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The Risk of Secondary Lymphedema due to Procedures in the Affected Arm Post-Mastectomy: A Literature Review

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THE RISK OF SECONDARY LYMPHEDEMA DUE TO PROCEDURES IN THE
AFFECTED ARM POST-MASTECTOMY: A LITERATURE REVIEW

by

LINDSAY A. PERNA

A thesis submitted in partial fulfillment of the requirements
for Honors in the Major Program in Nursing
in the College of Nursing
and in the Burnett Honors College
at the University of Central Florida
Orlando, FL

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Thesis Chair: Dr. Leslee D'Amato-Kubiet

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ABSTRACT

The risk for upper extremity lymphedema post-mastectomy in women surgically treated for breast cancer is a concern since it is often painful, aesthetically displeasing, and can increase the risk of infection. However, there is a paucity of data examining if diagnostic procedures performed in the ipsilateral arm post-mastectomy increases the risk of lymphedema. The purpose of this research is to examine the relationship between diagnostic procedures performed in the ipsilateral arm post-mastectomy and the occurrence of lymphedema with or without related complications. A systematic review of the literature was conducted from multiple, online databases available from 1992 through 2014, and included CINAHL, MedLine, PsychInfo, and ERIC. Search terms included lymphedema, breast cancer, mastectomy, blood pressure, and infection. Exclusion criteria comprised articles focused on male gender, primary lymphedema, metastases, survival, quality of life studies, reoccurrence breast cancer, breast conservation, lymphedema management, lymphedema, and lymphoma. The results of this study were inconclusive concerning a relationship between upper extremity lymphedema and procedures performed in the ipsilateral arm after mastectomy. This literature review outlines gaps in the data showing a need for more focused research on the causes of secondary lymphedema after breast cancer surgery with lymph node removal. Further research on the impact of diagnostic and other invasive procedures on the ipsilateral arm after mastectomy should be considered.

DEDICATION

For all nurses, using evidence-based practice
to provide the optimum standard of patient care,

For all women, living with or surviving breast cancer,

And especially, for my mentor, Dr. Leslee D'Amato-Kubiet,
for inspiring me to achieve my goals.

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INTRODUCTION

Breast cancer affects an estimated 232,340 women yearly in the United States (Society, 2013). A common surgical procedure for treatment of breast cancer is mastectomy (Breastcancer.org, 2014). This surgical procedure is often completed in conjunction with sentinel lymph node biopsy of the ipsilateral breast or a full axillary dissection, depending on the surgical site, for cancer staging purposes. After the surgery, women are educated to avoid having their blood pressure, and other invasive and noninvasive procedures, such as phlebotomy, performed on their ipsilateral arm associated with the axillary lymph node removal (Cole, 2006). Consequently, it has become common practice for health care providers to avoid performing any type of intervention to the woman's ipsilateral arm for an indefinite period of time. Avoidance of procedures using the affected arm is often advised regardless of the axillary lymph node procedure performed, whether it is a sentinel lymph node biopsy or a full axillary dissection. The concern for avoiding procedures in the ipsilateral arm is that it could expose the woman to the risk of lymphedema, which is often painful, aesthetically displeasing, and can increase the risk of infection. However, little data supports the practice that performing blood pressure measurements or establishing venous access in the ipsilateral arm increases the risk of lymphedema.

PROBLEM

After a diagnosis of breast cancer is confirmed, 89.2% of women have a predicted survival of at least 5 years (National Cancer Institute, 2014). The length of survival time provides a longer time interval for an opportunity of an increased risk for the post-operative complication of lymphedema. In fact, there is a lifetime risk for developing lymphedema in women who survive breast cancer (Armer & Stewart, 2010). Prevention of the development of debilitating and painful lymphedema as a result of treatment for breast cancer should be emphasized as much as possible. A method to decrease the risk of secondary lymphedema is to identify specific risk factors associated with lymphedema. A study of female breast cancer survivors showed that 77% developed lymphedema within 3 years post-operatively and linked weight gain, previous infection, or injury as a cause of the onset (Petrek, Senie, Peters, & Rosen, 2001). Injury was further defined as a cut or bruise to the area. This definition could be interpreted to include invasive or non-invasive procedures.

According to the National Cancer Institute (2014), “lymphedema is one of the most poorly understood, relatively underestimated, and least researched complications of cancer or its treatment” (Introduction section, para. 1). Understanding risk factors associated with the development of lymphedema post-mastectomy can assist health care providers in educating patients about how to avoid this painful and debilitating condition.

BACKGROUND

Lymphedema – What is it?

Two types of lymphedema predominate in atypical conditions of the endocrine system. Primary lymphedema, which is directly associated with a disease process, is not within the scope of this paper since it is associated with genetic abnormalities (National Lymphedema Network, 2015). Secondary lymphedema is defined as protein rich fluid accumulating in the interstitial spaces of the body. Secondary lymphedema related to women post-mastectomy is characterized by upper extremity swelling in the ipsilateral arm of lymph removal. It is often described as a perception of tightness, fullness, or heaviness in the affected extremity and can restrict movement and range of motion, such as those during activities of daily living (National Cancer Institute, 2014). Lymphedema in the affected limb can be painful and frequently requires interventions such as elevation and compression to decrease swelling, thereby relieving pain.

Measurement of lymphedema

Measurement of lymphedema in the upper extremities occurs through a variety of techniques. There are two units of measure for lymphedema; subjective and objective. Subjectively, women often “self-report” the symptoms of lymphedema (Geller, Vacek, O'Brien, & Secker-Walker, 2003). Research questions serve to characterize and validate these “self-reported” lymphedema claims (Norman, Miller, Erikson, Norman, & McCorkle, 2001).

Objectively, arm circumference measurements and water displacement volumetry are clinical units of measure for lymphedema (Geller et al., 2003). Other quantitative studies suggest that limb volume, calculated by a formula, is a more basic and easily reproducible measure as opposed to water displacement volumetry (Bates, Levick, & Mortimer, 1994). This study also evaluated the pressure caused by interstitial fluid in the compartment spaces of the arm and the trends of fluid movement over a period of time using Starling pressures (Bates et al., 1994). These objective measurements are not direct, invasive measures. However, both are used in practice today. Although objective methods of measuring lymphedema in the affected arm post mastectomy are available, most research related to lymphedema is qualitative research and focuses on “self-report” by participation in a study.

Possible factors influencing the risk of lymphedema

Non-modifiable risk factors

Age

Studies focusing on factors contributing to lymphedema often compare women at the time of lymphedema onset with their age. One study concluded that out of multiple factors, age had the most significant and independent effect. Women under the age of 50 years have an increased risk of lymphedema post mastectomy (Geller et al., 2003). Several studies showed no significant correlation between age and reflection on lymphedema risk (Geller et al., 2003). Other studies found increased age (women over 50 years) to have an increased risk for developing lymphedema as opposed to younger women (under 50 years of age) (Geller et al., 2003). Currently, the research regarding age as a non-modifiable risk

factor for lymphedema does not agree on whether increased age has an impact on post-mastectomy lymphedema or not.

