

How to manage lower limb complications

A comprehensive assessment of a patient presenting with limb problems needs to include a consideration of the lymphatic system to aid appropriate differential diagnosis. Often patients present with multifaceted manifestations and only by considering and treating all of them can treatment outcomes be achieved. The author presents the case of a woman presenting with bilateral lipoedema, where a treatment plan addressing all aspects of her problem was necessary for successful management.

Author:
Justine Whitaker

When an individual presents with problems of the lower limbs, a comprehensive assessment is paramount to understanding the presenting issues. There are many tests and procedures which help the practitioner to diagnose the underlying condition. Duplex scan can determine both venous and arterial deficiencies and more accessible tests, such as hand-held Doppler, can be repeatable in an outpatient clinic setting.

However, the state and impact of how well the lymphatic system is functioning is often overlooked and not considered to be as essential as the other forms of circulation. It is crucial to acknowledge that the lymphatic system plays a vital role in leg health to ensure a complete assessment is carried out.

The lymphatic system

The lymphatic system is a unidirectional, low pressure system which is relatively passive in its mode of action. It requires both extrinsic and intrinsic factors to function due to its passiveness. Respiration, skeletal muscle contraction and general movement, coupled with intrinsic smooth muscle contraction surrounding the larger collecting lymphatic vessels, contribute to this. The intrinsic pump of the smooth muscle relies on calcium in the same way as the arterial system. Calcium-channel blocking medication used to control hypertension can have an impact on the contractile function of the lymphatic system, which may go some way to explaining why some individuals develop oedema of the ankles when commencing this class of medication.

In the embryo, endothelial cells are derived from the anterior cardinal vein, and at around

5 weeks' gestation these cells form lymph sacs. Lymphatic vessels sprout from these sacs in a process known as lymphangiogenesis. The lymphatic vessels then separate to form their own network and only rejoin the venous system at the left subclavian vein and right jugular vein.^[1] Although the lymphatic system is its own entity, there is a constant communication with the venous system through the glycocalyx semi-permeable layer of endothelium.

The century-old Starling principle was revised in 2010 by Levick and Michel. They concluded that most of the filtered fluid returns to the circulation as lymph due to this communication^[2]. They also established that recent experiments confirm that the effect of the interstitial fluid colloid osmotic pressure on the flow of lymph is much less than predicted by Starling's principle, thus determining that tissue fluid balance depends critically on lymphatic function in most tissues^[2].

Clinicians can take this information into the assessment process and acknowledge that if there is any deficit in function of the lymphatic system, then there will be impairment of the tissues and therefore the overall limb health will be compromised.

Differential diagnosis of oedema can be formulated with a good understanding of Starling principle, thus determining whether the oedema is acute or chronic. Acute oedema is usually central in origin and can involve major organs such as the heart, kidneys and liver. It is also present in palliative care due to multi-organ failure and toxicity at end of life. Acute oedema also occurs in trauma and injury.

Chronic oedema is generally peripheral in origin, and consists of lymphoedema, lympho-

Justine Whitaker, Director and Lymphoedema Nurse Consultant, Northern Lymphology Ltd, and Senior Lecturer, University of Central Lancashire, UK

Table 1. International Society of Lymphology stages of lymphoedema^[4]

Stage 0	Latent or sub-clinical condition where swelling is not yet evident despite impaired lymph transport, subtle changes in tissue fluid/composition, and changes in subjective symptoms. It may exist months or years before overt oedema occurs.
Stage 1	Early accumulation of fluid relatively high in protein content (e.g. in comparison with venous oedema) which subsides with limb elevation. Pitting may occur. An increase in proliferating cells may also be seen.
Stage 2a/2b	Limb elevation alone rarely reduces tissue swelling and pitting is manifest. Late in Stage 2, the limb may or may not pit as excess fat and fibrosis supervenes.
Stage 3	Lymphostatic elephantiasis, where pitting can be absent, and trophic skin changes, such as acanthosis, further deposition of fat and fibrosis, and warty overgrowths, have developed.

venous oedema (phlebolympoedema), dependency oedema and lipoedema.

Oedema consists mainly of water, but oedema resulting from failure of the lymph system is rich in protein. It is important that the presence of lymph stasis is recognised because this indicates the failure of the lymphatic system.^[3]

Once a diagnosis has been achieved, an understanding of the stage of lymphoedema and the potential disease progression needs to be established [Table 1].^[4]

How clinicians intervene is governed by the patient's expectations and the treatment skills of the practitioner. Consideration of the following aims will prioritise which approach is taken initially:

- Reduce limb volume
- Reshape the limb
- Reverse skin changes
- Impact on subcutaneous tissue
- Reduce cellulitis attacks
- Heal a wound
- Improve general limb and overall mobility

and activity

- Assist in long-term rehabilitative disease management
- The wearing of appropriate footwear and clothing.

