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Update on Perioperative Myocardial Injury and Infarction

Definitions, Diagnosis, Biomarkers, Implications, and Approach to Care in the Perioperative Period

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Keywords

• Myocardial infarction • ST-elevation myocardial infarction • Troponin
• Natriuretic peptide • Myocardial injury after noncardiac surgery • MINS

Key points

- Elevations of biomarkers of myocardial infarction are more common and clinically important than once thought.
- Elevated biomarkers are associated with an increased risk of death following noncardiac surgery.
- The concept of myocardial injury after noncardiac surgery should be embraced, and studies should be performed to determine which therapies are most effective in preventing perioperative death.

INTRODUCTION

Most noncardiac surgery is undertaken to extend or improve the quality of a patient's life. There is a growing awareness that perioperative myocardial infarction (MI) is more common than initially appreciated and is associated with significant patient mortality. A recent analysis of data from the PeriOperative Ischemia Evaluation (POISE) trial indicates that perioperative MI is the most common cardiovascular complication following noncardiac surgery [1]. This study found that of the 8351 patients who were enrolled and were 45 years

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or older with cardiac risk factors, 415 patients (5.0%) who were diagnosed as having an MI. Most of the MIs occurred within 48 hours of surgery (74.1%). Of greater importance, the 30-day mortality rate was 11.6% among those who had an MI versus 2.2% for those who did not ($P<.001$). Of note, most of the MI patients were asymptomatic (65.3%) and the mortality was similar between those with (9.7%) and without (12.5%) ischemic symptoms.

DEFINITIONS

There are many pathologic factors and clinical scenarios that can result in myocardial injury. The detection of myocardial cell death resulting from prolonged ischemia is central to the diagnosis of acute MI. The time from onset of myocardial ischemia to heart-cell death can take anywhere between 20 minutes and more than 4 hours, depending on the cell's oxygen and nutrient demand and the cell's resistance to ischemia from ischemic preconditioning. In 2007 an international task force created a "universal definition of MI" [2], containing 5 sets of diagnostic criteria and 5 types of MI. The 5 types of MI are:

- Type 1, which is a spontaneous MI related to ischemia attributable to a primary coronary event such as plaque rupture, erosion, fissuring, or dissection. Type 1 MIs were further divided into unstable angina, Non–ST-elevation MI (NSTEMI), and ST-elevation MI (STEMI).
- Type 2 MIs are MIs resulting from ischemia induced by either increased myocardial demand or decreased coronary supply, such as arrhythmias, anemia, systemic hypotension or hypertension, coronary artery spasm, or embolism.
- Type 3 MIs are those that lead to sudden unexpected cardiac death.
- Type 4 MIs are associated with percutaneous coronary intervention (PCI) or coronary stent thrombosis.
- Type 5 MIs are associated with coronary artery bypass grafting (CABG) in the operating room and intensive care unit (ICU).

Types 1 and type 2 MI are most commonly encountered. Only for type 1 MI are there detailed, evidence-based management guidelines, which stress the time-critical nature of successful medical and/or percutaneous intervention [3,4].

DIAGNOSIS

The most recent universal definition describes MI as an increased plasma cardiac troponin concentration greater than 99% of the normal reference population range along with one of the following: (1) ST-segment, T-wave changes, new left bundle branch block, or pathologic Q-waves on electrocardiogram (ECG); (2) symptoms of cardiac ischemia; (3) new cardiac wall motion abnormalities or loss of viable myocardium on imaging; or (4) detection of intracoronary thrombus [5]. Many common abnormalities other than MI can result in an elevation of biomarkers of myocardial necrosis.

Symptoms of MI are rare or masked in the operating room and ICU, thus making the detection of inducible angina, especially unstable angina, very