60 year old male with history of chronic TB. The patient presented with hemoptysis estimated at 300 ml, decreased oxygen saturation and tachycardia.
CASE 1:

• Right bronchial arteriogram was performed
• No active extravasation was seen

QUESTION 1:
SHOULD THIS ARTERY BE EMBOLIZED?

A. Yes!
B. No!
QUESTION 2:
WHICH EMBOLIC AGENT WOULD BE MOST APPROPRIATE?

A. Microcoils
B. Absolute alcohol
C. Polyvinyl alcohol (PVA) particles
D. Gelfoam slurry
E. Autologous clot

MASSIVE HEMOPTYSIS:
DEFINITION

- Defined as anywhere between 100 ml and 1000 ml in 24 hours
- 300 ml seems popular
- Difficult to quantitate anyway
- “Life-threatening hemoptysis”
  - Hemoptysis > 100 ml/24 hours
  - Abnormal gas exchange/airway obstruction
  - Hemodynamic instability
Massive Hemoptysis: Causes

- Bronchiectasis
  - CF, alpha-1 antitrypsin deficiency
- Infection
  - TB, fungal, chronic pneumonia, abscess
- Neoplasm
  - Bronchogenic ca, mets
- Others
  - Immunologic (Goodpastures, SLE), BMT, pulmonary AVM, mitral stenosis, PE (esp with anticoagulants or thrombolysis), pulmonary HTN, trauma, iatrogenic (Swan Ganz), congenital heart disease

Massive Hemoptysis: Workup

- Medically stabilize:
  - Protect airway, optimize oxygenation, support hemodynamically, correct coagulopathy
- CXR
  - Localizes site of abnormality in 20%-80%
- Ask patient what side they think is bleeding!
Massive hemoptysis:

**Workup**

- Bronchoscopy
  - May identify site or at least side of bleeding to guide interventions
  - Often difficult secondary to blood filling airways
  - Sometimes therapeutic
    - Iced saline, balloon inflation, laser coagulation

- **CT:**
  - Depict underlying disease
  - Assess hemorrhage into alveoli and airways
  - Provide road-map of thoracic vasculature to guide intervention

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Massive hemoptysis: Imaging

- CT:
  - Depict underlying disease
  - Assess hemorrhage into alveoli and airways
  - Provide road-map of thoracic vasculature to guide intervention

![Alveolar hemorrhage from chemo](image)

Cavitary TB
**MASSIVE HEMOPTYSIS: ARTERIOGRAPHY**

- Bronchial arteries:
  - Source of bleeding in 95% of hemoptysis
- Pulmonary arteries:
  - PE
  - Direct invasion by tumor/necrotizing inflammatory process (Rasmussen aneurysm from TB)
  - Pulmonary AVM
- Non-bronchial systemic arteries:
  - More likely to contribute if previous embolization
  - Brachiocephalic, subclavian, axillary branches, inferior phrenic, celiac branches

**BRONCHIAL ARTERIAL ANATOMY**

- Arise from thoracic aorta at T3 to T8 level (T5 to T6 in 80%)
  - Type 1 (40%)
    - 1 right (ICBT), 2 left
  - Type 2 (20%)
    - 1 right (ICBT), 1 left
  - Type 3 (20%)
    - 2 right (1 ICBT), 2 left
  - Type 4 (10%)
    - 2 right (1 ICBT), 1 left
**BRONCHIAL ARTERIES**

- Appearance of culprit arteries:
  - Enlarged (> 2.5mm) and tortuous
  - Hypervascularity/hyperemia
  - Shunting to pulmonary artery or vein
  - Parenchymal staining
  - Vascular abnormality (aneurysm)
  - Extravasation (rare)

**ANTERIOR SPINAL ARTERY**

- Most dreaded complication of bronchial artery embolization is spinal cord ischemia
- Anterior spinal artery receives contributions from vertebral arteries and radiculomedullary branches of intercostals and lumbar arteries
- Largest is artery of Adamkiewicz (T8-L1 level)
- Anterior spinal artery may arise from a bronchial artery in 5% of patients
- Right ICBT most likely bronchial to supply spinal artery
- Rare from left bronchial arteries
- Characteristic hairpin turn
Bronchial artery embolization:

- Embolic material:
  - Particles (PVA or Embospheres)
  - 350 microns or larger
  - Not coils (blocks access for future treatment)
  - Not Gelfoam (more likely to recannalize and rebleed)

- Coaxial microcatheter to embolize distal portion of artery as spinals may not show up until after embolization.