If the aim is to address one or more of these points, then decongestive lymphoedema therapy (DLT) is the treatment plan of choice, depending on the severity and accessibility of the condition and available treatment options. DLT generally consists of in-elastic bandaging (short-stretch); manual lymphatic drainage (MLD); exercise; skin care and other treatment modalities, such as negative pressure; and intermittent pneumatic compression therapy (IPC).

Compression is the gold standard treatment. The amount of pressure exerted by the chosen product needs to be ascertained. Plan how long treatment should take and how many sessions should take place, in accordance with current evidence. For example, Whitaker et al showed a mean reduction of 33% in excess limb volume over 12 days, with most patients having six sessions of treatment in this period^[5].

Tissues changes are common in the later stages of lymphoedema, such as fibrosis, lipodermatosclerosis which is associated with inflammatory process [Table 1]. Whether the tissues 'pit' when the skin surface is depressed is another indicator of lymphoedema progression and will impact on how different levels of compression and types of compression materials will perform.

The effects of compression are multi-factorial. Oedema reduction is well documented and expected when pressure is applied. The reduction depends on the pressures used, how long they are sustained, frequency of compression change, the materials used and the individual's ability to tolerate wearing them^[5-7]. The effects on the microcirculation are affected by compression by inducing an anti-inflammatory effect^[8].

The stiffness of the material used in compression is integral to gaining the desired results. The amount of compression is proportional to the radius and curvature of the limb at various points and dependent on the addition of other materials such as dressings and pads^[9]. Both stiffness and compression form part of the overall prescription of treatment [Figure 2]. Whitaker's Golden Triangle indicates the components to take into consideration when choosing an initial treatment plan for an individual presenting with a lower limb complication.

Before applying compression of any nature, skin preparation should be taken into

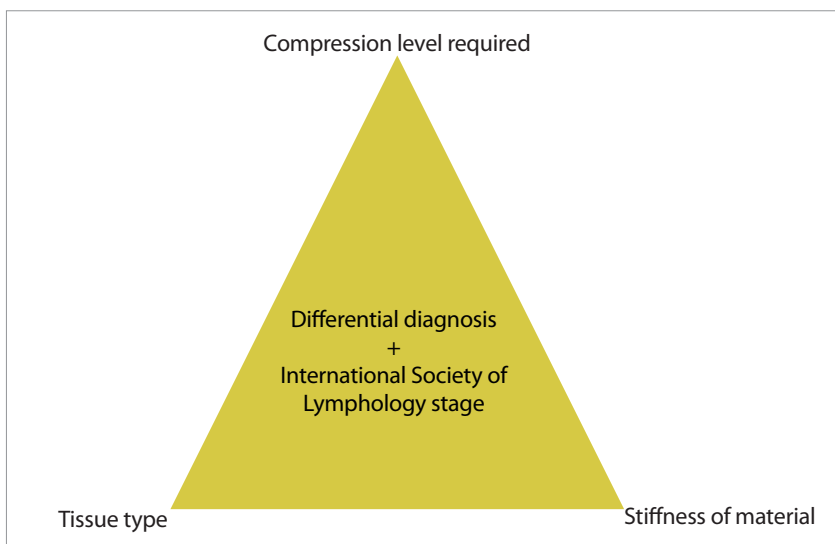


Figure 2. Whitaker's Golden Triangle

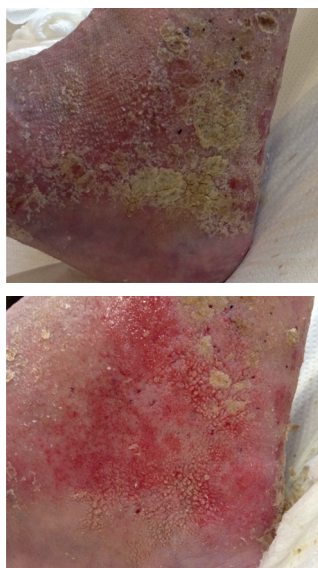


Figure 3. Debridement of hyperkeratosis on a male patient using Debrisoft.

consideration. If there is a large residue of hyperkeratosis on the skin that has formed due to the accumulation of large proteins in the skin, this will need removing prior to any application of compression. Removing hyperkeratosis:

- Removes non-viable tissue to provide an environment that is less likely to support a heavy growth of bacteria
- Assists in appropriate differential diagnosis
- Lessens the risk of further tissue induration and pressure damage under the plaques of hard skin when compression is applied
- Improves patient tolerance to wearing compression (lessens itching).

