Evaluation and management of chronic edema and lymphedema

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References

International Lymphœdema Framework
www.lymphho.org
Resources
CLF estimates of prevalence

Based on American estimates of prevalence rates, at least 1 % of the population have chronic edema/lymphedema

= 350,000

Saskatchewan 11,000
Quebec 80,000
Prevalence of lymphedema

The prevalence will rise because of increasing obesity and cancer rates in Western countries.
Noncancer chronic edema

It is now recognized that over 50% of cases of chronic edema/lymphedema are due to causes other than cancer.

Moffatt 2003
Key messages...

Chronic edema is common. It is diagnosed far too late and left untreated, even when complications develop. It leads to significant morbidity and mortality.
Objectives of this session

- Understand the complications of chronic edema / lymphedema, and the importance of prevention, early diagnosis and timely treatment
- Review how to prescribe compression therapy and to refer to appropriate resources
- Appreciate the role of the physician and other members of the health care team in improving the care of chronic edema / lymphedema.
What is the difference between edema and lymphedema?
Edema: Classification

Lymphedema – high protein = risk of CELLULITIS and fibrosis

Post surgery, radiotherapy
Venous insufficiency (stages II, III)
Immobility
Lymphedema related to obesity
Active tumour: malignant lymphedema
Lipedema stages II and III

Edema- low protein

Hypoproteinemia: cancer anorexia/cachexia kidney, liver disease, malnutrition
Cardiac
Venous insufficiency (stage I)

Adapted from Schuchhardt 2010
Edema is a general term that refers to excessive fluid in the body tissues. Most of the excess fluid is in the interstitial space but there is usually excess fluid both in the vascular bed and within cells.
Definition of lymphedema

Protein-rich fluid accumulation in the interstitial space due to reduced lymph transport capacity as a result of damage to the lymph vessels and nodes, or absence/malformation of lymph vessels

Kettenhuber, Shetty-Lee, Heim, adapted
Recent development

In the UK the term ‘chronic oedema’ is now commonly used in place of ‘lymphoedema’ as it is felt that this term encompasses all patients with edema for a minimum of three months.

Moffatt 2014, LIMPRINT
Lymphedema is often unilateral; if bilateral it is usually asymmetrical.
Continuous lymph flow when both valves are open

Filling phase with wall expansion due to increased lymph flow from a distal direction

Start of emptying phase with starting wall contraction

Expulsion of lymph content in a proximal direction with maximum wall contraction
The lymphangion

- Pumps 6-10 times per minute
- Exercise may increase contraction to 20 per minute or more, under the influence of the autonomic nervous system
Lymphatic capillary (initial lymphatic, lymphatic sinus)

Electron microscopy (Kastenholz, Kassel)
Chronic lymphostasis
Consequences

- Protein rich interstitial edema
- Fibrosis, sclerosis
- Infection (cellulitis, erysipelas)
- Increased production of fatty tissue (which further compromises lymphatic circulation)
- Lymphostasis in arterial vascular wall (leading to pathological changes in the blood vessels)
- Joint pathology (arthropathy)
- Alterations of ligaments and tendons

Weissleder, Schuchhardt, 2008
Which cancers besides breast cancer are often associated with lymphedema?
Other cancers whose treatment may lead to lymphedema

Melanoma
Gynecological (uterine, cervical, ovarian)
Prostate
Colon cancer, including rectal cancer
Sarcoma
Lung
Head and neck
Other genitourinary (renal, bladder, penile)
Others, less common
Incidence and prevalence of cancer-related lymphedema (Cormier, Askew, Armer et al 2010)

Mean LE incidence estimates (from systematic review of 47 studies)

- All cancer patients 15.5%
- Breast cancer 18%
- Melanoma upper extremity 5%, lower 18%
- GU malignancy (prostate, bladder, penile) 10%
- Gynecological malignancy (uterine, cervical, vulvar) 25%
- Sarcoma 30%
- Head and neck cancer 4%
Obesity-related lymphedema

- Prevalence: 75% of morbidly obese patients
- Histology: highly vascular fat, increased capillaries and lymphatics, interstitial oedema fluid
- Benign overgrowth of lymphoproliferative tissue
- Lymphedema is also linked with increased rate of venous insufficiency in obese people
Some common causes of secondary lymphedema

- Post cancer surgery and/or radiotherapy
- Longstanding chronic venous insufficiency
- Obesity
- Other trauma/ surgery
- Active malignancy
Complications of lymphedema

- Cellulitis (erysipelas)
- Interdigital and nail mycosis (fungal infection)
- Lymph cysts/fistulas
- Macerated skin
- Lymphorrhrea
- Malignancy (angiosarcoma, rare)
Complications of lymphedema

Psychosocial consequences: Disability, job loss, financial issues
Risk of developing cellulitis (rate per year)

Normal person 0.001%
Lymphedema Stage I 1%
Lymphedema Stage II 27%
Lymphedema Stage III 72%
Recurrent cellulitis 60%

(Brenda, Svestkova 1993)
Mycosis (fungal infection) in interdigital folds....

