Venous Reflux

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Disclosure - Passman

- I have no relationships to disclose.
- I have no unlabeled or unapproved uses of drugs or devices in my presentation.
- Selected source images – Rutherford 7th Editions

Chronic Venous Disease
Prevalence

- Varicose Veins: 20+ million
- Swollen Leg: 6 million
- Skin Changes: 1 million
- Skin Ulcer: 500,000

Venous Anatomy - Leg

- **Deep venous system**: main channel through which 90% of venous blood is pumped out of the legs
- **Perforating veins**: conduits for blood to travel from the superficial to the deep veins
- **Superficial venous system**: collecting system of veins just underneath skin
  - Varicose Veins
  - Reticular
  - Spider Veins

Venous Anatomy - Leg

Deep Veins
Superficial Veins
Perforators

Nomenclature of the veins of the lower limb: Extensions, refinements, and clinical application


**J Vasc Surg 2000; 41:719-24**
Venous Anatomy - Leg

- Dominant superficial collecting veins
  - Great saphenous vein
  - Small saphenous vein
  - Lateral subdermal venous plexus
- Communicating veins
  - Connects veins same fascial plane
- Perforator vein
  - Crosses fascial plane
  - Superficial → Deep

Venous Anatomy - Leg

- GSV - SFJ Tributaries
  - AL (Anterolateral)
  - SEP (Superficial external pudendal)
  - SE (Superficial epigastric)
  - SCI (Superficial circumflex iliac)
  - PM (Posteromedial) – Posterior thigh circumflex veins (Giacomini)

Venous Anatomy - Leg

- Small Saphenous Vein (SSV) – SFP junction – Variable Termination
  - Popliteal fossa (70%)
  - Profunda femoral vein (25%) [2]
  - Below popliteal fossa (5%) [1]
  - Perforating veins – lateral thigh [3]
  - Posterior Thigh Circumflex Vein ("Giacomini") – (Thigh extension SSV to Posterior accessory GSV) [1]
  - Postural or postthrombotic obstruction to drainage of the popliteal vein
  - Ascending reflux can develop during muscle contraction from the SFJ towards Giacomini’s vein and the GSV

Venous Anatomy - Leg

Superficial Reflux Patterns

- Great Saphenous
- Anterior Circumflex
- Pudendal

Venous Anatomy - Leg

Superficial Reflux Patterns

- Small Saphenous
- Posterior Thigh Circumflex ("Giacomini")


Venous Assessment Tools

CEAP

Revision of the CEAP classification for chronic venous disorders: Consensus statement

Clinical Classification (C):
- 0: No visible signs of venous disease
- 1: telangiectasias or reticular veins
- 2: varicose veins (>3mm)
- 3: edema
- 4: chronic venous skin changes
  - 4a: pigmentation, eczema,
  - 4b: lipodermatosclerosis
- 5: healed venous ulcer
- 6: active venous ulcer

Venous Assessment Tools

Venous Assessment Tools - CEAP
- Prevalence of venous disease by CEAP

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Bonn Vein Study</th>
<th>Polish Study</th>
<th>French Study</th>
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<tr>
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<td>&lt;2000</td>
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<td>Poland</td>
<td>France</td>
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<tr>
<td>Mean age</td>
<td>55</td>
<td>56</td>
<td>56</td>
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<tr>
<td>Healed Ulcer (C5)</td>
<td>27%</td>
<td>26%</td>
<td>25%</td>
</tr>
<tr>
<td>Active Ulcer (C5)</td>
<td>12%</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>Telangiectasies (C1)</td>
<td>12%</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>Varicose veins (C2)</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
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<tr>
<td>Pigmentation (C4a)</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Atrophie Blanche (C4b)</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>Healed ulcer (C5)</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Active ulcer (C5)</td>
<td>12%</td>
<td>16%</td>
<td>16%</td>
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</table>

