AUTOMATED ST-SEGMENT TRENDING: WHAT DOES IT MEAN?

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ABSTRACT. This article is the first segment of what we hope will become a regular feature in the Journal of Clinical Monitoring. The Monitoring Dilemmas series is designed for clinicians who are struggling with the information presented by new monitoring. The past decade has seen an explosion in the number and type of clinical monitors in daily use. Health-care providers are increasingly faced with a plethora of monitoring data, often without guidance on how to interpret it.

Each Monitoring Dilemma consists of a case report that describes a clinical dilemma brought on by information from a monitor—a dilemma that would not even have been considered had the monitor not been in place or existence. The case reports are sent to experts in the particular fields concerned. To prevent "Monday morning quarterbacking," each reviewer is sent several envelopes, each containing information that progressively reveals more and more about the case. The case is presented as it actually evolved, and the experts comment as the case unfolds. Thus, the reader can share the dilemma with the reviewers, as well as with the original clinicians. We welcome your comments on this new section. We also welcome your own Monitoring Dilemmas. Please contact the Section Editor, Dr Partridge, for more details.

KEY WORDS. Heart: myocardial ischemia. Complications: ischemia.

INTRODUCTION TO MONITORING DILEMMAS SECTION

Intraoperative myocardial ischemia may be a frequent event. Clinicians often fail to recognize ischemia on standard electrocardiographic monitors. As a result, interest has increased in noninvasive monitors of ischemia that can operate in the background.

Automated ST-segment trending (ASTST) is one such modality and, despite a paucity of studies validating it, it is fast becoming a de facto standard of care. Most major manufacturers of operating room and intensive care monitors (e.g., Marquette, Hewlett-Packard, SpaceLabs, Nihon-Koden, and Siemens) now offer automated ST-segment trending as a standard feature or option. Several case reports and small studies have suggested that ASTST has a sensitivity of 60 to 90% and a specificity of 50 to 80% [2–6]. These studies concluded that ST-segment analysis should be used as a routine operating room (OR) monitor.

Previously reported cases and limited studies describe patients with known heart disease. What about the specificity of ASTST in patients without known heart disease? Is this a monitor that should be employed routinely?

Recently SpaceLabs PC2 monitors (Redmond, Wash) were installed in the ORs of the San Diego VA Medical Center. ASTST is performed automatically for all cases. We describe here a case in which a 70-year-old man...
without previously documented heart disease exhibited 3.5-mm ST-segment depression in the absence of hemodynamic changes during intubation. We were faced with the question of whether or not to carry out a cardiac workup postoperatively.

We asked two cardiac anesthesiologists (Drs Paul Barash and Martin London) and a cardiologist (Dr Hugh McCann) to provide commentary. The doctors were provided with original electrocardiograms (ECGs), anesthetic records, and other material. Their remarks have been edited for brevity and to avoid repetition between consultants.

**PREOPERATIVE EVALUATION**

The patient was a previously healthy 70-year-old man weighing 75 kg who presented for a radical retropubic prostatectomy for prostate cancer in March 1990. His medical history was significant for untreated hypertension and transient ischemic attacks (TIAs), for which he had undergone a left carotid endarterectomy in 1986, after which he had no further symptoms of carotid disease. He was also a nonsmoker. He experienced gastrointestinal (GI) bleeding in March 1989, and was taking tetracycline. He had no history of heart disease, previous myocardial infarction (MI), or angina, and he denied orthopnea or paroxysmal nocturnal dyspnea. He was active and walked “one mile” daily. Physical examination was unremarkable, except that the patient was noted to have a small mouth. His chest was clear and no gallops, rubs, rales, or wheezes were noted. He had undergone multiple general anesthetics in the past for hernia repair without incident. Results of laboratory tests were unremarkable. Preoperative ECG, unchanged from February 1987, showed biphasic t waves in V3-6 and a pattern consistent with left ventricular hypertrophy (LVH) with strain (Fig 1). Blood pressure (BP) was 185/80 mm Hg and heart rate (HR) was 68 beats/min. The patient was seen the night before surgery and was observed to be alert and ambulating around the ward. A previous attempt at spinal anesthesia had been unsuccessful, and the patient requested general anesthesia.

**Question 1:** Considering your actual practice concerning patient safety, cost, and hospital efficiency, is this an adequate preoperative workup for this patient? Does he need further cardiac, carotid, or pulmonary studies or consultations?

**DR McCANN:** No, this is not an adequate preoperative cardiac evaluation. Many studies, most notably the Framingham study [7], have shown that LVH is a strong, independent predictor of cardiac events. The risk to the patient is twofold: (1) LVH is a strong risk factor for coexisting coronary artery disease, and (2) the increased left ventricular mass shifts the myocardial oxygen supply/demand balance, making the patient more prone to ischemia under conditions of stress. The fact that the patient has already had numerous general anesthetics without problem is comforting but not entirely reassuring. An exercise tolerance test (ETT) would have been the minimum I would have requested (bearing in mind that the baseline ST abnormalities secondary to LVH with strain will significantly decrease the specificity of this study). Ideally, a precordial ECG would be desirable to evaluate cardiac function and diastolic filling patterns which may be of benefit in managing intraoperative hemodynamics. If the ETT were equivocal, thallium scintigraphy would be necessary, although a thallium ETT would be preferable.

**DR LONDON:** The preoperative evaluation identifies two areas of concern for the proposed anesthetic and surgical procedure. The first is the patient’s hypertension, which has been untreated. Although the patient is asymptomatic and has excellent exercise tolerance (walks one mile per day), I am still concerned. The ECG shows significant LVH with strain. Before proceeding, I would wish to have another BP profile of the patient. How labile is his BP? Are there any other signs of other organ involvement due to hypertension?

I would seek cardiology consultation about management of his hypertension. Questions posed to the cardiologist should include: Does the patient truly have hypertension? Should it be treated? Can short-term therapy be efficacious in terms of the contemplated major surgical procedure? These issues become more important when one considers that one of the physiologic hallmarks of hypertension is an exaggerated pressor response. This may become manifest during laryngoscopy and intubation in a patient with an anatomic abnormality of the airway, the second major area of concern in this patient.

**DR BARASH:** The fact that this patient has had multiple previous general anesthetics for peripheral surgery without difficulty is encouraging but should not lessen the clinician’s concern over the patient’s fairly substantial medical problems and their potential to increase his risk of postoperative morbidity in major surgery involving significant blood loss and tissue dissection. I would carefully study the prior anesthesia and recovery room records and the patient’s current ward pressures to get an idea of the range of BPs (and HRs) to expect...