

Autonomic Function Can Evaluate Brain Stem Function to Determine Viability of Life

Joseph Colombo PhD, Charles CJ Wo, BS, Elif Aysin, MS, Ben Aysin, PhD, Kevan Iffrig, BS, Adam Colombo, DO, William C. Shoemaker MD

ABSTRACT

Introduction: Current methods in evaluating brain function to determine viability of life typically involves brain flow studies after cerebral edema or ischemia has occurred. We present data demonstrating earlier determination of lack of brain stem activity which can lead to earlier clinical decision-making, earlier family involvement in end-of-life issues, including organ donation, and decreased intensive care unit and ventilator-management time thereby decreasing hospital costs.

Methods: We non-invasively monitored concurrent autonomic and hemodynamic patterns in 71 consecutive brain dead (17, 4 female) and brain injured (54, 41 survivors, 14 females) patients. Simultaneous respiratory rate (RR) variability and heart rate (HR) variability (HRV) spectral patterns were collected and frequency analyzed to compute the autonomic measures relating to sympathetic and parasympathetic nervous activity (Low Frequency area or LFa in bpm^2 and Respiratory Frequency area or RFa in bpm^2 , respectively). Noninvasive hemodynamic monitoring included: a) cardiac index (CI) by bioimpedance, HR, and mean arterial pressure (MAP) to reflect cardiac function, b) pulse oximetry (SapO_2) to reflect changes in pulmonary function, and c) transcutaneous oxygen (PtcO_2) indexed to the FiO_2 as a marker of tissue perfusion.

Results: Brain dead patient were characterized by zero or near zero autonomic brain stem function as indicated by zero autonomic activity computed for either branch (average LFa = 0.13 ± 0.23 and average RFa = 0.19 ± 0.33). The end stage of the non-surviving brain injured patients had similar characteristics (average LFa = 0.23 ± 0.19 and average RFa = 0.23 ± 0.28). The end stage of the surviving brain injured patients had significant autonomic activity (average LFa = 2.41 ± 5.29 and average RFa = 3.95 ± 1.87).

Conclusion: Autonomic function testing results can be used to objectively evaluate brain stem function.