

An Overview of Vascular Surgery

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Scope of vascular surgery – treat all blood vessels in the body (exclusive of the heart). In hospitalized patients, vascular surgeons treat primarily lower extremity ischemia, carotid artery occlusive disease, and abdominal aortic aneurysms. Most patients with venous disorders and lymphedema are treated as outpatients.

Chronic Lower Extremity Ischemia

Definition: diminished distal perfusion secondary to obstructive disease

Prevalence: 5% in patients 60-70; 10% in patients 70-80 years old

Pathology: atherosclerotic lesions – especially superficial femoral artery occlusion

Manifestations: encompasses a spectrum of disease ranging from asymptomatic, to claudication, to rest pain, to gangrene.

Risk Factors:

Age
Male Sex
Tobacco Use
Diabetes
Hypertension
Hypercholesterolemia

ALL THE SAME AS CORONARY ARTERY DISEASE

Diagnosis:

History – claudication, rest pain, ulcers, gangrene? Risk factors

Physical Exam – always do a complete pulse exam, including 4-limb pressures and ankle-brachial index (ABI) even if the pulses are “palpable” (Normal ABI 1.0; claudication 0.5-0.9, rest pain 0.3-0.5, gangrene <0.4)

Vascular Laboratory-

- Peripheral arterial exam – segmental waveforms and pressures, toe pressures, plethysmography, TCpO₂, +/- treadmill.
- Arterial duplex

Angiography – only in patients considered for surgery

Natural History:

Initial ABI is best predictor of long-term outcome

Observational studies demonstrated that majority of patients with claudication will be stable or show slight improvement over time

Smoking and DM correlate with disease progression

5-year survival 80%

10-year amputation ~ 11%

Patients with rest pain or ulcers with observation will see ~ 10-20% resolve

Non-operative Treatment:

First line of therapy for patients with claudication is always non-operative:

- Smoking cessation will improve walking distance 100-200% within a few months
- Daily walking will increase walking distance about 100%
- Medications – Cilostazol (Pletal) and Pentoxifylline (Trental) – improve walking in some individuals, but not to same degree as smoking cessation and exercise.

Operative Treatment:

Indicated for: gangrene, non-healing ulcers, rest pain, severely limiting claudication

Type of operation is typically a leg bypass from femoral to popliteal or tibial arteries; vein graft preferred, prosthetic grafts available (PTFE, Dacron)

May need “in-flow” with aortobifemoral bypass or axillary-femoral bypass.

Rarely, angioplasty +/- stenting is an option.

Post-operative course:

- ICU overnight in most; frequent pulse checks; cardiac monitoring
- Early ambulation; continue to monitor blood pressure and CBGs; frequent pulse checks
- Concerns – leg edema common problems; early graft surveillance

Results:

5 year limb salvage 90%, graft patency 75% and survival 50%

Aortoiliac Occlusive Disease

Definition:

- A sub-category of chronic lower extremity ischemia

Pathology:

- Atherosclerotic occlusive disease affecting primarily the infrarenal aorta and iliac arteries

Diagnosis:

- History – similar to above typical patients complain of hip, thigh, and buttock claudication
- Leriche’s syndrome – abdominal bruits, absence of femoral pulses, buttock/thigh claudication, and impotence
- Physical exam – demonstrates quality of femoral pulses, ABI’s
- Non-invasive testing – especially peripheral arterial exam with treadmill

Treatment:

- Non-operative – smoking cessation, daily exercise
- Operative – aortobifemoral, axillary-femoral, iliac angioplasty +/- stenting, (iliac endarterectomy)

Acute Lower Extremity Ischemia

Definition:

Acute diminution in arterial blood flow to an extremity resulting in a threatened limb (some include any ischemia with duration of less than 2 weeks).

Pathology:

Emboic occlusion versus thrombosis of a chronically diseased artery
Native occlusion versus graft occlusion

Diagnosis:

History – sudden onset PMH of cardiac disease – esp. arrhythmia
6 P's – pain, pallor, pulselessness, paresthesias, poikilothermia, paralysis
Physical exam – pulses, viability of extremity – key issue is status of opposite limb
Use of arteriography is limited

Treatment:

Heparin once diagnosis is suspected
Surgery – of proven benefit
Thrombolysis – urokinase (no longer available) and tissue plasminogen activator

Results:

Limb salvage achieved in ~ 70-80%
Mortality ~ 15-20% (primarily due to concurrent cardiac disease)

Other Issues in Lower Extremity Ischemia

Atheroemboli

Classically from AAA, although although other proximal source possible (AIOD, CAD)

Popliteal artery aneurysms

May present as asymptomatic, acute or chronic lower extremity ischemia

Diabetic foot infections

May have foot sepsis with normal arterial circulation

Extracranial Cerebrovascular Disease

Definition:

Occlusive disease affecting the extracranial cervical carotid artery – most commonly at the carotid bifurcation

Pathology:

