Lymphedema in Cancer Patients

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Introduction

As we review the new information on supportive lymphedema care for our cancer patients, we need to reflect on the many new treatments that have been developed to treat the cancer. Comprehensive cancer therapy and the support to the survivor have also changed. As cure rates rise, there is more of an emphasis on the cancer survivors and their quality of life. Survivorship care is a growing area of specialty care in oncology. When deciding on a cancer treatment option, some patients now ask about long-term side effects of treatment before embarking on the therapy. Some patients come into their cancer experience aware of lymphedema and are hoping to be able to prevent it. This increased awareness of lymphedema has helped some patients get more education on how to prevent it or if they do develop it, how to get treatment early. Access to information about lymphedema and treatment remains highly variable. Ongoing professional education and advocacy continues to be needed so that more patients receive appropriate education on and treatment of lymphedema.

Lymphedema remains a low priority in many parts of the world. Patients in countries with good access to health care expect to be informed of potential complications of their cancer therapy. In other parts of the world, patients are much more worried about access to the cancer treatment than the side effects of the treatment. Funding is a key part of any health-care policy changes. As was true in 2000 when the journal of Clinical Cancer Care published a review article on “Lymphedema: Current Issues in Research and Management … as with other quality of life and nonlethal conditions, it receives less research funding and attention than do many other areas of study” [1].

Despite this lack of funding and support, lymphedema care is improving in recognition, quality, and new research efforts. Lymphedema advocates around the world are working to improve access to lymphedema care. In the United States, the Lymphedema Treatment Act has been introduced in the Senate, and advocates from many nonprofits are working to get this passed to improve access to care [2]. Public health-care reform to expand lymphedema care is an international effort. In Australia alone 19 groups have come together to form the Lymphedema Action Alliance (LAA 2016). In many parts of the world, patients do not have access to all the tools needed to give good compression or access to information about their disease. In the United States the Lymphedema Advocacy Group is working to change insurance coverage for tools to help treat lymphedema [3].

The research and advocacy efforts are international and are working to improve access to care
from many different angles. A recently published study “Self-Management of Secondary Lymphedema: a Systematic Review” detailed the many challenges of lymphedema care in resource-poor communities where patients have little access to education, tools, or treatment options [4]. In the 2016 spring issue of Lympho News, the International Lymphoedema Framework welcomed multiple new countries into their membership [5]. This need to look globally at the disparities in lymphedema care is expanding, as is the advocacy to expand cancer treatments throughout the world. The differences in access to health care between resource-rich countries and resource-poor countries are very significant on many levels. Global public health advocates and lymphedema experts have looked at these ongoing challenges [6].

Due to the growing advocacy and awareness, the tools of treatment are slowly changing. In general, the treatment of lymphedema continues to revolve around the basic components of complete decongestive therapy (CDT) followed by compression. How this is accomplished continues to expand as new techniques for drainage are researched, new tools are developed for compression, new research is published on exercise, and new skin care methods are tried. New drugs are being researched in clinical studies. As the population of cancer survivors grows, the demand for lymphedema care products grows. New companies have come into the marketplace with updated tools to make lymphedema care easier. More cancer centers have developed survivor centers to help patients cope with their burden of side effects. Lymphedema is a common side effect of many cancer treatments. Ideally these survivor-oriented centers will provide better access to referrals for lymphedema diagnosis and treatment.

Cancer and Cancer Treatments as the Risk Factors for Lymphedema

As with any chronic disease, prevention and/or cure would be the ideal goal. There are many risk factors for development of lymphedema. Lymphedema can be due to the tumor itself or due to the cancer treatments. As cancer treatments constantly keep changing, so will the risk factors to develop lymphedema. It is important to review the physiologic cause of each risk factor for lymphedema so that prevention interventions can be focused to each patient.

Some patients may present to oncology with lymphedema at the time of the diagnosis. This may be due to bulky disease blocking pathways or microscopic disease blockages. Occasionally patients may have primary lymphedema or secondary lymphedema due to other causes such as obesity. Obesity at the time of diagnosis or developing obesity at any time will increase the burden on the lymphatic system and increase the risk of lymphedema [7].