Severity of disease

Cancer staging is based on the tumor node metastasis (TMN) system. The severity, or stage, of breast cancer diagnosis leads women to choose the most appropriate level of care they receive. If the cancer is diagnosed at an earlier stage, the standard of care for treatment may only include a lumpectomy. One study stated that breast conservation surgery, such as lumpectomy, should be used over mastectomy to decrease the risk of developing lymphedema (Nesvold, Dahl, Løkkevik, Marit Mengshoel, & Fosså, 2008). On the other hand, if the woman has later stage cancer, the treatment often includes mastectomy as well as axillary node dissection along with chemotherapy and radiation. Studies have shown a relationship between more aggressive treatment regimens and an increased risk of lymphedema on the affected side (Kim et al., 2013).

While the severity of the disease is a non-modifiable factor, the type of surgery is based on the woman's need and the surgeon's discretion. The term mastectomy, in this case, encompasses radical mastectomy but also modified radical mastectomy, simple mastectomy, and partial mastectomy. The differences are the extent of the surgery. The partial mastectomy is closely related to a lumpectomy, where only a portion of the breast tumor is removed. The partial mastectomy, however, removes a larger portion of breast tissue, yet not the entire breast tissue (Breastcancer.org, 2015b).

The simple mastectomy is the least complex surgery performed involving the removal of the entire breast tissue (Breastcancer.org, 2015b). The simple mastectomy is a common procedure for women with a lower staged cancer or for those seeking prophylactic measures when there is a family history of breast cancer and the risk is high for the woman.

A more complicated surgery approach is the modified radical mastectomy. This procedure involves removing the entire tissue from the breast and, in addition, removing lymph nodes. This is the most frequently used mastectomy amongst women with breast cancer because the lymph node involvement provides information for staging purposes (Breastcancer.org, 2015b).

The most drastic and extensive procedure, while not widely practiced, is the radical mastectomy. This procedure can be more disfiguring to the woman due to removal of not only the entire breast tissue and lymph nodes, but also part of the muscle within the chest wall. As previously stated, this procedure is now rarely used due to statistics suggesting modified radical mastectomy to have similar survival outcomes to the radical mastectomy while sparing gross disfigurement (Breastcancer.org, 2015b).

Axillary node resection

Prior research has suggested that sentinel lymph node biopsy should decrease the risk of lymphedema as opposed to axillary node dissection (Pillai, Sharma, Ahmed, & Vijaykumar, 2010). According to a recent meta-analysis, risk for lymphedema was 4 times higher when women were treated with axillary lymph node dissection compared to

sentinel lymph node biopsy (DiSipio, Rye, Newman, & Hayes, 2013). The difference between axillary node dissection and sentinel lymph node biopsy is that the dissection removes considerably more lymph nodes than the sentinel biopsy.

Another study showed a correlation between the numbers of lymph nodes removed, a woman's BMI, and lymphedema development (Keskin et al., 2013). Since BMI can be considered a modifiable risk factor, women could possibly decrease the amount of lymph nodes needing to be removed by losing weight and therefore decrease their overall risk for lymphedema.

Post Surgical Radiation and Chemotherapy

Data regarding radiation interventions or chemotherapy post mastectomy and lymph node removal causing lymphedema is contradicting. One study claimed high dose radiation, with some radiation directly on the axilla, increases the risk of arm swelling or lymphedema (Geller et al., 2003). Another study found a positive relationship between radiation and developing lymphedema suggesting that combining radiation with axillary node dissection should be avoided (Deo et al., 2004). Conversely, there are studies that suggest no relationship between lymphedema and treatments, such as radiation and/or chemotherapy (Werner RS, 1991). Other studies, those of Geller et al. (2003) and Kiel and Rademacker (1996), showed decreased risk of lymphedema if chemotherapy was performed.

Modifiable Risk factors

Hypertension

Studies have shown that women with arterial hypertension have a higher risk for post-mastectomy lymphedema (Böhler, Rhomberg, & Doring, 1992). In one study, women treated for hypertension had a decreased risk of lymphedema. It was suggested that there is a need for further research comparing treated or controlled hypertension with medication and uncontrolled hypertension (Geller et al., 2003). The authors based this need off of their own research, as well as a German study that determined hypertension to be a diagnosis but did not specify whether the hypertension was treated or not (Togawa et al., 2014). If further research is done on hypertension and whether or not controlling it will decrease the risk of lymphedema, then women may have an opportunity to have more data-driven options to choose from and potentially decrease their risk for lymphedema.

BMI and weight

Body Mass Index or BMI is a measurement of body fat that is calculated based on a person's height and weight. A normal BMI ranges from 19 to 24, overweight ranges from 25 to 29, obese ranges from 30 to 39, and extreme obesity is anything over 40 (National Institute of Health, n.d.). A higher BMI appears to be a risk for developing lymphedema. However, many studies have shown that obesity is a more commonly reported risk factor than BMI (Meeske et al., 2009). While several studies showed a relationship between increased BMI and risk of lymphedema, others did not show any significance (Geller et al., 2003). The non-significant finding between BMI and weight may be due to the fact that data was only collected at the time of mammogram pre-diagnosis (Geller et al., 2003).

More comprehensive studies should be conducted on weight and the effects of developing lymphedema since the absence of weight gain could prevent complications.

Current prevention of lymphedema

Table 1: Treatment Characteristics

| Treatment Characteristics: Prevention Guidelines |
|--|
| <ul style="list-style-type: none"> • Maintain healthy weight • Do use your affected arm for normal, everyday activities (i.e. brush hair) • Do not overuse affected arm • Avoid vigorous and repeated activities • Avoid heavy lifting and pulling • Use a fitted compression sleeve during air travel • Avoid immunizations in the affected arm • Avoid blood draws in the affected arm • Avoid infection • Push back cuticles on fingernails as opposed to cutting • Protect skin from insect bites, cuts, and scrapes • Wear thimbles for sewing • Wear gloves in the garden • Wear gloves when working with animals • Wear gloves when working with harsh cleaning products or steel wool • Be careful when shaving armpits; use a new razor on clean skin • Prevent falls and broken bones • Avoid the sun to prevent sunburn or use protective clothing and sunscreen • Use oven mitts that cover lower arms • Be careful when boiling water, frying, or removing food from microwave oven • Avoid high heat from hot tubs or saunas • Avoid constriction from tight clothing or jewelry • Avoid use of shoulder straps when carrying a briefcase or purse • Wear loose fitting bras that do not dig into shoulders • Have blood pressure measurements taken on unaffected arm • Unless both arms are affected; then use the thigh |

Current guidelines available for women online list multiple prevention strategies to avoid the possibility of lymphedema onset (American Cancer Society, 2015).

