The legacy of lymphedema: Impact on nursing practice and vascular access

by Gail Larocque and Sheryl McDiarmid

ABSTRACT
Breast cancer is the most common cancer in women. Breast cancer related lymphedema (BCRL) is a chronic condition characterized by an abnormal accumulation of protein-rich fluid in tissues resulting in swelling of the upper limb or trunk after treatment. Lack of consensus on definition, classification and grading of BCRL has led to subjective and objective parameters estimating incidence and severity. Prospective studies estimate the risk of BCRL to be approximately 21.4% (14.9–29.8). In patients with axillary lymph node dissection (ALND), the estimated risk of 19% (13.5–28.2) was about four times higher than those patients who had sentinel lymph node biopsy (5.6%, 6.1–7.9). Seventy percent of these patients will experience BCRL within two years of surgery, 90% within three years, and a 1% rate per year thereafter. Many patients who have no high-risk variables such as mastectomy, ALND and radiation therapy develop BCRL. Patients fear this complication, which has no cure and no proven prevention strategies. Risk reduction strategies, primarily focused on reducing trauma to the surgical arm, are based on anecdotal information and effectively restrict the use of the at-risk limb for the patient’s lifetime.

INTRODUCTION
Breast cancer is the most common invasive cancer in women. In 2017, approximately 26,000 women were diagnosed with breast cancer, 80% of whom are diagnosed with Stage I or II disease. Thirty-one percent of patients are diagnosed after the cancer has spread to regional nodes or directly beyond the primary site, and subsequent treatment relies upon the pathologic information from the sentinel node biopsy or axillary node dissection. Although breast cancer incidence continues to rise, secondary to early detection strategies, the overall breast cancer mortality rate in Canada is the lowest it has been for 70 years and has fallen 44% since 1986. The five-year net survival for breast cancer patients in Canada is 87%. Even in patients with metastatic disease, 15% will survive longer than five years. The median age of diagnosis is 61 years and these breast cancer survivors go on to develop other healthcare issues (Canadian Cancer Society’s Advisory Committee on Cancer Statistics, 2017).

Breast cancer related lymphedema (BCRL) is a chronic condition characterized by an abnormal accumulation of protein-rich interstitial fluid, resulting in swelling of the upper limb or trunk after treatment for breast cancer, and is a feared complication for patients (Cheng, Deitch, Haines, Porter & Kilbreath, 2013). Although clinical risk factors are increasingly well defined, cellular and molecular mechanisms are poorly understood and fail to explain why patients with similar characteristics, treated identically, develop secondary lymphedema (LE) and others do not (Cemal, Pusic & Babak, 2011). A study by Newman et al. (2012) reported that approximately 40% of women who developed BCRL had no high-risk variables, suggesting these factors were partial causes at best. Despite this lack of scientific knowledge, national guidelines and standards have been developed and contain a wide range of strongly stated recommendations based on pathophysiology and expert opinion, but not supported by evidence. Strategies recommended by healthcare providers and breast cancer support organizations to decrease the risk of BRCL effectively eliminate the use of the at-risk limb (surgical side) for the patient’s lifetime.

