Article

Putting Evidence Into Practice: Cancer-Related Lymphedema

Evolving Evidence for Treatment and Management From 2009–2014

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Cancer-related lymphedema is a progressive and chronic syndrome of abnormal swelling and multiple symptoms resulting from cancer treatment. Even with modern medical advances, lymphedema remains a major health problem affecting thousands of cancer survivors. To provide healthcare professionals with evidence-based clinical practice guidelines for lymphedema treatment and management, a systematic review was conducted to evaluate 75 selected articles from 2009–2014 by the Oncology Nursing Society Putting Evidence Into Practice lymphedema team. Findings of the systematic review support complete decongestive therapy, compression bandages, and compression garments with highest evidence for best clinical practice. Weight management, full-body exercise, information provision, prevention, and early intervention protocols are likely to be effective for clinical practice. Historic recommendations for activity restriction and avoidance of aerobic and resistive exercises that limit cancer survivors' daily lives have been challenged with more evidence. Cancer survivors may not need to restrict activities such as resistive or aerobic exercises and weightlifting with gradual exercise progression. Future research should focus on providing high-level evidence using randomized clinical trials with larger samples and studying lymphedema beyond breast cancer.

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About 12.7 million people have been diagnosed with cancer worldwide, and the global burden of cancer is expected to increase largely because of aging and growth of the world population (Jemal et al., 2011). In 2008, the cost of cancer worldwide, including disability, was estimated to be $895 billion (American Cancer Society, 2014). With improved cancer survival, management of late effects and long-term survivorship issues have become more important.

Cancer-related lymphedema is a late effect that often develops 1–5 years or even 20 years after cancer treatment (McLaughlin et al., 2008; Paskett, Naughton, McCoy, Case, & Abbott, 2007; Petrek, Senie, Peters, & Rosen, 2001). Cancer-related lymphedema is a progressive and chronic syndrome of abnormal swelling and multiple symptoms resulting from the accumulation of lymph fluid from the obstruction or disruption of the lymphatic system associated with cancer treatment such as surgery or radiation (Fu & Rosedale, 2009; Johansson, Ohlsson, Ingvar, Albertsson, & Ekdahl, 2002; Stanton, Modi, Mellor, Levick, & Mortimer, 2009). The most perplexing aspect of this late effect of cancer treatment is that lymphedema can occur even after less invasive surgical procedures such as sentinel lymph node biopsy or partial mastectomy (McLaughlin et al., 2013). Lymphedema affects as many as 40% of the 2.9 million women treated for breast cancer in the United States (McLaughlin et al., 2008; Paskett et al., 2007). Globally, about 1.4 million women are diagnosed with breast cancer each year, accounting for 23% of all diagnosed cancers in women (Ferlay et al., 2010). Even more distressing is that all of the women treated for cancer are facing a lifetime risk of developing lymphedema. In addition, lymphedema affects a large proportion of cancer survivors with a variety of malignancies, including gynecologic cancer (20%), melanoma (16%), genitourinary cancer (10%), and head and neck cancer (4%) (Cormier et al., 2010).

Because no current surgical or medical interventions exist, lymphedema remains a major health issue. Significantly lower

quality of life is observed in cancer survivors with lymphedema than in those without it (Langer et al., 2007; McLaughlin et al., 2008). Treatment and management of lymphedema is, in most cases, palliative with a goal of preventing disease progression and alleviation of symptoms. Routine checkups for lymphedema management; long-term physical therapy; self-management and equipment (e.g., compression garments, bandages, special lotions); and repeated cellulitis, infections, and lymphangitis create financial and economic burdens not only to cancer survivors, but also to the healthcare system (Fu & Rosedale, 2009; Shih et al., 2009). For example, lymphedema is a significant source of biomedical expenditures for cancer survivors, increasing treatment costs by more than $10,000 annually (Shih et al., 2009). In addition, cancer survivors with lymphedema spend more days annually either hospitalized or visiting physicians' offices; they also are absent from work more often, which could adversely affect employment (Shih et al., 2009).

To provide healthcare professionals with evidence-based clinical practice guidelines for lymphedema treatment and management, the Oncology Nursing Society (ONS) Putting Evidence Into Practice (PEP®) lymphedema team conducted a systematic review in 2007 (Poage, Singer, Armer, Poundall, & Shellabarger, 2008). The review revealed common limitations in many studies from 1997–2007, 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. Complete decongestive therapy (CDT), compression garments and bandaging alone, and infection treatment were recommended for practice. However, the review also cautioned that the rigors of CDT may pose considerable challenges for patients and clinicians because of the multiple components of the treatment and access to trained lymphedema therapists.

With the enhanced realization that lymphedema is part of a progressive and chronic syndrome, researchers and clinicians have attempted to conduct more rigorous studies and explore a variety of treatment and management strategies for lymphedema. Under the leadership of the ONS PEP project, the lymphedema team continually reviews, evaluates, and updates treatment and management evidence on cancer-related lymphedema. The purpose of this article is to report the updated evidence for current treatment and management of cancer-related lymphedema through February 2014.

