Myocardial infarction/injury after non-cardiac surgery: It is time for a better understanding?

Carlo Rostagno

Department of Experimental and Clinical Medicine, University of Firenze, Firenze, Italy

Related article
by Studzińska et al.

Correspondence to:
Prof. Carlo Rostagno, MD, PhD, Department of Experimental and Clinical Medicine, University of Firenze, Firenze 50134, Italy,
phone: +39 055 794 51 24,
e-mail: carlo.rostagno@unifi.it

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Perioperative myocardial infarction/injury often complicates clinical course in patients undergoing non-cardiac surgery. According to the Fourth Universal Definition, diagnosis of myocardial infarction is based on clinical, electrocardiographic, or echocardiographic abnormalities in association with increased troponin levels [1]. Otherwise, in absence of objective evidence of ischemia, an alternative diagnosis of myocardial injury should be made in the case of raised troponin levels.

According to the criteria used in different studies and depending on the type of surgery, the incidence of perioperative myocardial infarction/injury varies from 6% to 35% and is higher after vascular, thoracic, and major orthopedic surgery, including hip fracture treatment [2–4]. Perioperative myocardial infarction/injury has consistently been associated with a higher 30-day and 1-year mortality [5, 6].

It was not unexpected, as reported in the paper by Studzińska et al. [7] in this issue of the Journal, that a preoperative rest electrocardiogram did not allow physicians to predict myocardial damage in patients undergoing vascular surgery. The authors report previous studies about the prognostic value of electrocardiography (ECG) before surgery, and this topic does not need further discussion.

But does rest ECG have no value in predicting postoperative ischemic damage or do we have other clinical tools to stratify the risk in patients undergoing non-cardiac surgery? The same criteria apply to elective or urgent/emergent surgery (e.g aortic abdominal aneurysm repair or trauma, including hip fracture). In these latter patients, adrenergic response, inflammatory changes, and hemostatic activation related to the acute event may cause an imbalance between myocardial oxygen requirement and effective supply that is frequently associated with an increase of troponin values already at hospital admission before surgery [8, 9].

Several clinical factors have been related to a higher risk of cardiovascular complications: sex, age, history of coronary heart disease or heart failure, and renal failure are all independently related to an increased rate of myocardial damage and mortality. Kristensen et al. [10] revised a cardiac index score including six variables (high-risk surgery, history of coronary heart disease, history of congestive heart failure, history of cerebrovascular disease, diabetes requiring insulin therapy, chronic kidney disease with a creatinine >2.0 mg/dl), which is widely used to predict major cardiac complications. Echocardiography may be useful to obtain a more accurate risk stratification. The functional evaluation of the left and right ventricle is useful to avoid unnecessary fluid administration which may precipitate heart failure, particularly in the post-operative period. In patients with suspected heart valve disease, assessment of hemodynamic severity of defects may favor a more accurate perioperative management. According to data from our center, pulmonary hypertension (defined as a right ventricular/right atrial gradient >40 mm Hg) is independently associated with a lower in-hospital and 3-month survival in patients undergoing hip fracture surgery [11]. Finally, the evaluation of the inferior vena cava diameter, in particular, for urgent/emergency surgery, may

allow for assessing volume status and correct hypovolemia, which affects adversely clinical outcomes.

According to the European Society of Cardiology (ESC) guideline, N-terminal pro-B-type natriuretic peptide (NT-proBNP) and BNP measurements have a class II, level B evidence as independent prognostic markers for perioperative and late cardiac events in high-risk patients [12].

In 75 patients with mild-to-moderate heart failure referred to our hospital for hip fracture, the NT-proBNP concentrations of 2000 pg/ml were associated with a two-fold increase in 3-month mortality (64% sensitivity and 70% specificity).

The second question concerns the need for a shared protocol for the diagnosis of myocardial infarction/injury after non-cardiac surgery. The ESC guidelines suggest assessment of cardiac troponins in high-risk patients, both before and 48–72 hours after major surgery (evidence class II, level B). However, most patients are asymptomatic and do not undergo ECG monitoring nor serial 12-lead ECG (and even more infrequently echocardiogram) after non-cardiac surgery. Therefore, in the case of the postoperative troponin increase, the differential diagnosis between myocardial infarction and myocardial injury with the related prognostic implications is often impossible. Nevertheless, several studies in which cardiac troponin I (cTnI) or cardiac troponin T (cTnT) were assayed demonstrated a proportional increase in both short-term and 1-year mortality with the increase of peak troponin values.

The introduction of high sensitivity troponin T (hs-TnT) assays for the diagnosis of myocardial damage has undoubtedly increased the sensitivity in patients presenting with acute chest pain [13], but these advantages do not necessarily appear in the perioperative setting where the main problem is poor specificity and not low sensitivity. A disproportionate increase of hs-TnT has been demonstrated both after cardiac and non-cardiac surgery. For cardiac surgery, a recent paper published by *New England Journal of Medicine* showed that the high-sensitivity cTnI values, which were identified as associated with excess mortality risk, ranged from approximately 40 to approximately 500 times the upper 99th percentile of normal distribution [14]. In the investigation by Studzińska et al. [7] myocardial injury after non-cardiac surgery (MINS) was defined as an absolute postoperative value of hs-TnT >65 ng/l or an elevation of at least 5 ng/l from the baseline, with postoperative troponin levels in the range of 20–64 ng/l. Other studies suggest that diagnosis of postoperative myocardial infarction/injury requires an absolute increase of hs-TnT >50% in comparison to preoperative values [15]. In an ongoing study from our department, the preliminary data suggest that in patients with hip fracture hs-TnT values >99th percentile are already present in 64% at hospital admission and in 90% postoperatively. Since an accepted cut-off value at present does not exist, comparison between different studies is difficult and a predictive instrument difficult to evaluate. A multicenter study involving patients undergoing a different type of major surgery might offer the possibility to better define diagnostic criteria, evaluate the prognostic value of different clinical-instrumental tools, and finally personalise prevention and management strategies.

Article information

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