PURPOSE OF PAPER
The primary objective of this paper is to provide an update on current literature and recommendations on the risk factors regarding BCRL and their management. The secondary objective is to discuss vascular access options for patients at risk for developing BCRL.
There is an abundance of evidence documenting the influence of mastectomy, axillary lymph node dissection (ALND), and radiation therapy on a patient’s risk of developing BCRL. Mastectomy and, in particular, bilateral mastectomies, has been identified as increasing the risk for the development of BCRL (DiSipio et al., 2013; Bromham, Schmidt-Hansen, Astin, Hasler, & Reed, 2017). In a review of mastectomy patients over a 13-year period, Basta et al. (2016) demonstrated that BCRL occurred in 10% of mastectomy patients, with or without reconstruction. Similarly, the differences in occurrence of BCRL in patients undergoing ALND compared to sentinel lymph node biopsy (SLNB) demonstrates the impact more extensive surgery has on patient outcomes. BCRL is three to four times higher (13–19.9% versus 3–5.6%) when comparing these surgical interventions (DiSipio et al., 2013; Bromham, Schmidt-Hansen, Astin, Hasler, & Reed, 2017). Patients with positive nodal disease, require additional radiation to the regional lymph nodes, and often the surgical bed, as well. Reviews in breast cancer, as well as for other disease sites (including melanoma, head and neck, and gynecology), have confirmed that patients who require regional radiation have an increased risk of LE (Cormier et al., 2010; DiSipio et al., 2013; Tsai et al., 2016). In a recent review, Schmidt-Hansen et al. (2010; DiSipio et al., 2013; Tsai et al., 2016) have confirmed that BCRL for other disease sites (including melanoma, head and neck, as well as for other disease sites (including melanoma, head and neck, and gynecology), have confirmed that patients who require regional radiation have an increased risk of LE (Cormier et al., 2010; DiSipio et al., 2013; Tsai et al., 2016). In a recent review, Schmidt-Hansen et al. (2010; DiSipio et al., 2013; Tsai et al., 2016) have confirmed that BCRL for other disease sites (including melanoma, head and neck, as well as for other disease sites (including melanoma, head and neck, and gynecology), have confirmed that patients who require regional radiation have an increased risk of LE (Cormier et al., 2010; DiSipio et al., 2013; Tsai et al., 2016). In 2016, The International Society of Lymphology (ISL) published its latest revision of a 1995 document on the evaluation and management of peripheral LE that provides both a clinical classification and staging severity for LE based on objective physical findings (Table 1; Figure 1). More recently, the American Physiotherapy Association (Levenhagen et al., 2017) published its clinical practice guidelines on the diagnosis and management of upper quadrant LE in cancer patients.

The diagnosis of LE begins with a clinical history and physical examination (Armer et al., 2013; Bernas, 2013; Levenhagen et al., 2017; Paskett, Dean, Oliveri, & Harrop, 2012). In unilateral extremity LE, a key part of the differential diagnosis is to determine the possibility of other pathologies known to cause swelling, such as a new solid tumour, thrombosis or recurrent disease (Bernas, 2013; ISL, 2016; Levenhagen et al., 2017; Paskett et al., 2012).

**Measurement in Lymphedema**

Quantification of limb measurement involves assessing limb volume and/or circumference. In the studies reviewed, where objective measurements were utilized, baseline data were obtained pre-operatively on both limbs for future comparison. This is of importance, as studies have demonstrated that 20% to 30% of patients have anatomic limb asymmetry of between 5% and 10% unrelated to hand dominance (Brunelle et al., 2015; Sun et al. 2016). These data suggest that early studies on the number of patients reported to develop BCRL may have been overestimated, given most diagnoses were made without baseline measurements. Challenges in clinical practice include: what degree of change in the unilateral limb measurement constitutes BCRL; what method of measurement should be used; and when should intervention be undertaken.

There are four objective measures of LE reported in the literature: water displacement; circumferential measurement; perometry; and bioimpedance spectrometry (BIS). Armer et al. (2013) state that the exact method used for measurement is not as important as using a standard, reproducible method, practised consistently over time. Some

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| Stage 0: Latent (subclinical) Lymphedema | • No visible edema or swelling  
|                       | • Subjective symptoms such as heaviness, tightness or tingling may occur  
|                       | • Symptoms may present for months/years before swelling occurs |
| Stage 1: Early Lymphedema | • Visible edema with or without pitting  
|                       | • Swelling subsides with limb elevation  
| Stage 2: Moderate Lymphedema | • Visible edema, usually with pitting  
|                       | • Limb elevation alone rarely reduces swelling  
|                       | • Increase in subcutaneous fat and fibrosis  
| Stage 3: Severe Lymphedema | • Visible edema  
|                       | • Pitting is absent  
|                       | • Enlargement of the affected area  
|                       | • Thickening of the skin (acanthosis)  
|                       | • Changes in skin character: thickening, fibrosis, overgrowth  

Adapted from: International Society of Lymphology Executive Committee, 2016 p. 173.

**Figure 1: Stages of Lymphedema**

methods, though useful in clinical studies, are both cumbersome and expensive in the general clinical setting (Sayegh et al., 2017).

