



Management of Breast Cancer-Related Lymphedema

Ayşe ARIKAN DÖNMEZ, Sevgisun KAPUCU

Department of Internal Medicine Nursing, Hacettepe University Faculty of Nursing, Ankara-Turkey

SUMMARY

Lymphedema is one of the most common complications to occur after breast cancer treatment. It is an important problem that affects individuals' lifestyles and activities, causing physical and psychosocial problems, and negatively affecting quality of life. Treatment of lymphedema was thought to be impossible in the past, but it has now become possible to manage the condition more effectively with current treatment methods. Nurses, who are important members of the healthcare team, play a key role in helping patients to take responsibility and play an active part in the prevention, management, and follow-up of lymphedema. Nurses should be able to identify patients at high risk for developing lymphedema, provide the necessary training for lymphedema prevention, evaluate lymphedema, and plan for appropriate nursing interventions in the early stages. This literature review aims to inform nurses and other healthcare professionals about lymphedema management.

Keywords: Breast cancer; lymphedema; lymphedema management; nursing.

Copyright © 2016, Turkish Society for Radiation Oncology

Introduction

Breast cancer (BC) is one of the most common types of cancer among women in the world and it is held responsible for 25% of all cancer and 15% cancer-related deaths.[1] In parallel with this increase in its incidence, pathogenesis of BC has been understood at the present time and under favor of advanced technology highly effective improvements have been made progress in BC treatment. Treatment methods of BC are surgery, chemotherapy, radiotherapy and hormonal therapy. One or more these treatment methods can be used in the treatment of patients according to their individual characteristics and status of disease. While these methods extend life span, they bring along some complications that negatively affect quality of life.[2-4] Lymphedema is one of the most common postoperative complication, especially after BC surgery, it has been defined as an abnormal accumulation of protein-rich fluid in

the interstitial space as a result of impaired lymphatic function due to axillary lymph node dissection, radiotherapy, fibrosis or inflammation.[2-6] Due to the differences in the diagnostic and assessment methods and the range of follow-up of patients, the incidence of breast cancer-related lymphedema (BCRL) is not known precisely.[7-11] While the exact incidence of lymphedema is unknown, the incidence of lymphedema is reported in the studies that show a wide range, such as 6-83%.[2,12-14] The reason of this wide range is due to the fact different grading scales and symptom assessment tools were being used. Further, because the use of patient-reported outcome measures and/or objective assessments result in a higher severity of BCRL as compared to clinician examination, it is thought that BCRL is typically underreported. Also lymphedema is an important complication that may ensue BC treatment in one out of every four women (25%).[12,13,15]

Classification and Staging of Lymphedema

Although there are numerous international classification and staging initiatives for lymphedema, there is no single method that provides a comprehensive view of the etiopathogenesis of lymphedema or important overlaps between lymphedema grades.[16]

Classification

Lymphedema classification is not a staging technique. Classification is divided into two groups according to lymphedema etiology; idiopathic/primary or acquired/secondary lymphedema.[16–21]

Primary lymphedema develops due to congenital dysfunction or malformation of the lymphatic system and it is not associated with any injury, trauma, illness and treatment.[17–21] Primary lymphedema is divided into different groups according to clinical indications which are age-related situations:

1. Congenital lymphedema; occurs present at or shortly after birth
2. Lymphedema praecox; develops during puberty shortly thereafter in most individuals.
3. Lymphedema tarda; occurs after the age of 35 [20, 22–24]

Secondary lymphedema occurs as a result of obstruction and/or loss of normal lymphatic flow and obstruction of lymphatic channels due to surgical intervention, radiation therapy, trauma, infection, inflammation (Table 1).[19,23–25] Secondary lymphedema is more common than primary lymphedema and ensues BC treatment in the majority of developed countries.[16–24]

Staging

After classification according to the etiology of lymphedema, staging is necessary based on clinical findings.[16,24] Staging allows an objective assessment to record deviations from the normal state. At the same time the staging system plays an essential role in planning the appropriate medical intervention and evaluating the effectiveness of the intervention.[16] Although not yet a single staging system, most researchers use the criteria set out in the International Society of Lymphology (ISL) consensus report.[16,26]

According to this report, ISL has staged lymphedema in 4 steps (Table 2):[16,19,20,24,26–30]

The severity of each stage is based on the volume differences between the extremities. It is stated that an increase of less than 20% in the extremity volume is minimal, an increase of 20% to 40% is moderate, and an increase of 40% is severe lymphedema. All these

Table 1 Causes of secondary lymphedema

Cause	Sample case
Trauma and tissue damage	Lymph node excision Radiotherapy Burns Varicose vein surgery
Malignant disease/tumor	Lymph node metastasis Infiltrative carcinoma Lymphoma Cancer surgery Kaposi's sarcoma
Venous disease	Chronic venous insufficiency Venous ulceration
Infection	Cellulite/erysipelas Lymphadenitis Filariasis Tuberculosis
Inflammation	Rheumatoid arthritis Dermatitis Lymphatic occlusion Crohn's disease Sarcoidosis Psoriasis
Medications	Oral contraceptives Antihypertensives Diuretics Corticosteroids

Reference: 19,23–25

stages only indicate the physical condition of the extremities.[16,19,20,24,26–29]

Lymphedema Risk Factors

In general, lymphedema risk factors are classified into three categories: treatment, disease, and patient-related factors (Table 3).

