Unusual Vascular Disorders

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Disclosure Statement: I have no financial disclosures related to this lecture
Unusual Vascular Disorders

These disorders may mimic other more commonly seen cardiovascular diseases. They are important for formulating a differential diagnosis and managing your patient.
Non-Atherosclerotic Arterial Vascular Disorders

- Fibromuscular Dysplasia
- Popliteal Artery Entrapment Syndrome
- Cystic Adventitial Disease
- External Iliac Artery Endofibrosis
- Thromboangiitis obliterans
- Uncommon Arteriopathies

When should you think of these disorders?
- Younger patients
- Patients with no traditional risk factors for atherosclerosis
A 44 year old female presents to your office complaining of a whooshing noise in her left ear. She has a history of hypertension but otherwise is in good health. You suspect she might have:

a). Meniere's disease  
b). Fibromuscular dysplasia  
c). An acoustic neuroma  
d). A stroke
Fibromuscular Dysplasia or FMD

- Affects small to medium sized vessels
- Nonatherosclerotic, noninflammatory vascular disease
- Affects young to middle aged women
- Can result in arterial stenosis, occlusion, aneurysm formation or dissection

<table>
<thead>
<tr>
<th>Renal</th>
<th>Cerebrovascular</th>
<th>Visceral</th>
<th>Extremities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Asymptomatic or headache, pulsatile tinnitus, vertigo, syncope, TIA, CVA, intracranial aneurysm</td>
<td>Abdominal pain, weight loss, epigastric bruit</td>
<td>Intermittent claudication, critical limb ischemia, embolization</td>
</tr>
</tbody>
</table>
Epidemiology of FMD

- Prevalence in the general population is not known
- More common in women than men (9:1 ratio)
- Renal artery FMD prevalence estimated - 1% to 5.7%
- Prevalence of carotid, vertebral and intracranial FMD is unknown but estimated - 0.3% to 3.2%
## 2014 American Heart Association
### Classification of Fibromuscular Dysplasia

<table>
<thead>
<tr>
<th></th>
<th>Multifocal</th>
<th>Focal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Angiographic appearance</strong></td>
<td>Alternating dilatation and constriction of the vessel (string of beads) Areas of dilatation are larger than the normal caliber of the artery Occurs in the mid and distal portion of the renal, internal carotid, and vertebral arteries May occur in any other artery in the body†</td>
<td>Focal concentric or tubular stenosis*</td>
</tr>
<tr>
<td><strong>Typical histology</strong></td>
<td>Medial fibroplasia (most common) Perimedial fibroplasia (rare)‡</td>
<td>Intimal fibroplasia (most common) Adventitial (periarterial) fibroplasia (rare) Medial hyperplasia (rare)</td>
</tr>
<tr>
<td><strong>Associated features</strong></td>
<td>Aneurysm, dissection, and vessel tortuosity of medium-sized arteries may be present; multifocal and focal lesions may coexist in the same patient</td>
<td>*Lesions are not necessarily confined to the mid or distal portion of the artery (ie, can occur in any arterial segment). †There are no cases of aortic fibromuscular dysplasia that are well documented pathologically. ‡This rare form of fibromuscular dysplasia typically occurs in young girls (eg, those 5 to 15 years of age). Although there is a beaded appearance to the renal arteries, the beads are smaller than the normal renal artery and less numerous. There is often collateralization around the area of stenosis (Figure 3).</td>
</tr>
</tbody>
</table>

*Circulation 2014;129:1048-1078*
Differential Diagnosis of FMD

- Atherosclerosis (FMD usually occurs at mid to distal portion of the arteries)
- Vasculitis (FMD is noninflammatory)
- Standing waves or stationary waves (associated with catheter or contrast-induced spasm of the artery)
Standing waves. Note the regular oscillations in the superficial femoral artery (arrows, A) and tibial arteries (arrows, B). This is often mistaken for FMD.
Pathogenesis: Unknown