Surgical methods continue to change dramatically in the treatment of cancer. Advancement of the sentinel node procedure for many types of cancers has allowed surgery to do less invasive procedures and has successfully prevented many axillary and inguinal dissections. Reverse mapping has also been used to guide the surgeon to preserve key lymphatic structures. Invasive deep dissections are associated with not only more direct damages to the lymphatic system by removal of additional lymph nodes, but it is also associated with more localized infections, wound complications, and drainage issue. These infections and post-op complications can further damage the lymphatic system.

Radiation Therapy as a Risk Factor for Lymphedema

Radiation is being used to treat many types of cancer, and the way the radiation is delivered is constantly changing. Radiation therapy always changes the tissue, but these changes may not be evident at the time of the exposure. Tissue changes should be put into two categories—those that are immediate and obvious and those that are delayed. During radiation therapy or immediately after radiation exposure, patients will often develop acute erythema and local swelling. This is typically mild, and short lived, and requires
only topical treatment and occasionally mild pain medication. Occasionally acute radiation treatments will be associated with more severe tissue damage and ulceration that can require delay or discontinuation of the planned intervention, and local wound care needs to be initiated. Typically, even with more severe wounds, only local care is needed, but occasionally there can be secondary infections and more life-threatening complications. These acute reactions complicate the burden on the lymphatic system, and there is often a transient increase in lymphedema and lymphatic congestion, and there may be a need for acute lymphatic therapy intervention.

In the 2007 Seminars in Radiation Oncology, Delanian leads with the comment “Tissue of irradiated cancer survivors always bears the trace of the radiation therapy … some are asymptomatic … some of them develop late clinical complications in normal tissue that affect organ function and may even be life threatening …” [8]. The late effects have the common histologic characteristic of radiation-induced fibrosis (RIF). The fibrosis is felt to be irreversible, but treatments can address the symptoms of this fibrosis. In the case of lymphedema, the goal is to treat the lymphedema and its effect on the patient’s quality of life. It is important for patients and therapists to understand that the fibrosis itself is not reversible and may be progressive.

Animal research has shown that even just irradiating one lymph node will cause a change in lymphatic flow. Irradiation of one popliteal node in a rabbit impaired the lymph transport and increased the pressure required to maintain flow in the lymphatic system. These pressure changes then lead to the compensatory mechanism of new vessel formation and growth of lymphatic venous anastomoses [9]. Clinical evaluation in humans has also shown increased lymphedema in patients that received lymphatic irradiation. Breast cancer patients that received axillary radiation as part of their therapy plan had a greater risk of lymphedema, than those that just received radiation to the breast or chest wall [10]. Patients receiving radiation therapy for rectal cancer showed considerable long-term effects on local tissue that impacted QOL [11]. Although we generally consider lymphedema as being a sign of radiation-induced vascular changes, it is not always present. In a 2016 review of radiation-associated angiosarcoma (RAAS) in breast cancer patients, none of these patients had developed lymphedema [12].

Radiation late effects are dependent on many factors including the dose and the volume of tissue radiated. Patients developing lymphedema years after radiation treatment cannot go back in time and change these risk factors, but there are factors that the patient and therapist can work to change. Obesity, inflammation, further trauma, and infection are all important burdens to try to prevent on this already “at-risk” tissue [13].

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**Lifestyle Risk Reduction Controversies**

Lymphedema research is full of many controversies. Every clinician would like to be able to help our patients prevent a chronic problem like lymphedema. Risk reduction lifestyle measures remain controversial, but these should be discussed with each patient so that patients can be informed and make their own choices. Many cancer patients have looked for information online about lymphedema and have unfortunately found frightening pictures of patients with advanced elephantiasis. These pictures may have psychologically burdened these patients who may already have been dealing with fears about their cancer. Many breast cancer patients have received lists of all the “never do” activities that they should avoid after treatment to avoid lymphedema. Instead of scaring our patients, perhaps we need to try harder to help them live well and follow a healthy well-balanced lifestyle.

