

Diagnosis and Classification: How to Investigate Lymphoedema

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Abstract

Pure lymphoedema is a swelling of the superficial tissues which occurs when the lymph load is greater than the lymphatic transport capacity. In terms of the legs, its major causes are damage due to surgery and/or radiotherapy in the groin, bowel or reproductive system or a malformation of the lymphatic system during early development. Between 10 and 30% of men and women develop lymphoedema with the prevalence relating to the extent of surgery and use of radiotherapy. Its time of onset is variable, and it can appear alongside of other conditions (oedema, myxoedema, lipoedema) which may appear like lymphoedema but are not and which require different treatment plans.

Assessment of risk level relating to the development of lymphoedema and early detection of subtle tissue changes including fluids and fibre are crucial since once lymphoedema is clinically manifest, treatment and management can be a life-time issue. However a well informed patient can make a big difference to outcomes. To ensure the patient is well managed the professional must first be lymphoedema aware and be able to early detect the potential for and real lymphatic failure.

Fluid accumulation in the tissues is one of the key signs of early lymphatic failure. But its appearance can be similar to that of systemic or local vascular or local venous system failure. Lymphoscintigraphy is the major test of a failing lymphatic system, but it should be ideally performed under a loaded lymphatic system to best show where and how it's failing. Both qualitative and quantitative aspects of a lymphoscintigram can be beneficial.

The diagnosis and remediation of other disorders and diseases, especially those of the vascular system, (which impact on lymphatic load), is crucial in those whose lymphatic system has been compromised and important even when a patient has a normally functioning lymphatic system.

Early recognition, intervention and appropriate referral are crucial for optimizing outcomes and in the sequencing and targeting of treatment.

This workshop/lecture will cover the key aspects of the identification of functional failure (or its potential) of the lymphatic system, and of the key attributes of its failure and the stages at which they present. Equipment and tools will be illustrated/demonstrated which will assist in accurate diagnosis.

Introduction/context

Generally the lymphatic system as a fluid drainage system is only functioning at about 10-15% of capacity so there is always a large reserve capacity. However, even a normal lymphatic system can fail to clear excessive fluid loads that might arise as a consequence of skin infections, CCF, CVI, hypertension, liver or kidney failure. Under these conditions the swelling is described as being “oedema”. However if the lymphatic system has accidentally been damaged by surgery or radiotherapy associated with cancer treatment or through harvesting of veins for cardiac repair, ligation or stripping of incompetent vessels then it may mean a reduced transport capacity then of the load on the lymphatic system is normal and it fails to clear its fluid load its called “secondary lymphoedema”. Further in some (particularly women) there are situations when lymphatic capillaries or collectors have not formed well and once lymph load starts to change for any reason then those collectors fail to remove fluids and a form of swelling called “primary lymphoedema” develops. These primary forms are categorized into three groups con-natal –(present at or slightly after birth), praecox (develops at puberty) and tardum (develops at 30-40 years of age). – forms. One of the biggest surprises is that the slight swelling that has appeared recently in the limb (or in a most inconvenient place such as the vulva or scrotum) is lymphoedema – it appears, because in that area, the ability of the lymphatic system to remove fluids and their contents is exceeded by the amount of fluid and materials awaiting removal. The further surprise is that its unlikely to resolve without some significant attention involving often a plethora of treatment and management programs, not all of which are well evidenced in scientifically rigorous studies. At best, the swelling may disappear, but on average it is reduced and at worst, it progresses insidiously. The third big surprise often it that it’s been some years since the surgery/radiotherapy. On the positive side however, is that early recognition and targeted treatment of the lymphoedema is likely to be relatively effective.¹

However for those without lymphoedema, its prevention by recognition and targeted response to the early pre-clinical signs of its appearance by education and some relatively simple management options are crucial.

What’s most important?

For those at assessed as being at any level of risk of lymphoedema, there is a delicate balance between making a person’s life miserable through a continual

focus on the “at risk” limb, trying to ensure that lymphoedema does not develop and allowing the person to live a normal life and not become fearful or paranoid about possible lymphoedema development. That is why it’s important to gauge who is at high, medium, low and no risk and to inform the patient appropriately. Generally a patient need not live for their limb but conduct a normal life with just a little more care and attention towards their limb.