- Hormonal effects (such as estrogen)
- Cigarette smoking
- Mechanical stress on vessel walls
- Genetic factors (but no genes for FMD have yet been identified)
Fibromuscular Dysplasia - Diagnosis

- History and physical examination
- Duplex ultrasound
- CTA, MRA
- Catheter-based angiography
## Presenting Signs and Symptoms

(Patients in the US Registry for FMD – 447 patients)

<table>
<thead>
<tr>
<th>Symptoms/Signs</th>
<th>(%) of 447 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>63.8</td>
</tr>
<tr>
<td>Headache (current, history of)</td>
<td>52.4, 30.2, 38.7</td>
</tr>
<tr>
<td>Pulsatile tinnitus</td>
<td>27.5</td>
</tr>
<tr>
<td>Dizziness</td>
<td>26</td>
</tr>
<tr>
<td>Cervical bruit</td>
<td>22.2</td>
</tr>
<tr>
<td>Neck pain</td>
<td>22.2</td>
</tr>
<tr>
<td>Chest pain or SOB</td>
<td>16.1</td>
</tr>
<tr>
<td>Flank/abdominal pain</td>
<td>15.7</td>
</tr>
<tr>
<td>Aneurysm</td>
<td>14.1</td>
</tr>
<tr>
<td>Cervical dissection</td>
<td>12.1</td>
</tr>
<tr>
<td>Epigastric bruit</td>
<td>9.4</td>
</tr>
<tr>
<td>TIA</td>
<td>8.7</td>
</tr>
<tr>
<td>Postprandial abdominal pain</td>
<td>7.8</td>
</tr>
<tr>
<td>Stroke</td>
<td>6.9</td>
</tr>
<tr>
<td>Claudication</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Circulation 2014;129:1048-1078
### Prevalence and Vascular Distribution of Arterial Aneurysm and Dissection in the US Registry for FMD

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
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</thead>
<tbody>
<tr>
<td>Aneurysm</td>
<td>76/447* (17)</td>
</tr>
<tr>
<td>Renal</td>
<td>25/76 (32.9)</td>
</tr>
<tr>
<td>Carotid</td>
<td>16/76 (21.1)</td>
</tr>
<tr>
<td>Aorta</td>
<td>15/76 (19.7)</td>
</tr>
<tr>
<td>Ascending</td>
<td>6/76 (7.9)</td>
</tr>
<tr>
<td>Descending</td>
<td>4/76 (5.3)</td>
</tr>
<tr>
<td>Abdominal</td>
<td>5/76 (6.6)</td>
</tr>
<tr>
<td>Celiac</td>
<td>12/76 (15.8)</td>
</tr>
<tr>
<td>Cerebral</td>
<td>9/76 (11.8)</td>
</tr>
<tr>
<td>Mesenteric</td>
<td>5/76 (6.6)</td>
</tr>
<tr>
<td>Basilar</td>
<td>5/76 (6.6)</td>
</tr>
<tr>
<td>Vertebral</td>
<td>2/76 (2.6)</td>
</tr>
<tr>
<td>Subclavian</td>
<td>2/76 (2.6)</td>
</tr>
<tr>
<td>Popliteal</td>
<td>2/76 (2.6)</td>
</tr>
<tr>
<td><strong>Dissection</strong></td>
<td>88/447* (19.7)</td>
</tr>
<tr>
<td>Carotid</td>
<td>68 (75)</td>
</tr>
<tr>
<td>Renal</td>
<td>19 (22)</td>
</tr>
<tr>
<td>Vertebral</td>
<td>15 (17)</td>
</tr>
<tr>
<td>Mesenteric</td>
<td>4 (4.5)</td>
</tr>
<tr>
<td>Coronary</td>
<td>3 (3.4)</td>
</tr>
<tr>
<td>Celiac</td>
<td>2 (2.3)</td>
</tr>
<tr>
<td>Iliac</td>
<td>2 (2.3)</td>
</tr>
</tbody>
</table>

*Circulation 2014;129:1048-1078*
Features suggesting FMD include elevated velocities, turbulence of color or spectral Doppler flow and tortuosity in the mid and distal segment of the renal or carotid arteries.