- Avoid embolizing to complete stasis, which may reflux material proximally.

Right bronchial arteriogram

5 French catheter in orifice of artery

Post embolization with 355-500 micron PVA particles
Bronchial artery embolization: results

- Technical success rates of around 90% in recent reports
- Recurrent bleeding in 10 to 50%
  - Progression of underlying disease
  - Recanalization of embolized arteries
  - Incomplete embolization
  - Collateral supply to affected area

Case 2:

- 49 year old male with hematochezia.
- He has required 5 units of blood over 24 hours and is requiring pressors for maintenance of blood pressure.
- Upper endoscopy was negative and colonoscopy was non-diagnostic secondary to large amount of blood.
**QUESTION 1:**
THE MOST APPROPRIATE DIAGNOSTIC STUDY TO PERFORM NEXT IS:

A. Repeat colonoscopy after adequate bowel prep
B. Tc-99m-labelled red blood cell study
C. CT Arteriogram
D. Catheter Arteriogram
E. Exploratory laparotomy

**CASE 2:**

- Superior mesenteric arteriogram showed brisk hemorrhage from a branch of the right colic artery
### Question 2:
The most common cause of lower GI bleeding is:

A. Angiodysplasia  
B. Diverticular disease  
C. Neoplasm  
D. Inflammatory bowel disease  
E. Ischemic bowel

### Acute Gastrointestinal Bleeding: Causes

- **Upper GI Bleeding:**  
  - Peptic ulcer disease (55-75%)  
  - Mallory-Weiss tear  
  - Gastroesophageal varices  
  - Neoplasm

- **Lower GI Bleeding:**  
  - Diverticulosis (20-55%)  
  - Angiodysplasia  
  - Neoplasm  
  - Colitis
GASTROINTESTINAL BLEEDING: WORKUP

- Supportive measures, blood transfusion, correct coagulopathy
  - 75% of patients respond to this alone
- Sometimes difficult to clinically distinguish upper and lower GI source
  - 10% of patients with major UGIB present with hematochezia
- Endoscopy/Colonoscopy
  - Usually first diagnostic and therapeutic intervention
  - Colonoscopy after rapid cleansing often useful even with active LGIB
- Direct to arteriography if:
  - Continuous rapid bleeding
  - > 4-6 units pRBCs over 24 hours
  - Hemodynamic instability

ACUTE GASTROINTESTINAL BLEEDING: IMAGING

- Radionuclide Imaging:
  - Tc-99m-labelled red blood cells or sulfur colloid
  - Threshold for detection
    - Nucs: 0.05 to 0.4 mL/min
    - Angio: 0.5 to 1.0 mL/min
  - Progressive accumulation of activity corresponding to a bowel segment with movement over time
  - Allows imaging over 24 hours for intermittent bleeding
  - May help guide arteriography but sometimes misleading

Bleed at hepatic flexure
ACUTE GASTROINTESTINAL BLEEDING: IMAGING

- CT Angiography:
  - Presence of high-attenuation material in bowel lumen not present on unenhanced CT
  - 89% sensitivity, 85% specificity for GIB
  - May reveal underlying cause of bleeding
  - Shows arterial anatomic variations to help guide interventions
  - May ultimately replace tagged red cell study

ACUTE GASTROINTESTINAL BLEEDING: ARTERIOGRAPHY

- Start with vessel most likely to supply bleeding site:
  - Upper: Celiac, SMA
  - Lower: SMA, IMA

- Then other vessels

- Confirm suspicious findings with selective and sub-selective injections
ACUTE GASTROINTESTINAL BLEEDING: ARTERIOGRAPHY

- Findings:
  - Hallmark: extravasation of contrast
  - Mimics: bowel subtraction artifact, renal collecting system, hypervascular mucosa
  - Varices (on venous phase)
  - Angiodysplasia
    - Tangle of vessels in bowel wall
    - Early venous return → “tram track sign”
    - Tumor blush, pseudoaneurysm, AVF