- Lymphedema
- Lymphoedema
- Therapy
- Treatment
- Management
- Complete decongestive therapy
- Decongestive
- Compression
- Bandaging
- Infection
- Body mass index
- Weight
- Drainage
- Skin care
- Exercise
- Prophylactic
- Garment
- Hyperbaric
- Laser
- Pneumatic
- Dressing
- Pump
- Air travel
- Travel
- Diuretic
- Benzopyrenes
- Venipuncture

FIGURE 1. Key Search Terms of the Literature

Inclusion Criteria

- Full research report
- Systematic review
- Guideline or meta-analysis
- The study must report the results of lymphedema measurement.
- The study examines an intervention aimed at affecting the symptom, including risk reduction and prevention as well as management.
- The study sample must include patients with cancer.

Exclusion Criteria

- Duplicates and studies that did not meet inclusion criteria were removed.
- Qualitative descriptive studies, case reports, and studies only on vascular changes were excluded.
- No grey literature was included; nonrefereed articles, secondary data analysis, review of guidelines, non-systematic review articles, abstracts, and dissertations also were excluded.

FIGURE 2. Study Inclusion and Exclusion Criteria

Methods

This systematic review was a continuing effort of the previous review of literature from 1997–2007 where 218 articles were extracted from five databases, and 57 articles were reviewed and evaluated (Poage et al., 2008). The current review was conducted from January 2009 through February 2014. To capture all literature potentially related to lymphedema, a broad range of key search terms listed in Figure 1 were applied to major medical indices: PubMed, MEDLINE®, CINAHL®, Cochrane Library databases, the National Library of Medicine's database, and CancerLit.

A total of 880 articles were retrieved: 732 articles were excluded because they did not meet the inclusion criteria, and 148 articles were selected for full article review based on inclusion and exclusion criteria listed in Figure 2. Each article was summarized and assessed independently by a member of the ONS PEP lymphedema team and then reviewed by a second member of the team to ensure appropriate and accurate representation of the material. Next, the team selected 75 articles based on inclusion and exclusion criteria and categorized the evidence using the research grading system from the ONS PEP level of evidence guidelines (Johnson, 2014; Mitchell & Friese, n.d.). This process was facilitated by ONS research associates. Consensus was achieved among the members of the ONS PEP lymphedema team by applying the PEP categorization of evidence (see Table 1).

Levels of Evidence

Recommended for Practice

Complete decongestive therapy: CDT includes manual lymph drainage; multilayer, short-stretch compression bandaging; gentle exercise; meticulous skin care; education in lymphedema self-management; and elastic compression garments. CDT was recommended for lymphedema treatment and management upon review and evaluation of nine primary research

TABLE 1. Comparison of Levels of Evidence Prior to 2009 and Levels of Evidence From 2009–2014

Intervention Prior to 2009	Intervention From 2009–2014	2009–2014 Research	Systematic Reviews
Recommended for Practice			
Complete decongestive therapy	Complete decongestive therapy	Carmeli & Bartoletti, 2011; Dayes et al., 2013; de Godoy & Godoy, 2013; Haghighat et al., 2010; Hwang, Hwang, et al., 2013; Hwang, Jeong, et al., 2013; Liao et al., 2013; Randheer et al., 2011; Vignes et al., 2013	Beck et al., 2012; Lasinski et al., 2012; Leal et al., 2009; Ridner, Fu, et al., 2012; Rodrick et al., 2014
Compression bandaging	Compression bandaging and compression garments	Damstra & Partsch, 2009; Kasseroller & Brenner, 2010; King et al., 2012; Sawan et al., 2009	McNeely et al., 2011
Infection treatment	–	None	None
Likely to Be Effective			
Maintaining optimal body weight	Weight management	None	None
–	Full-body exercise	Anderson et al., 2012; Gautam et al., 2011; Hayes et al., 2009; Jeffs & Wiseman, 2013; Johansson et al., 2013; Jonsson & Johansson, 2009; Kim et al., 2010; Malicka et al., 2011; McClure et al., 2010; Scaffidi et al., 2012	Chan et al., 2010; Kwan et al., 2011; McNeely et al., 2010
Manual lymph drainage	–	None	None
–	Information provision	Fu et al., 2010	None
–	Prevention and early intervention protocols	Boccardo et al., 2009; Torres Lacomba et al., 2010	None
Benefits Balance With Harms			
Exercise	Activity restriction and avoidance of weight lifting	Cormie, Galvão, et al., 2013; Cormie, Pumpa, et al., 2013; Sagen et al., 2009; Schmitz et al., 2010	None
–	Kinesio tape bandage	Tsai et al., 2009	None
Prophylactic antibiotics for recurrent infection	–	None	None
Surgical intervention	–	None	None
Effectiveness Not Established			
–	Manual lymph drainage	Clemens et al., 2010; Devoogdt et al., 2011; Martin et al., 2011; Vignes et al.,2011; Zimmerman et al., 2012	None
–	Surgical techniques (varied): liposuction, lymphatic venous anastamosis	Boccardo et al., 2009, 2011; Damstra et al., 2009; Schaverien et al., 2012	Cormier et al., 2012
Low-level laser therapy	Low-level laser therapy	Ahmed Omar et al., 2011; Dirican et al., 2011; Kozanoglu et al., 2009	None
Pneumatic compression pump	Pneumatic compression	Fife et al., 2012; Haghighat et al., 2010; Moattari et al., 2012; Ridner, Murphy, et al., 2011	None
Hyperbaric oxygen	Hyperbaric oxygen	Gothard et al., 2010	None
Simple lymphatic drainage	–	None	None

