
Assessing functional capacity before major non-cardiac surgery

Wijeyesundera DN, Pearse RM, Shulman MA, Abbott TEF, Torres E, Ambosta A, Croal BL, Granton JT, Thorpe KE, Grocott MPW, Farrington C, Myles PS, Cuthbertson BH, on behalf of the METS study investigators. (Li Ka Shing Knowledge Institute, St Michael's Hospital, Toronto, Ontario, Canada; Department of Anesthesia and Pain Management, University Health Network, Toronto, Ontario, Canada; Department of Anesthesia, University of Toronto, Toronto, Ontario, Canada; Institute of Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario, Canada; Queen Mary University of London, London, UK; Alfred Hospital, Melbourne, Victoria, Australia; Monash University, Melbourne, Victoria, Australia; Applied Health Research Centre, St Michael's Hospital, Toronto, Ontario, Canada; NHS Grampian, Aberdeen, UK; Department of Medicine, University of Toronto, Toronto, Ontario, Canada; Department of Medicine, Sinai Health System, Toronto, Ontario, Canada; Applied Health Research Centre, St Michael's Hospital, Toronto, Ontario, Canada; Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada; University Hospital Southampton, Southampton, UK; University of Southampton, Southampton, UK; Department of Critical Care Medicine, Sunnybrook Health Sciences Centre, Toronto, ON, Canada.) Assessment of functional capacity before major non-cardiac surgery: An international, prospective cohort study. *Lancet* 2018;**391**:2631–40.

SUMMARY

This prospective cohort study compared the subjective assessment of functional capacity with other preoperative risk prediction strategies such as Duke Activity Status Index (DASI), peak oxygen consumption (pVO_2) from cardiopulmonary exercise testing (CPET) and N-terminal pro-B-type natriuretic peptide (NT-pro-BNP) levels for predicting 30-day mortality and myocardial infarction after elective non-cardiac surgery.

A total of 1401 patients, 40 years or older with at least one risk factor for cardiac complications (history of cardiac failure, diabetes and stroke) or coronary artery disease scheduled for elective non-cardiac surgery under general or regional anaesthesia or both were recruited. An anaesthesiologist subjectively assessed their functional capacity in terms of metabolic equivalents (METs) and categorized as poor (<4 METs or uncertain), moderate (4–10 METs) or good (>10 METs). They also completed DASI questionnaire, pVO_2 measured by CPET and a blood sampling for NT-pro-BNP levels to assess functional capacity before surgery. The primary outcome was 30-day mortality or myocardial infarction. A secondary outcome was death or myocardial injury within 30 days after surgery. Other outcomes measured were moderate or severe complications during the initial hospital stay and death within 1 year of surgery.

Among 1401 patients, 28 (2%) died or had myocardial infarction; 176 (13%) died or had myocardial injury within 30 days and 38 (3%) died within 1 year after surgery. During hospitalization, 194 (14%) had moderate or severe complications as assessed by the modified Clavien–Dindo classification. Respiratory failure, pneumonia, surgical site infection, re-exploration and unplanned ICU (intensive care unit) admissions were frequent complications.

In subjective assessment, 107 (8%) patients had poor functional capacity, but in CPET, 230 (16%) had pVO_2 <14 ml/kg/minute (equivalent to <4 METs). The subjective assessment of poor functional capacity had sensitivity of only 19.2% (95% CI 14.2–25.0) in identifying patients with pVO_2 of <14 ml/kg/minute. Moreover, the subjective assessment had no correlation with any of the study outcomes. DASI was the only preoperative assessment that showed a correlation with both primary and secondary outcomes. Peak oxygen consumption by CPET showed correlation with moderate or severe postoperative complications but not with other outcomes. NT-pro-BNP levels predicted death or myocardial injury within 30 days and deaths within 1 year of surgery.

