

## **Lymphoedema reducing its risk though early detection and treatment**

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### **Abstract**

Lymphoedema occurs when the lymph load is greater than the lymphatic transport capacity. The major causes are damage associated with surgery and or radiotherapy or a malformation of the lymphatic system. Between 10 and 30% of men and women develop lymphoedema with the prevalence relating to the extent of surgery and use of radiotherapy. Lymphoedema does not always develop immediately, on average it takes 3 years to become clinically manifest. On occasions however surgical, radiotherapeutical or tissue trauma oedema may be replaced by lymphoedema in a continuum. Assessment of risk level and its sub-clinical detection using bioimpedance are crucial to reduce the risk of the development of chronic lymphoedema.. Once formed, treatment and management is a life-time issue although some self management strategies and improving patient awareness of what they can do can make a big difference. Of crucial importance however is the concomitant diagnosis and remediation of cardio vascular and other non lymphatic issues which impact on lymphatic load. Included in these is an improved awareness of the impact that vascular related interventions such as surgery, ligation and harvesting may have on the nearby lymphatic system. The vascular specialist has an important role in early detection and differential diagnosis of lymphoedemas as well as ensuring referral to specialist lymphoedema therapists to assist in the sequencing and targeting of treatment.

### **Introduction**

One of the biggest surprises for the patient is that the slight swelling that has appeared recently in the leg associated with surgery/vascular ligation/radiotherapy or other tissue trauma failed to resolve and continued to worsen.. The reason is because 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 for the patient is that its unlikely to resolve without some significant attention involving often a plethora of treatment (health professional based) and management (self/partner based) programs. Once clinically manifest at best, the swelling may disappear, but on average it is reduced and at worst, it progresses insidiously. The third big surprise often the surgical/radiotherapeutical oedema resolves for a varying period of time but then returns with vengeance after some stimulus usually associated with some event which has added load to the lymphatic system such as an infection. On the positive side however, is that early treatment when there is early detection of the early stage of the lymphoedema is likely to be relatively effective. (Piller and O'Connor, 2006, reviewed Piller 2006)

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. Phlebologists can play an important role in this process by using simple techniques for the early detection of lymphoedemas (Reviewed Piller, 2007)

## **What's most important?**

For every person, not matter what the nature of the intervention, there is a risk of overloading a damaged or dysfunctional lymphatic system and of the development of chronic lymphoedema. There is always 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.

## **Incidence of lymphoedema**

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). Foeldi et al (2003) 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.

While figures are possibly a little inaccurate due to variable diagnostic criteria, about 10%-15% of women who have an axillary clearance and mastectomy, develop arm lymphoedema, but when radiotherapy is added it jumps to around 20-30%. Lymphoedema is a problem for men also and this is a very understudied area. When they have had bowel or prostate cancer, melanoma or other lower abdominal cancers requiring the removal of nodes and/or radiotherapy then they too are at a similar risk level. Leg lymphoedemas are generally more of a problem and harder to manage. The same applies to women with cervical and other reproductive system cancers. (Commonwealth Government Medical Services Advisory Committee Report 2004)

Some patients develop lymphoedema subsequent to varicose vein stripping or incompetent vein ligation if large lymph collectors in their adventitial layer are inadvertently damaged others develop it when veins are harvested for cardiac repair work.

## **What is Lymphoedema?**

Lymphoedema, like venous oedemas, is generally a swelling of the compartment above the deep fascia of the musculature. The swelling initially is a protein rich fluid (which attracts further fluids due to the protein's osmotic action). As time progresses, there is an increase in the density and number of blood vessels, increases in adiposites

and changes in the populations of macrophages and fibroblasts and then finally an increasing fibrotic induration. Additionally the higher than normal levels of protein mean a chronic sub-clinical inflammatory process and further swelling in the epifascial tissues. 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.

All of the above 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 the long average latent period prior to the appearance of clinically manifest lymphoedema.

### **The forms of lymphoedema**

About 3-10% of lymphoedemas 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). An exploration of family history may expose this underlying lymphatic hypoplasia.

### **When the swelling is not lymphoedema**

When a patient presents with a swollen leg there are often reasons other than a disruption of the lymphatic system in the immediate area, why it might be swollen.

If there is damage or constriction of the lymphatic collectors and or thoracic duct anywhere along that pathway to its exit point at the subclavian/jugular junction, drainage from distal areas may be compromised. Examples include: radiotherapy to the supra-clavicular area or neck, diaphragmatic hernias, peritonitis (where the resulting adhesions may impede lymphatic drainage), radiotherapy in the abdominal/groin area.

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. The area of diet and its role in exacerbating lymphoedema needs further research but there are relatively strong links.

