Title: THE INFLUENCE OF RIGHT VENTRICULAR FUNCTION ON THE RELATIONSHIP BETWEEN END-DIASTOLIC VOLUME AND STROKE VOLUME

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Recently, a rapid-response thermistor pulmonary artery catheter (RRPAC), which measures right ventricular ejection fraction (RVEF) and stroke volume (SV) was introduced. Stroke volume is calculated from the area under the thermodilution curve and heart rate. Right ventricular ejection fraction is calculated from the exponential decay of the thermodilution curve. Dividing the SV by the RVEF, right ventricular end-diastolic volume (RVEDV), is then calculated. The reproducibility and accuracy of thermodilution RVEF measurements are suggested by the strong linear correlation with RVEF determinations by the nuclear first-pass technique. However, thermodilution RVEF calculations are based on certain assumptions, including a regular R-R interval, complete delivery of the injectate into the right ventricle with instantaneous complete chamber mixing, and no tricuspid regurgitation. In certain patients, these assumptions may not be met. To examine the influence of right ventricular function on thermodilution RVEDV, the relationship between RVEDV and SV was examined at varying levels of RVEF.

Methods. Fifty-seven patients presenting for myocardial revascularization or valve replacement surgery were studied following informed consent and institutional review. All patients were in sinus rhythm, and none had clinical evidence of tricuspid regurgitation. Placement of a radial arterial catheter and RRPAC was accomplished under local anesthesia. Anesthesia consisted of a high-dose opioid-muscle relaxant-oxygen technique. Five minutes following the induction of anesthesia, baseline thermodilution measurements were obtained until 3 values within 10% of each other were recorded. All measurements were obtained during brief periods of apnea. Pearson's correlation analyses were performed between RVEDV and SV at varying levels of RVEF. Fisher's Z transformation was used to test for significant differences between correlation coefficients.

Results. Results are summarized in Table I. Patients with higher RVEF showed better correlations between RVEDV and SV. When RVEF was greater than 0.50, r was equal to 0.89, which was highly significant compared to all patients with RVEF less than 0.50. This same relationship also held when RVEF was greater than 0.45 and greater than 0.40. When RVEF greater than 0.35 was tested, however, the significance of the correlation between RVEDV and SV was lost.

Discussion. The data indicate that RVEDV and SV do not correlate as well in patients with lower RVEF values. This finding may be due to physiologic factors or experimental error. A physiologic explanation is that, at lower RVEF values, the slope of the Frank-Starling curve is less steep. Thus large changes in RVEDV are associated with small changes in SV. Whereas at higher RVEF values, the slope of the Frank-Starling curve is steeper, and increases in RVEDV result in similar increases in SV.

Thermodilution techniques are invariably accompanied by a certain degree of error. This error becomes magnified when thermodilution-derived data are divided by one another to calculate RVEDV. Patients with lower RVEF values usually have larger right ventricular chamber size and higher intracavitary pressures. These factors may contribute to incomplete mixing of the injectate and/or subclinical tricuspid regurgitation.

Our results suggest that thermodilution RVEDV is predictive of SV in patients with RVEF greater than 0.40. However, when patients with RVEF values less than 0.40 are included, the relationship is less clear.

Table I. Stroke Volume vs. Right Ventricular End-Diastolic Volume
n=57

RVEF	>0.50	>0.45	>0.40	>0.35	>0.30
r	0.89	0.89	0.81	0.69	0.62
n	16	22	31	38	42
RVEF	<0.50	<0.45	<0.40	<0.35	<0.30
r	0.40	0.39	0.46	0.68	0.77
n	41	35	26	19	15
	p<0.001	p<0.001	p<0.05	n.s.	n.s.