ORIGINAL ARTICLE

CONTENTS

Rehabilitation in women after mastectomy: Clinical aspects

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ABSTRACT

Aim: To assess the efficacy of comprehensive physiotherapy in women after mastectomy.

The paper attempts to answer the following research questions:

1. How does physiotherapy influence the size of oedema?
2. What is the correlation between physiotherapy outcomes and sociodemographic factors?
3. What is the correlation between physiotherapy outcomes and the following: BMI, time from procedure, time to the development of oedema after procedure, type of management after surgery.

Materials and Methods: A total of 32 female patients after unilateral mastectomy performed at the Holy Cross Cancer Center in Kielce underwent treatment in this study. The mean age of study patients was 68.5 years. The duration of lymphoedema rehabilitation was 2 to 4 weeks (3.6 weeks on average). Almost three-fourths (71.9%) of the patients were treated for 4 weeks. The physiotherapy included respiratory exercises, kinesiotherapy, lymphatic massage, pneumatic massage, and whirlpool baths.

Results: Significantly lower arm circumference values were achieved in the affected limb after physiotherapy as compared to the pre-treatment values.

Conclusions: 1. Breast cancer is a difficult clinical and social problem in Poland and globally.2. Implementation of an appropriate physical therapy program both before and after surgery determines the reduction of lymphedema in women undergoing surgery.

KEY WORDS: breast cancer, lymphoedema, physiotherapy

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INTRODUCTION

Globally, breast cancer is the most frequently diagnosed malignancy in women, accounting for approximately 23% of all cancer cases and being responsible for approximately 14% of the deaths. Annually, it is diagnosed in 2.3 million women globally and leads to approximately 670,000 deaths. In Poland, there are 22,000 new breast cancer cases every year. The majority of cases are diagnosed at an early stage based on a clinical examination, mammography, microscopic examination, and MRI (Fig. 1) [1-8].

Breast cancer spreads through the lymph and blood vessels. Metastases spreading through the lymphatic system first involve the regional (axillary and parasternal) lymph nodes. Interpectoral (Rotter's) lymph nodes also play an important role in this process. Spread through blood vessels leads to metastases found in almost all organs. The most common metastases include distant metastases to the bones, liver, lungs, pleura, and central nervous system [6-12].

The breast cancer incidence in Poland is alarmingly high and constitutes a serious social problem. A radical surgical procedure consisting in the removal of the breast together with the lymph nodes of the axillary fossa (lymphadenectomy) on the side of the amputated breast is one of the treatment methods used in breast cancer. These surgeries may cause short-term complications: local wound infection, skin flap necrosis, wound dehiscence, haematoma, or chylothorax. In turn, long-term complications include hyperaesthesia and paraesthesia within the area of the operated skin, neuropathies, hypertrophic surgical scar, fibrosis and contractures that limit shoulder joint mobility, atrophy of certain muscle groups, permanent shoulder girdle joint deformities, postural defects, and lymphoedema of the upper limb [4-12].

Lymphoedema is an accumulation of protein-rich fluid in the tissue space and lymph vessels. This fluid contains migrating and sedentary immune cells, metabolic products, endothelial cells, and other substances. This

