Title: COMPARISON BETWEEN RADIAL ARTERIAL AND CENTRAL AORTIC PRESSURE-VOLUME RELATIONS

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Introduction It has been previously reported that the peak-systolic pressure end-ejection volume relation (PPEEVR) can be used to measure left ventricular contractility (LVC) in patients who had been weaned from cardiopulmonary bypass (CPB) after coronary artery bypass surgery (CABG).[1] The PPEEVR were derived from radial arterial (Ra) pressure tracings and 2D echocardiographic LV volumes. Since after CABG significant differences between central and peripheral blood pressures have been documented, the validity of these PPEEVR measurements has been questioned. The present study compares PPEEVR using Ra pressures and central aortic (Ao) pressures which in the absence of aortic outflow obstruction closely approximate LV systolic pressures.

Methods After institutional approval and informed consent, CABG patients with good LV function and without valvular disease were studied under fentanyl-pancuronium-oxygen anesthesia. Shortly after termination of CPB, synchronized recordings of Ra and Ao pressure and epicardial 2D echo views of the heart were initiated. The 2D echo viewed the short axis of the LV at the mid-papillary muscle level and was obtained using a 3.5 MHz ATL[R] transducer. While recording, 200-500 ml of oxygenator contents were rapidly transfused into the right atrium. In 5 of the 8 patients, the transfusion was repeated 5 minutes after a continuous infusion of dopamine 5ug/kg/min was started. The heart rate was kept constant by atrial pacing. 2D echo data were analyzed on a Cardio Revue Center[E] (Diasonics, Salt Lake City, Utah). For each transfusion, 6 to 8 different cardiac cycles were analyzed and for each cycle, the smallest short-axis endocardial area (SA) was assumed to occur at end-ejection. SA was determined from the average of 3 measurements and LV end-ejection volume (EEV) was calculated according to the formula: $EEV=(SA)^{3/2}(SA+36)/(SA+12)$. EEV data were correlated with the Ra and Ao peak-systolic pressure (PP) of the same cardiac cycles, according to the relation: PP=E (EEV-Vo) using least squares linear regression. The slope, E, which relates EEV to PP represents contractility. Differences between E values were tested for statistical significance using a modification of Student's T-test applicable to data which describe a sloping line. P .01 was considered significant.

Results Ao PP exceeded Ra PP by up to 30%. There were 13 sets of PPEEVR derived for the 8 patients. The 26 correlation coefficients averaged .86 ± .13 (±SD). Comparison between the Ra and the Ao PPEEVR revealed that in only 1 of 13 sets the E value was significantly different while in 12 of 13 it was not. The 13 PPEEVR were combined into 43 different pairs. We searched for significant differences between Ao PPEEVR within each combination pair and did the same for the corresponding Ra PPEEVR. Differences between matched pairs of Ao and Ra PPEEVR are tabulated in the Table. A true positive, (TP) was obtained when a significant difference within a Ao PPEEVR pair matched a significant difference within the corresponding Ra PPEEVR; a true negative (TN) was obtained when no significant difference within an Ao PPEEVR pair was matched by the same in the corresponding Ra PPEEVR; false negative (FN) was obtained when a significant difference within a Ao PPEEVR pair failed to match with a significant difference within the corresponding Ra PPEEVR and false positive (FP) was obtained when a significant difference within Ra PPEEVR pair failed to match with a significant difference within the corresponding Ao PPEEVR pair. These results indicate that Ra derived PPEEVR have 80% sensitivity and 100% specificity in representing changes observed with Ao derived PPEEVR.

Discussion The PPEEVR has been shown to be an excellent measure of LVC.[2] Changes in LVC in patients weaned from CPB for CABG have been reported based on PPEEVR derived from Ra PP. As there frequently are significant differences between Ra PP and Ao PP post-CPB, we studied a group of post-CPB patients to determine whether Ra PP could be used instead of Ao PP as described originally. We demonstrated that Ra PPEEVR have good sensitivity and excellent specificity when compared to Ao PPEEVR in spite of significant differences between Ra PP and Ao PP. This occurs because PPEEVR relate changes in PP with changes in EEV (ie slopes) rather than absolute values of these parameters. Two parameters of widely different size may change at identical rates. We conclude that meaningful intraoperative determinations of the LV inotropic state can be performed based on Ra pressure and 2D echo recordings.

References

1. Hillel Z, Thys D, Mindich P, et al. A new method for the intraoperative determination of contractility. Anesth Analg 65:572, 1986.
2. Kono A, Maughan WL, Sunagawa K, et al. The use of left ventricular end-ejection pressure and peak-pressure in the estimation of the end-systolic pressure-volume relationship. Circulation 70, 1057-1065, 1984.

TABLE

		Ao PPEEVR	
		Different	Not Different
Ra PPEEVR	Different	TP=11	FP=0
	Not Different	FN=3	TN=29