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Cardiovascular Ischemic Stroke Autonomic Imbalance During Exercise Stress Testing

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Introduction

Exercise stress testing (EST) has limited diagnostic power for obstructive coronary artery disease (CAD). The analysis of heart rate variability (HRV) may improve the sensitivity of CAD detection. The purpose of this study was to look at the relationship between short-term HRV and myocardial ischemia during EST, specifically the acceleration, maximum and recovery stages of heart rate (HR). HRV during EST was compared in 19 healthy (RHC) subjects and 35 CAD patients (25 with insignificant CAD (iCAD) and 10 with significant CAD (sCAD)). As a result, at the maximum stage, all HRV indices decreased and no significant differences between iCAD and sCAD were discovered.

Most HRV indices had smaller relative changes between maximum HR and recovery stage in the sCAD group than in the RHC group, particularly LF, the standard deviation of all normal to normal intervals (SDNN) and the standard deviation in the long axis direction of the Poincaré plot analysis (SD2). The LF recovery slope in the sCAD group was significantly lower than in the RHC group. The findings suggest that monitoring short-term HRV during EST can help patients with significant CAD understand their cardiovascular autonomic imbalance. The relative change in autonomic tone, particularly the delayed sympathetic recovery, could be used to help diagnose myocardial ischemia.

Description

Coronary artery disease (CAD), defined as a narrowing or obstruction of the coronary arteries, is the leading cause of death worldwide. As a result, early detection of CAD is critical in the primary prevention of cardiac death. CAD causes abnormal electrocardiograms (ECGs) and arterial waveforms [1-3]. Exercise accentuates the abnormal features of a CAD patient. In exercise stress testing, the effects of exercise on the heart can be monitored using an ECG for a subject running on a treadmill. As a result, EST is frequently used as a clinical approach to diagnosing CAD.

The diagnostic accuracy of EST, on the other hand, can be influenced by the patient's age, gender, or clinical characteristics. When compared to diagnostic imaging tests, EST has limited ability to rule in or rule out obstructive CAD. In practise, EST has a 68% sensitivity and a 77% specificity for detecting CAD. Because of the high false positive rate, positive EST results should be treated with caution. According to the 2019 European Society of Cardiology (ESC) Guidelines for Diagnosis and Management of Chronic Coronary Syndromes, EST should only be used to assess risk rather than to diagnose CAD. Heart rate variability (HRV), on the other hand, is a relevant marker reflecting cardiac variation by the sympathetic and vagal components of the autonomic nervous system. Autonomic dysfunction, which involves the development of cardiovascular disease or the progression of metabolic disease, is directly related to the morbidity and mortality caused by CAD [4,5].

Vagal-mediated HRV indices, for example, can be used to distinguish between healthy and diseased states and have been found to be inversely related to metabolic diseases such as diabetes, central obesity, dyslipidemia and hypertension. Long-term HRV was largely used to predict sudden cardiac death in the vagal-mediated HRV analysis. Short-term HRV is also used to improve risk assessment in low- to intermediate-risk individuals who do not have known CAD. HRV appears to be sensitive and responsive to acute stress, including exercise, as a dynamic marker while experiencing different loads.

Conclusion

However, the diagnostic potential of exercise-related HRV in diagnosing CAD remained controversial. It was discovered that HRV indices corrected by mean heart rate (HR) and respiratory frequency could improve the accuracy of EST by 76% to 95%. However, previous research found that the values of HRV indices alone or corrected with HR were insufficient for detecting CAD. As a result, the purpose of this study was to assess the relationship between short-term HRV and myocardial ischemia during EST, including the acceleration, maximum and recovery stages of heart rate.

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