Hemodynamic Monitoring: The ARDS Patient

Clinical Profile:

Adult Respiratory Distress Syndrome (ARDS). A form of restrictive lung disease due to abnormal permeability of either the pulmonary capillaries or the alveolar endothelium. Clinically, there is acute respiratory failure with pulmonary edema, hemorrhage into the lung tissue, hyaline membranes, and pulmonary fibrosis. The death rate is approximately 50%.[1]

ARDS patients have acute clinical needs for efficient, effective and accurate hemodynamic management due to their potential for increased pulmonary vascular resistance **(PVR)**, right ventricular **(RV)** afterload, and impaired **RV** function.[2] Historically, preload assessment using central venous pressure **(CVP)** and pulmonary artery wedge pressure **(PAWP)**[5] has been utilized to meet the challenging treatment modalities of **ARDS**, yet a new generation of volumetric measurements, right ventricular ejection fraction **(RVEF)** and end diastolic volume **(EDV)**, is now available and evaluated herein.

Correlations:

- **Correlation #1: between RVEDVI and CI**
  The right ventricular end diastolic volume index **(RVEDVI)** and pulmonary artery occlusion pressure **(PAOP)** were compared with the cardiac index **(CI)** in 64 surgical patients with acute respiratory failure requiring treatment with PEEP. The study showed that "at all levels of PEEP, the **CI** correlated significantly better with the **RVEDVI** than with **PAOP**. At levels of PEEP ≥ 15cm H_2O, **CI** was inversely correlated with **PAOP**, but remained positively correlated with **RVEDVI**."[2]

- **Correlation #2: between filling pressures and preload measurements**
  Studies by Safcsak, et al. have shown that critical care patients supported by positive-pressure mechanical ventilation can demonstrate a potentially misleading increase in filling pressure originating from increased airway / pleural pressures transmitted to the central vasculature. In this case, "traditional filling pressure measurements may show a disparate relation with a preload measurement by end diastolic volume assessment."[3]

- **Reliability of EDVI as an indicator of preload**
  In a study of 64 patients in acute respiratory failure, when PEEP was applied, the **PAOP** and **CVP** increased significantly. Many patients achieved **PAOP**'s > 20 mmHg, with some as high as 50 mmHg. These patients, however, had intravascular volume depletion evidenced by low urinary output, low **CI**, low **RVEDVI**, and elevated base deficit and lactate levels that responded appropriately to volume administration. The investigators concluded that in patients supported by application of PEEP, up to 50cm H_2O, the **RVEDVI** was statistically superior and a more reliable predictor of right ventricular preload status and fluid responsiveness than was **PAOP**.[2,3]

- **Correlation #3: between preload expansion and pulmonary function**
  39 trauma patients with **RVEF**'s < 40% were randomized to increase preload by fluid administration to maintain **RVEDVI** > 120ml/m² during resuscitation (or 90-100ml/m² using inotropes). It was shown that the incidence of **ARDS** was actually less in the increased preload group than in the group receiving inotropes ($p > 0.1$). This study by Miller, et al. also showed that "mortality was 37% and 55% in the preload and inotrope groups, respectively ($p > 0.1$)."[6]

- **Correlation #4: between RVEF, CO, oxygen delivery and ARDS survival**
  In a study of patients suffering from sepsis and ARDS, a depressed **RVEF** was associated with simultaneously reduced cardiac output **(CO)** and oxygen delivery in ARDS non-survivors.[4]

"Hemodynamic monitoring combined with oxygen transport assessment has been used to differentiate the relative magnitude of pulmonary and cardio-vascular dysfunction that contributes to hypoxemia."[5]

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Outcome: Effect of combining SvO_2, RVEF, RV, EDV and CCO in a single catheter

It has been recognized that a new catheter, combining **SvO_2** with **RVEF, RVEDV** measurements and continuous thermodilution cardiac output **(CTCO)**, 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 **LV** and **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.[5]

The quotes and information referenced in this brochure were selected from independent third party publications and are not intended to suggest that such third parties have reviewed and/or endorsed Edwards' products.

References:

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5. Nelson LD, et al., "The New Pulmonary Arterial Catheters: Right Ventricular Ejection Fraction and Continuous Cardiac Output", Critical Care Clinics, 1996;12:795-818.
6. Miller PR, et al., "Randomized, Prospective Comparison of Increased Preload versus Inotropes in the Resuscitation of Trauma Patients: Effects on Cardiopulmonary Function and Visceral Perfusion", Journal of Trauma: Injury, Infection and Critical Care, 1998; 44:107-113.

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