Edema: What We Should Know, What Should We Do?

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Massive Edema

Edema

- Is the presence of abnormally large amounts of fluid in the intercellular tissue spaces of the body, usually the subcutaneous tissues.
- Can occur in any tissue of the body
- Fluid contains low levels of protein
- Fluid containing high levels of protein—lymphedema
Why Worry About Edema?

- Sign of an important systemic condition
- Impairs local cell nutrition
- Is painful
- Gives rise to impaired mobility
- Increases risk of infection (cellulitis)
- Results in blistering of the skin and ulcers


Complications of Edema

- Cellulitis
- Edema With Blisters

Why Is Edema Important?

- Can be seen in 1 in 200 people > age 65
- 80% of patients have missed work because of edema
- 9% have changed employment status as a result of edema

Etiology of Edema

- The diagnosis of edema is the disease that causes it
- >90% of patients, diagnosis can be determined by history and physical exam
- 10% of patients with edema need laboratory exam or radiologic studies for diagnosis

Causes of Edema

<table>
<thead>
<tr>
<th>Bilateral</th>
<th>Unilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cardiac disease</td>
<td>1. Venous disease</td>
</tr>
<tr>
<td>2. Renal disease</td>
<td>2. Arterial disease usually A-V fistulae</td>
</tr>
<tr>
<td>3. Hepatic disease</td>
<td>3. Lymphatic disease</td>
</tr>
<tr>
<td>4. GI disease</td>
<td>4. Operations</td>
</tr>
<tr>
<td>5. Immune disease and allergy</td>
<td>5. Trauma</td>
</tr>
<tr>
<td>7. Endocrine disease</td>
<td></td>
</tr>
<tr>
<td>8. Pregnancy</td>
<td></td>
</tr>
<tr>
<td>9. Circulatory problems usually vena cavales obstruction</td>
<td></td>
</tr>
<tr>
<td>10. Drugs and medications</td>
<td></td>
</tr>
<tr>
<td>11. Inactivity and dependency of legs</td>
<td></td>
</tr>
</tbody>
</table>

Acute Post Op Wound (ORIF of Leg Fracture) with Edema and Lymphedema

Note Pitting!
Drugs Causing Edema

- Calcium channel blockers
- Hydralazine
- Clonidine
- Minoxidil
- Reserpine
- Beta-blockers
- Cilostazol
- Gabapentin
- Pregabalin (Lyrica)
- Corticosteroids
- Estrogen
- Progesterone
- Tamoxifen
- Testosterone
- MAO-inhibitors
- Non-steroidal anti-inflammatory drugs
- Cox-2 inhibitors


Venous Insufficiency

- Chronic ambulatory venous hypertension
- Incompetence of valves in veins
  - Long-standing saphenous, deep venous, and perforator incompetence
  - Local trauma
  - Undetected venous thrombosis
  - Operative injury
- Capillary and venular dilatation
- Calf muscle pump failure


Valvular Incompetence

Angiography

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Venous Hypertension with “Leaky” Vessels

Pericapillary Fibrin in Venous Insufficiency

Pathophysiology of Venous Insufficiency

- Capillary and venular dilatation
- Calf muscle pump failure
- Concentration of pressure at ankle
Capillary Pressures at Ankle

- Arterial end ~ 35-100 mm Hg
- Venous end ~ 8-15 mm Hg (1)
- Pressures increase when person stands—both arterial and venous by average of 100 mm Hg!! (2)


Development of Edema

**Normal Circulation**

<table>
<thead>
<tr>
<th>Venous End</th>
<th>Arterial End</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 mm Hg</td>
<td>35 mm Hg</td>
</tr>
<tr>
<td>~27 Liters/day</td>
<td>~30 Liters/day</td>
</tr>
<tr>
<td>~3 Liters/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lymphatics</td>
</tr>
</tbody>
</table>

**Increased Arterial Pressure**

<table>
<thead>
<tr>
<th>Venous End</th>
<th>Arterial End</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 mm Hg</td>
<td>135 mm Hg</td>
</tr>
<tr>
<td>~27 Liters/day</td>
<td>&gt;30 Liters/day</td>
</tr>
<tr>
<td>~3 Liters/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lymphatics</td>
</tr>
</tbody>
</table>
Development of Edema

Increased Venous Pressure

Venous End  Arterial End

108 mm Hg < 27 Liters/day > 30 Liters/day
~3 Liters/day
Lymphatics

Development of Edema

Leaky Capillaries

Venous End  Arterial End

8 mm Hg < 27 Liters/day > 30 Liters/day
~3 Liters/day
Lymphatics

Development of Edema

Decreased Lymphatic Flow

Venous End  Arterial End

8 mm Hg ~27 Liters/day ~30 Liters/day
<3 Liters/day
Lymphatics
Complications of Venous Hypertension

- Macromolecules trap growth factors
- Growth factors unavailable to repair or maintain
- Leukocytes accumulate and occlude capillaries
- Activated leukocytes release toxic metabolites
- Free radicals and proteolytic enzymes damage endothelium

Capillary Loss with Venous Hypertension

- Prolonged venous hypertension causes damage to and destruction of capillaries in skin
- Capillary thrombosis results in decreased number of capillaries in skin and wound bed

