

Physician Practices in the Management of Myocardial Injury after Non-Cardiac Surgery: A Survey Study

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Abstract

Objective: To describe how physicians manage patients with myocardial injury (i.e., a troponin elevation of presumed ischemic origin) after non-cardiac surgery (MINS).

Methods: Web-based survey to physicians distributed between December 2020 and September 2021, including a case scenario of asymptomatic MINS.

Results: Of 103 respondents, 94% were practicing in Canada and 65% were general internists. 97% of respondents would order an ECG; following a normal ECG, 46% of would order an echocardiogram; following a normal echocardiogram, 42% would order myocardial perfusion imaging. Of the respondents, 91% and 90% would initiate ASA and a statin, respectively; 24%, 21%, and 7% would initiate an ACE inhibitor, a beta-blocker, and dabigatran, respectively. Most participants indicated that outpatient follow-up with a medicine specialist within 1–2 months (90%) and 1 year (68%) was appropriate.

Conclusion: Respondents generally agreed that ASA and statins should be prescribed for MINS, and that post-discharge specialist follow-up is warranted. However, opinions regarding the role of cardiac imaging varied.

Résumé

Objectif: Décrire la manière dont les médecins prennent en charge les patients atteints d'une lésion myocardique (c'est-à-dire une élévation de la troponine d'origine ischémique présumée) à la suite d'une intervention chirurgicale non cardiaque (MINS pour *myocardial injury after non-cardiac surgery*).

Méthodologie: Enquête en ligne menée auprès de médecins et distribuée entre décembre 2020 et septembre 2021 et comprenant un scénario de cas de MINS asymptomatique.

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Résultats: Sur les 103 répondants au sondage, 94% pratiquent au Canada et 65% sont des internistes généralistes. Une proportion de 97% des répondants demanderaient un ECG; si l'ECG s'avère normal, 46% demanderaient un échocardiogramme; s'il s'avère normal, 42% demanderaient une imagerie de perfusion myocardique. Une proportion de 90 à 91% des répondants prescriraient un traitement par l'acide acétylsalicylique (ASA) ou une statine; 24% un traitement par un inhibiteur de l'enzyme de conversion de l'angiotensine (IECA), 21% un traitement par un bêtabloquant et 7% un traitement par le dabigatran. La plupart des participants indiquent qu'il est approprié d'assurer un suivi en consultation externe par un spécialiste dans le mois ou les deux mois (90%) et un an (68%) suivant l'intervention.

Conclusion: Les répondants au sondage sont généralement d'avis que l'ASA et les statines devraient être prescrits pour la MINS et qu'il est justifié d'assurer un suivi par un spécialiste après la sortie de l'hôpital. Les avis concernant le rôle de l'imagerie cardiaque varient.

Keywords: myocardial injury; noncardiac surgery; MINS; treatment; diagnostic testing; follow-up

Introduction

Over 300 million non-cardiac surgeries are performed worldwide every year, of which about 12–15% will be complicated by myocardial injury after non-cardiac surgery (MINS).^{1–3} MINS is defined as a rise in troponin within 30 days after non-cardiac surgery due to a presumed ischemic etiology and is associated with an increased short-term and long-term risk of cardiovascular morbidity and all-cause mortality.^{2–6}

MINS is a clinical entity that has only recently been defined, and its management remains an evolving area of research.⁴ The etiology of MINS is likely heterogeneous, though it is generally believed to be caused by either acute atherothrombosis or supply-demand mismatch.⁵ The occurrence of MINS (even when it does not meet the criteria for the definition of myocardial infarction) portends a poor prognosis regarding the risk of future adverse cardiovascular events, and most patients with MINS have underlying coronary artery disease.^{2,4–7} Some experts have suggested that patients with MINS undergo cardiovascular risk stratification and treatment according to secondary cardiovascular prevention guidelines.⁵ There is little evidence to guide the use of cardiac imaging for risk stratification in patients with MINS, and it is unclear how often cardiac imaging is used in clinical practice. While the 2016 Canadian Cardiovascular Society (CCS) perioperative guidelines state that patients with MINS should be treated with long-term acetylsalicylic acid (ASA) and statin therapy, whether clinicians are following these recommendations is unknown.⁸ Dabigatran has been shown to be effective for improving long-term cardiovascular outcomes in an international randomized controlled trial including 1754 patients with MINS; however,

to what extent this evidence has penetrated practice has not been investigated.⁹

We conducted a nationwide survey to determine current physicians' attitudes and practices for managing patients with MINS.

