Vascular

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What to Know: Covered in this lecture

- PCCN
  - Aneurysm
    - Dissecting
    - Repair
  - HTN Crisis
- Vascular disease
  - Carotid artery stenosis
  - Minimally-invasive interventions
  - Peripheral arterial occlusions
  - Peripheral surgical interventions
  - Peripheral venous thrombosis

- CCRN
  - Carotid artery stenosis
  - Endarterectomy, peripheral stents, Fem-Pop bypass
  - Hypertensive crisis
  - Ruptured or dissecting aneurysm (e.g., thoracic, abdominal, thoraco-abdominal)
  - Coagulopathies (e.g., ITP, DIC, HIT)
  - Acute peripheral vascular insufficiency (e.g., acute arterial occlusion)

Hypertensive Crisis

- Life threatening elevation in blood pressure necessitating emergency treatment to prevent severe end organ damage and death
Hypertensive Crisis

• Most patients have persistent BP elevation for years before they manifest a hypertensive emergency
• The rapid onset suggests a triggering factor that tips the patient over to a crisis
• A hypertensive crisis is associated with acute end-organ damage
• Requires immediate treatment with a titratable short-acting IV antihypertensive agent

Hypertensive Crisis

• Hypertensive crises encompass a spectrum of clinical situations
  — Severely elevated blood pressure, usually higher than 180/110 mm Hg,
  — Progressive or impending target organ damage
• Patients with hypertensive crises may present with
  — A range of blood pressures
  — Varied clinical symptoms
  — Presence or absence of target organ involvement

Hypertensive Crisis

• Risk Factors
  — DM
  — Obesity
  — Smoking
  — Hyperlipidemia
  — Oral contraceptives
  — History of hypertension with pregnancy
  — Alcohol abuse

Hypertensive Crisis

• Clinical Manifestation
  — Hypertensive encephalopathy
  — Acute aortic dissection
  — Acute myocardial infarction
  — Acute coronary syndrome
  — Pulmonary edema with respiratory failure
  — Severe pre-eclampsia
  — Acute renal failure
Hypertensive Crisis
Signs & Symptoms

- Headache
- Nausea
- Confusion & disorientation
- Visual changes
- Seizures
- Coma
- Hematuria, flank pain/tenderness
- Chest, back or abdominal pain
- Palpitations
- Dyspnea, orthopnea, abnormal lung sounds
- New murmurs, arrhythmias
- Abnormal peripheral pulses

Hypertensive Crisis
Diagnostic tests
- CXR
- ECG
- CT/MRI
- Angiogram
- Renal US
- Laboratory Testing
  - BUN/creatine
  - Ca+, Na+, K+
  - Cardiac enzymes

Hypertensive Crisis
Management of Patient
- Lower BP slowly
- Maintain IV access
  - Administer Nitroprusside (“Gold Standard”)
  - Transfer to ICU setting- continual arterial monitoring
- Monitor and document I/O
- Monitor electrolytes and lab values
- Provide reassurance and educate patient and family

Hypertensive Crisis
Complications
- Hypertensive encephalopathy
- Intracerebral or subarachnoid hemorrhage
- Cardiovascular dysfunction
- Renal failure
Summary

• Most hypertensive crises are preventable
• Hypertensive urgencies occur without evidence of progressive target organ damage
• Hypertensive emergencies are complicated by evidence of progressive target organ damage
• The levels of blood pressure readings alone do not determine action
  – It is determined by the degree of target organ damage

Question

• A sodium nitroprusside (Nipride) drip is started for a patient admitted with hypertensive crisis. Which of the following is most important to monitor?

A. Blood glucose levels every 2-4 hours
B. aPTT level after 12 hours of therapy
C. Blood pressure every 1-2 minutes, until stable
D. Symptoms of nausea

Carotid Artery Stenosis

• Carotid stenosis is a narrowing or constriction of the inner lumen of the carotid artery usually caused by atherosclerosis
• The plaque can be:
  – Stable and asymptomatic
  – A source of emboli
Carotid Artery Stenosis

- Emboli breaks off from the plaque and travels through the circulation to blood vessels in the brain
- This ischemia can either be:
  - Temporary - transient ischemic attack
  - Permanent - embolic stroke

Carotid Artery Stenosis

- Clinical Manifestations
  - Speech difficulties
  - Visual disturbances
  - Motor weakness
  - Vertigo
  - Syncope
  - Confusion
  - Memory loss

Carotid Artery Stenosis

- Diagnostic tests
  - Duplex ultrasound
  - CT/MRI
    - Dx infarction
    - Exclude other disorders that might be responsible for symptoms (eg, subdural hematoma, tumor)

Carotid Artery Stenosis

- Treatment
  - Carotid Endarterectomy
    - May place a carotid shunt
    - Use cerebral perfusion monitoring to guide the need for selective shunt placement
**Carotid Artery Stenosis**

- **Carotid Stent / since 1994**
  - During angioplasty, a balloon catheter is guided to the area of the blockage or narrowing.
  - During the angioplasty procedure, a carotid stent (a small, metal mesh tube) is placed inside the carotid artery at the site of the blockage and provides support to keep the artery open.

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**Carotid Artery Stenosis**

- Post intervention care:
  - The sheath remains in place or a vascular plug or suture is used to achieve hemostasis.
  - Patient will lay flat after the sheath is removed for 2 to 6 hours.
  - Neurovascular exam often.
  - Carotid ultrasound.
  - Aspirin and Plavix (clopidogrel bisulfate) to take for one month after the procedure (newer trends lifetime).

