Venous Physiology Predicts Anesthetic Induced Hypotension in Infants

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INTRODUCTION: Fast Fourier transform (FFT) of a peripheral venous pressure (PVP) waveform in infants has been shown to predict euvolemia. We hypothesized that the FFT of the PVP waveforms would differ between euvolemia and anesthesic induced vasodilation.

METHODS: PVP waveforms were collected in 13 infants via a 24-gauge peripheral intravenous catheter using a PowerLab (ADInstruments) data acquisition system. Datasets were collected 2 hours prior to surgery when the infant was euvolemic (preoperative) and during anesthesic induced vasodilation in the operating room (intraoperative). FFT was performed using MATLAB (MathWorks) custom designed software on all available 10-second waveform segments. Each segment was mapped from 0 Hz to 19.9 Hz at 0.1 Hz intervals in the frequency domain. Kernel Principal Component Analysis was performed to transform the high dimension frequency domain data to a non-linear lower dimension with orthogonal basis. A k-nearest neighbor algorithm was then applied to cluster the dataset. Each segment was tagged as 0 (preoperative) and as 1 (intraoperative); 80% of the data with 5-fold cross validation were used to train and tune the model, and 20% data were used to test the model.

RESULTS: A total of 718 10-second segments were analyzed: 575 in the preoperative group and 143 in the intraoperative group. The algorithm correctly predicted 93% as preoperative and 85% as intraoperative.

CONCLUSIONS: FFT of PVP waveforms can predict anesthesic induced vasodilation in infants and those waveforms are distinctly different from the euvolemia waveforms. This predictive model could be used to predict the vasodilation of sepsis with noninvasive monitoring in infants.