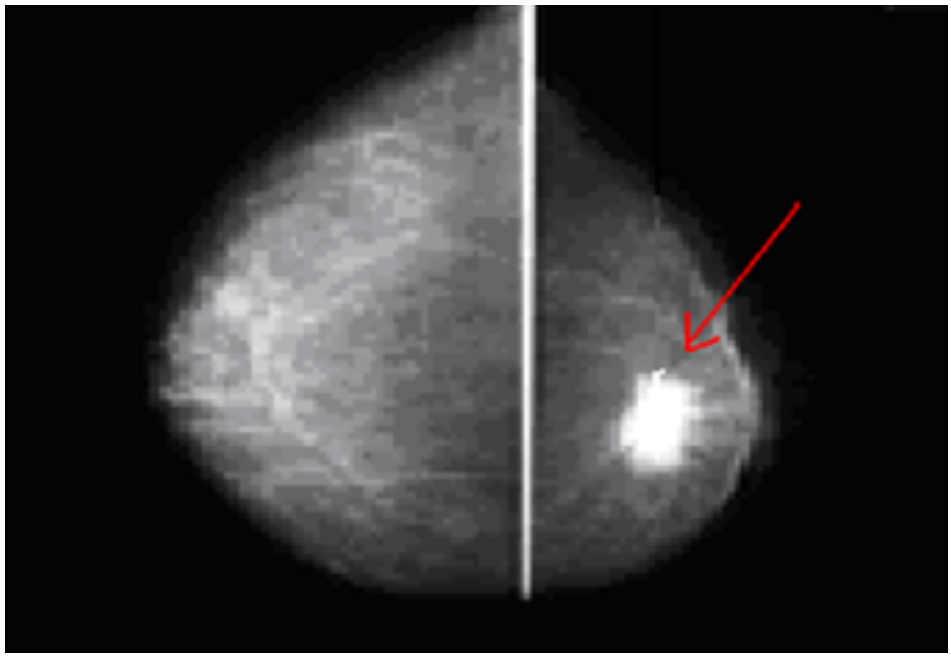

Fig. 1. Breast cancer on a mammogram
Source: Own materials

excess storage results in progressive tissue fibrosis: proliferation of keratinocytes and fibroblasts and collagen accumulation. Impaired lymph circulation contributes to the growth of skin-penetrating microorganisms and the development of inflammatory processes [5-12].

Breast cancer treatment results in an increased upper limb volume and sometimes causes considerable upper limb deformity. The limb becomes heavier, the patient develops limited joint mobility, impaired blood supply, and sometimes also neurological damage. All these changes result in an increased susceptibility to skin injuries, increased lymph infiltration, and a higher risk of complications in the form of secondary infections.

Oedema develops in one in four breast cancer patients after surgery and in one in three breast cancer patients who underwent radiation therapy after surgery, at different time points after treatment completion.

Treatment of lymphoedema consists in preventing complications and reducing limb circumference. Manual lymphatic massage is the most important therapeutic tool [8-16].

Maintaining a high quality of life in women after breast cancer treatment largely depends on an early rehabilitation programme. In order to fully restore their physical function and mental balance, patients need to systematically perform motor exercises and follow the recommendations for the activities of daily living [16-25].

Main aims of rehabilitation:

- increase the range of motion in the shoulder joint on the operated side,
- increase muscle strength of the upper limb on the operated side,
- prevent lymph retention in the limb and the area of the surgical procedure and help develop collateral circulation,
- eliminate oedema through the use of special exercises and physiotherapy procedures,
- correct postural defects that develop as a consequence of breast amputation,
- help with optimal adaptation to modified living conditions.

The first stage of rehabilitation starts before surgery. The aim of rehabilitation in this period is to prepare the patient physically and mentally for the procedure and to prevent short-term surgical sequelae. This includes training with respect to respiratory exercises and appropriate positioning of the operated limb as well as developing fundamental patient-physiotherapist cooperation, which will be beneficial after surgery. Effective cough training and elements of self-massage are already important at this stage.

After surgery, patients undergo intense respiratory exercises, exercises of all the joints, then self-assisted exercises, mobilisation, and kinesiotherapy. Limb elevation is necessary [22-25].