A number of treatment modalities, such as the more extensive and aggressive treatments, are reported to pose a risk in the development of lymphedema. Within these factors, axillary lymph node dissection (ALND) is one of the most important risk factor. Compared to sentinel lymph node dissection, it increases the risk of lymphedema fourfold. In addition to these factors it is indicated that especially large breast surgery, combined radiotherapy and chemotherapy regimens also increase the risk of lymphedema.[11,13,30–34]

Patient-related factors include age, overweight or obesity, hypertension, physical activity level, comorbid conditions.[35–37]

Table 2 Stages of lymphedema

Clinical stage	Definition
Stage 0	A latent or subclinical stage although alterations lymphatic system
Stage 1	Compared to venous edema, it is evident that early-stage fluid accumulation, which is relatively high protein content. Edema is reduced by elevation of extremity. At this stage pitting edema could be seen.
Stage 2	Edema rarely decreases with the elevation of the extremity and pitting is quite obvious. In the early stage pitting develops but later pitting does not occur
Stage 3	It is defined as the stage of lymphostatic elephantiasis. Excessive edema is located. Trophic changes such as fibrosis, hyperkeratosis, papillomatosis, hyperpigmentation, lenfore, ulcerations occur in the skin.

Reference: 16,19,20,24,26–30

Table 3 Lymphedema risk factors

Treatment-related factors	Surgical method
	Radiotherapy
	Chemotherapy
	Width of incision area
	Number of excised lymph nodes
Disease-related factors	Tumor stage
	Lymph node involvement
	Localization of tumor
	Tumor diameter
Patient-related factors	Age
	Body mass index
	Hypertension
	Infection
	Excessive use of the extremity
	Sedanter lifestyle

It is indicated that factors associated with the disease are tumor progression, localization, size, and lymph node involvement.[38,39]

Signs and Symptoms of Lymphedema

Different signs and symptoms may arise in the extremity where lymphedema develops. These symptoms and findings include following:

- Sensation of heaviness and tightness on the affected extremity
- Pain or discomfort
- Restricted movement
- Feeling of weakness in the affected extremity
- Swelling in all or a specific region of the extremity
- Narrow clothing, underwear or jewellery
- Feeling of numbness and tingling on the affected extremity.[8,19,40–42]

Sackey et al. (2014) found that 74.2% of patients with invasive breast cancer, pathologic lymph node involvement and ALND had early signs of lymphatic in-

sufficiency (heaviness, pain, fatigue and tightness) after one year of surgery.[43]

Lymphedema Diagnosis and Assessment Methods

Anamnesis (patient history), physical examination, limb circumference measurement, volumetric measurements, imaging methods are used in the diagnosis and assessment of lymphedema.[44]

Anamnesis (Patient History)

Each patient with a risk of lymphedema or have lymphedema should be assessed in terms of age, body mass index, lifestyle, past medical history, health status; etiology, duration, localization, prognosis of edema; condition of the skin and tissues, presence of infection, wounds or lymphorrhea; applied medical treatment, effect of lymphedema on the quality of life and the patient's/family's expectation from the treatment. [26,40,44,45] This information acquired from the patient and his/her family will be a helpful guide to health staff on how to effectively treat the problem of lymphedema.[40]

For the health condition, data such as time of BC diagnosis, the presence of the disease on the same side as the active arm, infection history, applied surgical method, axillary dissection, number of excised lymph nodes, axillary radiotherapy postoperative period and cardiovascular diseases should be taken.[3,5,45]

Physical Examination

In the physical examination, the condition of the skin and tissues are considered using the methods of inspection and palpation.

With inspection; skin color, folds and tags, scar and incision trace, moisture, integrity are assessed. In

palpation; skin temperature, thickness, moisture, mobility, pitting edema, pulse and senses are also considered.[46,47]

Upper Extremity Circumference Measurements

Measurements of the upper extremity circumference could be performed from bone protrusions (ulnar styloid, olecranon, metacarpophalangeal joint), as well as with equal spacing (2 cm, 4 cm, 5 cm or 10 cm) from the anatomical point of the arm, such as the antecubital fossa, to axillary. Lymphedema is clinically diagnosed when a 2 cm difference or more in arm circumference at least one anatomic point measured between the affected and nonaffected limbs.[5,45] Circumference measurements are preferred because they are simpler, lower cost and easier to use than volumetric measurements

Volumetric Measurements

In volumetric measurements, the patient's extremities are immersed in a cylindrical container filled with water and the amount of outflow is measured in milliliters. The difference between the healthy extremity and the affected extremity determines the amount of edema. A difference of more than 200 ml between the arms or a volume difference of 20% or more according to the normal extremity is accepted as lymphedema.[46,48,49]

Imaging Methods

When the diagnosis of lymphedema is uncertain after clinical evaluation and physical examination, or when better prognostic factors are needed; imaging methods such as lymphoscintigraphy, lymphangiography, ultrasonography (USG), color doppler USG, lymphatic capillaryoscopy, magnetic resonance imaging, computed tomography, bioimpedance are utilized.[19,26,44,46]

