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Gender Differences of Hemodynamic and Autonomic Activity in Septic Shock

Joseph Colombo, PhD, William C Shoemaker, MD, Charles CJ Wo, BS, Elif Aysin, MS,
Howard Belzberg, MD

From the Department of Surgery, Division of Trauma/Critical Care, U Southern California, LA

Objective: evaluate gender-based autonomic (ANS) differences in 1) early sepsis, and 2) septic related hemodynamic patterns and associated outcomes.

Methods: Shortly after admission to emergency dept., concurrent autonomic and hemodynamic patterns were monitored in 208 consecutive severely ill septic and septic shock patients; 48 females (23%). Simultaneous respiratory rate (RR) variability and heart rate (HR) variability (HRV) spectral patterns were collected and used to compute ANS parameters. Low Frequency area (LFa) and Respiratory Frequency area (RFa), are measures of sympathetic (SNS) and parasympathetic (PSNS) activity, respectively, according to the MIT approach to spectral analysis of HRV *with* RR spectral analysis. Noninvasive hemodynamic monitoring included: a) cardiac index (CI) by bioimpedance, HR, and mean arterial pressure (MAP) reflecting cardiac function, b) pulse oximetry (SapO₂) reflecting changes in pulmonary function, and c) transcutaneous oxygen (PtcO₂) indexed to the FiO₂ reflecting tissue perfusion.

Results: ANS branch activity as measured by HRV *with* respiratory analysis correlates with that as measured by the standard approach (HRV *without* respiratory analysis): for the two SNS measures $r=0.72$, $p=0.00$; for the two PSNS measures $r=0.52$, $p=0.0$. The only ANS measure associated with outcomes was RFA: male survivors' RFa averaged 18.86 bpm² and male non-survivors' RFa averaged 30.00 bpm² ($p=0.06$). Female data was too sparse.

Initially, female nonsurvivors had greater RFa (PSNS activity), while male survivors had greater LFa (SNS activity). Nonsurvivors' increases of both genders occurred early, *i.e.*, in the first day of admission. In survivors, these ANS patterns were associated with increased CI & HR, normal MAP, SapO₂, & PtcO₂/FiO₂. Nonsurvivors had normal CI, hypotension, tachycardia, low PtcO₂/FiO₂ & SapO₂, and reduced oxygen delivery. Sudden surges of increased autonomic activity, especially in nonsurvivors, were associated with increased HR, MAP, & CI, and tendencies toward reduced PtcO₂/FiO₂. With decreased SNS and PSNS activity, the opposite hemodynamic changes occurred.

Conclusions: Increased autonomic activity was greater in females and greater in those who died; especially females. Overall, the salient difference between survivors and non-survivors was parasympathetic activity.

Clinical Implications: ANS changes associated with sepsis show gender differences.