Venous Assessment Tools - VCSS

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Absent (0)</th>
<th>Mild (1)</th>
<th>Moderate (2)</th>
<th>Severe (3)</th>
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<tbody>
<tr>
<td>Pain</td>
<td>None</td>
<td>Occasional</td>
<td>Daily</td>
<td>Daily with med</td>
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<tr>
<td>Venous Edema</td>
<td>None</td>
<td>Evening only</td>
<td>Afternoon</td>
<td>Morning</td>
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<tr>
<td>Skin Pigmentation</td>
<td>None</td>
<td>Limited, old</td>
<td>Diffuse, more recent</td>
<td>Wider, recent</td>
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<td>Inflammation</td>
<td>None</td>
<td>Mild cellulitis</td>
<td>Moderate cellulitis</td>
<td>Severe</td>
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<tr>
<td>Induration</td>
<td>None</td>
<td>Focal &lt; 5cm</td>
<td>&lt; 1/3 gaiter</td>
<td>&lt; 1/3 gaiter</td>
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<tr>
<td>Active Ulcers</td>
<td>None</td>
<td>1</td>
<td>2</td>
<td>&gt;2</td>
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<tr>
<td>Active Ulcer Size</td>
<td>None</td>
<td>&lt; 2cm</td>
<td>2 – 6cm</td>
<td>&gt;6cm</td>
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<tr>
<td>Ulcer Duration</td>
<td>None</td>
<td>&lt;3 months</td>
<td>3 – 12 months</td>
<td>&gt;1 year</td>
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<tr>
<td>Compression</td>
<td>None</td>
<td>Intermittent</td>
<td>Most days</td>
<td>Fully compliant</td>
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</tbody>
</table>

Venous Reflux - Definitions

- Venous valvular incompetence:
  - Venous valve dysfunction resulting in retrograde venous flow of abnormal duration.
- Venous reflux:
  - Retrograde venous flow of abnormal duration in any venous segment.
  - Primary: Caused by idiopathic venous valve dysfunction.
  - Secondary: Caused by thrombosis, trauma, or mechanical, thermal, or chemical etiologies.
  - Congenital: Caused by the absence or abnormal development of venous valves.
- Axial reflux:
  - Uninterrupted retrograde venous flow from the groin to the calf.
  - Superficial: Confined to the superficial venous system.
  - Deep: Confined to the deep venous system.
- Combined: Involving any combination of the three venous systems (superficial, deep, perforating).
- Segmental reflux:
  - Localized retrograde flow in venous segments of any of the three venous systems (superficial, deep, perforating) in any combination in the thigh and/or the calf, but NOT in continuity from the groin to calf.

Venous Reflux - Physiology

- Valve leaflets allow unidirectional flow, upward or inward:
  - Number of valves decreases proximally
    - 9-11 anterior tibial
    - 9-15 posterior tibial
  - 7 popliteal
  - 3 femoral
  - 25% external iliac; 10% internal iliac
  - 0 inferior vena cava
- Deep veins have more valves than superficial veins
  - 7-9 greater saphenous
  - 7-9 lesser saphenous
- Dilatation of vein wall prevents opposition of valve leaflets, resulting in reflux
- Valvular fibrosis, destruction, or agenesis results in reflux
Venous Reflux - Physiology

• Normal Muscle Pump – Valves
  – Venous pressure low after ambulation
  – Prolonged refilling venous system

• Ambulatory Venous Hypertension
  – Common pathway of venous disease
  – Intravenous pressure rises during exercise
  – Transmitted to more superficial and distal veins
  – May be due to reflux, obstruction, or both
  – Rapid refilling venous system

Venous Reflux - Physiology

Cellular Cascade

• Increased ambulatory venous pressure
• Capillary/venule dilatation and elongation
• Microcirculatory changes and increased capillary permeability
• Increased interstitial edema formation
• Leakage of fibrin and inhibitors of fibrinolysis into interstitial tissue
• Pericapillary fibrin cuffs act as barrier to oxygen and nutrients (“Fibrin Cuff Theory”)
• Trapping of WBC in microcirculation with migration into the interstitium
• Release of lysozyme enzymes
• Release of inflammatory mediators
• Release of free oxygen radicals

Venous Reflux Testing

Trendelenburg Test

• Position
  – Supine position
  – Flexed leg at the hip and raised above heart level until the veins empty.
  – Tourniquet applied upper thigh
  – compress superficial veins but not deeper veins.