(Continued on the next page)

Note. For detailed evaluation of each study, visit www.ons.org/practice-resources/pep/lymphedema.
Note. Based on information from Poage et al., 2008.

TABLE 1. Comparison of Levels of Evidence Prior to 2009 and Levels of Evidence From 2009–2014 *(Continued)*

Intervention Prior to 2009	Intervention From 2009–2014	2009–2014 Research	Systematic Reviews
Effectiveness Not Established *(Continued)*			
Compression garments	–	None	None
–	Acupuncture	Cassileth et al., 2011, 2013	None
Nanocrystalline silver dressing on lymphatic ulcers	–	None	None
–	Aromatherapy	None	None
–	Aquatherapy	Johansson et al., 2013; Tidhar & Katz-Leurer, 2010	None
–	Axillary reverse mapping	Boneti et al., 2012	None
–	Cell transplantation	Maldonado et al., 2011	None
–	Low-intensity electrostatic stimulation	Belmonte et al., 2012	None
–	Lumbar sympathetic ganglion block	Woo et al., 2013	None
–	Massage or aromatherapy massage	Maher et al., 2012	None
–	Mechanical exercise devise	Bordin et al., 2009; Guerreiro Godoy et al., 2010, 2011, 2012	None
–	Electronic sound waves and vacuum	Cavezzi et al., 2013	None
–	Extracorporeal shockwave therapy	Bae & Kim, 2013	None
–	Qigong	Fong et al., 2014	None
Expert Opinion			
Skin care	Skin hygiene and care	None	None
Air travel precautions	Compression garments when flying	None	None
Blood pressure and venipuncture	–	None	None
Effectiveness Unlikely			
None	None	None	None
Not Recommended for Practice			
Drug therapy (diuretics)	–	None	None
Drug therapy (benzopyrones)	–	None	None

Note. For detailed evaluation of each study, visit www.ons.org/practice-resources/pep/lymphedema.
Note. Based on information from Poage et al., 2008.

articles and five systematic reviews on the effectiveness of CDT. The strengths of the existing literature from 2009–2014 include two randomized clinical trials (RCTs) with comparatively larger samples and the defined CDT outcome of limb volume reduction.

Haghighat et al. (2010) randomized 109 breast cancer survivors with postmastectomy lymphedema into CDT alone or CDT plus pneumatic compression therapy and followed the patients for three months. CDT alone had better results, with 16.9% limb volume reduction compared to 7.5% reduction with CDT plus

pneumatic compression therapy. Dayes et al. (2013) conducted a multisite RCT and assigned 95 breast cancer survivors, with lymphedema defined as increased arm volume of 10%, to manual lymph drainage (MLD) plus bandaging and compression garments or compression garments only. The study showed that reduction in arm volume was similar in both groups, but increased volume loss was reported with MLD plus bandaging and compression garments at a one-year follow-up. However, the study lost more than 10% of patients using compression garments only.

The remaining seven studies were quasiexperimental, observational, or retrospective (Carmeli & Bartoletti, 2011; de Godoy & Godoy, 2013; Hwang, Hwang, Kim, et al., 2013; Hwang, Jeong, Kim, & Sim, 2013; Liao et al., 2013; Randheer et al., 2011; Vignes, Blanchard, Arrault, & Porcher, 2013). In a prospective quasiexperimental study, 35 breast cancer survivors with lymphedema had statistically significant limb volume reduction after CDT intensive therapy (four times weekly) ($p < 0.001$), but skin irritation after bandaging was reported (Randheer et al., 2011). All of the studies were conducted among breast cancer survivors with lymphedema except for two. Hwang, Hwang, et al. (2013) conducted an observational study on CDT among 22 patients with upper- and lower-limb lymphedema associated with different cancers and found significant volume reduction in the upper and lower limbs after CDT. Carmeli and Bartoletti (2011) used a retrospective design to evaluate CDT among 12 melanoma survivors with lower-limb lymphedema. Findings of the study showed that baseline to post-CDT limb volume reduced 17% below baseline at the two-year follow-up ($p = 0.05$).

