4-2020

Phase Angle Adaptation to Exercise Training in Cancer Patients Undergoing Treatment

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ABSTRACT

Purpose: To assess the effect of chronic exercise on phase angle in cancer patients who are actively undergoing chemotherapy and/or radiation. **Methods:** A total of 56 cancer patients who were actively undergoing chemotherapy and/or radiotherapy were recruited to participate in a 12-week exercise-based rehabilitation program at the University of Northern Colorado Cancer Rehabilitation Institute (UNCCRI). Each participant underwent an initial assessment of body composition and phase angle analysis via the InBody 770 (InBody USA, Cerritos, CA). Results of this assessment were used to develop an individualized exercise prescription. Each participant received prescribed, supervised, one-on-one training from a Clinical Cancer Exercise Specialist, three times per week for one hour each session. Each session of exercise consisted of 20 minutes of aerobic training, 30 minutes of balance and resistance training, and 10 minutes of flexibility training at a low to moderate intensity. After 12 weeks, each participant underwent a follow-up assessment of body composition and phase angle. **Results:** After 12 weeks of exercise training, significant increases in whole body (Initial: 4.55 ± 0.72, Follow-up: 4.68 ± 0.68; p = 0.02), right arm (Initial: 4.45 ± 0.76, Follow-up: 4.57 ± 0.72; p = 0.03), and left arm (Initial: 4.28 ± 0.79, Follow-up: 4.39 ± 0.75; p = 0.03) phase angle were observed. **Conclusion:** This study demonstrates that prescribed exercise training can increase phase angle in cancer survivors even while undergoing chemotherapy and/or radiation treatments. These changes may provide insight into the protective and rehabilitative benefits (e.g., cellular health, membrane integrity, disease risk) that exercise may have in this population.

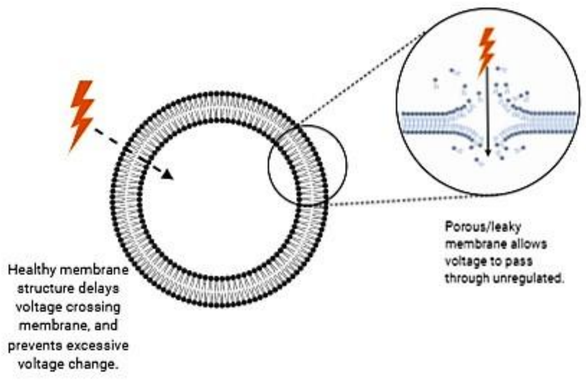

FIGURE 1: Visual summary of phase angle under optimal and suboptimal conditions along the cell membrane.

INTRODUCTION

Phase angle is a measure of cellular resistance and reactance to bioelectrical impedance analysis. This measure is comprised of resistance to the current from water within the body and time delay of the current at the membrane prior to passing through (Figure 1). Greater impedance results in a higher phase angle, thus indicating greater membrane integrity. Lower phase angle is indicative of a porous or leaky membrane which, due to this dysfunction, allows swifter movement of an impulse into the cell. Due to the relationship between phase angle and cell membrane integrity, it is used as a prognostic marker in several clinical populations. Cancer and its related treatments impact cell membrane integrity and lead to poor cell function. Exercise has been shown to increase phase angle, which is associated with lowered risk of hospitalization and cardiovascular events. However, the effect of chronic exercise training on phase angle in the cancer population is unclear.

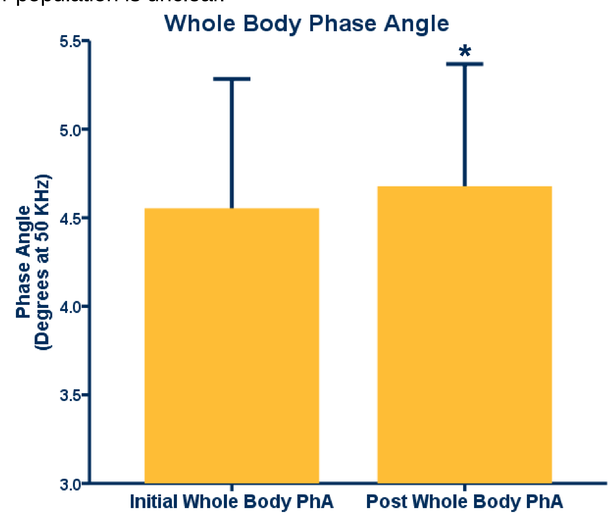

FIGURE 2: Change to whole body phase angle. Data are mean ± SD. *P < 0.05 Initial vs Post.

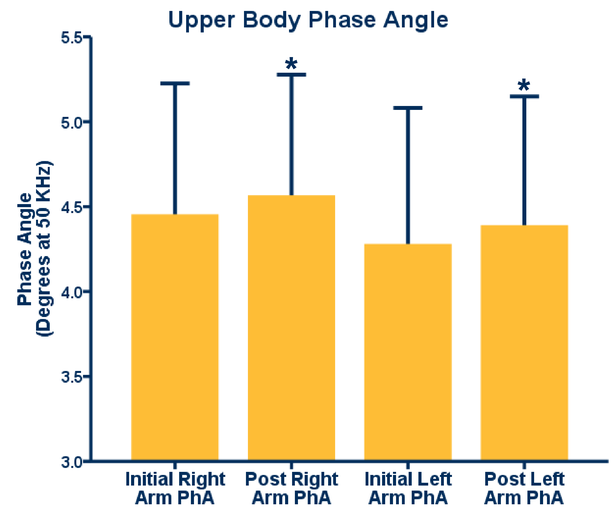

FIGURE 3: Change to upper body phase angle. Data are mean ± SD. *P < 0.05 Initial vs Post.

METHODS

Fifty-six cancer patients actively undergoing chemotherapy and/or radiation were recruited for enrollment in a 12-week exercise training program. Upon referral by a physician, participants underwent an initial assessment of various physiological parameters, including body composition and phase angle. Body composition and phase angle were assessed using the InBody 770 bioelectrical impedance analyzer. Phase angle was measured by applying 50 KHz of current through the participant. Phase angle was quantified via cellular impedance to the current at the membrane. Phase angle was assessed throughout the whole body and segmentally in the left arm, right arm, trunk, left leg, and right leg. Right and left arms and legs were used collectively to assess upper and lower body phase angle, respectively. All individuals completed their 12-week rehabilitation. After 12 weeks, participants were reassessed for body composition and phase angle. Paired t-tests were used to examine changes in phase angle over the 12-week training period.

RESULTS

Twelve weeks of exercise rehabilitation resulted in a significant improvement to whole body phase angle (Figure 2; Initial: 4.55 ± 0.72, Follow-up: 4.68 ± 0.68; p = 0.02) and upper body phase angle: right arm (Figure 3; Initial: 4.45 ± 0.76, Follow-up: 4.57 ± 0.72; p = 0.03), and left arm (Figure 3; Initial: 4.28 ± 0.79, Follow-up: 4.39 ± 0.75; p = 0.03). No significant improvement was seen in phase angle of the lower body, defined as either leg, or in the trunk.

CONCLUSIONS

- Prescribed exercise can increase phase angle in cancer patients, despite actively receiving chemotherapy and/or radiation.
- These changes provide insight into the protective benefit of exercise on cellular health in this population.
- Whole body and upper body phase angle see significant benefit from 12 weeks of exercise rehabilitation.
- The effect of chemotherapy and/or radiation on the phase angle of the trunk and lower body may require longer periods of exercise training to induce significant change.

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