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Impact of hand lymphedema on pain and grip strength of the hand in women with breast cancer

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Abstract---Background: It is not clear to what extent signs and symptoms other than arm swelling, including pain, grip strength differ between women with hand lymphedema and without hand lymphedema in breast cancer-related lymphedema (BCRL) Aim of Study: To estimate the extent to which the impairments associated with hand lymphedema on pain and grip strength in women with breast cancer related lymphedema (BCRL) and to see the association between severity of hand edema and each of independent variables (pain and hand grip strength)Methods: sixty women experiencing lymphedema after breast surgery participated in this study. They were recruited from Kasr Al-ainy , between 40: 60 years old were assigned into two equal groups, group (A) women with hand edema (HE+, n = 30) and without hand edema (HE-, n = 30) after breast cancer treatment .Pain and grip strength were evaluated Results: inter group difference showed that there is a there was significant difference in pain difference between the group A and group B (p = 0.04)And there was a significant increase in median value of strength difference of the group A compared with that of group B (p = 0.001). And intra group difference showed that there was no significant correlation between severity of hand lymphedema and pain intensity (p = 0.228). And there was no significant correlation between severity of hand lymphedema and hand grip strength (p=0.938), using Mann-Whitney U-test

between the two groups and Pearson correlation coefficients used to determine the association between the severity of hand edema and each of independent variables. Conclusion: Limbs affected by lymphedema are found to be weaker in handgrip strength and this weakness continued throughout the therapy and severity of edema and increased edema volume is not linked to increased symptoms of hand lymphedema like in pain and hand grip strength.

Keywords---Breast cancer related lymphedema, grip strength, pain, hand edema.

Introduction

Breast cancer-related lymphedema (BCRL) is a debilitating condition affecting nearly one in five women treated for breast cancer (BC). The cause for BCRL is an injury to lymphatic channels preventing adequate fluid drainage and resulting in swelling in the upper extremity, trunk, or breast on the side of the BC treatment (1).

Such a complication is characterized by the accumulation of interstitial fluid and tissue alterations due to insufficient lymph drainage (2). Usually, it develops gradually, and the swelling can range from mild to severe. Removal of axillary lymph nodes is the primary risk factor for (BCRL) which can increase significantly when it is followed by postoperative radiation therapy (3).

During surgery, axillary lymph nodes are removed for staging, local disease control, and determining adjuvant treatment. Axillary surgery type largely determines an individual's risk for developing lymphedema. Both ALND and the less invasive sentinel lymph node biopsy (SLNB) put patients at life-long risk for developing lymphedema due to the removal of either many axillary, in the case of ALND, or few sentinels, in the case of SLNB, lymph nodes. A recent meta-analysis of BCRL incidence in patients with unilateral breast cancer estimated that patients who receive ALND have a lymphedema incidence four times higher than those who receive SLNB [19.9% (95% CI: 13.5–28.2) and 5.6% respectively (4).

The clinical diagnosis of lymphedema is typically based on measurements of arm circumference or volume. Measuring circumference with a tape measure is the most frequently used technique in clinical practice (5). An alternative for measuring hand swelling is the figure-of-eight method (6)

Hand swelling is present in 60–70% of upper extremity lymphedema cases following breast cancer treatment. It can negatively affect sensation, strength, daily activities, and functional mobility (7). However, there is insufficient research related to the evaluation of hand function in upper-extremity lymphedema.

With hand edema, excess fluids accumulate and expand the subcutaneous tissues till reaching their maximum capacity, tissue spaces that are necessary for

free movement of the joints and muscle action become full of fluid that leads to reduction of joint mobility and inefficient muscular force production (8).

Although lymphedema can physically impair arm function by limiting the range of motion, as well as causing feelings of pain, heaviness, and numbness in the upper extremity (9). There is mixed evidence regarding whether the impact of lymphedema on patients' pain and heaviness which could affect the quality of life is due to arm swelling versus arm symptoms.(10) the improvement in patient pain and quality of life following complete decongestive therapy was unrelated to actual volume decrease in the affected arm in breast cancer survivors with lymphedema.(11)

Previous studies have shown that certain signs and symptoms in the upper limb region may be related to other conditions besides BCRL. In particular, pain, may be secondary to damage of the intercostal brachial and thoracodorsal nerves during breast cancer treatments, such as surgery, chemotherapy, and/or radiotherapy. (12)

Pain associated with lymphedema is due to the stretching of tissue to accommodate the build-up of lymph fluid. As fluid increases, the arm can become visibly swollen, heavy, stiff, tight, achy, and weak. These symptoms can range from a mild and sometimes vague "awareness" of discomfort to severe pain which is correlated with the degree of upper extremity motor function and handgrip power. hand weakness associated with lymphedema is due to the tourniquet effect created by swelling in the hand on tendons and nerves of the hand which over time decrease blood supply and lead to signs and symptoms of nerves compression and muscles weakness within the hand (13).