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**Aortic Disease**

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**Aortic Dissection**

- Entry of blood through a tear in the intima into the intimo-medial layers.
Aortic Dissection

• Most common catastrophic and often fatal condition affecting the aorta
• Most prevalent symptom is excruciating chest pain

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Aortic Dissection

• An acute aortic dissection / less that 2 weeks
  – High morbidity and mortality rates
  – Highest mortality in the first 7 days
• Chronic aortic dissection / longer than 2 weeks
  – Better prognosis

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Aortic Dissection

• Type A: Involves the ascending aorta
  – Typically occurs in younger patients
  – Chronic dissection is surgically treated if patient develops:
    – Aortic regurgitation
    – Extension of the dissection
  – The surgical treatment is to replace the ascending aorta to prevent aortic rupture

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Aortic Dissection

• Type B: Confined to the descending aorta
  – More often occurs in older patients with hypertension and atherosclerosis
  – Primary treatment is pharmacologic therapy to control hypertension
  – Surgery is performed if hypertension is unmanageable
  – Surgical repair has high incidence of paraplegia from spinal chord damage

Definition of Aortic Rupture

• Blood is recognized outside the aorta
  – CT scan
  – Retroperitoneal hematoma found during laparotomy

Causes of Aortic Rupture

• Tearing of aortic tissue
  – It may be rupture of an aneurysm
  – It may be due to trauma

• Spontaneous rupture of an aorta is rare
  – Cause may be
    – Atherosclerotic ulcer
    – Infected aorta

Traumatic Aortic Rupture

Underlying Cause

• An aortic rupture is caused by
  – A severe injury to the chest that occurs when the body’s motion suddenly stops at the time of a high-speed motor vehicle crash
  – May also be caused by gunshot wound or stab wound
Aortic Rupture Outlook

• What to expect with an aortic rupture:
  • About 85% of people with aortic rupture die
  • About half of those who survive the initial event, die within 24 hours

Aortic Rupture

• The patient’s hemodynamic stability is compromised
• If the patient is to survive:
  – Rapid fluid resuscitation
  – Blood administration
  – Surgery
  – Endovascular procedure

Symptoms of Aortic Rupture

• Pain
  – Back Pain
  – Chest pain
  – Abdominal pain
• Tachycardia due to loss of blood
• Loss of Blood Flow to Extremities
  – Numbness
  – Swelling

Aortic Aneurysm Definition

• Permanent localized dilation of the aorta that is at least 50% larger in diameter than a normal aorta

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Aortic Aneurysm

• Aortic aneurysm will expand with eventual rupture
• Some aneurysms remain stable for long periods of time

Pathophysiology of Aortic Aneurysm

• The underlying cause is unknown in many individuals
• Atherosclerosis may cause aneurysms

Aortic Aneurysm

• The most common location an aneurysm
  – Abdominal aortic aneurysm - AAA
• The second most common site for an aortic aneurysm to develop is in the thoracic aorta

Thoracoabdominal aneurysm (TAA)

• Extends from the chest to the abdomen.
• The greatest concern:
  – May grow quickly and rupture or leak blood
  – Aneurysms that rupture can be fatal
Pathophysiology of Aortic Aneurysm

• Degeneration of the arterial media
• Arterial media is made up of collagen and elastin
• There is no evidence that elastin is synthesized in adult life
• Elastin has half life of 40-70 yrs
• Elastin in normal vessel ~ 36%
• Elastin in aneurysmal vessel ~ 8%

Aortic Aneurysm Rates of Rupture

• < 4.0 cm = low
• 4.0 - 4.9 cm = 5%
• 5.0 - 5.9 cm = 25%
• 6.0 - 6.9 cm = 35%
• ≥ 7.0 cm = 75%

Open Surgical Repair

• Median sternotomy for ascending aorta and arch
• Left thoracotomy for descending aorta

Open Surgical Repair

• Aorta is cross clamped
• Diseased portion of aorta is replaced with a Dacron or Teflon graft
• Graft is sewn into place
• Recovery is similar to cardiac surgical procedure
Complications of Surgery

- If aortic valve is involved bradycardia or heart block may occur
- Colon ischemia
- Wound infection
- Renal complications
- Limb ischemia
- Groin hematoma or infection

Spinal Complications

- May cause paralysis
- Due to hypotension
- Decreased spinal perfusion
- Inflammation

Endovascular Aneurysm Repair

- Minimally invasive technique
- EVAR grafts have been used to repair thoracic and abdominal aneurysms

Endovascular Aneurysm Repair EVAR

- Use a metal stent covered with graft material
- The stent is deployed inside the aorta and held in place with metal hooks or barbs
Endovascular Aneurysm Repair (EVAR)

- Transvascular approach
- Femoral incision
- Insertion of a bypass conduit or endograft

During endovascular repair:
- Fluoroscopy is used
- To determine the position of the endograft
- Assess for renal complications

Practice Question

- Two days after aortic surgical repair, a patient develops hypotension, tachycardia, abdominal distention, diarrhea, and an elevated white blood cell count. The most likely cause of these findings is which of the following?
  A. Postoperative graft infection
  B. Ischemic Colitis
  C. Aorto-enteric fistula
  D. Abdominal compartment syndrome

Practice Question

- A patient admitted to the ICU after endovascular repair of an abdominal aortic aneurysm (AAA) has the following assessment findings: BP 120/74 mm Hg, HR 90/min, RR 20/min, temperature 36°C, Distal pulses are 2+, capillary refill is 2 seconds, and the groin site shows no sign of hematoma. Urine output is 20 mL/hr for 2 hours. The most likely cause of decreased urine output is
  A. Renal toxic effects of contrast agents
  B. Occlusion of the renal artery by the endograft
  C. Hypovolemia due to operative blood loss
  D. Hypovolemia due to retroperitoneal bleeding