Methods

We developed a 14-item anonymized survey in consultation with physician experts in perioperative medicine and MINS (Appendix). Participants were asked to answer a series of questions about a clinical scenario of a patient who had undergone orthopaedic surgery (Box). This patient fulfilled the criteria for MINS but did not fulfill the universal definition of myocardial infarction (i.e., did not have ischemic symptoms or ECG changes).¹⁰ Participants were asked to select on a five-point Likert scale ranging from 'Definitely No' to 'Definitely Yes' regarding whether they would order specific cardiac investigations, whether they would prescribe certain cardiovascular medications, and whether specialist outpatient follow-up was felt to be warranted. Only physicians in independent clinical practice who reported seeing patients with MINS were eligible to complete the survey. The study was approved by the Hamilton Integrated Research Ethics Board.

We developed our survey using the online tool LimeSurvey. An email invitation with a link to complete the survey was distributed by the Canadian Society of Internal Medicine, the Society for Perioperative Research and Care, and the CCS to their respective members. In addition, at least one reminder email per distribution list was sent. Responses were collected between December 2020 and September 2021.

Box. Clinical scenario. Participants were presented with the below case and asked a series of questions regarding their management choices.

As a consultant, you are asked to see the following patient in hospital.

Mrs. X is a 73 year-old woman who had her right knee total arthroplasty. Postoperatively, her high sensitivity troponin I (hsTnI) was elevated and peaked at 154 ng/L (upper limit of normal, 30 ng/L) on post-operative day 2. Her vitals are stable. There were no symptoms, in particular no chest pain or tightness, nor shortness of breath.

Hb 111 g/L (120 g/L at admission), creatinine 90 µmol/L, and hsTnI decreased to 76 ng/L on subsequent measurement.

Past medical history: hypertension, rheumatoid arthritis, depression, gout, and obesity (Body Mass Index 33). No history of alcohol use or smoking. Independent on activity of daily living but uses a cane.

Preoperative medications: amlodipine, hydrochlorothiazide, adalimumab (Humira®), and venlafaxine.

A total of 114 individuals responded to our invitation, of which 103 were eligible and completed the survey. Based on the number of society members included in the distribution lists, we possibly reached out to 4,500 physicians; however, many people were likely part of more than one list, and many might not have been eligible to answer the survey (e.g., residents, physicians not seeing patients with MINS).

We summarized data using descriptive statistics. Dichotomous variables were described using counts and percentages, and continuous variables were described as median (interquartile range) [IQR]. Statistical analyses were performed using Microsoft Excel.

Results

Of the 103 respondents, 97 (94%) were physicians practicing in Canada (Table 1). The median participant age was 44 years (IQR 20) and 60% were male. Most participants were general internists (65%), had been in independent practice for more than 5 years (64%), and were practicing in tertiary academic centres (74%).

When asked to assess the patient in the scenario (Figure 1), 97% of respondents indicated that they would probably or definitely order an electrocardiogram (ECG). After a normal ECG was reported, 46% indicated that echocardiography should definitely or probably be ordered. After being shown that the patient had a normal echocardiogram,

Table 1. Participant Demographics (N = 103)

Category	Number (%)
Sex	
Female	37 (36%)
Male	62 (60%)
No answer	4 (4%)
Age, median years [IQR]	44 [20]
Years of independent practice	
<5	36 (35%)
5–15	24 (23%)
>15	42 (41%)
No answer	1 (1%)
Practicing specialty	
General Internal Medicine	67 (65%)
Anesthesiology	8 (8%)
Critical Care	8 (8%)
Cardiology	7 (7%)
Other	7 (7%)
No Answer	6 (6%)
Primary practice location	
Tertiary teaching center	76 (74%)
Community hospital	23 (22%)
Other	4 (4%)
Country, province of practice	
Canada, Ontario	53 (51%)
Canada, British Columbia	20 (19%)
Canada, Quebec	14 (14%)
Canada, Other	6 (6%)
International	6 (6%)
No answer	4 (4%)
"My site has..."	
A preoperative clinic	94 (91%)
A postoperative clinic	29 (28%)
An inpatient perioperative consult service	91 (88%)
A perioperative care division	28 (27%)
Number of patients seen with MINS over last 12 months	
1–9	34 (33%)
10–30	37 (36%)
>30	32 (31%)