Limitations in shoulder motion may cause patients to hyperextend the wrist during basic activities such as door opening. Repetitive hyperextension of the wrist as compensation may stress the extensor tendons and ultimately lead to lateral epicondylitis which causes further weakness of hand muscles (14). So this study was conducted to assess the impact of hand lymphedema on pain and hand grip strength_and to know the impact of severity of hand lymphedema on each of them

Methodology

Study design

This study was a cross-sectional prospective study. This study was performed between MAY2021 and JULY 2021

Subjects: This study included 60 women with lymphedema after breast cancer treatment. The inclusion criteria were as follows: (a) All patients had completed breast cancer therapy (surgery, radiotherapy, or chemotherapy) at least 3 months before the beginning of the study, (b) all patient had signed consent form, (c) unilateral lymphedema ranging from mild to severe, and (d) willingness and ability to participate in the study. Meanwhile, the exclusion criteria were as follows: previous contralateral breast disease, cancer recurrence, disorders related to muscles or joints, severe axillary pain, and conditions that would make

participation difficult (e.g., dementia). All patients had lymphedema of the arm following treatment for breast cancer. The patients were divided into two groups according to the presence of hand edema: GROUP (A): 30 patients with hand edema (HE+ group) and GROUP (B): 30 patients without hand edema (HE- group). All measurements were made during one session lasting approximately 120 minutes. The lymphedema severity of the arms was assessed, and pain, hand grip strength and hand size were evaluated for both hands. Before testing, a complete medical history was obtained from each patient, including demographic information (i.e., age, sex, height, weight, body mass index [BMI], profession, dominant hand, and affected hand) and disease characteristics (i.e., type and side of the operation, number of excised axillary lymph nodes, number of tumors and positive lymph nodes, radiotherapy technique used, adjuvant systemic treatment, lymphedema duration, and previous infection episodes). Edema of the arm was assessed by circumference measurements taken with a standard 1-inch retractable fiberglass tape measure. For the arm circumference measurements, patients were in a supine position with their arms relaxed by their sides and elbows straight. Arm circumference was measured at 5-cm intervals beginning at the third phalanx nail fold and continuing 45 cm proximally. Both arms were assessed, and all measurements were recorded in centimeters. The severity of lymphedema was classified according to a modified version of the criteria described by the American Physical Therapy Association: circumference differences between arms 3, 3–5, and >5 cm was classed as mild, moderate, and severe lymphedema, respectively. (12). A standard 0.25-inch-wide retractable fiberglass tape measure was used to perform figure-of-eight measurements of hand size (12). The testing position required the patient to sit with their arms abducted and externally rotated 90°, elbow flexed 90°, wrist neutral, fingers adducted and extended, and thumb abducted in the plane of the hand. Each hand was measured twice. The same procedure was repeated for the other hand. All measurements were recorded in centimeters (± 0.1 cm, Fig. 1).



Figure 1) Figure-of-eight tape measure method for measuring hand size
(A) Nonaffected hand, (B) Affected hand

And pain assessment by A 100-mm visual analog scale (VAS) was used to determine the severity of pain in the hand. Patients quantified their pain sensation on VAS rating on a scale ranging from 0 to 10, with 0 being none and 10 being most severe. The severity of pain was categorized into three severity groups based on baseline scores (mild: < 4, moderate: 4–6, and severe: > 6). (15).

Hand grip strength was assessed by Jamar Hydraulic Hand Dynamometer to assess gross grasp following the American Society of Hand Therapists guidelines. The dynamometer was set at the hand position setting throughout the test. The patient instructed to press against the device as much as possible. The peak force from each trial was recorded. The three peak forces were averaged to obtain an average maximum force and compared to the other side for each subject



Figure (2): Standard hand positioning for the instrumented digital dynamometer

Statistical analysis

Descriptive statistics and unpaired t-test were conducted for comparison of the subjects' characteristics between groups. Unpaired t-test was conducted for comparison duration of lymphedema and number of nodes removed between groups. Chi squared test was conducted for comparison of lymphedema grade, affected side and dominant side distribution between groups. Mann-Whitney U-test was conducted for comparison of hand size, pain difference, ROM difference strength difference and kinesthetic sense between groups. Wilcoxon signed-rank test was conducted for comparison of kinesthetic sense score between the affected and non-affected sides in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical measures were performed through the statistical package for social studies (SPSS) version 25 for windows.

Results

The result of the study showed that there was significant difference in pain difference between the group A and group B ($p = 0.04$). There was a significant

increase in median value of strength difference of the group A compared with that of group B ($p = 0.001$). Pearson correlation coefficients used to determine the association between the severity of hand edema and each of independent variables revealed that there was no significant correlation between severity of hand lymphedema and pain intensity ($r = 0.231$) ($P = 0.228$) and also revealed that there was no significant correlation between severity of hand lymphedema and hand grip strength ($r = -0.015$) ($P = 0.938$).