ACUTE GASTROINTESTINAL BLEEDING: TRANSCATHETER EMBOLIZATION

- Embolic agents:
  - Microcoils
  - Gelfoam
  - PVA
  - Glue (Cyanoacrylate)
  - Onyx (ethylene-vinyl alcohol copolymer)
ACUTE GASTROINTESTINAL BLEEDING: TRANSCATHETER EMBOLIZATION

- Upper GI Bleeding:
  - Extensive collateral supply
  - May perform empiric embolization
    - Gastric fundus:
      - Left gastric artery embolization
    - Gastric antrum/Proximal Duodenum:
      - Gastroduodenal artery embolization
    - GDA: Need to trap site of bleeding to avoid “back door” bleeding via pancreaticoduodenal arcade

- Lower GI Bleeding:
  - Catheter positioned as close as possible to bleeding site to avoid bowel infarct
  - Coaxial microcatheters and microcoils have decreased risk of infarct
LOWER GASTROINTESTINAL BLEEDING: TRANSCATHETER EMBOLIZATION

Superior mesenteric arteriogram

Early

Late

LOWER GASTROINTESTINAL BLEEDING: TRANSCATHETER EMBOLIZATION

Right colic arteriogram
LOWER GASTROINTESTINAL BLEEDING: TRANSCATHETER EMBOLIZATION

- Right colic branch embolized with microcoils
LOWER GASTROINTESTINAL BLEEDING: TRANSCATHETER EMBOLIZATION

- Patient hemodynamically stable post embolization
- No evidence of ongoing hemorrhage

SMA Post Embo

ACUTE GASTROINTESTINAL BLEEDING: TRANSCATHETER EMBOLIZATION

- Results:
  - Stops gastrointestinal bleeding in 80%
  - Failure usually secondary to inability to obtain proper microcatheter position
  - Recurrent hemorrhage (< 30 days) in 20%
    - Recanalization
    - Collateral flow
    - Persistent coagulopathy
Case 3:

- 35 year old male with intermittent bilateral calf claudication
- Professional wrestler
- Normal resting ABI's
- Lower extremity arteriograms were performed
QUESTION 1: WHICH MANEUVER(S) MIGHT BE DIAGNOSTICALLY USEFUL?

A. Active plantar flexion of foot
B. Passive plantar flexion of foot
C. Frog-leg positioning
D. Active dorsiflexion of foot
E. Passive dorsiflexion of foot

CASE 1:

• Repeat arteriogram with active plantar flexion of the foot
QUESTION 2: REGARDING THIS ENTITY, WHICH OF THE FOLLOWING STATEMENTS ARE TRUE?

A. Bilateral disease is rare
B. It is more common in females
C. Lateral deviation of the popliteal artery is a typical finding
D. A functional form of the disease may be symptomatic
E. It may now be successfully treated without surgery

POPLITEAL ARTERY ENTRAPMENT SYNDROME

- Abnormal relationship of popliteal artery to gastrocnemius muscle
- Popliteal artery flow impeded with muscle contraction
- Recurrent external compression of the popliteal artery leads to mechanical damage to the vessel wall
- May lead to fixed stenosis, aneurysm, occlusion, thrombosis
POPLITEAL ARTERY ENTRAPMENT SYNDROME: EPIDEMIOLOGY

- Incidence: 0.2% to 3.5%
- Up to 60% of young athletes with calf claudication
- Young (60% < 30 years old)
- M:F 15:1
- About 1/3 bilateral

POPLITEAL ARTERY ENTRAPMENT SYNDROME

- Congenital:
  - Anatomical developmental abnormalities of popliteal fossa
  - Avg age: 43 years

- Acquired:
  - “Functional” PAES
  - Normal but hypertrophic muscle
  - Avg age: 24 years
  - Athletes
POPLITEAL ARTERY ENTRAPMENT SYNDROME: CLASSIFICATION

- Type I:
  - Abnormal position of popliteal artery medial to normal medial head of gastrocnemius
  - Most common

- Type II:
  - Normal position of popliteal artery medial to abnormal laterally displaced medial head of gastrocnemius
POPLITEAL ARTERY ENTRAPMENT SYNDROME:
CLASSIFICATION

- Type III:
  - *Normal* popliteal artery compressed by *abnormal* slip of gastrocnemius

- Type IV:
  - *Normal* popliteal artery compressed by fibrous band or popliteus muscle
POPLITEAL ARTERY ENTRAPMENT SYNDROME: CLASSIFICATION