Who gets lymphoedema and how many get it?

Rigorous experimental and clinical studies involving the lymphatic system and lymphoedema are few, as is its epidemiology, so many decisions about treatment and management are based on this relatively poor background. Notwithstanding this, the information, in most cases, is strongly supported by anecdotal evidence and based on reports of non controlled studies by experts in the field. ²

To develop swelling, there has to be a fairly significant damage to the lymphatic system in the affected area. It is believed that it is working at about 10% of its capacity at rest and that to show signs of failure, about 90% of the transport capacity must have been destroyed (as long as the lymph load is within normal range).³ has divided lymphatic failure into three categories. Mechanical insufficiency, in which there is a normal lymph load on a damaged (due to surgery/radiotherapy) lymphatic system, Dynamic insufficiency in which there is an increased load (due to high vascular permeability or high venous pressures for what ever reason) on a normal system and the very serious problem of an increased load on a damaged lymphatic system.

Lymphoedema of the legs and lower abdominal and genital area is a problem for men and women and this is an understudied area. Incidence/ prevalence rates vary greatly but range up to 60% of those who have had surgery and radiotherapy to the bowel/groin area.

What is Lymphoedema?

Subsequent to vein surgery/ligation/stripping (and in fact any other surgical intervention involving the soft tissues) there is a period of oedema – usually lasting up to 6-8 weeks. Its important to be aware if there have been any prior interventions to the lymphatic system locally or along its pathway to the exit point at the jugular/subclaviain junction since it means the load if additional fluids/metabolic wastes etc it can take are reduced potentially worsening the oedema and possibly provoking a range of tissue changes further compromising lymphatic drainage.

Lymphoedema, like venous oedemas, is generally a swelling of the compartment above the deep fascia of the musculature. ⁵ It’s rare to have any swelling in the

sub-fascial compartment due to the constraints of the deep fascia. Epi-fascially, initially it's a protein rich fluid (this environment attracts yet more fluids due to its osmotic action). As time progresses, there is an increase in the density and number of blood vessels, increases in adipocytes and changes in the populations of macrophages and fibroblasts and then finally an increasing fibrotic induration⁶. Additionally the higher than normal levels of protein mean a chronic sub-clinical grumbling inflammatory process and further swelling in the epifascial tissues.⁷ These events and the changes in the cell populations and their products lead to large and widespread changes. If left untreated, these changes to the cells in these tissues in the later stages may end up as Basal Cell Carcinoma (epidermal cells), melanoma (melanoblasts) fibrosarcomas (fibroblasts), liposarcoma (adipoblasts) or lymphangiosarcoma. But there is more to lymphoedema than the tissue changes and swelling.⁶ There are also associated problems of limb heaviness, discomfort, tension, aches and pains, loss of normal range of movement and muscle strength, which often are more of an issue for the patient than the swollen limb.⁸

These can be avoided if patients and practitioners are more aware of the risk factors leading to the swelling and its sequelae in the first place. Early recognition of pre clinical changes in the at risk limb are crucial, especially when we consider that on average there are about 2 years between the surgical/radiotherapeutical intervention and the appearance of clinically manifest lymphoedema.

The forms of lymphoedema

Not all lymphoedemas are a consequence of surgery or radiotherapy. About 3-10% are primary in nature and are caused by some congenital malformation (generally hypoplasia but sometimes hyperplasia) of the lymphatic system which can become apparent at birth (Nonne Milroy), puberty (Meige or Praecox) or in later life (Tardum).^{3,7} You and some patients may be surprised at the development of their lymphoedema after an apparently minor intervention, but an exploration of family history may expose this underlying lymphatic hypoplasia. Often lymphatic dysplasias are associated with vascular dysplasias so thinking broadly in any examination may disclose these other issues⁷.

