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Probing the Neural Mechanisms of Post-Anesthesia Care Unit Delirium Using Functional Near-Infrared Spectroscopy

Abstract

My objective is to develop fundamental knowledge necessary to prevent and treat post-anesthesia care unit (PACU) delirium (PACU-D). PACU-D is common and associated with increased morbidity, with surgery as a primary risk factor. However, little is known about its neuropathogenesis as it is difficult to neurologically assess patients recovering from anesthesia. Recent evidence suggests that the clinical manifestations of delirium are associated with oxidative stress and a decrease in connectivity between cortical regions. I hypothesize that PACU-D is marked by metabolic derangements in cortical areas comprising the default mode network, specifically the posteromedial complex (PMC) and prefrontal cortex (PFC). To test my hypothesis, I will use functional near-infrared spectroscopy (fNIRS): a non-invasive, safe, portable neuromonitoring technique that reveals changes in hemoglobin (Hb) concentrations over multiple cortical areas, similar to magnetic resonance imaging. I predict that patients with PACU-D will have 1) reduced oxyHb levels within PMC and/or PFC, and 2) reduced connectivity between PFC and PMC. In Aim 1 I will determine the relationship between PACU-D and local resting-state cortical hemodynamics. I will measure changes in Hb concentrations in PFC and PMC in age-matched, postoperative patients with and without PACU-D. In Aim 2 I will test whether PACU-D is associated with abnormal resting-state connectivity. Using signal processing techniques, I will compute functional connectivity between PFC and PMC in the same populations as in Aim 1. Together, my aims will test candidate brain regions underlying the clinical manifestations of PACU-D, which may ultimately aid in developing tailored treatments for delirium.