Providers should routinely educate women on proper precautions to prevent lymphedema after mastectomy surgery with axillary node removal. Women are informed that any trauma to the ipsilateral arm, including burns and wounds made by the puncture stick of a needle, can disrupt the compromised lymphatic system and increase the risk for lymphedema (Brennan & Weitz, 1992). Although definite risk factors for lymphedema are unclear, clinicians are encouraged to cast a wide net in order to encompass any influencing factors from becoming a potential risk (American Cancer Society, 2015). Currently, avoidance of performing invasive and non-invasive procedures to the affected arm is considered prudent practice. Total avoidance of blood pressure measurements and any procedure, including injections or venipuncture, in the ipsilateral arm may attest difficult when medical management becomes necessary.

PURPOSE

The primary purpose of this literature review was to examine the relationship between blood pressure measurement and related procedures performed in the ipsilateral arm after mastectomy as factors leading to secondary lymphedema in post-mastectomy women. The secondary purpose was to evaluate which types of risk factors increase the occurrence of lymphedema post mastectomy.

Understanding risk factors for developing upper extremity lymphedema post-mastectomy is essential for assisting women with decision-making processes regarding precautions and use or disuse of their ipsilateral arm for procedures. Research is needed to develop evidence-based interventions to guide women about use of the ipsilateral arm for invasive and noninvasive procedures following mastectomy with lymph node biopsy or removal. Furthermore, evidence-based guidelines are needed for all health care providers regarding the care of women with a risk for lymphedema following mastectomy for day-to-day interventions requiring upper extremity access to reduce the risk of lymphedema and for education purposes.

METHOD

A literature review was performed using information published from 1992 to 2015 regarding lymphedema risk in the postoperative woman. The information acquired over the 23-year span presented a comprehensive array of literature to confirm recent acquisitions. CINAHL, MedLine, PsychInfo, and ERIC databases were used. An initial search using the key terms lymphedema, breast cancer, mastectomy, blood pressure, infection, risk of lymphedema, women, post surgical, and axillary node dissection was conducted.

Exclusion criteria for this literature review included male gender, primary lymphedema, metastases, survival, quality of life (QOL) studies, reoccurrence breast cancer, breast conservation, lymphedema management, lymphedema only articles, and lymphoma. The review process compared and contrasted the research studies on each factor as it contributed to being a risk factor to secondary lymphedema. Sixteen articles were eliminated based on the exclusion criteria.

A total of 22 articles were retrieved that examined a relationship between secondary lymphedema and use of the ipsilateral arm for invasive and non-invasive therapies. Sixteen studies were utilized for including relevant criteria.

Additional searches were conducted manually from the article citations, which yielded 13 more articles of relevance, of which six were excluded due to comorbid conditions associated with generalized lymphedema that also included the ipsilateral arm. A total of 16 articles were analyzed for conclusive data related to the topic. Any further information resulting from secondary lymphedema based on infection, complications, and

interventions performed in the ipsilateral arm was presented based on the applicability of the obtained data ($n = 51$).

RESULTS

Of the 51 articles, no studies directly addressed the relationship between blood pressure measurement and lymphedema development. One article discussed a significant 40% increase in lymphedema onset when procedures, like phlebotomy, were done in the ipsilateral arm (Cole, 2006). Furthermore, one article stated the invasive procedure of repeated finger sticks by a needle directly correlated to an increased risk of lymphedema (Brennan & Weitz, 1992).

There were 16 articles that were directly relevant to secondary lymphedema risk factors. Six articles stated that mastectomy verses breast conservation therapy or lumpectomy increased a woman's risk of complications. Three articles had noticed a correlation between chemotherapy treatment and lymphedema. The most supported claim, with 12 articles, determined a direct link between an increased number of lymph nodes removed during an extensive axillary lymph node dissection (ALND) and lymphedema formation. There were 8 articles relating radiation therapy to an increased risk of complications and also 8 articles supporting a relationship between a higher body mass index (BMI) and lymphedema. Four studies found that an advanced diagnosis of breast cancer led to a higher risk of lymphedema. Comorbidities played a role in relation to lymphedema, but for the purpose of this review they have been separated into 2 main subcategories, hypertension and diabetes mellitus. Four studies found hypertension to be significant, while two studies mentioned diabetes as a pertinent risk factor. Age is a risk factor, yet studies are conflicting on whether advanced age or younger age increases risk.

Three studies suggest that a younger age when diagnosed with breast cancer leads to an increased risk of developing lymphedema as a complication.

Table 2: Risk Factors for Lymphedema

| Risk Factors for Lymphedema | Articles supporting Risk Factor | Relevant Articles |
|------------------------------------|--|--------------------------|
| Invasive Procedure (needle access) | (Brennan & Weitz, 1992), (Cole, 2006) | 2 |
| Mastectomy* | (Cole, 2006), (Deo et al., 2004) (Hack et al., 2010), (Nesvold et al., 2008), (Park, Lee, & Chung, 2008), (Togawa et al., 2014) | 6 |
| Radiotherapy/Radiation | (Brennan & Weitz, 1992), (Cole, 2006), (Deo et al., 2004), (Hack et al., 2010), (Kim et al., 2013), (Ozaslan & Kuru, 2004), (Park et al., 2008), (Pillai et al., 2010) | 8 |
| Chemotherapy | (Geller et al., 2003), (Kim et al., 2013), (Park et al., 2008) | 3 |
| Extensive Axillary Dissection | (Brennan & Weitz, 1992), (Bennett Britton et al., 2009), (Cole, 2006), (Geller et al., 2003), (Meeske et al., 2009), (Hack et al., 2010), (Keskin et al., 2013), (Kim et al., 2013), (Nesvold et al., 2008), (Park et al., 2008), (Pillai et al., 2010), (Togawa et al., 2014) | 12 |
| Advanced Diagnosis | (Cole, 2006), (Deo et al., 2004), (Kim et al., 2013), (Park et al., 2008) | 4 |
| High BMI | (Cole, 2006), (Meeske et al., 2009), (Ay, Kutun, & Cetin, 2014), (Keskin et al., 2013), (Nesvold et al., 2008), (Ozaslan & Kuru, 2004), (Park et al., 2008), (Togawa et al., 2014) | 8 |
| Hypertension | (Böhler et al., 1992), (Cole, 2006), (Meeske et al., 2009), (Deo et al., 2004) | 4 |
| Advanced Age (<50) | (Brennan & Weitz, 1992) | 1 |
| Younger Age (>50) | (Geller et al., 2003), (Meeske et al., 2009), (Hack et al., 2010) | 3 |
| Diabetes Mellitus | (Brennan & Weitz, 1992), (Deo et al., 2004) | 2 |

*Mastectomy term is not specific and may encompass simple mastectomy, modified radical mastectomy, and radical mastectomy.

Most research suggests that blood pressure measurements and related procedures are avoided in the ipsilateral arm after breast cancer surgery. The reasoning for these guidelines are not well defined. In fact, none of the studies demonstrated a direct relationship between blood pressure measurements performed on the ipsilateral arm and the onset of secondary lymphedema. One study compared the current lymphedema prevention professional guidelines to the pathophysiology of lymphedema (Cole, 2006). The study found no evidence-based research supporting or not supporting the use of blood pressure measurements or other procedures as a risk factor for lymphedema. Until there is more empirical research on the topic, health care providers should continue the prudent practice of avoiding measurements or procedures of any type in the affected arm post mastectomy (Ridner, 2002).