Differential diagnosis- other reasons for a swollen limb

When a patient presents with a swollen arm (or an arm perceived to be at risk of swelling) then it's likely that its lymphoedema. However, when a patient presents with a swollen leg there are often reasons other than a disruption of the lymphatic system, why it might be swollen. The reason for this is that the drainage point of the lymphatic system of the legs, abdominal, thoracic and left arm is at the junction of the left sub-clavian/jugular veins. Any where along that pathway, drainage may be compromised, ranging from the effect of radiotherapy to the

supra-clavicular area or neck, through diaphragmatic hernias, to peritonitis (where the resulting adhesions may impede lymphatic drainage) or radiotherapy in the abdominal/groin area where by again fibrous tissue build up may constrain normal lymphatic drainage.⁹ In addition diet (especially longer chain fatty acids) may result in such large flow from the mesenteric area that lymph flow from the legs is impeded or worse, there is retrograde flow from the mesenteric area into the limbs called chylous reflux.

These other issues should at least first be identified and possibly dealt with prior to trying to deal with any of the lymphatic problems that might be afflicting the limb.

A range of other reasons might be encountered as well and examples include an underlying primary lymphoedema described above, or a Myxoedema, associated with a dysfunctional thyroid, which, if uncorrected, can lead to the accumulation of mucinoid like materials in the tissues which can attract fluids and lead to other lymphoedema like tissue changes. Other reasons for a swollen leg include Lipoedema which is the excessive accumulation of fatty subcutaneous tissues due to a metabolic fat disorder. It's easily distinguished from lymphoedemas by the fact that it usually affects both legs and is very symmetrical, there is usually no swelling of the feet, the limb bruises easily and often there is pain on indent pressure. There is often superficial spider venation and clear fat pads in the medial knee and lateral thigh. This condition may often be accompanied by obesity.⁶

Another is Oedema, which all of you are acutely aware of where by the excessive accumulation of fluids in the tissues is due to an excessive exudation of materials and fluids from the vascular system.¹⁰ The reasons, such as high venous pressure (due to CVI or CCF), hypertension and can often easily be corrected thus often dramatically reducing lymph load.

Phleboedema is also the excessive accumulation of fluids but associated with the problems of vascular fragility, inflammation of the blood vessel walls (phlebitis) and often-similar problems with the lymphatic system such as lymphangitis or lymphadenitis.³⁷

Generally, irrespective of the reason for changes in the amount of composition of the extracellular fluids the end point is the same, that is, excessive extracellular fluids, changes to their contents (most noticeably an increase in protein and other inflammatory and signaling molecules), changes in the ratios of the cells within it, and changes in their migration rates. As will be obvious, this may be due to an increased load on the lymphatic system (generally related to vascular problems) or a reduced transport capacity of the lymphatic system (generally related to its damage or destruction by surgery or radiotherapy or though its congenital malformation).

Risk factors to consider at presentation

Some of the observed factors will be within the patient's control and others outside of it. Those under their control are body mass, skin integrity, and activity levels – (with inactivity being the worst) and constrictive clothing (particularly underwear that has elastic across the line of the groin or abdominal area. In fact, any garment which exerts an external force on the lymphatics should be regarded as a potential risk factor simply because most of the superficial lymph collectors are relatively close to the surface and the pressure of lymph within them generally low. Since intra-lymphatic pressures are far lower than venous ones (in the range 5-15 mm hg) the impact of external local area compression can often have a very significant influence on lymph clearance from an area.

Signs to look for at presentation

One of the other major measures to determine if the limb is swollen is to perform a circumferential measurement. If the problem is a unilateral one then at first presentation a comparison can be made with the contra-lateral (normal) limb the progression of the limb can then be assessed against this baseline. If the problem is bilateral, then at best the measurements can be used as a base level, although acknowledging that your baseline may not be the beginning of the lymphoedema.

Given that most Health Professionals are short of time where is the best place to measure? Using a fixed reference point such as the mid point of the patella or ante-cubital fossa and measuring 20 cms proximal and distal is usually enough, although those dealing specifically with lymphoedema treatment will usually measure every 10 cm. For the fitment of a support garment often a 4.5 cm measurement interval is necessary. Stocking garment manufacturers often have different measurement schemes. It's best to allow a person such as a physiotherapist or massage therapist or other expert to organize for their fitment as detailed measurement and fitment can be time consuming.^{11, 12}

Assessment Tools and Techniques

The early detection and effective monitoring of the progress of any lymphoedema is a crucial aspect of its management. Many tools are not available to the health professional within their practice but generally available in major health centers and specialist clinics

Fluid

The major early sign (apart from the patient often commenting that the limb feels different) is the appearance of fluids in the limb or a part of it. If you don't wish to

use the pitting test there are a range of bio-impedance meters (both local area, segmental and whole body) which will give an objective measurement of extracellular fluids and their differences between the limbs to an accuracy of about 5 ml^{13, 14, 15}

Perometry is useful in determining limb volume changes (in segments as small as 4 mm) but it measures summated changes and not just those of fluid and while useful over the short term, longer term trends in fluids can be masked by changes in epi-fascial fat and or muscle.

