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 Title : USE OF THE PA CATHETER TO DETECT EARLY MYOCARDIAL ISCHEMIA
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Introduction. ST segment changes in lead V₅ have been shown to be a good indication of myocardial ischemia during surgery. During exercise-induced angina pectoris, Wiener showed that increases in left ventricular (LV) filling pressure and the appearance of a prominent A wave due to decreased myocardial compliance occur prior to the development of ST depression on the ECG.¹ Controversy exists as to the use of a pulmonary artery (PA) catheter during coronary artery bypass surgery (CABG). Little information is available regarding the use of the pulmonary capillary wedge pressure (PCWP) and/or the wedge pressure tracing as further aids in the early diagnosis of myocardial ischemia. This study sought to evaluate the usefulness of the PA catheter during CABG in detecting early myocardial ischemia associated with reduced LV compliance.

Methods. 18 patients for elective CABG who developed signs of myocardial ischemia were studied. All patients gave written consent for the study which was approved by the Human Investigations Committee. LV function was determined by cardiac catheterization. Anesthesia consisted of morphine, diazepam, pancuronium, and 50% N₂O/O₂. Monitoring included radial and thermofluation catheters, and ECG leads II and V₅. The rate pressure product (RPP = SBP x HR) and triple index (TI = SBP x HR x PCWP) were used as indices of myocardial oxygen demand. Hemodynamic measurements were made if one of the following signs of early myocardial ischemia occurred: (1) ST depression >1mm; or (2) the PCWP tracing showed an abnormal AC wave >15 torr or V wave >20 torr.

Results. The patients were separated into 3 groups according to their individual response to ischemia: Group I - 3 patients developed only ST segment depression in lead V₅; Group II - 5 patients developed both ST segment depression and an abnormal PCWP tracing; and Group III - 10 patients demonstrated only abnormal AC or V waves. The figure demonstrates a Group III patient and the response to nitroglycerin (NTG). Hemodynamic data at the time of ischemia is summarized in the Table. Group I had a higher RPP due to a higher HR, and there were no abnormalities of the wedge pressure tracing. Groups II and III had lower HR and RPP, but elevated PCWP and TI, and abnormal PCWP tracings. In 2 of 5 patients in Group II, a progression from an abnormal PCWP trace alone to ST segment depression was noted. Degree of LV dysfunction did not correlate with the type of response the patient had to myocardial ischemia.

Discussion. Barnard² has recently shown that precordial ECG leads detect transmural

myocardial ischemia quite well, but are limited in detecting subendocardial ischemia. Surgical stress can induce subendocardial ischemia with reduced LV compliance that can be detected by abnormal AC and V waves on the wedge pressure tracing. These changes in LV compliance may precede ECG changes during surgery as previously shown during exercise-induced angina. Therefore, the PA catheter is useful in detecting early subendocardial ischemia, which can be treated prior to the development of ECG changes.

References. (1) Wiener L, Dwyer EM, Cox JW: Left ventricular hemodynamics in exercise-induced angina pectoris. *Circulation* 38:240, 1968. (2) Barnard RJ, Buckberg GD, Duncan HW: Limitations of the standard trans-thoracic ECG in detecting subendocardial ischemia. *Am Heart J* 99:476, 1980.

HEMODYNAMIC DATA

	Group I	Group II	Group III
SBP	162±22	155±23	175±19
HR	78±15*	67±11	62±12
CVP	5±5*	10±3	11±3
RPP (10 ²)	129±42*	104±28	107±23
TI (10 ³)	136±12*	254±67	236±70
PCWP	9±6*	25±4	22±3
MAX AC WAVE	-	28±1	25±4
MAX V WAVE	-	28±6	28±5
ST ↓ (mm)	1.0	1.6±1	0

1. $\bar{x} \pm SD$; 2. *= $P < .05$ between Group I & II or III

