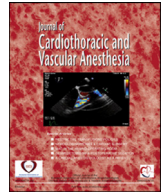




Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Pro and Con

Con: All High-risk Cardiac Patients Need the ICU After Major Noncardiac Surgery

Thomas Bidoul, MD¹, Mona Momeni, MD, PhD

Department of Anesthesiology, Cliniques Universitaires Saint-Luc, Université Catholique de Louvain, Institut de Recherche Expérimentale et Cliniques, Brussels, Belgium



Key Words: perioperative myocardial injury; intensive care unit; major noncardiac surgery; cardiovascular risk stratification

Summary

Intensive Care Unit admission after major noncardiac surgery might not be as beneficial as expected for all high-risk patients. Emphasis should be put on individualized preoperative risk stratification and intense postoperative screening of cardiovascular events. Preoperative high-sensitivity cardiac troponin T allows for both preoperative as well as postoperative screening.

Should all high-risk cardiac patients be admitted to the intensive care unit (ICU) after a major noncardiac surgery?

This question is important in the current era of perioperative medicine in which each unnecessary stay in the ICU represents the suboptimal use of health care resources. Even when excluding the economic aspect of this debate, sending all high-risk patients to the ICU might bring harm in some cases. Indeed, the intensive care setting tends to favor hypermedicalization and overtreatment of the patient, particularly in terms of anxiolytic use or inappropriate fluid therapy.

It is also well-known that an ICU stay can impact the circadian rhythm, leading to sleep impairment or even the development of postoperative delirium,¹ which can worsen the long-term prognosis of those patients.²

The question is, therefore, whether the expected benefit of systematic admission to the ICU justifies the potential associated risks.

The rationale behind sending all high-risk cardiac patients to the ICU after major noncardiac surgery is to allow early identification of cardiac-related complications and thus early intervention when appropriated. Given the estimated pooled incidence of perioperative myocardial injury (PMI) of 19.6% after major noncardiac surgery,³ the idea of sending high-risk patient to the ICU is even more enticing. However, one needs to take a closer look at the timing of major adverse cardiac events (MACEs) and PMI. In 2020, the BASEL-PMI investigators published a prospective observational study implementing an extensive screening for postoperative MACEs.⁴ In their study, the authors reported that a fifth of high-risk patients developed at least 1 MACE in the year after surgery and 15.2% within the first 30 days, and that the risk period extended from 3 to 5 months postoperatively. Among the MACEs observed, 13.2% were PMI at 30 days, and the vast majority of observed PMIs were silent and occurred within the first 3 days after surgery. It has been shown that, after major noncardiac surgery the median length of stay in the ICU is usually 2 days (interquartile range, 1–4 days).⁵ This means that most of these patients will in fact spend a significant part of their at-risk period in a traditional ward. Benefit from ICU admission might thus not be as great as first expected.

Realistic alternatives to the ICU are thus needed. In a systematic review published in 2020, Lloyd et al⁶ concluded that managing selected patients in the postanesthesia care unit did not seem to be associated with worse outcomes compared with ICU admission. However, none of the studies included in that systematic review focused specifically on high-risk patients

So, if the ICU might be harmful for some patients, useless for others, and alternatives seem to exist, how should we

¹Address correspondence to Thomas Bidoul, Ave Hippocrate 10, Woluwé-Saint-Lambert, Belgium, 1200.

E-mail address: thomas.bidoul@saintluc.uclouvain.be (T. Bidoul).

decide which patient should be sent to the ICU and which to the postanesthesia care unit or a similar unit? We strongly believe that the emphasis should be put on individual risk stratification and intense postoperative screening of PMI.

Let's consider first the individualized risk stratification, including patient-related factors and surgery-related factors. When evaluating preoperative patient-related factors, it is common to estimate the patient's functional reserve based on the metabolic equivalents that the patient believes he or she can perform. However, it has recently been shown that this subjective assessment does not predict patients at greatest risk of developing MACEs.⁷ Interestingly, according to this article the best functional evaluation score to predict PMI and mortality was the Duke Activity Status Index. This index contains 12 items regarding activities that the patient is able to perform. The Revised Cardiac Risk Index is the most commonly used score to predict perioperative cardiac complication. Although this score can predict cardiovascular complications and mortality accurately, it seems to be less accurate in some surgical settings when compared with the American University of Beirut-HAS2 score,⁸ which has the added benefit of integrating anemia in its calculation. From a complementary examination standpoint, it has been proposed to add cardiopulmonary exercise testing and myocardial perfusion imaging to improve risk classification, and although cardiopulmonary exercise testing was able to improve prediction of significant complication, myocardial perfusion imaging failed to do so.⁹ Such preoperative evaluation would not only allow for the identification of patients with a higher risk of MACEs, but also those who would need specific treatment such as noninvasive ventilation or infusion of inotropic drugs.

When evaluating preoperative patient-related factors, perioperative measurement of high-sensitivity cardiac troponin T (hs-cTnT) seems to greatly guide the clinician in the diagnosis of silent PMI and MACE.¹⁰ In contrast, a recent study by Zhao et al.¹¹ showed that hs-cTnT and N-terminal pro-B-type natriuretic peptide improved the prediction for cardiovascular events in addition to clinical evaluation, with the combination of both biomarkers providing maximal information.

When it comes to surgery-related factors, it is obvious that postoperative ICU admission will always be required in specific cases. For other procedures, some intraoperative factors such as hemodynamic instability and major blood loss are amongst those warranting ICU admission. The Surgical Apgar Score, which integrates the estimated blood loss, the lowest intraoperative mean arterial pressure, and the lowest intraoperative heart rate, has been proposed to predict need for postoperative ICU admission because it is associated strongly with postoperative ICU admission.¹² However, the routine use of the Surgical Apgar Score still needs to be validated in prospective studies and there is currently no consensus on the Surgical Apgar Score cut-off value providing the best information.

