Applicability of Telerehabilitation and its Effects on Functional Capacity and Pulmonary Function of Patients Undergoing Surgical Treatment for Breast Cancer

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Aplicabilidade da Telerreabilitação e seus Efeitos na Capacidade Funcional e Função Pulmonar de Pacientes em Tratamento Cirúrgico para o Câncer de Mama

Aplicabilidad de la Telerrehabilitación y sus Efectos sobre la Capacidad Funcional y la Función Pulmonar de Pacientes Sometidas a Tratamiento Quirúrgico por Cáncer de Mama

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ABSTRACT

Introduction: Surgical treatment is one of the options for breast cancer treatment, and this invasive procedure can cause several complications, such as decreased thoracic mobility and scar adhesions, resulting in respiratory and functional dysfunction. Telerehabilitation can be a tool to aid the recovery of these patients and prevent complications and sequelae. **Objective:** To investigate the applicability and effects of a telerehabilitation program on the respiratory and functional capacity of patients undergoing surgical treatment for breast cancer. **Method:** A single-arm intervention study was conducted with 20 patients undergoing surgical treatment for breast cancer who participated in a two-week telerehabilitation program. Functional capacity was assessed using the 6-Minute Walk Test and Respiratory Lung Capacity by Spirometry. Participants were evaluated before and after surgery, and variables were compared using the Wilcoxon signed-rank and Student's t-test. A significance level of $p<0.05$ was adopted. **Results:** There were no differences between participants' functional and lung capacity variables before and after two weeks of telerehabilitation. **Conclusion:** Telerehabilitation administered to patients undergoing treatment for breast cancer is safe in its applicability. Furthermore, functional and lung capacity levels remained within predicted values.

Key words: Telerehabilitation/methods; Walk Test/methods; Spirometry/methods; Total Lung Capacity; Breast Neoplasms/surgery.

RESUMO

Introdução: O tratamento cirúrgico é uma das opções como abordagem para o tratamento do câncer de mama e diversas são as complicações que esse procedimento invasivo pode ocasionar, como a diminuição de mobilidade torácica e aderências cicatriciais, resultando em disfunções respiratórias e funcionais. A telerreabilitação pode ser uma ferramenta para auxiliar na recuperação desses pacientes a fim de prevenir agravos e sequelas. **Objetivo:** Investigar a aplicabilidade e os efeitos de um programa de telerreabilitação na capacidade respiratória e funcional de pacientes que passaram por tratamento cirúrgico para câncer de mama. **Método:** Estudo de intervenção de braço único realizado com 20 pacientes sob tratamento cirúrgico para câncer de mama, que participaram de um programa de telerreabilitação pelo período de duas semanas. A capacidade funcional foi avaliada por meio do teste de caminhada de 6 minutos e da capacidade pulmonar respiratória pela espirometria. As participantes foram avaliadas antes e após a intervenção cirúrgica, e as variáveis foram comparadas utilizando o Wilcoxon e o teste t de Student. Foi adotado o nível de significância $p<0,05$. **Resultados:** Não houve diferença entre as variáveis de capacidade funcional e pulmonar nas participantes antes e após duas semanas de telerreabilitação. **Conclusão:** A telerreabilitação administrada a pacientes em tratamento para o câncer de mama é segura na sua aplicabilidade. Além disso, os níveis de capacidade funcional e pulmonar se mantiveram dentro dos valores previstos.

Palavras-chave: Telerreabilitação/métodos; Teste de Caminhada/métodos; Espirometria/métodos; Capacidade Pulmonar Total; Neoplasias da Mama/cirurgia.