Atherosclerotic plaque at carotid bifurcation is most common (area of low shear)
Other causes include fibromuscular dysplasia and radiation-induced lesions
Strokes are caused by atheroemboli with or without acute intraplaque hemorrhage
Low flow is a rare cause of symptoms

Manifestation:

Spectrum includes – asymptomatic, amaurosis fugax, transient ischemic attack, and stroke

Risk Factors:

Age, male sex, tobacco use, hypertension, hypercholesterolemia

Diagnosis:

History – CVA, TIA, amaurosis fugax; review any risk factors

Physical exam – carotid bruits (not very useful), heart murmur/arrhythmia, abdominal bruits, signs of lower extremity ischemia

Baseline neurologic exam is essential and fundoscopic exam helpful

Non-Invasive tests – carotid duplex can accurately determine degree of stenosis

Invasive tests: angiography used to be the standard but has a risk of stroke – 1%.

Angiography is reserved for unusual circumstances – arch disease, redo, bilateral disease, high lesion

Treatment:

Non-operative – aspirin

Operative – carotid endarterectomy plus aspirin

Accepted indications for operation

- Asymptomatic disease $\geq 60\%$ {ACAS 5.1% vs. 11% at 5 years}
- Symptomatic disease $\geq 70\%$ {NASCET 9% vs. 26% at 2 years}
Likely $\geq 50\%$ {NASCET 15.7% vs. 22.2% at 5 years}

Caveat – low perioperative CVA and death rate is essential

Asymptomatic patients must survive at least 5 years to benefit from a CEA

Operation performed is standard carotid endarterectomy (CEA)

Postoperative course typically includes one day in the hospital (intermediate care unit)

Intensive blood pressure monitoring and control – danger of hemorrhage vs thrombosis and frequent neurologic checks are essential

Patients with fluctuations in BP are at higher risk for perioperative neurologic events

“Fast-tracking” now discharge home POD#1

Evolving role for carotid angioplasty and Stenting (CAS)

Currently CAS reserved for “high-risk” symptomatic $>70\%$ stenosis

Ongoing trials will likely expand the scope of CAS

Most trials indicate equivalent results CAS versus CEA, with possible lower cardiac morbidity with CAS, with unclear long-term results.

Results:

5- Year freedom from stroke in symptomatic patients treated with CEA is 87% and in asymptomatic patients is 95%

CEA trades a small up-front risk of stroke for long-term protection from stroke

Other Issues:

Vertebrobasilar insufficiency – difficult to diagnose, ? role of vertebral artery reconstruction

Subclavian-steal – a frequent anatomic finding but rarely physiologically significant

Abdominal Aortic Aneurysm**Definition:**

Localized dilatation of an artery > 1.5 times normal diameter

Use 3.0cm for AAA

Pathology:

Most seen in conjunction with atherosclerosis; ? Genetic influence; ? role of elastase, metalloproteases, collagenase, infection

Prevalence:

3% in 60-70 year olds; 5% in hypertensive or CAD; 10% in patients with lower extremity occlusive disease; 20% in patients with first-degree relative

Risk Factors:

Tobacco 5.57 odds ratio; family history 1.95 OR; diabetes 0.49 OR

Diagnosis:

History – 75% of AAA are asymptomatic at diagnosis; most discovered incidentally

Physical exam – presence of AAA can be determined only in thin people (waist <40 inches); look for associated femoral and popliteal aneurysms

Non-invasive tests:

- Ultrasound – excellent screening test; sizes within 5 mm
- CT – best sizing test; rules out rupture; down-side is contrast
- MRI – no real benefit over CT except no contrast

Invasive tests:

- Angiography – indicated if suprarenal extension suspected, intractable hypertension, Aortoiliac occlusive disease, visceral (renal, celiac or superior mesenteric artery stenosis), horseshoe kidney or multiple aneurysms.

Natural History:

Typically no symptoms until rupture

Rupture risk is related to size (diameter)

Wall tension = pressure x radius / wall thickness

Rupture risks – 5-5.9cm ~ 2-4% / year; 6-6.9cm ~ 5-10%/year, ≥7cm ~ 15-20%/ year

Annual rate of growth is ~ 0.4cm / year

Indications for Treatment:

Mortality of a ruptured aneurysm is likely >90%

Only 50% who reach the hospital survive

Most likely never reach the hospital

Elective aneurysm repair carries mortality near 2% in most centers

The time to repair an aneurysm is when **risk of rupture > risk of operation**

Observation – for small aneurysms (<5cm) or high-risk patients

- Ultrasound q 6 months

Operation indicated for:

- Aneurysms > 5cm in most people
- Any symptoms (rupture, emboli, abdominal pain with no other cause)
- Rapid enlargement (>1cm in one year)
- Associated severe occlusive disease

Treatment Options for AAA:

Standard open surgical repair – retroperitoneal versus transperitoneal – tube graft, aortobiliac or aortobifemoral grafts

Endovascular repair (typically bifurcated stent-grafts AneuRx, Excluder, Zenith,...)

