CORRESPONDENCE

Improving adherence to a monitoring protocol for myocardial injury after non-cardiac surgery

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To the Editor,

In 2016, the Canadian Cardiovascular Society (CCS) released clinical practice guidelines¹ for the perioperative cardiovascular management of patients undergoing non-cardiac surgery. These new guidelines represented a significant departure from other widely used guidelines^{2,3} in that biomarkers, specifically brain natriuretic peptide (BNP) or N-terminal-pro hormone BNP (NT-proBNP), were strongly recommended for both cardiac risk assessment and monitoring for myocardial injury after non-cardiac surgery (MINS). The Department of Anesthesia at St. Paul's Hospital (SPH) in Vancouver, BC, a tertiary academic acute care hospital, was an early adopter of the CCS guidelines and implemented a local MINS protocol in January 2017.

Successful implementation of the MINS protocol requires appropriate patient identification, followed by protocol activation and completion for all eligible cases throughout the entire perioperative course. One year following our MINS protocol implementation, we sought to determine the rate of adherence for protocol activation and completion at SPH. We aimed to determine the baseline adherence rates for elective and emergency

surgeries and hypothesized that the use of bundled interventions would improve adherence rates.

The study was a quality improvement project and did not require institutional ethics approval. The pre-intervention phase was from 1 September to 30 November 2017 (at least six months following initial MINS protocol implementation, with three consecutive months of data collection that avoided the summer and winter holiday-related reductions in operating room scheduling). The bundled interventions that were introduced throughout March 2018 are listed in the Table. The post-intervention phase was from 1 April to 30 June 2018. All data were collected retrospectively by three anesthesiologists using the operating room administration records and the hospital's digital charting system. The availability of preoperative NT-proBNP and appropriate ordering of postoperative troponins for eligible patients were used to define adherence to protocol activation and completion, respectively. Rates of adherence were compared using Fisher's Exact test.

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Table Perioperative bundled interventions used to improve rates of adherence for MINS protocol activation and completion in elective and emergency surgeries

Phase	Specific intervention	Outcome and current clinical flow
Preoperative	In-service training for nursing staff and development of pre-admission clinic policies based on published guidelines	Pre-admission nursing staff screen all patients requiring hospital admission to determine eligibility for automatically ordered preoperative NT-proBNP
	Grand rounds re-education on the 2016 CCS guidelines	<i>Preoperative*</i> anesthesiologist performs risk stratification prior to surgery by evaluating available NT-proBNP results. For those without NT-proBNP, assess eligibility and add NT-proBNP as needed.
	Providing feedback statistics on departmental protocol adherence rates	Anesthesiologist is motivated to improve on baseline protocol adherence rates
Intraoperative	Development of electronic pre-printed order	<i>Intraoperative*</i> anesthesiologist completes pre-printed order forms intraoperatively for protocol completion
	Integration of care with perioperative anesthesiology and surgical teams	<i>Perioperative*</i> anesthesiologist screens slate to ensure all eligible patients are appropriately added to pathway. <i>Intraoperative</i> anesthesiologist writes a chart note and communicates to perioperative anesthesiologist and surgical team about protocol activation and completion.

Table continued

Phase	Specific intervention	Outcome and current clinical flow
Postoperative	In-service training for nursing staff and development of post anesthesia care unit policies based on published guidelines	Post-anesthesia care unit nursing staff follows pre-printed order to draw postoperative troponin and ECG
	Education and development of follow-up system	<i>Perioperative</i> anesthesiologist assesses postoperative troponin levels and ECG and performs risk stratification. <i>Perioperative</i> anesthesiologist monitors daily troponin level until discharge.
	Establish memorandum of understanding and timely transition of care to internal medicine team	<i>Perioperative</i> anesthesiologist consults internal medicine with significant troponin elevations for follow-up

*At St. Paul's Hospital, the *preoperative* anesthesiologist is the one who assesses the patient for readiness for surgery, whether it is the anesthesiologist in the pre-admission clinic or the intraoperative anesthesiologist (if the patient did not qualify to be seen in the pre-admission clinic). The *intraoperative* anesthesiologist is the one providing the anesthetic in the operating room. The *perioperative* anesthesiologist is the daily scheduled anesthesiologist coordinating all high-risk patient care both pre- and postoperatively with the rest of the anesthesiology and surgical team members

CCS = Canadian Cardiovascular Society; ECG = electrocardiogram; MINS = myocardial injury after non-cardiac surgery; NT-proBNP = N-terminal-pro hormone brain natriuretic peptide

A total of 2,430 surgical cases were assessed during the pre-intervention ($n = 1,166$) and post-intervention periods ($n = 1,264$); 46.6% (1132/2430) of patients met the criteria for MINS protocol activation. The baseline adherence for eligible patients undergoing elective surgeries requiring hospital admission was 68.1% (254/373) for protocol activation and 25.0% (55/220) for protocol completion; implementing the bundled interventions improved these adherence values to 81.3% (339/417; $P < 0.001$) and 43.1% (79/183; $P = 0.001$), respectively. At baseline, 254 patients had NT-proBNP levels drawn, 62 (24.4%) of which were positive. This was similar to 23.6% (80/335) in the post-intervention period. For emergency surgeries, only baseline protocol completion was assessed and there was a

significant improvement after the bundled interventions (11.9% vs 34.1%; $P < 0.001$).

During the study period, we found that almost one in two patients undergoing non-cardiac surgery requiring admission at SPH qualified for monitoring using the MINS protocol as per the 2016 CCS guidelines. For elective surgeries, preoperative NT-proBNP values had been measured in most eligible patients who started the protocol, often during pre-admission assessment; however, very few eligible patients completed the required daily troponin measurements. The low protocol completion rate was also seen in emergency surgeries. In both elective and emergency cases, protocol adherence rates improved significantly with bundled interventions. The bundled interventions have now become part of the permanent clinical workflow at our hospital, and ensure follow-up with the division of general internal medicine for patients who have suffered MINS. We hope our study provides a resource for other departments seeking to implement the MINS protocol.

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