The gold standard for measurement of limb volume is water displacement. Measurements are done by placing the limb in a cylinder of water and measuring, by weight, the water displaced from the vessel giving an almost exact volume of the limb (Bernas, 2013). This method is rarely used now given its inconvenience, time-intensive cleaning of equipment between patients, patient mobility, and the associated time required for this technique.

Circumferential tape measurement is an inexpensive, reliable, and highly accessible way to measure patients’ limbs in a variety of settings. Serial measurements, using this method, have become the most commonly used technique in clinical practice (Bernas, Askew, Armer, & Cormier, 2010). Measurements are made at designated landmarks, using a non-stretch tape measure to assess limb volume changes, and are reproducible when using a standardized protocol (Armer et al., 2013; Bernas et al., 2010; Campanholi, Neto, Pedreira, & Fregnani, 2015; Czerniec et al., 2010). The most frequently reported measurements are taken starting at the ulnar styloid then measured every 10 cm along the arm to a point 40 cm from the styloid. Limb volume can be calculated from these measures by summing the values of the calculated volume of the truncated cone. Online calculators are available for ease of clinical use (e.g. www.armvolume.com). Manual calculations of volume show excellent correlation with other methods, and have validity in the diagnosis of LE. Lymphedema is defined as a ≥ 2 cm difference in limb girth from baseline, or volume difference of >10% in the at-risk arm (Armer et al., 2013; Campanholi et al., 2013; Cormier et al., 2010; Fu, Ridner, & Armer, 2009; Paskett et al., 2012; Specht et al., 2013). Tape measurements are not limited by a patient’s mobility, limb size, or skin condition.

There are newer measurement devices, such as the perometer, which calculates total limb volume using infrared sensors. These measurements are highly reproducible and can be completed within two to three minutes bilaterally. Though a valid, reliable, sensitive measure of limb volume, it is both expensive and cumbersome for use in the clinical setting. Periometric measurements of >200 mls or volume increase of 5–10% over baseline are used to define LE (Specht et al., 2013).

Bioimpedance spectroscopy (BIS) is another measurement technique reported in clinical studies. The machine passes low-level electrical current through the tissues to measure resistance (impedance) to current, thereby determining the extracellular fluid volume. This measurement is then expressed as an impedance ratio (Bernas et al. 2010). BIS is quick to complete. However, it is limited to patients who have undergone only unilateral breast surgery. This method has good inter- and intra-reader reliability and studies suggest that it can detect ‘sub-clinical’ (asymptomatic) BCRL.

Clinical Examination

Though measurement of the affected limb has been the most commonly used method to determine the presence of swelling, measurement alone is insufficient for patients with pain and heaviness in their limb (Paskett et al., 2012). Clinical examination, along with subjective information, should always be included in screening and diagnosis. For example, the Stemmer sign can be easily assessed and is a more sensitive than specific sign in determining whether a patient may have LE. If the examiner is unable to pinch skin on the dorsum of the hand (or foot), this is considered a positive Stemmer sign and LE is likely (Green & Goss, 2018).

Ideally, preoperative baseline measurements serve as the best comparison for future evaluation. However, many centres do not include these measurements as part of their routine pre-operative assessment. The importance of these measures is highlighted in the work by Kilbreath et al. (2016) and Lee et al. (2015) showing that many patients have transient swelling in the first post-operative year. The median time to development of BCRL has been demonstrated to range from 18 to 36 months, and it is suggested that classifying swelling as BCRL in the first year may not be appropriate unless swelling has been present for at least six months (Kilbreath et al., 2013).

**THE ISSUES: AN UPDATE ON RISKS FOR BCRL**

Risk reduction for BCRL has been directed, historically, at minimizing stress on the at-risk arm, the premise being the reduction of load on the lymphatic system (Asdourian et al., 2016). The following sections explore some of the most frequently discussed issues around the risk of BCRL and some of the more current data addressing these issues. It is important to remember a statement by Bernas (2013), who emphasizes that all preventative measures for BCRL need to be tempered by the realization that the majority of patients will never develop BCRL.

**Air Travel and Compression Garments**

Long haul flights have been associated with edema in individuals with or without LE. It is suggested that low cabin pressure, limitation of movement, dehydration and the hypobaric environment in air travel might be sufficient enough to create BCRL, particularly in people where their lymphatic system may be compromised (Asdourian et al., 2016).