Lymphedema Management

Lymphedema can develop immediately after a month or years, as it can occur immediately in a group at risk. In some patients at risk, lymphedema never develops. Lymphedema negatively affects functional capacity, psychosocial well-being and quality of life.[50] Individuals at risk for lymphedema should be careful in their daily life activities throughout their life. The aims of the lymphedema management are to prevent the progression of the clinical picture and development of

Table 4 Two phased complete decongestive therapy

Phase I	Phase II
Skin and nail care	Manual lymphatic drainage
Compression bandages	Physical activity and exercise
Skin and nail care	Compression garments
Compression bandages	Physical activity and exercise

cellulitis and other infections, to reduce and maintain the size of the extremities, to alleviate the disturbance caused by excessive fluid and protein accumulation, and to train the patient about self-management.[51]

Lymphedema, which is thought to be impossible in the past, can be treated more effectively with some methods currently developed.[52] Nevertheless, the prevention of lymphedema development is easier, more effective and more important than treatment after it has developed. The recommended treatment modalities for controlling symptoms of lymphedema, increasing functional capacity, reducing complications, and treating lymphedema when it develops can be treated under the title of conservative (non-surgical) and surgical treatment.[50,53] Conservative treatment consists of physical therapy and medical treatment. Physical therapy includes implementations such as complete decongestive therapy (CDT), pneumatic compression pumps, low level laser therapy, kinesio taping.[2,53–56] With the report of the ISL (2001), CDT has been accepted as the international standard current treatment for lymphedema.[57] CDT is a special manual approach that allows for the reduction of volume in the patient with lymphedema.[48] CDT is a two-phase treatment program. Phase I is a phase of lymphedema reduction that lasts for 4 weeks or more and consist of 4 components. These components include skin and nail care, manual lymphatic drainage (MLD), compression bandages, therapeutic exercises with bandages. With this phase, the second phase, which is the protection phase, is passed when a volume reduction is achieved in the lymphedema. In this phase, there are skin care, compression garments, exercise programs with compression bandages and garments (Table 4).[44,54]

Skin and Nail Care

Skin and nail care is an important part of CDT. Skin healing and protective approaches are also important in both phases of CDT. While phase-I focuses on the repair and maintenance of damaged skin, it is important to maintain skin care in phase-II.[58] The pur-

poses of skin care in patients with lymphedema are to control bacterial and fungal colonization, reduce microbial colonization in skin folds, provide skin hydration to prevent dryness and fissure formation, provide patient comfort and reduce infection risk.[40,59]

Patients who are at risk for lymphedema should be thoroughly informed of their proper cleaning and moisturizing methods.[15,60] In the course of patient education, methods of evaluation of infection and inflammation should be explained in detail. At the beginning of the treatment, the patient should be given a checklist to indicate the activities that should be avoided, which may lead to lymphedema.[60]

Compression Treatment

Compression therapy is performed in three different ways to facilitate the circulation of the lymph fluid. These are compression bandages, compression garments and compression devices.[3]

Compression bandages

Compression bandages are systematic implementation of various types of filling material and short stretch bandages. Bandages are applied with moderate pressure in the distal parts of the affected extremities/limbs and a lower compression is applied by decreasing the pressure toward the proximal parts. In the bandaged extremity, the pressure on the interstitial area increases and the flow of the lymph fluid is facilitated.[61,62] Bandages also reduce the volume and help maintaining skin integrity and protect the skin from trauma.[62] While bandages are used 24 hours a day during the intensive treatment phase; they are used in conjunction with compression garments at nights. It is recommended that compression bandages should be worn every day; removed only when patients are asleep at night.[45,63]

Compression garments

Compression garments are often used in clinical practice to manage symptoms of lymphedema and require careful patient assessment, patient compliance and patient monitoring by the trainer. The compression garment should be tailor-made and apply 20–60 mmHg pressure according to the severity of the lymphedema. They should be replaced with the new one every three to six months when they lose their elasticity.[2,63] It is recommended that compression garments should be worn daily, 24 hours a day.[2] Compression garments should not be used in the presence of arterial insufficiency, acute heart failure, extreme deformity of the

limbs, skin ulceration, severe peripheral neuropathy and lymphorrhea.[2,63]

Compression devices

Compression devices are also called pneumatic pumps. Compression devices work by giving constant or intermittent pressure to the extremity during an adjustable time period.[5] The duration of treatment with compression devices can last up to 30 minutes to several hours depending on the severity of the lymphedema and the condition of the patient.[3] Studies on the physiological effects of these devices have shown that they direct lymph fluid from distal to proximal.[5,16]

Compression devices should not be used in case of congestive heart failure, known or suspected deep vein thrombosis or pulmonary embolism, active erysipelas or cellulitis, ischemic vascular disease, severe peripheral neuropathy, edema on the proximal limb of the extremity, active metastatic disease on the affected limb, as it would increase venous return with lymphatic transport.[3,50]

Manual Lymphatic Drainage (MLD)

MLD is a massage-like technique that is applied not only to the affected area of the body but also to the lymph nodes in other areas for 30 to 60 minutes to provide lymphatic flow.[64] It is performed by intermittently applying light pressure directly to the superficial lymph vessels below the skin. With MLD, the smooth muscles surrounding the lymph vessels are mechanically stimulated to provide more frequent contractions of the muscles and thus the lymphatic flow rate and the forward movement of the lymph fluid are increased. The proximal part of the limb is always first drained and then advanced to the distal parts.[5,45,46,49,62]

The aims of treatment are to reduce lymphedema by increasing lymphatic drainage, to prevent tissue fibrosis and the development of lymphedema again.[45]

Simple Lymphatic Drainage/ Self Lymphatic Drainage (SLD)

SLD is a simplified version of MLD. After the training, it can be done by the patient or his/her relatives. It shows its effect as it is in MLD.