You don’t have to look hard to find literature for breast cancer survivors telling them they should avoid having their blood pressure taken on the affected side or that they should avoid all injections and IVs on that side, they should not lift weights or carry a pocket book on that side, or they should always wear a compression sleeve when flying. Some tell women who have had a bilateral mastectomy to never get her blood
pressure checked in her upper extremities and that they should now get her blood pressure checked in their legs. These well-intended risk reduction recommendations can potentially do harm. We need to encourage our patients to keep their blood pressure under control and have it checked at regular intervals and that a standard cuff that is removed after measurement has not been found to be a problem. People need to be active and get exercise but should understand to build up their exercise and activity slowly after surgery or radiation. The Journal of Clinical Oncology published an excellent article in the March 2016 issue reviewing these topics in the breast cancer population, but we need to think of these practical recommendations for all our “at-risk” cancer patients [14].

Dr. Judith Nudelman, a physician and a survivor, published an excellent “counterpoint” guest editorial in Lymphatic Research and Biology [15]. She passionately advocates for individualized education for patients at risk for lymphedema so that they can be empowered to make their own informed choices about their lifestyles. Education of patients on their individual risks takes time, and teaching patients about healthy choices takes time, but ultimately as health-care providers, we need to develop health-care systems that do provide these services. Cancer treatments do put people at risk for a variety of long-term complications. Lymphedema is only one of many long-term potential problems of which cancer survivors need be aware. Survivorship clinics may help solve some of these issues. They may be able to do the individualized education for each cancer survivor to understand their “postcancer treated” body and how to best take care of it. Patients will need information about lymphedema pretreatment so that they are making informed choices about their care after treatment is completed and again as they move into survivorship care. How much they understand and can cope with may be very different at each stage in their continuum of care.

Obesity and risk for lymphedema clearly are related. This has been well documented for years. The National Lymphedema Network has been advising obese patients to work to lose weight as part of their evidence-based guidelines as have many other patient advisory groups [16]. Even relatively minor amounts of weight gain have been documented to increase the risk for lymphedema [17]. Good nutrition and exercise are going to be part of a balanced approach for the cancer survivor to try to keep their weight under control and lower their risk for lymphedema. Comprehensive oncology rehabilitation programs that help patients focus on diet and exercise are needed to help patients’ lead long healthy lives.

Breast reconstruction is a very personal issue. Patients have been told that any surgery that cuts more lymphatic pathways and disrupts more natural lymphatic pathways may be putting them at increased risk for lymphedema. Some research has shown that this additional surgery does not put the patient at increased risk [18]. Patients will need information on these controversies and will have to make these choices based on the best possible information.

There is very interesting research that indicates that women may be at risk for developing lymphedema even before they have any of these cancer treatments done or have any lifestyle adverse behaviors. Some women have been found to have “constitutively enhanced lymphatic pumping” that affects their risk for developing lymphedema. This infers that some people may have higher lymphatic pump pressures at baseline and that a population of people is predisposed [19].

**Lymphedema Treatments**
(See Fig. 21.1)

Some cancer patients present with lymphedema at the time of their diagnosis. Dealing with lymphedema is not their primary concern once they learn the cause of this swelling. For these patients they want to get their cancer treatment treated and cured as quickly as possible. Other patients do not develop their lymphedema until after their cancer treatment. For them lymphedema is often a chronic burden after an acute life-threatening burden. They may already be
exhausted physically, emotionally, and financially from all their cancer treatments to treat their primary tumor. When treating the patient with lymphedema secondary to cancer, it is important to take this into consideration and plan the lymphedema interventions to match the needs of the patient and the tumor status.

Lymphedema treatment goals are to decrease the swelling, enhance functional status, relieve discomfort, and improve quality of life. There are typically two phases of lymphedema care, the first is to reduce the volume of the edema, and then the second is to maintain this decreased volume. Again it is important to consider the stage of the cancer patient and their prognosis. The patient with advanced end-stage disease may never decrease their volume but will ideally be able to get pain relief. The patient that has been treated for cure will ideally be motivated to try to prevent the development of chronic disease complications from that treatment. The approach needs to be individualized. All lymphedema patients should be taught to take excellent care of their skin to avoid infection. High-volume lymphedema increases the risk of skin and wound infection. Infection prevention is a key goal for all patients with lymphedema or risk factors to develop lymphedema.