• Type V:
  • Any of the above + popliteal vein impingement

• Type VI:
  • “Functional” PAES
  • Normal anatomy
  • Muscular patient with hypertrophic muscle

POPLITEAL ARTERY ENTRAPMENT SYNDROME

• Symptoms:
  • Intermittent claudication in a young person without risk factors for atherosclerosis
  • Pain, pallor, paraesthesias from limb ischemia due to thrombosis (rare)

• Exam:
  • Positional Stress Test: Normal pulses that decrease or disappear with active plantar flexion or passive dorsiflexion of foot
  • Resting ABIs usually normal
  • Ankle pressures may decrease with exercise
  • Evidence of limb ischemia with advanced disease
POPLITEAL ARTERY ENTRAPMENT SYNDROME: IMAGING:

- **Duplex US**
  - Flexion maneuvers → stenosis and increased velocities
  - **Caveat:** May see compression with maneuvers in about 50% of normal subjects
  - Advanced disease → fixed stenosis, aneurysm, occlusion, thrombosis

- **MR or CT Angiography:**
  - Demonstrate the vessel lumen as well as the abnormal anatomy responsible for the entrapment
  - May perform with provocative maneuvers

  - Axial T1-weighted image
  - Abnormal muscle band arising from medial head of gastrocnemius muscle
  - Type III PAES
POPLITEAL ARTERY ENTRAPMENT SYNDROME:
IMAGING:

- Conventional Angiography:
  - Traditional diagnostic modality
  - Luminal changes with flexion maneuvers are well shown
  - Non-specific late changes:
    - Fixed stenosis, occlusion, thrombosis

POPLITEAL ARTERY ENTRAPMENT SYNDROME:
IMAGING

- Endovascular treatment:
  - No role for angioplasty or stenting
  - Pre-operative thrombolysis may be performed for thrombosis

- Surgical treatment:
  - Popliteal fossa exploration with myotomy or muscular/tendinous release
  - Bypass graft if fixed arterial disease
CASE 4:

40 year old male with right lung nodule on chest x-ray

QUESTION 1:
WHAT OTHER RELATED PROBLEM IS THIS PATIENT MOST LIKELY TO HAVE?

A. Painless hematuria
B. Limb asymmetry
C. Visceral and renal aneurysms
D. Frequent nosebleeds
E. Medullary nephrocalcinosis
QUESTION 2: WHICH OF THE FOLLOWING STATEMENTS IS TRUE REGARDING PAVMS?

A. Most are spontaneous

B. Less than half of patients with hereditary hemorrhagic telangiectasia (HHT) have PAVMs

C. They are usually treated with cyanoacrylate (glue) embolization

D. Most are complex (multiple feeding arteries)

E. Pulmonary arteriography remains the most important diagnostic tool

PULMONARY AVMS: DEFINITION

- Abnormal dilated connection between pulmonary artery and vein
- Provide right to left shunt
- Bypass pulmonary capillary bed

Normal Capillary Bed

Simple AVM
PULMONARY AVMS: EPIDEMIOLOGY

- 10% spontaneous
- 90% associated with hereditary hemorrhagic telangiectasia (HHT) (AKA Osler-Weber-Rendu)

HHT:
- Autosomal dominant
- Mucocutaneous telangiectasias
- Telangiectasias and AVMs of GI tract, brain, liver and lung
- Recurrent epistaxis most common symptom
- 30%-40% of HHT patients have pulmonary AVMs; 60% of these have multiple lesions

PULMONARY AVMS: PATHOPHYSIOLOGY

- Simple (85%)
  - Single segmental artery supply

- Complex (5-10%)
  - Multiple segmental artery supply

- Diffuse AVM/Telangiectatic AVMS/Acquired Lesions (5-10%)
  - Lower lobes, L > R
PULMONARY AVMS: SYMPTOMS

- Symptoms:
  - Dyspnea
  - Chest Pain
  - Hemoptysis
  - Cyanosis
  - Clubbing
  - Hemothorax
  - TIA/Stroke
  - Brain Abscess
  - 25-58% asymptomatic/incidental finding

PULMONARY AVMS: CHEST X-RAY

- Well-defined, rounded smooth mass
- Enlarged feeding and draining vessels
- Frequently multiple
- Most numerous at lung bases
PULMONARY AVMS: CT