• Interpretation
  – Normal
    – Superficial fills from below within 35 secs
  – Valvular Reflex
    – Deep or Perforator:
      – Superficial veins fill rapidly indicating reflux below tourniquet
      – Leg lowered - Patient stands.

  – Superficial:
    – After 20 seconds, if there has been no rapid filling, the tourniquet is released.
    – Sudden filling indicates competent perforators with incompetent superficial veins

Localization

• Repeat with the tourniquet at different above knee: mid-thigh
  – Below knee - SSV and popliteal

Venous Reflux Testing

Duplex Ultrasound

• Exam
  – Upright position
  – Augmentation
    – CFV / GSV: increased intra-abdominal pressure using a Valsalva maneuver to assess
    – Distal veins: manual or cuff compression and release of the limb distal to the point of examination.

• Location
  – Deep veins
    – Greater Saphenous
    – Saphenofemoral Junction
    – Lesser saphenous
    – Sapheno-Popliteal Junction
    – Thigh Perforating Veins
    – Calf Perforating Veins

• Criteria
  – Visualization, compressibility, venous flow (duration of reflux), and augmentation.

  • Reversal of flow
    – > 1 sec femoral/popliteal
    – > 0.5 sec GSV / SSV / Tibial / deep femoral / perforator

• Perforator Veins
  – Incompetent perforating veins have been demonstrated in the majority of patients with severe CVI
    – Class 3 52%
    – Class 4 83%
    – Class 5/6 90%

  • Standard definition lacking
    – Evaluate reflux patterns for hemodynamic importance
    – All perforators that demonstrate reflux are not equal

  • Clinically significant
    – outflow of duration >0.5 sec
    – diameter of 3.5 mm
    – location beneath healed or open venous ulcers

Perforator diameter | Incidence of reflux
---------------------|---------------------
2.0 mm               | 10%                 
2.5 mm               | 50%                 
3.0 mm               | 80%                 
3.5 mm               | 80%                 
4.0 mm               | 80%                 

Perforator Diameter (mm)
Venous Reflux Testing
Plethysmography

- Strain-gauge plethysmography (SGP)
- Impedence plethysmography (IPG)
- Photoplethysmography (PPG)

Abnormal: Venous refill time <20 sec
VV – Normal: 2% to 3% above baseline; Obstruction less than 2%
MVO(3sec) – decreased obstruction

Venous Reflux Testing
Plethysmography

- Air plethysmography (APG)

Venous Reflux
Medical Treatment

- General Measures
  - Weight reduction
  - Exercise
  - Physical therapy
  - Skin care
- Venous ulcers: venaactive drugs + compression
  - pentoxifylline
  - micrornized purified flavonoid fraction
- CVI – pain and swelling: venaactive drugs + compression
  - Diosmin
  - Hesperidin
  - Rutosides
  - Sulodexide
  - micrornized purified flavonoid fraction
  - horse chestnut seed extract (aescin)

Venous Reflux
Compression

- Provides a gradient of pressure, highest at the ankle, decreasing as it moves up the leg
- Facilitates venous return despite valvular dysfunction
- Improved calf muscle pump function
- Improved venous outflow
- Decreased ambulatory venous hypertension
- Decreased edema
- Decreased cellular cascade

<table>
<thead>
<tr>
<th>Compression Strength</th>
<th>Indications</th>
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<tbody>
<tr>
<td>8-15mm</td>
<td>Leg fatigue, mild swelling, stylish</td>
</tr>
<tr>
<td>15-20mm</td>
<td>Mild aching, swelling, stylish</td>
</tr>
<tr>
<td>20-30mm</td>
<td>Aching, pain, swelling, mild varicose veins</td>
</tr>
<tr>
<td>30-40mm *</td>
<td>Aching, pain, swelling, varicose veins, post-ulcer</td>
</tr>
<tr>
<td>40-50, 50-60mm *</td>
<td>Recurrent ulceration, lymphedema</td>
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</tbody>
</table>
Venous Reflux
Compression – Guidelines

