---VASCULAR---

Basics

Intima, int elastic lamina, **M**edia, ext elastic lamina, **A**dventitia (vasovasorum, nutrition, nerves)
Large vessels (>28 lamellae in media) have vasovasorum; smaller arteries oxygenated directly
Endothelium: antithromotic d/t: prot C, S, ATIII, NO, prostacyclins (vasodilation)
Atherosclerosis
- Formation: fatty streak→fibrous plaque→ulcerate→microcalcification
- Location: usu at bifurcation, tethered sites (turbulent flow, stasis)
- Carotid bifurcation, coronary a, prox iliacs, adductor canal
- Gradual occlusion allows collateral arterial flow
- Sudden thrombosis/embolus: no collateral flow, worse px w/ acute dz
- Risk reduction: diet, nutrition, smoking cessation, ACEI, BB, statins
- Smoking ↑s risk of peripheral athero 9x, and coronary athero 4x

Aneurysms

Dilation of artery >1.5x nl diameter
True aneurysm assoc w/ athero (all 3 layers); pseudoaneurysm secondary to trauma, infxn
Fusiform more common than saccular
Common locations: infrarenal aorta, iliac a, popliteal a (50% assoc risk of AAA)
NL aorta 2cm in diameter
Occurs in **5%** pts >60 y.o.
20% pts w/ AAA have 1st deg relative w/ AAA
90% of aneurysms d/t athero: ↑MMPs
Inrarenal aorta: poorly developed vasovasorum, ↑ risk of aneurysm formation (**95%** of AAAs)
Most AAAs grow 3mm/yr
Wall stress = Pressure x Radius / Wall thickness
Only 20% AAAs cz sxs; acute back pain + hypotension + pulsatile abd mass = rupture
Dx: U/S for screening, CT to assess size (A gram may show falsely ↓d diameter d/t thrombus)
Rx: 4cm AAA **<5%** annual risk of rupture: 6cm AAA **15%** annual risk of rupture
- Women have increased risk of rupt if AAA >5cm
- Repair when: 5.5cm, tender, rapid ↑ size, or abd pain
- Endovasc repair: ↓blood loss, hospital stay, but need annual contrast CT, ↑secondary interv
- AAA rupt: surv <50%, survivors have major cxs (MI, CVA, renal fail)
  - Emergent OR, poss endovasc, r/o LE embolus
- Popliteal aneurysm: repair if >2cm, saphenous v graft is best
  - Often w/ distant emboli, need preop lytics, 50% amp rate

Cx: Early: MI, ARF, colon ischemia if IMA sacrificed (post op diarrhea: need sigmoidoscopy)
- Late: Infxn (S aureus, S epidermis) need ax-fem, leak, aortoent fistula, thrombosis, pseudoaneurysm,
  - Ant spinal synd (A of Adamkiewicz; paraplegia, loss pain/temp, incontinence)
- Endoleaks: I) leak at attachment sites; needs repair
  - II) flow into aneurysm sac from lumbar a, or IMA; usu no repair
  - III) modular disconnection or tear; needs repair
  - IV) leak thru graft; resolves when anitcoag is reversed after surg

Aortic dissection

- Tear in intima, blood travels in media, h/o HTN
- Cx: propogate anterograde or retrograde, rupture, MI, CVA, valve insuff, tamponade
- Dx: ECG, CXR, TEE/CT
- Rx: ↓BP and HR immediately
  - Acute repair if in ascend aorta or occlude mesenteric, iliac, or renal arteries
  - Main indication for repair = chronic dissection w/ aneurysm enlargement

PAD

Iliac, superficial femoral, tibial arteries
Aortoiliac dz: ↑↑risk w/ smoking, HTN, hyperlipidemia (**20%** PAD pts have AAA)

