

Cardiopulmonary Exercise Testing for Risk Prediction in Major Abdominal Surgery



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KEYWORDS

- Cardiopulmonary exercise testing • Functional capacity • Preoperative
- Incremental exercise test • Anaerobic threshold (AT)
- Peak oxygen consumption ($\dot{V}O_2$ peak) • Risk assessment
- Collaborative decision making

KEY POINTS

- Preoperative exercise capacity is associated with postoperative outcome.
- Lower anaerobic threshold and peak oxygen consumption predict increased postoperative morbidity and mortality.
- Cardiopulmonary exercise testing (CPET) testing may also identify factors limiting exercise capacity.
- CPET-derived variables can be used to guide informed consent, collaborative decision making, and the choice of surgical intervention.
- CPET-derived variables can be used to guide decisions about the most appropriate level of preoperative care, although further studies are required to clarify this role.

THE CHALLENGE FOR PREOPERATIVE RISK STRATIFICATION

It is estimated that globally more than 230 million major surgical procedures are performed each year and that this number is increasing.¹ Surgical interventions are in general cost-effective and thus surgical volume is likely to continue to increase,

Disclosure: See last page of article.

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Anesthesiology Clin 33 (2015) 1–16

<http://dx.doi.org/10.1016/j.anclin.2014.11.001>

anesthesiology.theclinics.com

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particularly in resource-poor countries.² As a consequence the population of patients undergoing elective surgical is expanding. As life expectancy increases, an increasing proportion of these patients are likely to be high-risk elderly patients with multiple comorbidities who present particular challenges to both anesthetists and surgeons. The optimum perioperative management of such patients requires input from a multi-disciplinary team ideally incorporating a process of shared decision making.³ Accurate preoperative risk stratification is an essential element in such a care pathway, assisting in the process of informed consent, the choice of surgical procedure, and the determination of the appropriate location of postoperative care (critical care or general ward).

Recent cohort studies have reported 3% to 4% mortality associated with surgery in both European⁴ and North American⁵ patient populations, which was higher than had previously been anticipated. Furthermore, in the prospective European Surgical Outcomes Study (EuSOS) ($n = 46,539$), wide international variability in mortality was observed, suggesting that there may be the potential to implement measures to improve surgical outcome.⁴ In particular, 73% of the patients who died were not admitted to critical care and unplanned critical care admissions were associated with higher mortality than planned admissions. Identifying the subgroup of patients at high risk of mortality preoperatively may allow more appropriate risk counseling and the preemptive focus of personnel, critical care resources, and evidence-based interventions on this needy subgroup. Retrospective studies from the United Kingdom suggest that approximately 12% of patients are in a high-risk group and that these patients account for 80% of perioperative deaths.^{6,7}

Postoperative morbidity is more common than mortality (16%–18% in recent case series) and presents significant health care and social burdens.^{5,8} Postoperative complications not only increase short-term costs by prolonging hospital length of hospital stay but also have long-term implications for mortality.⁵ Furthermore, they may lead to repeated hospital admissions and chronic ill health.^{5,9} From the patient perspective this is often associated with a decline in functional capacity and quality of life.¹⁰ The avoidance of postoperative complications is consequently of great importance.⁸

Thus increasing volumes of surgery and an increasingly frail surgical population present perioperative physicians with a significant challenge. Effective shared decision making with patient involvement necessitates accurate individualized perioperative risk prediction, which in turn requires a valid means of stratifying risk.

CARDIOPULMONARY EXERCISE TESTING AND RISK STRATIFICATION

This article explores the utility of cardiopulmonary exercise testing (CPET) in preoperative risk stratification in major abdominal surgery. The hypothesis that preoperative physical fitness predicts surgical outcome is implicit in anesthetic preassessment. The evaluation of functional capacity is included both in clinical practice and perioperative guidelines.¹¹ However the validity of subjective assessments of functional capacity in a general surgical population is not clear, because patients may not accurately evaluate or report their fitness. Furthermore, the ability of questionnaires such as the Duke Activity Status to discriminate between high-risk and low-risk patients has not been validated.¹² CPET is an objective method of evaluating exercise capacity and is considered to be the gold standard test.¹³ It provides a global assessment of the integrated responses of the pulmonary, cardiovascular, hematological, and metabolic systems that are not adequately reflected through the measurement of individual organ system function. Furthermore, as a dynamic assessment it provides greater insights than a resting test into the response to physiologic stress,

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