lengths of the descending thoracic and abdominal aorta)
Type II – dissection is confined to the ascending aorta
Type III – starts distal to the left subclavian artery and the dissection is confined to the descending thoracic aorta (type IIIa) or extends into the abdominal aorta and iliac arteries (type IIIb)



Stanford Classification of Aortic Dissection
Type A –aortic dissection that involves the ascending aorta
Type B –aortic dissection that does not involve the ascending aorta
Surgical repair:
- Acute aortic dissection involving the ascending aorta (DeBakey types I and II, Stanford type A) is a surgical emergency that requires immediate cardiac surgical repair
- Acute dissections involving the descending aorta (DeBakey type III, Stanford type B) that are uncomplicated, that is, presents with normal hemodynamics, no periaortic hematoma, and no branch vessel involvement, are most often treated medically
    - Such therapy consists of blood pressure (goal sBP 100-120 mmHG) control with nitroprusside, and heart rate control with β-Blockers (esmolol, labetalol)
- Surgery is indicated for patients with type B aortic dissection who have signs of impending rupture (persistent pain, hypotension, left-sided hemothorax); ischemia of the legs, abdominal viscera, or spinal cord; and/or renal failure
- For patients with degenerative or chronic aneurysms, elective resection is advisable if the aneurysm exceeds 5 to 6 cm in diameter or if symptoms are present
    - Some liberalization of this size limit may be given to patients with a significant family history or a previous diagnosis of any of the hereditable diseases that affect blood vessels
- Approximately 90% of patients with acute dissection of the ascending aorta who are not treated surgically die within 3 months

AORTIC DISSECTION IN PREGNANCY
- One half of all cases of aortic rupture in women younger than 40 years are associated with pregnancy
- In a pregnancy with aortic dissection, maternal mortality is as high as 25%
- Acute aortic dissection may occur in association with severe hypertension due to preeclampsia, coarctation of the aorta, or connective tissue disease such as Marfan's and Ehlers-Danlos syndromes
- Other risk factors include systemic hypertension (chronic hypertension is present in 70% to 90% of patients with aortic dissection) and a congenitally bicuspid aortic valve
- Some physicians have suggested that the cardiovascular changes of pregnancy (i.e., increases in blood volume, cardiac output, stroke volume, and heart rate) impose significant stress on the wall of the aorta
- Signs and symptoms:
    - Severe chest or back pain during pregnancy or the puerperium
    - Shortness of breath
    - Syncope
    - Tachycardia
    - Ischemic extremity
    - Differential blood pressure in the arms or differential pulses in the lower extremities
- MRI is a useful technique for the evaluation of aortic disease because it avoids radiation exposure
- Management:
    - Aggressive control of blood pressure with a vasodilator agent is essential
    - Beta blockers decrease the force of ventricular ejection, which reduces shear stress against the aortic wall
    - Management should involve placement of an intra-arterial catheter and measurement of CVP
    - Intravenous opioids are important for minimizing pain, which helps diminish forces that can extend the dissection
- Pregnancy may affect the choice between medical and surgical therapy
    - The ultimate goal is to save both the mother and fetus, and the decision to repair is often determined by the maternal clinical condition and the stage of gestation
    - It is generally recommended that for an aortic dissection occurring in a pregnant woman before 28 weeks' gestation, the dissection should be surgically repaired and the pregnancy continued
    - For a dissection occurring beyond 32 weeks' gestation, a cesarean delivery followed immediately by aortic repair should be considered
    - For a dissection occurring between 28 and 32 weeks' gestation, an aortic repair is performed, and concurrent cesarean delivery is reserved for patients with evidence of fetal compromise

REFERENCES

- Co-existing Chapter 8
- Barash Chapter 42
- Miller Chapter 62
- Chestnut Chapter 41