Patients with a history of lymph node dissection have often been advised to avoid air travel or wear compression garments even without a history of LE (Cemal et al., 2011). Early work postulated there was a relationship between LE development and air travel, but the evidence was poor and often based on case studies or patient self-report (Asdourian et al., 2016; Cemal et al., 2011). These reports suggested that women who had an axillary lymph node dissection (ALND) and travelled were at a 2.5 times greater risk of developing BCRL than those who did not travel (Hayes, 2005, in Asdourian et al., 2016). Graham’s (2002) prospective study surveyed a group of women who had undergone ALND and assessed their exposure to a variety of BCRL risk factors. None of the women in this study reported the development or worsening of BCRL after air travel, and only nine
women (3%), reported cases of ‘transient’ swelling. There was evidence that the women who used precautionary measures (compression) had an increased risk of BCRL.

More recently, studies have demonstrated no association between air travel and the risk of developing BCRL. Kilbreath et al. (2010) examined the effect of air travel and BCRL risk by measuring fluid volume in the at-risk arms of women with breast cancer. Data were collected pre-flight, on arrival, and six weeks post-flight. Air travel did not cause any significant change in the bioimpedance ratio in the at-risk arms in the majority of these women. Subsequently, this same group undertook a prospective study to identify women at increased risk of BCRL based on having had axillary surgery. The study demonstrated that air travel did not increase the risk of BCRL regardless of the number of nodes removed (Kilbreath et al., 2016). These data were supported by Ferguson et al. (2016) who demonstrated there were no significant arm volume changes in women based on number or duration of flights taken.

Exercise
A major concern of patients is the use of their at-risk arm after LN surgery. For years, patients were advised to avoid exercise, as it was thought that the increase in blood flow increased lymphatic fluid in the affected limb. Sports such as rowing, golf, tennis, soccer, weight lifting, and running were ill advised (Cemal et al., 2011).

Systematic reviews examined studies directly addressing the effect of exercise on the risk of BCRL, and the data support the notion that strength exercises, particularly when done progressively, does not increase risk (Keilani, Hasenoehrl, Neubauer, & Crevenna, 2016; Stuiver et al., 2015). These reviews emphasize that monitoring for signs and symptoms of BCRL is important and treatment should be undertaken should these occur. Several studies have demonstrated that exercise, including progressive weight training, improves strength, enhances quality of life (QOL), and decreases fatigue without increasing the risk of BCRL (De Groef et al., 2016; Schmidt et al., 2017; Schmitz, Speck, Rye, Disipio & Hayes, 2012; Winters-Stone, LaBerg, & Schmitz, 2014). The NCI recognizes the importance of exercise for the increase in QOL and function, but also states that controlled exercise is SAFE in patients with LE (Cemal et al., 2011).

Body Weight/BMI
The evidence regarding weight and body mass index (BMI) and the relationship to BCRL has been well studied, and there is good evidence to support recommendations. Early data demonstrated that BCRL was more than two times higher in obese patients than those at “normal” weight. This continues to hold true with the more conservative axillary surgery used today.

Prospective studies have consistently demonstrated that a BMI ≥30 at diagnosis increases the risk of BCRL approximately three-fold (Dominick, Madlensky, Natarajan, & Pierce, 2013; Ridner, 2011; Basta et al., 2016). Basta et al. (2016) also demonstrated that a normal BMI at diagnosis appears to confer a protective effect against BCRL. Some authors suggest that patients with a high BMI preoperatively undergo nutrition counselling, and should be closely monitored for detection and early treatment of BCRL (Hua-Ping, Jian-Rong, & Zeng, 2012; Togawa et al., 2014).

Additionally, there has been concern around weight gain after surgery and its impact on the development of BCRL. Though it appears there may be a slight increase in the risk of BCRL, these studies show a non-significant difference when analyzing the change in weight from pre-operative to subsequent follow-up measurements (Petrek, Senie, Peters, & Rosen, 2001; McLaughlin et al., 2008).