Points to take into consideration when performing SLD can be summarized as follows:

- Supporting the affected extremity with a pillow or roller and placement of the shoulder in a comfortable area/table

- Leaving shoulder, neck, arms and hands freely during application
- Applying the pressure with the inner surfaces of the fingers and not using the fingertips when applying pressure
- Being very light the applied pressure
- Firstly stretching the skin gently then slacking off
- Directing drainage to unaffected lymph nodes
- Not implementing in the presence of any infection

Physical Activity and Exercise

Physical activity and exercise are important components in the control and prevention of cancer. Physical activity and exercise therapies play an important role in CDT by stimulating lymphatic system functions in cancer patients, as well as by reducing fatigue, body fat, anxiety and depression, and promoting cardiovascular health, muscle strength and functional capacity. Physiologically, exercise has the effect of increasing venous and lymphatic rotation in the affected extremities by activating skeletal muscles. The pumping activity that the muscle makes, along with other supporting mechanisms, directs these fluids towards the heart and provides an uninterrupted circulation.[17,44]

Exercise and the maintenance of ideal body weight are especially important for breast cancer patients. Because weight gain and/or obesity are known to increase the risk of lymphedema after breast cancer treatment. In the past, especially because of the limited availability of high evidence-based studies that address lymphedema-related exercises, patients were often advised to avoid exercise for the affected extremity, to protect the affected extremity, and to limit physical activity to reduce the risk of lymphedema.[65] These recommendations include some implementations such as avoidance of certain medical procedures (such as blood pressure measurement, injection, blood drawing), minimizing applications such as wearing tight clothing or lifting heavy items that will cause the extremity to become trapped, avoiding the stressful activities of the affected extremities, wearing compression garments during travel and exercise [65] (Table 5). Generally, these prophylactic recommendations may lead to anxiety and fear about what individuals should be able to exercise safely without causing lymphedema or exacerbating the existing lymphedema, and how to protect the affected extremity.[17,26]

The effect of physical activity and exercise on the lymphatic system may vary according to the recommended exercise. Studies in healthy subjects found that the exercise regimen, which included dynamic muscle

contractions, increased lymph flow in both the peripheral lymphatic system collecting ducts and skeletal muscles.[66–68]

In the literature, remedial, aerobic, strengthening, stretching, other exercises (such as pilates, Tai Chi, yoga) are recommended for lymphedema management and control.[19,69]

Therapeutic (remedial) exercises; are a type of exercise involving a specific group of repetitive movements designed to promote recurrent muscle contractions on the extremity with lymphedema. They include active, rhythmic, repetitive and unresistant movements of the extremity. It is stated that these exercises should be combined with respiratory exercises.[19,70]

These exercises lightly compress the smooth muscles of the walls of the lymph vessels with rhythmic muscle contractions and relaxation by providing contractions, as well as contractions of the smooth muscles in the walls of the lymph vessels and when this externally applied compression is sufficient, an internal pumping mechanism occurs that increases lymphatic flow along the pressure gradient, with the help of collateral drainage pathways from existing lymphatic channels.[19,70] The effect of aerobic exercises on the lymphatic system is summarized in the following Figure 1.

Aerobic exercises; are exercises that bring large muscle groups up to speed and increase the heart and respiratory rate of individuals. These types of exercises improve cardiovascular endurance by gradually increasing heart and lung capacity.[19,70]

Strengthening exercises; are based on basis of imposing burden on the muscles. The resistance created by this exercise provides stimulation of the motor units and contraction of most of the muscle fibers. Free weights are used in these exercises. To prevent muscle fatigue, it is recommended that these exercises should be started with low weights, progressing slowly and gradually.[19,70]

Stretching exercises; provide loosening of fibrous tissue, regulation of body biomechanics, and stimulation of lymph flow. These exercises minimize the complications that reduce lymph flow, such as skin scars and joint contractures and increase or maintain joint range of motion by stretching muscles and connective tissue.[19,70]

The Roles and Responsibilities of Nurses in Lymphedema Prevention and Treatment

Lymphedema is a problem that affects individuals' lifestyles and functions, causes physical and psychoso-

Table 5 Patient control list for reducing lymphedema risk**I. Skin care-Avoidance from trauma or injury and reducing of infection risk**