- Beading may be seen.
- Doppler criteria used for atherosclerotic renal or carotid artery disease cannot be used to determine the severity of FMD.

U/S of Right ICA “beading of vessel”
Color Doppler showing turbulence and spectral analysis demonstrating high peak systolic (419 cm/s) and end-diastolic velocities (186 cm/s). Color power angiography demonstrating severe tortuosity and redundancy (S curve) of the internal carotid artery.
Fibromuscular Dysplasia - CTA or MRA

CTA images demonstrating “string of beads”

MR imaging demonstrating “string of beads”
Fibromuscular Dysplasia

Predominately affects renal and internal carotid arteries - (65% of the Cases)

NEJM 2004; 350: 1862-1871
Circulation 2014;129: 1048-1078
Fibromuscular Dysplasia

Mesenteric arteries
Brachial artery

Reported in virtually every Arterial Bed
FMD and Coronary disease

LAD artery disease and right renal artery FMD
FMD of coronary arteries reported as a cause of MI
(7 cases of renal FMD with well-demarcated oblitative CAD)

Cath and Cardiovasc Interv 2005; 64: 138
Perimedial fibroplasia of the renal artery.

The beads (arrow) are smaller and less numerous than in medial fibroplasia.

Typical arteriographic findings of multifocal fibromuscular dysplasia in the carotid and renal arteries according to the American Heart Association classification system. Angiographic pattern is indicative of medial fibroplasia with multiple areas of alternating stenosis and dilatation (string of beads).

Arterial tortuosity is frequently encountered in patients with fibromuscular dysplasia.

Perimedial fibroplasia of the renal artery. The beads (arrow) are smaller and less numerous than in medial fibroplasia.

Circulation 2014;129:1048-1078
Treatment of Fibromuscular Dysplasia

- Medical therapy
  - antiplatelet/antithrombotics
  - antihypertensive meds
  - cardiovascular risk factors and lifestyle modification
- Endovascular therapy
  - angioplasty
  - stenting (dissections)
  - coils, stents (aneurysms)
- Surgery
- Evaluate for intracranial aneurysm
A 28 year old male is complaining of bilateral calf pain while running. He denies any recent trauma or injury. He has no cardiovascular risk factors. You suspect he has…….

a). Fibromuscular dysplasia
b). Popliteal artery entrapment syndrome
c). Arthritis
d). Patellofemoral pain syndrome
Popliteal Artery Entrapment Syndrome (PEAS)

- A group of conditions in which compression of the popliteal artery, vein, and tibial nerve (singly or in combination) in the popliteal fossa by surrounding musculoskeletal structures causes vascular and neurogenic symptoms.
PEAS

- Rare, but not a benign condition as progressive injury to the popliteal artery can lead to limb loss
- Median age 29 (16-47)
- Athletic young males (83%)
- Prevalence is unknown (reports range from 0.2% in Greek military recruits to 3.5% in postmortem study of patients with vascular disease)
- Often misdiagnosed or simply overlooked

J Vasc Surg 2012;55:252-262
Vascular and Endovascular Surgery 2013;47:513-518
**Symptoms:**
- Exercise-induced intermittent claudication (running, cycling)
- Affects calf and foot (69% of all patients)
- Onset of symptoms often sudden
- Acute limb ischemia including distal limb thromboemboli or CLI (rest pain, ulcers)
- Bilateral PAES (30% to 67%)
- Limb swelling (**popliteal vein entrapment**)
- Nocturnal cramps and paresthesias (**tibial nerve entrapment**)
## Popliteal Vascular Entrapment Forum Classification for PEAS

