

# Arterial vs. Venous Ulcers: How to Differentiate and Treat

Dr. Jennifer A Gardner-Harbison

---

---

---

---

---

---

---

---

## Provider Disclaimer

- Allied Health Education and the presenter of this webinar do not have any financial or other associations with the manufacturers of any products or suppliers of commercial services that may be discussed or displayed in this presentation.
- There was no commercial support for this presentation.
- The views expressed in this presentation are the views and opinions of the presenter.
- Participants must use discretion when using the information contained in this presentation.

---

---

---

---

---

---

---

---

## Objectives

1. Define characteristics of arterial, venous and mixed etiology wounds.
2. Identify risk factors for arterial, venous and mixed etiology wounds.
3. Describe tests to determine arterial and venous insufficiency.
4. Identify appropriate treatments for arterial and venous wounds, including dressings and physical therapy options.
5. Describe surgical interventions for arterial and venous wounds.

---

---

---

---

---

---

---

---

## Arterial Ulcers: Introduction

- Important to know that arterial ulcers make up only about 5-10% of all lower extremity ulcers
- Often arterial insufficiency is asymptomatic but is cause of 5% of amputations
- Greater than 80% of people with arterial insufficiency have a history of smoking

---

---

---

---

---

---

---

---

## Arterial System Overview

- Carries blood from the heart and into the rest of the body
- Arteries have 3 layers
  1. Tunica externa: Protective outer layer
  2. Tunica media: Middle layer, made of smooth muscle and collagen and elastin fibers
  3. Intimal layer: Single layer of endothelial cells that is in direct contact with blood
- Vary in size depending on what they are supplying blood to
  - Smaller arteries are called arterioles
- Capillaries: Simplest vessel, only 1 layer of endothelial cells and a thin basement membrane; Can only allow 1 red blood cell through at a time

---

---

---

---

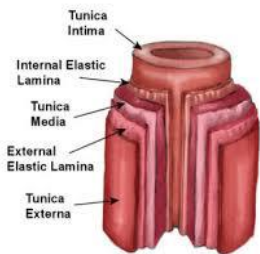
---

---

---

---

## Anatomy of Artery



---

---

---

---

---

---

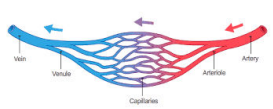
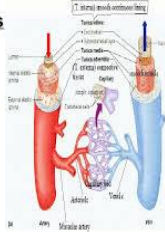
---

---

# Vascular System

## Blood Vessels

- Aorta →
- Arteries →
- Arterioles →
- Capillaries →
- Venules →
- Veins →
- Vena Cavae



---

---

---

---

---

---

---

---

---

---

# Insufficiency and Related Tissue Damage

- Arterial insufficiency is term for a decrease in blood getting to the extremities
- Often associated with trauma, acute embolism, rheumatoid arthritis, and diabetes
  - Ischemia is also common in other diseases such as sickle cell disease, Buerger's disease (thrombangiitis obliterans), Raynaud's disease, etc.
- Most common cause is arteriosclerosis
  - Thickening and hardening of arteries
  - Typically caused by atherosclerosis
    - "Systemic, degenerative disease process in which the arterial lumen is gradually and progressively encroached upon"
    - Cholesterol sticks to vessel walls, causing plaques
    - This leads to narrowing of the artery, thus causing increased impedance to blood flow and decreased overall blood flow

---

---

---

---

---

---

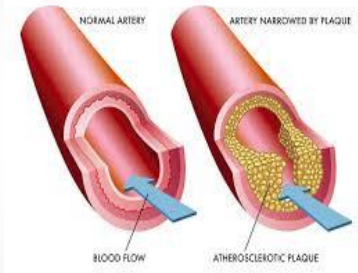
---

---

---

---

## ATHEROSCLEROSIS



---

---

---

---

---

---

---

---

---

---

# Peripheral Arterial Disease

- Sequelae of this disease include:
  - Intermittent Claudication
  - Nocturnal Pain
  - Rest Pain
  - Ulceration and Gangrene

---

---

---

---

---

---

---

---

# Intermittent Claudication

- Activity-dependent
- Pain from this is characterized by cramping or aching sensation while ambulating
- This is relieved by resting
- Pain occurs most often in calf
  - However, if occlusion occurs higher up, patient can complain of pain in buttocks and upper thigh
- Symptoms depend on degree of ischemia to which leg muscles are subjected to

---

---

---

---

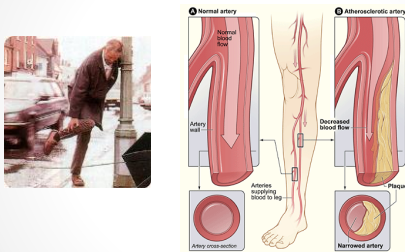
---

---

---

---

# Intermittent Claudication



---

---

---

---

---

---

---

---

## Intermittent Claudication



---

---

---

---

---

---

---

---

## Ischemic Rest Pain

- A progression of the atherosclerosis
- Patients begin to have pain even at rest
- Patients will state it feels better to dangle the leg at night
- 2 types
  1. Nocturnal Pain
  2. Rest Pain

---

---

---

---

---

---

---

---

## Nocturnal Pain

- Form of ischemic neuritis
- Usually precedes rest pain
- Occurs at night as blood flow circulates around core of body and not the extremities
- Pain usually occurs in the toes, across the base of the metatarsals and in the plantar arches
- Pain is relieved with standing, dangling feet over edge of bed and occasionally with walking

