Demystifying Lymphedema: Development of the Lymphedema Putting Evidence Into Practice® Card

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Cancer treatment is the leading cause of lymphedema in developed countries. Development and severity of lymphedema have a significant impact on comfort, psychological distress, and overall quality of life. Incidence statistics have ranged from 5%–60%, with onset of symptoms ranging from immediately after treatment to 30 years after treatment. Oncology nurses caring for patients throughout the cancer trajectory have a critical role to play in early assessment of risk, prompt identification of lymphedema, and implementation of evidence-based, individualized treatment plans in collaboration with therapists. As part of an Oncology Nursing Society (ONS) project team, the authors of this article undertook a review of current literature to identify effective interventions for the treatment of secondary lymphedema. Following the guidelines established by the ONS Evidence-Based Practice Resource Team, the authors evaluated current clinical practice guidelines, systematic reviews, and research studies conducted since 1998. The team reviewed and synthesized the literature and developed evidence tables and a Putting Evidence Into Practice® (PEP) card. The data were reviewed by experts in the field of lymphedema management. The lymphedema ONS PEP card, a user-friendly, succinct summary of interventions, was released at the 33rd Annual ONS Congress in May 2008.

Lymphedema is caused by a disruption or malformation of the lymphatic system that results in high-protein swelling of the affected body part. Although it may be acute or chronic, transient or progressive, lymphedema often is seen clinically as a chronic, progressive condition starting with seemingly innocuous superficial swelling that waxes and wanes. If left untreated, lymphedema may evolve into a permanent, disfiguring condition which is manageable but no longer reversible or curable.

Primary lymphedema has no known acquired causes and develops from an insufficiency in structure and/or function of the lymphatic system. The insufficiency is characterized by a failure of the lymph system to keep up with the lymph load demands of the affected body part. Secondary lymphedema is more common and, in developed countries, often is caused by surgical removal of lymph nodes or the use of radiation on lymph nodes during breast cancer treatment. The staging and treatment of cancers of the head and neck, ovaries, vulva, prostate, and any other cancer that may involve removal and/or irradiation of lymph nodes for managing disease also can trigger secondary lymphedema. Lymphedema is the result of hydrophilic protein congestion of the interstitial spaces in the tissues of the limb(s) or trunk (Mortimer, 1998), causing swelling of the affected area (see Figure 1). Primary and secondary lymphedema can be treated with similar approaches (Foldi, 1998).

At a Glance

- Although lymphedema may be a prevalent, debilitating outcome of cancer therapy, knowledge of lymphedema, its treatment, and how to reduce risk is increasingly available.
- Evidence supports early lymphedema diagnosis and referral for therapies to reduce patient burden.
- A ready-to-use synthesis of evidence-based information assists nurses in answering patient questions about lymphedema.

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Lymphedema may cause debilitating, distressing, and disfiguring changes (Armer, Radina, Porock, & Culbertson, 2003; Foldi, 1998; Ridner, 2002) at every stage (see Table 1). Early recognition and treatment of lymphedema provide optimal outcomes and may alleviate or minimize the physical and emotional burden of the condition. More than 2.47 million breast cancer survivors living in the United States (Ries et al., 2007) are at risk of developing lymphedema after treatment. The occurrence of lymphedema after breast cancer treatment has been estimated to be 5%–60%, with some onset as late as 30 years after treatment (Armer & Stewart, 2005; Petrek & Heelan, 1998). If the estimate of lymphedema incidence is set at 25%, more than 600,000 breast cancer survivors would be affected.

Most of the research to date has focused on upper-extremity lymphedema following breast cancer treatment. Relatively few research-supported interventions exist for lymphedema in other areas of the body. Despite the pervasive risk of lymphedema following treatment, research is lacking to support many of the clinical recommendations proposed to reduce the risk of lymphedema or prevent its progression to more advanced and permanent stages (Ridner, 2002).

Lymphedema may initially be dismissed as swelling, discomfort, and inflammation after surgery. Other early indications of lymphedema include self-reported sensations of heaviness, swelling, tingling, fatigue, or aching (Armer et al., 2003). In addition, axillary paresthesia and pain in the breast, chest, and arm have been reported as symptoms of lymphedema (Bani et al., 2007), although they also may be associated with other after-treatment effects. Given the common and seemingly transient nature of early-onset lymphedema, patients and providers often ignore the early warning signs and deny their significance.

Table 1. Stages of Lymphedema

STAGE	DESCRIPTION
0	Subclinical or pre-lymphedema. Typically includes all patients who have had lymph node dissection. Swelling is not evident, although impaired lymph flow is present. The stage may last for a long time.
I	Accumulation of fluid and protein in tissue is present. Elevation may influence the limb; pitting may be present.
II	Includes swelling that does not reduce with elevation; pitting is present with fibrosis.
III	Fibrotic tissue has indiscernible pitting; includes skin thickening and large limb volume known as elephantiasis, a morbid condition where lymphstasis and chronic inflammation develop into fibrosclerosis and additional tissue swelling (Foldi, 1998).

Note. From "The Diagnosis and Treatment of Lymphoedema. Consensus Document of the International Society of Lymphology," by the International Society of Lymphology, 2003, *Lymphology, 36*(2), pp. 85–86. Copyright 2003 by the International Society of Lymphology. Adapted with permission.

Figure 1. Legs of Caucasian Male With Right Leg Affected by Lymphedema

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This article was developed out of a need to have nurses take notice of complaints often regarded as minor and to offer appropriate evidence-based interventions for reducing risk of and treating lymphedema.

In a study of 263 patients with lymphedema, Jeffs (2006) found that 156 (59%) patients developed symptoms within the first year after surgery, but only 92 (35%) of the patients sought assistance from a specialist within three months of symptom onset. Twenty-nine patients (17%) delayed treatment longer than 12 months from onset because of a lack of awareness of their condition or therapy options. Increasing awareness and access to trained therapists have the potential to reverse the deleterious effects of delayed treatment.

The authors of this article critically reviewed the literature to identify and evaluate evidence-based interventions for cancer-related secondary lymphedema. The goal was to accurately describe lymphedema, its myriad consequences, and evidence-based interventions so oncology nurses can confidently identify patients who are at risk for or who are experiencing early-stage lymphedema and recommend prompt and effective interventions.

Methods

The Oncology Nursing Society's (ONS's) Lymphedema Putting Evidence Into Practice® (PEP) team consisted of two advanced practice nurses, two staff nurses, and a nurse researcher. The team undertook a thorough review of current literature to identify effective interventions for the treatment of secondary lymphedema. The evidence-based review consisted of evaluation of current clinical practice guidelines, systematic reviews, and research studies reported from 1997–2007. Search engines used

included MEDLINE®, the National Library of Medicine's database, CINAHL®, CancerLit, and the EBM-Cochrane database. Some 218 articles were extracted, reviewed, and categorized with the ONS Weight of the Evidence classification system (see Table 2).

Detailed evidence tables were created, reviewed, and weighted following PEP team reviews and conference calls from August to November 2007. An ONS PEP card was developed based on this review, externally reviewed by experts in the field of lymphedema management, revised, and finalized in May 2008. A detailed list of defined terms is available at www.ons.org/outcomes/volume4/anxiety.shtml (see Table 3).

