

Prospective Study of Patients with Myocardial Injury After Non-Cardiac Surgery Undergoing Myocardial Perfusion Imaging Using Rubidium-82 (82Rb) PET/CT: a Preliminary Analysis

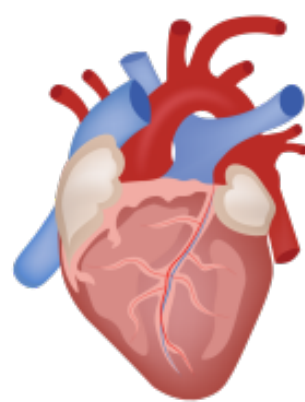


Steffen Blum (a,c), Sami Alameddine (b), Eric Dunne (c), Sunny Wei (c), Athari Al-Obaidani (d), Olfat Kamel (d), Christopher Marriott (d), David Conen (c,e), Tandon Vikas (c)

(a) University Hospital Basel, Basel, Switzerland; (b) Michael G. DeGroote School of Medicine, McMaster University, Hamilton, Ontario, Canada; (c) Department of Medicine, McMaster University, Hamilton, Ontario, Canada; (d) Nuclear medicine and molecular imaging, Medical imaging department, McMaster University, Hamilton, Ontario; (e) Population Health Research Institute, McMaster University, Hamilton, Ontario, Canada

BACKGROUND

- Myocardial injury after non-cardiac surgery (MINS) is defined as **post-operative myocardial injury due to ischemia**
- It is a common yet often asymptomatic condition in 90% of patients, and is associated with a nearly fivefold increase in 30-day post-operative mortality, with the risk persisting beyond one year.¹
- Despite its clinical significance, risk stratification and management strategies for MINS patients remain unclear, and the burden of ischemia in MINS has not been systematically investigated with cardiac imaging.²
- Cardiac positron emission tomography (PET) is a highly sensitive imaging modality that could improve risk stratification by identifying high-risk features predictive of adverse cardiovascular events in surgical patients.³



OBJECTIVES

This study aims to:

- Assess the frequency of high-risk imaging features on cardiac PET among MINS patients
- Identify clinical factors predictive of high-risk imaging features
- Evaluate changes in medical management based on PET findings and detect adverse cardiovascular outcomes 6- and 12-months post-surgery (in final analysis)
- Identify high-risk patients and inform guideline changes to the perioperative management of such patients (in final analysis)

METHODS

- A **prospective cohort study** including **185 patients** with MINS undergoing cardiac PET imaging either during hospitalization or post-discharge
- High-risk features on PET were defined based on parameters associated with increased ischemic event risk, including reduced global myocardial flow reserve and absolute myocardial flow at peak stress, stress defect size >10%, transient ischemic dilation (TID), and reduced left ventricular ejection fraction reserve
- Patients were followed for changes in medical management and adverse cardiovascular events at **6 and 12 months** (results to follow preliminary analysis)
- Statistical analyses including logistic regression for predictor identification and Cox regression for outcome comparisons were performed (results to follow preliminary analysis)



Age	73 ±9
Female sex	114 (61.6%)
Male sex	71 (38.4%)
BMI	28 ±7
Active smoking	27 (14.6%)
History of CAD	50 (27.3%)
History of hypertension	132 (71.7%)
History of diabetes	522 (28.4%)
History of dyslipidemia	102 (55.7%)
History of stroke/TIA	18 (9.9%)

Figure 1: Baseline Characteristics of MINS Patients Undergoing Cardiac PET This table summarizes the demographics and comorbidities of 185 patients with myocardial injury after non-cardiac surgery (MINS) enrolled in our study. The cohort was older (mean age 73 ± 9), predominantly female (61.6%), and had high rates of hypertension, dyslipidemia, and diabetes. Importantly, only 27% had known, diagnosed coronary artery disease (CAD).

Calcium score	Frequency	Percent
< 400	84	54.90%
>= 400	69	45.10%
Frequency missing = 34		

Figure 2. Coronary artery calcium (CAC) scores on post-operative PET scans in patients with myocardial injury after non-cardiac surgery (MINS). Among patients with available data, 45.1% had a CAC score ≥400, indicating extensive coronary calcification and a high risk of future cardiovascular events. Scores <400 represent low to moderate plaque burden⁴. Data were missing for 34 patients.

