

Title: MONITORING WITH TRANSESOPHAGEAL ECHOCARDIOGRAPHY: PATIENTS UNDERGOING SUPRACELIAC AORTIC OCCLUSION

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**Introduction.** Myocardial ischemia is avoided after supraceliac aortic occlusion by maintaining normal systemic arterial pressure and cardiac output. However, these indices of myocardial well-being may not be sufficiently sensitive as cardiac complications are still the most frequent cause of perioperative mortality and morbidity after aortic reconstruction. We investigated whether continuous two-dimensional (2-D) transesophageal echocardiograms would be more sensitive to myocardial dysfunction than measurements obtained from pulmonary artery catheters or electrocardiograms in patients undergoing supraceliac aortic occlusion.

**Methods.** With approval from the institutional committee on human experimentation and informed consent from each patient, we studied 8 ASA III or IV adult patients, (ages 59-89) undergoing supraceliac aortic occlusion for aortic reconstructive surgery. Although patients had abnormal preoperative electrocardiograms and previous symptoms of myocardial ischemia, no patient had angina more frequently than once a week. All patients were anesthetized with a halogenated anesthetic, paralyzed, and ventilated. Usual monitoring techniques for this type of surgery were employed, including radial artery and pulmonary artery catheters and MCL5 electrocardiograms. In addition, a gastroscope tipped with a special 3.5 MHz, 2-D transducer was introduced into the esophagus. The positional controls of the gastroscope allowed the transducer to show multiple and reproducible views of the heart. We selected and maintained a cross-sectional view of the left ventricle (LV) through the base of the capillary muscles. The echocardiograms were evaluated by a commercially available computer program (Diasonics Light Pen). The video tapes were reviewed for accuracy of intraoperative diagnosis. The hemodynamic consequences of supraceliac aortic clamping and unclamping were managed by titration of the volatile anesthetic, administration of afterload-reducing agents, and/or adjustment of fluid volumes so as to keep pressures in the systemic and pulmonary circulations normal.

**Results.** Although pressures in both systemic and pulmonary circulations were kept normal, supraceliac cross-clamping was associated with major increases in left-ventricular end-systolic and end-diastolic cross-section areas.

Upon supraceliac aortic occlusion, mean systemic arterial pressure increased from  $74 \pm 4$  to  $114 \pm 15$  torr (mean  $\pm$  1 S.D.) ( $p \leq 0.001$ ), pulmonary capillary wedge pressure increased from  $10.5 \pm 3$  to  $14.5 \pm 2.6$  ( $p \leq 0.05$ ), while heart rate, cardiac output, and calculated stroke volume did not change significantly; however, end-diastolic left ventricular cross-sectional area increased from  $7.8 \pm 2.9$  to  $10.0 \pm 3.1$   $\text{cm}^2$  ( $p \leq 0.001$ ), end-systolic left ventricular cross-sectional area increased from  $3.6 \pm 2.2$  to  $6.1 \pm 2.8$   $\text{cm}^2$  ( $p \leq 0.0001$ ) and ejection fraction decreased from  $58 \pm 1$  to  $42 \pm 7$  percent ( $p \leq 0.001$ ). Transient wall motion abnormalities ( dyskinesis, hypokinesis or global depression) were detected in all patients. No myocardial infarctions resulted as detected by patient symptoms or electrocardiograms routinely obtained on postoperative days 1, 3, or 7.

**Discussion.** This study indicates that continuous transesophageal 2-D echocardiography is more sensitive than conventional, more invasive means of detecting left-ventricular dysfunction during major vascular surgery. The heart maintained a relatively normal cardiac output by increasing its end-systolic and end-diastolic volumes without major alteration in pulmonary wedge pressure. Such events could be detected by 2-D echocardiograph and treated, whereas they would remain undetected by conventional monitoring techniques. The absence of serious morbid events in these patients calls into question whether this technique detects insignificant left-ventricular wall motion abnormalities. However, in no case was the anesthetist blinded to the occurrence of these abnormalities and in virtually every case, treatment was altered by knowledge of that abnormality. Thus, absence of morbidity cannot be taken as absence of significant wall-motion abnormality. Rather, we believe that further study is warranted.