.....major port of entry for bacteria and secondary cellulitis
The main factor that increases the risk of repeat cellulitis is uncontrolled chronic edema.
Risk factors for cellulitis

There is very little association between diabetes and cellulitis but 60 times the risk if there is chronic edema or lymphedema.
Diabetes vs. chronic edema/lymphedema in association with cellulitis

Dupuy et al, BMJ 1999 vol318, 12 Jun

Prospective case control study of 129 cases of cellulitis admitted to hospital in France vs 294 controls

<table>
<thead>
<tr>
<th>Condition</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>1.7 (0.8-3.5)</td>
</tr>
<tr>
<td>Leg edema</td>
<td>3.6 (2.2-6.0)</td>
</tr>
<tr>
<td>Lymphedema</td>
<td>57.7 (16.9-197)</td>
</tr>
</tbody>
</table>
Chart review of cellulitis cases

St George`s Hospital, London

85% had a co-existing chronic edema

Dr. Peter Mortimer, 2010
Personal communication
Cellulitis rates in a survey in USA
(Ridner, Deng, Fu et al. Lymphology 45 (2012): 113-123)

Survey of 1837 lymphedema patients (all stages)

<table>
<thead>
<tr>
<th></th>
<th>Leg lymphedema</th>
<th>Arm lymphedema</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>1114</td>
<td>723</td>
</tr>
<tr>
<td><strong>Cellulitis rate</strong></td>
<td>41.7%</td>
<td>24.6%</td>
</tr>
<tr>
<td><strong>Hospitalization for cellulitis</strong></td>
<td>24.8%</td>
<td>9.1%</td>
</tr>
</tbody>
</table>

No significant difference in cellulitis rates were found between primary and secondary lymphedema patients.
Any patient presenting with cellulitis should be evaluated for underlying lymphedema
Lymphedema staging

Stage I: Lymphedema spontaneously reversible with elevation

Stage II: Lymphedema not spontaneously reversible

Stage III: Skin changes - elephantiasis
Stemmer sign

( Stemmer was a phlebologist from Strausbourg, France )

• Normal thickness of skin fold 2\textsuperscript{nd} toe = 2-4 mm

• Positive Stemmer sign- unable to raise skin fold- means fibrosis is already present, is at least stage II
Stage 2: edema that does not disappear with elevation because of fibrosis...

Positive Stemmer sign = evidence of fibrosis
Skin changes in lymphedema

- **Hyperkeratosis** (hypertrophy of corneous layer of the skin)
- **Pachydermia** ("elephant-skin": increased skin thickness and heightened skin folds)
- **Papillomatosis** (increase and extension of dermal papillae). Papilloma= wart-like, benign connective tissue overgrowth.
- **Hyperpigmentation**
- **Inflammation, dermatitis** (eczema)

Weissleder 2009
Chronic venous insufficiency and lymphedema
What is the link between chronic venous insufficiency and lymphedema?
Pathophysiology of CVI – related lymphedema

Venous edema

Lymphatic collectors pump faster and more efficiently

Eventual lymphatic damage = lymphedema
Chronic Venous Insufficiency - Pathophysiology

Venous hypertension

Venous capillary pressure increased

Venous edema

Lymphatic compensation

Lymph vessel wall alteration (from continuous load)

Lymphatic decompensation

Weissleder, 2007
Stages of chronic venous insufficiency

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>varices, edema disappears with elevation</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Constant edema (lymphedema), skin changes (lipodermatosclerosis)</td>
</tr>
<tr>
<td>Stage 3</td>
<td>2, plus ulceration</td>
</tr>
</tbody>
</table>
Stage 2 with skin changes and co-existing lymphedema

- Worse in lower 1/3 of leg
- Hemosiderin (blue-brownish) deposits
- Chronic edema (phlebolymphedema)
- Hardening of the tissues (fibrosis)
Chronic Venous Insufficiency