This can be achieved by debriding the skin at an early stage of the assessment process. Non-invasive debridement should be used because there is an immune deficit due to the compromised lymphatic system. One option is the Debrisoft® monofilament debridement pad (Activa Healthcare); this contains monofibres that attach to debris and has been shown to be successful at debriding hyperkeratosis [Figure 3]^[9].

Treating a 'mixed' picture

Mrs X, a 54-year-old woman who is a full-time teacher, presented with bilateral lipoedema [Figure 4]. She had a family history of the condition, with her mother and her daughter affected. She had three episodes of cellulitis in the last 12 months. Mrs X had both venous and lymphatic impairment and a small ulcer to the medial posterior gaiter region of her right leg.

On examination, the tissues above the knees were soft and doughy, however below the knees the tissues were hard and congested, but a degree of pitting could be achieved. Other than arthritis in both knees, Mrs X was in good health.

Her main reason for accessing treatment was to ensure she did not deteriorate to the level of

extensive disease that her mother is currently experiencing, which is deep leg ulceration, immobility, numerous infections and very lengthy hospital admissions which require high dependency care.

Measuring the effects of treatment are somewhat limited in an outpatient setting, however what is available is essential not only for long-term monitoring process, but to also to encourage the patient during support of a long-term chronic condition.

Mrs X's limb volumes were measured using the 4 cm tape measure calculation. Proximal, distal segmental volumes and overall total limb volumes were calculated. Due to the bilateral presentation, it was not appropriate to calculate the limb volume excess, because this can only be measured truly on unilateral limb swelling.^[10]

Body mass index (BMI) was calculated on assessment prior to commencing treatment, and was 57 kg/m², which puts Mrs X in the very severely obese category.

Some services in the UK only treat lymphatic disorders if the patient's BMI is under 30 kg/m². However, if Mrs X is unable to access appropriate care, then she is very likely to deteriorate and be in the same situation as her mother, but at a much younger age. The burden on healthcare



Figure 4. Mrs X presented with bilateral lipoedema and a small ulcer on her right leg. Her leg tissues were soft above the knees and hard below the knees.

Table 6. Mrs X's limb volumes at day 1 and day 19.					
		Right	Left	BMI	Weight
Day 1	Distal	10,244 ml	9159 ml	57 kg/m ²	141.5 kg
	Proximal	10,331 ml	9784 ml		
	Total	20,576 ml	18,943 ml		
Day 19	Distal	6347 ml	6068 ml	48 kg/m ²	120.5 kg
	Proximal	9308 ml	8802 ml		
	Total	15,655 ml	14,870 ml		

services and finances is likely to be astronomical if treatment is not applied early.

A treatment plan was drawn up and the course of appointments booked. Due to the size of the limbs and the presentation being bilateral, 10 appointments over 19 days were arranged.

The treatment plan consisted of 10 sessions of the following:

- Bilateral IPC for 20 minutes on each leg at a pressure of 40 mmHg.
- MLD to anterior/posterior trunk and upper thigh using a negative pressure device (PhysioTouch), set at 80 mmHg.
- Skin care of applied emollient following cleaning of wound with Debrisoft (day 1 only), application of small foam dressing over 1cm ulcer on right leg. From day 2 Mrs X showered in the clinic at the start of each treatment session after removal of the bandages.
- Compression was bilateral, full leg from toes to top thigh using Rosidal® Soft foam direct to the skin, sizes 10/12/15 cm; Actico



Figure 5. Mrs X's compression bandaging

(Activa Healthcare) cohesive short stretch/inelastic bandage applied in a figure of eight up the limb starting with size 8 cm on the foot progressing to 10 cm, then 12 cm on the thigh. Conforming bandage (ActiWrap; Activa Healthcare) was applied to the toes individually [Figure 5].

- Appropriate footwear was supplied and exercises were recommended for Mrs X to do at home after her clinic sessions, consisting mainly of walking and steps.

Mrs X was measured for compression garments on day 5. These consisted of made-to-measure flat knit tights with a mesh gusset, compression class III (30–40 mmHg), and ReadyWrap neoprene Velcro® wrap system for the calf area to wear over the top of the tights. These were all fitted on day 19 at the end of the treatment plan.

Limb volumes and BMI were re-measured and calculated on appointment 10 of treatment regimen (day 19) [Table 6].

The results are testament to how a structured, conservative, planned, multifaceted approach to care can achieve excellent results in a short period of time.

