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Effect of Chest Biofeedback Exercises on Physical Stress Level on Leukemic Children Post Chemotherapy Session: A Review Article

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ABSTRACT

Background: Leukemia is the most common childhood cancer. Chemotherapy is the primary treatment for this kind of cancer and is typically administered in three steps: Induction, consolidation and maintenence chemotherapy. Chemotherapy treatment can lead to physical stress, anxiety and fatigue, which may interfere with drugs efficacy. Breathing exercises stimulates parasympathetic nervous system, which will trigger the release of endorphins and affect directly the autonomic nervous system and help in decrease child physical stress

Objective: This review aimed to highlight the effect of chest biofeedback exercises on physical stress level in leukemic children.

Methods: We searched both Google Scholar and PubMed for effect of chest biofeedback exercises, physical stress level on leukemic children, heart rate variability (HRV), and blood volume pulse (BVP). Only the latest or comprehensive study from January 2015 to January 2023 was included, while the authors additionally assessed references from pertinent literature. Languages other than English have been excluded because of the dearth of translation sources. Oral presentations, dissertations, conference abstracts, and unpublished articles were excluded since they did not pertain to significant scientific studies.

Conclusion: This review looked at how chest biofeedback exercises can affect physical stress in leukemic children. A lot of studies showed the psychological side effects of using chemotherapy. The physiological stress can affect HRV, respiratory rate, galvanic skin response (GSR) and BVP, Biofeedback chest exercises as diaphragmatic breathing and pursed have a significant effect on this physiological stress which help the children by diminish some of side effect after chemotherapy sessions.

Keywords: Acute lymphoblastic leukemia, HRV, GSR, BVP, Diaphragmatic breathing.

INTRODUCTION

The creation of aberrant leukocytes, either as a primary or subsequent process, is known as leukemia. They can be categorized as myeloid or lymphoid depending on the originator cell, and as acute or chronic depending on the rate of proliferation [(1)].

Acute lymphoblastic leukemia (also known as acute lymphocytic leukemia, or ALL) is a clonal malignancy of the bone marrow in which the normal hematopoietic cells in the marrow are replaced by early lymphoid progenitors. Children's leukemia and cancer are most commonly caused by ALL [(2)]. At over 25% of all pediatric malignancies, pediatric ALL is the most prevalent kind of childhood cancer [(3)]. Chemotherapy is the primary treatment for children with ALL, and it is typically administered in three stages: Induction, consolidation, and maintenance [(4)].

Anxiety, sadness, fatigue, and discomfort symptom can all exacerbate therapy adverse effects and reduce its efficacy. As a result, therapeutic measures that improve treatment tolerance are essential for cancer patients' quality of life [(5)].

Psychological distress can lead to non-compliance of patients with chemotherapy, resulting in failure of treatment [(6)].

This review aimed to highlight the effect of chest biofeedback exercises on physical stress level in leukemic children.

Chemotherapy:

Multidrug chemotherapy regimens have been the mainstay for treating ALL, and while they are typically successful in obtaining a high response rate, there is also a large amount of potential for improvement due to the high recurrence rates [(7)].

Anxiety and leukemia:

Anxiety and post-traumatic stress syndrome (PTSS) are among the negative psychological long-term effects linked to a cancer diagnosis and therapy in teenage survivors of pediatric malignancies [(8)].

Between 35% and 55% of cancer patients experience distress. Anxiety levels are raised and patients' quality of life is decreased by depression, despair, and a lack of control over treatment choices [(9)].

Heart rate variability — (HRV):

Given its affordability and ease of obtaining data, HRV—which is the instantaneous fluctuation of time intervals between consecutive heartbeats—is a potential technique for determining and assessing consumer psychophysiological reactions to marketing stimuli [(10)].

Since low parasympathetic activity is thought to be a sign of stress, HRV is frequently used to accurately measure the physiological stress response since it represents autonomic nervous system activity [(11)].