Stage III
Symptoms/signs as in stages I and II
In addition:
- ulcer scar (stage III a)
- active ulcer (stage III b)

Treatment: wound care + compression bandaging

Weissleder 2007
Lipedema

Starts at puberty
Seen exclusively in women
Genetic component
Abnormal fat deposits on hips
Pain
Easy bruising
Orthostatic edema
Can develop secondary lymphedema
Lipedema
Clinical assessment of chronic edema
Clinical assessment

Rule out

- recurrent cancer
- venous thrombosis
- other causes of edema
Assessing arterial circulation

Prior to commencing compression therapy on legs it is important to assess arterial circulation, if arterial insufficiency is suspected (e.g. in diabetics).
Ankle Brachial Pressure Index (ABPI)

- A doppler ultrasound study that reflects arterial circulation in lower limbs
- Done in vascular labs or clinics, wound care clinics
- Can help determine what level of compression is safe
<table>
<thead>
<tr>
<th>ABPI value</th>
<th>Interpretation</th>
<th>Nature of ulcers, if present</th>
</tr>
</thead>
<tbody>
<tr>
<td>above 1.2</td>
<td>Abnormal</td>
<td>Venous ulcer</td>
</tr>
<tr>
<td></td>
<td>Vessel hardening from peripheral vascular disease</td>
<td></td>
</tr>
<tr>
<td>1.0 - 1.2</td>
<td>Normal range</td>
<td>use full compression bandaging</td>
</tr>
<tr>
<td>0.9 - 1.0</td>
<td>Acceptable</td>
<td></td>
</tr>
<tr>
<td>0.8 - 0.9</td>
<td>Some arterial disease</td>
<td></td>
</tr>
<tr>
<td>0.5 - 0.8</td>
<td>Moderate arterial disease</td>
<td>Mixed ulcers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>use reduced compression bandaging. Claudication may be present at values less than 0.6.</td>
</tr>
<tr>
<td>under 0.5</td>
<td>Severe arterial disease</td>
<td>Arterial ulcers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no compression bandaging used. Pain at rest may be present at values less than 0.25.</td>
</tr>
</tbody>
</table>
Elements of decongestive therapy for lymphedema

- Patient education in self-management
- Skin care
- Compression
- Exercise
- Weight control
- Manual lymph drainage (particularly useful for trunk, head and neck swelling)
Patient self-management

Information about:

- Lymphatic system
- Trigger factors
- Prevention of infection
- Rationale for decongestive therapy
- Lifestyle changes
- Diet
- Psychological aspects
- Sources of support
- Importance of compliance
- Involvement of patient and partner(family) in self-care
Effect of external compression

- increases the tissue hydrostatic pressure during active movement so less fluid enters the interstitial space
- amplifies muscle and joint pump effects
- stimulates lymphatic contraction
- helps break down fibrosclerotic tissue
Other effects of therapeutic compression

European Wound Management Association, Moffatt 2007

Reduces:
- venous stasis and venous reflux
- inflammatory process (↓ cytokines)
- pain
Compression to reduce the risk of post-thrombotic syndrome

Compression with 30-40 mm Hg stockings reduces the risk of post-thrombotic syndrome by 50%.
Start compression within 1-2 weeks of initiating anticoagulant therapy.

Phases of combined decongestive therapy

- **Phase I** - Intensive bandaging phase
- **Aim:** eliminate pitting edema, reduce limb size
- **Phase II** - Maintenance phase (lifelong)
Combined decongestive therapy
Phase I

Daily bandaging +/- manual lymphatic drainage

• Approximate cost if not provided by health care system: $1800-$2200
• Results: Reduction of limb volume by 30-70%
Short stretch bandages

- Stretch to 40% à 90% of their length
- More resistant to stretch compared to «ace» bandages
- More compression on movement and less compression at rest
- Good for general edema reduction
Long stretch bandages

- 120 % à 200 % stretch
- Low resistance to stretch
- High resting pressure
- Use reserved for specialists in edema care
Examples of self-bandaging
Self-bandaging
Self-bandaging
First layer: Tubular cotton sleeve
Toe bandaging

4cm bandage anchored at base of toes

Fold bandage to fit toes
...toe bandaging

One more turn…

…leave small toe free

unbandaged
Padding layer
Padding of foot and ankle

Protect the foot, ankle, heel

Add an extra “ear” to each ankle.
Foam padding

Include extra pad under
Low stretch bandaging

Starting above toes, FLEXING THE FOOT…using figure eight around ankle.
...and we continue...
Fix bandages with tape

