Hemodynamic Monitoring:
The Septic Patient

Clinical Profile:

Sepsis (Sĕp´sĭs) [Gr. sēpsis, 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".[5]
- **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 **RVEF** 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 SvO_2, 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."[7] On a near continuous basis, the critical care team will thus be provided with complete hemodynamics and oxygen transport values.

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