Venous Interventions

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Case 1

- History: 38 year old female with left lower extremity swelling and pain over 3 years with recent worsening

Bilateral Femoral Venograms
Question 1: The findings on venography are most likely caused by:

A. Central propagation of femoral-popliteal thrombus  
B. An anatomic variant  
C. Compression of the left common iliac vein by the right common iliac artery  
D. Atherosclerosis  
E. Iliac arteriovenous fistula

Question 2: Optimal endovascular treatment for this entity includes:

A. Angioplasty alone  
B. Balloon-mounted stent placement  
C. Covered stent (stent graft) placement  
D. Self-expanding stent placement  
E. All of the above
May Thurner Syndrome

- **AKA:** Iliac vein compression syndrome, Cockett syndrome
- **Etiology:** Compression of the left common iliac vein by the overlying right common iliac artery → venous intimal injury → webs (“spurs”), stenosis, thrombosis
- **Most common in females** 2nd-4th decade
- **Typical symptoms:** Left leg swelling and pain without other risk factors for venous disease

May Thurner Syndrome

- **Imaging:**
  - **Doppler US:** will detect iliac DVT, but won’t visualize iliac vein compression and webs; may infer by abnormal waveform w/ resp maneuvers
  - **CT/MRI:**
    - Compression of left iliac vein between right iliac artery and spine
    - R/O other causes of extrinsic compression (LN, mass, aneurysm, etc.)
    - May be a normal anatomic finding (2/3 of asymptomatic patients have at least 25% left iliac vain compression)
May Thurner Syndrome

Compression of left common iliac vein between right common iliac artery and spine

Imaging:

- Venography:
  - Left common iliac vein stenosis, usually smooth and short, but may be long and irregular
May Thurner Syndrome

Imaging:
• Venography:
  • Left common iliac vein stenosis, usually smooth and short, but may be long and irregular
  • May progress to occlusion
  • Hemodynamic significance indicated by:
    • Regional collateral vein filling
    • Pressure gradient > 3-4 mmHg

Treatment:
• Surgical: Fem-fem or CFV-IVC bypass
• Placement of self-expanding stents (e.g., Wallstents) usually 14 – 16 mm diameter
• “Kissing stents” if stent will encroach on IVC
• Angioplasty alone insufficient due to extrinsic compression
• Balloon-expanded stents avoided as may get crushed
• +/- Thrombolysis if acute clot present
• +/- Anticoagulation following stent placement
IR Treatment Outcomes:
- Successful recanalization in > 90%
- 50 – 80% 1-year primary patency
- Major complications in 7%: access site bleeding/hematoma, stent malposition, stent migration
Case 2

- History: 38 year-old male with left iliofemoral DVT and GI bleeding on anticoagulation
- IVC filter requested

Question 1: The filter apex should be placed at:

A
B
C
D
E
Question 2: The venographic finding most likely represents:

- Circumaortic left renal vein
- Duplicated IVC
- Azygos continuation of IVC
- Artifact from overlying bowel
- IVC thrombus

Selective venogram of circumaortic left renal vein
Filter placed with apex at level of lowest (circumaortic) renal vein

Improper filter placement above retroaortic vein may allow clot to pass through renal sinus to the lung
Circumaortic left renal vein

CT Appearance

Preaortic vein

Retroaortic vein

IVC Anomalies

- **Left IVC**
  - 0.2%-0.5%
  - L IVC usually joins L renal vein
- **Duplicated IVC**
  - 0.2%-3%
  - L IVC usually crosses over via L renal vein
  - Need bilat IVC filters or suprarenal filter
- **Azygos continuation of IVC**
  - 0.6%
  - No intrahepatic IVC; hepatic veins drain to RA
ICV Anomalies

- Retroaortic left renal vein
  - 2%
  - Usually below level of R renal vein
- Circumaortic left renal vein
  - 1.5%-8.7%
  - Most common IVC anomaly
  - Usually 1-2 cm below anterior L renal vein

Case 3

- 78 year old female with bilateral lower extremity deep venous thrombosis and pulmonary embolism.
- Recent intracranial hemorrhage and craniotomy.