---

---

---

---

---

---

---

---

## Rest Pain

- Caused by increased nerve ischemia due to arterial insufficiency
- Pain is worse at night and usually requires narcotics to treat pain
- Pain decreased by dependency of lower extremities and is increased by heat, elevation, and exercise
- Usually seen with at least 2 significant arterial occlusions
- Patients with rest pain will usually have an ABI of less than 0.5mm Hg (will discuss ABI in future slides)

---

---

---

---

---

---

---

---

## Ulceration

- When arterial disease has become its most severe, ischemic ulcers occur
  - Tissue demand for blood exceeds the supply
- These are generally seen on distal portions of foot, toe or heel and are exquisitely painful
  - Commonly result from ill-fitting shoes, positional pressure, or shearing in medically compromised patients
- Ulcers generally do not bleed and often have necrotic rim or crater
- Pain can be relieved by dependence of limb

---

---

---

---

---

---

---

---

## Dry vs. Wet Gangrene

**Dry Gangrene:** "Dead tissue that is dry, dark, cold and contracted when compared similar areas or the contralateral side." Typically seen with arterial insufficiency and is a slow progression.

**Wet Gangrene:** Shows there is some type of infection going on. More frequently seen in diabetics. Typically advances very quickly



Dry Gangrene



Wet Gangrene

---

---

---

---

---

---

---

---

# Risk Factors Contributing to Arterial Insufficiency

- Some of these risk factors cannot be modified but many of them are easily modified
  - **Hyperlipidemia:** High cholesterol in blood leads to more plaque being deposited in blood vessels
  - **Smoking:** #1 modifiable risk factor
    - Causes vasoconstriction → decreased tissue perfusion
    - Decreases amount of oxygen available
    - Increased rate of clot formation and thickens blood
    - Enhances the effect of hyperlipidemia
  - **Diabetes:** Increased risk of calcium deposits; may not always consider arterial insufficiency in these patients because they don't have the sensation to sense ischemic pain
  - **Hypertension:** Increased pressure of the blood flow damages the delicate endothelial cells
  - **Trauma:** Common causes of arterial ulcers
  - **Advanced Age:** Less able to adapt to changes in oxygen demands

---

---

---

---

---

---

---

---

---

---

# Vascular Testing- Introduction

- If, after you have done your thorough history taking and have palpated and observed your patient's lower extremities thoroughly and you suspect a vascular issue, more objective testing must be done
- Vascular testing can be invasive or non-invasive
  - Some of non-invasive techniques we can do as physical therapists
    - Pulses
    - Ankle Brachial Index, Segmental Pressures
    - Transcutaneous Oxygen Pressures
    - Will not discuss these in class:
      - Trendelenburg's Test
      - Rubor of Dependency
      - Venous Filling Time

---

---

---

---

---

---

---

---

---

---

# Arterial System



---

---

---

---

---

---

---

---

---

---

## Grading Pulses

- Important to check both involved and uninvolved side
- Should assess these:
  - Femoral
  - Popliteal
  - Posterior tibial
  - Dorsalis pedis
    - Lack of posterior tibial is more accurate than lack of dorsalis pedis but a lack of both demonstrates peripheral arterial disease
- How to describe pulses
  - 0 = Absent pulse
  - 1+ = Diminished pulse
  - 2+ = Normal pulse(easily felt)
  - 3+ = Bounding or accentuated pulse
- If pulse is absent, need to do more in-depth testing

---

---

---

---

---

---

---

---

## Doppler Ultrasound

- Use of a Doppler to detect pulses that are not easily palpable
- Use ultrasound gel for coupling
- Place probe at 45-degree angle to skin and listen for "swooshing" sound
- If you cannot hear sound, there is no blood being moved and thus no perfusion

---

---

---

---

---

---

---

---

## Ankle Brachial Index(ABI)

- If you determine a patient to have diminished or absent pulses, you will then need to perform an ankle brachial index
  - Reliable, sensitive non-invasive test of blood flow
- New recommendations are to perform an ABI on anyone with a lower extremity ulcer to rule out arterial involvement
- ABI should also be performed prior to any compression is given for venous insufficiency
  - If patient already has compromised arteries and you compress them further, you will cause increased problems with blood flow.

---

---

---

---

---

---

---

---



## Ankle Brachial Index

- Measures the systolic blood pressure in the ankles and helps determine presence of arterial occlusive disease
  - Lower the number, more likely there is arterial insufficiency
- Equipment needed: Doppler ultrasound, blood pressure cuff and ultrasound gel

---

---

---

---

---

---

---

---

## ABI Procedure

1. Lay patient flat and have patient rest for 10-15 minutes
2. Apply BP cuff around patient's arm
3. Apply ultrasound gel
4. Hold Doppler probe at 45 degree angle and place over brachial pulse
5. Identify arterial signal and inflate cuff until signal disappears
6. Slowly deflate cuff until signal reappears. This is your brachial systolic pressure
7. Obtain brachial pressure in BOTH arms. Take the higher of the two pressures for your brachial pressure.
8. To obtain ankle pressures, place cuff above the ankle and place Doppler probe over the dorsalis pedis or the posterior tibial artery.
9. Repeat steps 3 to 6 for other leg.