In the first phase of treatment, patients are usually treated with manual lymphatic drainage by a trained therapist. The patient and/or family can then be taught to continue this massage independently when possible. The manual drainage is a very gentle massage that patients typically find very relaxing and comfortable. A trained lymphedema therapist will outline what drainage pathways have been damaged by the tumor or the treatment for the tumor and then design a drainage program to utilize alternative “watershed” pathways. These “watershed” pathways are the pathways that are assumed to be “open” and should provide an alternative route based on standardized lymphatic circulatory pathways. The therapist may evaluate the response to the

Fig. 21.1 Shows the relationship between treatment of the tumor and treatment of the lymphedema as related to the tumor. Cancer and lymphedema treatments are both based on the stage of the disease process
treatment to continually update the planned intervention [20].

Patients with high tumor loads may not get much of a change in volume with treatment but may get a nice relaxation response and relief of pain. Other patients may get a dramatic response to this treatment and move measurable volumes. Often patients will need to urinate within an hour of starting the drainage massage.

An exercise program can be utilized to promote enhanced lymphatic circulation. Muscle movement also enhances lymphatic pumping and can promote improved drainage. The active patient will be given an exercise program designed to utilize this. Deep breathing, moving the diaphragm muscle, is also used to promote pelvic lymphatic pumping. By changing the pressures within the intra-abdominal cavity, lymphatic pumping is enhanced. Even very debilitated patients can be taught to do this and again often find it relaxing and comforting.

Multiple types of tools can then be used to treat lymphedema. Most garment tools are designed to maintain this volume reduction. Compression bandaging programs can help reduce the volume of lymphedema fluid. Customized tools can be used to provide various levels of compression. For some patients they may require use of custom compression garments. This compression can be achieved through a wide variety of products. These products can range from custom-made high-grade medical compression garments that can tend to be very expensive to much cheaper over-the-counter products. The lower range of compression can often be provided by non-prescription simple sportswear. The amount of compression needs to be individualized to the patient’s needs. It is important to have the patient with a chronic disease understand the goals of therapy and have choices in how to manage their disease. For example, a young teenager with lower extremity mild edema may not want to wear a pair of panty hose, which looks very medical, to school around their peers. That same patient might be more compliant with layered athletic-looking compression for public events but willing to bandage at home or use a compression pump at home while doing homework. Chronic disease interventions need to be individualized to the patient’s physiological and psychological needs. As the population of cancer survivors increases, the choices in options are improving, and lymphedema therapists need to problem solve for each individualized patient.

Intermittent pneumatic compression therapy is helpful for some patients allowing them to have treatments in their own homes. A variety of pump designs are on the international market. Most pumps have sequential chambers that attempt to replicate the flow of the lymphatic system. The sequencing is intended to try to replicate a wave motion to move fluid from distal to central circulation. Many pumps treat the quadrant of disease, so that if it is for an arm, it also treats the trunk. Some pump designs include the ipsilateral lymphatic nodes and the regional nodes. So, for example, in a pump for a patient who has right upper extremity lymphedema, the pump will work on the right-sided inguinal nodes and the left axillary nodes. For patients with bilateral lower extremity lymphedema, pump design may include a full pant-like design or a method to compress the bilateral inguinal nodes, and some even use bilateral axillary nodes.

Surgical intervention for treatment of lymphedema has significantly expanded in the last 5 years. Multiple types of procedures are available at tertiary centers. The excisional surgical options include debulking or liposuction. Microsurgical techniques include lymph node transfers, lymph node flap transfers, lymphovenous shunts, and lymph node reanastomosis. The field of autologous lymph node transfer research is very exciting and is already helping many patients with severe lymphedema. In her invited review article in the *Journal of Reconstructive Microsurgery* 2016, Dr. Corinne Becker MD presents excellent cases of patients with severe advanced fibrosis and lymphedema. The review discusses long-term outcomes data. In her case presentations, Dr. Becker shows pre- and postoperative lymphoscintigraphy [21]. Not only is this exciting field of research expanding but multiple international teams are also
experimenting with adding growth factory therapy to these lymph node transfers. Growth factors such as VEGF-C/VEGF-D have been used in animal studies [22].

