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Letter to the Editor

Cardiovascular Rehabilitation Program and Its Effect on Cardiac Coherence

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Dear Editor-in-Chief

Cardiovascular diseases (CVD) persist as a leading global cause of death despite medical advancements. Stress, be it physical, metabolic, or emotional, poses a significant risk of CVD. The role of the autonomic nervous system (ANS) in CVD pathogenesis is increasingly recognized, with studies revealing correlations between autonomic imbalance (AI) and cardiovascular issues, including heart failure, arrhythmia, ischemia/reperfusion injury, and hypertension (1-3). The vagus nerve, comprising 75% of parasympathetic fibers, plays a crucial role in CVD regulation, influencing the heart, immune response, mood, and digestion (4). Its effects on the heart include negative chronotropic action (reducing heart rate), dromotropic action (reducing atrioventricular conduction), and inotropic action (reducing ventricular contractility) (5). Heart rate variability (HRV) is considered a measure of neurocardiac function, reflecting dynamic interactions between the sympathetic and parasympathetic nervous systems (6).

This study, conducted in 2018, enrolled 40 cardiovascular patients, referred within six months of an acute myocardial infarction, for a three-week rehabilitation at the Institute "Dr. Simo Milosevic" in Igalo, Montenegro. All participants underwent a standard cardio rehabilitation program, supervised by trained staff, involving interval training, walking, swimming, and muscle exercises.

Holter ECG monitoring (Schiller Medilog AR12 Plus) and echocardiography (ACUSON NX3™, Siemens) were conducted before and after the rehabilitation. To assess coherence states (CSs), the emWave Pro device (HeartMath) was utilized, measuring pulse and translating coherence information into graphics. Testing occurred in a quiet, air-conditioned room, with patients seated, lasting 15 minutes. The device, set at a medium-level challenge, displayed coherence as a smooth sine-wave-like pattern in the HRV tracing, with total CSs categorized as basic (0.5-1), good (1-2), very good (2-3), and excellent (+3). Coherence levels (CLs) were classified as low (absence of wavelike activity), medium (some wavelike activity), and high (considerable wavelike activity).

The study received approval from the Ethical Committee of the Faculty of Medicine, University of Montenegro (number 1113/2, 2018). Statistical analysis of results was performed using IBM SPSS Statistics, Version 26.0 software (IBM Corp., Armonk, NY, USA), with a significance level set at $P< 0.05$.

Holter ECG monitoring before and after rehabilitation showed no significant change. However, echocardiography revealed significant improvements in ejection fraction (P<0.001), end-diastolic volume (P <0.005), and posterior wall thickness (P <0.009), but not for end-systolic volume after rehabilitation. Rehabilitation had a substantial impact on cardiac wall motion, resulting in a reduction in the percentage of akinesia and an increase in hypokinesia (Chi-square 13.727; P <0.001). The coherence measurements are presented in Table 1.

Table 1: Coherence score and coherence levels before and after rehabilitation (mean ± SD)

Variables	*Before Rehabilitation*	*After Rehabilitation*	*P Value*
Coherence Score	0.89±0.23	0.87±0.25	0.780
Average Testing Heart Rates (/min)	73.23±11.67	68.55±8.53	0.012
Low Coherence Level (%)	50.41±14.69	49.95±11.98	0.903
Medium Coherence Level (%)	41.05±11.54	36.91±9.96	0.173
High Coherence Level (%)	8.14±6.02	13.14±6.02	0.043

Cardio rehabilitation significantly decreased average testing heart rates and increased the percentage of time in the high CLs. No significant relationships were found between anthropological parameters and CSs. Before rehabilitation, akinesia had a significant association (β=-0.450; P<0.001), while end-systolic (β=-0.074; P<0.026) and end-diastolic volume (β=0.067; P<0.046) demonstrated significant associations after rehabilitation.

Our study presents compelling evidence that a standard cardiovascular rehabilitation program, featuring moderate aerobic exercise over three weeks, significantly enhances cardiac coherence and ANS activity in patients who have suffered an acute myocardial infarction within the last six months. Notably, the program not only improved cardiac contractility and wall motion but also led to a noteworthy increase in high levels of cardiac coherence.

These results underscore the pivotal role of non-pharmacological approaches, such as cardiovascular rehabilitation programs, in ameliorating cardiac health and ANS function in individuals with cardiovascular diseases.

However, it is crucial to acknowledge certain limitations in our study, including a relatively modest sample size and a focus on patients specifically with acute myocardial infarction. To validate and extend these findings, further research with larger sample sizes and encompassing a broader spectrum of cardiovascular patients is warranted. Despite these limitations, our study contributes valuable insights to the expanding body of literature that affirms the efficacy of cardiovascular rehabilitation programs in enhancing cardiac health and autonomic function.

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