All the way to the groin
Shoes with velcro attachment
The patient measures herself to monitor the results of bandaging.
Self management and the chronic care model
Self-bandaging clinic

Report on a series of 30 patients
Lymphedema Clinic MUHC (2011-2012)
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aetiology</strong></td>
<td></td>
</tr>
<tr>
<td>Breast cancer</td>
<td>19 (66%)</td>
</tr>
<tr>
<td>Melanoma</td>
<td>3 (10%)</td>
</tr>
<tr>
<td>Sarcoma</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>Chronic venous insufficiency</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>Gynecological cancer</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>Obesity</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Primary LE</td>
<td>1 (3%)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>27 (91%)</td>
</tr>
<tr>
<td>Men</td>
<td>3 (9%)</td>
</tr>
<tr>
<td><strong>Area of lymphedema</strong></td>
<td></td>
</tr>
<tr>
<td>Unilateral arm</td>
<td>19 (59%)</td>
</tr>
<tr>
<td>Unilateral leg</td>
<td>7 (22%)</td>
</tr>
<tr>
<td>Bilateral legs</td>
<td>4 (13%)</td>
</tr>
<tr>
<td><strong>Duration of swelling (years, range)</strong></td>
<td>5 years (0.5-20)</td>
</tr>
<tr>
<td><strong>RLV (Severity of edema in unilateral limbs)</strong></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>4 (15%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>12 (48%)</td>
</tr>
<tr>
<td>Severe</td>
<td>10 (38%)</td>
</tr>
<tr>
<td><strong>Stages of lymphedema</strong></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Early stage 2</td>
<td>4 (13%)</td>
</tr>
<tr>
<td>Late stage 2</td>
<td>21 (66%)</td>
</tr>
<tr>
<td>Stage 3</td>
<td>5 (16%)</td>
</tr>
</tbody>
</table>
Results of self bandaging - arm

Percentage Relative Lymphedema Volume over Eight Weeks
Self bandaging results
(unilateral lymphedema)

% RLV of the most severe limb segment  Before and After
different periods of intensive bandaging
Various bandaging systems
Compression garments
Flat-knit (made to measure)
Comparison between compression garment types

<table>
<thead>
<tr>
<th></th>
<th>Seamless/ Circular knit</th>
<th>With seam/ Flat knit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Fashionable looking, lightweight and thin structure, high compliance</td>
<td>For all anatomical conditions, durable</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>Not suitable for every anatomy</td>
<td>Not fashionable More expensive</td>
</tr>
</tbody>
</table>
Antiembolic stockings – not useful to treat chronic edema
Cotton vs synthetic?

Latex allergy
Prevalence = 5%
Thigh high stocking, flat knit, class 2

Toe caps, class 1
For edema from immobility

class 1
7 yo primary lymphedema

With toe caps, flat knit class 1
Laplace’s Law

Graduated compression
Laplace‘s Law

« The pressure under a compression bandage is directly proportional to the tension applied but inversely proportional to the cross-sectional radius or circumference of the limb. »
Pressure = Tension

Tension = Radius or Circumference
Law of Laplace

\[ P = \frac{T \times N \times 4630}{C \times W} \]

- \( P \) = sub-bandage pressure (mmHg)
- \( T \) = bandage tension (kilograms force (kgf))
- \( N \) = number of layers
- \( C \) = limb circumference (cm)
- \( W \) = bandage width (cm)
Law of Laplace

• The pressure is high on bony prominences
• In more recessed or flat parts (perimalleolar region) no pressure is exerted
• In order to distribute the pressure equally:
  - Bony prominences must be covered with padding material
  - Recessed spaces must be filled in
→ the shape will resemble a cylinder as much as possible
Laplace’s Law
Laplace’s Law

Ruthi Peleg, 2010
La loi de Laplace
Laplace’s Law

The smaller the circumference, the greater the pressure (e.g. pressure at the ankle is greater than pressure at the thigh)
The challenge of bandage and garment fitting

Increased sub-garment or sub-bandage pressure at knee and ankle
Contraindications to compression therapy

- Arterial insufficiency (check ankle-brachial pressure index)
- Neuropathy (e.g. diabetes)
- Uncontrolled congestive heart failure
- Untreated cellulitis
- Acute thrombophlebitis (until adequately anticoagulated: 7-10 days)
Rx: How to prescribe compression garment