Drug treatment options for lymphedema remain very limited and experimental. Diuretics are useful in patients with edema. In a patient with a presentation of edema and lymphedema, careful diuretic use may be helpful but will require close monitoring as dehydration can complicate lymphatic function.

Platelet-rich plasma (PRP) is an autologous concentrated preparation of human platelets contained in a small volume of plasma. These preparations have been used to promote tissue regeneration in multiple areas of tissue healing. A team led by Dr. Ahmet Akgul MD in Turkey has been researching this as an intervention for lymphedema. Their interest is to use this PRP preparation to regenerate lymphatic tissue [23].

New targets for lymphedema drug intervention are being researched. Lymphedema and inflammation are closely linked, research is exploring these relationships, and anti-inflammatory agents may someday be targeted for lymphedema. Patients may hear of various food supplements that will help treat lymphedema. Caution is encouraged as coumarin, once popular for treatment, was found to be toxic to the liver. A healthy diet that encourages a normal BMI may be much better than supplements with little research verification. Patients should be encouraged to always report all supplements and over-the-counter drugs they are taking to all their health-care teams.

Acupuncture has been found in some small studies to be helpful in the treatment of lymphedema, and larger studies are being done. Some studies have used the needles on the affected tissues; other studies have not. As infections can be a major risk factor for persons with lymphedema, any use of needles in the swollen tissue needs to be done very cautiously. These preliminary studies did not report an increase in the episodes of cellulitis after needle insertion in the affected extremity, but it should be noted that these are small studies with limited numbers of patients and limited follow-up.

Antibiotic use for infections continues to be a very important tool in the treatment of lymphedema. Untreated cellulitis can lead to progression of disease. The type of antibiotic, dose, and duration will depend on the location of the infection, surgical procedure, patient tolerances and a host of other factors. Cellulitis can become a life-threatening problem if not treated quickly. Patients should be educated to be able to identify the symptoms of an infection and should understand to seek medical attention. Patients with a history of recurrent infections often keep antibiotics at home for quick intervention.

Lymphedema treatments can be a financial cost to cancer patients after they have already coped with the strain of cancer treatment. Effective lymphedema treatments can overall save costs by preventing further disabilities, infections, and hospitalizations. Insurance coverage for lymphedema treatment and tools is highly variable. International health-care systems have highly variable coverage for cancer care and for lymphedema care. Advocacy is needed internationally to improve access to care.

Special Attention for Patients with Lower Extremity Lymphedema

Much of the lymphedema research has been done on the patient with breast cancer and upper extremity lymphedema. I encourage oncology providers to pay special attention to their patients at risk for lower extremity lymphedema. Cancer patients coping with lower extremity lymphedema may have very different needs than the patient dealing with upper extremity lymphedema [24]. Quality-of-life studies and treatment outcomes research in this population show that these patients may have much more distress than previously appreciated [25]. These patients may have much larger volumes of lymphatic overload, and this high volume of fluid needs to be considered with interventions [26]. Intensive treatment can move large volumes, and it is generally well tolerated even in patients with elephantiasis [27]. Lower extremity lymphedema and survivorship research needs to be expanded so that care
guidelines can be updated. This is a patient group that needs much more advocacy.

Wound Care

Fistula formation or the non-healing wound can be a major complication for a cancer patient. Lymphedema drainage may be a part of this complex syndrome. When a patient with a compromised lymphatic system is not able to move the lymphatic fluid out of the area, the fluid may build up and break open the skin. This can then become a chronic draining wound or a fistula. Ideally this complication is avoided by drains placed at the time of surgery or drainage placed as needed in areas of tissue breakdown. The cancer patient may have poor nutritional status, so the wound healing is delayed, and tissue breakdown susceptibility is high. These patients present multiple challenges, but good lymphedema care may be a part of helping them heal. A lymphedema care plan that attempts to use watershed lymphatic pathways to move the fluid out of the area may be helpful. There have been significant improvements in the types of drainage that can utilized. Wound drainage pumps and improved wound care can help to decrease the risk of infections.

