Venous Leg Ulcerations: Compression, Intervention, and Beyond

Ryan Vancura, MD

Disclosures

• No financial disclosures

Background

• From Kansas City
• University of Kansas undergrad and med school
• UH Transitional program
• OHSU radiology residency (Portland, OR)
  – Dotter Interventional Institute
• UCLA IR fellowship
• Cedars-Sinai Neuroradiology fellowship

Who are Interventional Radiologists?

• Radiologists with specialized training in minimally invasive treatments.
  – Vascular specialists
  – Interventional Oncologists
  – Experts in embolization
  – Image guided procedures

History of Interventional Radiology

• Angioplasty and stent were first used by interventional radiologists to treat peripheral vascular disease to avoid amputation of gangrenous foot.
• Charles Dotter, MD - the “father of interventional radiology” was nominated for the Nobel Prize in medicine in 1978.

Benefits of IR

• Less risk, less pain, less recovery time
• Procedures often outpatient
• Patients usually don’t need general anesthesia
• Modern IRs provide full clinical service
  – Pre-procedure clinical consultations
  – Post-procedure follow-up care
Vascular disease
  - Abdominal aortic aneurysm
  - PAD
  - DVT and post-thrombotic syndrome
  - Varicose veins
  - IVC filter removal
  - Renovascular hypertension
  - Chronic mesenteric ischemia

Hemorrhage
  - GI bleed
  - Postpartum hemorrhage
  - Massive hemoptysis
  - Trauma, etc.

Infertility
  - Varicocele
  - Fallopian tube occlusion

Women’s health
  - Uterine Fibroids
  - Chronic pelvic pain

Liver disease
  - TIPS (transjugular intrahepatic portosystemic shunt)
  - BRTO (balloon-occluded retrograde transvenous obliteration)
  - Transjugular liver biopsy

Oncology
  - Chemoembolization of hepatocellular carcinoma
  - Other tumor embolizations
  - Tumor ablations (liver, lung, kidney, bone)
  - Pleurectomy
  - Hyperthermia

Spine
  - Vertebral compression fractures
  - Sacral insufficiency fractures
  - Degenerative disease

VLU Historical Perspective

- Leg ulcers were first described by Hippocrates, who noted an association with varicose veins and ulceration

VLU Historical Perspective

- In 1271, Raoul, a 20-year-old Norman cobbler suffered right calf pain and swelling extended up to the thigh
- He developed a leg ulcer.
- He visited the tomb of King Saint Louis and applied dust below the tombstone to the ulcer.
- He miraculously healed.
- DVT first known case Middle Ages

Lower Extermity Ulcers

- Venous
  - 50-75%
  - ≈ 1% prevalence of VLUs in U.S.

- Arterial
  - 15% pure
  - 18% mixed arterial and venous

- Neuropathic
  - 10%
  - Diabetic most common
    - Frequently associated with PAD
VLU

- Recurrence rates as high as 78%
- Large socioeconomic burden from morbidity, poor quality of life, and lost work days

Risk Factors

- Family history
- Advanced age
- Female gender
- DVT
- Obesity
- Pregnancy
- Trauma
- Occupation requiring prolonged standing

Pathophysiology

- Venous incompetence and consequent venous hypertension
- Incompetent valves result in venous reflux
- Reservoirs for circulatory system; tremendous capacity for dilation – expand and contract in response to pressure changes (compliant)
- LEs unique b/c we are bipeds and venous pressure largely related to simple hydrostatic pressure (column of fluid)

Pathophysiology

- Dilation of capillaries
- BM thickening – collagen and elastic fibers
- Leukocyte activation and PLT aggregation
- Endothelial damage
- Inflammatory mediators and proteolytic enzymes
- Increased permeability and intracellular edema
- Destruction of microlymphatics and nerve fibers
- Decreased fluid drainage and regulatory mechanisms, impairment of wound healing.

Anatomy

- Superficial venous system
  - Great saphenous vein >> small saphenous vein
  - “Greater,” “Lesser,” and “Short” no longer used
  - Highly variable anatomy
- Deep venous system from prior DVT
  - Iliac, femoral, and popliteal veins
  - “Superficial femoral” no longer used
- Perforators
Clinical Presentation

- LE ache, pain, or discomfort with swelling
- Worse with prolonged standing and improves with elevation and walking
- Venous ulcers predominantly in the “gaiter area” (over the medial malleolus)
  - Also lateral malleolus, calf, or feet.
- Often report trauma, but poor wound healing due to venous hypertension

Clinical Assessment

- Irregular borders
- Shallow
- Varicose veins or spider veins
  - Stasis dermatitis
  - Hyperpigmentation
  - Lipodermatosclerosis
- Atrophie blanche
- Edema