Table (1)

Comparison of median values of pain and strength difference between the group A and B

	Median (IQR)		U-value	p-value	Sig
	Group A	Group B			
Pain difference	4 (5.5-1)	2 (4-1)	291.5	0.04	S
	Median (IQR)		U-value	p-value	Sig
	Group A	Group B			
Strength difference	6 (7.75-3.25)	3.5 (5-1.75)	208.5	0.001	S

Table (2)

Pearson correlations between severity of hand lymphedema and independent variables of interest

Pearson correlations between severity of hand lymphedema and the independent variables of interest		
Independent variables	Spearman correlation	P value
Pain intensity	0.231	0.228
Strength difference	-0.015	0.938

Discussion

The aim of the study was designed to evaluate the impact of hand lymphedema on functional mobility, grip strength and kinesthetic sense of hand in women with BCRL and correlation between edema severity and pain, grip strength, functional mobility (hand ROM) and kinesthetic sense.

With this study, it was observed that Inter group difference showed that there is a significant difference between group A and group B in the impact of hand lymphedema on whichever hand pain and grip strength and Intra group difference showed that no association between severity of hand lymphedema on pain and on grip strength .firstly, for pain our result show that there was significant relation between hand edema and hand pain .In line with my result (16) Baran et al., 2021 Their findings suggest that women with lymphedema more frequently report pain and demonstrate bilateral impairments in shoulder range of motion, greater restrictions in upper limb activities and upper limb strength, and sensory disturbances compared to women without lymphedema (17)(18) Terada et al.,2020, De Groef et al.,2018 Their findings suggest that patients with self-reported BCRL, regardless of whether they have objective BCRL or not, have pain,

sensory, and perceptual alterations and limitations in daily functioning that may require intervention (19) Giray&Akyüz,2019 said that statistically significant positive correlations were found between The Disabilities of the Arm, Shoulder and Hand (*DASH*) questionnaire scores and lymphedema stage, edema, Visual analogue scale (VAS) for pain, visual analogue scale (VAS) for tension and heaviness, European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLO-30) symptom, function, and general health scores (20) Fu et al., 2015 found the common report of pain and other sensory symptoms, for example paresthesia, aching, numbness, tingling and tenderness in people with upper limb lymphedema. Included studies investigating differences in pain and sensory changes in people with and without upper limb lymphedema found were more frequent in the upper limb lymphedema group than in the non-upper limb lymphedema group.

(21) Hormes et al., 2010 Pain in hand or arm on the side treated for breast cancer was the most strongly associated individual symptom in the full cohort, regardless of lymphedema diagnosis. The importance of pain was reinforced by the fact that pain assessed in other ways (yes/no and severity scale) was also associated with poorer quality of life. Other individual symptoms correlated with worse quality of life included measures of functioning, such as difficulty writing and inability to wear rings, as well as heaviness in one arm or hand and changes in skin texture and appearance. He also said that pain in hand or arm on one side” was the most strongly associated with quality-of-life outcomes, correlating significantly with 16 of the 20 measures administered. Having “rings too tight on one side” and experiencing “difficulty writing” each correlated significantly with 12 of the 20 quality of life measures. and second for hand grip strength our result show that there was significant relation between hand lymphedema and hand grip strength.in line with my result (22) Mistry et al., 2020 said that reduction in the power grip and precision grip strengths in women with breast cancer related could be due to swelling in hand and wrist which in turn leads to decreased wrist and finger range of motion (ROM) and reduction of initiation of wrist extension and finger flexion.

(23) Baklaci et al., 2020 found that Patients who underwent sentinel node biopsy (SLNB) were tested for their handgrip strength before and after the first year of surgery, and it was reported that they had a significant decline during this period. The handgrip measurements before the therapy showed that the unaffected arm was stronger than the one with lymphedema ($p < 0.01$) and demonstrated that 13% of the patients had an impaired handgrip strength one year after sentinel node biopsy (SLNB). When taking into account handgrip strength before surgery, 8% had a decrease of 6.5 kg or more. And results showed a significant reduction of 2.5 kg ($p < 0.01$) one year after the sentinel node biopsy (SNLB). (24) De Groef et al.,2017 found that range of motion and handgrip strength were negatively correlated with upper limb function, indicating a higher range of motion and better strength is associated with lower scores on the disabilities of the arm, shoulder and hand (*DASH*) questionnaire (i.e., better upper limb function). (25) Smoot et al., 2010 found that the affected side had less strength in elbow flexion, wrist flexion, and 2 of the 3 grip tests, which resulted in an overall decrease in hand strength compared to the unaffected side. and this could be attributed to Clinical guidelines for breast cancer related lymphedema suggest that women

should minimize daily physical activity and restrict vigorous exercise as it may intensify lymphedema.(26) Basha et al.,2022 This suggestion, therefore, induces diminished physical activity and functional decline, and decreased range of motion (ROM), muscle strength, and quality of life (QoL).on the other hand.(27) Gomes et al.,2014 said that handgrip strength in women with presence or absence of lymphedema was similar. The time after surgery may have been decisive for the results of this study and this contradiction could be explained by the duration difference after surgery as he reseated only 6 months after surgery

Conclusion

Limbs affected by lymphedema are found to be weaker in handgrip strength and this weakness continued throughout the therapy and severity of edema and increased edema volume is not linked to increased symptoms of hand lymphedema like in pain and hand grip strength

Conflict of interest

There is no conflict of interest.

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