Pulse Oximeter Plethysmograph Variation and its Relationship to the Arterial Waveform in Mechanically Ventilated Children

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The variations induced by mechanical ventilation in the arterial pulse pressure and pulse oximeter plethysmograph waveforms have been shown to correlate closely and be effective in adults as markers of volume responsiveness. The aims of our study were to investigate: (1) the feasibility of recording plethysmograph indices; and (2) the relationship between pulse pressure variation (ΔPP), plethysmograph variation (ΔPOP) and plethysmograph variability index (PVI) in a diverse group of mechanically ventilated children.

A prospective, observational study was performed. Mechanically ventilated children less than 11 years of age, with arterial catheters, were enrolled during the course of their clinical care in the operating room or in the pediatric intensive care unit. Real time monitor waveforms and trend data were recorded. ΔPP and ΔPOP were manually calculated and the relationships between ΔPP, ΔPOP and PVI were compared using Bland-Altman analysis and Pearson correlations.

Forty-nine children were recruited; four (8%) subjects were excluded due to poor quality of the plethysmograph waveforms. ΔPP and ΔPOP demonstrated a strong correlation ($r = 0.8439$, $P < 0.0001$) and close agreement (Bias = 1.44 ± 6.4%). PVI was found to correlate strongly with ΔPP ($r = 0.7049$, $P < 0.0001$) and ΔPOP ($r = 0.715$, $P < 0.0001$).

This study demonstrates the feasibility of obtaining plethysmographic variability indices in children under various physiological stresses. These data show a similarly strong correlation to that described in adults, between the variations induced by mechanical ventilation in arterial pulse pressure and the pulse oximeter plethysmograph.