<table>
<thead>
<tr>
<th>Type</th>
<th>Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Popliteal artery running medial to the medial head of the gastrocnemius</td>
</tr>
<tr>
<td>Type II</td>
<td>Medial head of gastrocnemius laterally attached</td>
</tr>
<tr>
<td>Type III</td>
<td>Accessory slip of gastrocnemius/fibrous band arising from medial head of gastrocnemius</td>
</tr>
<tr>
<td>Type IV</td>
<td>Popliteal artery passing below popliteus muscle/fibrous bands</td>
</tr>
<tr>
<td>Type V</td>
<td>Primarily venous entrapment (more common in females)</td>
</tr>
<tr>
<td>Type VI</td>
<td>Other variants</td>
</tr>
<tr>
<td>Type VII</td>
<td>Functional entrapment defined as compression due to muscular hypertrophy</td>
</tr>
</tbody>
</table>

**Congenital abnormality between popliteal artery and medial head of gastrocnemius muscle**

Stenosis, occlusion, thromboembolism or aneurysmal formation can occur

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Diagnosis:

- History and physical exam
- Examine patient with passive dorsiflexion of the foot; plantar flexion against active resistance
Diagnosis:
• PVR’s with exercise followed by flexion maneuvers

ABI rest 1.13

Dorsiflexion of right foot

*Pulse not Dopplerable*
**Duplex scanning**: longitudinal view of popliteal artery. In *neutral position*, normal typical triphasic waveform is noticed.

**Duplex scanning**: longitudinal view of popliteal artery. During *dorsiflexion* of the ankle, a biphasic waveform with altered flow velocity is recorded.

*Clin J Sport Med 2004; 14: 8-12*
Allows visualization of the common vascular and abnormal muscle attachments and muscular hypertrophy that lead to arterial stenosis, and occlusion.

Bilateral popliteal artery entrapment demonstrating medial displacement of the popliteal artery (asymptomatic) and near occlusion of the popliteal artery (symptomatic). Angiographically may see: deviation of the popliteal artery, narrowing, poststenotic dilatation, occlusion or aneurysmal formation.
PEAS - Treatment

- Catheter-directed thrombolysis and endovascular techniques – "complementary treatment strategies"
- **Surgery for PAES** - (myotomy) release muscle to free entrapped artery if no arterial injury.
  - If arterial damage, revascularization surgery is needed (bypass or interposition grafts with reversed saphenous vein)
- **Surgery for PVES** – fasciotomy with or without musculotendinous section + popliteal vein reconstruction
- Avoid PTA or stenting as the only treatment

Cystic Adventitial Disease

- Rare condition in which mucinous cysts form within the adventitia of arteries and veins
- Can lead to lumen occlusion
- Affects young to middle-aged men most often
- Popliteal artery most commonly involved site

J Vasc Surg 2014;60:235-245
Cystic Adventitial Disease

- Incidence 1:1200
- Males > female (4:1)
- Typical age mid 40’s (reported in pediatric patients ages 5-15)
- Intermittent claudication
- Generally unilateral
- May also present as painless swelling

Intermittent claudication may wax and wane and takes a longer time to subside than ASO
Cystic Adventitial Disease

Anatomic locations:
- Popliteal artery (PCAD)
- External iliac artery
- Common femoral artery
- Venous (saphenous)
- Radial or ulnar artery
- Axillary artery
- Brachial artery

**Pathogenesis**

- Development of mucoid filled cyst(s) in the adventitial layer
- Luminal narrowing compresses the artery leading to arterial or venous insufficiency

**Theories:**

- Repetitive Trauma - leading to chronic degeneration?
- Systemic disorder – part of a connective tissue disorder?
- Ganglion cysts enlarge and expand into the adventitia?
- Embryological error – mucin secreting mesenchymal cells are incorrectly placed in the adventitia?
Cystic Adventitial Disease – Diagnosis
History and Physical Examination