Many studies investigating interventions for the treatment of lymphedema are limited by small sample size, lack of control groups, and limited follow-ups. The rigors of current therapies also may pose considerable challenges for patients and clinicians alike as they are dependent on access to lymphedema therapists.

Effective Interventions for Reducing the Risk for and Promoting Treatment of Secondary Lymphedema

Recommended for Practice

Complete decongestive therapy: Complete decongestive therapy (CDT), also recognized in the literature as complex decongestive physiotherapy and complex physical therapy, is the recommended treatment for lymphedema. CDT combines multiple modalities with the purpose of achieving the maximum possible swelling reduction in a limb or affected body area. Several studies support the use of CDT for the treatment of lymphedema (Browning, 1997; Moseley, Carati, & Piller, 2007). In addition, rigorously developed practice guidelines support the use of CDT (Lymphoedema Framework, 2006; National Lymphedema Network Medical Advisory Committee, [NLN MAC], 2006).

CDT is a two-phase therapy which initially includes an intensive phase when the limb volume is reduced during treatment by a therapist (NLN MAC, 2006) and a maintenance phase when the patient is instructed in self-management.

The intensive phase is comprised of five components or modalities: manual lymph drainage (MLD); compression applied through short-stretch compression bandages and compression garments; meticulous skin and nail care; remedial exercise; and education in self-care. The maintenance phase consists of simple lymphatic drainage, nightly compression bandaging (CB), daytime use of compression garments, skin care, and exercise.

CDT reduces congested interstitial lymphatic fluid and excess limb volume and has been shown to improve shoulder range of motion (Didem, Ufuk, Serdar, & Zumre, 2005; Szuba, Achalu, & Rockson, 2002) and decrease pain (Hamner & Fleming, 2007; Moseley et al., 2007). Hamner and Fleming reported that 76 of 135 patients (56%) had pain associated with their lymphedema. After CDT, 56 of the 76 patients (74%) were pain free. However, the study was retrospective and did not distinguish stage

Table 2. Putting Evidence Into Practice® Weight-of-Evidence Classification Schema

WEIGHT-OF-EVIDENCE CATEGORY	DESCRIPTION	EXAMPLES
Recommended for practice	Effectiveness is demonstrated by strong evidence from rigorously designed studies, meta-analyses, or systematic reviews. Expected benefit exceeds expected harms.	At least two multisite, well-conducted, randomized, controlled trials (RCTs) with at least 100 subjects Panel of expert recommendation derived from explicit literature search strategy; includes thorough analysis, quality rating, and synthesis of evidence
Likely to be effective	Effectiveness has been demonstrated by supportive evidence from a single rigorously conducted controlled trial, consistent supportive evidence from well-designed controlled trials using small samples, or guidelines developed from evidence and supported by expert opinion.	One well-conducted RCT with fewer than 100 patients or at one or more study sites Guidelines developed by consensus or expert opinion without synthesis or quality rating
Benefits balanced with harms	Clinicians and patients should weigh the beneficial and harmful effects according to individual circumstances and priorities.	RCTs, meta-analyses, or systematic reviews with documented adverse effects in certain populations
Effectiveness not established	Data currently are insufficient or are of inadequate quality.	Well-conducted case control study or poorly controlled RCT Conflicting evidence or statistically insignificant results
Effectiveness unlikely	Lack of effectiveness is less well established than those listed under not recommended for practice.	Single RCT with at least 100 subjects that showed no benefit No benefit and unacceptable toxicities found in observational or experimental studies
Not recommended for practice	Ineffectiveness or harm clearly is demonstrated, or cost or burden exceeds potential benefit.	No benefit or excess costs or burden from at least two multisite, well-conducted RCTs with at least 100 subjects Discouraged by expert recommendation derived from explicit literature search strategy; includes thorough analysis, quality rating, and synthesis of evidence

Note. Based on information from Mitchell & Friese, n.d.

Table 3. Definitions of Lymphedema Terms

TERM	DEFINITION
Bioimpedence	Measures tissue resistance to an electrical current to determine extracellular fluid volume
Body mass index (BMI)	A number calculated from a person's weight and height. BMI provides a reliable indicator of fat content for most people and is used to screen for weight categories that may lead to health issues. Elevated BMI may affect risk for development for lymphedema following cancer treatment and impact progression and management of lymphedema (Centers for Disease Control and Prevention, 2008).
Cellulitis	An infection that spreads freely, quickly, and uncontrollably within the deeper tissues of the skin. Cellulitis becomes a life-threatening emergency when it spreads through the lymphatic or circulatory systems and can reach vital organs and other body parts (lymphangitis), requiring prompt treatment with antibiotics. Cellulitis usually is caused by the bacteria *Staphylococcus aureus* (Lymphatic Research Foundation, 2006).
Complete decongestive therapy (CDT)	The system of lymphedema treatment that includes manual lymph drainage (MLD), compression techniques, exercise, skin care, and self-care training (Lymphatic Research Foundation, 2006). CDT is comprised of an initial reductive phase (phase I), followed by an ongoing, individualized maintenance phase (phase II). Components include MLD; multilayer, short-stretch compression bandaging (CB); remedial exercise; skin care; education in self-management; and elastic compression garments (National Lymphedema Network Medical Advisory Committee [NLN MAC], 2006).
Compression garment	A knit, two-way stretch sleeve or stocking that is worn to assist in controlling swelling and to aid in moving lymph from the affected area. A compression garment is worn only while the patient is awake and active (Lymphatic Research Foundation, 2006). The garment should be individualized for each patient.
Erysipelas	A painful skin infection that affects the skin plus the subcutaneous tissues and lymphatic structures that are located just under the skin (cellulitis affects the deeper tissues). Erysipelas also requires prompt treatment with antibiotics and is caused by streptococci bacteria. Erysipelas rapidly invades and spreads through the lymphatic vessels, damaging the lymph vessels and increasing the formation of fibrosis in the affected tissues. Erysipelas is one of the most common complications of lymphedema and tends to recur; correlated with stage of lymphedema (Lymphatic Research Foundation, 2006).
Exercise (low intensity)	Although activity and exercise may temporarily increase fluid load, appropriate exercises may enable the patient with lymphedema to resume exercise and activity while minimizing the risk of swelling exacerbation. Compression garments or CB must be used during exercise to counterbalance the excessive formation and stasis of interstitial fluid (NLN MAC, 2006). Exercise plans must be individualized for each patient. See NLN MAC (2008b) guidelines for specific suggestions. Lymphedema exercises (decongestive) are a standard and integral part of phase I and phase II CDT programs for individuals with lymphedema (NLN MAC, 2006).
Infrared perometry	Perometry using infrared light beams to measure the outline of the limb, which then can be used to estimate limb volume
Lymphangitis	A potentially life-threatening bacterial infection involving the lymphatic vessels that may spread to the bloodstream; sometimes associated with cellulitis (Lymphatic Research Foundation, 2006).
Lymphedema	A progressive, chronic condition that may appear as swelling of one or more limbs and may include the corresponding quadrant of the trunk. Swelling also may affect other areas, such as the head and neck, breast, or genitalia. Swelling occurs from an accumulation of fluid and other elements (e.g., subcutaneous fat, protein) in the tissue spaces because of an imbalance between interstitial fluid production and transport (usually low output failure) (International Society of Lymphology, 2003). Lymphedema arises from congenital malformation of the lymphatic system or damage to lymphatic vessels and/or lymph nodes (Lymphoedema Framework, 2006). The leading cause of lymphedema in the United States is cancer and its treatment (NLN MAC, 2006).
MLD	A treatment technique that uses a series of rhythmic, light strokes to reduce swelling and improve the return of lymph to the circulatory system (Lymphatic Research Foundation, 2006). The technique encourages fluid away from congested areas by increasing activity of normal lymphatics and bypassing ineffective or obliterated lymph vessels. MLD is widely advocated, but little research data conclusively support its use (Badger, Preston, Seers, & Mortimer, 2004; McNeely et al., 2004; Williams, Vadgama, Franks, & Mortimer, 2002; Woods, 2003). The most appropriate techniques, optimal frequency, and indications for MLD, as well as the benefits of treatment, have not been clarified. MLD is a specialist's skill that requires regular practice to maintain competence. Deep, heavy-handed massage should be avoided because it may damage tissues and exacerbate edema by increasing capillary filtration (Lymphoedema Framework, 2006).
Multilayer or CB	A specialized form of compression used in the treatment of lymphedema. Bandages are the most effective and flexible form of compression, particularly in the early stages of treatment. Bandages provide proper compression when the patient is active or when the patient is resting. They can also be easily adjusted to fit changing limb size and compression needs (Lymphatic Research Foundation, 2006). Multiple layers of short-stretch bandages are applied to the