Findings from the five systematic reviews conducted from 2009–2013 varied in terms of levels of evidence (Beck, Wanchai, Stewart, Cormier, & Armer, 2012; Lasinski et al., 2012; Leal, Carrara, Vieira, & Ferreira, 2009; Ridner, Fu, et al., 2012; Rodrick et al., 2014). Lasinski et al. (2012) evaluated 27 studies and case series on the effectiveness of CDT and its components and concluded that CDT was effective in limb volume reduction, but individual component contributions were unclear. Beck et al. (2012) reviewed 11 studies to evaluate the effectiveness of CDT as palliative care and concluded that the level of effectiveness for CDT, MLD, and compression therapy was not established in the field of palliative care. The most recent review of 22 articles reported that CDT plus Kinesio taping was likely to be effective (Rodrick et al., 2014). Ridner, Fu, et al. (2012) evaluated 16 studies on the effectiveness of CDT as self-care and concluded that CDT as self-care and whole-body exercise were likely to be effective. The five systematic reviews reported the limitations of the existing studies, including small sample sizes and inconsistency in treatment and outcome protocols.

Compression bandaging and compression garments: Compression bandaging and compression garments that provide external compression are important components of CDT. Compression bandaging uses inelastic or low-stretch bandages to produce a massaging effect and stimulate lymph flow. Compression garments (hosiery) are custom-made or ready-to-use elastic garments that provide 20–40 mmHg pressure to promote lymph flow. The time, effort, and dexterity required for bandaging can become burdensome and is not practical or possible for some patients, necessitating the use of an alternative compression method, such as compression garments. Four RCTs were identified that evaluated the comparative effectiveness of compression bandaging and compression garments; arm volume reduction with different bandage pressures; and comparison of low-stretch compression dressings and alginate semirigid bandages (Damstra & Partsch, 2009; Kasseroller & Brenner, 2010; King, Deveaux, White, & Rayson, 2012; Sawan, Mugnai, Lopes Ade, Hughes, & Edmondson, 2009). One systematic review was identified (McNeely, Peddle, Yurick, Dayes, & Mackey, 2011).

A small RCT demonstrated no significant difference between arm volume reduction after two weeks among breast cancer survivors with lymphedema (n = 25) who wore compression bandaging plus MLD and compression garments plus MLD (King et al., 2012). Another RCT evaluated bandage pressure among 36 breast cancer survivors with lymphedema and demonstrated no significant differences in arm volume reduction with different bandage pressure; however, nonelastic multilayer compression bandages with 20–30 mmHg pressure were better tolerated (Damstra & Partsch, 2009). The third RCT placed 61 breast cancer survivors with lymphedema into low-stretch compression dressings or alginate semirigid bandages (Kasseroller & Brenner, 2010). Overall, no significant difference was found in terms of arm volume reduction between the two groups, but participants in the semirigid bandage group had significantly better comfort ($p < 0.025$). Sawan et al. (2009) conducted a small RCT among vulva cancer survivors with lower-limb lymphedema post-inguinofemoral lymphadenectomy (n = 14) into supportive care with or without the use of graduated compression stockings for six months. Patients using graduated compression stockings had less increase in leg volume, better clinical performance, and fewer leg symptoms ($p < 0.05$). However, noncompliance and dropouts further reduced the sample size. One systematic review plus meta-analysis (McNeely et al., 2011) from 25 studies of 1,018 breast cancer survivors with lymphedema concluded that moderate evidence supports the effectiveness of compression garments and bandaging in reducing limb volume. The systematic review cautioned about the poor quality of the reviewed studies. The findings from these studies and the systematic review suggest that, in cancer survivors with lymphedema, compression bandaging and compression garments are beneficial, but more RCTs are needed with larger sample sizes and patients treated for different cancers.

Likely to Be Effective

Weight management: No new studies have been published on weight management since 2009. As a result, the evidence for weight management focusing on reduction of body mass index or weight continues to be likely to be effective for lymphedema treatment and management (Poage et al., 2008).

Full-body exercise: A total of 11 new primary research studies and 3 systematic reviews were identified. Among the 11 primary research articles, 9 were RCTs and 2 were quasiexperimental with pre- and post-test and comparative studies. All of the studies were conducted in breast cancer survivors experiencing lymphedema.

Jeffs and Wiseman (2013) randomized 23 breast cancer survivors with lymphedema into a treatment group of home-based exercise plus standard self-care or a control group of self-care alone. Significant arm volume reduction was found in the treatment group with 55% adherence and no arm volume reduction in the control group at the 26-week follow-up. A single-blind

multisite RCT assigned 82 breast cancer survivors without lymphedema to a treatment group of structured exercise and education sessions or a control group of education alone (Anderson et al., 2012). No significant changes were found in arm volume, but participants in the treatment group had better six-minute walk results ($p < 0.05$). A single-site blinded RCT placed 32 breast cancer survivors with lymphedema into a treatment group of therapist-supervised exercises or a control group of supportive coping education; it showed significant beneficial effects of treatment group in terms of bioelectrical impedance measurements (McClure, McClure, Day, & Brufsky, 2010).

