

Overview Of Lymphatic Anatomy & Physiology

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DISCLOSURES

NONE CURRENTLY

FORMERLY CONSULTANT TO TACTILE MEDICAL
 (Ended 5/31/2023)

PATHOGENESIS OF LYMPHEDEMA*

- Recent research in Lymphedema → fundamentally an immunologic process that ultimately results in:
- Inflammation
- Impaired lymphangiogenesis
- Dysfunctional lymphatic pumping**
- Fibroadipose deposition

*Dayan JH, et al. Lymphedema: Pathogenesis and Novel Therapies. Annu Rev Med. 2018 ;69 :263-276.

Lymphatic pumping: mechanics, mechanisms and malfunction*

Lymph propulsion requires: 1) robust contractions of lymphatic muscle cells, 2) contraction waves that are synchronized over the length of a lymphangion and 3) properly functioning intraluminal valves.

*Scallan JP, et al. J Physiol 2016;594.20:5749–5768

WHAT HAPPENS IN ADVANCED CVI?

JVS-VL Journal of Vascular Surgery Venous and Lymphatic Disorders 2016;4:9-17

Lymphatic transport in patients with chronic venous insufficiency and venous leg ulcers following sequential pneumatic compression

John C. Rasmussen, PhD,¹ Melissa B. Aldrich, PhD,² I-Chih Tan, PhD,¹ Chinmay Darme, PhD,¹ Banghe Zhu, PhD,¹ Thomas F. O'Donnell Jr, MD,¹ Caroline E. Fife, MD,¹ and Eva M. Sevcik-Muraca, PhD,¹ Houston and The Woodlands, Tex; and Boston, Mass

ADVANCED C4-6 CVI LYMPHANGION →
 *DILATION
 *REDUCED CONTRACTIONS

LYMPHATIC DYSFUNCTION WITH VLU

(Rasmussen JC, et al. J Vasc Surg V&LD 2016;4: 9 1-17)

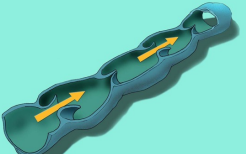
NIRFLI → LYMPH DYNAMICS

- LYMPHATIC FLOW VELOCITY
- CONTRACTION FREQUENCY

CONTRACTIONS OF THE LYMPHANGION (Function)

- NORMAL SUBJECTS → 0.46 +/- 0.3 lymphatic contractions/min (*Rasmussen J et al. Trans Onc 2010;3: 362-72*)
- PHLEBOLYMPHEDEMA → *Diminished contractile events* too infrequent to be quantified → DECREASED PUMPING

Besides obstruction or diminished # of lymphatic vessels
DECREASED PUMPING MAY BE THE UNDERLYING PATHOPHYSIOLOGY

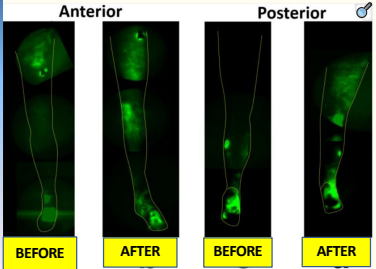


EFFECT OF MLD ON LYMPH VELOCITY & CONTRACTILE EVENTS*

- Lymph Velocity Improved +23%
- The average interval between lymphatic propulsion events decreased -9%
- NRFLI Quantified improved lymphatic contractile function following MLD

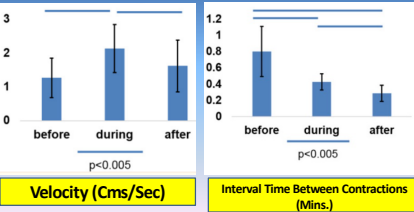
*Tan IC, et al. Arch Phys Med Rehabil. 2011; 92: 756-764.

THE EFFECT OF PNEUMATIC COMPRESSION



THE EFFECT OF APCD IN C4 CVI ON LYMPHANGION FUNCTION


(Aldrich MB, et al. J Innov Opt Health Sci. 2017 Mar;10(2))



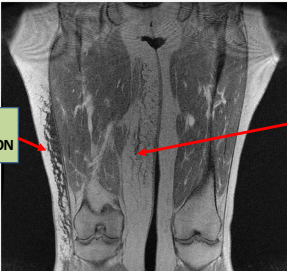
Phase	Mean Velocity (Cms/Sec)
before	~1.2
during	~2.1
after	~1.5

Phase	Mean Interval (Mins.)
before	~0.8
during	~0.4
after	~0.3

Dermis (D) corresponds to the hypointense layer located under the epidermis. The hypodermis appears hyperintense and contains a dark septated structure separating fat lobules.



40 yo Man S/P Treatment Of Melanoma

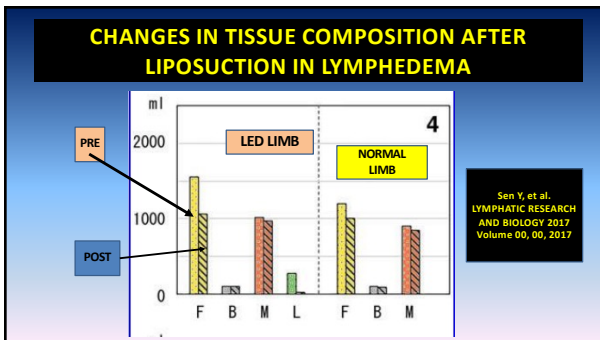


Mechanisms for Lymphedema to increase fat deposition

- Slowed lymph flow
- Diminished lymphatic drainage- *prevents fat tissue from converting stored fat into energy.*
- Fat lobules compressing lymphatic capillaries- *disrupts the transport of fluid and lipids → further fat accumulation*
- Chronic inflammation

IMPLICATIONS FOR TREATMENT

- Greater Volume of Limb due to Fat Deposition, not just fluid
↓
- Less Amenable to MLD or Pneumatic Compression Decreasing Limb Girth
- Requires "Debulking" by Liposuction & Continued PCD Rx



Lymphangion contractions and Fat deposition play a major role in affecting therapy in Lymphedema

The diagram illustrates the lymphatic system components: Lymphatic capillary, LMC (lymphatic muscle cell), LMC connector, Closed valve, Lymphangion, Collector vessel, Lymphocyte, Dendritic cell, and Macrophage. It shows the process of lymphangion contraction and the opening of overlapping LMC flaps to let in fluid and solutes. To the right, MRI scans compare a Healthy leg and an Edematous leg, showing Gradient echo images, PDFF (Phase-Dependent Fat Fraction) maps, and ROIs (Regions of Interest). A color scale for FF(%) ranges from 0 to 100.