Invasive Procedures

Invasive procedures can range from repeated finger sticks that a person with diabetes may be required to use for glucose monitoring to intravenous access in order to receive therapy in a hospital or outpatient setting. There was one study that focused on a case report of a woman who noticed arm swelling after pricking her ipsilateral arm 10 times for blood glucose monitoring (Brennan & Weitz, 1992). The theory behind invasive procedures resulting in lymphedema is associated with the inflammatory response. It is believed that when the body activates the immune response to heal the trauma to the skin, the lymph system is compromised and can not remove the extra cells, therefore resulting in swelling (Cole, 2006).

Mastectomy

The 6 studies represented in Table 2 found significant results reflecting that the more extensive the surgery, the higher the rate of complications. One article compared multiple studies and determined that the methods reported in the studies that supported mastectomy as a risk factor were more thorough (Cole, 2006). Another study determined that modified radical mastectomy increased the risk of lymphedema when compared to a partial mastectomy. This study suggested that a more complicated surgery performed conveyed a higher probability of lymphedema (Park et al., 2008). Deo et al. (2004) stated that there was a 39% risk of lymphedema after radical mastectomy versus an 8% risk after lumpectomy or breast conservation. This study had comparable results to the study done by Nesvold et al. (2008), which found that 20% of women with a radical mastectomy developed lymphedema compared to 8% of women with a breast conserving surgery. Women with a modified radical mastectomy experienced lymphedema more often than women who underwent a lumpectomy, yet no mention of how frequent was recorded (Hack et al., 2010). Another study also came to the same conclusion that the modified radical mastectomy was associated with an increased risk of lymphedema (Togawa et al., 2014). According to the statistical significant studies, there is enough data to determine that a radical mastectomy increases the risk of lymphedema when compared to breast conserving therapy.

Radiation and Chemotherapy

Multiple studies have identified a strong correlation between radiation therapy and the development of lymphedema. One study stated that when radiation to the axilla was performed, the risk of lymphedema doubled (Cole, 2006). Another study determined that 41% of women who had axillary radiation developed lymphedema compared to 17% of women who had surgery only (Park et al., 2008). A further study identified that women who received “radiation exposure of more than 4600 CGy” (Brennan & Weitz, 1992, p. 13), were at greatest risk for lymphedema. While there is a known risk for complications after radiation, sometimes radiation as treatment cannot be avoided depending on the extent of the tumor and other factors. The rate of occurrence for lymphedema is heightened when radiation is combined with chemotherapy. Chemotherapy was found to increase the risk of lymphedema significantly (Geller et al., 2003). Yet in a different study, there was no relationship between chemotherapy and lymphedema (Park et al., 2008). This study showed the inconsistencies in data regarding chemotherapy as a risk factor and identified the need for further research (Park et al., 2008).

Another study found no significance for chemotherapy alone to cause lymphedema, but when in combination with radiation as treatment for breast cancer, the rate is 2 to 4.5 times more significant (Kim et al., 2013). A study compared women who had surgery only with women who had surgery and radiation. This study showed that 13.4% of women with surgery only developed lymphedema while 42.4% of women with surgery and radiation developed lymphedema (Deo et al., 2004). This study’s findings suggest an increase of 3 to 7 more times a risk of lymphedema formation when radiation is used (Deo et al., 2004).

During a 6 to 12 month range after surgery, women with radiation to the axilla had a statistically significant risk for lymphedema (Hack et al., 2010). Another study found axillary radiation to have statistical significance for lymphedema development (Pillai et al., 2010) and there was increased risk of lymphedema by 2.75 fold in women when they underwent axillary radiation (Ozaslan & Kuru, 2004). According to the studies, radiation is supported as an independent risk factor for the development of lymphedema post operatively.

Axillary Dissection and Lymph Node Involvement

Axillary lymph node dissection has the most recognized link to lymphedema formation. From this review, 12 articles supported this as a tremendous risk factor. Again, there is a direct correlation between the higher amount of lymph nodes removed during the dissection and a greater risk for lymphedema formation. One study stated that axillary node dissection was the best predictor of lymphedema development (Geller et al., 2003). Two studies reported that even when five lymph nodes were removed, there was a higher risk for lymphedema (Hack et al., 2010). A multivariate study showed lymphedema to be associated with a greater number of lymph nodes removed (Nesvold et al., 2008). Another study found a positive risk with the amount of lymph nodes removed and lymphedema. This study also stated that there was a significant risk when 10 or more lymph nodes were removed (Meeske et al., 2009). In addition to this study, a second study also found a statistical significance in removing greater than 10 lymph nodes (Kim et al., 2013). 27% of women with greater than 10 lymph nodes removed developed lymphedema compared to

9% of women with less than 10 lymph nodes removed (Kim et al., 2013). A multivariable analysis determined that “the risk of lymphedema increased by 5% for each lymph node removed” (Togawa et al., 2014, section Multivariable analyses overall, para 1).

When women received axillary lymph node dissection, this increased their risk of lymphedema by 6.61 fold (Park et al., 2008). Another study showed a statistically significant risk for lymphedema when women had an aggressive lymph node involvement (pN3) (Pillai et al., 2010). When these studies are reviewed, the conclusion that the risk for lymphedema becomes increased when there are more lymph nodes removed or there is an extensive axillary surgery is thoroughly supported. These articles show a positive correlation between the number of lymph nodes removed and the risk for lymphedema development.

Advanced Diagnosis

Breast cancer diagnosis is determined by the TNM staging system. This system bases the diagnosis on the tumor size, the number of lymph nodes with cancer involvement, and whether or not the cancer cells have spread to other parts of the body. When the stage of the breast cancer diagnosis is high, the tumor is more aggressive and thus women are managed with a more aggressive form of treatment to eradicate the cancer (National Cancer Institute, 2015). An advanced diagnosis generally involves other treatment options, such as a more complicated surgery combined with radiation and chemotherapy (Cole, 2006). A woman with more treatments and procedures at an advanced diagnosis would put her at a higher risk than a woman with an early diagnosis.

In the univariate analysis of one study, a locally advanced cancer when compared to an early breast cancer was found to have a statistically significant risk for lymphedema (Deo et al., 2004). Women with a higher pathologic stage (either stage II or III) had a statistically significant increased risk of developing lymphedema (Kim et al., 2013). Additionally, another study determined that women with stage II cancer had an increase risk of lymphedema by 2.58 fold and women with stage III cancer had an increase risk of lymphedema by 2.84 fold compared to women with a stage I cancer (Park et al., 2008). From the studies in this literature review, it seems that there is a positive correlation with lymphedema and the pathologic staging of cancer.

