Cardiac Output by 2D Transthoracic Echocardiography and Swan-Ganz Catheters: A Prospective Comparative Pilot

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**Background:** The Swan-Ganz catheter (SGC) continues to fall further from favor in the management of critically ill patients. Stemming first from retrospective studies that demonstrated higher mortality in patients with SGCs, and later from consensus meetings on their use. SGCs are now infrequently used in ICUs. Many clinicians subscribe to management guidelines that outline appropriate addition of inotropes without real-time monitoring of their direct effect on cardiac output (CO). Many non-invasive methods of monitoring CO have been investigated, yet scarcely any are used in place of the SGC when CO must be assessed.

**Specific Aims:** Among a cohort of pre- and post-heart transplant patients undergoing right heart catheterization:

1. To calculate CO with resident-obtained, transthoracic echocardiography via images of the left ventricular outflow tract (LVOT)
2. To compare echocardiographic measurement of CO to those simultaneously obtained by SGCs

**Hypothesis:** The LVOT method of calculating CO by transthoracic echocardiography will correlate with cardiac outputs obtained via the Fick method and the thermodilution technique.

**Methods:** Fifteen patients in the catheterization lab with a SGC and stable hemodynamics were included. Parasternal long axis views of the LVOT and apical 5-chamber pulsed Doppler interrogation at the LVOT were obtained simultaneously with SCG measurements of CO. An echocardiographer, blinded to the hemodynamic data obtained in the lab, measured LVOT diameter and velocity time integral (VTI) of the blood flow profile. Echo CO was calculated using the formula: \( CO \ (L/min) = \text{cross-sectional area of the LVOT (cm}^2\) \times VTI (cm) \times \text{heart rate (bpm)} \).

**Results:** One patient was excluded when an elevated activated clotting time made SGC placement unsafe. Another was excluded due to post-surgical bandages that obscured echo windows. Simultaneous measurements were recorded in 13 patients. A statistically significant correlation existed between echo-measured CO and both thermodilution \((r=0.5621, p=0.05)\) and Fick \((r=0.6870, p=0.01)\) measurements. However, the clinical significance of these correlations is questionable; the percentage of echo measurements that were within 20% were only 5/13 compared with the Fick method and 8/13 compared with the thermodilution method.

**Conclusions:** Despite a statistically significant correlation, further study is required to assess if there is a clinically acceptable correlation between resident-obtained echocardiographic measurement of CO and those obtained by SGC. Studies in patients in other settings may overcome difficulties to obtaining accurate CO by echo in cath lab patients, such as sterile draping and patient positioning.