CONCLUSION

- This study provides **critical** insight into the role of cardiac PET in risk stratification for MINS patients
- Whereas only 27% of patients had known, diagnosed CAD pre-operatively, nearly half of patients had an abnormal cardiac PET
- Our preliminary analysis therefore reveals high rates of post-operative MINS patients with likely **subclinical, non-diagnosed coronary artery disease**
- PET provides valuable risk stratification and our analysis ought to support the integration of PET scanning into post-MINS investigations, which could ultimately alter medical management in post-operative patients with MINS
- The burden of undiagnosed, subclinical CAD uncovered by PET also offers evidence to support current practices aimed at risk factor modification, including **statin and aspirin therapy**



RESULTS

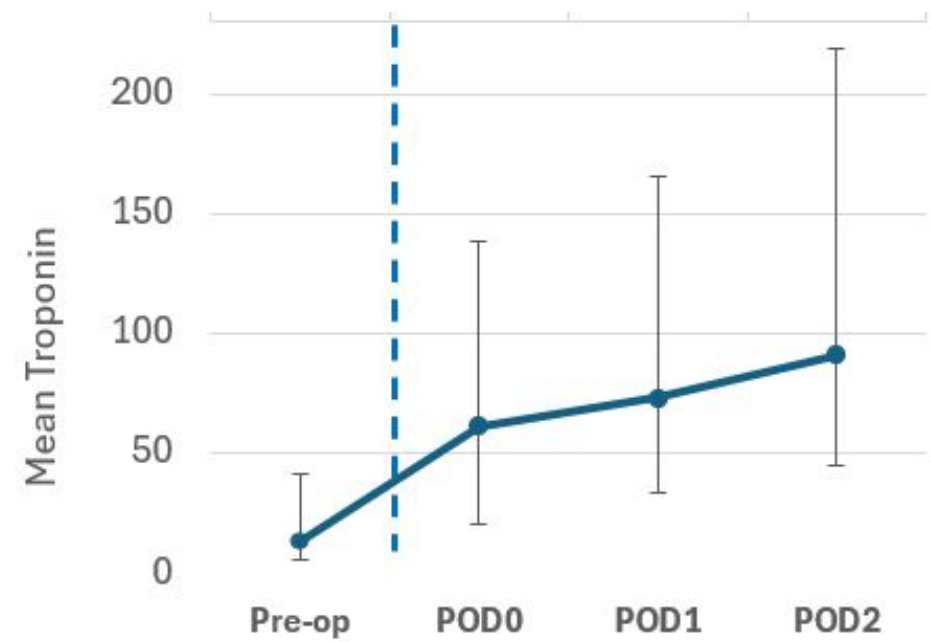


Figure 3. Mean troponin levels in patients with myocardial injury after non-cardiac surgery (MINS), measured pre-operatively and across postoperative days (POD) 0 to 2. Troponin levels rose sharply from baseline pre-operative values, peaking by POD 2. All values represent high-sensitivity cardiac troponin T (hs-cTnT), with MINS defined as hs-cTnT ≥35 ng/L. Error bars represent standard deviations, highlighting variability in post-operative troponin elevations.

