

## Peripheral photoplethysmography variability analysis of sepsis patients

### Abstract:

Sepsis is associated with impairment in autonomic regulatory function. This work investigates the application of heart rate and photoplethysmogram (PPG) waveform variability analysis in differentiating two categories of sepsis, namely systemic inflammatory response syndrome (SIRS) and severe sepsis. Electrocardiogram-derived heart period (RRi) and PPG waveforms, measured from fingertips (Fin-PPG) and earlobes (Ear-PPG), of Emergency Department sepsis patients ( $n = 28$ ) with different disease severity, were analysed by spectral technique, and were compared to control subjects ( $n = 10$ ) in supine and  $80^\circ$  head-up tilted positions. Analysis of covariance (ANCOVA) was applied to adjust for the confounding factor of age. Low-frequency (LF, 0.04-0.15 Hz), mid-frequency (MF, 0.09-0.15 Hz) and high-frequency (HF, 0.15-0.60 Hz) powers were computed. The normalised MF power in Ear-PPG (MFnu Ear) was significantly reduced in severe sepsis patients with hyperlactataemia (lactate  $> 2$  mmol/l), compared to SIRS patients ( $P < 0.05$ ). Moreover, in a group of normal controls, MFnu Ear was not altered by head-up tilting ( $P > 0.05$ ), suggesting that there may be a link between 0.1 Hz ear blood flow oscillation and tissue metabolic changes in sepsis, in addition to autonomic factors. The study highlighted the value of PPG spectral analysis in the non-invasive assessment of peripheral vascular regulation in sepsis patients, with potential implications in monitoring the progression of sepsis.