(Continued on next page)

Table 3. Definitions of Lymphedema Terms *(Continued)*

TERM	DEFINITION
Multilayer or CB *(continued)*	lymphedematous area(s). Short-stretch bandages have limited extensibility under tension (50%), in contrast to Ace® (Becton, Dickinson and Co.) bandages (300%). To achieve an effective compression gradient, bandages must be strategically applied with low to moderate tension using more layers in the distal portions of the affected limb(s). Pressure within the short-stretch bandages is low when the patient is inactive (resting pressure). Muscle contractions increase interstitial pressure (working pressure) as muscles expand within the limited volume of the semi-rigid bandages. Interstitial cycling between low-resting and high-working pressures creates an internal pump that encourages movement of congested lymph along the distal to proximal gradient created by the bandaging. The non-elastic bandage sheath also counters refilling of fluid and reduces tissue fibrosis, adding more volume reduction (Lymphoedema Framework, 2006; NLN MAC, 2006).
Pneumatic compression pump	This is the basic component of intermittent pneumatic compression, a widely used technique where an electrical air compression pump is attached to an inflatable plastic garment that is placed over the affected limb. The garment is inflated and deflated cyclically for a set period, usually about 30–120 minutes. The pressure produced by the garment can be varied. Garments may be single chambered or contain multiple chambers (usually 3, 5, or 10) that are inflated sequentially to provide a peristaltic massaging effect along the length of the limb (Lymphoedema Framework, 2006).
Simple lymphatic drainage	Simplified self-massaging techniques that normally take about 20 minutes and are done daily. Physical therapist or other specialist also can teach a partner, friend, or relative how to perform the massage (Activa Health Care, n.d.). The technique incorporates simplified hand movements in a set sequence, which work across lymphatic watersheds toward functioning lymphatics. Treatment is mainly to the neck and trunk area, although the limb may be treated depending on patient need and the condition of the limb. No oils or creams are used (British Lymphology Society, 1999).

Note. Based on information from Oncology Nursing Society, 2008.

of lymphedema, timing of referral, or factors that may make therapy less effective or pain more significant. Moseley et al. reviewed three studies that reported subjective symptom improvement after CDT, but none reported long-term follow-up. In all, Moseley et al. reviewed nine studies reporting lymphedema improvement after about one month of CDT.

Positive therapeutic outcomes have routinely been documented when trained therapists provided CDT (Lymphoedema Framework, 2006; McNeely et al., 2004). Experts typically recommend comprehensive CDT when lymphedema is moderate to severe (Jeffs, 2006; Koul et al., 2007; Lymphoedema Framework; Moseley et al., 2007). When lymphedema is detected early or symptoms are mild, CDT may be modified to exclude one or two of the five modalities (Koul et al.; Lymphoedema Framework; Moseley et al.). Modifying CDT also may be appropriate when a patient is unwilling or unable to participate in comprehensive CDT (Jeffs). The lymphedema therapist will be knowledgeable in ways to appropriately modify the therapy (NLN MAC, 2006).

Early treatment of lymphedema with CDT is less costly and burdensome to the patient and yields far better outcomes (Hamner & Flemming, 2007; Jeffs, 2006; McNeely et al., 2004; Moseley et al., 2007). In one well-designed, randomized, controlled trial by McNeely et al., when MLD with CB was compared to CB alone, a significantly larger relative reduction in arm volume was seen in patients with mild lymphedema versus chronic lymphedema, regardless of therapeutic intervention. Because most research has focused on breast cancer–related lymphedema, additional research is needed to assess the benefits of CDT for different oncology populations and to tailor the therapy to their unique needs.

Compression bandaging: CB is a systematic application of short-stretch bandages with various types of padding. Wraps are applied with moderate tension at the distal portions of the affected limb(s), gradually decreasing to low tension in the more proximal portions. CB is distinguished from elastic bandaging because of the relative inelasticity of the special bandaging material used in CDT. The special bandages are known as short- or low-stretch versus the high-stretch material of the more familiar elastic bandages. This type of bandaging is physiologically correct for the purpose of reducing volume of lymphedematous limbs and is less likely to cause injury from excessive pressure. CB is used 24 hours per day during intensive therapy. Bandages are used nightly in combination with a daytime compression garment during maintenance therapy.

Research supports the use of CB alone to reduce swelling (Lymphoedema Framework, 2006). In a study by Jeffs (2006), patients who had received CB and MLD achieved a 40% reduction, whereas patients who had only CB achieved a 25% reduction.

In a well-designed, prospective, randomized, controlled trial by McNeely et al. (2004), patients who had four weeks of CB, with (n = 21) or without MLD (n = 24), experienced a significant reduction in limb volume. A major finding was the significantly larger reduction in the MLD with CB group for subjects with mild lymphedema (n = 7) compared to subjects in all other subgroups (n = 38). In addition, the study found that the greatest benefits occurred after two weeks of daily treatment, supporting the use of CB as an intervention for lymphedema, potentially conserving time, energy, and resources. The few studies that examined CB with and without MLD validate the contribution of CB to managing lymphedema and provide evidence of value added with MLD.