IQR, interquartile range; MINS, myocardial injury after non-cardiac surgery.

42% of participants indicated that myocardial perfusion imaging should definitely or probably be ordered.

In the scenario of MINS with normal ECG and normal echocardiogram, 91% of respondents would start ASA, 90% a statin, and 87% of participants indicated that they would

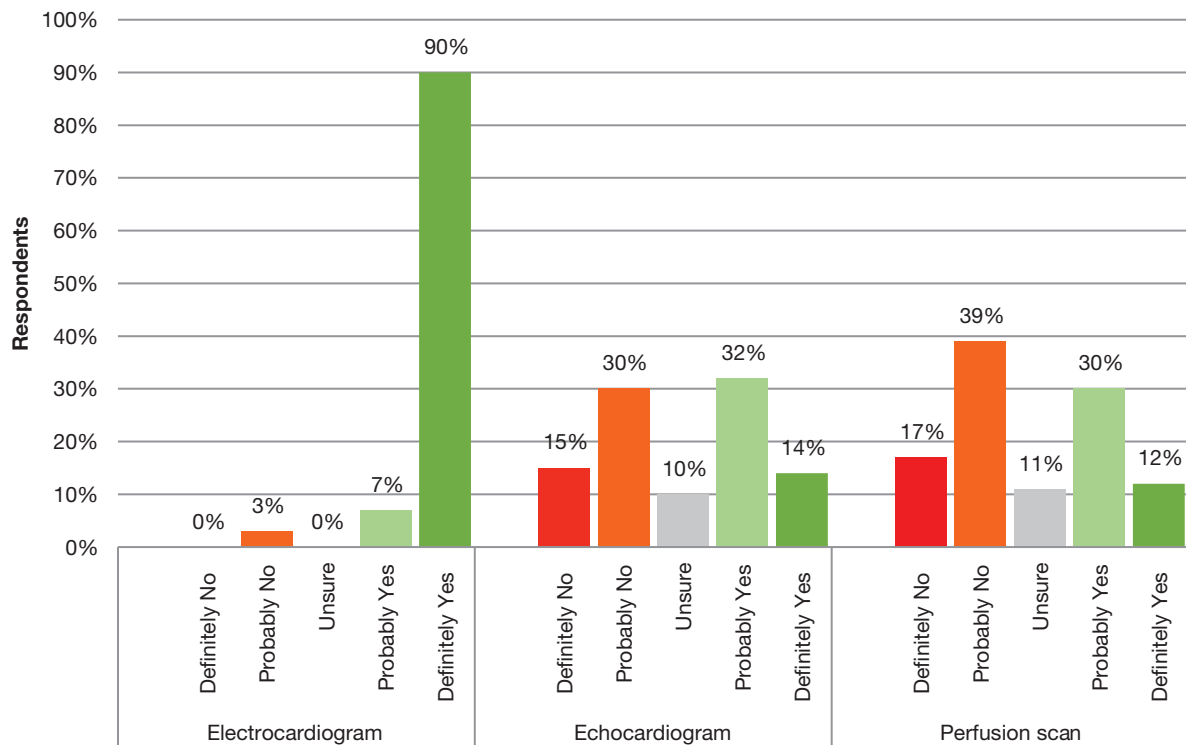


Figure 1. Use of cardiac investigations after MINS. Participants were sequentially asked to indicate whether they would order an electrocardiogram, echocardiogram, and cardiac perfusion scan in the clinical scenario.

start both medications. However, in this same scenario, less than one-fourth of respondents would start either an angiotensin-converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) (24%), or a beta-blocker (21%), and 7% would initiate dabigatran.

