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Role of Autonomic Activity in the Hemodynamic Pattern of Septic Shock

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Objective: 1) evaluate early effects of sympathetic (SNS) and parasympathetic nervous system (PSNS) activity by two methods of autonomic (ANS) monitoring, and 2) describe the role of ANS in the evolving hemodynamic patterns of sepsis.

Methods: We noninvasively monitored concurrent autonomic and hemodynamic patterns in 208 consecutive severely ill septic and septic shock patients. Simultaneous respiratory rate (RR) variability and heart rate (HR) variability (HRV) spectral patterns were collected. We used two types of ANS monitoring: a) HRV *without* respiratory analysis, and b) HRV *with* respiratory analysis. The former calculates the SNS and PSNS, Low Frequency (LF) and High Frequency (HF) parameters, respectively, according to the standard spectral analysis of HRV methodology. The latter adds spectral analysis of RR variability to compute more sensitive SNS and PSNS measures (the Low Frequency areas (LFa) and Respiratory Frequency area (RFa), respectively) according to the MIT technique. Noninvasive hemodynamic monitoring included: a) cardiac index (CI) by bioimpedance, HR, and mean arterial pressure (MAP) to reflect cardiac function, b) pulse oximetry (SapO₂) to reflect changes in pulmonary function, and c) transcutaneous oxygen (PtcO₂) indexed to the FiO₂ as a marker of tissue perfusion.

Results: LF & LFa were most correlated ($r=0.72$, $p=0.00$). They are from the same frequency band. HF & RFa were least correlated ($r=0.52$, $p=0.0$). HF is from a fixed broad band and RFa is from narrow bands that follow the RR. HRV *with* respiratory analysis differentiated survivors and nonsurvivors. HRV *without* respiratory analysis did not.

Early in their emergency department stay, nonsurvivors had greater RFa's, indicating greater PSNS activity, with normal CI, hypotension, tachycardia, low PtcO₂/FiO₂ & SapO₂, and reduced oxygen delivery. Survivors had greater LFa's, indicating greater SNS activity, with increased CI & HR, and normal MAP, PtcO₂/FiO₂, & SapO₂. Sudden surges of increased autonomic activity were associated with increased HR, MAP, and CI.

Conclusion: The ANS measurement techniques were correlated. ANS measures from HRV *with* respiratory analysis were associated with outcomes and corresponding hemodynamic patterns.

Clinical Implications: ANS changes may precede sepsis.