- Contrast-enhanced CT is primary diagnostic tool
- High sensitivity for detecting lesions requiring treatment
- Best evaluated on lung windows
- Simple AVMs:
  - Well-defined peripheral nodule
  - One feeding artery
  - One or more draining veins
  - Veins typically 1-2mm larger than arteries
  - PAVM sac, feeding and draining vessels enhance homogeneously

PULMONARY AVMS: CT

- Complex AVMs:
  - Multiple sacs, feeding arteries and draining veins
PULMONARY AVMS: CT

- Diffuse AVMs:
  - Involve whole segments or entire lobe
  - Smooth dilation and tortuosity of arteries and veins of affected area

Diffuse PAVM Anterior Segment Left Upper Lobe

PULMONARY AVMS: CT

- Telangiectatic AVMs
  - Most often in children
  - Usually in HHT
  - Focal area of ground-glass opacity associated with prominent artery and vein
  - Frequently multiple; usually co-exist with typical PAVMs

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PULMONARY AVMS: PULMONARY ARTERIOGRAM TECHNIQUE

- Performed in anticipation of embolization
- Assume everything is going to brain
- Care to avoid air embolism
- Withdraw guidewires in saline bath

PULMONARY AVMS: PULMONARY ARTERIOGRAM FINDINGS

- Dilated segmental arteries feeding aneurysmally dilated sac with rapid venous outflow via dilated veins
- Absent or decreased venous dilatation in telangiectatic and diffuse forms
• Transcatheter embolization is treatment of choice
• “3mm guideline”
  • Treat AVMs with feeding artery > 3mm diameter due to high risk of stroke
  • Based on tiny series from 1992
  • Smaller AVMs may be associated with symptomatic paradoxical emboli
  • Many will now treat smaller AVMs
• Fully heparinize
• Antibiotic prophylaxis
• Air embolism precautions

PULMONARY AVMS: EMBOLIZATION MATERIALS

• Coils:
  • 1-2 mm larger diameter than artery
  • Placed in feeding artery as close as possible to nidus
  • First coil (most terrifying):
    • Anchor technique: partially deploy in side branch
    • Scaffold technique: Oversized coil with high radial force
• Amplatzer Vascular Plugs:
  • Advantage: single plug vs. multiple coils
  • May be more likely to recanalize over time
PULMONARY AVM EMBOLIZATION: COMPLICATIONS

- Post-embolization syndrome:
  - Fever, pleuritic chest pain
  - 15%
- Paradoxical embolization of coils or air →
  - Coronary ischemia, transient ischemic attack, stroke
    - < 5%
    - Major stroke
      - 0.5%

Migration of coil to left atrium

PULMONARY AVM EMBOLIZATION: OUTCOMES

- “Success”
  - Complete fibrosis of aneurysm sac
  - Sac shrinkage to < 30%
  - Decrease in feeding artery to < 3mm
- Success rate 75% to 95%
- 25% of patients will demonstrate subsequent growth of previously undetectable or small AVMs
- F/U:
  - Chest CT 1 year after treatment, then q 3 to 5 years
  - Earlier imaging if symptoms develop or pregnancy is planned
Case 5:

- 49-year-old healthy, active, non-smoking male with sudden onset of right-lower extremity claudication
- Symptoms usually incited by walking
- MRI of spine and electrodiagnostic studies of right leg were normal
- ABIs: 0.28 on right, 1.26 on left
- MRA and MRI of the lower extremities were performed

Sagittal and axial T2-weighted MRI
Cystic Adventitial Disease

Narrowing of the popliteal arterial lumen due to surrounding T2-bright lobulated lesion
Cystic adventitial disease:

**Epidemiology**

- Rare
  - 1 in 1,200 cases of claudication
- Location:
  - Popliteal artery (85%)
  - External iliac, common femoral, radial, ulnar
- M:F 15:1
- Presents in 4th or 5th decade

**Pathophysiology**

- Formation of mucoid cysts in adventitial layer of artery
- Cysts grow, coalesce and rupture → narrowing or occlusion of artery
- Etiology:
  - Unknown
  - Theories: Embryologic (most widely accepted), degenerative, repetitive trauma
Cystic adventitial disease: imaging

- **Ultrasound:**
  - Anechoic or hypoechoic cystic structures eccentric to artery
  - No flow in cyst
  - May see communication between knee joint and arterial adventitia
  - Narrowing or occlusion of artery