Keeping the extremities clean and dry

- Daily evaluation of skin for scratches, infection, rash and redness
- Apply daily moisturizers to prevent cracks and scallies in the skin
- Elevation of the affected extremity
- Attention to nail care; being short of the nails, not cutting cuticles
- Protecting of the affected extremity with suncream and anti-insects
- Avoiding implementations such as injections and bloodshed, as far as possible
- Wearing gloves while performing activities that can cause skin injuries (gardening, working with cutting tools, using chemicals such as detergents, contact with animals)
- The use of electric machines instead of razors for axillary cleaning
- If there are scratches on the skin, washing with water and soap, implementation of antibiotics and observation of the skin in terms of infection (e.g. redness)
- Drying of the washing area thoroughly (not scrubbing, not rubbed with a towel)
- Contacting with physican immediately, if there are signs of rash, itching, redness, pain, increased skin temperature, fever or flu-like symptoms
- Avoiding from tattoos and piercings
- Using of thimble when sewing

Not getting a massage the upper part of the body (Manual lymphatic drainage should not be considered as a massage)

II. Activity/Lifestyle

- Avoiding extreme coercive activities
- Increasing gradually in duration and severity of any activity or exercise
- Resting frequently during the activity to allow the extremities to rest
- Monitoring of the extremity during and after the activity for any changes such as size, shape, texture, structure, pain, weight or stiffness
- Avoiding from long-term inactivity

Useful activities: Swimming, lymphedema exercise program, self-manual lymphatic drainage, yoga, walking

Medium risk activities: Jogging, running, walking band, riding, mountaineering

High risk activities: Gardening, tennis/racquet sports, golf, plowing, carrying goods, carrying suitcases, carrying heavy shopping bags (4–6 kilos more), advanced riding

III. Nutrition

- Protection of ideal body weight
- Consuming balanced, low salinity, low fat, fiber foods
- Not reducing of protein uptake (Protein restriction does not reduce the content of protein in the lymphedema)

IV. Avoiding Extremity Compression

- Not measuring blood pressure from the arm at risk (if measurement is mandatory, blood pressure manometer should be removed up to 10 mmHg above systolic pressure)
- Using loose jewelry and clothes

Reference: 60,76,77

cial problems, affects their quality of life in a negative way, and could be prevented or reduced by appropriate nursing interventions.[71] Nurses, who are important members of the healthcare team play a key role in helping individuals take responsibility for their own lymphedema, in the prevention, management and follow-up of lymphedema. Nurses should identify the group of patients at high risk for developing lymphedema, take necessary precautions to protect from lymphedema, intervene early by assessing lymphedema and inform

the patients about their self-care.

Nursing Interventions for Lymphedema Prevention and Treatment

- Assessment of the patient's in preoperative and postoperative period in terms of the risk of developing lymphedema
- Performing routine extremity measurement to evaluate the changes in the volume of the patient

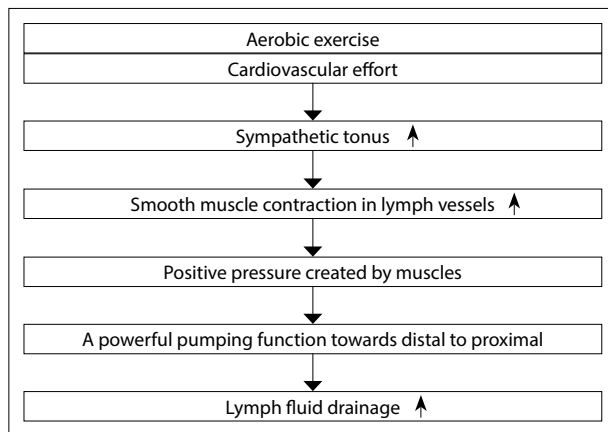


Fig. 1. The effect of aerobic exercises on the lymphatic system.

in pre-postoperative period and assessment the degree of movement of the extremity

- Assessing the body weight of patient in pre-post-operative period and calculating the body mass index
- Not using the extremity on the side of the operation side for any parenteral intervention and blood pressure measurement
- Protecting the position of affected extremity during the first 24 hours after surgery
- Initiating mild exercises to keep the patient's hand muscles and fingers function as far as possible 24 hours after surgery
- Monitoring of affected area after surgery in terms of infection and lymphedema symptoms
- Performing of lymph drainage to ensure the continuity of the lymph circulation in the affected area and teaching to patient/his or her relatives after the surgery
- Establishing an appropriate exercise program for the patient after surgery and encouraging and supporting the patient in this program adaptation
- Training patients/ his or her relatives about subjects such as lymphedema, signs-symptoms of lymphedema, points to consider when performing daily living activities to prevent or reduce the risk of lymphedema development, actions to be taken in the event of lymphedema development, and so on (see Table 5).
- Physical evaluation of the affected extremity in terms of lymphedema by monitoring the patient at appropriate intervals, measurement of the extremities and comparison with the previous measurement results, monitoring of the exercise program

and maintenance of the individual's home care in the post-discharge period.[72–74]

As stated in the Regulation on the Amendment of the Nursing Regulation published in the Official Gazette dated April 19, 2011 with number 27910; nurses have duties, powers and responsibilities, such as symptom management and provision of support to improve the quality of life for patients and their families, assessing the individuals with holistic view, providing communication and independent living skills necessary for daily life process, teaching, supporting and monitoring the individuals to improve their quality of life by improving self care.[75]

As a result, as mentioned in the nursing regulation, within the scope of the educational, supportive, rehabilitative roles; nurses should be informed about lymphedema, risk factors, symptoms, protective approaches and management, inform individuals and their families, have active role in preventing and reducing this problem with appropriate nursing interventions.