Trauma
Medical procedures in the at-risk arm demonstrate the potential impact of trauma on the ipsilateral limb. An early publication by Dawson (1995) followed 315 breast cancer patients who underwent carpal tunnel surgery (CTS) on the ipsilateral side. In this series, there were no new cases of BCRL or infection. Since then, several reviews and prospective studies have examined outcomes for patients undergoing elective hand surgery who had ALND for breast cancer and/or melanoma. These studies showed no new cases and no exacerbation of existing LE (Baltzer, Harvey, Fox, & Moran 2017; Gunnoo, Ebelin, Arrault, & Vignes, 2015; Lee et al., 2015).

Reconstruction/Seroma
Women with mastectomies often opt for immediate or delayed reconstructive surgery, done with autologous tissue or breast implants. Given the surgery is done on the ipsilateral side, studies have been undertaken to assess the impact of reconstruction on the risk of BCRL. These studies compared the risk for women with or without reconstruction and analyses based on known confounding variables. Results have consistently demonstrated no increase in the risk of BCRL for women undergoing reconstructive surgery (Basta et al., 2015; Crosby, Card, Liu, Lindstrom, & Chang, 2012; Lopez Penha et al., 2014; Miller et al., 2016; Menezes et al., 2016).

Interestingly, in the surgical studies, seromas have been identified as an independent risk factor for the development of BCRL in the order of a two- to three-fold increase (Soares et al., 2014; Tsuyerkan, Jorgensen, Haugaard, & Sorensen, 2017).

Temperature Extremes
Patients at risk of, and those with BCRL have been advised to be cautious with sudden, prolonged temperature changes, and to avoid sunburns and exposure to extremes in temperature. In particular, avoid submersion of the at-risk limb in water above 38.9°C, including the avoidance of thermal-based heat and cold therapy (Asdourian et al., 2016). This was based on the assumption that inflammation and increased blood flow could result in increased lymphatic fluid production.

Showalter et al. (2013) examined the exposure of breast cancer survivors to 30 different lifestyle behaviours. Surveys were completed every three months for a year and temperature related risk factors were included in the analysis (e.g., vigorous exercise in the heat, travel to hot or humid climates, use of hot tubs and saunas, and the development of
Despite the small number of patients, only the sauna was associated with arm swelling. These patients also reported concurrent skin abrasions on the affected arm as a complicating factor not further assessed. In a review by Cemal et al. (2011) there is documentation of randomized studies using heat and microwave treatment for patients with LE that showed positive effects in lower extremity LE; 75% of the patients in one large study had at least a 50% reduction in the measured LE symptoms.

**HISTORICAL PERSPECTIVES ON VASCULAR ACCESS AND THE RISK OF BCRL**

The first reported case linking BCRL with needle-stick injury was published in 1992. Brennan & Weitz (1992) noted that a patient developed LE 30 years post mastectomy after initiating finger sticks to monitor blood sugars. Brennan (1992) subsequently published an article building on this theme and reported strategies to reduce the risk of BCRL focused on reducing the risk of limb injury, including needle puncture. Although there were several recommendations, the avoidance of needle sticks became the most common preventative strategy enforced through institutional policies and procedures and reinforced through patient education initiatives and breast cancer support groups.

Historical data from seven studies conducted between 1970 and 1998, prior to the widespread adoption of venipuncture avoidance in the surgical arm reported a 24% (6–30%) incidence of BCRL (Petrek et al., 1998). Current studies where avoidance of the surgical side is widely practised, the estimated risk of BCRL is in the range of 14.9–29.8%. Therefore, as healthcare professionals, we have performed a single arm study where the vast majority of patients do not have venipuncture in the surgical arm, yet the rate of BCRL remains approximately 21%.

There are no known clinical trials demonstrating a causal association between venipuncture and BCRL. Studies, primarily retrospective and subjective, rarely include sufficient information regarding patient and treatment characteristics that allow for multivariate analysis. Clark (2005), in a prospective study where 20.7% of patients developed BCRL, identified hospital skin puncture (versus none) as a risk factor. However, there were no data regarding the time to development of BCRL or multivariate analysis that could identify other factors that may have contributed (e.g., finger prick for glucose testing for diabetes may be a surrogate).

