

Wavelet Transform Cardiorespiratory Coherence for Monitoring Nociception

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Introduction: Heart rate variability (HRV) may provide anesthesiologists with a noninvasive tool for monitoring nociception during general anesthesia. Real-time HRV monitoring would allow dynamic drug delivery adjustment to compensate for surgical stimuli. The Fourier LF/HF power ratio is the most widely accepted HRV analysis method; however, it is incapable of analyzing the ultra short windows required in real-time analysis (5-10 s). Furthermore, recent research has cast doubt on its theoretical validity, and it malfunctions when the respiratory rate (RR) is in the LF band. A novel wavelet transform cardiorespiratory coherence (WTCRC) algorithm was used to calculate ultra short term estimates of linear coupling between heart rate and respiration. WTCRC has previously been shown to reflect autonomic balance in volunteer studies, but has never been used during general anesthesia nor have its results been compared to traditional methods. **Methods:** With ethics approval and informed consent, data were recorded from 9 pediatric patients during dental surgery. Patients experienced periods of nociceptive stimuli followed by an increase in depth of anesthesia. Clean data segments (388 minutes total) were manually extracted. Segments were divided into categories with normal RR (in the HF band) and low RR (in the LF band), then split into 2-minute windows. Normal and low RR categories comprised 150 and 44 windows respectively. WTCRC and LF/HF were calculated for each window. WTCRC produces estimates for every data sample (480/window); these were averaged for direct comparison with LF/HF. **Results:** WTCRC decreased during periods of nociception, and increased following additional anesthetic drugs. WTCRC and LF/HF showed a correlation of -0.6737 for data with normal RR, and 0.0407 with low RR. **Conclusion:** WTCRC and LF/HF are comparable when RR is normal, while WTCRC outperforms LF/HF when RR is low. WTCRC is also better suited to real-time monitoring, as it can analyze much shorter windows.