Disclosure Statement

The authors declare no conflicts of interest.

References

1. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global Cancer Statistics, 2012. *CA Cancer J Clin* 2015;65:87–108. [Crossref](#)
2. Harris SR, Hugi RM, Olivetto IA, Levine M. Clinical practice guidelines for the care and treatment of breast cancer. 11. Lymphedema. *CMAJ* 2001;164(2):191–9.
3. Morrell RM, Halyard MY, Schild SE, Ali MS, Gundersen LL, Pockaj BA. Breast cancer-related lymphedema. *Mayo Clin Proc* 2005;80(11):1480–4. [Crossref](#)
4. Baron RH. Surgical management of breast cancer. *Semin Oncol Nurs* 2007;23(1):10–9. [Crossref](#)
5. Golshan M, Smith B. Prevention and management of arm lymphedema in the patient with breast cancer. *J Support Oncol* 2006;4(8):381–6.
6. Bicego D, Brown K, Ruddick M, Storey D, Wong C, Harris SR. Exercise for women with or at risk for breast cancer-related lymphedema. *Phys Ther* 2006;86(10):1398–405. [Crossref](#)
7. Mortimer PS, Bates DO, Brassington HD, Stanton AWB, Strachan DP, Levick JR. The prevalence of arm oedema following treatment for breast cancer. *QJ Med* 1996;89(5):377–80. [Crossref](#)
8. Petrek JA, Heelan MC. Incidence of breast carcinoma-related lymphedema. *Cancer* 1998;83(S12B):2776–81.

9. Herd-Smith A, Russo A, Muraca MG, Del Turco MR, Cardona G. Prognostic factors for lymphedema after primary treatment of breast carcinoma. *Cancer* 2001;92(7):1783-7. [Crossref](#)
10. Petrek JA, Senie RT, Peters M, Rosen PP. Lymphedema in a cohort of breast carcinoma survivors 20 years after diagnosis. *Cancer* 2001;92(6):1368-77. [Crossref](#)
11. Tsai HJ, Hung HC, Yang JL, Huang CS, Tsauo JY. Could Kinesio tape replace the bandage in decongestive lymphatic therapy for breast-cancer-related lymphedema? A pilot study. *Support Care Cancer* 2009;17(11):1353-60. [Crossref](#)
12. Clark B, Sitzia J, Harlow W. Incidence and risk of arm oedema following treatment for breast cancer: a three-year follow-up study. *QJM* 2005;98(5):343-8. [Crossref](#)
13. Bani HA, Fasching PA, Lux MM, Rauh C, Willner M, Eder I, et al. Lymphedema in breast cancer survivors: assessment and information provision in a specialized breast unit. *Patient Educ Couns* 2007;66(3):311-8. [Crossref](#)
14. Park JH, Lee WH, Chung HS. Incidence and risk factors of breast cancer lymphoedema. *J Clin Nurs* 2008;17(11):1450-9. [Crossref](#)
15. Williams AF, Vadgama A, Franks PJ, Mortimer PS. A randomized controlled crossover study of manual lymphatic drainage therapy in women with breast cancer-related lymphoedema. *Eur J Cancer Care (Engl)* 2002;11(4):254-61.16. Tretbar LL, Morgan CL, Byung-Boong L, Simonian SJ, Blondeau B. *Lymphedema*. London: Springer; 2008.
17. Chang CJ, Cormier JN. Lymphedema interventions: exercise, surgery, and compression devices. *Semin Oncol Nurs* 2013;29(1):28-40. [Crossref](#)
18. Lasinski BB. Complete decongestive therapy for treatment of lymphedema. *Semin Oncol Nurs* 2013;29(1):20-7. [Crossref](#)
19. International Lymphoedema Framework: An International Perspective. International Consensus Best practice for the management of lymphoedema. *Skin Care and Cellulitis/Erysipelas*; 2006. p. 24-9.
20. Oremus M, Walker K, Dayes I, Raina P. *Diagnosis and treatment of secondary lymphedema*. Rockville (MD): Agency for Healthcare Research and Quality (US); 2010.
21. Ridner SH. Pathophysiology of lymphedema. *Semin Oncol Nurs* 2013;29(1):4-11. [Crossref](#)
22. Glociczki P. *Handbook of venous disorders. Guidelines of the American Venous Forum*. London: Edward Arnold; 2009.
23. Burns T, Breathnach S, Cox N, Griffiths C. *Rook's Textbook of Dermatology*. Oxford: Wiley-Blackwell; 2010. [Crossref](#)
24. Singh N. *Radioisotopes-Applications in Bio-Medical Science*. Intech Open Access Publisher; 2011. [Crossref](#)
25. Burgdorf WHC, Plewig G, Wolff HH, Landthaler M, Braun-Falco's *Dermatology*. Heidelberg: Springer; 2009. [Crossref](#)
26. Bernas M. Assessment and risk reduction in lymphedema. *Semin Oncol Nurs* 2013;29(1):12-9. [Crossref](#)
27. International Society of Lymphology. The diagnosis and treatment of peripheral lymphedema. Consensus document of the International Society of Lymphology. *Lymphology* 2003;36(2):84-91.
28. International Society of Lymphology. The diagnosis and treatment of peripheral lymphedema. 2009 Consensus Document of the International Society of Lymphology. *Lymphology* 2009;42(2):51-60.
29. Lee BB, Bergan J, Rockson SG. *Lymphedema: a concise compendium of theory and practice*. Springer Science & Business Media; 2011. [Crossref](#)
30. Özslan C, Kuru B. Lymphedema after treatment of breast cancer. *Am J of Surg* 2004;187:69-72. [Crossref](#)
31. Shah C, Vicini FA. Breast cancer-related arm lymphedema: incidence rates, diagnostic techniques, optimal management and risk reduction strategies. *Int J Radiat Oncol Biol Phys* 2011;81(4):907-14. [Crossref](#)
32. DiSipio T, Rye S, Newman B, Hayes S. Incidence of unilateral arm lymphoedema after breast cancer: a systematic review and meta-analysis. *Lancet Oncol* 2013;14(6):500-15. [Crossref](#)
33. Helyer LK, Varnic M, Le LW, Leong W, McCready D. Obesity is a risk factor for developing postoperative lymphedema in breast cancer patients. *Breast J* 2010;16(1):48-54. [Crossref](#)
34. Das N, Baumgartner RN, Riley EC, Pinkston CM, Yang D, Baumgartner KB. Treatment-related risk factors for arm lymphedema among long-term breast cancer survivors. *J Cancer Surviv* 2015;9(3):422-30.
35. Deo SV, Ray S, Rath GK, Shukla NK, Kar M, Asthana S, Raina V. Prevalence and risk factors for development of lymphedema following breast cancer treatment. *Indian J Cancer* 2004;41(1):8-12.
36. Ahmed RL, Thomas W, Yee D, Schmitz KH. Randomized controlled trial of weight training and lymphedema in breast cancer survivors. *J Clin Oncol* 2006;24(18):2765-72. [Crossref](#)
37. Meeske KA, Sullivan-Halley J, Smith AW, McTiernan A, Baumgartner KB, Harlan LC, et al. Risk factors for arm lymphedema following breast cancer diagnosis in Black women and White women. *Breast Cancer Res Treat* 2009;113(2):383-91. [Crossref](#)
38. Ahmed RL, Schmitz KH, Prizment AE, Folsom AR. Risk factors for lymphedema in breast cancer survivors, the Iowa Women's Health Study. *Breast Cancer Res Treat* 2011;130(3):981-91. [Crossref](#)