Body Mass Index

Most studies agreed upon a high BMI correlating with an increased risk of lymphedema (Cole, 2006), but what each study considered a high BMI varied. A few studies determined women in the category of obese, BMI greater than 30, to have a higher risk of lymphedema. One study determined the probability of lymphedema development to be 3 times the risk when obese (Meeske et al., 2009). This same study found overweight women, BMI of 25-29, to have 2 times the risk of lymphedema when compared to women with a normal BMI (Meeske et al., 2009). One study found any BMI greater than 30 to be significant (Ay, Kutun, & Cetin, 2014). While another study observed the same significance with having a BMI greater than 30 (Togawa et al., 2014).

Further studies defined overweight and obesity to have significance in developing complications. This included those with a BMI of greater than 25 (Park et al., 2008). Yet

another study had the same significance regarding a BMI of greater than 25 (Ozaslan & Kuru, 2004). Other multivariate studies stated that there was a significant increase in the risk of lymphedema when BMI was considered (Nesvold et al., 2008). The relationship between weight and lymphedema may be due to hormones located within fat tissue (Keskin et al., 2013). Regardless of the specific BMI the studies have outlined, the end result determines that being overweight or obese increases the risk for lymphedema.

Comorbidities

The comorbidities outlined within this literature review include hypertension (HTN) and diabetes mellitus. The diagnosis of diabetes is a risk factor for lymphedema secondary to breast cancer according to two studies. The first study determined diabetes to be a risk factor due to the daily maintenance of this disease, the blood glucose monitoring (Brennan & Weitz, 1992). The second study grouped diabetes and hypertension together under the canopy of co-morbid conditions but there was statistical significance found to support both as being a risk factor for complications (Deo et al., 2004).

Cole (2006) mentioned that hypertension was a risk factor for lymphedema. One retrospective study of 130 women with breast cancer showed a statistical significance that women with arterial hypertension had an increased risk of developing lymphedema after surgery (Böhler et al., 1992). Another study determined that women with hypertension were twice as likely to develop lymphedema than women with normal blood pressure

(Meeske et al., 2009). Although a few studies have shown statistical significance, further research should be conducted.

Age

There were three studies that found women of a younger age (less than 50 years) to be associated with a higher chance of lymphedema development. In one of the studies, age was the only independent variable for lymphedema formation and it was statistically significant, yet the reason for the high significance may have been due to the tendency for younger women to be more apt to report symptoms (Geller et al., 2003). Another study found that “women diagnosed before the age of 55 were nearly twice as likely to develop lymphedema as those diagnosed at an older age” (Meeske et al., 2009, p. 386). Hack et al. (2010), brought mention to other studies supporting that younger age played a role as a factor for lymphedema development, but did not include this factor in their study as significant.

On the other hand, a single study supported advanced age as a risk factor for lymphedema. It referred to one case study in which an 85 year-old woman developed lymphedema 30 years after her extensive surgery (Brennan & Weitz, 1992). In the article supporting age as a significant factor, the authors have considered the reporting of the data to be a limitation (Geller et al., 2003). Based off of these studies, age, whether advanced or not, has not received extensive research as an independent variable in order to be considered a significant risk factor for the formation of lymphedema.

DISCUSSION

As women are surviving breast cancer after surgery, they have an approximate 40% probability of developing secondary lymphedema and its associated complications (Fu, 2014). Healthcare providers are unaware of the triggers that set off the advancement of lymphedema and must utilize current practices based off of past research. Current prudent practices include avoidance of procedures in the ipsilateral arm and even avoidance of hot tubs (Breastcancer.org, 2015a)

At the time of this literature review, there are clinical trials involved in educating women with breast cancer of the signs and symptoms of lymphedema and lymphedema prophylaxis for women at high risk in the form of new devices (National Cancer Institute, n.d.). These trials outline the need for further research on the cause of lymphedema for education purposes. Once the causes are properly identified, healthcare providers should be better able to assist women with options regarding use or disuse of their ipsilateral arm for procedures. In turn, women may take the necessary precautions to avoid stimulating the process of lymphedema.

The implications of blood pressure measurements and related procedures on the compromised arm have not been studied. Based on the articles reviewed for this thesis, mostly retrospective studies have been conducted on this area due to the possibility of harm to participants. In theory, blood pressure measure taken by a manual cuff may not be as harmful as an automatic blood pressure cuff, due to the fact that an automatic cuff holds inflation longer and at higher pressures than manual measurements (American Cancer Society, 2015).

From the results of this literature review, blood pressure measurements and procedures in the ipsilateral arm post mastectomy as a cause of lymphedema were not supported. On the other hand, having a radical mastectomy, axillary radiation, extensive axillary dissection, having greater than 10 lymph nodes removed, and having a pathologically staged II or III cancer are statistically significant and supported risk factors for developing lymphedema.

LIMITATIONS

Several limitations were noted in this review of the literature. Initial search results revealed numerous findings on keywords lymphedema, breast cancer, mastectomy, blood pressure, infection, risk of lymphedema, women, post-surgical, and axillary node dissection. However, fewer original research articles remained relevant to the purpose of this investigation. Only 22 initial results met inclusion criteria for this review of the literature. Search terms were expanded to include citations from initial articles in order to provide more relevant search results. This limitation may be an indication of the relative absence of specific and interactive causative factors for lymphedema in the ipsilateral arm post-mastectomy; thus, an indication for future research.

Other limitations included lymphedema measured subjectively as opposed to objectively. There was no standard determinant that women based their measurement off of. Measurements were conducted via “self-report” and telephone interviews, not numerical measurements or weights. Furthermore, there were no articles specifically addressing the topic of blood pressure measurements directly causing the onset of secondary lymphedema in the post-surgical woman. According to some, “self-report” may act as an easier clinical tool for healthcare providers to use as opposed to another objective measurement (Geller et al., 2003).

Further limitations may include demographics. The participants in these studies were compliant to treatments and follow up studies. There may be women with lymphedema who are unaccounted for due to not seeking care or reporting symptoms, amongst other reasons.

CONCLUSION

The purpose of this literature review was to determine if blood pressure measurements or invasive procedures had a direct relationship with secondary lymphedema in the post-surgical woman. The results yielded inconclusive findings. The cause for secondary lymphedema is not well known and appears to be multifactorial. Even with the available technology, there is no specific diagnostic test that can determine the cause of secondary lymphedema. The only proposed studies that could determine if blood pressure measurements or invasive procedures had a direct correlation to secondary lymphedema could be unethical. The reason for this would be subjecting the woman to the irreversible harm of an incurable complication.

Secondary lymphedema in the post-surgical woman causes swelling, tightness, and physical disfigurement of the upper extremity. There is no cure for this and symptom management is required daily.

Specifically, research on blood pressure measurements relating to lymphedema is lacking. A manual or an automatic blood pressure cuff might be inflated to such a high amount that it could cause pressure to the small vessels within the ipsilateral arm. When an axilla has been compromised with surgery and lymph node removal, there is resulting damage to the microvasculature of the arm, which may lead to the formation of lymphedema when pressure is applied. Finally, the compiled results of this review of the literature showed no evidence of blood pressure measurements or other procedures performed in the ipsilateral arm post-mastectomy; therefore, neither supporting nor negating the cause of secondary lymphedema by blood pressure measurement.