RESUMEN

Introducción: El tratamiento quirúrgico es una de las opciones para el cáncer de mama. Este procedimiento invasivo puede causar diversas complicaciones, como disminución de la movilidad torácica y adherencias cicatriciales, lo que resulta en disfunción respiratoria y funcional. La telerrehabilitación puede ser una herramienta para facilitar la recuperación de estas pacientes y prevenir complicaciones y secuelas. **Objetivo:** Investigar la aplicabilidad y los efectos de un programa de telerrehabilitación en la capacidad respiratoria y funcional de pacientes sometidas a tratamiento quirúrgico por cáncer de mama. **Método:** Estudio de intervención de un solo brazo realizado con 20 pacientes sometidas a tratamiento quirúrgico por cáncer de mama que participaron en un programa de telerrehabilitación de dos semanas. La capacidad funcional se evaluó mediante la prueba de marcha de 6 minutos y la capacidad pulmonar respiratoria mediante espirometría. Se evaluó a las participantes antes y después de la cirugía, y las variables se compararon mediante la prueba de rangos con signo de Wilcoxon y la prueba *t* de Student. Se adoptó un nivel de significación de $p<0,05$. **Resultados:** No se observaron diferencias entre las variables funcionales y de capacidad pulmonar de las participantes antes y después de dos semanas de telerrehabilitación. **Conclusión:** La telerrehabilitación administrada a pacientes en tratamiento por cáncer de mama es segura en su aplicabilidad. Además, los niveles funcionales y de capacidad pulmonar se mantuvieron dentro de los valores previstos.

Palabras clave: Telerrehabilitación/métodos; Prueba de Paso/métodos; Espirometría/métodos; Capacidad Pulmonar Total; Neoplasias de la Mama/cirugía.

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INTRODUCTION

Breast cancer is an important public health problem in Brazil and worldwide, the most prevalent breast neoplasm in women, the second most common type of cancer and main cause of death for this population. It was estimated that breast cancer has accounted for nearly 685 thousand deaths in the whole world and a previewed incidence of 30.1% of new cases in women in 2023[1-3].

According to Hong et al.[4], breast cancer treatment encompasses local therapies (surgery and radiotherapy) and systemic therapies (chemotherapy and hormone therapy), however, these modalities can cause some complications as pain, altered sensitivity, limitation of range of motion, scar adhesions, muscle weakness and winged scapula. These complications can occur because the therapies were targeted to the axillary and shoulder region affecting the function of upper limbs in general, potentially damaging writing, dressing, open and close recipients and lift shopping bags[5].

Together with cancer symptoms and treatment side effects, these factors contribute to the process of physical deconditioning of the patient, diminishing the body ability to utilize and provide oxygen, which leads to reduced physical activity requiring moderate and/or intense efforts, directly related to the performance of activities of daily life[6].

Physiotherapy intervention through post-operative telerehabilitation has been considered an effective alternative to prevent and treat the aforementioned breast cancer related harms[7-9]. In addition, studies have demonstrated that increased home-based physical activity by patients with breast cancer can improve the cardiorespiratory conditions and reduce cancer-related fatigue, especially when physical treatment is supervised by family members[10].

Telerehabilitation has been widely utilized in follow-up of cardiopulmonary and musculoskeletal diseases[7,8]. This approach comprehends habilitation and rehabilitation as monitoring, education, evaluation and prevention for patients in this modality of treatment. Assisted technologies as telemedicine play an important role while offering care, overcoming distance and time issues to improve physical activity and functional capacity of patients with breast cancer[7,8,11].

Since 2020, telerehabilitation is ruled by Directive COFFITO number 516[12], can be performed concurrently in real-time through videocall among others or not in real-time through pre-recorded videos, digital images and other resources to ensure the patients the access to the treatment at their convenience.

Whereas the global COVID-19 pandemic and the social distancing policies implemented, it became even more evident the necessity of remote health services for patients with breast cancer. In addition, patients who live far from oncologic treatment centers may also have been a significant factor to interrupt the traditional services and engagement of remote treatment approaches[11-13].

The objective of the present study is to investigate the applicability and effects of a telerehabilitation program on respiratory and functional capacity of patients who were submitted to breast cancer surgical treatment.

