LITERATURE REVIEW

Virtual reality-based interventions, a neoteric approach for management and rehabilitation in patients with breast cancer

Qurat-Ul-Ain Mohib, Lubna Vohra, Sana Zeeshan

Abstract

Breast cancer (BC) patients and survivors can experience immense emotional and psychosocial trauma. Treatment modalities for BC, including surgery, chemotherapy and radiotherapy are associated with certain displeasing and undesirable effects, including physical restrictions as well as mental stress. However, it has been ascertained that appropriate supportive and rehabilitative strategies can significantly help to alleviate the distress. Along with several conventional physical therapy options, the novel Virtual Reality (VR) tool has opened a new gateway in rehabilitative approaches in patients with BC. We reviewed the role of VR based management for BC-related incapacitations and found that its efficacy is comparable to that of contemporary therapy options. It has the additional benefits of modulating pain perceptions, improving mobility, and overall enhancing the quality of life of BC survivors.

Keywords: Breast Neoplasms, Pain Perception, Physical Therapy, Virtual Reality, Rehabilitation, Cancer survivors.

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Introduction

Currently, one of the most frequently encountered cancers globally in females is breast cancer (BC), transcending lung cancer with an approximation of over 2.3 million new cases in 2020.[1] It has been attributed to be the fifth leading cause of cancer mortality and second most common cause of mortality in women worldwide.[2,3] BC diagnosis and treatment have witnessed significant improvement during the last few decades, resulting in an increasing number of BC survivors, with up to 82% survival at 5 years in early stage of disease.[4] Diagnosis of BC follows enormous physical, emotional, and psychosocial distress, and so do the effects encountered during its treatment, causing unavoidable anxiety and depression.[5] Oncological management of BC varies widely depending on several prognostic factors, including the extent of disease, its metastasis, clinical staging, histological type, and molecular subtypes. Surgical intervention, chemotherapy and radiotherapy are considered the standard treatment options for BC, which may exhibit adverse effects, further worsening the quality of life of the patients.[5]

Patients undergoing treatment can experience a wide range of symptoms, including pain (both acute and post-mastectomy pain syndrome), lethargy, reduced muscle strength and range of motion (ROM) in shoulders, lymphoedema, post-fibrosis scarring, and an overall restriction of the upper extremity. Restricted ROM hampers daily living activities such as combing hair, head tilting, and movements that require shoulder lifting.[6] Furthermore, the inevitable complications such as bleeding, effusion, wound dehiscence, and flap necrosis during treatment can add to the agony.[7-9] As a result, there is a significant hindrance in treatment continuation, compliance, and duration. However, adequate supportive strategies have been found to notably reduce this drawback, resulting in improved mortality and recurrence rates.[10]

The rehabilitative measures in patients with BC mainly aim to improve upper limb mobility, which can be offered through several modalities such as conventional physiotherapy, kinesiotherapy, and massage techniques. On the other hand, different task-oriented programmes offer adaptability to daily living activities, which have shown to have better outcomes than conventional repetitive movement exercises.[11] Recent advances in technology have widely contributed to modifying rehabilitation and offering noninvasive techniques to manage unpleasant symptoms of cancer treatment.[12] Virtual reality, commonly addressed as VR, is one such tool that functions as an amiable technique to minimize the consequences of BC treatment, both psychologically and physically. It is as efficient as conventional physiotherapy in improving functionality in the upper extremity and activities of daily living.[13] The aim of this article is to review the promising role of VR-based interventions as a supportive modality for BC survivors.

Department of surgery, Section of Breast Surgery, Aga Khan University, Karachi, Pakistan.

Correspondence: Sana Zeeshan Email: sana.zeeshan@aku.edu

ORCID ID. 0000-0003-1645-400X

Materials and Methods

This literature review employed a structured approach to gather and analyze information related to the role of VR in BC post treatment rehabilitation. A comprehensive search of electronic databases, including PubMed and Google Scholar, was conducted to identify relevant articles published from the year 2000 up to the present date. The search strategy incorporated keywords such as "virtual reality", "breast cancer" and "rehabilitation". The inclusion criteria encompassed peer-reviewed articles, reviews, and guidelines addressing role of VR in rehabilitation of patients with BC. Additionally, grey literature and reports from reputable health organizations were considered to obtain a broad spectrum of data.

The identified literature was then diligently reviewed, and relevant data was extracted. The data extraction process focused on key aspects such as effects of BC treatment on quality of life and role of VR and its rehabilitative outcomes. The selected studies were critically appraised for methodological quality and relevance to the research objectives.

The limitations of this review include the potential bias in the available literature and the absence of specific data on utilization of VR as an adjunct therapy in BC patients' rehabilitation. Despite these challenges, the review aimed to provide a comprehensive overview of the existing knowledge and highlight the critical gaps in understanding routine use of VR in this area of medicine. The findings from this review are expected to contribute valuable insights for future research, clinical guidelines, and incorporating VR as a rehabilitation tool for BC patients.