A single-blind RCT assigned 29 breast cancer survivors with lymphedema to a treatment group of a water-based exercise program or a control group of no exercise (Johansson, Hayes, Speck, & Schmitz, 2013). Twenty-five percent of participants in the treatment group did not complete the intervention. No significant difference was found in lymphedema status between groups; however, shoulder mobility was significantly better in the exercise group ($p \leq 0.05$). Another RCT put 38 patients treated for breast cancer into a treatment group of a Nordic walking program (two sessions of a 60-minute walk for eight weeks) or a control group of no walking (Malicka et al., 2011). Among the 38 participants, 34% had lymphedema. No significant differences were found between groups in arm volume, and the treatment group showed no increase in arm volume.

An RCT placed 40 breast cancer survivors into CDT with or without active resistive exercises, such as shoulder-stretching exercises followed by using dumbbells for 15 minutes, while wearing a compression stocking or multilayer bandage supervised

Patient Education: Lymphedema Following Cancer

What is lymphedema following cancer?

Lymphedema is a condition that some patients may get after cancer treatment. Lymphedema causes swelling and uncomfortable symptoms that can get worse over time. Lymphedema is caused by the blocking, removal, or scarring of the lymph system from cancer treatment, such as cancer surgery or radiation therapy. Lymphedema can start a few months to five years, or even 20 years, after cancer treatment.

What are common symptoms of lymphedema?

- Feeling of heaviness, fullness, tightness, or firmness in the limb or body part treated for cancer
- Swelling you can see or feel
- Pain, soreness, aching, or discomfort

What helps to reduce the risk of or manage lymphedema?

There is no cure for lymphedema. Research has shown some ways to manage or lower the risk of lymphedema.

- Complete decongestive therapy (CDT) is a helpful treatment to manage lymphedema. CDT includes four parts: compression garments and/or bandaging, exercise, careful skin care, and manual lymphatic drainage. This treatment is done by healthcare professionals with extra training in lymphedema.
- Using compression bandaging and compression garments alone may also help to control swelling and symptoms.
- Losing weight or staying at an ideal body weight and full-body exercise (such as walking and swimming) may be helpful in managing lymphedema.
- Learning about and understanding lymphedema are likely to be helpful for lowering the risk of developing lymphedema and keeping it from getting worse.
- Cancer survivors may not need to limit exercise activities, such as resistive or aerobic exercises, as well as weightlifting, as long as it starts slowly and builds up over time.

Medications, such as diuretics (water pills) and benzopyrones, should not be used for lymphedema. More research is needed before using other approaches, such as low-level laser therapy, compression pump therapy, or surgical procedures, including lymph node transplantation or liposuction as first treatments for lymphedema before CDT.

Note. Full Oncology Nursing Society Putting Evidence Into Practice information for this topic and description of the categories of evidence are located at www.ons.org/practice-resources/pep/lymphedema. Users should refer to this resource for full dosages, references, and other essential information about the evidence.

by physical therapists five days per week for two weeks (Kim, Sim, Jeong, & Kim, 2010). Significant proximal arm volume reduction was noted in those in the active resistive exercise group ($p < 0.05$), but no statistical significant reduction was found in the distal or overall arm volume. No significant difference was found in arm volume in another RCT that put 32 breast cancer survivors with lymphedema into a treatment group of 12-week aerobic and resistance exercise with a control group (Hayes, Reul-Hirche, & Turner, 2009).

A quasiexperimental study with a pre- and post-test design on the effect of home-based exercise among 32 breast cancer survivors with lymphedema demonstrated significant reduction in arm circumference and limb volume ($p < 0.001$) (Gautam, Maiya, & Vidyasagar, 2011). Another pre- and post-test quasiexperimental study of 26 breast cancer survivors with lymphedema found no significant changes in arm volume after pole-walking (Jonsson & Johansson, 2009). A comparative study of 83 breast cancer survivors on the effect of postoperative physical therapist–supervised exercise and home exercise demonstrated that patients receiving supervised exercise had better arm mobility and function ($p < 0.001$) and less lymphedema ($p = 0.036$) at a six-month follow-up (Scaffidi et al., 2012).

One systematic review of 24 RCTs in breast cancer survivors with lymphedema yielded no evidence of negative effect of upper-extremity exercise on upper-limb lymphedema (McNeely et al., 2010). Another systematic review of six RCTs on the effectiveness of exercise programs on shoulder mobility and lymphedema incidence with 429 women treated for breast cancer showed that early shoulder exercise did not increase lymphedema incidence but prevented deterioration of shoulder mobility (Chan, Lui, & So, 2010). In addition, a review of 10 studies concluded that resistance, aerobic, and other exercises were effective for lymphedema management (Kwan, Cohn, Armer, Stewart, & Cormier, 2011).