**Current perspectives on venipuncture and BCRL**

Current literature supports that up to 15–20% of breast cancer survivors are at a clinical risk of developing BCRL. Conversely 80-85% of patients remain free of BCRL occurrence. Seventy percent of these patients will experience BCRL within two years of surgery, 90% within three years and a 1% rate per year onwards (Cheng et al., 2013). Yet, 100% of patients are instructed to avoid venipuncture in the surgical arm for the rest of their lives. A recent publication from our centre reported that when patients were asked about specific factors that would increase the chance of BCRL, the most frequently identified risk factor was blood draws on the surgical arm (117/156; 75%). Chemotherapy administration in the surgical arm was identified as a risk factor by 52/156 patients (33%), the same number that identified the use of hot tubs or saunas as a risk (LeVasseur, et al., 2018). The perception that venipuncture in the surgical arm increases the risk for BCRL continues despite published data suggesting otherwise. Other publications found no association between blood draws and injections in the surgical arm and the development of BCRL and acknowledge that current guidelines are burdensome to both patients and clinicians without any consideration to other factors that occur when the at-risk arm is always protected from venipuncture (Asdourian et al., 2016; Ferguson et al., 2016; Kilbreath et al., 2016). In summary, what are supported by evidence as risk factors for the development of BCRL are: axillary node dissection; mastectomy; administration of chemotherapy and/or radiotherapy; obesity; and the presence of arm swelling.

**Approaches to address vascular access in patients with lymphedema**

The following sections provide practical approaches for addressing the vascular access needs of patients presenting with a diagnosis of BCRL, those at risk of BCRL during the first three years’ post-surgery (where 90% of BCRL will occur), and those greater than three years’ post-surgery (where the incidence is remarkably reduced, but continues for the patients’ life time). As practice patterns change, vascular access specialists can lead the collaborative effort necessary to ensure information is available to patients and practitioners to promote understanding of the risk and benefits of each vascular access decision.

Reduction in the number and frequency of venipuncture should be a planning priority. When venipuncture is necessary, employ strategies to facilitate vessel dilation such as hydration, topical heat and arm positioning (Canadian Vascular Access Association, 2019; Infusion Nurses Society, 2016). The use of vein visualization technology such as ultrasound and near infrared light may also be helpful in locating peripheral veins, reducing the number of attempts and associated trauma.

**Phlebotomy**

The Clinical and Laboratory Standards Institute (2017) states that a phlebotomist requires a physician order before performing venipuncture on the at-risk arm. However, they acknowledge that studies are scant and inconclusive. There is no time limitation and the restriction applies whether there is arm swelling or not. Registered nurses have a broader knowledge base and the ability to undertake a thorough assessment and risk/benefit analysis. It is recommended to use the non-surgical side if veins are adequate. However, if venipuncture becomes problematic, perform a risk/benefit analysis and discuss with the patient and healthcare team, as use of an adequate vein on the surgical side may be the best option.

**Peripheral intravenous (IV) access**

When emergent vascular access is required, establishing prompt IV access in the most readily available vein in either arm should be considered the

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appropriate approach with the least risk and most benefit. Use a systematic approach to plan for subsequent and ongoing access.

As the body of evidence grows, perhaps the most appropriate timeframe to introduce change is in patients without BCRL who are three years post-surgery where the risk of experiencing BCRL has markedly decreased to a rate of 1% per year (Cheng et al., 2013). When the need for IV therapy arises, the decision to choose the optimal vein and site in either arm is the appropriate clinical decision. Choose the best upper extremity vein for cannulation, limit the number of attempts and use sterile technique to reduce the risk of infusion-associated complications such as infiltration, extravasation, phlebitis and infection (Helm et al., 2015). When LE is present, avoid the limb for IV access, as LE contributes to poor tissue perfusion, impairs immune function and increases the risk, frequency and severity of infections (Cemal et al., 2011). Use of veins in the lower extremities has the potential for medical complications (e.g. phlebitis, thrombosis, tissue necrosis) and should not be performed as a substitute for the use of adequate veins in the at-risk arm (Infusion Nurses Society, 2016). When veins are inadequate in the non-surgical arm, initiate a vascular access specialist referral for assessment and recommendations. Figure 2 provides a decision tree to assist in decision making when performing vascular access procedures in patients greater than three years post-surgery.