- Palpate pulses
- Obliteration of pedal pulse on flexion of the knee (Ishikawa’s sign)
Cystic Adventitial Disease – PVR’s

- ABI with exercise

- Right ABI rest 1.17

- Right ABI with exercise 0.34
Ultrasound imaging of the right knee. Sagittal Doppler images confirm a focal stenosis within the popliteal artery (arrow) with post-stenotic turbulent flow, seen as multicolor flow on color Doppler. There is absence of Doppler flow within the hypoechoic structures surrounding the popliteal artery representing the cystic lesions (arrowheads).
MRI image shows fusiform mass of high signal intensity at the posterior aspect of the popliteal artery.

MRI image shows intramural crescentic Mass of low signal intensity compressing the arterial lumen.

Cystic Adventitial Disease - Angiography

Angiogram at rest

Flexion of knee against resistance

Scimitar sign

Smooth, gradually tapering stenosis (Scimitar or Hourglass signs) without poststenotic dilation.

Eur J Vasc Endovasc Surg 2005; 29:93-96
Cystic Adventitial Disease - Treatment

• **Nonsurgical**
  – percutaneous or open cyst aspiration
  – angioplasty—usually unsatisfactory as intima is normal
  – stent (few case reports)

• **Surgical**
  – evacuate the cyst, resect affected arterial segment and reconstruct with a venous graft or synthetic graft
  – direct vascular bypass surgery

• **Thrombolytic therapy if artery recently occluded**
Attempt at aspiration – usually results in early recurrence

Eur J Vasc Endovasc Surg 2005; 29:93-96
Cystic Adventitial Disease - Endovascular Treatment

CTA – Pre intervention

6 x 40 mm bare-metal, Nitinol self expanding stent

CTA - 24 mos. after reconstruction
Case Report

- A 28 year old female cyclist is complaining of left thigh pain and weakness when racing. She is a highly trained athlete who has seen a number of different physicians with no clear diagnosis. She has not had any recent injury or trauma. You suspect she has........
  a). Bursitis  
  b). Popliteal artery entrapment  
  c). External iliac artery endofibrosis  
  d). Iliotibial band syndrome
External Iliac Artery Endofibrosis - EIAE

- Affects highly trained athletes (cyclists, endurance runners, rugby players, speed skaters)
- Most common in men – women account < 7% of cases
- Most common (left) external iliac artery (~90%) but also reported in common, internal iliac and femoral arteries
- Unilateral (85%), rarely bilateral (15%)

Helv Chir Acta 1985; 51:793-795
Acta Chir Belg 2004; 104: 635-640
Symptoms:

- Exercise-induced leg pain (thigh) or feeling of a “lack of power”
- Swollen thigh, cramping
- Numbness or paresthesias
- Symptoms relieved with rest
- Results in compromised training, early retirement
External Iliac Artery Endofibrosis

**Physical exam:**

- Usually normal at rest
- May have some muscle wasting in the thigh
- Absent DP or PT pulses are rarely found
- Post exercise (may hear an arterial bruit)
Complications

- Thrombosis
- Dissection

Pathophysiology (anatomic or mechanical factors)

- arterial kinking with hip flexion exacerbated by psoas muscle hypertrophy and excess arterial length
- high blood flow causing arterial wall stress and reactive intimal hypertrophy

References:

Vascular and Endovascular Surgery 2011;45:761
Diagnosis:

- ABI before, after maximal exercise
- Use bicycle ergometer
- Other useful tests:
  - Duplex ultrasound may demonstrate artery wall thickening, artery kinking and high flow velocities in the external iliac artery
  - Conventional angiography, MRI
External Iliac Artery Endofibrosis - Diagnosis

Digital subtraction angiogram demonstrates normal aorta and peripheral run-off vessels.

DSA shows left external iliac artery occlusion with collateral flow to the common femoral artery (arrows).
CT scan reveals left psoas muscle (LPM) hypertrophy, external iliac artery occlusion (arrow), and a patent hypogastric artery (dotted arrow).