Taken together, the findings from these studies and systematic reviews suggest that full-body exercise, particularly in breast cancer survivors, was not associated with an increase in arm volume and may have helped improve shoulder mobility.

Information provision: The importance of patient education that provides lymphedema information and risk-reduction strategies has been recognized by patients and professional organizations (Fu & Rosedale, 2009). In practice, many women treated for breast cancer do not recall being offered any lymphedema information or risk-reduction strategies (Fu, Chen, Haber, Guth, & Axelrod, 2010). A study of 136 breast cancer survivors demonstrated that patients who received lymphedema information reported significantly fewer symptoms and more practice of risk-reduction behaviors than those who did not. After controlling for confounding factors of treatment-related risk factors, patient education remains an important predictor of lymphedema outcome (Fu et al., 2010).

Prevention and early intervention protocols: A single-site blinded trial randomized 116 Spanish patients treated for breast cancer into an experimental group of an early physiotherapy program for reducing lymphedema risk or a control group (Torres Lacomba et al., 2010). The limb volumes of the affected arm increased over time among the participants in the control and intervention groups, but significantly fewer participants (7%) in the intervention group had lymphedema compared to those in the control group (25%) ($p = 0.01$). In terms of interlimb differences, the average limb volume in the affected arm was greater than the volume in the unaffected arm in the control and intervention groups. However, the interlimb differences of the affected arm were less in the participants in the intervention group (1.6%) than those in the control group (5.1%) ($p = 0.00$). Overall, early physiotherapy had a longer protective effect for participants in the intervention group, and lymphedema emerged more quickly in the control group.

In a small RCT, Boccardo et al. (2009) placed 49 women treated for breast cancer into an experimental group of prevention and early intervention with preoperative lymphscintigraphy, risk minimization via surgical techniques ($n = 25$), and early use of elastic sleeves or a control group ($n = 24$). At 12- and 24-month follow-ups, participants in the experimental group had a lower incidence of arm volume increases ($p < 0.04$). Of the 49 women with unilateral breast cancer surgery who were measured at 24 months, 10 (21%) had lymphedema, with 8% in the experimental group and 33% in control group. At 12 and 24 months, the number of patients with arm volume increases was significantly lower in the experimental group ($p = 0.03$). Taken together, the studies suggest that prevention and early intervention protocols are likely to be effective.

Benefits Balance With Harms

Activity restriction and lifting weights: Four RCTs were conducted on the effects of activity restriction and lifting weights on lymphedema. A single-blind and multisite RCT in Norway assigned women after breast cancer surgery to groups with no activity restrictions or activity restrictions (Sagen, Karesen, & Risberg, 2009). Participants with no activity restrictions had a supervised physical therapy program in an outpatient clinic, which emphasized progressive resistance training two to three times per week; they also received standard detailed information on the unrestricted program. Participants with activity restrictions were told to restrict the use of the affected limb for six months, including avoidance of aerobic or other types of exercise involving heavy upper-limb activity, and to avoid carrying or lifting items weighing more than 3 kg. They also were instructed on passive techniques emphasizing flexibility and light massage. At the two-year follow-up, 13% of patients in each group had arm lymphedema, and no significant differences were found in the incidence of developing lymphedema between the groups. Findings suggest that activity restriction does not result in improved outcomes.

An RCT of an equivalence trial on physical activity and lymphedema placed 134 breast cancer survivors at risk for lymphedema into a weightlifting intervention, which included a gym membership and 13 weeks of supervised instruction followed by 9 months unsupervised, or a control group of no exercise (Schmitz et al., 2010). After two sessions of completing three sets of 10 repetitions with no change in arm symptoms, weights were increased for each exercise by the smallest possible increment. At the 12-month follow-up, onset of lymphedema (5% or more increase in interlimb volume difference during the 12 months) was 17% (13 of 75) in the control group and 11% (8 of 72) in the weightlifting group. The findings demonstrated that slowly progressive weightlifting did not increase the risk of lymphedema in breast cancer survivors.

A single-blind RCT in Australia randomly assigned 60 breast cancer survivors with lymphedema into one of three groups: low- or high-load resistance exercise or a wait-list usual care control group (Cormie, Galvão, Spry, & Newton, 2013). Participants in the low- and high-load exercise groups were instructed and supervised by an exercise physiologist to perform six exercises targeting the major upper-body muscle groups. The intensity of the exercises was measured on the Borg scale as moderate to high. Participants were supervised to perform the exercises once a week for 60 minutes for three months. During each exercise session, participants had the choice of whether to wear compression garments. Patients were encouraged to continue their lymphedema care and routine daily activity. At the three-month follow-up, physical-functioning measurement showed significant improvement in both exercise groups compared to the control group, which showed a decline in physical functioning ($p = 0.04$). Twenty-five percent of participants wore compression garments during exercise. Findings show that breast cancer survivors with lymphedema can safely lift weights at low- and high-relative loads. Moderate- to high-intensity exercise may be beneficial to improve physical functioning ($p = 0.001$).

