Chronic DVT/PTS Management
What we’ve learned

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What’s really important

- PTS -deep vein obstruction and superficial reflux
  - Importance of preservation of deep vein valvular function is overestimated

- Accurate stent sizing and placement is critical
  - If the stents are placed incorrectly patients will be persistently symptomatic
Open the deep system

Close the superficial system

Use good medical and physical therapy adjuvant treatments

Know your anticoagulants

Pray someone smarter than I figures out the deep valvular reflux issue and be grateful it’s rarely the root cause of incurable venous disease
2009 Vendantham published a compilation of data suggesting that valvular dysfunction and venous obstruction are the culprits in PTS

* Patients do better with thrombus removal
* Ambulatory venous hypertension can be relieved by venous stenting
* The procedure has a “very low likelihood of harming the patient and when successful tends to produce dramatic clinical improvement”
### Clinical Outcomes:

#### Symptom Relief

Raju & Neglén Experience:

<table>
<thead>
<tr>
<th>Outcome 2.5 years Following Stenting</th>
<th>NIVL with Reflux</th>
<th>NIVL without Reflux</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Pain</td>
<td>82%</td>
<td>77%</td>
</tr>
<tr>
<td>Ulcer Healed</td>
<td>67%</td>
<td>76%</td>
</tr>
<tr>
<td>No Swelling</td>
<td>47%</td>
<td>53%</td>
</tr>
<tr>
<td>Good/Excellent Outcome</td>
<td>75%</td>
<td>79%</td>
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### Patient Characteristics

**NIVL with Reflux (n=151)**  
- 36% Superficial reflux  
- 21% Deep reflux only*  
- 44% Combined superficial & deep reflux*  
  *Axial deep reflux to the calf in 30% of limbs

**NIVL without Reflux (n=181)**

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Deep Reflux

CFV reflux before ablation
4.3 seconds - symptomatic

CFV reflux after ablation
1.6 sec - asymptomatic

Garcia presented data on 106 pts with prolonged balloon angioplasty of fem pop occlusions with EKOS infusion:
- US primary patency at 1 yr 78%
- Us primary patency at 2 years 58%

2014 Spencer et al. wrote technical paper in TVIR on recanalization of fem pop DVT after performing many cases with ulcer healing

Case 1 – Chronic Fem-pop
Case 1 – Chronic Fem-pop
Case 1 – Chronic Fem-pop
Case 1 – Chronic Fem-pop
Before and After
Case 2 Chronic Fem-pop

Before

After
Case 3 Chronic Fem-pop

Before

After
- Fix symptomatic deep venous occlusion
- Ablate symptomatic superficial venous reflux
  - Complete therapy with phlebectomy/foam
- Recognize that deep venous reflux usually improves or resolves with these measures and is NOT a contraindication to these venous therapies
Seeing Venous Disease Differently

* Superficial venous reflux
* Deep venous obstruction
* Deep veins trump the superficial every time
Causes of deep vein “obstruction”

* Work from the heart back
  * Cardiomyopathy/heart failure
  * Morbid obesity
  * Pulmonary arterial hypertension/ right heart failure
  * IVC – post thrombotic, surgical ligation, IVC filters
  * Iliac May- Thurner, post thrombotic obstruction, XRT
  * Chronic fem pop DVT
Tools for ruling out deep venous “obstruction”

- Echocardiogram
- CT or MR Venogram
- US
44 yo male with strong family history of superficial venous disease

No history of prior DVT

Non-healing ulcer anterior left shin 5 months

Bilateral truncal saphenous reflux for 6 seconds with 1 cm saphenous veins and large varices
CTV – IV only at 120 second delay

* Look for stenosis at CIV and measure transverse diameter
* Evaluate vein all the way down
* If concern for significant stenosis or equivocal consider venography and IVUS
Figure 1: Mean CT time-density curves with standard deviation for suprarenal inferior vena cava (IVC) (A) and the external iliac (B),
Is Venography Alone Adequate to Evaluate the Deep Veins?

“We develop strategies to compensate for the shortcomings of [venography] and convince ourselves it’s adequate.” – Peter Neglén, MD, Ph.D.

• The poor diagnostic sensitivity of venography has been well described by Negus¹

  34% of patients with chronic venous disease symptoms had iliac vein obstructive lesions that appeared normal on venography²

• Raju & Neglén observed collaterals in only 43% of limbs [that were stented]³

44 yo venogram: who thinks this is abnormal?
Normal proximal CIV

Severe compression of CIV
May-Thurner

Post stent May-Thurner
Pre and Post stenting

Pre stent

Post stent
Stent internal iliac vein and EIV junc

Left proximal common iliac vein is patent

CIV narrows at junction of EIV stent
Courtesy of Dr Brooke Spencer
Occluded left EIV stent
Synechiae in CFV
Occluded EIV stent with collaterals

