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Review Article

REVIEW ARTICLES

Risk assessment tools validated for patients undergoing emergency laparotomy: a systematic review

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Abstract

Emergency laparotomies are performed commonly throughout the world, but one in six patients die within a month of surgery. Current international initiatives to reduce the considerable associated morbidity and mortality are founded upon delivering individualised perioperative care. However, while the identification of high-risk patients requires the routine assessment of individual risk, no method of doing so has been demonstrated to be practical and reliable across the commonly encountered spectrum of presentations, co-morbidities and operative procedures. A systematic review of Embase and Medline identified 20 validation studies assessing 25 risk assessment tools in patients undergoing emergency laparotomy. The most frequently studied general tools were APACHE II, ASA-PS and P-POSSUM. Comparative, quantitative analysis of tool performance was not feasible due to the heterogeneity of study design, poor reporting and infrequent within-study statistical comparison of tool performance. Reporting of calibration was notably absent in many prognostic tool validation studies. APACHE II demonstrated the most consistent discrimination of individual outcome across a variety of patient groups undergoing emergency laparotomy when used either preoperatively or postoperatively (area under the curve 0.76–0.98). While APACHE systems were designed for use in critical care, the ability of APACHE II to generate individual risk estimates from objective, exclusively preoperative data items may lead to better-informed shared decisions, triage and perioperative management of patients undergoing emergency laparotomy. Future endeavours should include the recalibration of APACHE II and P-POSSUM in contemporary cohorts, modifications to enable prediction of morbidity and assessment of the impact of adoption of these tools on clinical practice and patient outcomes.

Key words: emergency laparotomy; postoperative mortality; prognostic tool; risk adjustment; risk assessment

Editor's key points

- In this systematic review, the authors considered the effectiveness of current risk-assessment tools to predict outcome following emergency laparotomy.
- Poor study standardisation and homogeneity prevented comparison of the various tools available, but APACHE II appeared to demonstrate the most consistent discrimination of individual outcome.

Introduction

Emergency laparotomy is a commonly utilized group of intra-abdominal surgical procedures performed for a variety of acute pathologies. In excess of 30 000 emergency laparotomies are performed annually in England alone, and Emergency General Surgical (EGS) admissions are considerably more numerous.[1 2]

Internationally reported mortality rates following emergency laparotomy range from 13 to 18% at 30 days, increasing to 25% at 24 months.[3–7] This is second only to short-term mortality after emergency open repair of life-threatening ruptured abdominal aortic aneurysm (AAA).[8]

Reduction of the considerable morbidity and mortality after emergency laparotomy is the focus of several ongoing national and international audit and quality improvement programs, including the National Emergency Laparotomy Audit (NELA), the Australian and New Zealand Audit of Surgical Mortality, the American College of Surgeons National Surgical Quality Improvement Program (NSQIP), the Enhanced Peri-Operative Care for High-risk patients (EPOCH) study and the Dr Foster global comparators study.[9–12] Central to each of these programs is the identification of high-risk patients to target perioperative interventions and augmented pathways of care.

Because patients who undergo emergency laparotomy are markedly heterogeneous, the likelihood of suffering postoperative morbidity or mortality is not evenly distributed within patient populations. The delivery of individualised care and reduction of postoperative adverse events require that both the structure and delivery of perioperative care are tailored to the needs of the individual. To this end, substantial efforts have been made to characterise high-risk patient subgroups and to identify patients at the greatest risk of death and morbidity.[8 13 14]

Assessment of an individual's risk of an adverse event may be informed by clinical judgement, use of risk assessment tools, evaluation of functional capacity or plasma biomarker assay.[15] Clinical judgement may vary with experience, observations of exercise tolerance are often unfeasible in patients requiring emergency laparotomy since they are acutely unwell and evidence to support the routine use of biomarkers has yet to be established.[16–18] Risk assessment tools, which incorporate clinical variables into a score or prognostic model, currently represent the most practical means of estimating risk in patients undergoing unplanned surgery, but no tool has been widely incorporated into routine practice.

Due to prevalent co-morbidities, surgical pathologies and their systemic effects and the urgency of required intervention, patients undergoing emergency laparotomy form a population distinct from those undergoing planned general surgery,[19] evidenced by a higher incidence of adverse postoperative events.[19–21] Therefore, while there is evidence to support the routine use of selected risk assessment tools in other clinical contexts, generalisability of the performance of these tools to patients undergoing emergency laparotomy is unknown.[22–25]

The objectives of this systematic review were to identify all perioperative validation studies of risk assessment tools undertaken in adult patients undergoing emergency laparotomy and to compare the reported performance and utility of the assessed tools with the aim of identifying the best tools for routine clinical use.

Prior presentation of data

Presented at the third joint meeting of the Centre for Anaesthesia, UCL's Current Controversies in Anaesthesia and Perioperative Medicine and the Intensive Care Society of Ireland Autumn Meeting in Dingle, Ireland, September 2013.

Methods

This systematic review was registered with the PROSPERO database (CRD42014009062). Methods and reporting conform to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), BMC and Cochrane guidelines.[26–28]

Definitions for the purposes of this review

Emergency

Urgent, emergent and immediately indicated surgical interventions.

Laparotomy

Open intra-abdominal surgery performed for non-aortic pathologies.

Risk assessment tool

A scoring system or prognostic model incorporating two or more variables to stratify or predict the likelihood of a specified adverse event.

Validation study

Assessment of the accuracy of one or more risk assessment tools through application to a study population. Classified as internal (application of a newly created tool to the cohort from which it was derived by practical or mathematical techniques), temporal [application of a tool to a cohort distinct in time from the derivation cohort at the institution(s) in which it was created] or external (application to patients in institutions other than that from which the tool was derived).[29 30]

Discrimination

How well a tool is able to discriminate between dichotomous outcomes (e.g. death and survival at 30 days) across a spectrum of risk profiles within a population of patients. Presentation as area under the receiver operator characteristic curve (AUC) provides a single, quantitative measure of the accuracy of a prognostic tool and also facilitates the comparison of dissimilar systems.[31] In interpreting AUC values: >0.9, good discrimination; 0.7–0.9, moderate; and <0.7, poor.[31]

Calibration

How closely a prognostic model's estimations match the observed incidence of a specified outcome across a study population. Assessed using χ^2 techniques, $P>0.05$ indicates that observed and expected outcomes are similar and $P<0.05$ differences are statistically significant.