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Original Article

Revitalizing Post-Mastectomy Lives: Unveiling the Impact of Aerobic and Mobility with Strengthening Exercises in Improving Shoulder Pain, ROM, and Strength

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ABSTRACT

Background: Breast cancer is the most prevalent cancer among women globally, with Pakistan having one of the highest incidence rates in Asia. Post-mastectomy patients often suffer from shoulder pain, reduced range of motion (ROM), and muscle weakness, impacting their quality of life. This study investigates the efficacy of a comprehensive exercise regimen in alleviating these symptoms.

Objective: To evaluate the impact of aerobic, mobility, and strengthening exercises on shoulder pain, ROM, and muscle strength in post-mastectomy patients undergoing chemotherapy.

Methods: A six-month case-control study was conducted with 60 participants, aged 25-65, who had undergone radical mastectomy and were in the chemotherapy phase. Participants were randomly assigned to two groups: the case group (n=30), which underwent an eight-week program of aerobic, mobility, and strengthening exercises, and the control group (n=30), which performed only aerobic exercises. Data collection tools included the Visual Analogue Scale (VAS) for pain assessment, a Goniometer for ROM measurement, and Manual Muscle Testing (MMT) for muscle strength evaluation. Data analysis was conducted using SPSS version 25, with paired and independent t-tests applied to compare pre- and post-intervention scores.

Results: The case group showed a significant reduction in VAS scores (mean difference = 2.93333, $p<0.001$) compared to the control group (mean difference = 0.40000, $p=0.028$). MMT results indicated significant improvements in muscle strength for the right deltoid (mean difference =-0.40000, $p=0.009$) and left pectoralis major (mean difference =-0.73333, $p<0.001$) in the case group. ROM improvements were significant for right shoulder extension (mean difference =-0.80000, $p<0.001$) and left shoulder external rotation (mean difference =-1.73333, $p<0.001$) in the case group.

Conclusion: A comprehensive exercise regimen, including aerobic, mobility, and strengthening exercises, significantly improved shoulder pain, ROM, and muscle strength in post-mastectomy patients. These findings support the integration of multifactorial physiotherapy into rehabilitation protocols for breast cancer survivors to enhance their long-term health and quality of life.

Keywords: Breast cancer, mastectomy, shoulder pain, range of motion, muscle strength, aerobic exercises, mobility exercises, strengthening exercises, rehabilitation, physiotherapy, post-mastectomy recovery.

INTRODUCTION

Breast cancer, a pervasive malignancy originating in the breast tissue, predominantly begins in the inner lining of milk ducts or the lobules that supply them with milk. Unlike normal cells, which divide, grow, and die in a predictable manner, cancer cells proliferate uncontrollably, leading to tumor formation and potential metastasis. Breast cancer is the most prevalent cancer among women globally, with Pakistan exhibiting one of the highest incidence rates in Asia. Recent data from Shaukat Khanum Memorial Cancer Hospital indicate that breast cancer accounts for 21.5% of all cancers and 45.9% of female cancers in Pakistan. Annually, around 40,000 women succumb to this disease in Pakistan, and 90,000 new cases are diagnosed, equating to approximately 109 deaths daily (1,2,3).

Multiple risk factors contribute to the high incidence of breast cancer in Asia, including older age, family history, early menarche, late menopause, high body mass index (BMI), obesity, tobacco use, and high-fat diets. Hormonal changes, sedentary lifestyles, and

obesity, particularly post-menopause, further elevate the risk. Extended exposure to low-dose radiation also slightly increases the risk, particularly among X-ray technicians. Treatment options encompass early pregnancy, hormone replacement therapy, and oral medications, with the timing and duration of hormone replacement therapy significantly impacting breast cancer risk. Women initiating hormone therapy closer to menopause face a higher risk, which diminishes the longer it has been since menopause (4,5,6). Post-treatment, about 89% of women with breast cancer survive at least five years; however, side effects such as musculoskeletal pain, neuropathic pain induced by drugs, radiation-induced pain, and chronic persistent pain can persist for months or years. Conservative surgery is now favored in breast cancer management. A modified radical mastectomy, which removes the entire breast and lymph nodes but spares the pectoral muscles, is commonly performed using an oblique elliptical incision angled toward the axilla. The U.S. Preventive Services Task Force recommends routine breast cancer screening for women aged 50-69 every 1-2 years, utilizing mammography with or without additional clinical examination and imaging as necessary. Asymptomatic women undergo breast screening to detect cancer early, which includes physical examination, risk assessment, mammography, and occasionally MRI (7,8,9).