- Endovascular repair is possible in less than half of all AAA, short and medium-term results are equivalent to open repair, long-term results >5 years are unknown
- Pitfalls are endoleaks, device failures, late ruptures, need for life-long follow-up with CT

Post-operative course:

Standard surgery – ICU for 1-2 days; often extubated in the operating room, hemodynamic monitoring, fluid resuscitation, monitor urine output

Warning signs – anuria and acidosis

As always, frequent pulse checks

To ward POD 1, early mobilization, await resolution of ileus (less with retroperitoneal), home 4-5 days

Stent graft – no ICU stay; home POD 2

Results:

Long-term outlook is very good with survival nearly equaling age-matched cohort

Small risk of anastomatic aneurysms – esp. femoral

1% risk of graft infection

Long-term results of stent-grafts remain unknown

Visceral Ischemia Syndromes

Definition:

Insufficient perfusion of viscera to maintain normal viability and function.

Pathophysiology:

Most common syndromes account for 95% of instances of visceral ischemia

- Acute embolic mesenteric ischemia (primarily emboli from heart to SMA)
- Acute thrombotic mesenteric ischemia (underlying occlusive disease)
- Chronic mesenteric ischemia
- Non-occlusive mesenteric ischemia (low-flow seen in severe pump failure)
- Mesenteric venous thrombosis

Diagnosis:

Acute Mesenteric ischemia – abrupt onset of severe cramping and periumbilical abdominal pain – typically in a patient with a history of cardiac disease

May have explosive, bloody diarrhea (Fever, nausea, vomiting, abdominal distension may be present)

Classic “pain out of proportion to physical findings”

Arteriography is diagnostic test of choice

Chronic mesenteric ischemia – characteristically post-prandial pain, food phobia and weight loss

More common in women

Seen in patients with extensive arteriosclerotic risk factors

Duplex is useful as a screening test

Arteriography is diagnostic test of choice

Treatment:

Acute embolic mesenteric ischemia – SMA embolectomy

Acute thrombotic mesenteric ischemia – visceral bypass

Chronic mesenteric ischemia – visceral bypass or transaortic endarterectomy

(Non-occlusive mesenteric ischemia - treat underlying heart disease, may benefit from intraarterial papaverine; mesenteric venous thrombosis – treat with anticoagulation, may need segmental bowel resection)

Results:

Acute mesenteric ischemia – mortality close to 50%

Chronic mesenteric ischemia – mortality 5-10% with good long-term patency, and weight gain

Visceral Ischemia Syndromes

Definition:

A spectrum of disease that includes spider telangiectasias, varicose veins, chronic edema, lipodermatosclerosis, healed ulcers, and active ulcers.

Diagnosis:

Physical exam – skin changes, spiders, varicose veins, edema, ulcers

Document pulses

Accurately record location, size and depth of ulcers (typically in the gaiter area)

Vascular Lab

- Duplex – shows anatomic location and can quantify reflux, also can identify deep vein thrombosis
- APG – venous ejection fraction
- PPG – venous refill time

Classification – CEAP – **C**linical **E**tiologic **A**natomic **P**athophysiologic

Treatment:

For ulcers:

- Compression will heal virtually all venous ulcers
- Local wound care
- Antibiotics as needed
- ?Apligraf
- ?Role of perforator vein division

For spiders and varicose veins:

- Office & day surgery
- Spider veins – sodium morrhuate injections (0.2% & 1.0%)
- Subfascial endoscopic perforator surgery
- Varicose vein stripping

Results:

For ulcers long-term compression therapy is mandatory to prevent ulcer recurrence

Cosmetic results of sclerotherapy and varicose vein surgery are excellent, however long-term development of new varicosities and spiders is the rule

Lymphedema

Definition:

Primary –

- Congenital 10-15%
- Praecox (adolescence) 80%
- Tarda (>35 years) 10%

Secondary –

- Trauma (esp. post-surgical)
- Infection (filariasis), inflammation
- Intraabdominal process (tumor rare)

Diagnosis:

Primarily clinical

Exclude severe venous disease with noninvasive tests

Treatment:

Compression, massage therapy

Aggressive treatment of cellulitis (patient with antibiotic prescription)

Goal is early treatment prior to severe skin changes

Results:

Good with a compliant patient

Smoking Cessation

Smoking is the most important risk factor for the development of vascular disease

The addiction is 10X worse than heroin and 20X worse than cocaine

The proper approach to the patient who continues to smoke is:

- Repetitive positive encouragement
- Stress that “cutting down” is useless
- Encourage his/her partner to be involved
- Stress that quitting is a process
- Remind patient that recidivism is common and is no reason to give up
- Inform the patient that, on average, smoking cessation takes 2-5 years
- Successful quitters have an average of 6 episodes of abstinence prior to success

Adjuncts – Nicorette, the “Patch,” Zyban