Diagnostic Testing

The diagnosis of lymphedema in a cancer patient is typically done clinically and is often a diagnosis of exclusion. After all other causes of swelling are ruled out such as deep venous thrombosis, tumor progression, or infection, the swelling is labeled as lymphedema. The patients’ disease is then put into one of the three groupings or clinical stages. Patients are categorized as having stage I, II, or III disease based on the physical findings. Stage I is reversed with simple elevation of the limb, shows pitting edema, and is early mild disease. The next step in the spectrum is stage II disease that is no longer reversible with elevation alone and has a component of fibrosis and texture changes. Stage III is elephantiasis with advanced tissue changes, inflammation, infection, and deformity. All of our cancer patients might be considered to have stage 0 disease or latent lymphedema. Education of patients at risk for the disease will help with early identification and early treatment.

In order to better delineate lymphedema and more subtle changes in the patient, further measurement tools are needed. The most basic and widely used system to monitor the volume of the lymphedema is the circumference method. For many clinicians, they simply use a tape measure to measure the circumference of a limb at a specific part of the anatomy such as at the wrist, the ankle, or other joints. This is a quick, inexpensive way to get a sense of volume of fluid in an extremity. Some therapists use a more detailed method of calculating a volume by measuring the extremity at every 2 cm using a standardized system taught in most of the lymphedema training programs. This method of measurement is so commonly used that cell phone apps are now available for patients or therapists to use to make this calculation quickly and easily. There are obvious inherent problems with this, as it does not take into consideration all the other tissue changes that can cause a change in circumference such as muscle loss or gain. Although this may help in the clinical setting, some researchers believe that it should not be used in the research setting due these inaccuracies [28]. The same concept can be done also using an electric Perometer tool which is much faster. This is often used in the research setting but is expensive and not typically found in most cancer centers.

Portable ultrasound can also be used to measure the skin thickness and the dilation of the lymphatic vessels and allows the observer to look at lymph nodes and other structures. Training in ultrasound measurement of lymphedema is not as widely used. Texture analysis of the skin changes with lymphedema has also been used in research; again this is rarely used and requires specialized software [29]. A Belgian rehabilitation team recently did an excellent review of the use of ultrasound as a tool to diagnose and stage lymphedema more accurately. This was published in the Lymphatic Research and Biology journal. They advocate that these techniques are clinically relevant and could improve staging and early diagnosis [30].
Bioelectrical impedance analysis (BIA) has become the method of choice for detection of early lymphedema at the Lymphedema Research Unit in Australia [31]. This method uses a harmless electrical current to measure the impedance to flow through the body. This methodology is now available throughout the world. Like every methodology it has limitations, for example, it is not useful for advanced lymphedema and fibrosis. Some clinics use bioimpedance measurement preoperatively and then use this as a method to measure for early lymphedema after surgery and as a guide for early intervention and treatment of lymphedema. Impedance technology and research are a growing field, and more clinics are using this internationally. Magnetic resonance imaging is a safe, noninvasive radiologic technique that allows detailed visualization of soft tissue changes associated with lymphedema. Lymphedema causes distinct patterns of structural changes in the subcutaneous tissues. MRI-related research shows cancer-related lymphedema in the adipose tissue, fluid accumulation in the fibrous septa, and fat globule hypertrophy. This is an excellent tool for research as it allows very detailed information. The cost is a major limiting factor [32].

Lymphoscintigraphy is widely used throughout the world. There are a variety of techniques and protocols. There are two main types of preparations used for this, either macromolecules or colloidal suspensions that are attached to a radiolabel. A qualitative lymphoscintigraphy aims to image the morphology of the lymphatic system. A quantitative study may be a port-sensitive method of diagnosing impairment in flow [33]. Lymphoscintigraphy is a highly useful tool for documentation of lymphedema in the patient when the etiology of the swelling needs further investigation. It can help guide the diagnosis and disease staging and guide interventions when appropriate.