Leriche synd: impotence, buttock wasting, claudication, absence of femoral pulse
Femoropopliteal dz: usu distal superficial femoral a (Hunter's canal)
Distal dz (below popliteal trifurcation): pts w/ DM, ESRD, elderly
Intermittent claudication: reproducible pain in muscle groups w/ exercise (**calf** pain); joints / foot NOT painful
Amp rate only **5% at 5** years w/ intermit claud + conservative Rx (stop smoking, exercise)
Ischemic rest pain: pain in **toes & feet** while sleeping, ↓'d by placing in dependent position
Amp rate increased to **50%**
Distinguish from nocturnal cramps (which czs pain in calf, **NOT foot**)
Ulcers
Ischemic: **toes and foot**, punched out, pale, necrotic base
Venous: **b/t malleoli** (d/t perforating v), orange brown color, edema (lipodermatosclerosis)
Diabetic: painless, Charcot's foot, plantar/lateral foot
S/Sx: search for cervical bruits, pulsatile masses, ulcers, hair loss, muscle atrophy, color change
U/S: Triphasic waveform nl, becomes biphasic then monophasic w/ stenosis
ABI: >1 = NL, 0.8 = claudication, 0.4 = rest pain
Pts w/ claudication will have a decrease in ABI on treadmill test when sxs occur
Indications for surgery: Rest pain, Infxn, Necrosis, Severe claud
Rx: Angio w/ balloon, stent; cx: hematoma, intimal flap, pseudoaneurysm, contrast rxn
50% obtain relief w/ smoking cessation + exercise
Cilostazol may help
All pts: ACEI, BB, statins to prevent athero progression
Angioplasty of distal vessels for poor surgical risk pts only
Only 40% patency at 1 yr (d/t intimal hyperplasia)
Endarterectomy limited in LE b/c athero dz is often extensive
Bypass is optimal Rx; aortofem bypass graft has >90% 5yr patency
Poor surgical risk pts: extraanatomic bypass (ax-fem); grafts tunneled in subQ tiss
Fempop dz: bypass to arteries above knee, equal patency for prosthetic or autologous graft
Bypass to arteries below knee, much higher patency w/ autologous vein graft
Postop duplex for surveillance (restenosis in 20%); good patency if early reintervenention
Cx: Early: hematoma, thrombosis, lymphocele
Late: aortoduod fistula, infxn, pseudoaneurysm
Amputation
Pts w/ arterial dz causing severe rest pain or gangrene and no distal target vessel for bypass
Avoid AKA when possible (↑↑ energy req'd to ambulate); also indicated for bed ridden pts

Chronic intestinal ischemia
Gastroduodenal A and marginal A can supply collateral flow (ischemia w/ 2 vessel dz)
Abd pain ½ hr to 1 hr post prandial
"Food fear" leads to significant wt loss
Dx: U/S, arteriogram (lateral view to eval SMA, celiac axis)
Rx: balloon angio (technically challenging), endarterectomy, bypass

Renal artery stenosis
#1 cz of surgically correctable HTN
Suspect in hypertensive children or young females, or new onset HTN in elderly
Athero dz usu affects prox to middle portion of renal A (d/t extension of dz from aorta)
Fibromuscular dysplasia affects middle to distal renal A (more common in females)
S/Sx: may hear flank bruit, and most pts have profound diastolic HTN
Dx: renal duplex U/S >90% sens/spec
Rx: Avoid ACEIs (cz renal failure)
Balloon angio for fibromusc dysplasia
Stent best for athero dz
Endarterectomy or bypass for pts w/ recurrent stenosis

Acute arterial occlusion

Classification of acute limb ischemia						
	Description	Cap refill	Weakness	Sensory loss	Art. Dop	Ven. Dop
Viable	No immed threat	+			+	+
Threatened marginal	Prompt Rx	+/slow		NL/toes	usu +	+
Threatened immed	Immed revasc	Slow/none	Mild	Toes, rest pain	Absent	+
Irreversible	Amp	None	Paralysis	Profound	Absent	Absent

Etio: thrombosis, embolus (**A fib [80%]**, **a**neurysm, **a**theroma), dissection, vasopasm
#1 site for embolism is femoral artery
With embolism, pts can tell you exactly when the pain began
S/Sx: 6 Ps: pain, pallor, paralysis, parasthesias, pulseless, poikilothermia
Rx: Keep extremity in dependent position
Hemodilution w/ aggressive IVF, mannitol, dextrose
Heparin drip STAT
EKG
Emergent revascularization; embolectomy/thrombect b/c 1/3 pts have additional thrombus
Fasciotomy may be needed if ischemia >4 hours
Px: Damage irreversible after 6 hours (esp pts w/ no collateral flow)
Cx: Compartment synd, myoglobinuria, hyperK, ARF, MI
Pulses usu present w/ compartment synd (b/c only need 30mmHg to cz synd)
Acute mesenteric ischemia
50% embolus to SMA, usu just distal to origin of middle colic A
25% thrombosis of preexisting athero plaque
25% nonocclusive dz d/t decreased CO, vasoconstrictors, digitalis