The literature¹³ suggests that Bio-impedance spectroscopy can determine subtle (subclinical) accumulations of fluid in the tissues long before the patient is aware and before other instruments such as a perometer can reliably detect the changes in limb volume.

Fibre

If you do not wish to use the pinch and roll test in which the suspected tissue is held between the thumb and forefinger and gently rolled another objective means is by using a tissue tonometer which can record the resistance to compression to within 1 mm.¹⁶

Structual Status

Often in difficult cases it may be useful to get a larger picture of the problems facing the fluid removal from the affected limb. Among the other useful tools are Ultrasound to indicate the extent and spread of induration and assess changes to the fascias and depths of the compartments, MRI, to assess areas of fluid pooling, lymphocoeles and the larger lymph vessels as well as the distribution and spread of adipose tissues which are a characteristic of later stage lymphoedemas.

Functional Status

Perhaps the most useful tool to determine the functional status of the lymphatic system is lymphoscintigraphy which can indicate the residual lymphatic transport capacity.

You can do this through an examination of the rate of arrival of the injected radio-opaque tracer in the root of the extremity and the rate of clearance from the depot site. It's also useful for showing areas of dermal back-flow and for suggesting pathways that remain open which might be focussed on in massage treatment.

For some patients knowing what their risk is of developing lymphoedema can be determined by examining the transport index as indicated by lymphoscintigraphy.^{17, 18} If the report shows little or no influence of the surgery/radiotherapy on the lymph transport then the risk of them developing lymphoedema is low and they do not perhaps have to be as concerned as a person in which the transport index is significantly lowered.

All other measurements we make are a sign of a failing (or failed) lymphatic system, Lymphoscintigraphy is the only tool which can measure the functional status of the lymphatic system. To be useful in this functional assessment ideally the test should be conducted under a standard exercise/activity load since this is usually the time when the lymphatics show signs of failure¹⁸

Staging

An accurate and differential diagnosis which will eliminate non-lymphatic disorders/diseases will set the basis for and appropriate staging of the treatment for the lymphoedema.

One of the first aspects of the staging will be to determine if there are any regions of fibrotic induration (due to the surgery, radiotherapy or the progress of lymphoedema), which will not only greatly impair lymph drainage through the area but slow or prevent the regeneration of new lymphatic pathways through those regions. New lymph capillaries do not bud well through any form of fibrous tissue.

If fibre is detected, then an attempt to conservatively lessen the impact of the induration must be made. This will be likely to have a strong effect on improving lymphatic transport capacity. This may range from specific frictional massage to low level scanning or hand held laser treatment³⁶

Treatment options

The range is large and often confusing, but perhaps necessarily so. Each patient is different and each lymphoedema may have different factors determining its development and progression.²⁵ Often EBM findings do not fit into the individual patient treatment picture, but a strategy based on your experience or on the advice of other experts can help provide a balanced treatment pathway.

Conclusion

As long as there is damage to the lymphatic system and lymph nodes through surgery, radiotherapy, burns or motor vehicle accidents, there will be a risk of developing lymphoedema. Being aware of and reactive to any major risk factors is crucial if the risk of lymphoedema is to be reduced. The early detection of

lymphoedema also is important, and this can be done simply by listening to the patients comments about their limb, by simple tests such as the tissue pitting and pinch and roll tests and by basic circumference measurement. Techniques such as bio-impedance, tonometry and lymphoscintigraphy can provide some objectivity to any suspicions.

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General Information about lymphoedema, risk assessment charts, quality of life charts and treatment and management option details

DVD –CD Rom: The Vital Essence Understanding the lymphatic system in Health and Disease. For Health Professionals (2003) Available www.flinders.sa.gov.au/lymphoedema