Rehabilitation after neoplastic disease is usually a life-long effort. Patients develop habits that need to be maintained in order to preserve physical function. Only full participation of the patient in the treatment process guarantees its long-term positive effect. Lymphatic massage should be followed by wrapping the limb in bandage or wearing appropriate compression tights to prevent recurrence. The limb should be wrapped in a tourniquet characterised by a very low elasticity, with an appropriate lower layer made of a cotton stocking,

Table 1. Circumferences and arm volumes on the side of mastectomy before treatment

Point of measurement	Mean	SD	Me	min	max
10 cm below acromion (cm)	31.2	1.0	31.0	29.1	33.0
10 cm above elbow joint (cm)	18.4	0.6	18.0	17.0	19.0
elbow (cm)	16.4	0.5	16.0	16.0	17.0
10 cm below elbow joint (cm)	25.0	0.8	25.0	24.0	26.6
3 cm above wrist (cm)	16.5	0.5	16.6	15.5	17.0
wrist (cm)	17.3	0.4	17.0	16.8	18.0
metacarpus (cm)	19.7	0.4	19.8	19.2	20.3
Volume (mL)	1823.4	46.6	1832.6	1738.8	1890.9

Source: Own materials

Table 2. Circumferences and arm volumes on the side of mastectomy after treatment in the study group

Point of measurement	Mean	SD	Me	min	max
10 cm below acromion (cm)	30.5	1.0	30.3	28.3	32.5
10 cm above elbow joint (cm)	17.7	0.8	17.3	16.3	18.5
elbow (cm)	15.9	0.8	15.5	15.0	16.9
10 cm below elbow joint (cm)	24.6	1.0	24.5	23.0	26.4
3 cm above wrist (cm)	16.0	0.8	16.0	14.0	16.9
wrist (cm)	17.2	0.5	17.2	16.5	18.0
metacarpus (cm)	19.5	0.3	19.6	19.0	20.0
Volume (mL)	1738.3	72.9	1716.0	1563.4	1830.8

Source: Own materials

cotton wool, and corrugated sponge, with the highest force tolerated by the patient.

Self-massage of the upper limb facilitates lymph and venous circulation, improves trophics, and prevents/eliminates oedema. Rehabilitation in women with impaired lymph circulation should include broadly understood motor rehabilitation. Exercises aimed at maintaining the full range of joint motion in the limbs and strengthening the abdominal and back muscles should be performed every day. Respiratory exercises play an important role [12-15].

Rehabilitation with appropriately selected exercises is very important in the treatment of lymphoedema as these reduce the volume of accumulated interstitial fluid.

Kinesio taping is an increasingly popular method of rehabilitation that consists in sticking special tape (kinesio tex) with specific properties directly onto the skin.

Pneumatic massage is used in compression therapy and is always performed immediately after manual massage. It uses single-chamber or multi-chamber sleeves that generate variable pressure up to approximately 40–60 mmHg.

Whirlpool baths may be used to improve circulation and ensure tissue flexibility. Whirlpool massage is performed according to the general methodology principles. Most physiotherapy procedures are used to reduce pain.

Comprehensive postoperative rehabilitation leads to a reduction in or elimination of lymphoedema, improved joint mobility or at least to improved nourishment of the skin of the limb and a change in the consistency of oedema. Persistent oedema and joint contractures hinder rehabilitation and lower its efficacy. Appropriate rehabilitation and education of patients help decrease the number of complications, shorten the hospital stay, and reduce treatment costs [21-25].

AIM

The aim of this study was to assess the efficacy of comprehensive physiotherapy in women after mastectomy.

The paper attempts to answer the following research questions:

1. How does physiotherapy influence the size of oedema?
2. What is the correlation between physiotherapy outcomes and sociodemographic factors?
3. What is the correlation between physiotherapy outcomes and the following: BMI, time from procedure, time to the development of oedema after procedure, type of management after surgery.

