Title: DETECTION OF INTRAOPERATIVE MYOCARDIAL ISCHEMIA: ECG VS 2-D TRANSESOPHAGEAL ECHOCARDIOGRAPHY

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Introduction. Although irreversible damage may be prevented or minimized by the prompt detection and treatment of myocardial ischemia,[1] myocardial infarction remains a major determinant of perioperative morbidity and mortality. Despite its insensitivity,[2] the ECG is commonly used to detect intraoperative myocardial ischemia. In contrast, segmental wall motion abnormalities (SWMA) are sensitive and specific markers of regional myocardial ischemia.[3] SWMA occur within seconds of regional lactate production, even when only the subendocardium is affected, and before or in the absence of changes on the ECG.[4] Since two-dimensional (2-D) echocardiography reliably detects SWMA,[5] we compared the intraoperative incidence of ischemia as detected by 2-D transesophageal echocardiography and multilead electrocardiography in a high-risk population. The occurrence of perioperative myocardial infarctions was determined to ascertain the significance, if any, of these intraoperative events.

Methods. With approval from our committee on human experimentation and with informed consent, we studied 50 patients undergoing vascular (n = 29) or cardiac (n = 21) surgery. In all patients we recorded seven electrocardiographic leads, (I, II, III, avR, avL, avF, and V5) immediately before induction, after endotracheal intubation, after incision, before bypass or vascular clamping, during vascular clamping, 5-7 min after clamping or bypass, 30 min after bypass or release of vascular clamp, and at skin closure. In the last 30 patients, we also recorded the same ECG leads at 3-min intervals throughout induction. Following induction of anesthesia and endotracheal intubation, a 9-mm gastroscope tipped with a 3.5-mHz ultrasonic transducer was introduced into the esophagus and positioned behind the heart to obtain a short-axis view of the left ventricle at the level of the papillary muscles. These images were recorded on videotape at the times mentioned earlier. The images were graded by two independent "blinded" observers for the occurrence, location, and severity of new SWMA. All disagreements were decided by a third "blinded" observer, the senior echocardiographer. The ST segment of the ECG was read in the conventional manner 80 msec after the J point. All patients had postoperative ECGs and serum enzyme studies, and myocardial infarction (MI) was diagnosed if CK isoenzymes were elevated and new Q waves occurred. In one patient, acute infarction was diagnosed at autopsy.

Results. Eleven patients had ST segment changes of 1 mm or more: five occurred during induction of anesthesia (all of these changes reverted to baseline by the postinduction measurement and did not recur) and six during surgery. Conduction abnormalities precluded analysis of ST segments during at least one interval in 16 patients, five of whom had conduction disturbances throughout the procedure. Using the first echocardiograms as controls we documented the development of new SWMA in 24 patients. All six patients who had intraoperative ST segment changes also had SWMA simultaneously. In three of these patients, SWMA preceded the change on ECG. Four patients who had SWMA had a conduction abnormality during that interval. One patient with SWMA during left bundle branch block continued to have SWMA after conduction normalized, but without ST segment abnormality. In 339 of 350 intervals, adequate echocardiograms were recorded. In only one patient were we unable to obtain the appropriate left ventricular cross-sectional view at any time during the case. Echocardiograms were obtained for all intervals in which changes on ECG occurred. Four patients had perioperative myocardial infarction: three had persistent SWMA, while only one had a persistent ST segment change. An additional eight patients with persistent SWMA and two with persistent changes on ECG did not suffer MI.

Discussion. Intraoperatively, new SWMA occurred four times more frequently than did ST segment changes. The ECG never changed without a corresponding echocardiographic change. Additionally, new SWMA were detected in 25% of patients whose baseline ECG abnormality precluded ST segment analysis. Although the incidence of changes on ECG during induction of anesthesia before transesophageal monitoring was available was 16%, we conclude that once 2-D transesophageal echocardiographic monitoring is established, it is superior to the ECG for the detection of intraoperative myocardial ischemia and the prediction of perioperative MI. If real-time analysis of SWMA can be achieved, perhaps more episodes of intraoperative ischemia can be diagnosed and treated before irreversible myocardial damage occurs.

References.

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