New Directions

“Big data” is a buzz term in many areas of research. Using new data collected from multiple studies and bringing this information together in new ways are hopefully going to advance the world of lymphedema research. Lymphology researchers will be able to link everything from genetic profile to outcomes data from large studies directed at other end points. It is hoped that by utilizing big data in new ways, science will move forward faster. Lymphedema has been referred to as an “orphan disease,” and research in the field has been limited by lack of funding. Tools to precisely measure the disease in large populations of patients with similar disease have also been a challenge to the research. In many aspects of cancer research, it is hoped that “big data” will advance our understanding of the disease and help find cures. As yet, the movement toward collection of large data sets is behind in the field of lymphedema, but as cancer and precision medicine initiatives move forward, there may be more large databases that lymphedema research may be able to build on [34].

As large databases are used to research the safety of radiation therapy, then there will be improved documentation of the side effects of radiation therapy. Lymphedema and fibrosis can be long term side effects of radiation therapy, and can happen late in the course of cancer survivorship. These side effects can get worse, not better with time. It is important to follow cancer survivors for long periods of time, and monitor their lymphedema so that we can better understand the burden of complications from cancer therapies [35]. The large surgical studies needed to show that lymph nodes did not need to be taken out, collecting the first large-scale data on the surgical complications of axillary dissection. The rates of lymphedema with various surgical treatments were finally collected so that the problem could be better addressed [36]. Big data analysis is the future of medicine and cancer care. Lymphedema care providers will be asked to participate in this future by using standardized data collection so that they can participate in long-term clinical studies that monitor the side effects of various cancer treatments [37]. Radiation therapy side effects such as lymphedema and fibrosis tend to be late in the course of the cancer survivor. Big data research will help in the analysis of this “bystander” effect. This side effect research may help improve data on lymphedema and other complications [38].
Lymphedema Case Studies

Discussing cases is often a good way to transition from abstract information about a disease to the actual clinical issues that confront the clinician and patient. As with many diseases, lymphedema presents a spectrum of severity. The disease can progress, and the patient can develop progressive symptoms and require more intensive care. Other patients may respond to treatment and stabilize. Both spectrums of the disease will be discussed.

Stage 0 lymphedema is also referred to as latent lymphedema. For the cancer patient this often means that the patient had an early cancer, they presented with no edema, and the surgery done to cure the cancer did not cause any edema. They are considered to have latent lymphatic disease. The lymphatic system has been injured by the cancer treatments, but there is no evidence of actual edema. The second case will be of advanced end-stage lymphedema in a patient with metastatic disease. The chart below gives a sense of how the disease intervention needs to match the actual disease. Each level of lymphedema treatment will need to match the needs of the patient.

Case 1

JC is a young man that presented with a mole that was changing on his calf. On biopsy it was found to be melanoma. He had a wide excision and a sentinel node procedure. The node in the inguinal area was found to be negative, and no further surgical investigation was done. The patient never developed any swelling at the ankle or distally. He had minor swelling at the site of the surgery and the sentinel node procedure. The swelling at both sites was resolved quickly and was gone by the post-op visit when the bandage was removed. He continued to receive local skin care and dressing changes at the calf and inguinal sites but had no postoperative infections or swelling.

Depending on where in the world this patient was being treated, a variety of interventions might have been done to try to prevent his development of lymphedema. In some surgical centers, he would have been seen before surgery for baseline measurements that could have included circumference data on the whole lower extremity, photogic documentation, and baseline bioelectric impedance data collection. The surgeon doing the sentinel node procedure would typically have done an ultrasound of the inguinal area, and these images would be collected, and the lymphatic vessels might have been measured and analyzed.

This baseline data would not be collected at all facilities and is presently not the standard of care. Some surgical centers would have moved on with the sentinel node procedure prior to any lymphedema data collection. Then in some centers a physical therapy session would be set up to collect the data and do some preoperative education. The patient at that point might or might not be given a stocking to use for postoperative compression to try to prevent excessive swelling. Some patients are routinely given prescriptions for compression; it is not a policy of all institutions. Some patients get extensive education on lymphedema risk reductions; some patients are not told about lymphedema unless they develop this complication. These prevention and educational efforts are highly variable with each cancer center utilizing different protocols. During the ideal education session, the patient would receive risk reduction information which typically would include avoiding infection, keeping his weight normal, and avoiding trauma and how to monitor for swelling. The patient would learn how to monitor for cellulitis and how and when to seek medical attention for a possible infection.

