

## **Heart Rate Response to Maximal Exercise in a Participant with C8 Spinal Cord Injury**

NORBERT HOLOWAT<sup>1</sup>, ALEXANDER ROTHSTEIN<sup>2</sup>, JESSIE HIRSCH<sup>4</sup>, MICHELE AQUINO<sup>1</sup>, AMERIGO ROSSI<sup>2</sup> FACSM, & JOHN P. HANDRAKIS<sup>3</sup>

<sup>1</sup>Health and Sports Sciences Department; Adelphi University; Garden City, NY

<sup>2</sup>Interdisciplinary Health Sciences; <sup>3</sup>Department of Physical Therapy, New York Institute of Technology; Old Westbury, NY

<sup>4</sup>Department of Allied Health and Kinesiology; Hofstra University; Hempstead, NY

---

*Category: Graduate*

*Advisor / Mentor: Rothstein, Alex (arothste@nyit.edu)*

### **ABSTRACT**

Motor, sensory, and autonomic dysfunction are a common sequela after spinal cord injury (SCI) and typically impair cardiovascular responses to exercise. However, some individuals with cervical SCI (tetraplegia) and “complete” motor and sensory injury (AIS A) demonstrate the ability to increase heart rate (HR) above the limit achievable by vagal withdrawal alone (~110 bpm). **PURPOSE:** The purpose of this test was to highlight the unexpected HR response to a continuous graded exercise test. (GXT) in a wheelchair athlete with tetraplegia. **METHODS:** A 26-year-old male with tetraplegia after a SCI (classification neurological level of injury (NLI) C8, AIS A) who regularly competes in wheelchair road racing. He was classified in 8/2019 as NLI C6, AIS A by the International Standards for Neurological Classifications of SCI (ISNCSCI). Subsequent reassessment in 2023 reclassified his SCI as NLI C8, AIS A. This person is highly motivated, consistently engages in intense training for strength and aerobic performance.  $VO_2$  was measured using a MGC diagnostics Ultima series metabolic cart (Medgraphics Corporation, St. Paul, MN, USA). The participant used his personal push rim racing chair with stationary rollers designed for this chair as the ergometer. Speed was measured using his CATEYE Velo 7 Wired Bike Computer. A ramp-based protocol was performed starting at a speed of 6.38 mph, which was increased by 0.26 mph every 30 seconds until volitional fatigue. HR was collected every 15 seconds using an Apple Watch (Series 5, Apple Inc., Cupertino, California, USA). **RESULTS:** A  $VO_{2peak}$  of 28.2 ml/kg/min and a  $HR_{max}$  of 122 bpm were observed. **CONCLUSION:** The participant realized some neurological return, as evidenced by motor and sensory function two levels lower than his initial ISNCSCI exam. He also appears to have gained some return of sympathetic control of HR, evidenced by a  $HR_{max}$  greater than achievable by vagal withdrawal alone and a higher than expected  $VO_{2peak}$ . Expected  $HR_{max}$  and  $VO_{2peak}$  for persons with tetraplegia during maximal testing is ~110 bpm and  $17.4 \pm 4.7$  ml/kg/min, respectively. The improvement in motor, sensory, and sympathetic function may have occurred due to neuroplasticity being enhanced by the intensity and consistency of this person’s training.