- **Symptomatic varicose veins**
  - moderate compression (20 to 30 mm Hg) [GRADE 2C]

- **Candidates endovenous ablation - GSV**
  - Against compression as primary treatment [GRADE 1B]

- **Venous ulcers**
  - Primary therapeutic modality [GRADE 1B]
  - Adjuvant to superficial venous surgery / ablation to prevent ulcer recurrence [GRADE 1A]

Vein Reflux
Operations - Overview

- **Saphenous Incompetence**
  - Ligation and/or stripping
  - Endovenous ablation

- **Varicose Veins**
  - Excision – Stab Avulsion
  - Hook phlebectomy
  - Transilluminated powered phlebectomy
  - Foam sclerotherapy

- **Perforator Incompetence**
  - Linton procedure
  - SEPs
  - Ablation / Sclerotherapy

- **Deep Vein Insufficiency**
  - Valvuloplasty
  - Axillary vein transfer
  - Femoral – femoral vein bypass
  - (Percutaneous vein valve bioprosthesis)

- **Spider veins, reticular veins, small varicose veins**
  - Sclerotherapy
  - Laser therapy
  - Foam

Saphenous Incompetence
Ligation and Stripping

- **Early Results**
  - Improved symptoms
  - Improved quality of life parameters
  - Improved physiologic venous parameters

- **Late Results - Problems**
  - [Ligation alone] vs [Ligation plus Stripping]
  - Superficial to deep venous reconnection
  - Neovascularization
  - Recurrence 24% to 88% at 15 years

Saphenous Incompetence
Endovenous Ablation

- **Radiofrequency**
  - Registry data (N=1184)
  - 1 year 4 year
  - Absence Reflux 89% 88%
  - Prospective randomized trials (3)
  - RF ablation superior to GSV stripping
  - patient recuperation quality of life
  - 94% no reflux at 2 years
  - Low neovascularization 0.5% - 2.9% (GSV stripping 16% - 40%)

- **Laser**
  - 498 GSV in 423 patients over 3 years
  - 99.2% technical success
  - Complications:
    - Bruising 24%; “Tightness” 90%;
    - No DVT, Skin Burns, Paresthesias
  - 113 of 121 limbs followed for >2 years
  - Recurrence 7% at 2 years
  - All recurrences occurred within 9 months
  - J Vasc Interv Radiol. 2003;14(8): 991-6
Saphenous Incompetence
Endovenous Ablation – Laser

- Wavelength – absorption characteristics
  - 810-nm: specific for hemoglobin absorption.
  - 940-nm: balanced ratio between light irradiated into tissue and absorption by hemoglobin and water.
  - 980-nm: specific for hemoglobin and water.
  - 1319/1320-nm: specific for water absorption; targets collagen in vein wall.
  - 1470-nm: absorption coefficient in water that is 40 times greater than 810- and 980-nm wavelengths.

Does wavelength matter? (940nm vs 1320nm)
- N = 113
- Randomized, prospective, blinded
- 940nm (15 W) 3mm/sec 24 J/cm 90% 3 month
- 1320nm (8W) 1 mm/sec 62 J/cm 97% 3 month

Does wavelength matter? (810nm vs 980nm)
- N = 51
- Randomized, prospective, blinded
- 810nm (50 J/cm) 4 J/cm 100% 3 month
- 980nm (30W) 6 J/cm 90% 3 month

*Skin Surg 2005; 31:1678

Varicose Vein
Ambulatory Phlebectomy - Complications

- Anesthetic
  - Injection discomfort, allergic reaction, emotional patient
- Skin
  - Blister, keloid, dimpling, infection, induration, hypopigmentation, hyperpigmentation, tattooing
- Compression
  - Swelling, blisters, skin necrosis, contact dermatitis
- Vascular
  - Bleeding, superficial thrombophlebitis, DVT, PE, telangiectasias, matting
- Lymphatic
  - Edema, lymphorrhea, lymphocele
- Neurologic
  - Hypesthesia, dyesthesia, neurona,
- Compression
  - Swelling, blisters, skin necrosis, contact dermatitis