---

---

---

---

---

---

---

---

## Calculating the ABI

- $$\text{ABI} = \frac{\text{Highest ankle Doppler Pressure}}{\text{Highest brachial Doppler Pressure}}$$
- **1.0 is normal value** (0.9-1.1 normal range)
- Significance of ABI Values
  - ABI  $\leq 0.5$ : Refer to vascular surgeon, compression contraindicated
  - ABI 0.5 to 0.7: May be accompanied by intermittent claudication, Refer to vascular surgeon, compression contraindicated
  - ABI 0.7-0.9: Mild peripheral arterial occlusive disease, compression therapy with caution
  - ABI  $> 1.0$ : Referral to vascular surgeon; Indicates calcified vessels if diabetic

---

---

---

---

---

---

---

---

# Ankle Brachial Index




---

---

---

---

---

---

---

---

## ABI Interpretation

ABI	Interpretation	Possible Vascular Intervention
1.1-1.3	Vessel Calcification	ABI is not a valid measure of tissue perfusion
0.9-1.1	Normal	None needed
0.7-0.9	Mild to moderate arterial insufficiency	Conservative interventions normally provide satisfactory wound healing
0.5-0.7	Moderate arterial insufficiency, intermittent claudication	May perform trial of conservative care, physician may consider revascularization
<0.5	Severe arterial insufficiency, rest pain	Wound is unlikely to heal without revascularization, limb-threatening arterial insufficiency
<0.3	Rest pain and gangrene	Revascularization or amputation

---

---

---

---

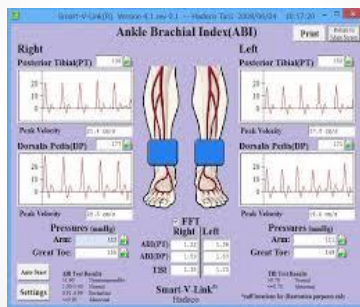
---

---

---

---

## ABI Interpretation




---

---

---

---

---

---

---

---

## Calculating the ABI(example)

- Your patient's Right brachial pressure is 180
- His Left Brachial pressure is 170
- His involved ankle pressure is 120  
 $120/180 = 0.67$
- What will you do? Will you do compression therapy for this patient?

---

---

---

---

---

---

---

---

## Diabetics and ABI's

- ABI values can be falsely elevated in diabetics due to an inability to compress their arteries
- Diabetics develop calcifications in their arteries which makes it difficult to obtain accurate ABI
- So, if you are sure there is an arterial involvement in a patient with DM and their ABI comes back 1.0 or greater, you still will need to refer to vascular surgeon.
- Don't be fooled!

---

---

---

---

---

---

---

---

## Segmental Pressure Measurements

- Vascular labs do more in-depth studies, looking at Doppler pressures at different levels of the legs. This can give an indication where a blockage may be occurring
- Similar to ABI but you do at different segments of the leg
  - Dorsalis pedis/posterior tibial
  - Above the malleoli
  - Below the knee
  - Around the thigh
- Can help determine where the occlusion or narrowing is occurring
- Toe pressures are also done in the vascular lab, especially important for diabetics

---

---

---

---

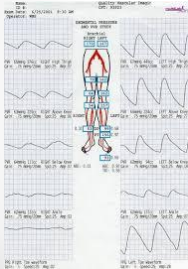
---

---

---

---

## Segmental Pressure Measurements



---

---

---

---

---

---

---

---

## Transcutaneous Oxygen Measurements(tcPO<sub>2</sub>)

- Measures oxygen delivery to skin tissue
- Useful in predicting ulcer healing
- Documents the hypoxemia characteristic of ischemic tissue
- Sensor is placed over skin for 20 minutes and then reading is taken
- Less than 20mmHg, wound will not heal.
- 30mmHg or greater, healing will occur
- If low, refer to vascular surgeon
- Test not reliable in patients with swelling or infection

---

---

---

---

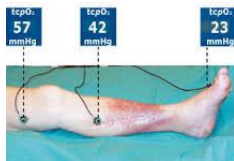
---

---

---

---

## Transcutaneous Oxygen Measurements(tcPO<sub>2</sub>)



---

---

---

---

---

---

---

---

## When to refer to a Vascular Surgeon?

- No need for vascular consult:
  - ABI greater than 1.0 and tcPO2 measurement greater than 30mmHg
  - ABI greater than 0.8 and wound healing well
- Semiurgent vascular consult:
  - ABI between 0.5-0.8
  - ABI less than 1.0 with diminished or absent pulses
  - Non-healing wound despite 3+ pulses and good wound care
- Urgent Vascular Consult:
  - Gangrene present
  - ABI below 0.6
  - Exposed bone or tendon at base of ulcer
  - Gross infection or cellulitis
- **When in doubt, refer out!**

---

---

---

---

---

---

---

---

## Classification and Characteristics of Arterial Ulcers

- Pain: Usually severe; worse with elevation
- Position: Typically distal toes, dorsal foot or if trauma has occurred
- Presentation: Pale granulation bed; Eschar or gangrene. Minimal drainage
- Periwound and structural changes: Shiny, dry skin; lack of hair growth; thickened nails; Cyanotic skin
- Pulses: Decreased or absent
- Temperature: Cool

---

---

---

---

---

---

---

---

## Prognosis

- Depends on severity of arterial disease
- Also depends on severity of sequelae of disease
  - How bad is the wound
  - How bad is the atherosclerotic pain

---

---

---

---

---

---

---

---

# Management of Arterial Wounds

- Concept is simple!
  - Must increase perfusion to extremity/ulcer site
- Wound Care Precautions
  - Debridement of gangrene contraindicated in the presence of ischemia until blood flow restored
  - Avoid compression
- Moist wound healing applies to ulcers with adequate blood supply
  - However, there is no real consensus on what type of dressing to use
    - A meta-analysis by Broderick et al published in 2020 cited there is "insufficient evidence to determine whether the choice of topical agent or dressing affects the healing of arterial leg ulcers."

