NON-INVASIVE MEASUREMENT OF CEREBRAL TISSUE OXYGENATION DURING A BLOOD TRANSFUSION IN TRAUMATIC BRAIN INJURED PATIENTS
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Introduction: The avoidance of secondary brain injury is a key objective during the acute care of traumatic brain injury (TBI) [1,2]. This is predominantly achieved by ensuring adequate cerebral blood flow and oxygen delivery. Because the concentration of hemoglobin is a major determinant of arterial oxygen content there is a strong therapeutic rationale to avoid anemia, and so it would seem physiologically rational to transfuse packed red blood cells (RBCs) when patients with brain injuries are anemic [3]. However, there are several lines of evidence that suggest the transfusion of RBCs in critically ill patients may have potentially harmful implications [4]. Thus, there is a diverse opinion on the benefits and thresholds for transfusion and an urgent need to understand the neurophysiologic effects [5-7].

Objectives: The aim of this study was to evaluate the effects of RBC transfusions on cerebral tissue oxygenation in critically ill TBI patients using the novel application of four-wavelength near-infrared spectroscopy (NIRS) technology. The purpose was to provide objective, non-invasively achieved, physiologically relevant data in order to provide some rational basis for transfusion-related decision-making in TBI patients.

Methods: This prospective, observational study has to date enrolled eight TBI patients admitted to a Neuro-Trauma Intensive Care Unit at a university hospital. Patients who, at the discretion of the treating physician, reached a threshold for transfusion of RBCs were monitored with the FORESIGHT cerebral tissue oximeter (Casmed, CT, USA). Cerebral tissue oxygenation (StO2) was measured pre-, during and post-transfusion of RBCs using two frontal scalp probes. StO2 readings for the left and right side of the brain were collected with concurrent values for vital signs and hemoglobin (Hb).

Results: Eight patients were measured over a 24-hour period, no transfusion-related adverse reactions were observed during the study. Blood transfusions resulted in increased Hb concentrations (median 73 (IQR 70.5-77.5) to 84.5 (IQR 83-93) g/L). Bilateral StO2 readings were not feasible in 2 patients due to complicated facial fractures and frontal hematomas. StO2 values strongly correlated with values obtained from the contralateral side in 5 out of 6 patients (p <0.01). RBC transfusion did not globally improve NIRS-derived StO2 values; there was a degree of inter-individual variation with improvement in most patients but deterioration in others. StO2 values on the left side increased in 4 out of 6 patients after a RBC transfusion (see Fig. 1) and 5 out of 6 on the right side (see Fig. 2).

Figure 2. Change in Right-Sided StO2 with Transfusion of RBCs