In a prospective cohort by Vignes, Porcher, Arrault, and Dupuy (2007) (N = 537), nonadherence with low-stretch bandaging and elastic sleeves were risk factors for progression of lymphedema after one year of maintenance treatment. Continued use of low-stretch self-bandages allowed additional volume reduction during maintenance therapy, compared to no use of bandages. Unfortunately, patients often resist bandaging and the wearing of elastic compression garments. Bani et al. (2007) provided patients (N = 742) with information about compression

sleeves or garments, but use did not increase. Adherence with effective self-care interventions is an area ripe for additional research to help improve outcomes and quality of life in cancer survivors.

Infection treatment: Patients with lymphedema are at increased risk for infection. Cellulitis, an acute infection of the skin and underlying tissue that is characterized by painful swelling, erythema, and heat, often is caused by normal skin flora entering through a break in the skin (Braunwald et al., 2001). The most common cause of infection in the lymphedematous limb is group A hemolytic streptococcus bacterium or *Streptococcus pyogenes*, although the emergence of *Staphylococcus aureus* co-infection, particularly with concerns for methicillin-resistant *S. aureus*, and co-infection with numerous other organisms, must be considered in at-risk populations (Bernard, 2008; Lymphoedema Framework, 2006). Erysipelas is an acute superficial non-necrotizing dermal infection caused by *S. pyogenes* that is characterized by rapid onset of fiery red edema of the affected extremity with well-defined indurated borders (Bernard; Braunwald et al.). Despite effective treatment, generally with penicillin-based therapies, swelling may persist. Immediate attention to signs of infection and prompt initiation of antibiotic therapy are critical to preventing sepsis. Antibiotic coverage should include coverage for strep and staph species. Careful history of trauma and injury is important, although, in many cases, no injury is apparent. The presence of comorbidities, age, neutropenia, and allergies will determine antibiotic choices.

Antibiotics for first-line treatment include penicillin-based therapies (if no history of allergy exists), either orally (if no signs of systemic infection are seen) or by IV. Oral penicillins, such as amoxicillin and dicloxacillin, often are used and continued for a period of no less than 14 days or until inflammation has resolved. For patients with penicillin allergy, clindamycin or clarithromycin may be used (Bernard, 2008; Lymphoedema Framework, 2006). Consult with infectious disease colleagues regarding antibiotic choices, particularly in the case of recurrent infection. One of the most common errors made when treating an infection in the lymphedematous limb is too short of a treatment course. At least a 14-day course of antibiotic therapy after an acute episode has responded clinically is recommended (Lymphoedema Framework); it may take one to two months of therapy for symptoms to completely resolve in some patients.

Antibiotics should begin as soon as possible. Criteria for hospital admission include presence of

- Fevers, hypotension, tachycardia, confusion, or vomiting
- Continuing symptoms despite oral antibiotics for 48 hours
- Unresolved local symptoms despite the use of first- and second-line oral antibiotics.

Simple lymph drainage and MLD should be avoided during acute infection with fever. If tolerated, reduced-tension compression garments or CB may be applied. Prolonged periods without compression should be avoided (Lymphoedema Framework, 2006), and Bernard (2008) suggested aggressively initiating treatment after infection to decrease edema. Recurrent infections occur in up to 20% of patients (Bernard); the most frequent reason for treatment failure is lack of adherence with prescribed drug regimen. Reducing underlying edema may assist in reducing the risk of recurrent infections (Bernard). Patients with a history of lymphedema and prior cellulitis (see Figure 2) should routinely have a two-week supply of oral antibiotics on hand, particularly for travel (Lymphoedema Framework).

Figure 2. Cellulitis in a Patient's Hand, Causing Redness and Inflammation

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In a retrospective analysis of more than 601 cases of breast cancer in 580 women, Indelicato et al. (2006) found an 8% incidence of delayed breast cellulitis. Delayed breast cellulitis consists of diffuse breast erythema, edema, tenderness, and slight warmth occurring at least three months after definitive surgery and more than three weeks after completion of radiation therapy. Erythema has no distinct erysepiloid edges and has an insidious onset and indolent course (Indelicato et al.). The median time of onset in Indelicato et al. was 226 days; range was 137 days to 16.1 years.

Breast or trunk edema is a complication of breast cancer treatment that has not been widely studied. Impaired lymphatics and injury likely play a role in the development of delayed breast cellulitis. Breast cellulitis was significantly more prevalent in women with arm edema (Indelicato et al., 2006). Risk factors for the development of cellulitis include obesity, tumor size, number of lymph nodes removed (> 5), and presence and aspiration of postoperative seroma or hematoma. Of the patients who developed cellulitis (n = 50), 22% went on to develop recurrent cellulitis and one went on to electively undergo mastectomy because of intractable breast pain. This study is limited to a single institution but does represent one of the largest cohorts of patients reported and analyzed to date with regard to infection in the breast where lymphedema is a risk and often overlooked.

Likely to Be Effective

Maintaining optimal body weight: Studies examining patient-related factors in women who develop lymphedema after breast cancer treatment are becoming more prevalent. One important patient-related factor is weight according to body mass index. Evidence exists that a body mass index greater than 30 is a risk factor for lymphedema (Mahamaneerat, Shyu, Stewart, & Armer, in press; Ridner & Dietrich, 2008; Soran et al., 2006). Ridner and Dietrich age-matched their sample (N = 64) of breast cancer survivors with and without lymphedema within

three years of therapy and found statistically significant group differences in body mass index for lymphedema occurrence, with higher weights associated with higher occurrence of lymphedema. Although how body weight affects lymphedema is unknown, evidence indicates that it does influence lymphedema development and affects management.

A prospective longitudinal study of breast cancer survivors 12 months after surgery found higher risk of lymphedema among survivors of higher body mass index (Mahamaneerat et al., in press). Likewise, efforts to reduce body weight may influence lymphedema volume and improve management. In a study (N = 64) by Shaw, Mortimer, and Judd (2007), weight loss by caloric reduction was compared with fat reduction alone and to a third control group with no dietary interventions. Although no differences seemed to exist among the groups (largely from a lack of dietary adherence), weight loss by whatever means appeared to benefit arm volume ($p = 0.002$). End results showed significant reductions in body mass index ($p = 0.008$) in the intervention groups compared to the control group. Causality could not be demonstrated but findings such as these may help researchers understand the characteristics of patients at higher risk of developing lymphedema following breast cancer and allow nurses and other healthcare professionals to target a particular population with interventions to reduce the risk of lymphedema development.

Manual lymph drainage: MLD, one of the five modalities of CDT, decongests and softens tissues. Through a gentle, specialized, manual technique, MLD creates a pressure gradient that stimulates the lymphatic flow from one area to another. Although systematic reviews support the effectiveness of MLD in combination with other CDT components (Browning, 1997; Lymphoedema Framework, 2006; Moseley et al., 2007) and the added value of MLD with CB in treating lymphedema, little evidence exists to support MLD's sole use for the purpose of limb volume reduction independent from CDT (Lymphoedema Framework). In a randomized, controlled trial by Didem et al. (2005), the study group (n = 27) received standard CDT (MLD, multilayer CB, limb elevation, remedial exercises, and skin care). The control group (n = 26) had standard therapy without MLD. A 55.7% reduction in arm edema was seen in the study group and 36% reduction in the control group (Didem et al.), indicating that the difference was the use of MLD.