External Iliac Artery Endofibrosis - Treatment

**Treatment:**
- Conservative = change sports activity but patients often demanding and expect nothing but full recovery
- PTA (recoil an issue)
- PTA with stenting
- Endarterectomy with vein patch
- Resect and bypass
Case Report

- This 35 year old male is seen for ischemic ulcers on his right hand. He denies drug abuse and trauma but has smoked two packs of cigarettes daily for 17 years. He has ........
  
  a). Atheroembolism  
  b). Thoracic outlet syndrome  
  c). Thromboangiitis obliterans  
  d). A myxoma
Thromboangiitis Obliterans - Buerger’s Disease

- Nonatherosclerotic, segmental inflammatory disease affecting
  - small and medium-sized arteries, veins, and nerves
- Males > females
- Etiology unknown but strong association with tobacco use
- 2/3 have severe periodontal disease

Circulation. 2010;121:1858-1861.
NEJM 2000;343:864-869
Thromboangiitis Obliterans

• Reported with cigars, smokeless tobacco, marijuana and chewers
• Claudication of the foot (arch), legs, occasionally arms and hands
• Distal ischemic ulceration, gangrene
• Superficial thrombophlebitis, Raynaud’s phenomenon
• Two or more limbs generally involved
Thromboangiitis Obliterans – Diagnosis
History and Physical Exam

Allen test
A vasculitis characterized by a highly cellular inflammatory thrombus with sparing of the vessel wall.
Thromboangiitis Obliterans - Diagnosis

- Lab tests (exclude other disorders)
  - LAC, ACA), WSR, C-RP, cold agglutinins, cryoglobulins, ANA, anticentromere antibodies, anti-SCL-70, anti-endothelial antibodies
- Echocardiography
- Consistent arteriographic findings: segmental occlusions around areas of normal vessels and “corkscrew collaterals”

Circulation 2010; 121: 1858-1861
Thromboangiitis Obliterans - Treatment

• Stop smoking
• Avoid nicotine replacement therapy
• Palliative therapy
• Iloprost infusion
• Calcium channel blockers
• Sympathectomy
• Spinal cord stimulator
• Surgery
• Therapeutic angiogenesis
• Foot and/or hand care

Circulation 2010; 121: 1858-1861
Uncommon Arteriopathies

- Radiation Arteritis
- Pseudoxanthoma elasticum
- Drug-induced or abuse
Radiation Arteritis

- Affects major vessels in irradiated fields
  - Cervicocranial stenosis (head/neck cancers)
  - Visceral vessels (lymphoma)
  - Iliac artery (cervical cancer)
- Latency period >10 yrs. before symptoms
- Extensive radiation-accelerated atherosclerosis
- Stenosis or occlusion of arteries (aneurysm)
- Symptoms similar to atherosclerosis
- Angiographic - mimics large vessel vasculitis

Pseudoxanthoma Elasticum (PXE)

- Rare, autosomal recessive, systemic disease (female-to-male ~ 2:1)
- Xanthomas (pebbly skin) “plucked chicken skin” affects posterior neck, axillae, groin
- Retinal hemorrhage and blindness
- Accelerated atherosclerosis: angina, heart failure due to restrictive cardiomyopathy, CVA, intermittent claudication
- GI bleeding (avoid antiplatelets, anticoagulants)
- Loss of function mutations in ABCC6 gene
- Genetic counseling, risk factor modification, avoid contact sports

Drug -Induced Arteriopathies
Drug –Induced Arteriopathies

- Clinical manifestations:
  - Vasospasm, digital necrosis, myocardial infarction, Raynaud’s phenomenon, stroke, venous thrombosis, mesenteric ischemia
- Drugs most commonly associated include: sympathomimetic amines (phenylephrine, epinephrine, norepinephrine, high-dose dopamine, methamphetamines, cocaine)
- Inadvertent arterial injection