Typically medical and/or surgical oncology would monitor this melanoma patient for recurrent cancer. Ideally when he came back in for his cancer follow-up, they would also monitor for lymphedema. If he did develop swelling later, he would be typically referred back to physical therapy for evaluation and treatment. His lymphedema tools should be checked once a year at a minimum, and his leg would be measured annually even if he felt it was “under good control.” Ideally he would know how and where to seek lymphedema assistance and reevaluation at any time if he felt his leg was swelling.

Case 2

This is a case of a woman with progressive breast cancer. As her disease progressed over several years, she developed severe lymphedema and
ulcerations. She eventually went on to hospice care. She passed away with massive uncontrolled lymphedema despite ongoing aggressive attempts to treat the lymphedema. There are two sets of images. The first set shows the advanced disease as she presented to the clinic for palliative lymphedema physical therapy. The second set is from her at autopsy. This type of side-by-side image shows the deformity that advanced lymphedema can cause despite intensive treatment. It is important to understand from this case that despite very dedicated lymphedema care, it is not always possible to control the swelling. At the end of life cancer patients may have massive deformities that are painful and may require a comprehensive team to manage these symptoms.

In Fig. 21.2, the pictures on the left were done in physical therapy. Her therapy consisted of intensive manual lymphatic therapy, daytime and nighttime compression, and use of a compression pump as well as wound care, antibiotic treatment of infections, and constant adaption as her condition progressed. Despite all of these compression and treatment methods, the volume of her lymph-

**Advanced care-Autopsy**

Note neck swelling and contractures at radiation site on upper Right breast
Full trunk, arm, breast compression
Skin is intact, but very swollen

Diffuse metastatic hard nodules on trunk, neck, and arm,
Breast ulceration, drainage,
Advanced severe swelling of arm, trunk

**Fig. 21.2** The first picture shows the patient in custom compression garments while in treatment; the second picture shows the extent of lymphedema and tissue necrosis at time of autopsy. This patient was in significant pain related to her lymphedema and metastatic disease at the time of end-of-life transfer to hospice care.

Arm is very swollen, neck contracted
Small metastatic nodules skin
Breast ulcer starting

Skin of arm, chest, and truck has many metastatic nodules, leakage, ulcerations
Breast is open, necotic
edema continued to progress. This was due to ongoing progression of the tumor. Her pain medications were continually being adjusted as the lymphedema progressed.

Other methods of intervention that could have been employed would have been to create a fistula for artificial drainage or potentially to use a suction wound vacuum. Due to her hospice status, personal choice, and a variety of issues, these options were not pursued but might be considered in other patients with draining wounds on hospice. Topical antibiotics were used to try to control the infected wound and odor from the wound. The International Lymphedema Framework has done an excellent job of reviewing all of the information on advanced lymphedema at the end of life. This position paper can be found at their website: www.lympho.org. The type of services that patients can access at end of life is highly variable. Not all hospice programs are trained to provide lymphedema care. More education, advocacy, and support are needed to expand these services to the patients who need end-of-life lymphedema services.

**Conclusion**

Care of the patient with lymphedema is constantly changing as more resources and attention are being paid to the quality of life of the cancer survivor. As the treatment of cancer is constantly changing, ideally more patients are achieving long-term cures with less morbidity from their treatments. Ideally as more patients receive preoperative or pretreatment education about possible lymphedema complications, more lymphedema can be prevented. Earlier attention to lymphedema may prevent some deformities or the clinical burden of lymphedema. As the basic science knowledge is advanced, other mechanisms to prevent injury or to treat injury will be pursued. Until then each of us providing care to patients at risk for lymphedema will need to develop teams to care for these patients. These teams will vary depending on the country we live in, the funding, and the health-care environment. We will each need to be informed advocates to make sure our patients receive comprehensive care.

**References**