In a prospective randomized, controlled trial by McNeely et al. (2004) with clearly defined inclusion and exclusion criteria (N = 45), researchers looked at the reduction of arm volume from MLD in combination with CB to that achieved by CB alone. Although no significant difference was seen between the groups in terms of volume reduction ($p = 0.8$) or percentage reduction ($p = 0.3$), the study did not address reduction of subjective symptoms (McNeeley et al.).

In a systematic review by Moseley et al. (2007), MLD was found to contribute to the improvement of self-reported patient symptoms and MLD was recommended for symptom management in palliative care (Lymphoedema Framework, 2006).

In a summary of three years of treatment data collected from patients with lymphedema after breast cancer treatment (N = 168), breast edema showed the most improvement when MLD was performed (Jeffs, 2006). MLD may be the only intervention possible in cases involving head and neck, genital, or breast swelling and in palliative care situations where compression by bandaging or garments is not well tolerated or not possible (Jeffs; Lymphoedema Framework, 2006).

Because the MLD practitioner requires training at the specialist level (Lymphoedema Framework, 2006; McNeely et al., 2004; Moseley et al., 2007; NLN MAC, 2008b), the lymphedema therapist must individualize CDT and may exclude certain modalities (such as potentially performing MLD alone without CB) based on the patient's premorbid condition and stage of lymphedema at diagnosis. An 80-question survey by Bani et al. (2007) of 742 breast cancer survivors found that providing patients with information about MLD directly correlated with use.

Numerous shortcomings exist in the available literature regarding MLD. A general lack of consistency is seen in study design, sample sizes often are small, criteria are poorly defined, and many lack long-term follow-up. Most studies did not assess the effects of treatment on range of motion, pain, function, body image, quality of life, and tissue quality (pitting, fibrosis). However, a small number of well-designed studies focusing on MLD do support that it is likely to be an effective intervention for lymphedema.

Benefits Balanced With Harms

Exercise: Exercise and movement therapies play an important role in CDT by supporting cardiovascular health, muscle strength, and functional capacity, as well as stimulating the function of the lymphatic system. Integrating exercise requires an individualized approach (Lymphoedema Framework, 2006) and should be part of a systematic approach to rehabilitation for all patients with (or at risk for) secondary lymphedema (NLN MAC, 2008c). Historically, heavy resistance training has been discouraged for patients with lymphedema; however, current evidence is somewhat unclear and the recommendation may be changing (Bicego et al., 2006; Lymphoedema Framework; Moseley et al., 2007). In the past, healthcare professionals believed that exercise could exacerbate or lead to lymphedema in women at risk. Patients were advised to avoid upper-body exercises because of the belief that exercise increased the flow of blood to tissues, adding to the workload of the lymph system and overwhelming an already compromised system. However, the claim is not supported by current literature.

Exercise increases muscle mass, which increases the muscular pump that the flow of lymph depends on. Exercise increases flexibility and strength and helps combat obesity, which is another risk factor for lymphedema. A review of the literature indicated that upper-extremity exercise may well be safe within certain parameters. Two randomized, prospective clinical trials (Ahmed, Thomas, Yee, & Schmitz, 2006; de Rezende et al., 2006) concluded that supervised exercise did not increase the risk for or exacerbate lymphedema. The trials involved weight training but were limited by small numbers of participants and short follow-up time.

Research by Harris and Niesen-Vertommen (2000) demonstrated evidence that women with breast cancer could engage in upper-extremity exercise without developing lymphedema. Exercises included 20–30 minutes of a brisk aerobic workout, stretching, and resistance training of back and upper extremities. Limb volume monitoring revealed no significant changes. The

study, however, was limited by not using a consistent time of day for measuring arm circumference, and arm circumference alone was used as a measure of lymphedema.

Courneya et al. (2003) conducted a randomized, controlled trial evaluating the effect of exercise on lymphedema development. Patients were placed in experimental (n = 24) and control (n = 28) groups. Three patients in the experimental group developed lymphedema, compared to none from the control group: clinically significant but not statistically significant findings.

Sandel, Judge, and Landry (2005) used a crossover design in a randomized, controlled trial (N = 30) to evaluate the effect of dance and movement therapy on lymphedema in women who had undergone surgery for breast cancer. Three women reported lymphedema at baseline, but no additional lymphedema events occurred.

A pilot study by Kolden et al. (2002) examined 40 women treated for stages I–III breast cancer to evaluate the safety and availability of an exercise program. Eighty-eight percent of participants completed planned sessions with noted improvement in flexibility, aerobic capacity, bench press strength, leg press strength, mood, and well-being. However, the study was limited by a lack of control group and no long-term follow-up.

Common limitations were noted in all of the studies reviewed for this article. Examining exercise as a risk factor is difficult because the interventions for breast cancer involve wide variations in treatment, which could impact outcomes. Diverse measurement tools were used, including upper-extremity circumference measurement, upper-extremity volume measurement by perometry, and bioelectrical impendence monitor. In addition, most of the studies involved follow-up of less than one year. A uniform tool for measuring lymphedema and common definitions of the exercise intervention intensity must be applied to compare findings across studies.

Additional investigation with larger samples and longer follow-up time frames are needed before any definite conclusions can be reached regarding safety and benefit of exercise for women at risk for or with lymphedema. However, no definite evidence exists to support the commonly administered advice that upper-extremity light exercise or movement is a risk factor or contributing factor to the development of lymphedema. Potential benefits must be balanced with potential harm on a case-by-case basis until more evidence exists (NLN MAC, 2008b). The evidence to date can, however, provide guidance to patients after treatment for breast cancer.

Prophylactic antibiotics for recurrent infections: Because antibiotic resistance continues to be a public health issue, decisions about the use of prophylactic antibiotics for patients at risk for infection should be made in collaboration with a treating primary care physician and, perhaps, an infectious disease specialist. Recurrent infection occurs in almost 25% of patients with lymphedema who experience an episode of initial cellulitis (Bernard, 2008; Indelicato et al., 2006). For patients with lymphedema who have had two to three infections per year, daily prophylaxis should be considered with careful evaluation of risks and benefits (Bernard; Lymphoedema Framework, 2006). First-line antibiotics commonly used in this setting include penicillin or erythromycin (in the event of penicillin allergy). Second-line agents for prophylaxis include clindamycin and clarithromycin (Bernard; Lymphoedema Framework). Most of the data on prophylactic use of antibiotics are gleaned through case reports and retrospective cohort studies (Bernard).

Surgical intervention: Many of the case studies presented in the literature related to potentially promising surgical therapies for lymphedema focus on managing the most challenging lymphedematous limbs. Recurrent infection or lack of response to more conservative approaches, such as compression bandaging, will sometimes lead to consideration of lymphatic grafting, lymphovenous anastomosis, liposuction, or even amputation. These approaches should be reserved for carefully selected patients (Lymphoedema Framework, 2006) for whom alternatives and more traditional treatments have failed.