- **MRI:**
  - T2:
    - Hyperintense cystic lesions (water signal) surrounding and compressing artery
  - T1:
    - Often high signal due to mucoid content
    - May be low T signal
  - MRA:
    - Popliteal stenosis
    - Typical hourglass or scimitar appearance

Contrast-enhanced MRI: Hourglass sign
Cystic adventitial disease:

**Imaging**

- Catheter Arteriogram:
  - Not usually needed for diagnosis
  - Classic appearance:
    - Hourglass: Concentric cysts
    - Scimitar: Eccentric cysts
  - Non-specific once progresses to occlusion

**Treatment**

- Cases of spontaneous regression reported, but more typically progressive
- Resection of the cyst and arterial bypass
  - Favored when artery is occluded or thrombosed
  - 93% success rate
- US-guided aspiration
  - Safe and efficacious in patients without thrombosis
- Endovascular treatment not successful
Case 5:

- 73 year old female underwent cardiac catheterization with left coronary artery stent placement
- She complained post-procedure of pain and swelling at her right groin punctures site
- Duplex ultrasound was performed

Question: What would be a typical dose of thrombin to treat this lesion?

A. 20 to 60 units
B. 100 to 300 units
C. 1000 to 3000 units
D. 3000 to 5000 units
E. Thrombin should not be used to treat this lesion
FEMORAL ARTERY PSEUDOANEURYSM

- Incidence:
  - 0.2% of diagnostic arteriograms
  - 8% of interventional procedures
  - Higher in cardiac procedures
    - Longer procedure time
    - Larger sheath size (> 7 Fr)
    - Anti-platelet treatment

FEMORAL ARTERY PSEUDOANEURYSM: TREATMENT

- Ultrasound-guided compression
  - Compress neck of pseudoaneurysm with transducer while maintaining flow in SFA
  - Advantage: easy, safe, cheap
  - Disadvantage: time-consuming (20 to 30 minutes), painful, high recurrence rate

- Surgical repair
  - Technically straightforward
  - Requires OR time and general anesthesia
  - Potential complications: wound infection, nerve damage
FEMORAL ARTERY PSEUDOANEURYSM: TREATMENT

- Ultrasound-guided thrombin injection:
  - Treatment of choice for iatrogenic femoral artery pseudoaneurysm
  - May be performed in US suite or at bedside
  - Procedure time usually < 15 minutes

- Ultrasound-guided thrombin injection:
  - US assessment of pseudoaneurysm:
    - Yin-yang sign
    - Neck typically posterior and thin
    - Large neck (>1 cm) relative contraindication
POST-CATHETERIZATION PSEUDOANEURYSM: TREATMENT

- Ultrasound-guided thrombin injection:
  - Technique:
    - Bovine thrombin 1000 units/ml
    - Small (25 to 21-gauge) needle inserted into anterior pseudoaneurysm away from neck
    - Slowly injected in 0.1 to 0.3 ml increments over five to ten seconds
    - Monitor clot formation with Doppler imaging
    - Usually 0.1 to 0.3 ml for thrombosis
    - Confirm patency of CFA post injection

- Outcomes:
  - 95 to 100% success rate
  - May repeat if first attempt fails
  - Effective in anticoagulated patients
• Ultrasound-guided thrombin injection:
  • Complications:
    • 0 to 4%
    • Anaphylactic reaction
      • Prior exposure to thrombin
    • Infection
    • Distal embolization
      • Short/wide neck predisposes
      • Small distal thrombi in 2% but almost all asymptomatic

CASE 6:

• 43 year old female with heavy, prolonged periods which have worsened over the last 3 years
• Ultrasound and MRI showed multiple fibroids
QUESTION 1:
WHAT PERCENTAGE OF WOMEN WITH FIBROIDS ARE SYMPTOMATIC?

A. 20%
B. 40%
C. 50%
D. 60%
E. 80%

CASE 6:
The patient elected to undergo uterine artery embolization

Right uterine arteriogram
QUESTION 2: REGARDING UTERINE ARTERY EMBOLIZATION, WHICH OF THE FOLLOWING IS NOT TRUE?