[\\*https://pubmed.ncbi.nlm.nih.gov/31978262/](https://pubmed.ncbi.nlm.nih.gov/31978262/)

---

---

---

---

---

---

---

---

# Physical Therapy Interventions

- Similar to other PT interventions
  - Therapeutic Exercise
  - Gait and Mobility training
  - Patient positioning
  - Aerobic exercises
    - In 2017, CMS issued a decision memorandum to support health insurance coverage of 12 weeks of supervised treadmill exercise for patients with walking impairment due to PAD\*\*
  - Resistive exercises
- Flexibility exercises
- Physical agents/Modalities
  - Therapeutic heat
- Proper footwear
- Education of patient and family
  - Foot Care Guidelines
- Coordination with other ancillary services
  - Vascular surgery
  - Endocrinology
  - Dietician
  - Counselor or behavioral psychologist

[\\*https://pubmed.ncbi.nlm.nih.gov/28874320/](https://pubmed.ncbi.nlm.nih.gov/28874320/)

---

---

---

---

---

---

---

---

# Medical Intervention

- Interdisciplinary
- Tests to be performed:
  - Plethysmography and duplex scanning
  - Toe pressures: Similar to ABI but looks at pressure in toes
  - Arteriography: Dye is injected into artery to look at blood flow
- Need for vascular consultation:
  - Absence of both dorsalis pedis & posterior tibial pulses
  - ABI < 0.9, plus any of the following:
    - No ulcer improvement w/ 2-4 weeks of treatment.
    - Intermittent claudication
    - TcPO2 < 30 mm Hg
    - Clinical Signs & Symptoms of infection
- NEED FOR URGENT CONSULTATION:
  - ABI < 0.4 and gangrene

WOCN guidelines, 2003

---

---

---

---

---

---

---

---

## Medical Intervention (Interdisciplinary)

### Education on Management of Risk Factors:

- Smoking cessation
- Exercise program – walking to near maximal pain 3x's per week
- Lipid control – If patient has high cholesterol, Niacin often prescribed
- Glycemic control if diabetic
- Nutrition: L-arginine – increases pain-free ambulation and vasodilatation of femoral artery

---

---

---

---

---

---

---

---

## Pharmacological Interventions for pain

- Pain management plays huge role in treating these patients
- Some medication may be aimed at improving circulation
- Sympathetic blocks may also help with pain

---

---

---

---

---

---

---

---

## Surgical Intervention

- Debridement: But only once revascularized
- Revascularization: Bypass surgery
  - "First identifying the most distal segment with normal blood flow and the occluded artery segment , then choosing a new conduit, or bypass to replace the diseased segment"
  - <https://www.youtube.com/watch?v=bwKmlCodJo>
- Percutaneous balloon angioplasty
  - May involve use of balloons to open arteries or place stents
  - <https://www.youtube.com/watch?v=UOXQbF3K56g>
- Amputation
  - Last resort; after many attempts to revascularize
  - "Level of amputation determined by most distal satisfactorily perfused arteries and the patient's future mobility"

---

---

---

---

---

---

---

---

## Examples of Arterial Ulcers



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---





---

---

---

---

---

---

---

---

## Take Away Points

- Most common cause of arterial insufficiency is arteriosclerosis/atherosclerosis but can also be caused by trauma, acute embolism
- Signs of Arterial Insufficiency from least to most severe:
  - Intermittent claudication
  - Ischemic rest pain
  - Nocturnal pain
  - Rest pain
  - Ulceration: Typically distal portions of foot, toe or heel; very dry; pain relieved by dangling leg
- Risk Factors
  - High cholesterol, smoking, diabetes, hypertension, trauma, age
- Testing
  - Pulses
  - ABI/Segmental Pressures
- Management
  - Most important, surgical intervention → know when to refer
  - Pain management
  - Exercise/Ambulation as tolerated

---

---

---

---

---

---

---

---

## Summary

- Arterial Insufficiency caused by atherosclerosis
- Many risk factors contribute to arterial insufficiency
  - Those that can be modified should be big focus of treatment of disease
- Many tests available to test for adequate blood flow
- Important to treat patient to restore blood flow prior to treating wound itself
  - Without adequate blood flow, cannot heal wound despite the best wound care
- <https://www.youtube.com/watch?v=l4jxjWlbWvg>  
Good review of Peripheral Vascular Disease

---

---

---

---

---

---

---

---

# Venous Insufficiency Ulcers: Introduction

- 70% to 90% of all leg ulcers
- Afflicts 1% of general population and 3.5% of those over 65 with recurrence rate of 70%
- Approximately 150,000 new patients diagnosed each year
  - Nearly \$500 million is used to treat these patients(Patel and Surowiec, 2019)\*
- Women affected 3 times more than men
- Up to 26% of patients with venous ulcers have concomitant arterial disease
- The annual expenditure to treat a venous ulcer is estimated at \$10,563. For chronic, nonhealing venous ulcers, the treatment expenditure is estimated to be ~\$34,000 or higher.\*\*