METHOD

Single-arm intervention study conducted at "*Laboratório de Reabilitação Pulmonar* of "*Hospital Universitário João de Barros Barreto (HUJBB*")*,* in Belém, Pará from January 2022 to May 2023, one of the reference centers of oncologic treatment at the region.

Sociodemographic data, spirometry and functional capacity of patients in breast cancer treatment at HUJBB have been collected by convenience sample. 20 patients agreed to join the study.

Women older than 18 years of age diagnosed with breast cancer submitted to surgery at the hospital, cognizant and able to communicate verbally with access to Internet and a mobile phone have been enrolled. Those with musculoskeletal, orthopedic, neurologic disorders, with cognitive and/or communication impairment (evaluated by the Mini Mental State Examination, score 13 points) that could hinder the applicability of the evaluation and who declined to sign the Informed Consent Form were excluded.

An asynchronous telerehabilitation program through a message app was implemented. Two protocols with exercises were sent, the first with flexion, extension and abduction of the shoulder at a 90º angle and guidelines to walk at home at least for 150 minutes/week with moderate intensity according to the modified Borg scale. The second protocol listed the same exercises of the first, but with full angle for the exercises plus the 150 minutes/week home walk[14,15].

The program was followed for two weeks, matching the time range from hospital discharge and return visit to the hospital to remove the stitches and drains. The intervention flowchart is portrayed in Figure 1.

On a daily-bases, the investigators sent a proprietary online file through messages to follow-up whether the women were able to perform the exercises. Once a week, they called to detect possible difficulties and discuss the patients demands, in addition to communication

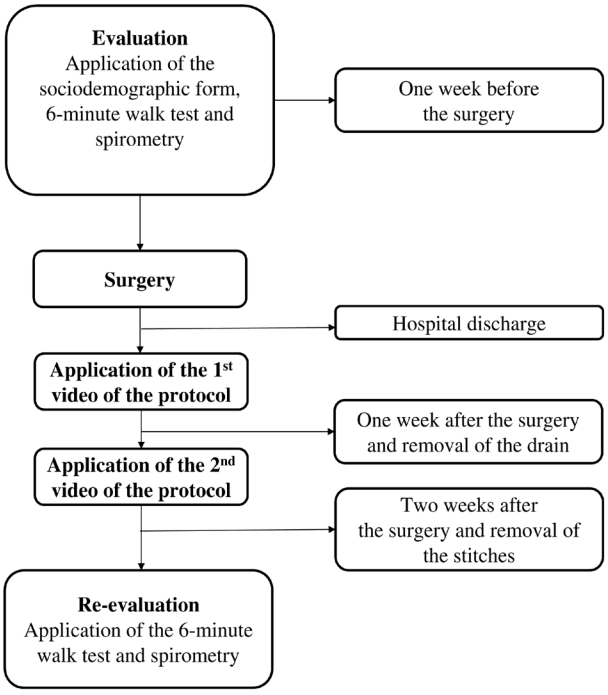

Figure 1. Flowchart of application of the intervention protocols of telerehabilitation

via messages app. Telemonitoring utilized an exclusive telerehabilitation phone number.

Digital spirometer Spirobank II Advanced was utilized to evaluate the respiratory function, including volume and capacity, the patient remained seated, head in neutral position during inspiratory and expiratory efforts. A nasal clip was placed to guide three maximal expirations, only the best result was selected[16].

The 6-minute walk test (6MWT) was applied to evaluate the functional capacity in a closed environment along a 30-meter flat and straight corridor with cones marking the beginning and the end. Vital signs (heart rate, oxygen saturation and blood pressure) were measured, in addition to the modified Borg scale to evaluate the perception of effort[17].

The evaluations were conducted in a single day, the spirometry was applied before the 6MWT, with 10-minute interval between them.

The variables collected were tabulated in Microsoft Excel. The normality test Doornik Hansen[18] was utilized. Categorical variables were described in absolute and percent values, the continuous variables as mean and standard-deviation and non-parametric variables as median and interquartile range and level of significance $p<0.05$. The Wilcoxon or Student's t test were applied to compare the patients' data prior and after the protocol of intervention[19], accordingly. The software STATA[20] version 18 was utilized for the tests.

