Title: Evaluation of RPVI as an Improved Non-Invasive Dynamic Monitor of Cardiac Function

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Intraoperative fluid mismanagement can have clinical consequences ranging from shock to pulmonary edema. While various management strategies exist, there is still a need to develop an accurate, non-invasive parameter predictive of fluid responsiveness. Recent investigations have demonstrated that dynamic monitors of cardiac function like pulse pressure variation (PPV) and pleth variability index (PVI) can predict fluid responsiveness [1]. PPV has limited clinical applicability due to its requirement of an invasive arterial line. PVI is based on the pulse oximeter waveform and therefore is non-invasive, but it is less sensitive and specific than PPV [2]. PVI is also only predictive in specific clinical scenarios [3-5]. A new, non-invasive parameter: Rainbow pleth variability index (RPVI) was recently developed to correlate better with PPV. In this investigation, we compared PPV to RPVI.

Data was collected from Loma Linda, University of Florida, Jacksonville and University of California, Davis using IRB approved protocols. Each patient provided written informed consent. Acquisition software collected intraoperative data every three seconds for offline calculations of PPV and RPVI. Pearson's correlation and Bland-Altman analyses were used to evaluate the relationship between PPV and RPVI at each sample time. To evaluate the trending abilities of RPVI, four-quadrant plots were constructed using consecutive differences between five-minute averages. The concordance rate (the proportion of data located in quadrants one and four) was calculated to characterize trending abilities. The trending abilities of RPVI was also assessed using ROC analysis. This is NOT the more frequently used application of ROC analysis to assess the ability of a dynamic monitor to predict fluid responsiveness. For this analysis of trending ability, a clinically significant change in PPV was arbitrarily defined as an absolute percentage change of 3%. The AUC for this ROC curve characterized the ability of RPVI to detect a significant change in PPV. All analyses were completed using Microsoft Excel 2019 and SigmaPlot 12.5.

Data was collected from 154 subjects. 10 datasets were excluded due to sensor/software malfunctioning. 531,140 data points were ultimately analyzed. For PPV and RPVI Pearson's correlation coefficient, $r = 0.746$. Bland-Altman analysis of PPV and RPVI generated a bias of 1.07 and limits of agreements of 6.24 and -8.38. The PPV/RPVI concordance rate (0.60) increased to 0.98 with the introduction of a 3% absolute percentage exclusion zone. ROC analysis of RPVI's trending ability for PPV increases yielded an AUC of 0.71 ($p<0.0001$). The sensitivities and specificities were 0.85 and 0.53 respectively. ROC analysis of RPVI's trending abilities for PPV decreases yielded an AUC of 0.72 ($p<0.0001$). The sensitivities and specificities were 0.54 and 0.84 respectively.

Preliminary analysis suggests that RPVI exhibits good correlation with PPV. Based on the measures used in this analysis, we conclude that there is a significant concordance between RPVI and PPV trends. A prospective study evaluating RPVI as a predictor of fluid responsiveness is currently underway.

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