COMMENT

The assessment of functional capacity or exercise tolerance (ET) is an important component of risk stratification in a patient undergoing major surgery. Perioperative morbidity and mortality is high in those with poor functional capacity.¹ The identification of patients with low functional capacity allows referring them for

additional cardiovascular testing or treatment modifications before intermediate or high-risk surgery.² Further, the American College of Cardiologists/American Heart Association Guideline recommends those with functional capacity >4 METs can directly proceed to surgery without further cardiovascular testing.² Hence, accurate measurement of functional capacity is vital.

Exercise tolerance can be assessed by both subjective and objective methods. Physicians' subjective assessment from patients history is the simple way to assess ET while the DASI questionnaire, exercise stress test, 6-minute walk test, incremental shuttle walk test (ISWT), stair climbing test and CPET with ventilator gas analysis are other methods.³ Clinicians estimate functional capacity from the patient's ability to perform activities of daily living and express them in METs.⁴ Being simple and as it does not need any extra set-up, subjective assessment is the primary tool used to estimate ET before surgery. This study has brought out the limitations of subjective assessment and found that it neither correlated with peak oxygen consumption of CPET nor with postoperative mortality or complications. Melon *et al.* also found that subjective assessment underestimates ET and correlates poorly with the METs assessed by the DASI questionnaire.⁵

In this study, DASI scores showed a strong positive correlation with peak oxygen consumption of CPET and predicted postoperative death and cardiac complications. Hence, the authors emphasize using a standard validated questionnaire for the estimation of ET and thereby risk prediction. Struthers *et al.* found that both DASI score and ISWT underestimated ET of a patient scheduled for major intra-abdominal surgery.⁶ Those classified as having low ET by DASI scores had better ET in CEPT (peak oxygen consumption >15 ml/kg/minute). Recently, Li *et al.* arrived at a similar finding that DASI score could not be used as a surrogate for pVO₂ measured by CPET in patients undergoing major oncology surgery.⁷ However, both studies were from a single centre and with a small sample size—50 and 43, respectively. These studies were inadequately powered to predict perioperative mortality and morbidity.

Functional capacity measured by CPET is objective and inclusive of cardiac, pulmonary, haematinic and cellular systems. Initially used in patients undergoing lung resection surgery, it now has a wider application in major intra-abdominal, oncological and vascular surgeries for preoperative assessment and risk stratification.^{8,9} Previous studies have shown those with pVO₂ <14 ml/kg/minute and anaerobic threshold (AT) <11 ml/kg/minute are at high risk for perioperative mortality and morbidity. In this study, low pVO₂/AT predicted moderate or severe postoperative complications but not postoperative death, myocardial infarction or myocardial injury. The authors' assumption that pVO₂ or AT might not be an ideal metric to predict perioperative cardiac events needs further evaluation. If so, the role of other novel CPET-derived parameters in predicting cardiovascular complications needs to be explored.¹⁰

Consistent with the recent evidence, preoperative NT-pro-BNP levels predicted postoperative death or myocardial injury and 1-year mortality. There is increasing evidence suggesting usefulness of serum biomarkers (troponin and NT-pro-BNP) in predicting postoperative cardiac events and long-term mortality.

The European Society of Cardiology and European Society of Anaesthesiology in their joint guidelines recommend that serum biomarkers may be considered in high-risk patients (<4 METs or >1 revised cardiac risk factor undergoing vascular surgery or >2 risk factors for non-vascular surgery).¹¹ The prognostic value of serum biomarkers is independent, as well as contributory when combined with other risk predicting indices.

Although the gold standard for measurement of ET, CPET needs a separate laboratory set-up with skilled personnel and equipment. Due to its resource-intensiveness, CPET is not widely available in India. Objective scales such as DASI questionnaire to assess ET can be easily implemented in our setting without additional cost, and it improves clinical practice. This multicentre study concluded that a standardized validated scale should be used to assess the functional capacity. Further, the measurement of serum biomarkers (NT-pro-BNP) in high-risk patients improves the predictability of risk assessment models.

Conflicts of interest. None declared

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