Ninety percent of participants believed that outpatient follow-up within 1–2 months after the diagnosis of MINS should probably or definitely be arranged with a medicine specialist, while 68% indicated that specialist follow-up should probably or definitely be arranged after one year.

Discussion

In this survey comprising mostly general internists who manage patients with MINS, we found consensus that MINS should be investigated with an ECG, treated with ASA and statin therapy, and followed by a specialist after hospital discharge. By contrast, in a patient scenario with no ischemic symptoms or ECG changes, we found that there was equipoise regarding the role of cardiac imaging for risk stratification and the use of other cardiac medications for managing MINS.

Observational data have suggested that using ASA and statins after MINS may reduce mortality risk.^{11,12} The 2016 CCS perioperative guidelines strongly recommend the initiation of long-term ASA and statin for the treatment of MINS based on moderate-quality evidence.⁸ More recently, the American Heart Association also endorsed using ASA and statin for patients with MINS.⁴ Our findings suggest a general acceptance of these recommendations among Canadian physicians seeing patients with MINS. Our survey respondents were more likely to prescribe ASA and statins compared to previous studies conducted elsewhere. For example, a 2019 American cohort study of 236 patients with MINS found that 47.5% were discharged on both medications, and a 2020 Korean cohort of 5,109 MINS patients found only 15% were discharged with this combination.^{13,14}

The clinical rationale for administering ACEI/ARBs and beta-blockers in patients with MINS extends from their well-established effectiveness for secondary prevention among patients with coronary artery disease and nonoperative myocardial infarction.^{15,16} However, the data supporting the use of these medications in patients with MINS is limited.^{12,17} We found that 21–25% of physicians would prescribe these medications for patients with MINS. These

results are consistent with those from a previous Swiss observational study which found that only 34.7% and 31.6% of patients with MINS were prescribed an ACEI/ARB and beta-blocker on discharge, respectively.¹⁸ The number of physicians who would prescribe dabigatran for MINS was also low in our study. This is despite the fact that dabigatran is both safe and effective for the long-term prevention of arterial and venous thrombotic events in a large international clinical trial.⁹ While we did not explore the underlying reasons for this discrepancy, our findings may reflect physicians' hesitancy to start long-term anticoagulation.^{19,20} It is possible that more of our survey respondents would have opted to use dabigatran if explicitly allowed to initiate the drug later or for patients who fulfill the universal definition of myocardial infarction.

The diagnostic yield and cost-effectiveness of routine echocardiography and myocardial perfusion imaging after MINS are unknown. These investigations could provide valuable prognostic information for patients with underlying coronary artery disease and identify high-risk patients who may benefit from invasive coronary angiography and/or revascularization, similar to the nonsurgical setting.^{7,21,22} Until the diagnostic yield of these investigations is better described, physicians may remain hesitant about their utility. A retrospective study of 268 patients with a perioperative myocardial injury who subsequently underwent cardiovascular imaging suggests that myocardial perfusion imaging and coronary angiography may be useful for identifying patients with type 1 myocardial infarction.²³ Our study found that diagnostic testing for cardiac risk stratification after MINS varies among clinicians. Consistent with our findings, a small single-centre Canadian observational study of 65 MINS patients previously found that only 29.7% received an echocardiogram and 51.6% received cardiac perfusion imaging and/or coronary intervention.²⁴

Theoretical benefits of specialist follow-up after MINS include additional cardiac risk stratification, cardiovascular risk factor modification, and closer monitoring for cardiovascular complications. In addition, most clinicians in our study agreed that short-term and long-term follow-up was indicated in this population. This is consistent with the fact that patients with MINS are at increased risk of postoperative mortality after 30 days and 1 year.⁶ Our findings may also reflect the uncertainty in managing these patients in the immediate perioperative setting, with deferral of decisions regarding medications and investigations to a later time.

