“DO PRE-EJECTION PERIODS SIMULTANEOUSLY MEASURED WITH PLETHYSMOGRAPHY REFLECT INVASIVE ARTERIAL LINE MEASUREMENTS?”

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Background

- PEP is the time interval from the R spike of the ECG to the beginning of the upstroke of the arterial pressure wave.
- Ventilation-induced changes in PEP reflect the intravascular volume status, and therefore has been proposed as an alternative to Pulse Pressure Variation.

$$PPV = 100 \times [(PP_{max} - PP_{min}) / [(PP_{max} + PP_{min})/2]]$$

- Are PEP variation measurements feasible with plethysmography?
- First step: do PEP's measured with an arterial wave (PEPa) versus a plethysmographic curve (PEPpl) correlate?

Materials & Methods

- This study is a subanalysis, based on two studies: COMPAS2 and VENTIRATE.
- Both studies were performed after ethical approval and informed consent was obtained.
- Measurements were made during a 60 seconds period, while the subjects/patients were ventilated with tidal volumes of 8 mL/kg at a ventilation rate of 12/minute.
- ECG, invasive arterial waveform and plethysmographic waveform were recorded simultaneously.
- PEP's were synchronized and calculated offline. (see figure 1)
- Two linear mixed models were calculated to predict PEPpl from PEPa. MOD1 is a repeated measure model, MOD2 adds a clustering effect per monitor.

Figure 1: Measurement of PEPa and PEPpl. Red: arterial pressure waveform, blue: plethysmographic waveform, green: ECG.

Results

- 21 patients were included.
- Median values for PEPa and PEPpl per patient were 176 [147 , 207] msec and 254 [108 , 460] respectively.
- MOD1 and MOD2 differed significantly, pointing out a clustering effect of the different monitors used in the two groups.
- Based on MOD2 model (see figure 2), a systematic error of 199 msec was found between the two monitors.
- The median (range) R² per patient was 0.08 (0.0 – 0.35).

Figure 2: Pooled and individual linear regressions of MOD2. Bold line: pooled linear regression per monitor; thin line: individual linear regression.

Discussion

- The clustering effect seen in the results, represents a difference in processing between two monitors, with different latencies.
- The low R² values represent the weak overall interchangeability between PEPa and PEPpl.
- This weak correlation can be due to the difference in data-processing, or due to the different physiologic phenomenon behind both curves.

Conclusion

- The arterial and plethysmographic curve are morphologically similar, however, the measured PEP values drawn from both curves are not freely interchangeable.