Cerebrovascular insufficiency
75% of cerebral infarcts d/t emboli from carotid arteries (bifurcation)
Circle of Willis is complete in only 25% of pts
Sx: Amaruosis fugax: transient, monocular blindness (curtain like) d/t emboli to ophth A
Middle cerebral A: C/L arm, leg, facial weakness, aphasia (dom hemisph)
Ant cerebral A: monoplegia (one limb), usu more severe in LE
Post cerebral A: dz d/t carotid or verteb/basilar occlusion;
Syncope, dizziness, visual defects, I/L CN III palsy, C/L sensory loss
Dx: Cervical bruit, Hollenhorst plaque (cholest emboli) on ophtho exam
Doppler, arteriography
Rx: NASCET: sx + 70-99% stenosis, CEA helpful (↓2yr poor outcome from 26% to 9%)
Sx + 50-70% stenosis , CEA beneficial (compared to meds alone)
ACAS: Asx + stenosis 60-99%, CEA helpful (↓5yr poor outcome from 11% to 5%)
Restenosis w/in 2 yrs = intimal hyperplasia, while late recurrence = athero

Vertebral basilar disease
Sxs when stenosis prox to origin of vertebral A (3-4x↑ in L d/t ↑length of L subclavian)
W/ arm exercise, distal vasodilation czs reversal of flow in vertebral A
Sx: Syncope, dizziness, nausea w/ arm exercise, ↓BP >40mmHg in I/L arm
Rx: CEA or carotid to subclavian bypass

Venous disease
Superficial LE veins: greater and lesser saphenous v
Deep LE veins: Com fem v, Supeficial fem v, profunda fem v parallel their arteries

AT, PT, Peroneal veins almost always paired
Incompetency of valves and perforating veins allows retrograde flow from deep to superf v
Leads to chronic venous insuff, venous ulcers, varicosities
90% of venous return from deep venous system (superf v may be removed w/o cxs)
Superf v thrombosis: swelling, erythema, tenderness; Rx: NSAID, warm compress
DVT
50% of inpt DVTs are Asx
4x more common in L iliac vs R d/t compression by aortic bifurcation
DDx of acute edema + pain: CHF, ARF, art insuff, hematoma, infxn, trauma
TPA indications: subclav / renal v thromb, SVC occlusion
Thrombectomy rarely indicated b/c >50% thrombi recurr; best Rx TPN
Varicose veins
#1 cz: incompetent saphenofemoral valve
S/Sxs: heaviness, fatigue after standing, night cramps
Dx: U/S in all pts w/ sxs
Rx: Goal: ensure patency of deep system for good venous return
Radiofreq ablation of saphenous v, saphenous ligation, saphenous v stripping
Secondary varicose v and venous ulcers (usu postthrombotic after DVT)
Sx: Lipodermatosclerosis
Dx: duplex to find incompetent perforating v
Rx: compression hose, elevate, radiofreq ablation of peforator
Chronic venous insufficiency
Leads to local venous HTN
S/Sx: edema, hyperpigmentation in gaiter zone, ulceration
Dx: duplex can show venous occlusion and reflux at valves
Rx: compression stockings, Unna boot

Misc
AVM: Palpable thrill; may cz heart failure; Rx percutaneous intravessel sclerosis
Fistula may develop b/t A and V after trauma; all acquired AV fistulae need repair
Vascular trauma: may cz intimal flaps (thrombose in hrs or days)
If extremity viable and ABI=1, vessel inj unlikely; eval w/ duplex
If ischemic, angiogram indicated
Injuries to knees, elbows always require at least duplex
Rx: ligation or bypass
Raynaud's synd: 90% are females w/ assoc autoimm dz (SLE, scleroderma, RA, Sjogrens)
Digits turn white, then blue, then red in response to cold triggered vasospasm
Check all pulses and d/c vasoconstrictive meds; revasc if ischemic
Thoracic outlet synd: young, mid aged women
Compression of brachial plexus, subclav A, d/t cervical rib, congenital bands, scalene musc
Neuro sxs more common than arterial sxs
Dx: C spine XR, nerve conduction velocity
Rx: physical therapy, botox, surgery (resection of 1st thoracic rib most commonly)
Vasculogenic TOS req's immed thrombolysis + surg
Lymphedema: diffuse, painless, enlargement of extremity
Soft, pitting edema becomes woody w/ time
Rx: compression hose, avoid long standing, foot care
Increased risk of lymphosarcoma