Table 3. Volume of upper limb on the side of mastectomy before and after treatment in the study group

Examination	Volume of upper limb on the side of mastectomy (mL)					Significance
	Mean	SD	Me	min	max	
Before treatment	1823.4	46.6	1832.6	1738.8	1890.9	p<0.001
After treatment	1738.3	72.9	1716.0	1563.4	1830.8	

Source: Own materials

Table 4. Treatment outcomes for upper limb oedema on the side of mastectomy in the study group

Treatment outcome	Mean	SD	Me	min	max
Oedema reduction (mL)	85.1	42.4	61.8	45.2	175.3
Oedema treatment efficacy (%)	4.7	2.4	3.4	2.4	10.1

Source: Own materials

Table 5. Effects of age of study patients and their BMI on treatment outcomes in terms of oedema reduction and treatment efficacy

	Oedema reduction [mL]		Treatment efficacy [%]	
Age [years]	r=-0.3321	p=0.063	r=-0.3421	p=0.055
BMI [kg/m^2]	r=-0.2117	p=0.245	r=-0.201	p=0.270

Source: Own materials

Table 6. Effects of level of education of study patients on treatment outcomes in terms of lymphoedema reduction

Education	n	Oedema reduction (mL)					Significance
		Mean	SD	Me	min	max	
Higher	4	107.9	53.3	105.5	45.2	175.3	p=0.208
Secondary	15	79.6	40.1	60.1	45.2	174.1	
Secondary vocational	10	74.3	37.3	52.7	45.2	147.5	
Primary	3	118.4	50.4	147.5	60.1	147.5	

Source: Own materials

MATERIALS AND METHODS

STATISTICAL METHODS

The data obtained in the study were statistically analysed.

Arm volume on the side of mastectomy before and after treatment was calculated using the following formula:

$V=1/4\pi$ (c1c2 + c2c3 + c3c4 + c4c5 + c5c6 + c6c7)

where: V: limb volume

C: limb circumferences measured in cm at 7 points:

1. below acromion 2. above elbow joint 3. elbow 4. below elbow joint
5. above wrist 6. wrist 7. metacarpus

Oedema reduction and treatment efficacy were calculated using the following formulas:

Oedema reduction = Vch2 – Vch1

Treatment efficacy = Vch2 – Vch1/Vch1 x 100%

where:

Vch2: volume of affected limb after rehabilitation

Vch1: volume of affected limb before rehabilitation

Age, BMI, limb volume, oedema reduction, and treatment efficacy were presented using distribution parameters: mean – arithmetic mean, SD – standard deviation, Me – median, or middle value, min – lowest value, max – highest value.

The statistical analysis used Student's t-test for independent groups, one-way analysis of variance, and Pearson's linear correlation.

Test results with a significance level lower than or equal to 0.05 ($p \leq 0.05$) were deemed statistically significant. The lack of statistical significance was marked with the abbreviation NS (not significant). Statistical calculations were performed with Statistica 13 PL software.

CHARACTERICS OF THE PATIENTS

A total of 32 female patients after unilateral mastectomy performed at the Holy Cross Cancer Center in Kielce underwent treatment in the study. The mean age of study patients was 68.5 years. A half of the patients were over the age of 70 years.

The BMI of study patients ranged from 20.7 kg/m^2 to 25.7 kg/m^2, with a mean BMI of 23.4 kg/m^2. The vast majority (93.8%) of study patients had a normal BMI, and two patients were overweight.

Table 7. Effects of marital status of study patients on treatment outcomes in terms of lymphoedema reduction

Marital status	n	Oedema reduction (mL)					Significance
		Mean	SD	Me	min	max	
Never married	4	59.3	28.2	45.2	45.2	101.6	p=0.363
Married	8	104.4	54.6	105.5	45.2	175.3	
Divorced	4	77.3	37.0	77.3	45.2	109.4	
Widow	16	83.9	38.7	75.4	45.2	174.1	

Source: Own materialszz

Almost half (46.9%) of study patients had secondary education, 4 (12.5%) patients had a university degree, 31.3% of study patients had vocational secondary education, and 9.4% of the women had only completed primary school.

A half of the women were widows, 25% were married, and the rest were either divorced or had never been married (12.5% each).

A total of 11 (34.4%) women were professionally active; 21 patients did not work, including 19 pensioners or individuals drawing a disability pension and 2 unemployed women.

Out of the 11 women who did work, 5 were manual workers, 4 were intellectual workers, and 2 reported their type of work as mixed.

