Continuous ECG Monitoring for Ischemia in the ICU

In the last 2 decades, monitoring techniques in ICUs have evolved considerably but mainly in respiratory and hemodynamic measurements. Oximetry has become routine; capnography, mixed venous oximetry, and even continuous cardiac output measurements are widely used. Monitoring by electrocardiography (ECG) for ischemia, however, has not kept pace.

There are substantial reasons to be concerned. Of the 27 million patients undergoing surgery annually in the United States, as many as 1 million may develop a cardiac complication, at an estimated cost of $20 billion. Clinical studies have validated this concern. For example, in one study of 474 men with coronary artery disease (CAD) or at high risk for it, continuous monitoring of two bipolar leads in the peroperative period of noncardiac surgery demonstrated a 41% incidence of myocardial ischemia postoperatively. The ischemia on ECG correlated with a 9.2-fold increase in ischemic events (cardiac death, myocardial infarction, unstable angina). Almost all of the postoperative ischemia in this study was silent and would not have been detected without the continuous two-lead ECG monitoring.

Studies in continuously monitored patients with peripheral vascular disease undergoing vascular surgery have shown a similar incidence of ischemia in patients at risk. In one study, 176 patients were monitored preoperatively from inferior and lateral leads; 32 had 75 episodes of ischemia. Seventy-three of the 75 episodes were asymptomatic. Of the 32 patients with preoperative ischemia, 12 had postoperative cardiac events (myocardial infarction, unstable angina, ischemic pulmonary edema). Only 1 of the 144 patients without preoperative ischemia had an untoward postoperative event, suggesting postoperative ischemia might be confined to high risk groups. Another study in patients having peripheral vascular surgery demonstrated an astonishing 63.5% incidence of silent perioperative ischemia. Nine of 200 patients suffered a myocardial infarction, and there were 2 cardiac deaths. Infarctions here too correlated with silent ischemia time detected by continuous ECG monitoring. These studies clearly demonstrate a high incidence of silent ischemia and comitant adverse outcome in patients with known vascular disease or at high risk for it.

Ischemia in these patients postoperatively was presumably related to pain, fluid balance, fever, catecholamine levels, or other postoperative stresses. More recently, continuous ECG monitoring has been applied to a different kind of stress—weaning from mechanical ventilation. Hurford et al., originally using thallium scintigraphy, documented a high incidence of myocardial perfusion abnormalities occurring or worsening in patients rapidly weaned from positive pressure to spontaneous ventilation. This group then applied continuous two-bipolar-lead ECG monitoring to 17 patients weaning from mechanical ventilation in a mixed population ICU. Six of 17 patients had ECG evidence of ischemia during the 24-h study period; only two episodes were clearly related to discontinuation or changes of ventilatory support. Patients with ischemia did, however, fail to wean more commonly, reflecting either myocardial dysfunction or possibly a “sicker” cohort identified by their vascular disease.

In this issue of CHEST (see page 1577), Chatila and colleagues extend this work. As in the earlier study, a mixed population of 93 patients with a high incidence of coronary disease was studied. Continuous ECG monitoring in this study detected a 6.4% incidence of ischemia during weaning in the group. As might be expected, five of the six patients with ischemia had known CAD, and again half of the ischemic episodes were asymptomatic. Four of the six failed initial weaning attempts, although it is by no means clear that the failure to wean was causally related to ischemia.

What can we make of all of this? First, silent ische-
mia is common in patients with known vascular or CAD, particularly in postoperative patients, and is associated with adverse and even fatal outcomes. Second, we are probably failing to detect a great deal of this ischemia, and hence, are undertreating it. Finally, because we are not effectively monitoring it, we do not yet know the true incidence of silent ischemia in our ICU patients nor can we estimate our ability to modify outcomes, possibly including weaning from mechanical ventilation.

Important caveats remain. As indicated by a task force of the American College of Cardiology and the American Heart Association, there are significant technical issues in using continuous ECG monitoring to detect ischemia.7 Responsiveness to the very low frequency of ST segments and T waves has been a limiting factor in many systems. ST-T wave changes can also occur in the ICU during common physiologic events like eating, standing, hyperventilation, or as an effect of drugs. As always, Bayesian considerations apply as well, so that prior probability of disease will affect the diagnostic accuracy of the test—monitoring of this type should probably be confined to patients at risk for ischemia. It is now time, however, for us to consider more seriously in the ICU, as we do in our CCUs, the true frequency and real implications of silent ischemia in our patients.

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