Furthermore, there is insufficient evidence to suggest that procedures involving the ipsilateral arm after axillary node dissection will have any effect on the risk of lymphedema. A prospective, randomized double blind study has yet to be conducted to determine if procedures on the ipsilateral arm after axillary node dissections cause secondary lymphedema. A prototype study and further research into causes of upper extremity lymphedema in post mastectomy women has not been conducted. Partly, this lack of evidence is attributable to past observations, which have alluded to a potential connection between invasive and non-invasive procedures and lymphedema (Cole, 2006). Nonetheless, the risk of lymphedema is multi-factorial in nature even when modifiable risk factors have been minimized.

Further research should focus on long-term and intricate retrospective studies to determine factors associated with lymphedema. Invasive procedures should continue to be studied. There is also a need to determine whether inflation pressures are significant when comparing an automatic cuff verses a manual blood pressure cuff to the risk of lymphedema. Furthermore, weight reduction and hypertension may contribute to an increased risk of lymphedema development and further studies should be conducted to determine any significance.

NURSING IMPLICATIONS

In the field of nursing, this review of the literature should serve as a reminder to ask women if they have ever had surgery for breast cancer or if they have ever had axillary lymph nodes removed. Some studies have shown that not all women have been educated on the risks of lymphedema post operatively. As advocates for women, nurses have the ability to educate and reinforce the education of preventative measures by assisting women to find reliable resources and to ask their physicians about preventative measures.

Since causative factors of secondary lymphedema have not been perfectly identified, nurses and other healthcare providers should follow the current preventative guidelines determined by the American Cancer Society (2015).