39. Paskett ED, Naughton MJ, McCoy TP, Case LD, Abbott JM. The epidemiology of arm and hand swelling in premenopausal breast cancer survivors. *Cancer Epidemiol Biomarkers Prev* 2007;16(4):775–82. [Crossref](#)
40. Wanchai A, Beck M, Stewart BR, Armer JM. Management of lymphedema for cancer patients with complex needs. *Semin Oncol Nurs* 2013;29(1):61–5. [Crossref](#)
41. Shahpar H, Atieh A, Maryam A, Fatemeh HS, Massoome N, Mandana E, et al. Risk factors of lymphedema in breast cancer patients. *Int J Breast Cancer* 2013;1–7. [Crossref](#)
42. Müezzinzler NE, Karayurt Ö. Investigation of Experiences of Women Who Developed Lymphedema Related to Breast Cancer Treatment. *J Breast Health* 2014;10:23–9. [Crossref](#)
43. Sackey H, Magnuson A, Sandelin K, Liljegren G, Bergkvist L, Fülep Z, et al. Arm lymphoedema after axillary surgery in women with invasive breast cancer. *Br J Surg* 2014;101(4):390–97. [Crossref](#)
44. Maclellan RA, Greene AK. Lymphedema. *Semin Pediatr Surg* 2014;23(4):191–7. [Crossref](#)
45. Gary DE. Lymphedema diagnosis and management. *J Am Acad Nurse Pract* 2007;19(2):72–8. [Crossref](#)
46. Başaran S, Kozanoğlu E. Breast cancer related lymphedema and conservative therapies. *Türk Fiz Tıp Rehab Derg* 2009;55(1):30–5.
47. Földi E, Földi M. Lymphostatic Diseases. In: Földi, M., Földi, E. (Ed.), *Földi's Textbook of Lymphology for Physicians and Lymphedema Therapists*. 2nd edition. Munich, Mosby-Elsevier; 2006. p. 223–317.
48. Szuba A, Rockson SG. Lymphedema: classification, diagnosis and therapy. *Vasc Med* 1998;3(2):145–56.
49. Petrek JA, Pressman PI, Smith RA. Lymphedema: current issues in research and management. *CA Cancer J Clin* 2000;50(5):292–311. [Crossref](#)
50. Rodrick JR, Poage E, Wanchai A, Stewart BR, Cormier JN, Armer JM. Complementary, alternative, and other noncomplete decongestive therapy treatment methods in the management of lymphedema: a systematic search and review. *PM R* 2014;6(3):250–74. [Crossref](#)
51. Sayko O, Pezzin LE, Yen TW, Nattinger AB. Diagnosis and treatment of lymphedema after breast cancer: a population-based study. *PM R* 2013;5(11):915–23.
52. Cheville AL, McGarvey CL, Petrek JA, Russo SA, Taylor ME, Thiadens SR. Lymphedema management. *Semin Radiat Oncol* 2003;13(3):290–301. [Crossref](#)
53. Cancer Australia. Clinical Best Practice/Lymphoedema Specialised treatment 2012. <http://canceraustralia.gov.au/clinical-best-practice/lymphoedema/gp-guides-and-resources/specialised-treatment>. (Accessed: 01.02.2015).
54. Lasinski BB, McKillip Thrift K, Squire D, Austin MK, Smith KM, et al. A systematic review of the evidence for complete decongestive therapy in the treatment of lymphedema from 2004 to 2011. *PM R* 2012;4(8):580–601. [Crossref](#)
55. Oremus M, Dayes I, Walker K, Raina P. Systematic review: conservative treatments for secondary lymphedema. *BMC Cancer* 2012;12(1):6. [Crossref](#)
56. Vignes S, Blanchard M, Arrault M, Porcher R. Intensive complete decongestive physiotherapy for cancer-related upper-limb lymphedema: 11 days achieved greater volume reduction than 4. *Gynecol Oncol* 2013;131(1):127–30. [Crossref](#)
57. Bernas MJ, Witte CL, Witte MH. The diagnosis and treatment of peripheral lymphedema: draft revision of the 1995 Consensus Document of the International Society of Lymphology Executive Committee for discussion at the September 3–7, 2001, XVIII International Congress of Lymphology in Genoa, Italy. *Lymphology* 2001;34(2):84–91.
58. Asmussen PD, Strössenreuther RHK. *Földi's Textbook of Lymphology for Physicians and Lymphedema Therapists*. Mosby-Elsevier; 2006.
59. Olszewski WL. Contractility patterns of normal and pathologically changed human lymphatics. *Ann N Y Acad Sci* 2002;979:52–63; discussion 76–9. [Crossref](#)
60. Zuther JE, Norton S. *Lymphedema Management*. Stuttgart New York: Thieme; 2013. [Crossref](#)
61. Pain SJ, Purushotham AD. Lymphoedema following surgery for breast cancer. *Br J Surg* 2000;87(9):1128–41. [Crossref](#)
62. Holcomb SS. Identification and treatment of different types of lymphedema. *Adv Skin Wound Care* 2006;19(2):103–10. [Crossref](#)
63. Cheville AL. Current and future trends in lymphedema management: implications for women's health. *Phys Med Rehabil Clin N Am* 2007;18(3):539–53.
64. Devoogdt N, Van Kampen M, Geraerts I, Coremans T, Christiaens MR. Different physical treatment modalities for lymphoedema developing after axillary lymph node dissection for breast cancer: a review. *Eur J Obstet Gynecol Reprod Biol* 2010;149(1):3–9. [Crossref](#)
65. McLaughlin SA. Lymphedema: Separating Fact From Fiction. *Oncology* 2012;26(3):242–9.
66. Olszewski WL, Engeset A. Studies on the lymphatic circulation of humans. In M. G. Johnston (Ed.), *Experimental Biology of the Lymphatic Circulation*, Amsterdam: Elsevier Science Publishers; 1985. p. 395–422.
67. Havas E, Parviainen T, Vuorela J, Toivanen J, Nikula T, Vihko V. Lymph flow dynamics in exercising human skeletal muscle as detected by scintigraphy. *J Physiol* 1997;504 (Pt 1):233–9. [Crossref](#)