\*<https://www.ncbi.nlm.nih.gov/books/NBK430975/>

\*\*<https://www.liebertpub.com/doi/10.1089/wound.2019.0946>

---

---

---

---

---

---

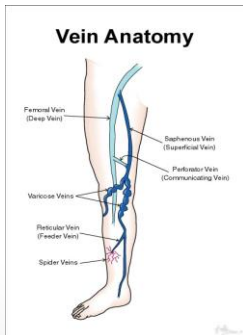
---

---

---

---

# Venous System



---

---

---

---

---

---

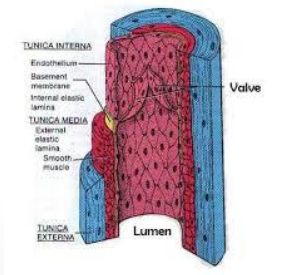
---

---

---

---

# Anatomy of a Vein



---

---

---

---

---

---

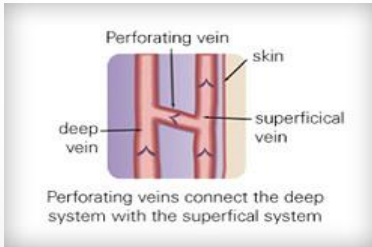
---

---

---

---

# Venous System



---

---

---

---

---

---

---

---

# Venous System Overview

- Low pressure system that carries blood from extremities back to the heart
- Anatomy of vein similar to anatomy of artery
  - 3 layers: Outer tunica externa, middle tunica media, and inner intimal layer
  - Except veins have valves preventing backsliding of blood and thinner layers, making veins able to expand more than arteries
- 3 types of veins
  - Deep: Femoral, popliteal and tibial; parallel arteries
  - Superficial: Greater and lesser saphenous veins; Located in subcutaneous tissue. Drain blood from skin and subcutaneous tissue and helps in temperature regulation
  - Perforating: Perforates the fascia; Connect deep and superficial veins

---

---

---

---

---

---

---

---

# Venous System Overview

- Major difference from arteries, veins have bicuspid valves that only allow blood flow towards heart;
  - Valves prevent retrograde blood flow, thus decreasing increased venous backpressure, or **venous hypertension**
- Since pressure in veins is so low, the body relies on 2 pumps to assist with blood flow to heart
  - Respiratory Pump: Powered by breathing
  - Calf Muscle Pump: Powered by ambulation or calf muscle contractions. Helps push the blood towards the heart

---

---

---

---

---

---

---

---

# Function of the Venous Pump

- Calf muscle contracts, pumping blood from lower extremity via veins with one-way valves
- When valves are incompetent, it allows blood to leak back down into interstitial space, thus causing edema and hemosiderin staining

---

---

---

---

---

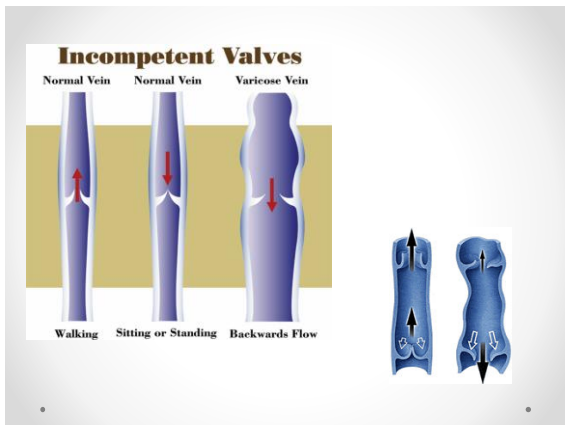
---

---

---

---

---




---

---

---

---

---

---

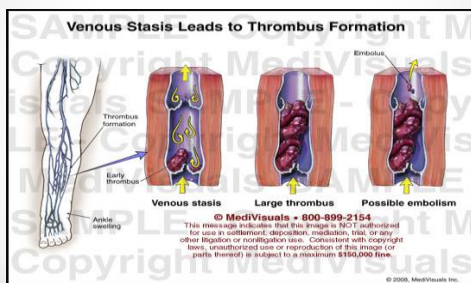
---

---

---

---

# Venous Stasis




---

---

---

---

---

---

---

---

---

---

## Etiology of Venous Insufficiency and Associated Tissue Damage

- Mechanism behind these ulcers is poorly understood
- **Sustained venous hypertension** is common factor in all patients with venous insufficiency ulcers.
- First common complaint is swelling of legs which can be accompanied by discomfort and feeling of heaviness in legs
  - This is relieved by elevation

---

---

---

---

---

---

---

---

## Etiology

- Primary
  - Symptomatic presentation without a precipitating event
  - 70% of patients
- Secondary (trauma, birth control pill)
  - Usually follows an episode of acute deep vein thrombosis
  - 30% of patients
- Congenital
  - Venous malformation at birth
  - Klippel-Trenaunay Syndrome
    - Rare congenital vascular disorder in which a limb is affected by port wine stains (red-purple birthmarks involving blood vessels), varicose veins, and/or too much bone and soft tissue growth (<https://my.clevelandclinic.org/health/diseases/17152-klippel-trenaunay-syndrome-kt>)
- No known cause

---

---

---

---

---

---

---

---

## Pathophysiology

- Increase hydrostatic pressure  $\Rightarrow$  venous hypertension  $\Rightarrow$  dermal ulceration
- Disorders associated with or capable of inducing venous disease
  - **Thrombosis of deep venous system**
  - **Postphlebitic syndrome**
  - CHF
  - Incompetent valves
  - Obesity
  - Pregnancy
  - Superficial vein regurgitation
  - Muscle weakness