Lymphoedema of the left arm was present in 13 (40.6%) study patients while lymphoedema of the right arm was seen in 19 (59.4%) of study patients.

All study patients underwent combination treatment after mastectomy. Postoperative chemotherapy alone was used in 14 (43.8%) study patients while chemotherapy plus radiotherapy were used in 18 (56.3%) study patients.

The mean time from the procedure was 3.6 years (between 2 and 6 years). Usually (40.6%), study patients were 3 years after the procedure.

The mean time of first onset of lymphoedema after surgery in the study group was 3.6 months. A total of 14 (43.8%) study patients developed lymphoedema in the 1st month after the procedure, another 6 (18.8%) study patients experienced it for the first time in the 2nd month after the procedure, and 12 (37.5%) study patients first developed arm oedema 3 months after the procedure.

The duration of lymphoedema rehabilitation was between 2 and 4 weeks (mean value: 3.6 weeks). Almost three-fourths (71.9%) of study patients underwent treatment for 4 weeks. The physiotherapy included respiratory exercises, kinesiotherapy, lymphatic massage, pneumatic massage, and whirlpool baths.

RESULTS

EFFECTS OF PHYSIOTHERAPY ON OEDEMA SIZE

Table 1 presents the calculated volumes of the arm with lymphoedema before treatment together with the arm circumference values that were used to calculate the volumes.

Table 2 presents the calculated volumes of the arm with lymphoedema after treatment together with the arm circumference values that were used to calculate the volumes.

After treatment, upper limb volume in the study patients was significantly lower ($p<0.001$) than before treatment. The mean volume of the treated limb was 1823.4 mL before treatment and 1738.3 mL after treatment (Table 3).

The mean lymphoedema reduction after treatment was 85.1 mL (range: 45.2 mL to 175.3 mL) (Table. 4).

Correlation between physiotherapy outcomes and sociodemographic factors

Age was inversely proportional ($r=-0.3321$) to lymphoedema reduction after treatment at a level of $p=0.063$, which was close to the significance level. Moreover, age was inversely proportional ($r=-0.3421$) to lymphoedema treatment efficacy at a level of $p=0.055$, which was close to the significance level. No correlation was found between the outcomes of lymphoedema treatment, such as oedema reduction and treatment efficacy, and the BMI value in the study patients (Table 5). Physiotherapy outcomes did not depend on the BMI. There was an inversely proportional correlation between treatment outcomes and the age of study patients, but it was not statistically significant.

The level of education of study patients did not influence lymphoedema reduction after treatment (Table 6).

The level of education of study patients did not influence the efficacy of lymphoedema treatment in the study group.

The marital status of study patients did not influence lymphoedema reduction after treatment (Table 7).

Professional activity of study patients did not influence lymphoedema reduction after treatment (Table 8).

Professional activity of study patients did not influence the efficacy of lymphoedema treatment in the study group.

CORRELATION OF PHYSIOTHERAPY OUTCOMES

BMI, time from procedure, time to the development of oedema after procedure, type of management after surgery

The side on which lymphoedema developed after mastectomy and influence on lymphoedema reduction in the study group (Table 9).

Table 8. Effects of professional activity of study patients on treatment outcomes in terms of lymphoedema reduction

Professional activity	n	Oedema reduction (mL)					Significance
		Mean	SD	Me	min	max	
Working	13	90.4	49.6	63.5	45.2	175.3	p=0.570

Source: Own materials

Table 9. Effects of the side of mastectomy in study patients on treatment outcomes in terms of lymphoedema reduction

Mastectomy side	n	Oedema reduction (mL)					Significance
		Mean	SD	Me	min	max	
Right	19	88.0	43.3	90.6	45.2	175.3	p=0.648
Left	13	80.9	42.4	60.1	45.2	174.1	

Source: Own materials

Table 10. Effects of type of treatment after mastectomy used in study patients on treatment outcomes in terms of lymphoedema reduction