ICV gram
Diameter of infrarenal IVC: 30.5 cm
Question 1: Appropriate therapy for this patient includes:

- Placement of permanent Bird’s Nest IVC filter.
- Full anticoagulation
- Placement of retrievable IVC filter
- Placement of bilateral common iliac vein retrievable filters
- A and D

Megacava

- IVC transverse diameter > 28 mm
- 1% to 2% of population
- Options for filter placement:
  - Bird’s Nest Filter (only filter for diam > 35mm)
  - Standard filters (permanent or retrievable) in each common iliac vein
Infrarenal Bird’s Nest
IVC filter placed

Alternative: Bilateral common iliac vein filters
Indications for IVC filter placement:

- **Widely accepted:**
  - Contraindication to anticoagulation
  - Complication of anticoagulation
  - Failure of anticoagulation

- **Moderately accepted:**
  - Massive PE
  - Free-floating iliofemoral or IVC thrombus (“Widowmaker”)
  - Severe cardiopulmonary dz
  - Poor anticoagulation candidate (e.g., falls, compliance)
  - Recurrent PE with filter
Indications for IVC filter placement:

- Controversial:
  - Prophylaxis:
    - Severe trauma
    - Immobilized patients
    - Preoperative with multiple risk factors for venous thromboembolism
    - Advanced malignancy
    - Pre LE thrombolysis
    - Pregnancy with proximal DVT

“Indications” for retrievable IVC filter placement:

- Young patient
- Prophylaxis (major trauma, ICU, pre-op)
- During LE thrombolysis
- During pregnancy
49 year old male with elevated liver enzymes, ascites and abdominal pain

Case 4

Question 1: The most likely cause of the patient’s symptoms is:

A. Alcoholic cirrhosis
B. Hepatocellular carcinoma
C. Primary biliary cirrhosis
D. Sclerosing cholangitis
E. Budd-Chiari syndrome
Question 2: The following venogram was obtained. Possible treatments include:

- Hepatic vein angioplasty
- Hepatic vein stent
- TIPS
- Liver transplant
- All of the above

Budd-Chiari Syndrome

- Hepatic vein outflow obstruction
- Level of obstruction:
  - Hepatic venules
    - Hepatic venoocclusive disease
    - Etiol: chemotherapy, irradiation for stem cell/BMT
  - Major hepatic veins
    - Classic Budd-Chiari
    - Etiol: thrombophilic states (polycythemia vera, OCPs, malignancy), neoplastic invasion from HCC
  - Hepatic vein confluence/IVC/RA
    - Etiol: membranous IVC obstruction, bland thrombus, tumor, extrinsic compression, RA tumor, constrictive pericarditis)
Budd-Chiari: Symptoms

- Depends on chronicity
- Classic triad: hepatomegaly, abdominal pain, ascites
- Splenomegaly, jaundice, variceal bleeding
- May be asymptomatic

Budd-Chiari: Imaging Findings

CT/MRI:
- Ascites, hepatomegaly, splenomegaly
- Mottled/patchy enhancement of liver
- Atrophy of right lobe with sparing/hypertrophy of caudate lobe
- Slit like/obliterated hepatic veins
- Hepatic vein to hepatic vein collaterals
- Hepatic vein or IVC webs
Budd-Chiari: Imaging Findings

- **US:**
  - Absent or dampened hepatic vein flow with loss of transmitted atrial waves

- **Venography:**
  - Classic: "Spiderweb" appearance of small collateral veins
  - Narrowing/webs/occlusions of hepatic veins or IVC
Budd-Chiari: Treatment

- **IR:**
  - Thrombolysis if acute thrombus
  - Angioplasty and/or stenting of hepatic or IVC stenoses
  - TIPS

- **Surgical:**
  - Mesocaval/mesoatrial shunt
  - Liver transplantation

Web-like hepatic vein stenosis
Gradient: 18 mmHg

Post stent placement
Gradient: 2 mmHg
Symptoms resolved
Case 5

- 28 year old male house painter with acute onset of heaviness, pain, and swelling of right arm.
- Doppler → R axillary and subclavian thrombosis
- Venography performed

![RUE Venogram]

Question 1: Management of this patient should begin with:

- A. Surgical decompression
- B. Venoplasty
- C. Thrombolysis
- D. Stent placement
- E. Anticoagulation alone
Question 2: Thoracic outlet syndrome most commonly involves the:

A. Arteries  
B. Veins  
C. Nerves  
D. All about equal

Thoracic Outlet Syndrome

- Caused by anatomical abnormalities involving the thoracic outlet
  - cervical rib
  - congenital bands
  - hypertrophied scalene muscles
  - Bony exostoses
  - Anomalous muscle or ligament anatomy

http://my.clevelandclinic.org
Thoracic Outlet Syndrome

Subgroups:
- **Neurologic**
  - Most common (95%)
  - Compression of brachial plexus
- **Venous**
  - 3-4%
  - Compression of subclavian vein
- **Arterial**
  - 1-2%
  - Compression of subclavian artery

AKA: Paget-Schroetter syndrome, effort thrombosis

Minority (5-20%) of UE venous thrombosis

M:F 2:1

2nd through 5th decade; mean 30’s

Typically young & active

60-80% recent vigorous UE exercise

R > L; Bilat in 6%
Venous Thoracic Outlet Syndrome: Pathophysiology

- Subclavian vein runs within anterior part of the thoracic outlet
  - subclavius muscle and costoclavicular ligament anteromedially
  - anterior scalene muscle posterolaterally