Table 1  Clinical-Etiology-Anatomy-Pathophysiology
Classification for Chronic Venous Disease

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C0</td>
<td>Asymptomatic; no visible or palpable signs of disease.</td>
</tr>
<tr>
<td>C1</td>
<td>Telangiectasias, or reticular or spider veins (&lt;3 mm)</td>
</tr>
<tr>
<td>C2</td>
<td>Varicose veins (≥3 mm)</td>
</tr>
<tr>
<td>C3</td>
<td>Edema of the legs</td>
</tr>
<tr>
<td>C4</td>
<td>Changes in skin and subcutaneous tissue</td>
</tr>
<tr>
<td>C4A</td>
<td>Pigmentation or eczema</td>
</tr>
<tr>
<td>C4B</td>
<td>Lipodermatosclerosis or atrophie blanche</td>
</tr>
<tr>
<td>C5</td>
<td>Healed, closed venous ulcer</td>
</tr>
<tr>
<td>C6</td>
<td>Active, open venous ulcer</td>
</tr>
</tbody>
</table>

Clinical Assessment

- Irregular borders
- Shallow
- Varicose veins or spider veins
  - Stasis dermatitis
  - Hyperpigmentation
  - Lipodermatosclerosis and atrophie blanche high risk for new and recurrent VLUs.
- Atrophie blanche
- Edema
- Stasis eczema or venous eczema
- Lipodermatosclerosis and atrophie blanche high risk for new and recurrent VLUs.

Clinical Assessment

- Irregular borders
- Shallow
- Varicose veins or spider veins
  - Stasis dermatitis
  - Hyperpigmentation
  - Lipodermatosclerosis
- Atrophie blanche
- Edema
- Stasis eczema or venous eczema
  - Lipodermatosclerosis and atrophie blanche high risk for new and recurrent VLUs.
VLU. Irregular margins w/pale slough mixed w/healthy granulation tissue surrounded by circumferential atrophie blanche.

VENOUS ECZEMA. Speckled, scaly, inflammed and hyperpigmented.
Differential Diagnosis of Edema

- CVI or DVT
- Cardiac
  - Biventricular and right-sided heart failure (OSA and PAH)
- Liver failure/cirrhosis
  - Decreased protein synthesis
- Renal
  - Increased protein losses
- Endocrine - Thyroid and Cushing syndrome
- Lymphedema
- Medications
  - Glitizones, CCBs, NSAIDs, estrogens or steroids
- Pelvic tumor or adenopathy causing extrinsic venous obstruction
- May-Thurner syndrome
- Phlebolymphedema
- Idiopathic
- Other
  - Infectious or inflammatory
  - Trauma or injury (CRPS)
  - Premenstrual edema
  - Pre-eclampsia
  - Pregnancy
  - Lipedema

Work-Up

- CMP, CBC, TFTs
- Urine for microalbuminuria
- Echo - RV and PA pressures
- Venous duplex MAPPING to assess valvular incompetence
  - Assessment of superficial & deep systems and pathologic perforators in close proximity to ulcer.
- CTV/MRV to assess for venous/iliocaval occlusion/thrombosis and malignancy

Work-up

- Causes of edema
- Crucial to rule out concomitant PAD
  - ABI minimum
Treatment

- Primary objectives
  - Control edema
  - Heal ulcer
  - Prevent recurrence
- Collaborative, multimodality and simultaneous
  - Conservative measures
  - Routine and advanced wound care
  - Medications
  - Interventional therapies

Compression Therapy

- Reduces venous diameter and reflux and improves calf muscle pump function
  - Venous return
  - Lymphatic flow
- Decreased proinflammatory mediators
  - MMP and kinases
- Releases anti-inflammatory agents
- Not just hemodynamic, but biochemical effects

Compression

- Inelastic compression (Heal)
  - “short stretch”
  - Best for healing VLUs
  - Multilayer bandages, “plaster boot”
- Elastic compression (Maintain)
  - “long stretch”
  - Best for preventing VLUs
  - Graduated compression stockings
  - ACE wraps

Inelastic/multilayer wraps
- labor intensive

Diagram of the different types of bandages

Inelastic material
Compression Therapy

- Intermittent pneumatic compression devices
  - Pump inflates/deflates cuff.
  - Calf pump dysfunction and/or severe immobility.
  - Mimick effect of the calf muscle.

Contraindications

- Acute infection
- Severe PAD
- Caution in patients with ABI 0.6-0.8
- Severe peripheral neuropathy
- Contact dermatitis
- Allergy to compression material
- Severe CHF

Wound Dressings

- Prevent adherence to ulcer
- Allow drainage
- Maintain moist environment
- Bacteriostatic/prevent infection
- Topical steroids w/stasis eczema and pruritus.