Effectiveness Not Established

Compression garments: Compression garments (hosiery) are commonly used in clinical practice to manage symptoms of lymphedema and require careful patient assessment, fitting, and monitoring by a practitioner (Lymphoedema Framework, 2006; NLN MAC, 2006) (see Table 4). Compression garments are used at all points in the lymphedema trajectory, from prophylaxis for at-risk patients to the comprehensive CDT maintenance plan following intensive CDT. Compression garments should be replaced every three to six months. Contraindications for use of compression garments include arterial insufficiency, acute cardiac failure, extreme limb shape distortion, very deep skin folds, extensive skin ulceration, severe peripheral neuropathy, and lymphorrhea (Lymphoedema Framework). Although limited clinical trial data exist to support using compression garments alone, clinical expertise supports additional research.

In a systematic review by Moseley et al. (2007), two studies with small samples evaluated the use of compression garments alone. Johansson, Lie, Edkahl, and Lindfeldt (1998) studied 12 patients who wore garments for two weeks with mean volume reduction of 5%. Swedborg (1984) studied 26 patients and found that 8% limb volume reduction occurred; however, only 12 patients remained in the study at six months, limiting generalizability.

Stout-Gergich et al. (2008) evaluated early intervention using compression garments in women with an increase in limb volume of 3% from baseline after breast cancer treatment. A mean volume decrease of 4.1% was achieved, lasting a mean of 4.8 months. From the cohort of 196 patients who participated in this monitoring trial, 43 (22%) developed early lymphedema. Although this may be promising preliminary data to support early intervention with compression garments, additional research with a larger sample: randomized, controlled design; and longer follow-up is warranted.

Hyperbaric oxygen: Hyperbaric oxygen (HBO_2) is the delivery of high concentration of oxygen at greater than normal atmospheric pressure. HBO_2's mechanism of action in the treatment of lymphedema is possibly related to the promotion of lymphangiogenesis. However, HBO_2 requires specialized hyperbaric chambers, trained staff, and careful screening and selection of patients owing to the rigors of treatment within the pressurized chamber. Two descriptive, correlational studies (Gothard et al., 2004; Teas et al., 2004) with small sample sizes examined the role of HBO_2 in the management of lymphedema.

Table 4. Compression Garment Classification

INDICATION	STOCKING CLASS	PRESSURE TO ORDER	STOCKING TYPES
Stage I Mild lymphedema	I	20–30 mm/Hg	Circular, flat knit, or over the counter
Stage II Moderate lymphedema	II	30–40 mm/Hg	Circular, flat knit, over the counter, or custom fit
Stage III Severe lymphedema	≥ III	40–50 mm/Hg	Preferably flat knit and custom

Note. Based on information from Gordon & Mortimer, 2007.

Gothard et al. (2004) looked at the use of HBO_2 in the treatment of chronic arm lymphedema after radiotherapy to the chest wall/breast and axilla. The study (N = 21) enrolled patients who had at least 30% increase in arm volume. All patients received 30 pressure treatments, five days per week for six weeks, and were followed through a 12-month time frame. Mean percentage reduction in arm volume was 7.7%. Quality-of-life measure changes after treatment were not clinically significant. Lymphoscintigraphy demonstrated statistically significant changes in the removal rate constant for the radiotracer. At baseline (one week after treatment), the removal rate constant between the contralateral and ipsilateral arms was statistically significant ($p = 0.03$). At 12 months after the start of HBO_2 therapy, the difference in the removal rate constant between arms was not significant. Although the removal rate constant of the ipsilateral arm at baseline and at 12 months was statistically significant ($p = 0.03$), no significant difference existed between the removal rate constant of the contralateral arm at baseline and at 12 months, indicating no change in the nonaffected limb. No randomized, control group design was used and the sample size was small. Although the contralateral limb could be used as a control limb for volume comparisons, the whole body was treated (including the nonaffected limb).

A pilot study by Teas et al. (2004) enrolled 10 postmenopausal women with persistent arm lymphedema following breast surgery and radiation in an HBO_2 trial. All received 20 HBO_2 treatments (daily for four weeks). Endpoints included changes in upper-extremity volume, platelet counts, and plasma levels of vascular endothelial growth factor–C. Circumferential measurements were obtained at the beginning of the study, three days following the last treatment, and one month later. Limb volumes were computed for hand, lower arm, and upper arm, as well as total limb. An average reduction in hand volume of 38% was noted at the end of HBO_2 treatment. Arm volumes showed no significant changes in the lower or upper arms. For patients who did benefit, the reduction was noted from the end of treatment to an average of 14.2 months after treatment. However, total volume did not change significantly. Vascular endothelial growth factor–C increased from baseline ($p = 0.004$) to the final treatment period, suggesting HBO_2 had begun to stimulate this growth factor. The results of this pilot study suggest that 20 HBO_2 treatments for women with breast cancer treatment–related lymphedema may be beneficial, but the sample was small and the design was that of a case study series with no control group. Gothard et al. (2004) and Teas et al. (2004) indicated that additional rigorous studies with larger samples are needed to determine the potential benefit of lymphedema treatment using HBO_2.

Low-level laser therapy: Low-level laser therapy (LLLT) has been evaluated for potential effectiveness in lymphedema after mastectomy. Early studies with small samples show a trend toward volume reduction, improvement of self-reported symptoms, and increased quality of life, with additional research needed with a true randomized, clinical trial design; larger number of patients; clearer intervention; and longer follow-up. The exact mechanism of the effects of LLLT is unknown; however, hypotheses include improved cellular repair and stimulation of the immune, lymphatic, and vascular systems.

Carati, Anderson, Gannon, and Piller (2003) conducted a small, double-blind, placebo-controlled trial for treatment of lymphedema after mastectomy using LLLT. The 28 participants were randomized to an intervention group (two blocks of LLLT separated by an eight-week rest period) and placebo therapy group (composed of a block of placebo-administered treatment, rest for eight weeks, and LLLT). Both groups received treatment at eight weeks in this design; therefore, no true placebo group existed. Measurements taken at the beginning and end of every session included perometry, bioimpedence, and tonometry. Carati et al. recorded limb volumes at three months after two LLLT treatments and reported that limb volumes were significantly less in the intervention group compared to the placebo therapy group ($p < 0.02$). Limb extracellular fluid was significantly decreased by both placebo and one treatment of LLLT; however, the mean extracellular fluid was most significantly reduced after two LLLT cycles, with immediate reduction ($p = 0.01$), one month follow-up ($p = 0.06$), and three month follow-up ($p = 0.02$). Significant decreases in tonometry readings (indicating increased tissue hardness) were noted in patients treated with placebo or one LLLT. Participants receiving two LLLT cycles had increased tonometry readings associated with tissue softening. No significant changes were noted in range of motion. Additional long-term follow-up with a true placebo-control design and a CDT arm is recommended.

Kaviani, Fateh, Yousefi Nooraie, Alinagi-Zadeh, and Ataie-Fashtami (2006) studied the effects of LLLT in lymphedema after mastectomy in 11 patients. In this double-blind trial, eight (73%) enrolled patients completed the study. Patients were randomly assigned to LLLT or placebo groups. Patients received therapy three times per week for three weeks. The same treatment was repeated at eight weeks for a total of 18 treatments. Study endpoints included measurements of limb circumferences, pain score, range of motion, heaviness of the affected limb, and desire to continue treatment. The measurements were performed before and during treatment at weeks 3, 9, 12, 18, and 22 with comparison to values before treatment. The study revealed a reduction in limb circumference in both groups, with a trend toward greater reduction in the treatment group ($p = 0.3$) and nonsignificant differences between groups for limb circumferences, pain reduction, range of motion, and heaviness report.