Extrinsic compression $\rightarrow$ Intimal injury $\rightarrow$ Stenosis $\rightarrow$ Thrombosis
Venous Thoracic Outlet Syndrome: Symptoms

- Typically young person with sudden onset
- Often in setting of repeated activities involving arm elevation/exertion
- UE swelling, heaviness, pain, fatigue, cyanosis
- Enlarged subcutaneous veins of arm, shoulder, chest wall
- Much less likely than LE DVT to present with symptomatic PE (9% vs 29%)

Ultrasound:
- Color doppler will show axillo-subclavian thrombus
- Duplex US → flat tracing without normal resp variation and reflected atrial activity
- Hard to directly visualize more central veins
- Duplex has 80%-100% sensitivity and specificity

Venous Thoracic Outlet Syndrome: Imaging

- **Venography:**
  - Occlusion of subclavian vein at costoclavicular junction
  - Distal extension of thrombus
  - Collaterals
  - Arm abduction for subtle/early cases

(J Vasc Surg 2010; 51(6):153)

Venous Thoracic Outlet Syndrome: Treatment

- Important to treat early!
- Catheter-directed thrombolysis
- Surgical decompression (1st rib resection)
- No pre-operative stent placement
  - May fracture from external compression
- Post-operative venoplasty/stent if residual stenosis
- Post-treatment anticoagulation (3-6 mos)
- Follow by clinical symptoms and US
Venous Thoracic Outlet Syndrome: Treatment

- Initial venogram
- Post thrombolysis
- Surgical decompression subsequently performed
- Symptoms resolved

Case 6

- 38 year old female with sickle cell anemia
- Attempted central venous catheter placement
Question 1: The patient complains of head and neck edema. What treatment do you recommend?

A. Catheter directed thrombolysis  
B. Systemic thrombolysis  
C. Balloon angioplasty  
D. Stent placement  
E. Surgical bypass

Question 2: The most common cause of SVC syndrome is:

A. Central venous catheters  
B. Bronchogenic carcinoma  
C. Mediastinitis  
D. Pacemaker wires  
E. Lymphoma
SVC Syndrome: Etiology

Malignant (90%)
- Bronchogenic carcinoma (#1 cause)
- Lymphoma, mets, mesothelioma, germ-cell, thymoma

Benign
- Central venous catheters/pacers (75% of benign)
- Granulomatous mediastinitis (TB, histoplasmosis, sarcoidosis)
- Aortic aneurysms
- Radiation
SVC Syndrome: Symptoms

- Edema of face, neck and upper extremities
- Enlarged cutaneous collaterals
- Headache, dizziness, syncope
- Dysphagia
- Chest pain
- Respiratory distress
- Death

SVC Syndrome: Imaging

CT:
- Most frequently used
- Site and extent of occlusion
- Presence of thrombus
- Presence of collaterals
- Primary cause of occlusion
MRI:
- Similar advantages to CT
- MRV may help delineate venous obstruction

Venography:
- “Gold standard”
- Cannot identify cause of obstruction
- Used to determine extent of obstruction and guide treatment
Malignant SVC Syndrome: Treatment

- **Chemo, XRT, steroids**
  - **Bronchogenic carcinoma:**
    - Chemo and XRT provide relief in 60-80% of patients
    - 20% recurrence
    - May take 2-4 weeks to have effect
    - Chemo is 1st line treatment for lymphoma

- **SVC Stenting:**
  - 1st line treatment for bronchogenic ca and mets
  - Rapid relief of symptoms while underlying etiology is treated
Benign SVC Syndrome: Treatment

- Usually more insidious course
- No role for steroids
- Surgical bypass—high morbidity
- Thrombolysis if secondary to thrombus
- Stenting
  - Now considered primary treatment
  - May require repeat intervention

SVC Syndrome: Stent Success Rates

- No randomized controlled study comparing SVC stenting to chemo or XRT
- Stents 87%-100% effective in relieving symptoms at initial presentation
- Re-obstruction rate as high as 40% in long-term follow-up
- Stent patency restored in majority by secondary interventions
2% mortality:
- Hemorrhage, cardiac events, resp failure, PE

4% major complications:
- Stent migration, bleeding, infection, thrombotic events, SVC rupture, pericardial tamponade, arrhythmias

3.2% minor complications:
- Puncture site hematoma, chest pain

38 year old female with sickle cell anemia
Attempted central venous catheter placement
Head and neck edema
SVC Syndrome

- Sheaths placed from jugular and femoral

SVC Syndrome

- Guidewire advanced across occlusion from below
- Snare placed from above
Guidewire snared and pulled through jugular sheath → “body floss”

Venoplasty of occlusion
SVC Syndrome

- Stent placed

SVC Syndrome

- Post stent venogram
Almost immediate resolution of symptoms

Case 7

- 48 year old male undergoing chemotherapy for colon cancer
Question 1: This complication may be prevented by which 2 strategies?