68. Havas E, Lehtonen M, Vuorela J, Parviainen T, Vihko V. Albumin clearance from human skeletal muscle during prolonged steady-state running. *Exp Physiol* 2000;85(6):863-8. [Crossref](#)
69. Johansson K. Is physiotherapy useful to the breast cancer patient? *Acta Oncol* 2005;44(5):423-4. [Crossref](#)
70. Földi M, Földi E, Kubik S. Textbook of lymphology for physicians and lymphedema therapists. Urgan & Fischer Verlag (Elsevier); 2003.
71. Ahmed RL, Prizment A, Lazovich D, Schmitz KH, Folsom AR. Lymphedema and quality of life in breast cancer survivors: the Iowa Women's Health Study. *J Clin Oncol* 2008;26(35):5689-96. [Crossref](#)
72. Gürsoy AA. Meme kanseri tedavisine bağlı lenfödem ve hemşirelik bakımı. Cumhuriyet Üniversitesi Hemşirelik Yüksekokulu Dergisi 2005;9(2):18-25.
73. Hull MM. Lymphedema in women treated for breast cancer. *Semin Oncol Nurs* 2000;16(3):226-37. [Crossref](#)
74. Jennings-Sanders A, Kuo YF, Anderson ET, Freeman JL. How do nurse case managers care for older women with breast cancer? *Oncol Nurs Forum* 2005;32(3):625-32. [Crossref](#)
75. Hemşirelik Yönetmeliğinde Değişiklik Yapılmasına Dair Yönetmelik (2011). T. C. Resmi Gazete, 27910, 19 Nisan 2011.
76. Cemal Y, Pusic A, Mehrara BJ. Preventative measures for lymphedema: separating fact from fiction. *J Am Coll Surg* 2011;213(4):543-51. [Crossref](#)
77. Uzkeser H. Assessment of postmastectomy lymphedema and current treatment approaches. *Eur J Gen Med* 2012;9(2):130-34.