A. UAE may be performed in women desiring future pregnancy
B. Submucosal fibroids are more likely to cause post UAE complications than other types
C. Post-embolization syndrome occurs in 100% of patients after UAE
D. Outcomes are better with a single large fibroid than with multiple small ones
E. MRI is the preferred imaging modality before UAE

UTERINE FIBROIDS: CLINICAL FEATURES

• Benign, leiomyomatous, vascular neoplasms
• Most common tumor of female reproductive tract
• Occur in 25-50% of reproductive age females
• 80% are asymptomatic
• 3X more common in African-American women
• Symptomatic between 35 and 50 years of age
• Hormonally sensitive; usually regress following menopause
• Leiomyosarcomas are rare
  • 0.5% of rapidly growing fibroids
  • Suspect with post-menopausal fibroid enlargement
UTERINE FIBROIDS: SYMPTOMS

- Bleeding
  - Heavy, prolonged periods
- Mass symptoms
  - Pain, pressure, heaviness
  - Abdominal bloating
  - Urinary frequency
  - Constipation
- Infertility

UTERINE FIBROIDS: TREATMENT OPTIONS

- Watchful waiting
- Drugs
  - Anti-inflammatory
  - Hormonal (OCPs or GnRH analogues)
- Surgery
  - Hysterectomy
  - Myomectomy
- Interventional
  - MR-guided focused ultrasound (HiFU)
  - Uterine artery embolization
**UTERINE FIBROIDS: PATIENT EVALUATION**

- Collaborative effort between IR and gynecologist
- Pre-procedure consultation:
  - Gynecologic history
  - Exclude other causes of symptoms
  - Review imaging
  - Pap smear
  - Endometrial biopsy
  - Interest in future pregnancy
  - General medical history
  - Discussion of all treatment options

**UTERINE FIBROID IMAGING: ULTRASOUND**

- Demonstrates fibroids and concurrent disease
- Inferior to MRI in depicting number, size and location of fibroids
- Inferior to MRI at showing adenomyosis and other pathology
Uterine fibroid imaging:

- MRI

- Preferred study prior to and following embolization
- Assess:
  - Fibroid location in uterus
  - Fibroid number and size
  - Fibroid enhancement
  - Presence of other pelvic pathology

Uterine fibroid imaging:

- MRI

- Fibroid appearance:
  - Discrete round masses
  - Heterogeneous low signal on T2
  - Isointense with myometrium on T1
  - Enhance variably on T1 post-gadolinium
Uterine fibroids: Anatomic Types Deserving Special Consideration

- Submucosal/intracavitary fibroids
  - More likely to be expelled material following embolization → pain, cramping, infection

- Pedunculated subserosal fibroids
  - Potential for detachment if narrow stalk
  - Generally good outcomes

- Cervical fibroids
  - More likely to have incomplete infarction
UTERINE ARTERY EMBOLIZATION

• Indication:
  • Symptomatic uterine fibroids

• Contraindications:
  • Pregnancy
  • Known or suspected gynecologic malignancy
  • Uterine or adnexal infection

UTERINE ARTERY EMBOLIZATION: TECHNIQUE

• Embolic material:
  • Particles (300 to 900 micron)
    • PVA (polyvinyl alcohol)
    • Embospheres (tris-acryl gelatin microspheres)

• Selective uterine artery embolization using microcatheter

• Embolized until sluggish flow

• Bilateral uterine artery embolization mandatory
• Pelvic Arteriogram:

• Selective uterine arteriograms:
**Uterine Artery Embolization**

- Selective uterine arteriograms:

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Post Embolization
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**Uterine Artery Embolization: Post-Procedural Care**

- Usually same day procedure or single overnight stay
- Post-Embolization Syndrome:
  - Occurs in 100%
  - Pain, cramping, fatigue, nausea, malaise, low grade fever (33%)
  - Peaks at 12-24 hours; gradually decreases over 1 week
  - Results in readmission in 10%
- PCA pump, narcotics, anti-inflammatories key
UTERINE ARTERY EMBOLIZATION: COMPLICATIONS

• Ovarian failure/Amenorrhea: 7.5%
  • Usually > 45 years old

• Fibroid expulsion: 5%
  • Submucosal component
  • Pain, discharge, bleeding, infection
  • #1 reason for gynecologic intervention post UAE