Courtesy of Dr Brooke Spencer
Patent right CIV

Left EIV stent is short of the IVC confluence

Courtesy of Dr Brooke Spencer
Access from above with 6 Fr sheath in 8 Fr sheath

Braided tapered tip catheter and stiff glide wire

Snare glide wire and pull through and through access
Jet stream and angioplasty
Post Jetstream IVUS
In stent residual lining after Jetstream and angioplasty
Post relining stents
3 month US

LFT EJU STENT TO PELVIS

LFT EJU STENT

LFT CFV STENT
Algorithm to live by

- Open the deep system
- Close the superficial system
- Use IVUS and venography together to identify lesions and accurately place stents.
Future of DVT

* Better Stents
* Devices to remove chronic debris from the veins
* Early thrombolytic intervention to avoid PTS and the battle of treating chronic venous occlusions
* Better drugs for treating acute DVT
* Genetic markers to match best drugs to individual patients
* Access from the posterior tibial vein
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Controversial

Started using 10 -12 mm stents in 1990’s and IR generally used Nitinol stents

Over time, teaching has become that the bigger the better

Also teaching that Wall stents have been successfully used
% venous stenosis calculated based on anatomic minimums

- CIV: 16 mm Diameter; 200 sq mm Area
- EIV: 14 mm Diameter; 150 sq mm Area
- CFV: 12 mm Diameter; 125 sq mm Area

The basis of symptoms in CVD is elevation of peripheral venous pressure.

Peripheral venous pressure begins to rise with as little as 20% stenosis and becomes significant at 50% stenosis.

“In our experience the iliac veins are remarkably uniform in caliber in normal-sized adults with variation of no more than +/- 10%”

Teleologically this is essential to maintain peripheral venous pressure (also constant) at homeostatic levels

“As as rough guide the following diameter/area parameters are appropriate for the location in normal–sized adults”:

- 16mm/200mm$^2$ – CIV
- 14mm/150mm$^2$ – EIV
- 12mm/125mm$^2$ - CFV
Clinical Value: Diagnostic Information Applied

Example 1. Rokitanski Stenosis

ROKITANSKI STENOSIS: Long diffuse lesion with no focal cues. Common in the iliacs. Not apparent in venograms. IVUS definitive. This means stenosis% cannot be calculated based on comparison with adjacent segment as in arterial stenosis.

~% Stenosis = 1 – 67.7mm² / 200mm² = 66%

Venographic % stenosis based on comparison to adjacent ‘normal’ segment does not work as diffuse stenosis involving the entire iliac vein (Rokitanski stenosis) with or w/o focal lesions are common.

Raju S, “How to Measure Iliac Vein Stenosis”, VEITH 2014 Symposium Presentation Physician commentary is specific to the examples being highlighted. Results from this case study are not predictive of future results.

Example 2. Post-Thrombotic Syndrome

Normal venogram but IVUS stenosis (PTS). Note trabaculae and perivenous fibrosis on IVUS but not seen on venogram. IVUS area 72 sq mm. Difficult to tell position of iliac confluence in venograms (understenting). Easy with IVUS

~% Stenosis = 1 – 72.3mm² / 200mm² = 64%

<table>
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<tr>
<th>Vein</th>
<th>Diameter (mm)</th>
<th>~Area (mm²)</th>
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<tbody>
<tr>
<td>Common Iliac Vein</td>
<td>16</td>
<td>200</td>
</tr>
<tr>
<td>External Iliac Vein</td>
<td>14</td>
<td>150</td>
</tr>
<tr>
<td>Common Femoral Vein</td>
<td>12</td>
<td>125</td>
</tr>
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That would make sense if the average size of a CIV was 16mm

* Kibbe et al
  * Studied 50 consecutive patients in ER abdominal pain
  * Mean age 40 years, 60% female
  * Average Vein Size by location
    * Right CIV 12.85 +/- 0.36
    * Left CIV 12.09 +/- 0.34

How do we think about this in 2016

* PTS - deep vein obstruction and superficial reflux
  * Importance of preservation of deep vein valvular function is overestimated

* Accurate stenting is critical
  * If the stents are placed incorrectly patients will be persistently symptomatic or worse than before

* Clinical understanding and management
  * How you build a practice and add value beyond others just performing procedures
  * Improve the long term outcomes of your procedures
Resources

* Lymphedema physical therapists and compression
* Become a hematologist “light”
* Know how to combine anatomy and risk factors to assist in selection of anticoagulation management
Chronic femoral popliteal occlusion

Pre PT

Post PT – 2 weeks

Chronic femoral popliteal occlusion
Lupus anticoagulant, factor 2 mutation, antiphospholipid antibodies

* Be very careful about taking off anticoagulants

Heterozygous factor V Leiden

* Many can be managed with routine timing of anticoagulation after venous reconstruction

MTHF mutation and hyperhomocysteinemia

* Methylate folic acid replacement – normalizing homocysteine levels returns their risk to baseline
Aspirin Is Your Friend

- ASA overall 40% relative reduction VTED

- ASA Provides Significant Benefit for PE
  - 7% absolute reduction
  - 60% relative risk reduction
  - Hence treat 15 people with ASA after PE and prevent one recurrent symptomatic PE