When there is excessive accumulation of fluids in the tissues is due to high venous pressure (due to CVI or CCF), hypertension etc may excessively load the lymphatics.

The excessive accumulation of fluids associated with the problems of vascular fragility, phlebitis and often-similar problems with the lymphatic system such as lymphangitis or lymphadenitis can also excessively load the lymphatics..

In the main, irrespective of the reason for changes in the amount or 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 through its congenital malformation).

## **Risk factors**

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 and bra's which are under-wired and have narrow straps). 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 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.

Factors out of the patient's immediate control are the extent (level) of axillary or groin clearance and radiotherapy to the root of the extremity are certainly well established. Others also outside of their control but less well established are age, whether the intervention was on the dominant arm and to a lesser extent dominant leg, seroma duration, the number of drains and wound infection.

## **Signs**

If there is no swelling which can be measured objectively by a tape measure or some other means then it's worth testing if any part of the limb (particularly the distal part) shows signs of pitting. This is a sign of local area free fluid accumulation. Pitting may be observable before any circumference change is detected.

There may also be signs of tissue changes associated with the buildup of fatty tissue and fibrotic induration. These changes can often be detected by conducting a pinch and roll test by holding the affected tissues between the thumb and forefinger and gently rolling the tissues between them. Both of these tests are best done in consideration of the major lymphatic territories of the limbs. Even if these two tests show little or are equivocal then it's often worth asking the presenting patient if they have any subjective changes to the limb ie heaviness, tension, bursting pains and the like as these are signs of impending lymphoedema. .

## **Assessment of Fluids**

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. There are hand held bio-impedance meters which are made in Queensland (Impedimed) which will give an objective measurement of extracellular fluids and their differences between the limbs to an accuracy of about 5 ml. Ratios of change of impedance are also used in the more

basic instruments but all can inform of subtle tissue fluid changes up to 10 months before they can be detected by other detection means ( reviewed Piller 2007)

### **Assessment of 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 (BME, Flinders Medical Center) which can record the resistance to compression to within 1 mm. (reviewed Piller 2007)

### **Other Assessment forms**

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.

### **Assessment of the Functional Status of the Lymphatic System**

All the signs and symptoms we have discussed about are a consequence of functional changes in the lymphatic system but non of them actually measure it. The only tool in this respect is lymphoscintigraphy which can indicate the residual lymphatic transport capacity. It is able to 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 often 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. 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. (reviewed Keeley 2006)

### **When lymphoedema is detected or a patient is at high risk**

As a Specialist, often there is little that one can do to become actively involved in the treatments, other than as mentioned before in helping determine if there are other disorders or diseases (especially the vascular ones) which generally contribute to an increased load on the system. The role of the specialist can best relate to continuity of care in terms of a holistic monitoring of the patient's progress and possibly some staging, direction and coordination of the treatment program.

Those best to refer to are massage therapists, physiotherapists, nurses or occupational therapists who have trained in lymphatic massage.

Lymphatic massage is very different from all other forms of massage, its light, gentle and works by clearing accumulated lymph by helping load it into the lymph capillaries and then along the lymph collectors. Always the proximal parts of the limb are cleared first.

The core treatments and management strategies for lymphoedema revolve around education and awareness which are linked to the major factors which are known to facilitate a good control of the lymphoedema such as improving skin and wound care, reducing excess weight which reduce the load on the remaining lymphatic system, reducing exudation from the vascular system, through the use of sleeves and compression bandages and helping lymph to enter and move along the lymph collectors, through encouraging mild exercise and manual lymphatic drainage. The names of these programs are Complex Physical Therapy, Complex Decongestive Therapy, but the core underlying action is the massage – called Manual Lymphatic Drainage. There are a number of major lymphatic massage training groups in Australia including the Dr Vodder School which trains internationally.

## **Treatments**

There are a plethora of treatments and many review of their efficacy (Badger, et al 2004). However, not all of which have been well trailed and so it's hard to make strong recommendations about some of them (Bernas et al 2001). But if it's kept in mind that the strategies are to either increase the lymphatic transport capacity or reduce the lymph load then reasonable results are likely.

### **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 though any form of fibrous tissue.

If fiber 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 treatment.

### **How do you/your patient know that the treatment is working?**

At first the limb may feel better (less heaviness and tension and bursting pain) and may become softer and later it may show a decrease in circumference or volume. There may be improvements in range of movement.

## 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. 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.

**Antibiotics** – useful when an infection is present – and infections are common in lymphoedema patients, as often their specific and general defense systems are compromised in the affected limb.

**Benzopyrones (Flavonoids)** - experimental and some clinical trial evidence indicates that some members assist in the removal of accumulated protein and fluid while others may slow the leakage from the vascular system or improve lymphatic function. The most common ones are Paroven and Lymphodran although there are certainly others including Bruise and Vein Capsules marketed through a range of CAM groups.

