

Title: The effect of increasing passive cycling intensity on global hemodynamics, brain and heart perfusion in septic patients

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Structured Abstract:

INTRODUCTION: Sepsis is a global problem associated with high mortality, morbidity and healthcare costs (1). Early mobilization of septic patients in the intensive care unit (ICU) improves cognitive, functional and healthcare utilization outcomes (2). However, patients' ventilator dependence and decreased level of consciousness often prohibit active exercise in the early stages of sepsis. In-bed passive cycling (PC) circumvents these barriers, but given tenuous hemodynamics and altered autoregulation in septic patients, it may cause harm by impairing perfusion of vital ischemia-prone organs, such as the brain and the heart, especially if delivered at the wrong intensity. We assessed the effect of varying PC intensities on global hemodynamics, brain perfusion and cardiac function in a cohort of septic patients.

METHODS: We used Finapres NOVA and arterial line to monitor hemodynamics, transcranial Doppler to monitor middle cerebral artery velocity (MCAv) as an indicator of cerebral blood flow, and speckle-tracking echocardiography to monitor heart function by measuring left ventricular ejection fraction (EF) and global longitudinal strain (GLS) in a cohort of septic patients undergoing incremental increase in passive cycling intensity. The protocol consisted of 8 stages each lasting 5 minutes. Starting at baseline (0 RPM), the cadence on the bicycle was increased in stages from 5 to 55 RPM in increments of 10 RPM, followed by 5 min recovery period at 0 RPM. Mean values were calculated for all measured parameters during the last 2 minutes of each experimental stage and ANOVA was used to determine difference between experimental stages both within and between patients.

RESULTS: Ten septic patients (six males, age 53.3 ± 9.8 years) completed the protocol within 1-3 days of ICU admission. PC intensity had no effect on hemodynamics, but was associated with a dose-dependent decrease in MCAv ($-5.7 \pm 2.0\%$ from baseline at peak intensity), and improvements in EF (7.4% increase from baseline at recovery stage) and GLS (10.9% decrease improvement from baseline at peak intensity). The changes in MCAv, EF and GLS were not uniform across patients, occurring at different PC intensities in some, while not changing in others.

DISCUSSION: In contrast to healthy subjects, septic patients responded to increase in passive cycling intensity by a dose-dependent decrease in MCAv and improvement in heart function, with no change in hemodynamics. These changes occurred at different cycling intensities between subjects, highlighting the need to consider individualized exercise dose prescription in septic patients. Future studies should explore the effects of observed changes on clinically relevant outcomes, including cognition and cardiovascular mortality and morbidity in septic patients.

REFERENCES: (1) Angus DC et al., 2006., (2) Cameron S et al., 2015