Another randomized crossover study in Australia (Cormie, Pumpa, et al., 2013) assigned 17 breast cancer survivors with lymphedema to low- or high-load exercises involving moderate to high intensity first and then, after a 10–12 day washout period, crossed over to the other load condition. Patients were instructed and supervised by an exercise physiologist to perform high-load exercise (i.e., to lift as much weight as possible for 15–20 repetitions) or low-load exercise (i.e., to lift as much weight as possible for six to eight repetitions). Patients had the option to wear compression garments during exercise. Arm volume or circumference was measured before exercise, immediately after exercise, and 24 and 72 hours after each exercise session. Patients were instructed to continue their usual lymphedema care and physical activities. No significant changes were found in arm volume or circumference of the affected arm before and immediately after each exercise session, no significant changes were noted across most time points, and no significant differences were identified between high- and low-load exercises. In addition, no significant differences were reported in severity of pain, heaviness, or tightness across all study time points. Findings of the study show that neither low- nor heavy-load resistance upper-body exercises had any acute impact on lymphedema measurement and symptoms.

The current research provides the evidence that activity restriction is unlikely to improve lymphedema outcomes and that weightlifting and high- or low-load resistance exercise can be safe for breast cancer survivors with lymphedema.

Kinesio tape bandage: Kinesio tape, or K-tape, is made of 100% cotton fibers with acrylic heat-sensitive glue. A single-blind RCT in Taiwan placed breast cancer survivors with lymphedema into standard decongestive lymphatic therapy combined with pneumatic compression ($n = 40$) and modified decongestive lymphatic therapy, in which the use of a short-stretch bandage is replaced with Kinesio tape ($n = 20$) (Tsai, Hung, Yang, Huang, & Tsauo, 2009). At the three-month follow-up, no significant difference was reported between groups in terms of arm circumference and limb volume by water displacement ($p > 0.05$). Compared to bandaging, Kinesio tape was accepted by patients more because the patients did not need to bandage themselves; in addition, Kinesio tape was less difficult, more comfortable, and more convenient to use ($p < 0.05$). However, more patients who used Kinesio tape had wounds compared to patients who used bandaging ($p < 0.05$). Kinesio tape may be an alternative choice for patients who have difficulty using short-stretch bandaging. Care with skin integrity is essential with the use of Kinesio tape.

Implications for Practice

- Recommend lymphedema interventions with the highest evidence for best clinical practice, such as complete decongestive therapy consisting of compression garments, bandaging, exercise, meticulous skin care, and manual lymphatic drainage by trained therapists, as well as compression bandaging and compression garments alone.
- Provide information on lymphedema, early detection, and early interventions to reduce risk or prevent progression.
- Understand the weight of evidence for potentially helpful lymphedema interventions and interpret research findings for patients and families in an accessible language and format.

Effectiveness Not Established

Manual lymph drainage: One RCT with 90 advanced stage cancer survivors with lymphedema (Clemens, Jaspers, Klaschik, & Nieland, 2010) and a descriptive study of 682 breast cancer survivors with lymphedema (Vignes, Porcher, Arrault, & Dupuy, 2011) demonstrated no significant effect of manual lymph drainage alone on treating lymphedema. An RCT of 154 breast cancer survivors (Devoogdt et al., 2011) and another RCT of 58 breast cancer survivors (Martin, Hernandez, Avendano, Rodrigues, & Martinez, 2011) demonstrated no significant effect of MLD alone on preventing lymphedema. A small prospective trial of 67 breast cancer survivors showed that women in the control group without MLD had a statistically significant increase of 16 ml in arm volume compared to a group with MLD alone (Zimmermann, Wozniewski, Szklarska, Lipowicz, & Szuba, 2012).

Low-level laser therapy: A small randomized, double-blind, placebo-controlled trial of 50 breast cancer survivors with lymphedema showed significant volume reduction in a low-level laser group compared to a control group with traditional lymphedema therapy in Egypt (Ahmed Omar, Abd-El-Gayed Ebid, & El Morsy, 2011). No further evidence to support the use of low-level laser was found in two other studies that evaluated the effect of adding low-level laser therapy to traditional lymphedema therapy (Dirican et al., 2011) or intermittent use of a pneumatic compression device (Kozanoglu, Basaran, Paydas, & Sarpel, 2009).