An individual's state of well-being is significantly influenced by their HRV. It is the outcome

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of how the parasympathetic and sympathetic nervous systems interact. Where HRV is increased by the sympathetic nervous system and decreased by the parasympathetic nervous system. A high HRV is thought to be a sign of excellent health [(12)].

Blood volume pulse — (BVP):

By measuring the amount of blood that passes through the sensor in either red or infrared light, BVP is a technique for detecting heartbeats. HR and HRV may be computed from BVP. Along with the variations in heartbeats, BVP reveals the variations in blood volume between each heartbeat. Optical, non-invasive sensors compare the amount of light absorbed by the blood to determine BVP [(13)].

In order to determine meaningful factors including heart rate (HR), HR variability (HRV), BP and HRV, the BVP signal is frequently studied to evaluate the physiological and psychological states of persons [(14)].

Electrodermal activity — (EDA):

By revealing changes in the electrical characteristics of the skin, EDA serves as a valuable marker for neurocognitive stress. The body is supposed to begin perspiring when a subject is placed in a stressful situation, which raises the conductance of the skin [(15)].

People can monitor their stress levels at home with a wearable device that incorporates GSR. If there are any concerning circumstances or even signs of stress, they can try to alter their lifestyle and engage in therapeutic activities like yoga, dancing, exercise, or anything else that helps them feel better [(16)].

A shift in the skin's electrical characteristics is the definition of the GSR. The signal may be utilized to gauge the sweat gland function by measuring the ANS's response. It appears that the reaction is a decrease in resistance and an increase in electrical conductivity of the skin across the palms of the hands or soles of the feet. One strategy for lowering stress is to practice breathing techniques. Diaphragmatic breathing acts on the ANS to reduce stress, which may also lower BP. GSR is an outcome measure that indicates the body's level of stress [(17)].

Breathing exercises:

A variety of non-resisted, timed breathing techniques, such as abdominal and diaphragmatic breathing, are included in the general phrase "breathing exercise." Additional physiological responses to breathing exercises include better ventilation efficiency, elevated HRV, and changes in autonomic activity. The duration of inhaling, holding, and releasing each breath, the frequency of breathing (breaths per minute), and whether to use mouth or nose breathing are all factors in breathing exercises [(18)].

According to research, breathing exercises play a significant role in the regulation of many bodily processes. Improving their effectiveness can have a number of positive health effects, including preventing heart attacks and treating conditions like depression, anxiety, stress, asthma, and post-traumatic stress disorder (PTSD) [(19)].

Types of breathing:

The diaphragm, the primary muscle involved in breathing, is strengthened via diaphragmatic breathing, often known as belly breathing or abdominal breathing. The diaphragm is responsible for 80% of breathing. People might feel more at ease and refreshed by performing diaphragmatic exercises [(20)].

The practice of inhaling via the nose while keeping the mouth shut and expelling through firmly pursed lips is known as pursed-lip breathing. It is a useful technique for slowing down breathing and lengthening the time spent exhaling, which permits the release of more air with each breath cycle. People with obstructive lung illnesses, such as chronic obstructive pulmonary disease and asthma that causes dyspnea, have been found to benefit from this method [(21)].

The technique known as "biofeedback" combines the feedback from biosensors, such electrodes, to show the client physiological reactions in real time using technological equipment. The teaching of physiological responses by operant conditioning encourages interoceptive self-regulation, which is typically not a conscious activity. Autonomic mechanisms for feedback through respiratory feedback, HR, HRV, and EDA is well-established in relation to the treatment of anxiety disorders. Through operant control, physiological processes are often better regulated based on the feedback of these signals (such as through intonation or vision). The use of HRV is noteworthy since it significantly lowers self-reported stress and anxiety [(22)].

CONCLUSION

This review looked at how chest biofeedback exercises can affect physical stress in leukemic children. A lot of studies showed the psychological side effects of using chemotherapy. The physiological stress can affect HRV, respiratory rate, GSR and BVP. Biofeedback chest exercises as diaphragmatic breathing and pursed have a significant effect on this physiological stress, which help the children by diminishing some of side effect after chemotherapy sessions.

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