

Attenuated Pulse Pressure Recovery Following Orthostatic Stress in Patients with Long COVID-19

Ana L G dos Santos¹, Kelly C B da Silva¹, Stella T Maximo², Silvia H Bastos de Paula³, José L Puglisi⁴, Daniel G Goroso¹⁻⁵

¹Universidade Mogi das Cruzes, SP, Brasil.

²São Leopoldo Mandic Medical School, SP, Brazil.

³Health Institute of São Paulo, SP, Brazil.

⁴College of Medicine, California North State University, USA.

⁵Facultad de Education Physical, Universidad Nacional de Tucumán, Argentina

Long COVID-19 is recognized as a condition associated with autonomic nervous system (ANS) dysfunction, yet quantitative evidence regarding its impact on integrated hemodynamic regulation during recovery from orthostatic stress remains limited. This study assessed autonomic and hemodynamic imbalance in post-COVID-19 patients by evaluating heart rate variability (HRV) and blood pressure (BP) responses during tilt table testing.

We enrolled 61 participants, consisting of 39 Long COVID patients (Study Group, SG) and 22 healthy controls (Control Group, CG). The standardized protocol included three phases: 15 minutes of supine rest (Phase 1), 15 minutes of upright tilt at 75° (Phase 2), and 20 minutes of return to supine position (Phase 3). Pulse pressure (PP = SBP – DBP) was calculated for each phase, and baroreflex sensitivity (BRS) was derived from the $\Delta RR/\Delta SBP$ ratio during phase transitions.

The results indicated that SG participants exhibited autonomic dysfunction during tilt. In the upright phase, they showed a blunted sympathetic response characterized by a significant increase in mean RR intervals ($p=0.0136$) and a decreased LF/HF ratio ($p=0.0316$) compared to CG. Specifically, the SG demonstrated a significantly attenuated PP recovery when transitioning from the upright position back to the supine position (ΔPP_{2-3} mmHg; 95% CI: 5.6–10.4) compared to the CG ($\Delta PP_{2-3}=11.8$ mmHg; 95% CI: 9.2–14.4; $p=0.037$). Notably, BRS values did not differ significantly between groups during this transition ($p=0.401$), suggesting that fundamental baroreflex gain remains intact.

In conclusion, Long COVID-19 is associated with a discoordination of integrated autonomic and hemodynamic responses to orthostatic stress. The attenuated PP recovery suggests inefficient cardiovascular compensation and altered vascular reactivity occurring downstream of the baroreceptor reflex arc. These findings emphasize the clinical value of combined tilt testing and dynamic pressure analysis in uncovering hidden dysautonomia.