Post-mastectomy shoulder pain, a significant complication, can result from musculoskeletal, neuropathic, and radiation-induced factors. Shortened pectoral muscles due to scar formation can cause shoulder depression and scapula misalignment, exacerbating chronic shoulder pain, especially in patients with extensive lymph node removal. Early upper limb rehabilitation has shown to improve quality of life and function in breast cancer patients. The literature indicates that multifactorial physiotherapy, including stretching and exercises, is effective in treating postoperative pain and joint dysfunctions following mammary carcinoma surgery. High-quality studies advocate for carefully monitored exercise prescriptions to address persistent upper limb dysfunctions, which, if untreated, can lead to post-surgical complications (10,11,12).

Chronic pain, decreased muscle strength, reduced cardiorespiratory fitness, shoulder dysfunction, weight gain, and other health-related issues are common post-treatment. Evaluating the benefits of a customized fitness program incorporating range-of-motion, aerobic, and strengthening exercises is crucial for improving the long-term health of breast cancer patients. However, there is a notable gap in studies focusing on the Pakistani population undergoing these therapies post-mastectomy. This study aims to fill this gap by evaluating the impact of a comprehensive exercise regimen, including aerobic, mobility, and strengthening exercises, on shoulder pain, range of motion, and muscle strength in post-mastectomy patients undergoing chemotherapy (13,14,15). The study's findings will contribute to evidence-based guidelines for implementing effective rehabilitation techniques to enhance patients' long-term health following breast cancer treatment.

MATERIAL AND METHODS

The study was conducted over a period of six months and utilized a case-control design to investigate the effects of a comprehensive exercise regimen on shoulder pain, range of motion (ROM), and muscle strength in post-mastectomy patients undergoing chemotherapy. The study was approved by the institutional review board and conducted in accordance with the ethical principles of the Declaration of Helsinki (16). Participants were recruited from the oncology departments of Allied Hospital and the Pakistan Institute of Nuclear Medicine (PINUM) in Faisalabad.

A total of 60 participants, aged between 25 and 65 years, who had undergone radical mastectomy and were in the chemotherapy phase of their treatment, were included in the study. The participants were selected using a purposive sampling technique. They were randomly divided into two groups: the case group and the control group, each comprising 30 participants. The case group participated in an eight-week program of combined aerobic, mobility, and strengthening exercises, while the control group performed only aerobic exercises.

Data collection tools included the Visual Analogue Scale (VAS) for assessing pain, a Goniometer for measuring range of motion, and Manual Muscle Testing (MMT) for evaluating muscle strength. The VAS is a reliable and widely used tool for quantifying pain intensity. Participants were asked to mark their pain level on a 10 cm line, with 0 indicating no pain and 10 indicating the worst pain imaginable. ROM was measured using a Goniometer, which provides accurate assessments of joint angles and mobility. MMT was employed to evaluate the strength of specific muscle groups, using a standardized grading system from 0 (no muscle contraction) to 5 (normal muscle strength).

Participants in the case group engaged in a supervised exercise program that included aerobic exercises, mobility exercises, and strengthening exercises. The aerobic component consisted of activities such as walking and cycling, performed at moderate intensity for 30 minutes, five days a week. Mobility exercises focused on improving shoulder joint flexibility and included stretching routines. Strengthening exercises targeted major muscle groups of the upper limb and were performed using resistance bands and light weights, gradually increasing in intensity over the eight-week period.

Data analysis was performed using SPSS version 25. Descriptive statistics were calculated for baseline characteristics of the participants. Paired t-tests were used to compare pre- and post-intervention scores within each group. Independent t-tests were conducted to compare the differences between the case and control groups. Statistical significance was set at $p<0.05$.

The study ensured the confidentiality and anonymity of all participants. Written informed consent was obtained from each participant prior to their inclusion in the study. The potential risks and benefits of the study were thoroughly explained, and participants were assured that they could withdraw from the study at any time without any consequences to their ongoing treatment.

This rigorous methodology aimed to provide a comprehensive understanding of the impact of combined aerobic, mobility, and strengthening exercises on post-mastectomy shoulder pain, ROM, and muscle strength. The findings of this study are expected to contribute significantly to the development of effective rehabilitation protocols for breast cancer survivors (17).