Treatment after surgery	n	Oedema reduction (mL)					Significance
		Mean	SD	Me	min	max	
CHT+RT	18	90.4	46.1	77.0	45.2	175.3	p=0.430
CHT	14	78.3	37.7	60.1	45.2	147.5	

CHT: chemotherapy; RT: radiotherapy

Source: Own materials

Table 11. Effects of time from mastectomy in study patients on treatment outcomes in terms of lymphoedema reduction

Time from surgery	n	Oedema reduction (mL)					Significance
		Mean	SD	Me	min	max	
2 years	7	89.5	43.8	90.6	45.2	147.5	p=0.964
3 years	13	81.1	44.2	60.1	45.2	175.3	
4 years	5	91.2	39.9	90.6	45.2	147.5	
6 years	7	83.6	48.0	60.1	45.2	174.1	

Source: Own materials

Table 12. Effects of treatment duration in study patients on treatment outcomes in terms of lymphoedema reduction

Treatment time	n	Oedema reduction (mL)					Significance
		Mean	SD	Me	min	max	
2 weeks	3	99.4	44.3	90.6	60.1	147.5	p=0.807
3 weeks	6	79.3	51.9	54.3	45.2	175.3	
4 weeks	23	84.7	41.3	60.1	45.2	174.1	

Source: Own materials

The side on which lymphoedema developed after mastectomy in study patients did not influence the efficacy of lymphoedema treatment in the study group.

The type of combination treatment used after mastectomy in study patients did not influence lymphoedema reduction in the study group (Table 10).

Time from mastectomy in study patients did not influence lymphoedema reduction in the study group (Table 11).

The duration of treatment in study patients did not influence lymphoedema reduction in the study group (Table 12).

DISCUSSION

Breast cancer is a difficult clinical and social problem. After surgical breast cancer treatment, patients develop latent, subclinical lymphatic failure. Studies show that secondary lymphoedema occurs usually in the first year after the procedure (immediately after surgery in 30% of women and up to one year after surgery in 58% of women).

In the case of impaired lymph flow, valves begin to leak and the lymph flows backwards. Untreated oedema becomes increasingly harder, and the progressive pro-

cess of connective tissue proliferation is associated with the risk of skin sclerosis and cylindrical limb deformity. This causes aesthetic issues, often leading to stress and concomitant emotional problems and social conflicts. Moreover, the consequences of lymphoedema worsen physical activity limitations in the patients, decrease their level of independence, and cause social isolation, which includes giving up on professional activity. Mental disorders, caused by the stress associated with long-term treatment, are common. Women after mastectomy have to be aware of the factors that influence oedema severity and of the methods of management in everyday life.

In the present study, patients after treatment showed reduced upper limb circumferences on the operated side at all levels and increased ranges of motion in the joints of the limb on the operated side. The largest improvement in mobility after treatment was seen in the shoulder joint.

Physiotherapy methods used to eliminate lymphoedema should be selected on a case-by-case basis, taking into account systematic and persistent efforts from the patient. As far as oedema grades are concerned, it should be pointed out that in grade 1 lymphoedema (so-called reversible lymphoedema, where no tissue fibrosis occurs), the swelling is reduced by upper limb elevation, self-massage, and exercises. With grade 2 oedema (where considerable tissue fibrosis occurs), self-massage and limb elevation are supplementary measures.

It should also be stressed that physiotherapy methods used to treat oedema are of a long-term nature. Reducing lymphoedema has beneficial effects not only on the physical condition, but also on the mental state of the woman, allowing her to live her life by increasing her independence, helping her return to work and, consequently, improving her self-worth. Studies confirm that these methods constitute an important part of physiotherapy in patients after breast removal surgery.

CONCLUSIONS

1. Breast cancer is a difficult clinical and social problem in Poland and globally.
2. Implementation of an appropriate physical therapy program both before and after surgery determines the reduction of lymphedema in women undergoing surgery.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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