**Compression Bandaging** - Low stretch bandages are commonly applied between intensive lymphatic massage treatment programs and often worn overnight. Often uncomfortable but they do help reduce exudation of additional fluids from the vascular system. (Badger et al 2004)

**Compression Garments** – for most patients whose lymphatic transport capacity cannot be improved significantly these are the mainstay of lymphoedema management. These reduce the exudation of fluids from the vascular system. There are two basic groups of garments – made to measure (for unusual shaped limbs) and off the shelf (for the average type of swollen limb). The later are often available from chemists while the former are made on order through garment manufacturers. Often it's better to refer to a physiotherapist or massage therapist for garment measurement. Subsequent to fitment, care has to be made to ensure a pressure gradient from distal to proximal and the exerting of an appropriate pressure on the limb. It's important to watch for distal limb swelling though the wearing of poorly fitted garments. Garments seem to be more effective when combined with mild forms of exercise.

**Compression pumps** – These generally administer variable external pressure supplied by an air pump. Pumps may have between 1 and 12 chambers. Care must be taken if they are to be used since there is a small risk of pushing fluids from the affected limb into its root or worse, into the genital area. Often fibrous bands can develop around the root of the extremity. These may compromise future drainage from the limb.

**Diet** - Long chain triglycerides (Fatty acids) are dependant on the lymphatic system for their absorption from the intestine and thus an attempt to reduce or at least monitor their intake may firstly help reduce lymph load in this area and reduce the risk of the retrograde flow of chyle into the lower limbs producing chyle filled papillomati and reduce the risk of chylous ascites.

**Diuretics** – Often wrongly prescribed for pure lymphoedemas. Do have benefit if there is an underlying oedema however. If a withdrawal of diuretics from a patient with lymphoedema is contemplated then it should be done slowly over time. Diuretics have no effect on the proteins accumulated in the tissues or on lymph flow.

**Elevation**- Valuable at any time, especially in the earlier stage lymphoedemas when the limb is predominantly fluid rich. Works more effectively when combined with exercise and variation in intra-thoracic pressure associated with deeper than normal breathing. This pressure variation seems essential to facilitate optimal clearance of lymph from the capacitance vessels in the abdominal and thoracic areas thus establishing a better pressure gradient to the limbs (particularly the legs).

**Exercise** – Whatever the form, can be very beneficial. Exercise will generally help vary the tissue pressures and so help fluids and their contents to enter the lymph capillaries and to move along them into the lymph collectors which normally pulsate at 6-10 beats per minute. Clearing materials from the interstitial spaces effectively is crucial in all lymphoedemas (and oedemas) so that optimal oxygen levels and effective waste product clearance are achieved.

Exercises do however need to be planned and it's very important for the patient to warm up and cool down appropriately. Some exercise programs have been clinically trialled and most convey some benefit and certainly none have been shown to cause harm. Often the question is asked – how much exercise? Well there is no answer – some women with lymphoedema play A grade tennis, others participate in dragon boat races. The important point is to warm down slowly and in some instances to wear a support sleeve or stocking if the lymphatics are unable to handle the additional lymph load. Recent studies have shown that even strenuous exercise does not always worsen lymphoedemas. (Johansson and Piller 2006)

One exercise program which has been shown to be beneficial is that of a combination of a Tai Chi and Qi Gong like regimen. These have been shown to be particularly beneficial for upper limb lymphoedemas. One trial has shown that the combined variation in tissue pressure brought about by variation in muscular tone and the establishment of a pressure gradient to the major lymph ducts though increased depth of respiration significantly reduces arm lymphoedema. (Moseley, Piller and Carati, 2005)

**Exercise facilitating machines** – For some patients who do not wish to undertake a formal group exercise program there are a range of home user friendly exercise machines. Few have been clinically tested, although one trial was able to show a machine which helped change tissue pressures by passive movement to be of significant benefit for those with lower limb lymphoedema. (Moseley et al 2002)

**Hydrotherapy** – This water based exercise program is useful especially for lower limb lymphoedemas although the YMCA based Encore program for women who have had breast surgery is very beneficial and available Australia wide. The gentle supported movement and external pressure gradient from the surrounding water assist



lymph flow to the root of the extremity. Hydrotherapy programs are also beneficial to improve range of movement and limb mobility. (Box et al 2004)

**Low Level Laser** – There is considerable experimental and some clinical evidence in the form of a double blind cross over trial (which tested the Rian Corp Hand held laser), that low level laser treatment is useful in reducing lymphoedemas. The exact mode of action is under investigation but some known effects include stimulatory action on macrophages, antibacterial effects and a tendency to make lymph collectors pump faster. It is hypothesized that laser also helps break up collagen's tissues allowing better flow through of fluids and materials through the tissues thus improving lymph drainage.(Carati et al, 2003,

