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Heart Rate Variability Parameters Indicate Altered Autonomic Tone in Patients with COVID-19

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Abstract

The COVID-19 disease induces long term heart health complications and may induce autonomic nervous system dysfunction. Heart Rate Variability (HRV) is a measure of sympathetic (SNS) and parasympathetic (PNS) control of heart function. Recently, studies have shown that HRV analysis may be used as a predictor of COVID-19 symptoms and correlates with progression of the disease. We aimed to uncover the interplay between SNS and PNS in hospitalized COVID-19 patients at the time of admission and compare it with similar measurements in healthy patients (no comorbidities) and patients with cardiovascular disease. We hypothesized that COVID-19 would induce autonomic dysfunction similar to patients with cardiovascular disease (CVD). ECG telemetry recordings of 30-60 minutes in duration were acquired from patients that were admitted to Indiana University Health system hospitals for either COVID-19 complications or for complications associated with cardiovascular disease (CVD) states (arrhythmia, heart failure, coronary artery disease). In addition, 20-minute ECG Lead I recordings were obtained from healthy volunteers with no associated comorbidities. HRV parameters were calculated during sinus rhythm in the time, frequency, and nonlinear domains from the ECG telemetry recordings. The patient population was composed of 50 COVID-19 patients (average age 63, range 26-94), 32 healthy (average age 32.7, range 17-69) and 49 patients with cardiovascular disease (average age 65.4, range 30-88) as control groups. The COVID-19 group had a higher percentage of patients with BMI>30 (obese) than the control groups (55% vs 36%). Also, the COVID-19 and CVD patients had significantly higher heart rate and time-domain HRV parameters (including SDRR,

RMSSD, SDSD) and SD1 in the non-linear domain when compared to healthy patients (88.8 ± 53.0 and 87.9 ± 55.2 vs 49.5 ± 31.3 , $p < 0.01$). In the frequency domain, the LF/HF ratio was significantly lower in the COVID and CVD groups compared to healthy controls (0.5 ± 0.76 and 0.55 ± 0.50 vs 1.05 ± 0.96 , $p < 0.01$). COVID-19 patients have significant HRV alterations which suggest increased vagal tone than in healthy volunteers but similar to patients with severe cardiovascular disease comorbidities. Even though the COVID patients had an increased heart rate, the results of the HRV analysis indicate increased vagal tone which would support autonomic nervous system dysfunction in these patients.