---

---

---

---

---

---

---

---

## Pathophysiology

- All increase venous pressure resulting in edema and ulceration
- Research by Browse and Burnand in 1982 reputed early theory of insufficiency of blood being the primary culprit in development of venous ulcers.
  - Instead, they found excessive pressure may provoke extravasation of erythrocytes and fibrinogen (increase in vascular permeability) resulting in **fibrin cuffs** developing at the capillary level leading to cellular dysfunction and cell death and skin ulceration

---

---

---

---

---

---

---

---

## Pathophysiology

- Recent years new additional theory suggests a "**white blood cell-trapping theory**" where an accumulation of white blood cells block the capillaries resulting in local ischemia and inflammatory process
- Why venous ulcers are often called "venous stasis"
- Contributing factors
  - Malnutrition
  - Hypoalbuminemia
  - Immobility
  - Trauma

---

---

---

---

---

---

---

---

## Risk Factors Contributing To Venous Ulceration

- Anything that causes sustained venous hypertension can cause venous insufficiency related tissue damage
  - **Vein Dysfunction:** Blood clots can damage veins. Varicose veins are dilated veins often caused by congestive heart failure, pregnancy, obesity and tight clothing
  - **Calf Muscle Pump Failure:** Anything that affects the contraction of the calf muscle. Immobility or prolonged standing in one place.
  - **Trauma:** Fluid is pooling in interstitial space so any opening in the skin from trauma will allow a place for that fluid to leak out
  - **Previous Venous Insufficiency Ulcer:** Recurrence rates ~81%. Often due to patient noncompliance
  - **Advanced Age:** Valve degeneration and normal age-related skin and tissue changes
  - **Diabetes:** Increased risk of microvascular disease and impaired immune response

---

---

---

---

---

---

---

---

## Physical Therapy Tests and Measures for Venous Insufficiency

- Some of these we already discussed with arterial insufficiency ulcers and can help identify venous insufficiency as well.
- Clinical Assessment for DVT: Gold standard is venogram or ultrasound. However, we can use the Homan's sign to screen a patient for DVT
- ABI: Common to see mixed ulcers with both arterial and venous involvement. Must make sure patient has good blood flow before initiating compression therapy
- Doppler Ultrasound: More subjective test; need to interpret changes in sound you are hearing.

---

---

---

---

---

---

---

---

## Classification

- Clinical-Etiology-Anatomy-Physiology (CEAP): How venous disease is classified based on severity

Classification	Description
C0	Asymptomatic
C1	Telangiectasias or spider veins <3 mm
C2	Varicose veins > or = 3 mm
C3	Leg edema, no skin changes
C4	Skin and subcutaneous tissue changes <ul style="list-style-type: none"> <li>• C4A: Hemosiderin deposition</li> <li>• C4B: Lipodermatosclerosis</li> </ul>
C5	Healed venous ulcer
C6	Current venous ulcer

---

---

---

---

---

---

---

---

## Characteristics

- 5PT:
  - Pain: Usually mild; Better with elevation and compression
  - Position: Medial malleolus, medial lower leg, areas of trauma
  - Presentation: Irregular shape, red granular base, may have slough or fibrin, large amount of drainage
  - Periwound: Dermatitis or cellulitis often seen
    - Hemosiderin Staining: Hemosiderin is by-product of breakdown of RBC that leaks into interstitial space, thus staining the skin
    - Lipodermatosclerosis: "Hyperpigmentation and accompanying erythema, induration and plaque-like structural changes that occur due to long-standing venous insufficiency"
  - Pulses: Normal typically; may be decreased due to edema or concomitant arterial disease
  - Temperature: Normal to mild warmth

---

---

---

---

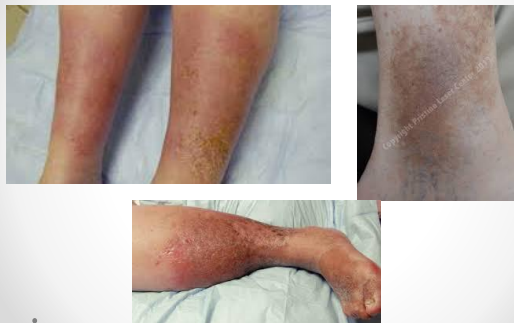
---

---

---

---

## Hemosiderin Staining



---

---

---

---

---

---

---

---

## Lipodermatosclerosis



---

---

---

---

---

---

---

---

## Prognosis

- Again depends on severity of disease and how long the patient has been living with it
- Biggest factor in how well patients will heal and stay healed is use of compression
  - This is a long-standing diagnosis and needs lifelong treatment with compression
- VLU also has a high, 50-70% recurrence rate\*,
  - May be linked to:
    - \*Noncompliance with compression therapy
    - Failure of surgical procedures
    - Incorrect ulcer diagnosis.
    - Progression of venous disease.
    - Poorly understood pathophysiology\*\*

\*<https://pubmed.ncbi.nlm.nih.gov/33374372/>

---

---

---

---

---

---

---

---



## Goals of Treatment of Venous Insufficiency Ulcers

1. Decrease venous pressure
2. Decrease edema & prevent reoccurrence
3. Optimize wound healing environment
4. Prevent recurrence due to chronic nature of disease

---

---

---

---

---

---

---

## Physical Therapy Interventions

- Similar to other PT interventions
  - Education of patient and family
    - Guidelines
      - Control swelling
      - Protect feet and legs
      - Live healthy
      - When to call physician/clinician
  - Coordination with other ancillary services
    - Vascular surgery
    - Infectious disease
    - Dietician
- Precautions for treating Venous Insufficiency Ulcers
  - Concomitant arterial disease
  - Allergic reactions and sensitization
  - Inappropriate whirlpool use
    - Places limb in dependent position, thus increases edema
    - Increased temperature also increased edema
    - Adds moisture to an already wet wound
    - Increased risk of infection if whirlpools not properly cleaned

