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What is This?
Detection and management of asymptomatic myocardial injury after noncardiac surgery

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Surgery and the subsequent recovery are serious circulatory stress tests that may result in symptomatic cardiac events in vulnerable patients.1–3 Despite efforts to prevent the occurrence of postoperative adverse events, myocardial infarction following noncardiac surgery remains common.1–3 Even more worrisome, the typical symptoms of myocardial ischaemia, such as chest pain, are easily masked by postoperative pain treatment including opioids. As a consequence, the clinical course of postoperative myocardial infarction is mainly silent.3 Yet, cardiac morbidity and mortality rates in patients with asymptomatic postoperative myocardial infarction reportedly are similar to those among patients with a clinical diagnosis of myocardial infarction.1,3 As postoperative myocardial infarction may go largely undetected, the available evidence further indicates significant elevations of risk in postoperative patients with increases in circulating biomarkers reflecting cardiac cell damage, such as troponin, but without a conventional clinical diagnosis of myocardial infarction.3,6 A meta-analysis of studies in such patients showed isolated troponin elevations to be a strong independent predictor of mortality within the first year after surgery.5,6 Moreover, the VISION study, including over 15,000 noncardiac surgery patients, showed a strong association between any troponin elevation after surgery, which occurred in 11% of the patients, and 30-day mortality.6 After implementing routine postoperative troponin monitoring in elderly noncardiac surgery patients at our institution, we found similar results: 19% of the patients had a troponin elevation following surgery and such elevation was significantly associated with 30-day mortality.9 These patients go largely undetected, and if detected, clinical guidelines for the management of isolated increases in cardiac biomarkers do presently not exist.

Coronary plaque rupture

Although the pathophysiology of isolated postoperative troponin elevation is incompletely understood, coronary plaque rupture is likely to play a role.10,11 A recent study among patients with a clinically suspected acute coronary syndrome (troponin elevation and ischaemia) after noncardiac surgery, who had an indication for coronary angiography, showed that the percentage of coronary lesions indicating plaque rupture (50%) was comparable to that in patients presenting with spontaneous acute coronary syndrome.12 The release of numerous inflammatory, pro-thrombotic and other coronary plaque destabilizing factors during and following surgery are likely candidates to promote rupture of vulnerable plaques.4,13 Therefore, an acute coronary syndrome due to plaque rupture (type 1 myocardial infarction) in the perioperative period seems an obvious player in the increased mortality risk. A type 2 myocardial infarction in patients with a pre-existing stable obstructive coronary disease in combination with perioperative provoking factors like anaemia, tachycardia or hypotension may also occur. Apart from these two epicardial coronary artery disease based causes, microvessel coronary disease may further contribute to myocardial damage.

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However, in the perioperative setting other non-coronary disease related pathophysiological mechanisms may have a role in silent troponin release, such as pulmonary embolism with right ventricular failure, sepsis or the systemic inflammatory response syndrome. Each of these conditions, occurring either alone or in combination, is also associated with an increased risk of mortality in the postoperative period. Therefore, an accurate diagnostic work-up for the purpose of understanding the underlying pathophysiology of troponin elevation is a prerequisite to guide optimal treatment in individual patients.

**Diagnostic work-up**

First of all, patients with silent postoperative troponin release should have a consultation with a cardiologist during the postoperative admission. In the absence of ischaemic symptoms or ECG changes, it is difficult to distinguish coronary plaque rupture or pre-existing obstructive coronary disease from other causes of troponin release. Coronary angiography as the gold standard for the diagnosis of epicardial coronary disease is not the most suitable method to use in this early postoperative period. Therefore we suggest using less invasive diagnostic imaging tools such as coronary CT-angiography or magnetic resonance imaging (MRI) in patients with silent troponin release without signs of ischaemia. Coronary artery disease, pulmonary embolism and other thoracic abnormalities can be diagnosed by CT-angiography. MRI can be helpful to detect left ventricular function and hypertrophy, valvular disease or Takotsubo cardiomyopathy. In addition, localization of minor myocardial damage with delayed enhancement imaging may be helpful in understanding the underlying mechanism of the troponin release. Echocardiography as the less invasive cardiac imaging modality may not be useful because of the expected poor quality of the images in the early postoperative period, disabling detection of local wall motion abnormalities. A close cardiac follow-up of those patients with unexplained troponin rise after their discharge from the hospital seems mandatory. We would suggest performing a pharmacological based stress test for the detection of myocardial ischaemia within a couple of weeks after discharge. A nuclear stress test or MRI perfusion tests are the most appropriate modalities to consider. A conventional ergometry based stress test with its low sensitivity and specificity does not seem appropriate in this early postoperative setting.

