

## Response to Letter Regarding Article, “Development and Validation of a Risk Calculator for Prediction of Cardiac Risk After Surgery”

We thank Drs Lee and Goldman for their comments on our publication.<sup>1</sup> The doctors state that the ratio of postoperative cardiac arrest to myocardial infarction (MI) is 2.5:1 in our study in comparison with a ratio of 0.3:1 in their study.<sup>2</sup> Based on this finding, they contend that cardiac arrests in our study should more appropriately be attributed to noncardiac causes, and thus the Revised Cardiac Risk Index (RCRI) more accurately estimates the risk of cardiac complications after surgery.

It should be remembered that, among the patients in the dataset used to develop the RCRI (n=2893) in 1999, 56 (2%) patients developed a major cardiac complication. There were only 9 (0.3%) with cardiac arrest, 2 (0.1%) with complete heart block, 28 (1%) with MI, and 24 (0.8%) with pulmonary edema. The authors did not mention whether these cardiac complications were due to cardiac or noncardiac factors. In fact, associated postoperative complications, such as renal failure or stroke, were not addressed in their article at all.

In our opinion, because the number of patients experiencing cardiac arrest is <10, one cannot just assume that 0.3:1 should be the default ratio for cardiac arrest to MI in a postoperative patient population.

Furthermore, a patient who develops postoperative cardiac arrest secondary to another postoperative complication, such as pneumonia, respiratory, or renal failure, has a cardiac complication. To term cardiac arrest subsequent to another complication, a noncardiac complication is to categorize a patient with renal failure secondary to hypovolemia as a nonrenal complication, because the patient does not have intrinsic kidney disease.

Although our colleagues raise an interesting argument with regard to the pathogenesis of postoperative cardiac complications, we currently lack the necessary tools to determine the exact origin of these complications. Even if we consider the outcomes to be different in the 2 studies, the outcomes assessed by our study are probably more relevant to surgeons and patients in terms of making a decision to proceed with the surgery. Hence, evaluation of hard outcomes, as in our study, is probably more relevant than those studied in RCRI, regardless of whether these are primary (cardiac arrests) or secondary to other systems.

We did not include complete heart block and pulmonary edema as part of our outcomes because they are not part of National Surgical Quality Improvement Program dataset. The RCRI had only 2 patients develop complete heart block, so this probably has little impact on the debate. Whether all cases of pulmonary edema are cardiac complications is also debatable.

Use of National Surgical Quality Improvement Program allows for estimation of risk based on surgical procedure because of its large sample size. It would seem self-evident that a laparoscopic cholecystectomy and a Whipple resection carry markedly different cardiac risks in the same patient, unlike RCRI estimates that would assume that all intraperitoneal operations have the same perioperative risk.

We contend that our risk calculator offers significant advantages in comparison with the RCRI, both in terms of discrimination and calibration. A cardiac arrest or MI after surgery remains a cardiac complication, and a preceding renal, respiratory, or neurological complication does not render the cardiac arrest or MI a noncardiac complication.

## Disclosures

None.

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