Varicose Vein
Transilluminated Powered Phlebectomy

- Advantages
  - Transillumination = Superior visualization
  - Good pain relief
  - Easy recovery
  - Fewer incisions
  - Less operative/anesthesia time
  - Excellent cosmetic result
- Disadvantages
  - General or Regional Anesthesia
  - Operative setting
  - More extensive dissection
- Pitfalls - Early Experience
  - Bruising
  - Hematoma
  - Hyperpigmentation
  - Subcutaneous scarring

REACTIV TRIAL
The Randomised Clinical Trial, Observational Study and Assessment of Cost-Effectiveness of the Treatment of Varicose Veins

- Randomized 246 patients with varicose veins (class C2)
  - Conservative treatment included lifestyle advice relating to exercise, leg elevation, management of weight and diet, and the use of compression hosiery
  - Surgery = conservative + high ligation, stripping, and phlebectomy

- Conclusions
  - Surgery provides more symptomatic relief and improvements in QOL than conservative management.
  - Surgery was significantly more cost-effective than both sclerotherapy and conservative management.

Eschar Trial

- Prospective randomized trial of compression vs. compression+SVS for C:5-6 patients
- Primary outcomes:
  - Ulcer healing and ulcer recurrence
  - Secondary outcome: ulcer-free time
- 3 centers: 500 patients randomized
  - Compression: 258 (3 to SVS)
  - Compression+SVS: 242 (24% refused surgery)
- Analysis based on intent to treat

- Ulcer healing at 3 years
  - Compression: 89%
  - Compression+SVS: 93% p=0.73
- Ulcer recurrence at 4 years
  - Compression: 16%
  - Compression+SVS: 31% p=0.001
- Ulcer free time assessed to 3 years
  - Compression: 85 weeks
  - Compression+SVS: 100 weeks p=0.013

*BMJ 2007;335:83

Venous Reflux Superficial Operation – Guidelines

- GSV Incompetence
  - High ligation and inversion stripping to the level of the knee [GRADE 2B]
  - Endovenous thermal ablations (laser and radiofrequency ablations) are safe and effective and preferred over open surgery or foam sclerotherapy [GRADE 1B]
  - Postop compression - reduce hematoma formation, pain, and swelling [GRADE 1B]

- Varicose Veins
  - Ambulatory phlebectomy (staged or combined) [GRADE 1B]
  - Transilluminated powered phlebectomy for extensive [GRADE 2C]

- SSV Incompetence
  - High ligation at knee crease, about 3 to 5 cm distal to the saphenopopliteal junction with selective inversion stripping [GRADE 1B]

- Venous Ulcers
  - Ablation of incompetent superficial veins in addition to compression [GRADE 1A]

- Recurrent
  - Ligation saphenous stump, ambulatory phlebectomy, sclerotherapy, or endovenous thermal ablation, depending on the etiology, source, location, and extent of varicosity [GRADE 2C]

Perforator Incompetence Linton Operation

Perforator Incompetence SEPS

Perforator Incompetence SEPS - Results

- Pooled data:

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<thead>
<tr>
<th></th>
<th>Linton</th>
<th>SEPS</th>
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<tbody>
<tr>
<td>Ulcer healing</td>
<td>88%</td>
<td>90%</td>
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<tr>
<td>Ulcer recurrence</td>
<td>22%</td>
<td>11%</td>
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<tr>
<td>Wound complications</td>
<td>24%</td>
<td>5%</td>
</tr>
<tr>
<td>LOS</td>
<td>2-7%</td>
<td>1-3%</td>
</tr>
</tbody>
</table>

  - SEPS equally efficacious with decreased wound problems for venous ulcer
  - Role debated for less severe venous disease