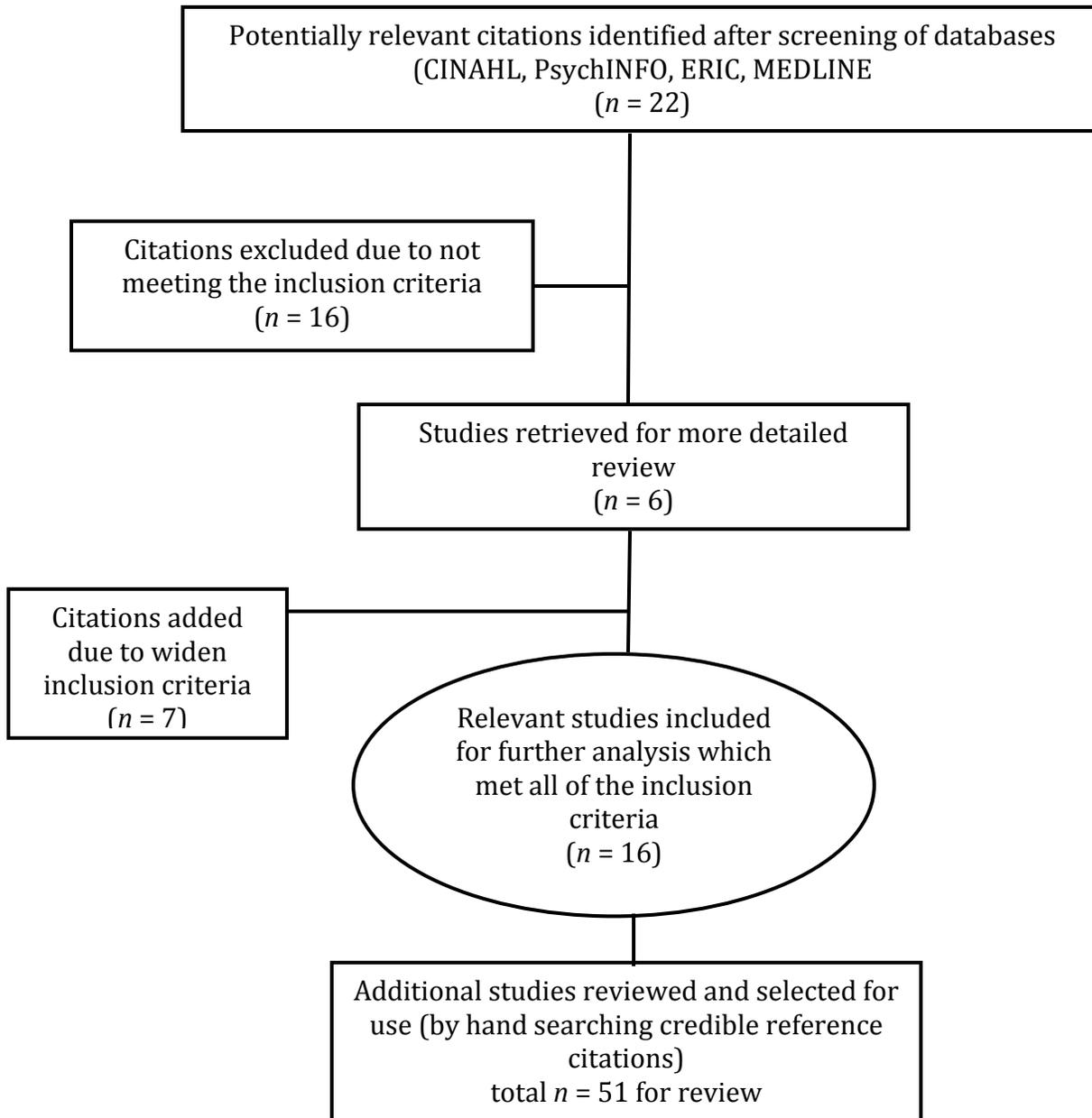
Appendix A: Figures

Figure 1: Consort Diagram

Key Search Terms = Breast cancer/Lymphedema*/Blood pressure

Exclusions: Men

Limiters = English language, humans, peer-reviewed



Appendix B: Tables

Table 3: Table of Evidence

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|---|---|--|---|--|---|
| <p>Ay, A. A., Kutun, S., & Cetin, A. (2014). Lymphoedema after mastectomy for breast cancer: importance of supportive care. <i>South African Journal Of Surgery. Suid-Afrikaanse Tydskrif Vir Chirurgie</i>, 52(2), 41-44. doi: 10.7196/sajs.1908</p> | <p>Retrospective 1995- 2010 Ankara Oncology Research and Training Hospital, Turkey</p> | <p>N: 5064 Stage II and III disease Modified Radical Mastectomy Level I, II, III axillary dissection</p> | <p>To examine the effects of supportive therapy such as rehabilitation and medical and physical treatment on the development of lymphedema, in an attempt to establish non-surgical ways to help prevent or reduce it.</p> | <p>BMI: 30-34.9 Chemotherapy Unemployed</p> | <p>This study suggests walking and engaging in physical therapy reduce the risk of lymphedema.</p> | <p>Prevention of lymphedema is the best way to avoid it. Suggest educating patients on postoperative physical therapy and rehabilitation facilities.</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|--------------------------|--|--|---------------------------------|--|---|
| <p>Bennett Britton, T. M., Wallace, S. M. L., Wilkinson, I. B., Mortimer, P. S., Peters, A. M., & Purushotham, A. D. (2009). Sympathetic nerve damage as a potential cause of lymphoedema after axillary dissection for breast cancer. <i>The British Journal Of Surgery</i>, 96(8), 865-869. doi: 10.1002/bjs.6660</p> | <p>Prospective Study</p> | <p>N: 36 Axillary Lymph Node Dissection</p> | <p>The purpose of this study was to determine if breast cancer related lymphedema was related to damage of the sympathetic nervous system.</p> | <p>Axillary Node dissection</p> | <p>Damage to the sympathetic nervous system does not contribute to breast cancer related lymphedema.</p> | <p>Suggests that pre-operative measure of forearm vascular resistance could be a potential measure to predict breast cancer related lymphedema.</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|--|---|--|---|---|--|--|
| Brennan, M. J., & Weitz, J. (1992). Lymphedema 30 years after radical mastectomy. <i>American Journal Of Physical Medicine & Rehabilitation / Association Of Academic Physiatrists</i> , 71(1), 12-14. | Case Report 1992 Memorial Sloan-Kettering Cancer Center, New York, New York | N: 1 Post Left Radical Mastectomy 30 years prior to report Previous chest wall resection External radiation | The purpose of this case report was to highlight efforts to prevent the development of edema. | Axillary Node Resection – Level 3 External Radiation Advanced age Invasive procedure (finger sticks) Diabetes | This report suspects this patient’s edema was the result of physician prescribed finger sticks in an extremity that should have been considered inviolate to trauma. | Patients at risk for lymphedema should follow precautions to prevent the development of edema. |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|--------------------------|-------------|--|---|--|---|
| <p>Cole, T. (2006). Risks and benefits of needle use in patients after axillary node surgery. <i>British Journal Of Nursing (Mark Allen Publishing)</i>, 15(18), 969.</p> | <p>Literature Review</p> | <p>None</p> | <p>This article discusses the current evidence available on the subject of non-accidental skin puncture (NASP) relating to the patient at risk of lymphedema and provides guidelines for any professionals conducting such procedures for patients with a history of cancer.</p> | <p>BMI Lymphedema often occurs within 3 years after surgery. Hypertension Advanced disease Extensive axillary surgery Axillary radiation</p> | <p>There is a need for further research on the risk of non-accidental skin puncture (NASP) procedures triggering lymphedema. Identifies need for a large multi-centered, long-term prospective study.</p> | <p>Raise awareness for the risk of any patient undergoing axillary node surgery. Determines the need for previous guidelines based on expert opinion to be based on research-based evidence.</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|--|---|---|--|---|--|
| Deo, S. V. S., Ray, S., Rath, G. K., Shukla, N. K., Kar, M., Asthana, S., & Raina, V. (2004). Prevalence and risk factors for development of lymphedema following breast cancer treatment. <i>Indian Journal Of Cancer, 41</i> (1), 8-12. | Retrospective Analysis December 1998 to March 2000 Institute Rotary Cancer Hospital, All India Institute of Medical sciences | N: 300 Breast cancer treatment prior to 1997 | This study was conducted to evaluate the prevalence and risk factors for development of lymphedema. | Radiation Mastectomy Advanced dx Diabetes Hypertension | Since there is no ideal treatment available for established lymphedema future efforts should be focused on optimizing treatment combinations, evolving minimally invasive methods like sentinel node biopsy for staging axilla. | Women should avoid axillary dissection in combination with radiation if possible. Lymphedema continues to be a long term morbidity. |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|--|--|---------------|---|---|---|---|
| <p>Geller, B. M., Vacek, P. M., O'Brien, P., & Secker-Walker, R. H. (2003). Factors associated with arm swelling after breast cancer surgery. <i>Journal of Women's Health (15409996)</i>, 12(9), 921-930. doi: 10.1089/154099903770948159</p> | <p>Telephone interview 1996-1997 Random selection from the Vermont Breast Cancer Surveillance System</p> | <p>N: 145</p> | <p>The purpose of this study was to report the incidence of arm/hand swelling after invasive breast cancer in women and related risk factors.</p> | <p>Hypertension Young age (< 50 years) Chemotherapy Axillary node dissection</p> | <p>38% of women in this study stated increased swelling after invasive surgery.</p> | <p>Weight loss may benefit by decreasing the risk of swelling. Treating hypertension in post-surgical women should be further studied to decrease risk of lymphedema.</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|--|--|--|--|---|---|---|
| Hack, T. F., Kwan, W. B., Thomas-Maclean, R. L., Towers, A., Miedema, B., Tilley, A., & Chateau, D. (2010). Predictors of arm morbidity following breast cancer surgery. <i>Psycho-Oncology</i> , 19(11), 1205-1212. doi: 10.1002/pon.1685 | National, Multisite study Surrey, Canada; Montreal, Canada; Winnipeg, Canada; and Fredericton, Canada | N: 316 Unilateral breast cancer | The purpose of this study was to examine demographic, disease, and treatment-related predictors of a comprehensive array of chronic arm morbidity (pain, lymphedema, functional disability, and range of motion) post-breast cancer surgery. | Higher BMI Mastectomy (more extensive breast surgery) Younger age HTN Radiation >5 lymph nodes removed Axillary lymph node dissection | Women may benefit from more detailed pre- and post-surgical teaching about the nature of arm morbidity, its risks and consequences to minimize the severity and impact of symptoms that do develop. | In this study, significant arm morbidity in women was assessed between 6–12 months after breast cancer surgery. |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|---|----------------|--|--|--|---|
| <p>Keskin, O., Aksoy, S., Babacan, T., Sarici, F., Kertmen, N., Solak, M., . . . Altundag, K. (2013). Impact of the obesity on lymph node status in operable breast cancer patients. <i>Journal Of B.U.ON.: Official Journal Of The Balkan Union Of Oncology, 18</i>(4), 824-830.</p> | <p>Retrospective cohort study</p> <p>Department of Medical Oncology of Hacettepe University Cancer Institute</p> <p>2001-2011</p> | <p>N: 1295</p> | <p>The purpose of this study was to examine the relationship between axillary lymph node status and obesity.</p> | <p>BMI > 30</p> <p>Axillary lymph node dissection</p> | <p>There was a statistically significant relationship between obesity and the number of lymph nodes involved.</p> <p>This may be due to increased estrogen in obese women.</p> | <p>Further studies are needed to determine a relationship between obesity and lymph node involvement.</p> <p>Results may lead to weight loss interventions.</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|---|---------------|--|--|---|---|