---

---

---

---

---

---

---

## Local Wound Care

- Protect periwound from excess moisture
- Absorb drainage
- Provide compression to assist with venous return
- Educate patient and family

---

---

---

---

---

---

---

## Team Intervention

- Compression therapy
- Pharmacologic
- Moist wound therapy while controlling exudate
- Periwound care
- Leg elevation
- Exercise
- Pain management
- Patient education

---

---

---

---

---

---

---

---

## Compression Therapy

- Works with exercise to facilitate movement of fluid from lower extremity back to heart
- Depending on patient's need for vascular support, different levels of compression are available
- For venous disease, ~40mm Hg is needed; however, this is only for those who are ambulatory and able to work the calf muscles
  - In non-ambulatory patients, lower compression is better tolerated

---

---

---

---

---

---

---

---

## Compression Therapy

- Be cautious when placing compression therapy on patients with ABI's less than 0.8 as this is suggestive of arterial disease
  - Recommendations:
    - ABI 0.8-1.0, use high compression(40-50mm Hg)
    - ABI 0.5-0.8, use light compression(18-24mm Hg)
      - -Use extreme caution; some experts say any compression is contraindicated in this population
    - ABI 0.5 or below, compression is contraindicated
- Elastic bandages are relatively easy to apply, inexpensive and easily removed
- Usually removed at night

---

---

---

---

---

---

---

---

## Different types of Compression Therapy

- **Paste Bandages:** Also called Unna boots; Consists of fine gauze impregnated with zinc oxide, gelatin and glycerin. Some may also have calamine. Applied without tension in circular fashion from base of toes to fibular head. Does not apply compression but simply does not allow the foot and leg to swell any further. Must be changed every 7-10 days.
- **Short-Stretch Compression Wraps:** Used most frequently in Europe. Used frequently in lymphedema therapy
- **Multilayer bandages:** Provides graduated, sustained compression through series of layers providing protection, padding and compression. Can be changed weekly. Examples are Coban 2, ProFore and FourPress

---

---

---

---

---

---

---

---

## Paste Bandages



---

---

---

---

---

---

---

---

## Unna Boot



---

---

---

---

---

---

---

---

## Short Stretch Bandages



---

---

---

---

---

---

---

---

## Multilayer Compression Bandage Systems



---

---

---

---

---

---

---

---

## Coban 2

3M™ Coban™ 2 Layer Compression System  
Full Leg Application



---

---

---

---

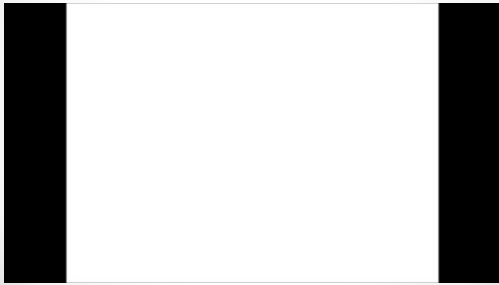
---

---

---

---

## ProFore



---

---

---

---

---

---

---

---

## More Compression Therapy

- CircAid: Non-elastic, adjustable garment. Consists of a legging with interlocking, non-elastic bands and Velcro fasteners that surround the leg. Can adjust bands as edema increases or decreases, providing constant compression. Will have brochure available in lab.
- Tubular bandages: Give light compression; must be tapered at ankle so more compression is given at ankle than at calf

---

---

---

---

---

---

---

---

## Circ-aid



---

---

---

---

---

---

---

---

## Circ-aid



---

---

---

---

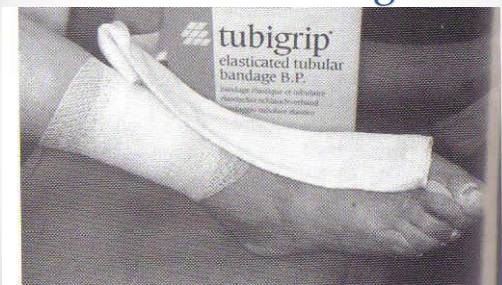
---

---

---

---

## Tubular Bandage



---

---

---

---

---

---

---

---

## Graduated Compression Stockings

- Assists venous return by reducing edema.
- Client is measured and fitted for compression stockings when edema is absent or minimal.
- Can be difficult to don.
- Needs frequent replacement as elasticity is lost and adequate amount of compression is not sustained.

---

---

---

---

---

---

---

---

## Graduated Compression Stockings



---

---

---

---

---

---

---

---

- Compression Pump Therapy: Consists of leg sleeve with 3-, 5- or 10-chambers with peak pressures of 45-60 mm Hg. Inflates first at ankle, then works up to thigh. Can be done 1-2 hours twice a day. Should be followed by application of compression bandage or garment.
- With all compression therapy, close monitoring of patients with congestive heart failure should be done due to increased intravascular fluid burden

---

---

---

---

---

---

---

---

## Compression Pump



<https://www.youtube.com/watch?v=MWjGo-eXiUU>

---

---

---

---

---

---

---

---

## Therapeutic Exercises

- Very important in venous insufficiency that the patient exercises due to calf muscle pump
  - Ankle pumps, heel raises
  - Therapeutic exercises that target ankle plantar flexors
    - Improve strength and calf muscle efficiency
  - Gastrocnemius and soleus stretching
- Aerobic exercise also important to help with weight loss

---

---

---

---

---

---

---

---

## Surgical Intervention

- Debridement of wound
- Skin Grafting and Skin Substitutes
- Vein Surgery
  - Ligation: Tying off of veins to decrease venous hypertension
  - Vein Stripping: Fibrose dysfunctional veins with injection of fluid. Also helps decrease venous hypertension
  - Endoscopic surgery: Improves venous reflux and lipodermatosclerosis
  - Ultrasound for ablation of perforator veins
- FOOD FOR THOUGHT: If perforator system is affected, surgery can be successful. If deep vein system affected, probably not.

