Surname*et al. CHATmed* Year;Volume:Number
DOI: 10.20517/chatmed.xxxx.xx

Connected Health And Telemedicine

Open Access

Original Research Article

Effects of Cold Pressor Test on Heart Rate and Heart Rate Variability

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Abstract

This study aims to investigate the effects of cold pressor test (CPT) on heart rate (HR) and HR variability (HRV), which are clinically useful parameters for the assessment of autonomic nerve function and cardiovascular activities. The CPTs were conducted on 22 subjects under 4 different phases including: baseline phase (Rest1), cold stimulus phase, recovery phase and followed by another baseline phase (Rest2). It was found in this study that exposure to the cold water would result in significant increased HR ($p<0.001$) and decreased HRV, reflecting the regulation process of the autonomic balance to adapt to the temperature change. Notably, a unique response was observed in one hypertensive subject that his HR decreased during cold stimulus phase. The results of this study should be helpful for understanding the regulatory mechanisms of the autonomic system and its effects on the cardiovascular system and thus, provide a possible approach for the intervention and management of cardiovascular diseases (CVDs).

Keywords: Heart rate, Heart rate variability, Cold pressor test, Cardiovascular activities

INTRODUCTION

The autonomic nervous system (ANS) plays a pivotal role in driving cardiovascular control dynamics, including the regulation of heart rate (HR), blood pressure (BP), respiration etc. [1, 2] It has been shown that the heart rate variability (HRV) analysis provides a reliable reflection of the balance between the sympathetic nervous systems (SNS) and parasympathetic nervous systems (PNS), which is a powerful non-invasive parameter for assessing the function of the ANS and the status of various heart diseases by measuring the changes in the cardiac rhythm through time.[3] The cold pressor test (CPT), in which the subject immerses one hand or foot into ice water for 1–3 min, serves as a valuable tool to provoke sympathetic activation and has been used in the clinical and research settings to evaluate sympathetic neural control in humans.[4] Therefore, the analysis of the HR and HRV during CPT is a simple and efficient method to trigger the cardiovascular dynamics and understand the mechanism behind.