Debridement

- ESSENTIAL!
- Compression w/debridement heals 50-60% of VLUs.

Skin Substitutes and Skin Grafts

- Apligraf
  - Human foreskin–derived neonatal fibroblasts.
- EpiFix
  - Human Amnion/Chorion Membrane allograft
- Autologous skin graft
  - Used for large or refractory venous ulcers
Medications

- Pentoxifylline (Trental) 800 mg po tid
  - PLT aggregation inhibitor
  - Reduce blood viscosity and improves microcirculation.
  - Monotherapy in pts unable to tolerate compression.
  - N/V/D and loss of appetite

Medications

- Aspirin (325 mg/d)
  - Combined with compression therapy
  - Small, flawed trials
  - Concomitant PAD

Medications

- Antibiotics
  - Topical routinely used
  - CR of 22 RCTs of systemic and topical abx and antiseptics found no evidence of improved healing w/routine use of abx
  - Oral for concomitant cellulitis or active wound or bone infection.

Timeline

- 50-80% ulcers are “healing” at 12-16 weeks
  - If not 40% healed at 12 weeks, unlikely to heal

Interventional Therapies

- Reduce venous hypertension
- Most VLU associated with SVI
  - 51-53% prevalence of isolated SVI
  - 32-34% of SVI and DVI
- VLU less commonly related to PTS
  - 5-15% prevalence of isolated deep vein reflux and obstruction
- PTS
  - More likely to develop than with isolated SVI
  - Develop more rapidly
Venous Interventions

- Superficial system
  - Exclude/remove/plug up the pathologic veins
  - Stripping, SEPS
  - Ablation, sclerotherapy, phlebectomy
- Deep System
  - Open/enlarge veins or restore valvular function
  - Venous bypass +/- AV fistula
  - Venous stenting and prolonged balloon angioplasty
  - Endophlebectomy
  - Valvuloplasty or valve transplant
  - Neovalve operation

Surgical Therapies

- Saphenous Stripping
  - Effect of Surgery and Compression on Healing and Recurrence study (ESCHAR)
  - 500 patients, 3 hospitals RCT
  - Compression v. Compression with stripping
  - 65% healed at 24-months both groups
  - Decreased recurrence in compression + stripping (12% vs 28%).

Surgery

- ESCHCAR Trial Flaws
  - 20% randomized to surgery refused
  - 7 week delay in surgical arm
  - Small, shallow ulcers
  - 40% incidence of DVI and 15% with severe DVI

Endovascular

- Endovenous thermal ablations
  - Laser and RF
  - Safe and effective
  - Recommended for saphenous incompetence
  - Rapid recovery and less pain and morbidity
  - Recommended over open surgery

Endovascular Therapies

- Endovenous Ablation
  - No RCT on VLU healing, recurrence, or QOL
  - No adequately powered study comparing ablation with compression or surgery
  - Meta-analysis (van den Bos et al)
    - Ablative therapies at least as effective as surgery for varicose veins
Endovascular Therapies

- **Sclerotherapy**
    - Faster healing compared with compression alone (4 weeks vs 6 weeks)
  - Kulkarni et al (2013)
    - 200 legs (186 patients)
    - 71.1% healing at 6 months
    - 4.7% 1 year and 4.7% 4-year recurrence

Endovascular Therapies

- Deep Venous System
- Post-thrombotic syndrome and iliac venous obstruction
- May-Thurner Syndrome (MTS)
  - Increase risk LLE-iliofemoral DVT & venous htn
Endovascular Therapies

- Consider iliac obstruction in pts with VLU
- Marston et al assess iliac obstruction in pts w/active and healed ulcers.
  - 37% obstruction at least 50%
  - 23% obstruction of 480%
    - Female, hx of DVT, and deep venous reflux
- Stenting and prolonged balloon angioplasty improves hemodynamics, sxs, and QOL
- VLUs and above risk factors undergo CTV, MRV, and/or venography with IVUS

Surgical

- Venous bypass
  - Rarely necessary
  - Used when endovascular methods fail
- Valvuloplasty
- Valve transplants
- Prosthetic Valves
- Neovalve Operation

Deep venous endovascular interventions...
Sharp Recanalization
Percutaneous mechanical thrombectomy “AngioJet”
Pull hard
Conclusion

• VLU under recognized and undertreated
• Multispecialty collaborative efforts
• Appropriate patient and physician education
• Utilization of minimally invasive techniques.
• Primary Care
  – Identify and treat venous insufficiency early, especially CEAP 4 patients
  – Remove IVC filters when appropriate
  – Aggressive, early treatment of DVT

References

Contact information

Ryan Vancura, MD
Vascular and Interventional Radiology
Neuroradiology
Email: ryan.vancura@ahss.org
www.mplex.org/care-services/IR