---

---

---

---

---

---

---

---

This video is intended for informational purposes only and should not be construed as medical advice, or relied upon as a substitute for medical advice from a health care provider.

---

---

---

---

---

---

---

---



# Examples of Venous Stasis Ulcers



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---

## Take Away Points

- Veins have valves which, when healthy, prevent backsliding of blood
- Problem when people have incompetent valves which leads to edema in legs and often venous insufficiency ulcers
- Risk Factors
  - Vein dysfunction, calf muscle pump failure, trauma, previous ulcers, advanced age, diabetes, obesity, pregnancy, previous DVT
- Classification: CEAP
- Treatment
  - COMPRESSION is Gold Standard
  - Ulcer management
  - Exercise
  - Weight loss
  - Surgical intervention

---

---

---

---

---

---

---

---

## Summary

- Venous insufficiency most common type of lower extremity wounds
- Many different risk factors for venous insufficiency
- Life-long commitment to treatment of venous insufficiency with compression therapy

---

---

---

---

---

---

---

---

## Mixed Etiology Wounds

- Combination of arterial and venous insufficiency
- Makes treatment difficult because treatment for venous ulcer is contraindicated in presence of significant arterial disease
- ESSENTIAL these patients are evaluated by a vascular surgeon before any type of compression is applied
- Does not mean NO compression but means that less aggressive compression must be used and close monitoring of limb to prevent worsening of arterial disease

---

---

---

---

---

---

---

---

# Mixed Etiology Wounds



[https://www.researchgate.net/figure/Clinical-presentation-of-mixed-arteriovenous-leg-ulcers-of-the-left-lower-leg\\_fig2\\_322152815](https://www.researchgate.net/figure/Clinical-presentation-of-mixed-arteriovenous-leg-ulcers-of-the-left-lower-leg_fig2_322152815)

<https://evtoday.com/articles/2017-may/ischemic-and-venous-wound-identification-what-we-look-for>

---

---

---

---

---

---

---

---

## Conclusion

- Important to understand the difference between arterial and venous insufficiency/ulcers as the treatment is completely different
- Not ruling out arterial disease prior to compression can lead to potential amputation so imperative to do vascular studies prior to compression
  - This does not mean simply checking pulses because patient may have a palpable pulse but still have atherosclerosis and inadequate blood flow to limb
- Once arterial insufficiency is ruled out or a vascular surgeon has advised you on what level of compression a patient can tolerate, then compression is the **GOLD STANDARD** for treating venous insufficiency ulcers
  - This is a life long diagnosis and it is imperative patients continue to wear compression stockings and/or use compression pumps or their venous wound will recur

---

---

---

---

---

---

---

---



## Questions?

[jgard86037@aol.com](mailto:jgard86037@aol.com)

Thank you!

---

---

---

---

---

---

---

---

## References

- Bolton, L. (2019). Exercise and chronic wound healing. *Wounds*, 31(2), 65-67. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/30694211/>.
- Broderick, C., Pagnamenta, F., & Forster, R. (2020). Dressings and topical agents for arterial leg ulcers. *Cochrane Database of Systematic Reviews*, 1(1). Retrieved from <https://pubmed.ncbi.nlm.nih.gov/31978262/>.
- Grey, J.E., Harding, K.G. (2006). Venous and arterial leg ulcers. *BMJ*, 332(7537), 347-350. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1363917/>.
- Lawrence, P.F., Hager, E.S., Harlander-Locke, M.P., Pace, N., Jayaraj, A., Yohann, A., Kabbaugh, C., Marston, W., Kabnick, L., Saqib, N., Paulol, S., Piccolo, C., Kiguchi, M., Peralta, S., & Molegnahtali, R. (2020). Treatment of superficial and perforator reflux and deep venous stenosis improves healing of chronic leg ulcers. *Journal of Vascular Surgery: Venous and Lymphatic Disorders*, 8(4), 601-609. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/32089497/>.
- McDermott, M.M. (2017). Exercise training for intermittent claudication. *Journal of Vascular Surgery*, 66(5), 1612-1620. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/28874320/>.
- Raffetto, J.D., Ligi, D., Maniscalco, R., Khalil, R.A., & Mannello, F. (2020). Why venous leg ulcers have difficulty healing: Overview on pathophysiology, clinical consequences, and treatment. *Journal of Clinical Medicine*, 10(1), 29. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/33374372/>.
- Ren, S.Y., Liu, Y.S., Zhu, G.J., Liu, M., Shi, S.H., Ren, X.D., Hao, Y.G., & Gao, R.D. (2020). Strategies and challenges in the treatment of chronic venous leg ulcers. *World Journal of Clinical Cases*, 8(21), 5070-5085. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/33269244/>.
- Sen, C.K. (2019). Human wounds and its burden: An updated compendium of estimates. *Advances in Wound Care*, 8(2), 39-48. Retrieved from <https://doi.org/10.1089/wound.2019.0946>.