- More lateral subclavian vein puncture site
- More medial subclavian vein puncture site
- Internal jugular vein access
- Use of a polyurethane catheter
- Use of a silicone catheter

Pinch-off syndrome

- Excessively medial entry into subclavian vein
- Catheter extravascular in costoclavicular space
- Catheter compressed between clavicle and first rib
Pinch-off syndrome: Prevention

- Jugular vein access
- If subclavian access, lateral vein entry point
- Recognize “pinch-off sign” on CXR

Pinch-off sign

- Grade 0
  - Normal appearance
- Grade 1
  - Catheter deviation
- Grade 2
  - Catheter narrowing
- Grade 3
  - Transection with embolization
Pinch-off syndrome: Treatment

- Ruptured subclavian chest port with catheter fragment in RA/RV

Pinch-off syndrome: Treatment

Fragment snared...
Pinch-off syndrome: Treatment

...pulled into IVC...

...and out groin
Case 8:

- 35 year-old male with painful left scrotal mass
- Ultrasound obtained

Question 1:
Which of the following is true regarding this entity?

A. About ¼ are bilateral
B. A secondary cause should be sought if it is isolated on the right
C. Most are symptomatic
D. It may undergo malignant degeneration
E. It is present in < 5% of infertile males
Dilation of pampiniform plexus in the scrotum

Etiology:
- Incompetent gonadal vein valve allowing reflux of blood
- Secondary varicocele
  - Abdominal or pelvic mass impeding drainage of pampiniform plexus
  - Look for neoplasm if sudden onset in older man or isolated right sided varicocele
Varicocele: Epidemiology

- 5 to 17% of males
- L:R 10:1
- Bilateral 10%
- Isolated to right: 1-2%

Varicocele: Symptoms

- 80% asymptomatic
- Pain
- Infertility
  - 40% of males evaluated for infertility have varicocele
- Testicular atrophy
- Scrotal swelling
Varicocele: Physical Exam

- Physical exam:
  - Palpable scrotal abnormality
  - Increases in size with Valsalva and upright position

Varicocele: Ultrasound

- Preferred imaging modality
- Findings:
  - Dilated pampiniform plexus (> 2mm)
  - Doppler/color flow → reflux with Valsalva
Indications for treatment:
- Infertility
- Groin pain
- Adolescent varicocele
- Recurrence post surgery

Varicocele Treatment

- Conservative
- Surgical
  - Spermatic vein ligation
- Interventional
  - Spermatic vein embolization
Varicocele: Conservative Treatment

- Testicular Hypothermia Device (THD)
  - AKA Refrigerated Underwear

The principal complication of wearing the device, which is damp, has been exacerbation of fungal infection in the genital area. This can be controlled by application of nystatin powder or miconazole spray.

Varicocele: Surgical Treatment

- Ligation of internal spermatic vein
- Open or laparoscopic
- Outpatient
- Approximately 2 week recovery
- Recurrence rate:
  - 10-20%
  - Usually caused by collateral flow around ligature
Varicocele Embolization: Technique

Diagnostic venogram:
• Right internal spermatic vein usually drains into IVC and left into left renal vein
• Document valvular incompetence, collaterals

Left internal spermatic venogram

Varicocele Embolization: Technique

Diagnostic venogram:
• Right internal spermatic vein usually drains into IVC and left into left renal vein
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Left internal spermatic venogram
Varicocele Embolization: Technique

- Embolic agent:
  - Coils
  - May add liquid sclerosing agent
    - Sotradecol
    - Cyanoacrylate (glue)

- Begin occlusion at superior pubic ramus and continue to vein origin
- Coils placed along entire length of vein to prevent collateralization
With solitary left varicocele, only need to perform right-sided embolization if:
- Treating infertility and
- Right internal spermatic vein incompetent

Multiple spermatic veins may be present and need to be embolized

If use liquid agents, care to avoid reflux into scrotum and thrombosis of pampiniform plexus

Varicocele Embolization: Outcomes

Similar results to surgery
- Technical success rate > 90%
- Recurrence rate 10%
- Improved sperm counts in 80%

Failures due to:
- Inability to canalize internal spermatic vein
- Missed additional veins
- Collateralization
- Recanalization of occluded segments

Good outcomes after failed ligation
Varicocele Embolization: Complications

- Minor flank pain or scrotal pain
- Low grade fever
- Vein rupture (usually self-limited)
- Migration of coil to lung
- Thrombosis of pampiniform plexus

THANKS!