To conclude our argument, we are strongly convinced that not all high-risk patients need ICU-level care after major noncardiac surgery. However, it is necessary to emphasize individual risk stratification focusing on preoperative patient-related factors. In specific cases, and if needed, the surgery

might be postponed to improve the patient's cardiovascular condition. Knowing that most cardiovascular events occur in the first 3 days postoperatively, it is the responsibility of the clinician to look for these events actively, particularly by perioperative measurements of hs-cTnT, which have shown to reliably detect silent PMI.^{4,10,11} An increase of hs-cTnT of ≥ 14 ng L⁻¹ above preoperative values is indicative of PMI and is independently associated with 30-day mortality and MACE. This threshold is, however, still in need of validation. Based on the timing of PMI, such screening should focus on the first 3 postoperative days. It remains unclear which patients would benefit the most from such screening. According to a recent article, screening using the European or Canadian guidelines proved to be highly sensitive (85%), but did poorly in terms of specificity wise.¹³ The opposite was found regarding the American guidelines. Adequate studies are, therefore, needed to refine patient selection and decrease the number of unnecessary screenings.

Overall, ICU admission for all high-risk patients after major noncardiac surgery might not be as beneficial as expected and may bring a false sense of security in some cases. Whether or not such patients should be admitted to the ICU will depend largely on preoperative risk stratification, as well as the inner workings of the hospital. However, regardless of ICU admission, most high-risk cardiac patients would benefit from an intensive cardiovascular follow-up in the post operative period, primarily using hs-cTnT serum levels to detect the occurrence of silent PMI.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRedit authorship contribution statement

Thomas Bidoul: Writing – original draft. **Mona Momeni:** Writing – review & editing.

References

- 1 Perry H, Alight A, Wilcox ME. Light, sleep and circadian rhythm in critical illness. *Curr Opin Crit Care* 2024;30:283–9. <https://doi.org/10.1097/MCC.0000000000001163>.
- 2 Fiest KM, Soo A, Hee Lee C, et al. Long-term outcomes in ICU patients with delirium: A population-based cohort study. *Am J Respir Crit Care Med* 2021;204:412–20. <https://doi.org/10.1164/rccm.202002-0320OC>.
- 3 Smilowitz NR, Redel-Traub G, Hausvater A, et al. Myocardial injury after noncardiac surgery: A systematic review and meta-analysis. *Cardiol Rev* 2019;27:267–73. <https://doi.org/10.1097/CRD.0000000000000254>.
- 4 Sazgary L, Puelacher C, Lurati Buse G, et al. Incidence of major adverse cardiac events following non-cardiac surgery. *Eur Heart J Acute Cardiovasc Care* 2020;10:550–8. <https://doi.org/10.1093/ehjacc/zaaa008>.
- 5 Ekeloef S, Thygesen LC, Gögenur I. Short- and long-term mortality in major non-cardiac surgical patients admitted to the intensive care unit. *Acta Anaesthesiol Scand* 2019;63:639–46. <https://doi.org/10.1111/aas.13319>.

- 6 Lloyd C, Ludbrook G, Story D, Maddern G. Organisation of delivery of care in operating suite recovery rooms within 48 hours postoperatively and patient outcomes after adult non-cardiac surgery: A systematic review. *BMJ Open* 2020;10:e027262. <https://doi.org/10.1136/bmjopen-2018-027262>.
- 7 Wijeyesundera DN, Pearse RM, Shulman MA, et al. Assessment of functional capacity before major non-cardiac surgery: an international, prospective cohort study. *Lancet* 2018;391:2631–40. [https://doi.org/10.1016/S0140-6736\(18\)31131-0](https://doi.org/10.1016/S0140-6736(18)31131-0).
- 8 Dakik HA, Sbaity E, Msheik A, et al. AUB-HAS2 Cardiovascular Risk Index: Performance in surgical subpopulations and comparison to the Revised Cardiac Risk Index. *J Am Heart Assoc* 2020;9:e016228. <https://doi.org/10.1161/JAHA.119.016228>.
- 9 Yao Y, Quirk T, French M, et al. Myocardial perfusion imaging failed to improve patient risk classification compared with the revised cardiac risk index for early cardiac complications after major non-cardiac surgery. *Intern Med J* 2022;52:1203–14. <https://doi.org/10.1111/imj.15662>.
- 10 Chew MS, Puelacher C, Patel A, et al. Identification of myocardial injury using perioperative troponin surveillance in major noncardiac surgery and net benefit over the Revised Cardiac Risk Index. *Br J Anaesth* 2022;128:26–36. <https://doi.org/10.1016/j.bja.2021.10.006>.
- 11 Zhao B, Lei S, Zhuang P, et al. Preoperative N-terminal pro-B-type natriuretic peptide and high-sensitivity cardiac troponin T and outcomes after major noncardiac surgery: A prospective cohort study. *Anesthesiology* 2024;141:475–88. <https://doi.org/10.1097/ALN.0000000000005073>; Advance online publication.
- 12 Lin YC, Chen YC, Yang CH, et al. Surgical Apgar score is strongly associated with postoperative ICU admission. *Sci Rep* 2021;11:115. <https://doi.org/10.1038/s41598-020-80393-z>.
- 13 Martinez-Perez S, van Waes JAR, Vernooij LM, et al. Postoperative troponin surveillance to detect myocardial infarction: An observational cohort modelling study. *Br J Anaesth* 2024;132:667–74. <https://doi.org/10.1016/j.bja.2023.12.019>.