Study approved according to the guidelines of clinical trials with human beings, report number 4,689,283 (CAAE: submission for ethical review): 45610521.0.0000.0018), in compliance with Directive 466/12[21] of the National Health Council. All the participants were briefed about the study and signed the informed consent form (ICF). The study was published at the "*Registro Brasileiro de Ensaios Clínicos*" (ReBEC).

RESULTS

Table 1 presents sociodemographic data of 20 study participants.

Table 2 presents the spirometry values and distance walked in the walk test, pre and post intervention expressed in mean and standard deviation with their respective confidence intervals and p.

DISCUSSION

More than half of the study sample are or were alcohol users (70%) and smokers (40%), factors that can lead to post-operative respiratory compromise, comorbidities and osteo-muscular dysfunctions as concluded by the prospective observational study with 20,691 women and the impacts of these variables over the prognosis of breast cancer[22].

The mean age of the population investigated was approximately 55 years and most of the participants had more than eight years of education. These sociodemographic characteristics are similar to those found in epidemiologic studies of oncologic estimates in Brazil, where a mean age of 56 years was found in women affected by breast cancer and the high prevalence of this disease for those who have not a university degree[3,23].

The population of the study was classified as overweight, which, if associated with non-physical practice as is the case of 50% of the sample, is related to increased cardiorespiratory risk, development of associated comorbidities and high incidence of post-surgical complications[24]. Similar results were observed in a study with 20 women submitted to conserving quadrantectomy surgery or mastectomy where the values estimated for pre-operative respiratory muscle strength and lung function were reduced, in addition to the maximal expiratory pressure[24,25].

Every surgical procedure is followed by a certain degree of respiratory dysfunction, regardless whether lungs are directly or not involved. These dysfunctions occur more frequently when patients are submitted to thoracic surgery[26]. Type of surgery, respiratory depression and suppression of the central nervous system due to anesthetics are some of the factors that can occasionally cause post-operative dysfunction of the diaphragm, the

Table 1. Clinical, sociodemographic, health and life habits data

Variables	n*	%*
Age		55.15 ± 11.64***
BMI		27.81 ± 5.14***
Education		
< 8 years	15	75%
> 8 years	5	25%
Labor		
Working	14	70%
Unemployed	3	15%
Retired	3	15%
Alcohol use		
Alcohol user/Ex-alcohol user	8	40%
Never drank	12	60%
Tobacco		
Smoker/ex-smoker	8	40%
Never smoked	12	60%
Previous physical activity		
Yes	10	50%
No	10	50%
Current physical activity		
Yes	2	10%
No	18	90%
Comorbidities		
One	8	40%
Two	9	45%
Three or more	3	15%
Type of surgery		
Mastectomy	2	10%
Setorectomy	18	90%
Neoadjuvant treatment		
No	7	35%
Chemotherapy	13	65%

Captions: * = number (n); ** = approximate percent (%); *** = mean and standard-deviation; BMI = body mass index.

main respiratory muscle. Therefore, sectorectomy surgery (90%), the most common in this study, can show the little compromise of the lung capacity and functionality, since it tends to have least impact than radical surgeries as mastectomy (10%)[25,26].

Studies report that thoracic surgical procedures can cause local tissue adhesions, causing posture dysfunctions and reduction of the respiratory muscle strength, increasing the susceptibility of the patient to lung complications. All these factors contribute to the risk of post-operative respiratory failure in malignant breast cancer[25,27].

The several types of therapies utilized to fight cancer are one of the main causes of local and systemic effects that impact the respiratory and muscles systems of oncologic patients, both for those in treatment or who had completed the treament[28,29]. The high number of women who submitted to neoadjuvant therapy (65%) in the present study can be related to long-term dismal outcome of the functional and respiratory capacity, causing damages on quality of life, since patients who underwent chemotherapy are more susceptible to present oncologic fatigue, and reducing their activities to daily life tasks[30].