Review of literature

VR is an innovative technology that functions through a computer simulation system, enabling users to experience and perform activities in a virtual/artificial environment.[14] Its mechanism incorporates sensory stimuli such as sounds, visuals, and tactile stimulation into a three-dimensional virtual world. It renders a perception of being physically present, hence, allowing users to interact with their environment.[15]

The origin of VR dates to late 1960s, however, it was not until early 1990s when clinicians began to use it as a tool in both mental and physical rehabilitation.[16]

In healthcare, VR is benefited as a non-invasive modality to manage obnoxious symptoms associated with cancer treatment.[12] VR systems are available as head-mounted devices (HMDs) with stereographic potential and other somatosensory devices, including headphones, 3D glasses, body tracking sensors, and input devices such as gloves and joysticks. This helps bridge the gap between the real and virtual world, thus providing an opportunity for interactive feedback between the user and the virtual environment.[17]

VR systems are broadly categorized as immersive, semi-immersive and non-immersive, based on how disconnected a person can get from the real world and 'immerse' in a 3-dimensional virtual environment.[18] In immersive VR systems, HMDs are used that entirely occlude the perception of the external environment and cancel any sound or light from the surroundings, letting the subject have computer-generated visuals instead. This facilitates the patients in peacefully concentrating on the pleasant stimuli offered to distract them from the torment of cancer treatment in an apparently isolated environment.[17,18] On the contrary, non-immersive VR system involves the interaction of the subject with a screen (mobile, TV, computer) displaying the visuals, yet being able to interact with their real-world milieu. This allows the patients to receive certain interventional procedures in a relatively secure environment.[19] A semi-immersive system is somewhere between the immersive and non-immersive VR systems, capable of enabling the subjects to still interact with the screen with certain body movements while being linked to the world outside. [19-21]

Lately, VR has surfaced as a promising technology tool in supporting patients undergoing cancer treatment and minimizing their suffering.[12] It functions as a distraction intervention in alleviating pain, fatigue, anxiety, depression, and cognitive dysfunction and can be utilized in numerous ways by playing mind-relaxing sceneries, virtual interaction, and feedback, or engaging in a task-based activity or even incorporating it with music therapy.[22] It can also be used for mind relaxing or meditation in the form of VR-guided sessions.[22] VR has a profound application in physical rehabilitation to improve functionality and encourage performing activities of daily living, making it ideal to be used as an adjunct in patients with BC.[23,24] According to several studies, VR plays a significant role in educating and rehabilitating BC patients and empowering them to endure the torment of cancer-associated symptoms.[23] Bu et al., 2022 reported that VR-based interventions are more effective in enhancing the emotional, cognitive, and physical well-being of BC survivors by playing relaxing visuals, such as visually soothing landscapes, etc.[4]

Feyzioğlu et al., 2020 compared 20 women with BC who received VR-based therapy with 20 women who received standardized physical therapy for pain and motion limitation after BC surgery. They found that the VR

therapy group had significantly better pain relief and functionality outcomes as compared to conventional therapy group.[25] House et al., 2016 found notable improvement in pain, ROM, muscle strength, grip strength, and functionality, as well as reduced fear of movements in patients who underwent mastectomy or axillary clearance surgery.[26] Additionally, JIN et al., 2018 conducted a study involving 76 cases of BC and found that a VR system with a supplemental game-based treatment reduces negative emotions after surgery and also improves limb function recovery by reducing lymphoedema.[27] Chirico et al., 2020 reported immersive form of VR to be an effective intervention in relieving anxiety, depression, and fatigue and a source of mood elevation in BC patients during chemotherapy. Its efficacy was also compared with musical therapy and was found to be greater.[24]

Like any other advancements in the modern world, VR-based rehabilitation also has constraints. Cybersickness, the most noteworthy, refers to the undesirable effects a user might experience after an immersive VR encounter.[28] It may manifest as nausea, vomiting, headache, fatigue, eyestrain, dizziness, confusion, gait abnormalities, diaphoresis, and other psychosomatic features.[24,29] It is due to the subject's sensorimotor adjustment to the VR immersion, which is a natural and automated response to an intersensory deficient virtual experience. It has been found that these intersensory mismatches are rectified continuously to new inputs by the plasticity of the human brain [28,29] Additional challenges include weighted and large headsets, user discomfort and reluctance, insufficient number of trained therapists, high equipment costs, etc. User hesitancy is yet another prominent factor hindering VR's successful implementation. This is understandable as there is a lack of awareness, familiarity, and fear of using it.[30]

Conclusion

VR-based interventions have brought forth a new outlook in the rehabilitative management of BC. It has proved to be an excellent non-invasive approach to overcome the misery of symptoms that follow BC treatment, including pain, fatigue, anxiety, depression, cognitive dysfunction, and ROM restrictions that impede activities of daily living. Numerous VR-based rehabilitation tools and devices are available, including computers, TV, and mobiles. Nevertheless, certain limitations still hamper the widespread availability and utilization of VR. These include cybersickness, uncomfortable headsets, user discomfort and reluctance, and high equipment cost. In the upcoming era, it is essential to conduct extensive studies, particularly randomized controlled trials on a larger sample size and longer follow-up on VR-based management and rehabilitation and inspect its aptness, accessibility, and acceptance among BC patients.

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