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Title : PREOPERATIVE ASSESSMENT OF CARDIAC CATHETERIZATION DATA: WHICH PARAMETERS ARE THE MOST IMPORTANT?

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Introduction. Data from cardiac catheterization can be most valuable to the anesthesiologist for the perioperative management of the patient with cardiac disease. The anesthesiologist is usually confronted with multiple measurements of ventricular function, e.g., ejection fraction (EF), stroke work index (SWI), cardiac index (CI), end-diastolic and end-systolic volumes (EDV, ESV), end-diastolic pressure (EDP), and degrees of dyssynergy (DYS). However, the relative importance (both prognostic and physiologic) of these measures generally remains unknown. Which of these measurements have the greatest clinical significance? What is the significance of an elevated EDP when CI is normal? When data from catheterization are incomplete, are measures of ventricular filling (EDP, EDV) predictive of measures of output (CI, SWI) or ejection (EF, ESV)? The following study delineates the relative importance of normal and abnormal catheterization findings in 317 patients with significant coronary artery disease.

Methods. We studied 317 patients who had angiographically proven coronary artery disease but no valvular disease. All patients underwent cardiac catheterization at the Veterans Administration Medical Center between the years 1975 and 1980. Roentgenography of the left ventricle was performed in the single-plane, 30° right anterior oblique projection. The ventriculograms were quantitatively characterized by segmental analysis according to the method of Herman. If two or more segments had less than 20% contraction, dyssynergy (DYS) was said to exist. Ejection fractions were determined using EDV's and ESV's obtained by the area-length method of Kennedy. Cardiac output was determined using thermodilution. Seven catheterization parameters were studied: EF, ESV, CI, SWI, EDV, EDP, and DYS. The data were statistically analyzed by calculation of correlation coefficients and indices of specificity (Sp) and sensitivity (Sn), defined as $Sp = Tn/(Tn + Fp)$ and $Sn = Tp/(Tp + Fn)$, where Tn = true negative, Tp = true positive, Fn = false negative, and Fp = false positive.

Results. The tables show the specificity and sensitivity of each catheterization index in detecting abnormality of the other six indices. In order, the most specific indices are EF, DYS, SWI, EDV, ESV, CI, and EDP. For example, abnormality of EF implies abnormality of the other indices 82 to 95% of the time. However, abnormality of EDP implies other abnormalities only 53 to 59% of the time. The sensitivity of the data, in general, is low. Normality of any index does not imply normality of another index. The major exception is that in patients without dyssynergy, all other indices are normal 75 to 88% of the time.

Discussion. The implications of this study are as follows. First, ventricular dysfunction is best predicted by EF and DYS. That is, abnormalities of EF and DYS are most commonly associated with abnormalities in ventricular output (CI, SWI), filling (EDV, EDP), and ejection (ESV). Abnormality of SWI, EDV, and ESV are good indicators of dysfunction. CI is a marginal index. (It is associated with normality of other indices 23-41% of the time.) EDP is a weak index of ventricular systolic dysfunction. Second, only the absence of dyssynergy accurately predicts normal ventricular function. That is, normality of DYS assures (75-88%) normality of the other indices. Normality of EF, SWI, EDV, ESV, CI, or EDP does not accurately predict normal ventricular function (in more than 50% of the patients). Thus, EF and DYS are important data for perioperative prognosis, and, in this study, are the most informative indices of ventricular function. Therefore, these indices should be sought by the anesthesiologist as part of his preoperative evaluation. Interpretation of normality or abnormality of other indices, especially EDP or CI, must be carefully considered, since these indices are far less informative.

Table 1. Specificity

	EF<.50	DYS	SWI<30 (g·m/M²)	ESV>34 (ml/M²)	EDV>90 (ml/M²)	CI<2.5 (l/min/M²)	EDP>12 (mm Hg)
EF	--	.92	.85	.95	.87	.84	.82
DYS	.32	--	.32	.35	.30	.32	.29
SWI	.89	.95	--	.88	.84	.94	.81
ESV	.77	.82	.68	--	.81	.63	.69
EDV	.81	.82	.75	.93	--	.66	.74
CI	.71	.77	.75	.65	.59	--	.64
EDP	.57	.59	.54	.59	.55	.53	--

Table 2. Sensitivity

	EF<.50	DYS	SWI<30 (g·m/M²)	ESV>34 (ml/M²)	EDV>90 (ml/M²)	CI<2.5 (l/min/M²)	EDP>12 (mm Hg)
EF	--	.23	.50	.50	.42	.34	.29
DYS	.83	--	.83	.88	.83	.83	.75
SWI	.41	.20	--	.22	.14	.40	.17
ESV	.86	.43	.46	--	.81	.34	.41
EDV	.52	.29	.21	.58	--	.11	.25
CI	.55	.38	.79	.32	.14	--	.35
EDP	.62	.46	.46	.52	.44	.47	--