O'Donnell et al.[31] reported that physical deconditioning in women with breast cancer involves several factors as decline of the ventilatory capacity due to inspiratory muscle weakness, cardiocirculatory compromise, lung restriction among others. Even after recovery, the patients can continue to present morbidity as dyspnea and inability to practice exercises, in addition to impaired physical activity, leading to unstable health condition.

Similarly, based on the results obtained, it is possible to observe a potential impact of the telerehabilitation-based program over the progress of the PEF for these patients. However, there was no statistically significant improvement on other spirometry data, that can be explained by the fact that 65% of the study patients underwent chemotherapy as neoadjuvant therapy, since this treatment influences even more the reduction of the lung function and the values of forced vital capacity (FVC) and forced expiratory volume in the first second (FEV1) than those who submitted to surgery alone[32,33].

It is possible that the unchanged lung functional capacity pre and post intervention has been influenced by the type of surgery the study sample was submitted to. Only 10% of the participants submitted to radical surgeries because they cause more scar adhesions and muscle retraction that restrain the lung expansibility while 90% of the women submitted to segmental surgeries tend to provoke minor impacts than radical surgeries on respiratory and muscle functions as reported in other studies[34,35]. As a consequence, functional lung capacity post telerehabilitation have come closer to baseline values.

Table 2. Comparison of the respiratory and volume capacity and functional capacity

	Pre-intervention		Post-intervention			
Variables	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**CI (95%)**	***p***
FVC (liters)	2.7095	.589	2.549	.451	2.46 to 2.79	0.9670
FEV1 (liters)	2.268	.469	2.1315	.39	2.06 to 2.33	0.9993
FEV1/FVC (%)	83.975	4.415	83.71	4.471	82.43 to 85.24	0.1886
PEF (liters)	5.692	1.372	5.8125	1.155	5.35 to 6.15	0.3828
FEF25-75 (liters)	2.6465	.692	2.425	.71	2.31 to 2.76	0.1621
Distance walked (meters)	477.28	51.93	474.9658	56.638	458.78 to 493.51	0.1331

Captions: CI = confidence interval 95%; FVC = forced vital capacity; FEV1 = forced expiratory volume in the first second; PEF = peak expiratory flow; FEF25-75 = forced expiratory flow between 25 and 75%.

Another variable that may have interfered in the results was the duration of the program and time of application of the exercises protocol, immediately after the surgery until removal of the stitches, a period the patients were in pain and denied any mobilization at the region, compromising the respiratory mechanic because of the proximity of the lung and the area affected, potentially creating discontinuation of the progress of application of the intervention[25,34,35].

Alternative methods for the applicability and structuring of the physiotherapy assistance are of uttermost importance for the Amazon region due to geographical distances and travel logistics issues that affect the physiotherapeutic conducts and continuity of the treatment[36]. Thus, asynchronous telerehabilitation appear as an alternative to reduce this deficit very common in the North region, making the continuity of the treatment of patients with breast cancer more effective.

The type and sample size (small and non-randomized) are the study limitations and may not be generalizable to the general population of women with breast cancer. Additionally, some women were unable to follow the intervention protocol because they had no Internet access or a mobile phone, which was one of the eligibility criteria. However, no technical limitations were found, except some participants who faced problems of Internet access that were resolved the next day in all the cases.

CONCLUSION

The results of the present study suggest that the exercises-based telerehabilitation administered to patients in breast cancer treatment is safe. Furthermore, the data indicate that telerehabilitation had positive effects on the maintenance of the lung function and capacity, promoting improvement on PEF. The levels of lung functionality and capacity were within the estimated ranges.

CONTRIBUTIONS

All the authors contributed to the conception and design of the study, analysis and interpretation of the data, writing and critical review. They approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interests to declare.

DATA AVAILABILITY STATEMENT

All content underlying the text is contained in the manuscript.

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