Hemodynamic Monitoring: The CHF Patient

Clinical Profile:

Congestion – c., passive. Hyperemia resulting from interference with flow of blood from capillaries into venules. May also result from myocardial insufficiency.[1]

Patients diagnosed in various stages of congestive heart failure **(CHF)** (left or right ventricular dysfunction) prompt careful monitoring of ventricular filling pressures [central venous pressure **(CVP)** and pulmonary artery wedge pressure **(PAWP)],** historically[9] and treatment to maintain tissue perfusion, decrease intravascular volume and optimize cardiac performance[2] (due to an assumed correlation with end diastolic volume[9]). A new generation of volumetric measurements, right ventricular ejection fraction **(RVEF)** and end diastolic volume **(EDV)**, is now available and is evaluated herein.

Correlations:

- **Correlation #1: Nature of relationship between PCWP and EDV**
  It has been established that "in the patient with cardiac disease, regardless of etiology, the pulmonary capillary wedge pressure **(PCWP)** has little relationship to the left ventricular end diastolic volume **[EDV]**, due to marked changes in compliance or valvular disease."[4]

- **Correlation #2: Role of diastolic function in determining heart failure**
  Dysfunction in systole and/or diastole may result in CHF, related to passive backup of blood into the pulmonary and systemic venous beds and/or resistance in ventricular filling. It has been shown that "although there is some degree of diastolic dysfunction in most patients who present clinically with heart failure, as many as 40% of patients with congestive heart failure have normal systolic function and thus, have primary diastolic heart failure."[5]

- **Diagnosing right heart failure when clinical signs are obscured**
  Right-sided heart failure is not always clinically evident. This is expected since therapeutic utilization of diuretic drugs will reduce preload significantly, obscuring the clinical signs of right-sided failure. It has become apparent that "our modern therapeutic approaches and their great reliance on diuretic drugs have made the evaluation of ventricular function more difficult clinically and thus more heavily dependent on invasive hemodynamic measurements."[6]

- **Correlation #3: Effect of RVEF on diagnosis of severe chronic failure**
  It has been shown that right ventricular **(RV)** volume determination is useful in the diagnosis of diastolic disorders, such as constrictive pericarditis, cardiac tamponade, or restrictive cardiomyopathy.[7]

  In a recent study, statistical analysis identified right ventricular ejection fraction **(RVEF)** as the "single most important predictor of short-term prognosis in a large cohort of patients who had symptoms in spite of a standardized, optimized, multipharmacologic treatment."[8] This variable provides guidance and assessment for transplantation timing and indications for patients with uniformly depressed **LVEF** and severe chronic heart failure.[8]

Outcome: Effect of combining SvO_2, REF, EDV and CCO

It has been recognized that a new catheter, combining mixed venous oxygen saturation **(SvO_2)** with **RVEF**, right ventricular end diastolic volume **(RVEDV)** measurements and continuous cardiac output **(CCO)**, will yield not only information regarding oxygen consumption and delivery, but will also permit a better understanding of hemodynamics. Dr. Nelson concluded in his report that the combination of intravascular pressure measurements and continuous cardiac output **(CCO)** also allows calculation of left ventricular **(LV)** and right ventricular **(RV)** stroke work that "under conditions of steady state preload and afterload, reflect 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.[9]

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