Bilateral breast cancer poses unique challenges. In this clinical scenario patients should be given additional post-operative information that describes what procedure was performed on each side. It is important for the vascular access clinician to understand the impact of therapeutic and prophylactic mastectomies. The use of contralateral prophylactic mastectomy has increased over the past two decades among women diagnosed with early-stage unilateral breast cancer (Asdourian et al., 2017; Yao, Stewart, Winchester, & Winchester, 2010). However, unlike the surgical side in patients with bilateral breast cancer, the surgical side of a prophylactic mastectomy where no ALND was performed does not appear to increase the risk of developing BCRL (Miller, Colwell, Horick, Skolny, Jammallo, O'Toole, et al., 2012).

Central Vascular Access

Every vascular access device option is associated with its own risks and benefits, which are often higher than those associated with peripheral catheters (Piran, et al., 2014; McDiarmid, et al., 2017). Peripherally inserted central catheters (PICCs) placed in the upper extremity and implanted vascular access devices (IVADs), placed directly in the central veins, are the most common central venous catheters placed in patients receiving breast cancer therapy (LeVasseur et al., 2018). Ghandi et al. (2003) reported that the placement of IVADs on the surgical side did not increase the incidence of LE. However, if radiation therapy is planned on the ipsilateral side, the radiation oncologist

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**Figure 2**

Vascular Access* Algorithm for Breast Cancer Patients >3 years Post-Surgery**

Does patient have arm swelling on surgical side?

Yes

- Do not use surgical arm

- Are veins adequate in the non surgical arm?

  Yes

  - Perform phlebotomy, initiate intravenous or insert peripherally inserted central catheter into the most appropriate vein in the non surgical side

  No

  - Consult vascular access expert for assessment and recommendations

No

- Perform phlebotomy, initiate intravenous or insert peripherally inserted central catheter into the most appropriate vein in either arm

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* Assumes appropriateness of device has been determined

**90% of initial LE diagnosis occurs <3 years post surgery (Cheng et al., 2013)
will need to consider the composite material of the device and the impact on radiation treatment dosimetry and may request the device be placed on the contralateral side (Gossman, et al., 2009).

The algorithms provided in Figures 2 & 3 are applicable to PICCs. Although the use of ultrasound guidance has reduced the complication rate with PICCs, upper extremity thrombosis reportedly occurs in approximately 1.4% to 3.3% of patients with breast cancer (Kang, 2016; Ellis & Satomi, 2017). Adhering to recommendations maintaining a minimum catheter to vein ratio of < 45% may decrease catheter-related upper extremity deep vein thrombosis (Sharp, Cummings Fielder, Mikocka-Walas, Grech, & Esterman, 2015).

CONCLUSIONS

There is a growing body of evidence on the risks and management of BCRL and many areas in which we can make strides. Firstly, given the issues with transient swelling post-operatively, and with some chemotherapy regimens, it is important to ensure we accurately identify the patients who are at risk or affected. We need to establish a routine technique to diagnose BCRL that could be used at individual centres with standardized documentation and interpretation. Additionally, given the large proportion of patients who have asymmetry in their limbs unrelated to hand dominance, thought should be given to establishing baseline measurements prior to treatment and medical management.

Long-held beliefs with regard to the risks factors and preventative measures need to be challenged. Education of healthcare providers, patients and support groups through the dissemination of evidence-based information on prevention and treatment of BCRL is necessary to ensure that patients receive the best care possible with the least risk to their health.

Less invasive diagnostic strategies such as sentinel lymph node biopsy, shorter course therapy with HER2/neu receptor antagonist use, increased interval dosing of bone modifying agents, and fewer anthracycline based chemotherapies are factors to consider when developing a plan for vascular access therapy in breast cancer patients. This, combined with the increasing evidence base that fails to support a cause-effect relationship between skin puncture and the impracticality of complete avoidance of the surgical arm for the rest of the patient’s life, provides the opportunity to improve recommendations given to patients. Patients at different risks for BCRL should be given appropriate precautionary guidelines.

Finally, developing a designated specialty service for vascular access and infusion therapy, with staff members educated in theory and skilled in practice, can serve as a resource for best practice, clinical guidance, policy and procedure development, and staff training. Ultimately, it could improve the overall experience for breast cancer patients.
REFERENCES