**Massage** – The arms and legs and body superficially are divided up into a number of lymph territories. Specialized forms of lymphatic massage have been developed to help move lymph from territories which are blocked to those which have still a patent system. The major type of lymphatic massage is called Manual Lymphatic Drainage. Its often combined with other treatments listed here such as bandaging and skin care and exercise programs where it is called complex lymphatic therapy or complex decongestive therapy or one of a multitude of other names. Lymphatic massage is gentle and light. Often the massage is also combined with essential oils such as lavender which has evidenced antibacterial effects. Tea tree oil has also similar properties but trials on lymphoedema are still underway.

**Massage pads and massage tools** – For the patient who cannot afford the necessary professional massage or for times between professional massage, often the alternate is a home based equivalent. There are a variety of massage pads and aids not all of which have been clinically tested but anecdotally most seem to have some benefit and none do harm. A clinical trial on a Niagara pad has shown it to be beneficial in chronic secondary leg lymphoedemas.

**Electrical stimulation of lymphatic and skeletal smooth musculature** – This recent innovation exploits the fact that there are two components (myogenic and neurogenic) to the determination of lymph flow. Electrical stimulation of the smooth musculature of the lymphangions encourages more forceful (and regular) contraction and thus is believed to improve lymph flow. A recent clinical trial at Flinders Medical Centre has shown this treatment to be beneficial for patients with secondary leg lymphoedemas and will be discussed in more detail at this congress. (Piller et al 2008 in press)

**Skin care** –One of the significant leverage points in the treatment of lymphoedema is to reduce the load on the compromised lymphatic system. Improving the quality of the skin as a barrier through improved skin care by whatever appropriate means is crucial. A commonly used beneficial cream is Sorbolene although any with aloe vera and vitamin E are often as effective. Care must be taken as many creams significantly reduce the life of support garments.

**Other treatments** - There are a plethora of other treatments and just because they are not presented here does not mean they do not work. Most are conservative and many have not been clinically trialled but have strong anecdotal evidence of their effectiveness. When conservative treatment fails there are a range of surgical

techniques, including, microsurgery, excisional operations and various forms of liposuction. Recent developments in the later techniques which avoid damaging further the lymphatic system collectors have shown promising results (Brorson 2005).

If there are problems finding the right therapists then a call to the local patient support group in your state may help as might a check with web sites of the Lymphoedema Association of Australia, the Australian Lymphology Association, the Dr Vodder School web site or your nearby hospital which may have a lymphoedema clinic.

## Gaining a good outcome for your patient

Review the patient's prior surgical, medical and family history for factors which may have impacted on lymphatic transport

### **For Those with Clinically Manifest Lymphoedema**

Exclude or include other reasons for the apparent changes in the limbs

Measure the limb - how big and different is it?

Encourage self-measurement of the limb

Ask for comments about the limb - how different does it feel?

Separate factors that are a consequence of the surgery and radiotherapy from those due to lymphoedema development or its progression

Treat (or refer for treatment) non-lymphatic related reasons for limb swelling

Indicate the range of treatments for their lymphatic issues

Refer to experts for further lymphoedema assessment and treatment

Be aware that Lymphoedema massage techniques are very different from normal massage

Review at 6 to 12 month intervals – be alert for events which may have changed load on or transport capabilities of the lymph system

### **For those at risk of lymphoedema**

Assess and review risk factors – particularly those which may increase lymphatic load

Measure the limb – this may be a useful future baseline measurement

Encourage self-measurement of limb – perhaps monthly

Encourage attendance at Lions free screening programs

Provide educational material relevant to risk reduction management

Reduce the impact of any factors which may be increasing lymphatic load

Encourage early reaction to the perception of any changes in size or how the limb feels

Encourage review at intervals between 6 and 12 months with a higher frequency for higher risk category patients

## **Major factors affecting lymph load and transport**

### **Factors which may increase lymph load**

Elevated Blood pressure

Inflammatory events  
Poorly functioning vascular system especially on the venous side  
Being obese or overweight  
Poor skin care  
Over activity, especially repetitive actions  
Infections which are not treated  
A diet rich in long chain triglycerides (Fatty Acids)  
Sunburn  
Becoming overheated

### **Factors which may reduce lymphatic transport**

Being obese or overweight  
Being immobile  
Constrictive clothing or undergarments (especially in the groin or axillary areas)  
Chronic inflammatory disorders and skin conditions

### **Factors which may increase lymph transport capacity**

Gentle or moderate exercise – with warm down period  
Occasional deeper respiration than normal  
Water based exercise programs  
T'ai Chi and Qi Gong type of exercise programs

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