RESULTS

The results of the study are presented in the following tables, highlighting the effects of the exercise interventions on shoulder pain, range of motion (ROM), and muscle strength in post-mastectomy patients.The Visual Analogue Scale (VAS) scores for pain before and after treatment were analyzed for both the control and case groups.

Table 1: Paired Sample T-Test for VAS Scores

Group	Mean Difference	Std. Deviation	Std. Error Mean	95% Confidence Interval	t	df	P-value
Control Group	0.40000	0.63246	0.16330	0.04976 to 0.75024	2.449	14	0.028
Case Group	2.93333	1.57963	0.40786	2.05856 to 3.80810	7.192	14	<0.001

The paired sample t-test indicated a significant reduction in VAS scores post-treatment in both groups, with the case group showing a greater reduction in pain ($p<0.001$) compared to the control group ($p=0.028$).

Table 2: Independent T-Test for VAS Scores

Variable	t	df	Mean Difference	Std. Error Difference	95% Confidence Interval	P-value
Before Treatment	-1.379	28	-0.80000	0.58009	-1.98827 to 0.38827	0.179
After Treatment	2.736	28	1.73333	0.63346	0.43575 to 3.03091	0.011

The independent t-test revealed no significant difference between the groups before treatment ($p=0.179$), but a significant difference in VAS scores after treatment, indicating a greater reduction in the case group ($p=0.011$). The Manual Muscle Testing (MMT) scores for various muscles before and after treatment were analyzed for both the control and case groups.

Table 3: Paired Sample T-Test for MMT Scores in Control Group

Muscle	Mean Difference	Std. Deviation	Std. Error Mean	95% Confidence Interval	t	df	P-value
Right Deltoid	-0.26667	0.45774	0.11819	-0.52015 to-0.01318	-2.256	14	0.041
Right Pectoralis Major	-0.06667	0.25820	0.06667	-0.20965 to 0.07632	-1.000	14	0.334
Right Supraspinatus	-0.06667	0.25820	0.06667	-0.20965 to 0.07632	-1.000	14	0.334
Right Latissimus Dorsi	0.00000	0.37796	0.09759	-0.20931 to 0.20931	0.000	14	1.000
Left Deltoid	0.06667	0.25820	0.06667	-0.07632 to 0.20965	1.000	14	0.334
Left Pectoralis Major	0.06667	0.25820	0.06667	-0.07632 to 0.20965	1.000	14	0.334
Left Supraspinatus	0.00000	0.37796	0.09759	-0.20931 to 0.20931	0.000	14	1.000
Left Latissimus Dorsi	-0.06667	0.25820	0.06667	-0.20965 to 0.07632	-1.000	14	0.334

In the control group, only the right deltoid muscle showed significant improvement in strength post-treatment ($p=0.041$).

Table 4: Paired Sample T-Test for MMT Scores in Case Group

Muscle	Mean Difference	Std. Deviation	Std. Error Mean	95% Confidence Interval	t	df	P-value

Right Deltoid	-0.40000	0.50709	0.13093	-0.68082 to-0.11918	-3.055	14	0.009
Right Pectoralis Major	-0.53333	0.51640	0.13333	-0.81930 to-0.24736	-4.000	14	0.001
Right Supraspinatus	-0.60000	0.50709	0.13093	-0.88082 to-0.31918	-4.583	14	<0.001
Right Latissimus Dorsi	-0.53333	0.51640	0.13333	-0.81930 to-0.24736	-4.000	14	0.001
Left Deltoid	-0.46667	0.51640	0.13333	-0.75264 to-0.18070	-3.500	14	0.004
Left Pectoralis Major	-0.73333	0.45774	0.11819	-0.98682 to-0.47985	-6.205	14	<0.001
Left Supraspinatus	-0.40000	0.50709	0.13093	-0.68082 to-0.11918	-3.055	14	0.009
Left Latissimus Dorsi	-0.46667	0.51640	0.13333	-0.75264 to-0.18070	-3.500	14	0.004

In the case group, significant improvements in muscle strength were observed across all tested muscles, with p-values indicating high statistical significance.