A total of 9 litres was lost during the 19-day care plan. What was surprising to both the patient and practitioner was the reduction in the thigh area (proximal region), amounting to around a 2 litre reduction.

On clinical examination with abundant adipose tissue present, it is difficult to ascertain whether there is excess fluid present. It is only by being objective in measuring and monitoring the effectiveness of any intervention can it be determined that in this case the problem was worse than originally anticipated. This also highlights the importance of considering the whole limb when applying compression and not just below the knee. Trying to drain into an already congested area (albeit unknown in this case) could further congest and cause more problems long-term.

The reduction in BMI is remarkable. The reduction from 57 kg/m² to 48 kg/m² was greater than expected and very encouraging for the patient and others considering this treatment regimen.

A weight reduction of 1 kg per litre of fluid lost is to be expected. In theory Mrs X should have been expected to lose 9 kg, having lost 9 litres, however she lost 21 kg. This could be due to several reasons.

The limb volume was only calculated on the legs and not elsewhere on the body. It is likely that she could be retaining fluid in other

Table 8. Mrs X's limb volumes after one year

		Right	Left
One year	Distal	6697 ml	6017 ml
	Proximal	8728 ml	8214 ml
	Total	15,425 ml	14,231 ml

body parts in general and the approach using negative pressure, clearing the spinal area (thoracic duct region) during MLD could have contributed to a greater body fluid reduction.

Another reason could be due that the effort required to mobilise with two full leg, semi-rigid bandages on for 19 days will burn additional calories and lead to a weight reduction. While these are hypotheses, they do have substance and cannot be discounted.

In less than 3 weeks Mrs X was able to mobilise much more efficiently, apply her own compression garments and wraps and return to work 21 kg lighter with no leg ulcer. The ulcer had healed completely [Figure 7].

Maintaining this limb volume reduction over the next 12 months without rebound of the oedema needed monitoring because it was possible that there could be some reoccurrence, due to the pressures and stiffness of Mrs X's bandages. Her continued treatment regimen consisted of a monthly 90-minute appointment for IPC and MLD.

After a year following the monthly regimen, Mrs X's limb volumes were measured [Table 8]. A continued reduction has been achieved of 869 ml. Her weight has remained stable and she has had no episodes of cellulitis in the last 12 months. Full credit must go to the patient for following the recommended self-care treatment plan of walking and compression, along with attending her regular monthly appointment.



Figure 7. At day 19, Mrs X had lost 9 litres of leg fluid and her leg ulcer had healed completely.

Conclusion

A comprehensive assessment of the limbs incorporating the lymphatic system will aid appropriate differential diagnosis. Often patients present with multifaceted manifestations and only by considering and treating all of them can therapeutic outcomes be achieved.

Should the clinicians have chosen to only apply one aspect of the treatment plan for Mrs X then they would not have got it right first time.

Consideration of the lymphatic system, the venous system, the genetics of lipoedema and not dismissing obesity has to be the full approach to managing an individual, not an initially perceived condition. WME

References

1. Kesler CT, Liao S, Munn LL, Padera TP. Lymphatic vessels in health and disease. *Wiley Interdiscip Rev Syst Biol Med* 2013; 5: 111–24
2. Levick JR, Michel CC. Microvascular fluid exchange and the revised Starling principle. *Cardiovasc Res* 2010; 87: 198–210
3. Macdonald JM, Geyer MJ. *Wound and lymphoedema management*. World Health Organization, 2010
4. International Society of Lymphology. The diagnosis and treatment of peripheral lymphoedema: 2013 consensus document of the International Society of Lymphology. *Lymphology* 2013; 42: 1–11
5. Whitaker J, Williams A, Pope D et al. Clinical audit of a lymphoedema bandaging system: a foam roll and cohesive short stretch bandages. *J Wound Care* 2015; 24: 83–94
6. Damstra RJ, Partsch H. Compression therapy in breast cancer-related lymphedema: A randomized, controlled comparative study of relation between volume and interface pressure changes. *J Vasc Surg* 2009; 49: 1256–63
7. Moffatt C, Pinnington LL. *Facilitating Development of Community Based Lymphoedema Services through Clinical Education*. University of Nottingham and Derby Hospitals NHS Foundation Trust; 2012
8. Partsch H, Mortimer P. Compression for leg wounds. *Br J Dermatol* 2015; 173: 359–69
9. NICE. *The Debrisoft monofilament debridement pad for use in acute or chronic wounds*. London: NICE, 2014.
10. Williams AF, Whitaker J. Measuring change in limb volume to evaluate lymphoedema treatment outcome. *EWMA J* 2015; 15: 27–32