| <p>Kim, M., Kim, S. W., Lee, S. U., Lee, N. K., Jung, S.-Y., Kim, T. H., . . . Shin, K. H. (2013). A model to estimate the risk of breast cancer-related lymphedema: combinations of treatment-related factors of the number of dissected axillary nodes, adjuvant chemotherapy, and radiation therapy. <i>International Journal Of Radiation Oncology, Biology, Physics</i>, 86(3), 498-503. doi: 10.1016/j.ijrobp.2013.02.018</p> | <p>Prospective Study 2004-2009 5 year study National Cancer Center, Korea</p> | <p>N: 772</p> | <p>The purpose of this article was the estimate the risk of lymphedema based on treatment related factors.</p> | <p>Radiation therapy Chemotherapy Axillary lymph node dissection</p> | <p>More risk factors correlated to an increased risk of Lymphedema development.</p> | <p>A simple model may help clinicians determine women's risk for lymphedema</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|---|---|---|--|--|---|
| Meeske, K. A., Sullivan-Halley, J., Smith, A. W., McTiernan, A., Baumgartner, K. B., Harlan, L. C., & Bernstein, L. (2009). Risk factors for arm lymphedema following breast cancer diagnosis in Black women and White women. <i>Breast Cancer Research And Treatment, 113</i> (2), 383-391. doi: 10.1007/s10549-008-9940-5 | Case-control study of invasive breast cancer Los Angeles County Cancer Surveillance Program Baseline interview Face-to-face interview Telephone Interview | N: 494 Black, Latina and non-Latina women In-situ to Stage III-A breast cancer Diagnosis between 1995-1998 | This study examines pre-disposing factors that may operate in conjunction with treatment-related factors in the development of arm lymphedema in a large cohort of White and Black breast cancer survivors. | <u>Univariable Model:</u> BMI: >30 Hypertension History of Oral contraceptive use Younger Age (<55 years) Axillary Surgery and number of lymph nodes removed Chemotherapy <u>Multivariable Model:</u> BMI >30 Hypertension More lymph nodes excised Younger Age (<55 years) | Hypertension and obesity are two key areas for risk reduction. Age as a factor needs further research. One of four breast cancer survivors developed arm lymphedema in this study. | Interventions for reducing lymphedema include weight loss, control of blood pressure, and use of sentinel lymph node biopsy when possible |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|--|------------------------------|---|---|--|---|--|
| <p>Nesvold, I.-L., Dahl, A. A., Løkkevik, E., Marit Mengshoel, A., & Fosså, S. D. (2008). Arm and shoulder morbidity in breast cancer patients after breast-conserving therapy versus mastectomy. <i>Acta Oncologica (Stockholm, Sweden)</i>, 47(5), 835-842. doi: 10.1080/02841860801961257</p> | <p>Multivariate analysis</p> | <p>N: 263 The Norwegian Radium Hospital Stage II Breast Cancer Between 1198-2002</p> | <p>The purpose of this study was to compare the prevalence of arm and shoulder morbidity in women with stage II breast cancer who had undergone radical modified mastectomy or breast conservation therapy.</p> | <p>Radical Mastectomy Increased number of metastatic lymph nodes BMI</p> | <p>20% of women with radical mastectomy developed lymphedema compared to 8% of women who had breast-conserving therapy. Lymphedema was associated with radical mas</p> | <p>Breast conserving therapy should be encouraged when it is appropriate to decrease risk of developing lymphedema</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|--|--|---------------|--|---|--|--|
| <p>Ozaslan, C., & Kuru, B. (2004). Lymphedema after treatment of breast cancer. <i>American Journal Of Surgery</i>, 187(1), 69-72.</p> | <p>Analysis 1998 - 2000 Ankara Oncology Hospital</p> | <p>N: 240</p> | <p>The purpose of this study was to determine risk factors that were predicted to effect lymphedema development after surgery.</p> | <p>Axillary Radiation BMI > 25</p> | <p>Lymphedema was found in 28% of participants in this study. Women with full axillary lymph node dissection and axillary radiation are at increased risk for lymphedema.</p> | <p>Women must be informed during the follow-up period about BMI > 25 and the increased incidence of lymphedema.</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|--|---|------------|--|--|--|---|
| Park, J. H., Lee, W. H., & Chung, H. S. (2008). Incidence and risk factors of breast cancer lymphoedema. <i>Journal Of Clinical Nursing, 17</i> (11), 1450-1459. doi: 10.1111/j.1365-2702.2007.02187.x | Retrospective study Seoul, Korea 2004- 2005 | N: 450 | The purpose of this study is to determine the incidence of lymphedema and identify risk factors. | BMI > 25 Axillary lymph node dissection Axillary radiation | Axillary lymph node dissection is an independent risk factor for lymphedema development. | It is important to determine the risk for lymphedema in order to apply preventative measures. |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|---|--|---|--|--|--|---|
| <p>Pillai, P. R., Sharma, S., Ahmed, S. Z., & Vijaykumar, D. K. (2010). Study of incidence of lymphedema in Indian patients undergoing axillary dissection for breast cancer. <i>Indian Journal Of Surgical Oncology</i>, 1(3), 263-269. doi: 10.1007/s13193-011-0046-x</p> | <p>Multivariate analysis</p> <p>Followed up for at least 12 months</p> | <p>N: 231</p> <p>Department of Surgical Oncology at Cancer Institute, Amrita Institute of Medical Sciences, Cochin</p> <p>India</p> | <p>The purpose of this study is to determine the incidence of lymphedema in a hospital population.</p> | <p>Axillary irradiation</p> <p>Pathological nodal status of 3 (pN3).</p> | <p>The risk of lymphedema presents throughout the lifetime.</p> <p>Approximately 10% of women developed significant lymphedema.</p> <p>Clinically significant lymphedema was any symptomatic lymphedema, moderate or severe.</p> | <p>Although there is no known method to prevent lymphedema, prevention by means of arm care post surgery, exercise, and massage therapy may help reduce the severity of lymphedema.</p> |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|--|---|---|---|--|---|--|
| Togawa, K., Ma, H., Sullivan-Halley, J., Neuhausser, M. L., Imayama, I., Baumgartner, K. B., . . . Bernstein, L. (2014). Risk factors for self-reported arm lymphedema among female breast cancer survivors: a prospective cohort study. <i>Breast Cancer Research: BCR</i> , 16(4), 414-414. doi: 10.1186/s13058-014-0414-x | Analytic cohort Prospective cohort study Data was used from a previously published HEAL study | N: 666 Hispanic white, non-Hispanic white, and black women | The purpose of this study was to assess incidence of lymphedema across 3 racial/ethnic groups and determine incidence | BMI Hypertension Increased number of lymph nodes removed | No significant difference in lymphedema was determined in the 3 ethnic/racial groups. Women with a higher BMI pre breast cancer diagnosis have a higher risk of lymphedema. Association between anti-hypertensive medications and lymphedema should be clarified in future studies. | Provide education and information early on in women with high risk. High risk includes women with extensive surgery, increased lymph nodes removed, and women who were obese prior to treatment. Clinical trials are needed to determine if treatment for hypertension and obesity may decrease severity or onset of lymphedema in |

| Article | Design | Population | Purpose | Significant Risk Factors | Key Findings | Nursing Implications |
|----------------|---------------|-------------------|----------------|---------------------------------|---------------------|-----------------------------|
| Continued | | | | | | post operative women. |

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