The studies were too small to offer generalizable information, and additional studies with larger samples and careful methodological control are warranted.

Lymphedema Patient Education

The lymphatics are a transport system made up of vessels and lymph nodes that carry lymph to the heart, where it mixes with blood before circulating to the liver and kidneys, where it is cleaned out as waste or recycled. Unlike the circulatory system, where the heart pumps the blood away from the heart via arteries and back again through veins, the lymphatics originate in the skin and the lymph is transported to the heart through lymphatics with the assistance of muscle activity, skin resistance, and pressure changes. The lymph system helps in getting oxygen and nutrients to the cells by removing water, proteins, dead cells, fatty acids, and metabolic waste from tissue spaces around the cells. Cancer cells also are transported in lymph. When the transport capacity fails, lymphedema develops.

Secondary lymphedema, swelling resulting from damage to lymphatic vessels and/or lymph nodes after treatment, leads to the accumulation of lymphatic fluid and other substances that may result in chronic inflammation and swelling. When secondary lymphedema becomes chronic, it can result in fibrosis or scarring and skin irritation with increased risk of infection.

Patients at risk for lymphedema include those who have had lymph nodes removed or radiation to an area of the body with lymph nodes as part of their cancer treatment. Lymphedema can occur in the body area affected by surgery or radiation (i.e., the arm, leg, head and neck, breast, or genitalia). Although breast cancer treatment is the most common cause of secondary lymphedema, lymphedema also can be the result of burns, trauma, venous disease, infection, inflammation, or immobility.

Patients at risk should be aware of ways to lower risks and watch for signs and symptoms of complications from lymphedema. Complications include infection, pain, loss of function, and deep vein thrombosis.

Self-Care

- Use neutral soaps to avoid excessive drying.
- Use moisturizing cream.
- Inspect skin folds and keep them clean and dry.
- Inspect for cuts, scrapes, abrasions, and insect bites.
- Wear protective gloves and garments when working outdoors.
- Use sunscreen and insect repellents.
- If injury occurs, wash with soap and water, apply topical antibiotics, and monitor for redness, pain, or swelling. If swelling occurs, contact a clinician immediately.
- Maintain a healthy weight and exercise routine.
- Monitor limbs after exercise; gradually build up duration and intensity of exercise, avoiding heavy resistance; and discuss embarking on exercise programs with clinician.
- Avoid wearing tight garments, underwear, or jewelry on affected areas of the body.
- Use compression garments as directed by a clinician; discuss use during air travel.
- Avoid blood pressure and blood draws or venipuncture on affected limbs if possible.
- Should lymphedema occur, seek early treatment from a trained therapist to prevent and minimize progression.

Note. Based on information from Lymphoedema Framework, 2006; National Lymphedema Network Medical Advisory Committee, 2008c.

Nanocrystalline silver dressing on lymphatic ulcers: Lower-extremity edema presents unique challenges because of gravitational forces that can further exacerbate limb congestion. Prevention and treatment of infection remain challenging, and the risk of ulceration and stasis ulcers can add to the physical and psychological burden of living with a lymphedematous limb. Forner-Cordero, Navarro-Monsoliu, Munoz-Langa, Alcober-Fuster, and Rel-Monza (2007) presented a prospective evaluation of the effect of treatment on lymphatic ulceration in lower extremities using nanocrystalline silver dressings and multilayer bandaging. Silver dressings are widely used for treatment of burns and venous stasis ulcers (Jones, Bowler, & Walker, 2005). Forner-Cordero et al. evaluated this approach to managing very difficult to treat ulcers resulting from severe lymphedema, the only study to date exploring this technique. Eight patients with nine involved limbs received weekly dressing changes with a mean time from first treatment to complete healing of 26.6 days. This series of case reports was remarkable for the severity of lymphedema in cases reported: one patient had stage II lymphedema; seven patients had stage III lymphedema. The ulcers were difficult to heal and, in one case, the patient had an open ulceration for many months. The study illustrates the challenge in managing some of the more complex patients and the impact such a small but important change in care can have on a patient's quality of life. Lower-extremity lymphedema can make a difference between mobility and being bed bound. No case control exists in this study except the patient's prior history of not healing, but rigorous research is needed to investigate this and other topical aids to healing wounds related to lymph stasis.

Pneumatic compression pump: Intermittent pneumatic compression is not a component of CDT (NLN MAC, 2006) but may be an effective adjunct to a comprehensive treatment plan when ordered and performed by trained clinicians. It should not, however, be used as a stand-alone therapy and should be carefully used only in selected patient populations. In a systematic review of interventions to treat lymphedema, Moseley et al. (2007) found a 26% decrease in limb volume with intermittent pneumatic compression pump therapy used in combination with CDT.

Moseley et al.'s (2007) review was limited by a number of studies with small sample sizes, including ones that evaluated pneumatic pumps. In a small, randomized, controlled trial, Szuba et al. (2002) evaluated the effect of CDT (consisting of MLD, compressive wrapping, and decongestive exercises) plus intermittent pneumatic compression (n = 12) compared to CDT alone (n = 11). Phase one of the trial evaluated initial treatment for untreated lymphedema; phase two evaluated maintenance therapy. CDT plus intermittent pneumatic compression showed superior reduction in arm volume compared to CDT alone (Szuba et al.).

Some researchers, however, have suggested that intermittent pneumatic pumps may actually cause harm, increasing lymphedema by causing increased scarring and fibrosis or by damaging remaining functional lymphatic structures (Zuther, 2005). This effect occurs because of movement of water without removing the proteins in the interstitial space and failure to create space for the moved fluid in the larger lymphatic vessels in the trunk of the body. Additional research concerns include possible variation in techniques of MLD by the therapist (intensive phase) and patient (maintenance phase), leading to inconsistent outcomes in volume reduction. Contraindications to the use of intermittent pneumatic compression (Lymphoedema Framework, 2006) include

- Chronic nonpitting lymphedema
- Known or suspected deep vein thrombosis or pulmonary embolus
- Uncontrolled or significant congestive heart failure
- Active erysipelas or cellulitis

- Ischemic vascular disease
- Severe peripheral neuropathy
- Edema at the proximal portion of extremity
- Active metastatic disease affecting the limb.

Simple lymphatic drainage: A study by Barclay, Vestey, Lambert, and Balmer (2006) found that self-MLD with the additional use of aromatherapy cream did not significantly reduce limb volume more effectively than self-MLD without aromatherapy. Neither the study group (n = 40) nor the control group (n = 41) in this study was very effective in reducing limb volume; however, patients reported improved symptom relief. Aromatherapy did not appear to add benefit to self-MLD. The sample size was relatively large among lymphedema studies reviewed, but it did include mixed categories of patients with primary and secondary lymphedema and upper and lower lymphedema. However, because symptom improvement and slight limb reduction ($p = 0.03$) were seen, the study supported the use of self-MLD with no added benefit of aromatherapy in outcomes studied (Barclay et al.). Patients should be encouraged to perform self-MLD, the application of compression through bandages and garments, and active exercise in the maintenance phase.