This study is the first to describe physicians' attitudes toward managing patients with MINS. Our study has

limitations. First, we opted for a distribution method known to be less effective than personal invitations,²⁵ and does not enable a reliable calculation of the response rate. For this study, we were concerned that any more selective recruitment method would introduce bias. Second, our results might not be generalizable to physicians practicing outside Canada and not speaking English; also, the generalizability might be limited for specialists other than general internists. Third, our case scenario did not include any features suggestive of underlying high-risk coronary artery disease. It is possible that responses would differ in other MINS scenarios. We strategically decided to focus on the most common type of MINS presentation (i.e., no ischemic symptoms or ECG findings) and to limit the survey to one scenario to enhance the response rate. Finally, as our intent was to describe the current practice, our survey did not explore the rationale behind physician responses, which might be the focus of future research.

Conclusion

Our survey of physicians suggests that most Canadian physicians believe that MINS is a condition that warrants treatment with ASA and a statin, as well as follow-up with a specialist. However, few physicians initiate long-term oral anticoagulation and other medications for cardiovascular prevention; and attitudes towards using cardiovascular risk stratification testing in this population varies. There is a need for more evidence regarding the role of cardiac imaging and secondary cardiovascular prevention strategies for MINS to facilitate greater consensus in practice among physicians managing this patient population.

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Appendix. MINS survey distributed to participants

Managing Patients with Myocardial Injury after Noncardiac Surgery (MINS)

There are 16 questions in this survey.

Physician Practices in the Management of Elevated Troponin after Non-Cardiac Surgery (After-MINS)

Dear Colleague,

You are being invited to participate in a research study exploring physician management patterns with patients who experience myocardial injury after noncardiac surgery (MINS), defined as troponin elevation after noncardiac surgery deemed to be ischemic in nature.

Participation is voluntary. If you elect to participate in the study, you will be asked to complete the following survey, which takes no longer than 10 minutes. You will be asked to provide answers to multiple-choice questions regarding your perspective on the management of MINS.

The results of this study will be reported in aggregate form without identifying participant information. There is therefore minimal risk to your privacy.

By electing to continue with this survey you consent to inclusion in this study. You may interrupt the survey at any time, or withdraw your completed survey by sending a request by e-mail to minsurv@mcmaster.ca (<mailto:minsurv@mcmaster.ca>)

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This study has been reviewed by the Hamilton Integrated Research Ethics Board (HIREB). The HIREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, Hamilton Integrated Research Ethics Board at 905.521.2100 x 42013.

Do you agree to take part in this survey? *

Please choose **only one** of the following:

- Yes
 No

In the last year have you seen a patient with MINS*?

***myocardial injury after noncardiac surgery**, defined as troponin elevation after noncardiac surgery deemed to be ischemic in nature

*

Please choose **only one** of the following:

- Yes
 No

Demographics and Practice

Please tell us a little about yourself.

Please enter your age.

Please write your answer(s) here:

Age

Sex *

Please choose **only one** of the following:

- Male
 Female
 I prefer not to answer

For how many years have you been in independent clinical practice?

*

Please choose **only one** of the following:

- <5
- 5-15
- >15
- I prefer not to answer

What is your practicing specialty? *

Please choose **only one** of the following:

- Cardiology
- General Internal Medicine only
- I prefer not to answer
- Internal Medicine with other subspecialty training (please specify)

What best describes your practice setting? *

Please choose **only one** of the following:

- Community hospital
- Tertiary teaching hospital
- Private practice
- I prefer not to answer

Other

Which of the following do you have at your site? Check all that apply.

Please choose **all** that apply:

- Preoperative clinic(s)
- Postoperative clinic(s)
- Inpatient perioperative consult service(s)
- Perioperative care division

What is the name of your centre? *

Please write your answer here:

Over the last 12 months, how many patients **did you happen to see** that had MINS (regardless of whether or not you were directly managing their MINS)?

*

Please choose **only one** of the following:

- None
- 1-9
- 10-30
- >30
- I prefer not to answer

Clinical Scenario

As a consultant, you are asked to see the following patient in hospital.

Mrs. X is a 73 years old woman who had her R knee total arthroplasty. Postoperatively, her high sensitivity troponin I (hsTnI) was elevated, and peaked at 154 ng/L (upper limit of normal range 30) on postoperative day 2. Vitals are stable. No symptoms, in particular no chest pain or tightness, nor shortness of breath.