• Venous thromboembolism: 0.25%
  • Reported deaths

UTERINE ARTERY EMBOLIZATION: FERTILITY

• Jury still out

• Studies show higher rate of miscarriage, infertility with UAE c/w myomectomy

• Many successful pregnancies post UAE

• Not first-line treatment for women desiring pregnancy

• Appropriate counseling important
Uterine artery embolization: outcomes

- Menorrhagia control: 90% at 12 months
- Improvement in bulk symptoms: 90% at 12 months

Embolization vs. hysterectomy:
- Similar symptom relief, quality of life and patient satisfaction
- Quicker recovery with UAE
- More re-intervention with UAE

Embolization vs. myomectomy:
- Both substantially improve
- UAE: Quicker recovery, higher re-intervention rate, less symptom relief

Persistent symptoms after UAE:
- Incomplete fibroid infarction with regrowth
  - Choice of embolic, embolization end-point, collateral blood supply
- Comorbidities:
  - Adenomyosis
  - Endometrial polyps
  - Endometriosis
- Large fibroid with mass symptoms
  - Even marked volume reduction may leave a large mass

Factors associated with positive outcome:
- Smaller fibroids vs. single large fibroid
- Menorrhagia as primary presenting symptom
Case 7:

- 42 year old asymptomatic female with vague left flank pain, Otherwise asymptomatic
- MRI performed
- 6 cm upper pole renal mass upper pole seen

Question 1:
Which of the following is true?

A. Over half of patients with this type of tumor have tuberous sclerosis
B. This tumor is more common in males
C. Over half of patients with tuberous sclerosis have this type of tumor
D. Arteriogram will usually demonstrate AV shunting
E. These tumors are less likely to cause bleeding in patients with tuberous sclerosis
**Question 2:**

The usually accepted size threshold for treating asymptomatic AML is:

A. 2 cm
B. 4 cm
C. 6 cm
D. 8 cm
E. AMLs only need to be treated if they cause symptoms

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**Angiomyolipoma**

- Hamartomatous tumor containing fat, smooth muscle and blood vessels
- 0.3% incidence in general population
- F:M 4:1
- 30-60 years
ANGIOMYOLIPOMA

• Isolated
  • 80%
  • Usually unilateral, solitary

• Associated with Tuberous Sclerosis
  • 20%
  • 80% of patients with tuberous sclerosis have AMLs
  • Younger at presentation
  • Often bilateral, multiple

ANGIOMYOLIPOMA

• Most asymptomatic

• Risk of hemorrhage associated with:
  • Size (> 4 cm)
  • Aneurysms (> 5mm)
  • Tuberous sclerosis
  • Pregnancy

• 1/3 of patients with bleeding AML have hypovolemic shock
Angiomyolipoma: Imaging

• US, CT and MRI:
  • Hallmark is fat within tumor
  • Smaller lesions (< 3-4 cm) may be “fat-poor” and difficult to distinguish from other tumors

CT

Angiomyolipoma: Imaging

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Coronal T2-weighted MRI
ANGIOMYOLIPOMA: IMAGING

- Arteriography:
  - Hypervascular
  - Enlarged feeding arteries
  - Aneurysms (1/3)
  - Venous pooling
  - Capillary phase: “Sunburst, whorled, onion peel” appearance
  - No AV shunting

ANGIOMYOLIPOMA: TREATMENT

- Asymptomatic and < 4 cm
  - No intervention
  - Serial imaging
    - US, CT or MRI yearly
    - More frequent if pregnant or on estrogen therapy
- Treatment if:
  - Symptomatic
  - > 4 cm, especially if has aneurysm > 5 mm
  - Some advocate observation and close follow-up of asymptomatic 4 – 8 mm AMLs
ANGIOMYOLIPOMA: TREATMENT

• Surgical:
  • Partial nephrectomy
  • Complete nephrectomy

• Interventional:
  • Selective embolization
    • Particulate agents:
      ◦ PVA polyvinyl alcohol
      ◦ Embospheres (tris-acryl gelatin spheres)
      ◦ Alcohol/Lipiodol
    • As selective as possible to spare functioning kidney
  • RFA or cryoablation
    • Small (<3 cm), growing AMLs

Elected to perform embolization, as tumor > 4cm
ANGIOMYOLIPOMA: TREATMENT

- Embolization of subsegmental branch supplying tumor performed with 100-300 micron Embospheres
- Follow-up imaging at 1 month showed decreased tumor size

Superselective arteriogram  Post-embolization arteriogram

THANKS!