- What compression?
- What components (e.g. sleeve, gauntlet, open glove, stocking, panty, toe-caps)?
- One piece or not?
- Flat-knit custom-made or circular-knit off-the-shelf
Compression classes

- **Class I** - 20-30 mm Hg – mild arm lymphedema
- **Class II** - 30-40 mm Hg: the usual prescription for arm lymphedema or mild leg edema
- **Class III** - 40-50 mm Hg: leg lymphedema
- **Class IV** - >50mm Hg: severe leg lymphedema
Compression garment prescriptions

- If there is moderate to severe edema, or an irregular shape, garment must be custom-made, flat-knit rather than circular knit
- For edema above the knee, stocking must be at least thigh-length and not just to the knee
Compression garments for moderate to severe lymphedema

- ‘Flat-knit’ – with seam, made to measure
- Must be replaced every 4-6 months
- Cost: $180-$250 or more (per component) for an arm, $250-$600 or more for a leg
Compression stockings sold in pharmacies

<table>
<thead>
<tr>
<th>8-15 mm Hg (very light compression)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are not adequate to treat venous insufficiency or lymphedema</td>
</tr>
</tbody>
</table>
Prescription: Summary

- Compression (class, mm Hg)
- Standard, or made-to-measure flat knit?
- Components (stocking, panty, toe-caps, sleeve, gaunetelet, glove)
- Length and style of stocking (to thigh or to knee, open toe or closed toe)
- Renewals

Instructions to patient
- Wear daily, morning to night
- Guarantee period, if garment does not fit properly
When to get fitted for stocking?

Get measured
Night compression device (Solaris)
Circaid
Juxta-Fit
Circaid
Juxta-Fit
Exercise: an essential element of decongestive therapy
Daily Walking: Activation of calf pump
When the muscle contracts, it creates a high working pressure which stimulates lymphangion pumping. The compression bandage promotes forward flow.
Other potentially good forms of exercise

Legs:
- Walking
- Treadmill
- Aquaforme (standing)
- Cycling
- Snow-shoeing

Arms:
- Walking with poles
- Swimming
- X-country skiing

Both arms and legs:
- T’ai Chi
- Yoga
- Dancing
- Belly-dancing
Weight training

- Is not contraindicated but must be done slowly
- Done progressively, can help build muscle tone that will help the lymphatic circulation
Manual lymph drainage  (courtesy Zuther 2009)
Manual lymph drainage

Is especially useful for proximal, trunk, genital and head and neck edemas.
What about diuretics?
Diuretics

- Diuretics are usually contraindicated for lymphedema/chronic edema since they remove water but not protein and can make the protein-rich condition worse.
- Diuretics may be used for mixed edemas in far advanced cancer patients.
Is there a role for intermittent compression pumps?
Pneumatic compression pump

Home equipment
The problem with pumps...

Proximal fibrosis, especially if trunk is not covered.

Newer models with trunk coverage preferred.
Intermittent compression pumps

May be useful in those with venous insufficiency, especially if they cannot tolerate bandaging or in those with edema and arterial insufficiency where compression bandaging or stockings are contraindicated

Ref: Compression in venous leg ulcers: a consensus document, MEP 2008
Surgery for chronic edema/lymphedema
ILF position document on surgery for lymphedema, 2012

www.lympho.org
Ressources
ILF Document on Surgical Treatments

The controversies:

Liposuction
Lymphaticovenous anastomoses
Autologous lymph node transplantation
“Conservative decongestive therapies remain the mainstay of lymphedema treatment and surgical options do not eliminate the need for compression.”
“When organizing a comprehensive lymphedema service...a major part of the treatment is a well structured program on awareness, prevention and self management.
Organization of care: a public health approach  (ref BPD2-2012)

“The goal is to stratify patients in terms of risk for developing lymphedema (low risk versus high risk) and in terms of severity....The goal is provide integrated care for chronic diseases with a strong scope for prevention and cost reduction.”
Multidisciplinary intervention

- Physician
- Lymphedema therapist
- Physiotherapist
- Nurse
- Fitness trainer/kinesiologist
- Garment fitter
- Volunteer from the Lymphedema Association
- Pain Service
- Community therapists, MDs, nurses
- Social services, psychology
- Involvement of spouse and family members, friends
Interdisciplinary models of care

Cancer Treatment Centre
- Post-treatment education and rehabilitation

Community services

Medical and Surgical Units

Specialized lymphedema and wound care services