Hb 111 g/L (120 g/L at admission), creatinine 90 μ mol/L, and hsTnI decreased to 76 ng/L on subsequent measurement.

Past medical history: hypertension, rheumatoid arthritis, depression, gout, and obesity (BMI 33). No history of alcohol use or smoking. Independent on activity of daily living but uses a cane.

Preoperative medications: amlodipine, hydrochlorothiazide, adalimumab (humira), and venlafaxine.

Please respond to the following:

Would you ask for an ECG?

Please choose **only one** of the following:

- Definitely no
- Probably no
- Uncertain
- Probably yes
- Definitely yes

Clinical Scenario

As a consultant, you are asked to see the following patient in hospital.

Mrs. X is a 73 years old woman who had her R knee total arthroplasty. Postoperatively, her high sensitivity troponin I (hsTnI) was elevated, and peaked at 154 ng/L (upper limit of normal range 30) on postoperative day 2. Vitals are stable. No symptoms, in particular no chest pain or tightness, nor shortness of breath.

Hb 111 g/L (120 g/L at admission), creatinine 90 μ mol/L, and hsTnI decreased to 76 ng/L on subsequent measurement.

Past medical history: hypertension, rheumatoid arthritis, depression, gout, and obesity (BMI 33). No history of alcohol use or smoking. Independent on activity of daily living but uses a cane.

Preoperative medications: amlodipine, hydrochlorothiazide, adalimumab (humira), and venlafaxine.

The ECG is performed and is unremarkable.

Would you perform an echocardiogram?

Please choose **only one** of the following:

- Definitely no
- Probably no
- Uncertain
- Probably yes
- Definitely yes

Clinical Scenario

As a consultant, you are asked to see the following patient in hospital.

Mrs. X is a 73 years old woman who had her R knee total arthroplasty. Postoperatively, her high sensitivity troponin I (hsTnI) was elevated, and peaked at 154 ng/L (upper limit of normal range 30) on postoperative day 2. Vitals are stable. No symptoms, in particular no chest pain or tightness, nor shortness of breath.

Hb 111 g/L (120 g/L at admission), creatinine 90 μ mol/L, and hsTnI decreased to 76 ng/L on subsequent measurement.

Past medical history: hypertension, rheumatoid arthritis, depression, gout, and obesity (BMI 33). No history of alcohol use or smoking. Independent on activity of daily living but uses a cane.

Preoperative medications: amlodipine, hydrochlorothiazide, adalimumab (humira), and venlafaxine.

The ECG is performed and is unremarkable.

An echocardiogram is performed and shows a left ventricular ejection fraction of 65% with no regional wall abnormalities; left ventricle thickness is increased and there is a filling pattern in keeping with some diastolic dysfunction. The rest is normal

Would you ask for a cardiac perfusion test (e.g., Persantine MIBI)?

Please choose **only one** of the following:

- Definitely no
- Probably no
- Uncertain
- Probably yes
- Definitely yes

Which medications would you start this patient on? Check all that apply.

Please choose **all** that apply:

- Aspirin
- Statin
- Dabigatran
- Beta-blocker
- ACEI/ARB
- I do not know

Other (specify):

Assuming necessary resources are available, do you believe this patient should be followed up by a medicine specialist (e.g., internal medicine or cardiology) within 1-2 months of her surgery for her MINS?

Please choose **only one** of the following:

- Definitely no
- Probably no
- Uncertain
- Probably yes
- Definitely yes

Assuming necessary resources are available, do you believe this patient should be followed up by a medicine specialist (e.g., internal medicine or cardiology) within 1 year of her surgery for her MINS?

Please choose **only one** of the following:

- Definitely no
- Probably no
- Uncertain
- Probably yes
- Definitely yes

Thank you for taking the time to complete this survey.

If you are reading this message you have reached the end of our questionnaire, and for that we are sincerely grateful.

We commit to using the data you have provided to improve outcomes in patients during the sensitive perioperative period. We will share these results with you once they are published. Keep an eye out for further communication through the newsletter of your professional society.

Once again, we are extremely grateful for your honest contributions and your valuable time.

Submit your survey.

Thank you for completing this survey.