Hemodynamic Monitoring: The Septic Patient

Clinical Profile:
Sepsis (Sêp’sis) [Gr. sépsis, putrefaction]. Pathologic state, usually febrile, resulting from the presence of microorganisms or their poisonous products in the bloodstream.1

Sepsis must be assessed, treated and arrested utilizing accurate and efficient diagnostic modalities.2

Given the marked right ventricular (RV) dysfunction demonstrated by septic and hypovolemic patients, preload measurement most accurately was assessed, historically, by using the filling pressures, central venous pressure (CVP) and pulmonary artery wedge pressure (PAWP)7, due to an assumed correlation with diastolic volume.

Correlations:
• Correlation #1: between PCWP and LVEDV
It has been shown that pulmonary capillary wedge pressure (PCWP) did not accurately reflect changes in left ventricular (LV) preload. Left ventricular end diastolic volume (LVEDV) was found to depend on right ventricular (RV) function and pulmonary vascular resistance (PVR). In patients with a positive response to volume loading, there was an increase in either LVEDV or left ventricular ejection fraction (LVEF).3

• Correlation #2: between RVEDVI and CI
Right ventricular end diastolic volume index (RVEDVI) has been shown to be a better predictor of cardiac index (CI) (r=0.61) than pulmonary artery wedge pressure (PAWP) (r=0.42). Discrepancies between PAWP and RVEDVI occurred in more than 50% of patients studied. “RVEDVI more accurately predicted preload recruitable increases in cardiac output (CO).”4

• Effect of monitoring in cases of severe septic shock
It has been shown that “RV monitoring during severe septic shock permits the identification of patients with RV dysfunction who are difficult to identify with usual measurements”.3

• Correlation #3: between RVEF interpretation and indication for treatment of septic patients
Right ventricular ejection fraction (RVEF) values should be interpreted after accounting for the increase in RV afterload and the inverse relationship between RVEF and pulmonary artery (PA) pressures. In acute respiratory failure, severe sepsis or trauma and during or after surgery, these measurements have been used to assess RV function.

Despite a well preserved stroke volume (SV) and CI, septic shock patients can have a low RVEF. A recent series of these patients that were studied by Jean-Louis Vincent, M.D. demonstrated a reduction in RVEF early in the course of septic shock with a return to baseline RFEF during the resolution of shock. Dr. Vincent concluded that, prognostically, a very low RVEF was a bad sign. Vasopressors may be indicated for treatment in septic patients when arterial hypotension and pulmonary hypertension threaten RV perfusion.6

Outcome: Effect of combining SvO₂, REF, EDV and CCO in a single catheter
It has been recognized that a new catheter, combining continuous venous oximetry, RVEF, end diastolic volume (EDV) measurements, and continuous thermodilution cardiac output (CTCO), will yield not only information regarding oxygen consumption and delivery, but will also allow an even better understanding of hemodynamics. A continuous indication of pulmonary vascular resistance (PVR) and systemic vascular resistance (SVR) may be used as an index to left ventricular (LV) and right ventricular (RV) afterload when continuous cardiac output (CCO) is integrated with continuous central and arterial pressure measurements.7

Loren D. Nelson, M.D. concluded in his report that the combination of intravascular pressure measurements and CCO also allows calculation of LV and RV stroke work, “that, under conditions of steady state preload and afterload, reflects the contractile function of the heart as a determinant of cardiac performance.” On a near continuous basis, the critical care team will thus be provided with complete hemodynamics and oxygen transport values.
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