Perforator Incompetence PAPS - Ablation
Venous Reflux Perforator – Guidelines

- Against selective treatment of incompetent perforating veins in patients with simple varicose veins (CEAP C2). [GRADE 1C]
- Recommend treatment of “pathologic” perforating veins that includes those with an outward flow duration of 500 ms, with a diameter of 3.5 mm, located beneath a healed or open venous ulcer (CEAP C5-C6) [GRADE 2B]
- Recommend subfascial endoscopic perforating vein surgery, ultrasound guided sclerotherapy, or thermal ablation. [GRADE 2B]

Deep Vein Insufficiency Femoral – Femoral Vein Bypass

Deep Vein Insufficiency Valvuloplasty

Deep Vein Insufficiency Axillary Vein Transfer Vein Valve Transplant

Deep Vein Insufficiency Vein Valve Transplant

Cumulative Patency (N=27) Cumulative Valvular Competence (N=27)

Neglen and Raju, J Vasc Surg, 2003

Spider Veins Sclerotherapy

<table>
<thead>
<tr>
<th>Agent</th>
<th>Manufacturer</th>
<th>Category</th>
<th>FDA Approval</th>
<th>Strength</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>Hypertonic saline</td>
<td>Multiple</td>
<td>Genetic</td>
<td>DR-label use</td>
<td>++</td>
<td>Low risk of allergic reaction, potent sclerosant, rapid response</td>
<td></td>
</tr>
<tr>
<td>Sodium tetradecyl sulfate</td>
<td>Bioniche Pharma, USA (distributed by AngioDynamics, Inc.)</td>
<td>Detergent</td>
<td>Approved</td>
<td>+++</td>
<td>FDA approved, low risk of allergic reaction, potent sclerosant</td>
<td>Potential necrosis with extravasation, matting of telangiectases</td>
</tr>
<tr>
<td>Chromex (72% chromated glycerin)</td>
<td>Omega Laboratories, Canada</td>
<td>Alcohol</td>
<td>Off-label use</td>
<td>+</td>
<td>Low incidence of hyperpigmentation, necrosis, and allergic reaction</td>
<td>Weak sclerosing agent, highly viscous and painful to inject, may cause hematuria at high doses</td>
</tr>
<tr>
<td>Sotradecol (sodium tetradecyl sulfate)</td>
<td>Glenwood, LLC, USA</td>
<td>Detergent</td>
<td>Approved</td>
<td>+++</td>
<td>FDA approved, low risk of allergic reaction</td>
<td>Potential necrosis with extravasation, matting of telangiectases</td>
</tr>
<tr>
<td>Aethoxysklerol (polidocanol)</td>
<td>Kreussler Pharma, Germany</td>
<td>Detergent</td>
<td>Approved</td>
<td>+++</td>
<td>Very low risk of allergic reaction, painless to inject</td>
<td>Associated with matting of telangiectases</td>
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Spider Veins Sclerotherapy

<table>
<thead>
<tr>
<th>Indications</th>
<th>Recommended STS Concentration</th>
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<tbody>
<tr>
<td>Varicose veins &lt; 8 mm</td>
<td>0.5%-3.0%</td>
</tr>
<tr>
<td>Reticular veins 2-4 mm</td>
<td>0.25%-0.5%</td>
</tr>
<tr>
<td>Telangiectasias 0.1-2.0 mm</td>
<td>0.125%-0.25%</td>
</tr>
<tr>
<td>Recurrent varicose</td>
<td>0.5%-0.8%</td>
</tr>
<tr>
<td>Failed segments of endothermal</td>
<td>0.5%-3.5%</td>
</tr>
<tr>
<td>Unilateral veins of the hands</td>
<td>0.25%-0.5%</td>
</tr>
<tr>
<td>Skin congestion</td>
<td>0.125%-0.25%</td>
</tr>
<tr>
<td>Vascular malformations</td>
<td>0.125%-0.25%</td>
</tr>
<tr>
<td>Facial telangiectases</td>
<td>0.125%-0.25%</td>
</tr>
</tbody>
</table>