Pneumatic compression: One larger RCT in Iran ($N = 112$) (Haghighat et al., 2010) and a small RCT ($N = 36$) in the United States (Fife, Davey, Maus, Guiliod, & Mayrovitz, 2012) demonstrated no significant effect of a pneumatic compression device alone in treating breast cancer–related lymphedema in terms of arm volume reduction among breast cancer survivors with lymphedema. In addition, Fife et al. (2012) reported adverse events that were considered to be possibly or definitely pneumatic compression device–related, including increased arm swelling, breast inflammation, pain, fibrosis and infection, increased hand swelling, arm pain, finger numbness, increased swelling

of torso, pain in axilla and back in the standard device group, and increased swelling of the lymph nodes in the contralateral axilla in the advanced device group; however, the researchers did not report the exact prevalence of the adverse events. In a small pre- and post-test study of 21 breast cancer survivors with lymphedema, Moattari et al. (2012) reported a significant effect of combined CDT and pneumatic compression device on arm volume reduction ($p < 0.05$).

A small RCT in the United States assigned 42 breast cancer survivors with lymphedema into an experimental group receiving truncal, chest, and arm pneumatic compression to treat lymphedema and a control group of arm compression only (Ridner, Murphy, et al., 2012). Findings demonstrated no significant effect of the pneumatic compression device on lymphedema symptoms, bioimpedance ratio, and physical functioning.

Other Treatments

No new research was published on nanocrystalline silver dressing on lymphatic ulcers and aromatherapy. Current published literature did not provide supporting evidence to change the level of evidence for hyperbaric oxygen (Gothard et al., 2010), acupuncture (Cassileth et al., 2011, 2013), varied surgical techniques (Boccardo et al., 2009, 2011; Damstra, Voesten, van Schelven, & van der Lei, 2009), liposuction (Schaverien, Munro, Baker, & Munnoch, 2012), and lymphatic venous anastamosis (Boccardo et al., 2011; Cormier, Rourke, Crosby, Chang, & Armer, 2012; Damstra et al., 2009).

New emerging treatments were under investigation, including aquatherapy (Johansson et al., 2013; Tidhar & Katz-Leurer, 2010), axillary reverse mapping (Boneti et al., 2012), cell transplantation (Maldonado et al., 2011), massage (Maher, Refshauge, Ward, Paterson, & Kilbreath, 2012), qigong (Fong et al., 2014), the use of a device delivering electronic sound waves and vacuum (Cavezzi, Paccasassi, & Elio, 2013), extracorporeal shockwave therapy (Bae & Kim, 2013), use of a mechanical exercise device (Bordin, Guerreiro Godoy, & Pereira de Godoy, 2009; Guerreiro Godoy, Guimaraes, Oliani, & Pereira de Godoy, 2011; Guerreiro Godoy, Oliani, & Pereira de Godoy, 2010; Guerreiro Godoy, Pereira, Oliani, & Pereira de Godoy, 2012), low-intensity electrostatic stimulation (Belmonte et al., 2012), and lumbar sympathetic ganglion block (Woo, Park, Kim, & Kim, 2013).

American Cancer Society
www.cancer.org

BreastCancer.org
www.breastcancer.org

Lymphology Association of North America
www.clt-lana.org

National Cancer Institute
www.nci.nih.gov/cancerinfo/pdq/supportivecare/lymphedema

National Lymphedema Network
www.lymphnet.org

Oncology Nursing Society Putting Evidence Into Practice
www.ons.org/practice-resources/pep

Stepup-speakout.org
www.stepup-speakout.org

FIGURE 3. Selected Resources on Lymphedema Care

Expert Opinion

Skin hygiene and care, compression garments when flying, and avoidance of blood pressure and venipuncture remain at the level of expert opinion.

Not Recommended for Practice

Drug therapy (the use of diuretics and benzopyrones) remains at the level of not recommended for practice.

Conclusion and Implications for Future Research

This systematic review supports the application of CDT, compression bandages, and compression garments with the highest evidence for clinical best practice for lymphedema. Nurses can advocate for the use of CDT and compression for their patients with lymphedema with the patients themselves and with other healthcare practitioners. Weight management, full-body exercise, information provision, and prevention and early intervention protocols are likely to be effective. New emerging treatments have been under investigation for this chronic and incurable condition, which is encouraging. Historic recommendations for activity restriction and avoidance of weightlifting that limit cancer survivors' daily lives have been challenged with more evidence. Although more RCTs were conducted, the majority of the literature from 2009–2013 has similar limitations as the literature from 1997–2007: small sample sizes, homogeneity of breast cancer survivor samples, and lack of RCTs. Future research should focus on providing a high level of evidence using RCTs with larger samples and RCTs on lymphedema associated with other cancers.

Nurses should educate all patients and families at risk for lymphedema about risk-reduction and prevention methods. Nurses should also be prepared to provide access to further resources on request. Figure 3 provides a list of clinical resources for lymphedema care. In addition, nurses can advocate for health policy coverage for effective interventions that reduce lymphedema risk and assist in management.

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