Not Recommended for Practice

Drug therapy (diuretics): No evidence supports the efficacy of diuretics in treating lymphedema. Although short courses may help treat edema of mixed etiologies, lymphedema is an issue with protein displacement, not water, and diuretics are not effective (Lymphoedema Framework, 2006).

Drug therapy (benzopyrenes): Little evidence exists to support the use of benzopyrenes, such as flavonoids, oxerutins, escins, coumarin, and ruscogen, combined with hesperidin in the treatment of lymphedema (Lymphoedema Framework, 2006; Moseley et al., 2007). Significant hepatotoxicity has been associated with the use of coumarin. A systematic review by Moseley et al. evaluated several trials using pharmaceuticals (diosmin plus hesperidin) in combination with MLD and coumarin. Although some agents showed variable reductions in limb volume, agents with the greatest effect were in the combination trial with MLD. Numerous side effects, limited sample size, and conflicting results make recommendations difficult with current knowledge.

Expert Opinion

Blood pressure and venipuncture: Students are taught in nursing school not to draw blood or take blood pressures on the ipsilateral limb of a patient with breast cancer. However, no known clinical trials exist that have evaluated the risk or incidence of lymphedema as the result of venipuncture or blood pressure monitoring. The physiologic consequences of lymphatic injury from surgery and treatment have resulted in expert consensus regarding best practices for avoiding injury to patients at risk for or with lymphedema (NLN MAC, 2008c; Ridner, 2002). Indeed, what nurses were taught in school is valid based on best clinical knowledge to date. Venipuncture and blood pressure measurements may increase the risk of lymphedema (Greene, Borud, & Slavin, 2005). Skin punctures may introduce bacteria in the absence of strict asepsis. Blood pressure cuffs may exert too much pressure in a localized area, although pneumatic pressure is used to treat lymphedema and the amount of time for routine blood pressure measurements is small (Greene et al.). Risk reduction guidelines include

- Avoid venipuncture, injections, and blood pressure measurements in at-risk limbs.
- If venipuncture is unavoidable, strict asepsis may minimize risk (Greene et al.).
- For blood pressure measurements with bilateral lymphedema or at-risk limbs, use lower extremity to take blood pressure. If that is not possible, use the limb at lesser risk because of treatment factors.
- Avoid using automated blood pressure devices on affected or at-risk limbs; manual cuffs should be inflated only 20–40 mm/Hg above a patient's baseline blood pressure.

Skin care: Skin hygiene is an essential component in the prevention of infection, although very few studies evaluate skin care regimems. Patients at risk for lymphedema should practice good skin and nail care using neutral pH soaps and emollient creams (NLN MAC, 2006). In hot or warm climates, vegetable-based skin care products are preferable to mineral oil or petroleum-based products (Lymphoedema Framework, 2006) because oil- and petroleum-based products may block pores, preventing body oils from moisturizing the skin. Careful inspection of the affected limb for skin breaks, dry flaking skin, and nail changes or integrity may assist in preventing infection (Lymphoedema Framework) and reduce the risk of lymphedema development or progression. Preventing sunburn with use of sunscreens and reducing exposure to direct sun during peak hours will promote skin integrity and prevent infection.

Although no evidence exists to support gum disease as a mode of transmission, healthcare providers should consider gingivitis as a source of infection that potentially leads to septicemia and lymphedema development, particularly with recurrent infections.

Air travel precautions: Evidence suggests that lymphedema can be exacerbated by air travel, generally attributed to changes in cabin pressure. In a survey of more than 1,000 patients with lymphedema (Casley-Smith & Casley-Smith, 1996), 27 of 490 respondents (5%) recalled that aircraft flight was the triggering event for the onset of their lymphedema. In addition, several respondents felt that air flight caused their preexisting

Updates to the Lymphedema Putting Evidence Into Practice® Card

The Oncology Nursing Society's (ONS's) Lymphedema Putting Evidence Into Practice® (PEP) card, along with ONS's other PEP cards, currently is being updated with new evidence that has been released since the card was developed. The full revision will be available in May 2009. This article reflects the changes made to the status of "maintaining optimal body weight," which is now in the *likely to be effective* category; "compression garments," which is now in the *effectiveness not established* category; and "surgical intervention," which is now in the *benefits balanced with harms* category. The changes were made as supportive research studies surfaced since the time of the PEP card's writing. In addition, "low level laser therapy" moved from *likely to be effective* to *effectiveness not established* because of concerns about the small sample sizes in the researched literature.

lymphedema to permanently worsen. Patients with a history of established lymphedema should use a correctly fitted compression sleeve with gauntlet, glove, or stocking to reduce the risk of swelling. Individuals at risk of lymphedema should discuss the risk and benefits of wearing a compression garment during air travel with their healthcare providers, as concern exists that use of restrictive (poorly fitted) garments may contribute to lymphedema onset (NLN MAC, 2008a). In all cases, garments must be assessed for proper fit by a lymphedema therapist. Poorly fitted compression garments are not helpful and may actually increase the risk of lymphedema emergence and progression. Other travel precautions include

- Exercising, deep breathing, standing, and moving about every 30 minutes during air travel
- Maintaining adequate hydration and fluid intake
- Avoiding pushing, pulling, or carrying heavy luggage.

Future Research Considerations

Common limitations were found in many of the studies reviewed, including small sample sizes, lack of randomized control groups, imprecise intervention standardization within and across groups, imprecise or diverse measurement approaches, and limited follow-up. Conclusively, examining the risk factors for lymphedema in cancer survivors is difficult because interventions for cancer involve wide variations in treatment that could impact outcomes.

Without a uniform and generally accepted standard of assessment before cancer treatment, knowledge of factors that influence lymphedema development will remain incomplete. A uniform method and protocol for assessing and measuring lymphedema should be developed. Differing criteria and protocols are used in the measurement and diagnosis of lymphedema, including water displacement, circumferences, perometry, electrical impedance, and self-reporting of symptoms (Armer & Stewart, 2005; Ridner, Montgomery, Hepworth, Stewart, & Armer, 2007). These disparate methods make it difficult to evaluate intervention outcomes across studies. Within this body of research, consideration of issues related to bias must continually be monitored in industry-sponsored research.

Conclusion

Oncology nurses play a pivotal role in caring for patients throughout the cancer trajectory and are sentinels for the early assessment of lymphedema risk, prompt identification of lymphedema symptoms, and implementation of evidence-based, individualized treatment plans in collaboration with lymphedema therapists. Additional investigations with larger sample sizes, consistent measurement approaches that are precisely defined and delivered, and theoretically sound interventions are required. In addition, longer follow-up timeframes are needed before definitive conclusions can be reached regarding interventions for patients at risk for or with lymphedema. Only then can additional evidence-based recommendations be made on the intervention classifications identified. Ongoing research is needed to assess the interventions which are most effective in reducing risk and preventing progression of lymphedema after treatment for cancer.

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