Pelvic Venous Syndromes

- Pelvic Congestion Syndrome
  - Pain
  - Dyspareunia
  - Dysuria
  - Vulvar varices
- Internal Iliac Venous Insufficiency
  - Ostial, pteryng, vulvar varices
- Nutcracker Syndrome
  - Perineal, ovarian, pelvic varices
- Isolated Vulvar Varices

Pelvic Venous Reflux

Ovarian Vein Anatomy

- Provides drainage of:
  - Parametrium
  - Cervix
  - Mesosalpinx
  - Pampiniform plexus
- 2-3 trunks form single vein at L4
  - Right - IVC
  - Left - L Renal Vein
- Mean diameter 3.1 mm
- 2-3 valves
- Valvular incompetence - 47% of women

Pelvic Venous Reflux

Vulvar Varices - Communication

- Ovarian Veins
  - Round Ligament
  - Ovarian Plexus
  - Broad Ligament Varices
  - Internal Pudendal Vein
  - Obturator Vein
  - Inferior Gluteal Vein
- Legs
  - Superficial External Pudendal Vein
  - Posterior Medial Tributary
- Great Saphenous Vein (50%)
  - Deep External Pudendal Vein
  - Circumflex Femoral Vein
- Common / Deep Femoral Vein

Pelvic Venous Reflux

Diagnostic Tests

- Lower Extremity Venous
  - Duplex
- Transabdominal / Transpelvic Ultrasound
- MR / CT Venography
- Varicography
- Retrograde Ovarian / Internal Iliac Venography
  - Ovarian vein diameter ≥ 5 mm
  - Contrast retention > 20 sec
  - Pelvic venous congestion / Filling of internal iliac vein
  - Filling of vulvar / thigh varices

Pelvic Venous Reflux

Pelvic Anatomy

- Pubis, Vulva, Labia majora
  - Ovarian veins
  - Gluteal, Posteromedial thigh
  - Internal pudendal
  - Obturator vein
- Inner thigh, posterior vulva
- Inferior Gluteal vein
- Inferior Gluteal Vein
- Common / Deep Femoral Vein
Pelvic Venous Reflux Treatment Options

- Medical
  - Medroxyprogesterone
  - Gonadotrophin releasing hormone (GnRh)
- Surgical
  - Hysterectomy / oophorectomy
  - Overian vein ligation / resection
  - Saphenous tributary ligation
- Percutaneous
  - Transcatheter embolization
  - Sclerotherapy
    - Ovarian tributaries
    - Internal iliac tributaries

Nutcracker Syndrome Mesoaortic Compression - Left Renal Vein

- Anatomic entrapment
  - Left renal vein (LRV) between aorta and superior mesenteric artery (SMA)
- Anatomic abnormality
  - Initial steep descent of SMA
  - Normal: ventral direction in proximal 4-5 mm
  - Minority of affected individuals with symptoms
- Clinical Presentation
  - Hematuria (micro or gross)
  - Left flank pain
  - Left sided varicocele
  - Pelvic congestion
  - Orthostatic proteinuria
  - Gastrointestinal symptoms

- Increase L Renal Vein Pressure - Development of collaterals
  - Renal pelvis
  - Abnormal (valveless) hypertensive veins
  - Connections between varices and collecting system

Nutcracker Syndrome Mesoaortic Compression - Left Renal Vein

- Endovascular
  - Angioplasty and stent
  - Embolization of ovarian varicosities
- Open surgical
  - Renal vein transposition
  - Autotransplantation of left kidney

Venous Reflux Conclusion

- Comprehensive evaluation
  - Anatomic patterns reflux
  - Clinical CEAP Classes
  - Diagnostic evaluation
    - Differentiate obstructive vs reflux causes
- For chronic venous reflux:
  - Compression based therapy \( \rightarrow \) first line
  - Treat superficial venous reflux
  - Reserve deep venous options for failure
- Pelvic Reflux Syndromes
  - Understand pelvic venous anatomy and pattern
  - Differentiate ovarian vein vs nutcracker