Table 5: Independent T-Test for MMT Scores

Muscle	t	df	Mean Difference	Std. Error Difference	95% Confidence Interval	P-value
Right Deltoid	2.316	28	0.40000	0.17275	0.04615 to 0.75385	0.028
Right Latissimus Dorsi	2.316	28	0.40000	0.17275	0.04615 to 0.75385	0.028
Other Muscles	Varies	28	Varies	Varies	Varies	>0.05

The independent t-test showed significant improvement in muscle strength for the right deltoid and right latissimus dorsi in the case group (p=0.028). Other muscle groups did not show significant changes (p>0.05).ROM for various shoulder movements before and after treatment was analyzed for both groups.

Table 6: Paired Sample T-Test for ROM in Control Group

Movement	Mean Difference	Std. Deviation	Std. Error Mean	95% Confidence Interval	t	df	P-value
Left Shoulder External Rotation	-0.26667	0.45774	0.11819	-0.52015 to-0.01318	-2.258	14	0.041
Other Movements	Varies	Varies	Varies	Varies	>0.05		

In the control group, significant improvement in ROM was observed only in left.

DISCUSSION

The study aimed to assess the impact of a comprehensive exercise regimen on shoulder pain, range of motion (ROM), and muscle strength in post-mastectomy patients undergoing chemotherapy. The findings indicated significant improvements in these parameters, particularly in the group that performed combined aerobic, mobility, and strengthening exercises.

The reduction in shoulder pain observed in the case group was notable, with a mean difference in VAS scores significantly greater than that in the control group. This result suggested that incorporating mobility and strengthening exercises into the rehabilitation program provided additional benefits beyond those achieved with aerobic exercises alone. Previous studies have also highlighted the efficacy of multifactorial physiotherapy in managing postoperative pain and improving joint function in breast cancer patients. Ribeiro et al. (2010) found that ROM exercises significantly improved shoulder flexion, abduction, and external rotation, supporting the current study's findings (10).

The improvement in muscle strength, as measured by MMT, was also significant in the case group across several muscle groups. This result aligns with the work of Philip et al. (2024), who demonstrated that combined aerobic and resistance exercises effectively reduce cancer-related pain, improve physical function, and enhance mood in breast cancer patients (11). The significant gains in muscle strength observed in the right deltoid and right latissimus dorsi muscles in the case group corroborated these findings and underscored the importance of a comprehensive exercise regimen in the rehabilitation of post-mastectomy patients.

ROM improvements were more pronounced in the case group, with significant gains in movements such as right shoulder extension and left shoulder external rotation. These findings are consistent with the results of Wang et al. (2023), who reported significant enhancements in shoulder ROM following a structured upper limb rehabilitation program for breast cancer patients (12). However, the current study noted that some movements did not show significant improvement, indicating variability in the effectiveness of the exercise regimen for different shoulder movements.

One strength of this study was its rigorous methodological design, including the use of validated assessment tools such as VAS, Goniometer, and MMT, which ensured the reliability of the data collected. The inclusion of a control group allowed for a comparative analysis, highlighting the additional benefits of mobility and strengthening exercises. Moreover, the study adhered to ethical guidelines, ensuring participant safety and confidentiality throughout the research process.

However, the study had several limitations. The sample size was relatively small, limiting the generalizability of the findings. Larger, randomized controlled trials are needed to validate these results and provide more robust evidence. Additionally, the eight-week duration of the exercise program might not have been sufficient to capture long-term outcomes, necessitating extended follow-up studies to assess the sustainability of the observed benefits. The use of purposive sampling introduced potential bias, which could affect the reliability of the results.

Future research should focus on addressing these limitations by conducting studies with larger sample sizes and longer follow-up periods. Investigating the psychosocial benefits of exercise, such as improvements in mental health and quality of life, would also provide a more comprehensive understanding of the impact of rehabilitation programs on breast cancer survivors. Incorporating a more diverse range of exercises and tailoring interventions to individual patient needs could further enhance the effectiveness of post-mastectomy rehabilitation.

In conclusion, this study demonstrated that a comprehensive exercise regimen incorporating aerobic, mobility, and strengthening exercises significantly improved shoulder pain, ROM, and muscle strength in post-mastectomy patients. These findings contribute to the growing body of evidence supporting the integration of multifactorial physiotherapy into rehabilitation protocols for breast cancer survivors, ultimately aiming to enhance their long-term health and quality of life.

CONCLUSION

A comprehensive exercise regimen, including aerobic, mobility, and strengthening exercises, significantly improved shoulder pain, ROM, and muscle strength in post-mastectomy patients. These findings support the integration of multifactorial physiotherapy into rehabilitation protocols for breast cancer survivors to enhance their long-term health and quality of life.

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