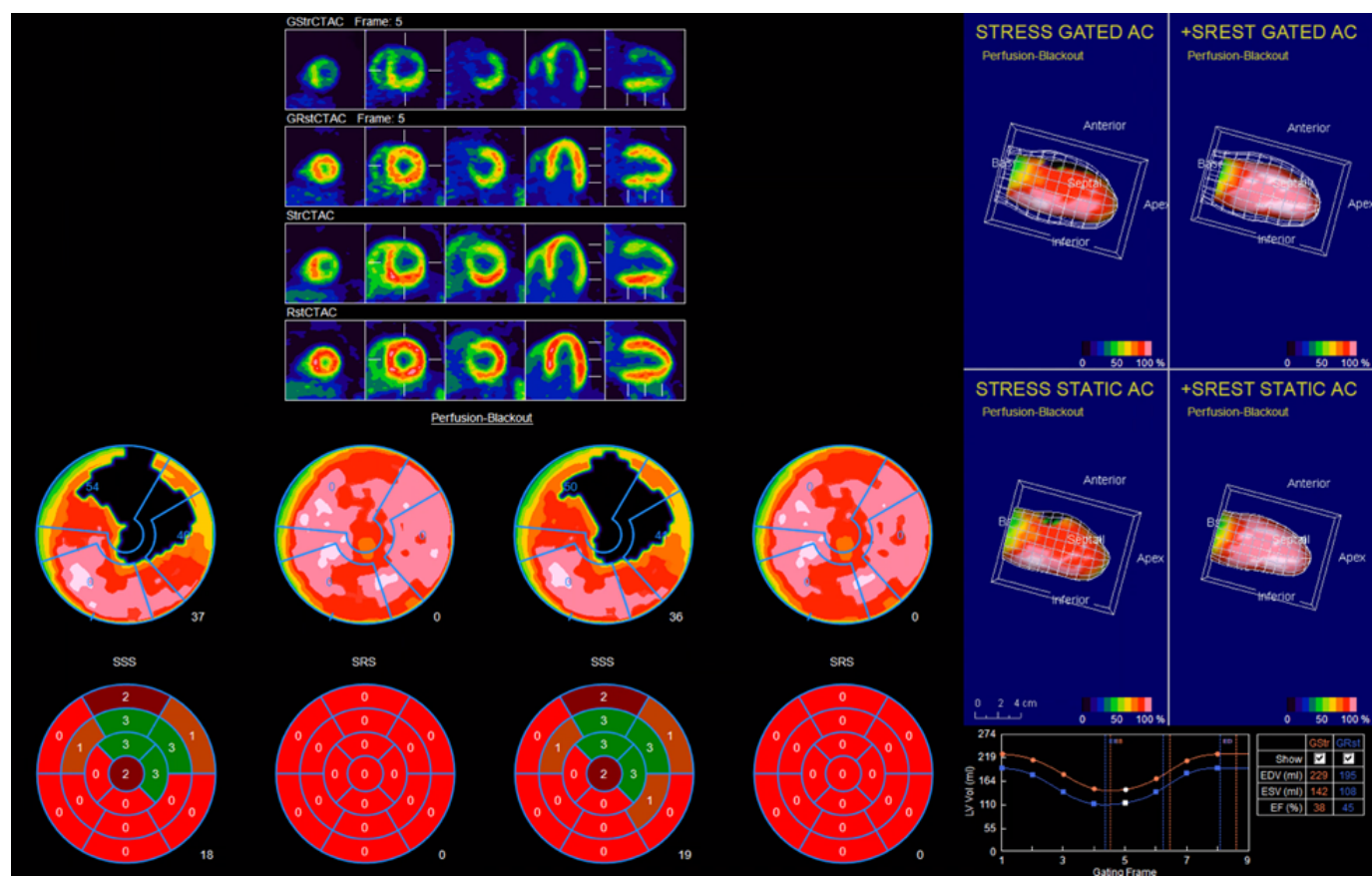


Figure 4. Cardiac PET imaging of a 77-year-old asymptomatic male with postoperative troponin elevation (peak 1045 ng/L on Day 1 following hemicolectomy). The scan reveals a severe reversible perfusion defect in the anterior and anterolateral walls, along with a reduced left ventricular ejection fraction reserve. These findings indicate significant inducible ischemia in the LAD and RCx territories.

Summed Difference Score	Frequency	Percent
< 7	169	91.30%
>= 7	16	8.65%
Frequency missing = 2		

Figure 5. Summed Difference Scores (SDS) on post-operative PET scans in patients with myocardial injury after non-cardiac surgery (MINS). An SDS ≥7, observed in 8.7% of patients, indicates significant myocardial ischemia and typically warrants further evaluation with cardiac catheterization⁵. The majority of patients (91.3%) had SDS <7, reflecting mild or no inducible ischemia. SDS data were missing for 2 patients.

Overall Impression	Frequency	Percentage
Normal	95	54.60%
Ischemia without scar	26	14.90%
Scar, no ischemia	3	1.70%
Scar and ischemia	10	5.70%
Other	40	23%

Figure 6. Overall impression of postoperative PET scans in patients with myocardial injury after non-cardiac surgery (MINS). More than half of the scans were interpreted as normal (54.6%), while ischemia without scar was identified in 14.9% of patients. Scar tissue without ischemia was rare (1.7%), and combined scar with ischemia was observed in 5.7%. Other findings, including non-specific or atypical results, comprised 23.0% of scans.

LIMITATIONS & FUTURE DIRECTIONS

Limitations:

- Limited generalizability (185 patients)
- Unable to identify MINS predictors in the general peri-operative population
- Unclear whether management changes driven by PET results alter outcomes

Future directions:

- Larger, multi-center study
- Cost-effectiveness study
- Randomized control trial: does PET-guided management alter outcomes?

REFERENCES

- Jacka MJ, Youngson E, Bigam D, et al. Myocardial injury after noncardiac surgery in major general surgical patients: a prospective observational cohort study. *Ann Surg.* 2023;278(6):e1192–e1197
- Kashlan B, Kinno M, Syed M, et al. Perioperative myocardial injury and infarction after noncardiac surgery: a review of pathophysiology, diagnosis, and management. *Front Cardiovasc Med.* 2024;11:1323425
- McCubrey RO, Mason SM, et al. A highly predictive cardiac positron emission tomography (PET) risk score for 90-day and one-year major adverse cardiac events and revascularization. *J Nucl Cardiol.* 2023 Feb;30(1):46–58.
- Bell KJL et al. Evaluation of the Incremental Value of a Coronary Artery Calcium Score Beyond Traditional Cardiovascular Risk Assessment: A Systematic Review and Meta-analysis. *JAMA Intern Med.* 2022;182(6):634–642
- Frey SM et al. Stress myocardial perfusion imaging: relevance of Summed Difference Score (SDS ≥ 7) in detecting significant myocardial ischemia and guiding invasive evaluation.