Venous Disease and Ulceration

Edema and Pigmentation

Lipodermatosclerosis and Ulceration

References:
Chronic Venous Disease and Capillary Density

Examination of the Swollen Lower Extremity

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Medical Conditions</th>
<th>Medicines</th>
<th>Venous Disease</th>
<th>Lymphedema</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes/No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Pitting</td>
<td>Yes</td>
<td>Yes</td>
<td>Early; Late; +/-</td>
<td>No</td>
</tr>
<tr>
<td>Skin Changes</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Yes; Can be severe</td>
</tr>
<tr>
<td>Location</td>
<td>Worse distally</td>
<td>Leg; occasionally foot</td>
<td>Leg; occasionally foot</td>
<td>Varies but worse distally</td>
</tr>
<tr>
<td>Benefit with Elevation</td>
<td>Yes</td>
<td>Yes/No</td>
<td>Yes</td>
<td>Minimal</td>
</tr>
</tbody>
</table>

Edema Severity Scale

<table>
<thead>
<tr>
<th>Depth of Pitting</th>
<th>Scale of Pitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to ¼ inch</td>
<td>1+</td>
</tr>
<tr>
<td>¼ to ½ inch</td>
<td>2+</td>
</tr>
<tr>
<td>½ to 1 inch</td>
<td>3+</td>
</tr>
<tr>
<td>&gt; 1 inch</td>
<td>4+</td>
</tr>
</tbody>
</table>

Treatment of Edema

Elevation of Legs? But how high?

http://www.losethebackpain.com/ inversion3.html Accessed 8/14/12

Treatment of Edema

Compression!
Compression!!

COMPRESSION!!!

Are all compression bandages the same?
**Compression Therapy**

- Short stretch or inelastic
- Elastic
  1. Single layer
  2. Multiple layers
- Higher pressure better than lower pressure

Compression therapy significantly increases healing compared to no compression


**Compartments**

- Tibia
- Anterior Tibial
- Greater Saphenous
- Posterior Tibial
- Skin
- Superficial Posterior
- Posterior Tibial
- Peroneal
- Deep Posterior
- Lesser Saphenous
- Fibula
- Anterior Tibial

**Pressures of Interest**

- Tibialis m.
- Popliteus m.
- Soleus m.
- Gastroc m.
- Popliteus m.
- Tibialis m.
- Peroneus

- Sub-bandage
- Surface
- Contact
- Compression Bandage or Device
- Tissue
- Interstitial
- Intramuscular
- Skin

Dr. HN Mayrovitz
**Resting Pressure**

Pressure (P) due to tension (T) of bandage and the radius (R) of the leg.

Laplace's Law: \( P \approx \frac{T}{R} \)

Superficial vessels affected the most.

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**Working (Dynamic) Pressure**

Muscles contract.

High pressure develops on deeper tissues.

Pressure is from WITHIN.

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**Dynamic Pressure Depends on Bandage Material**

- Form-fitted steel pipe
- Inelastic (short stretch)
- Elastic (long stretch)
- No external compression

Working vs. Resting Pressures
Role of Compression Material

Arterial Flow Pulses
Below Knee Blood Flow via Nuclear Magnetic Resonance

Venous Ulcer
99 year old lady with ulcer for 8 months
ABI - 0.45
Informed that BK amputation was the only therapy
Treated with light compression and bi-layered tissue engineered skin
Wound healed after 47 weeks
Types of Compression Therapy

Unna’s Boot

*The original short stretch compression wrap*

2 Layer Compression Bandage

1st Layer Complete  |  Beginning 2nd Layer  |  Completed
3 Layer Compression Bandage

4 Layer Compression Bandage

Allergies and Compression Bandages
Compression Bandage Too Tight Over Bony Prominences

Effective Compression?

- Achieve the appropriate sub-bandage pressure—30-40 mm Hg
- Use the correct techniques
- Use the appropriate materials

Is Effective Compression Therapy Being Used?

- Effective compression therapy—sub-bandage pressure of 30-40 mm Hg.
- Study of compression bandages applied by skilled, experienced wound care nurses
- 34.9% of compression bandages -- < 20 mm Hg pressure (56.7% -- applied by nurses with > 10 years experience!)
- 0% of compression bandages -- > 60 mm Hg

Sub-bandage Pressure Measurement

Pico Press

Sub-bandage Pressures After Training

- Only 4.8% -- pressures < 20 mm Hg
- 12.7% -- pressures > 60 mm Hg
- 82.5% -- within therapeutic range (30-40 mm Hg)!


Effective Compression Therapy

PRACTICE

Practice

PRACTICE!

With Feedback!!
**Correct Technique**

- Wrap to the Tibial Tubercle
- Always Begin at The Base of the Toes

**Not Good!**

**Oops!**

- Failure To Wrap All The Way To The Knee
Failure to Wrap Feet! (Or to the Knees!)

Wrap with Even Pressure

Wrap with Appropriate Materials

Leg Wrapped with Fragments of 3 Bandages!
Fact: Patients Don’t Like Compression Bandages!

- Only 48.8% of patients wear their compression bandages.
- May be as high as 80%.
- Determinants for NOT wearing compression bandages:
  a. Age
  b. Pain
  c. Wound size
  d. Wound depth


When a Bandage Won’t Stay Up!

Slippage in cm: after 24 and 48 hours

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Good Therapy?

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For more information on 3M Compression Therapy visit

www.3m.com/coban2layer

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