**Potential impact of prevention**

The number of patients undergoing noncardiac surgery who potentially may benefit from preventive treatment is significant. In 2008, the estimated yearly global volume of major surgery was 234 million. More than 60% of these patients are of higher age (older than 50 or 60 years), that is, more than 140 million. This number is likely to increase due to the increasing age of people in developed countries and an increase in surgical volume in developing countries. Between 10% and 20% of these 140 million patients will have postoperative myocardial injury, as potentially detected by an elevated troponin level. Consequently, annually between 14 and 28 million patients may benefit from preventive treatment after noncardiac surgery. As most fatal and non-fatal cardiac events seem to occur within a year after detection of elevated troponin levels immediately after surgery, this creates an important window of opportunity for prevention of subsequent morbidity and mortality. However, in spite of accumulating evidence of the risks associated with postoperative asymptomatic troponin elevation, there are currently no generally accepted guidelines for proper management and preventive strategies.

**Options for treatment**

Whatever treatment is considered, it is of paramount importance to initiate any treatment in close collaboration with the responsible surgeon.

Patients with ST-segment elevation on the ECG should be treated according to guidelines for ST-elevation myocardial infarction (STEMI). A primary PCI as soon as possible is the treatment of choice in order to reduce ongoing damage to myocardial tissue. If possible, the implantation of stents should be avoided in order to restrict the use of triple antithrombotic therapy in the early postoperative setting. However, additional medical therapy with beta-blockers and statins is mandatory.

The goal in patients with ischaemia defined by a depression of >1 mm in more than one contiguous lead as compared with the preoperative ECG (non-STEMI) is to stabilize the patient in order to prevent total occlusion of the coronary artery (STEMI). To our knowledge, there is no evidence on how to best manage these postoperative patients. Therefore, awaiting further data we propose a pragmatic treatment policy. In addition to the usual postoperative prophylactic anti-coagulant therapy, we propose to start a single antiplatelet agent. This adjusted regimen of antithrombotic therapy in postoperative patients is different from the guidelines for non-STEMI, but seems logical to reduce the risk of bleeding in the early postoperative setting. Theoretically, patients with postoperative myocardial ischaemia may benefit most from antiplatelet drugs, while patients with postoperative pulmonary embolism may benefit more from...
anti-coagulant agents. However, because of the potential risk of bleeding in the immediate postoperative period, one should be cautious with initiating the use of multiple anti-thrombotic agents. Unfortunately, there is insufficient data on the risk of bleeding in this particular patient group, but an estimation can be obtained from the PEP trial, in which the effect of aspirin for the prevention of pulmonary thromboembolism was studied. The risk of a life threatening bleeding was low and not different between aspirin and placebo, and there was no increase in operative wound related bleedings. However, more patients in the aspirin group required a blood transfusion (2.96% vs. 2.41%). These data suggest that the incidence of life threatening bleeding when starting treatment with a single anti-platelet agent in the post-operative period is low and acceptable, at the cost of a slightly increased transfusion risk.

In patients with silent troponin elevation without any ischaemic ECG changes, individualized therapy including treatment with beta-blockers and statins should be considered, based on the cause of the troponin rise. The use of non-invasive imaging tools may be helpful in diagnosing the underlying cause. Non-invasive ischaemia detection or coronary angiography and FFR-guided PCI should be considered in a later phase.

Conclusion

Annually, millions of patients undergoing noncardiac surgery worldwide may develop postoperative asymptomatic myocardial injury with a materially increased risk of morbidity and mortality in the subsequent period. Routine postoperative troponin measurement monitoring likely will be helpful in identifying these patients. Additional (noninvasive) diagnostic work-up, and targeted individualized treatment and follow-up may improve long-term outcomes. The current challenge is to search for effective diagnostic tools and to conduct randomized trials evaluating the effects of therapeutic interventions, in order to decrease the burden of adverse cardiovascular events after noncardiac surgery.

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Conflict of interest

None declared.

References


