British Journal of Anaesthesia **110** (6): 926–39 (2013)
Advance Access publication 11 April 2013 · doi:10.1093/bja/aet071

BJA

Effectiveness of non-cardiac preoperative testing in non-cardiac elective surgery: a systematic review

T. Johansson[1*†], G. Fritsch[2†], M. Flamm[1,3], B. Hansbauer[1], N. Bachofner[1], E. Mann[1], M. Bock[2,4] and A. C. Sönnichsen[1,5]

[1] Institute of General Practice, Family Medicine and Preventive Medicine, Paracelsus Medical University, Strubergasse 21, 5020 Salzburg, Austria
[2] Department of Anaesthesiology, Perioperative Medicine and Intensive Care, Paracelsus Medical University, Muellner Hauptrstrasse 48, 5020 Salzburg, Austria
[3] Department of Evidence-based Medicine and Clinical Epidemiology, Danube University, Krems, Dr-Karl-Dorrek-Strasse 30, 3500 Krems, Austria
[4] Department of Anaesthesiology and Intensive Care Medicine I, Hospital of Bolzano, Via Lorenz Boehler 5, 39100 Bolzano, Italy
[5] Institute of General Practice and Family Medicine, University of Witten/Herdecke, Alfred-Herrhausen-Straße 50, 58448 Witten, Germany

* Corresponding author. E-mail: tim.johansson@pmu.ac.at

Editor's key points

- This review intends to systematically review the evidence for modes of preoperative testing in elective non-cardiac surgery patients.
- The authors have reviewed evidence from the years between 2001 and 2011.
- Importantly, routine preoperative testing in healthy adults was not found to add any value to their management.

Summary. Elective surgery is usually preceded by preoperative diagnostics to minimize risk. The results are assumed to elicit preventive measures or even cancellation of surgery. Moreover, physicians perform preoperative tests as a baseline to detect subsequent changes. This systematic review aims to explore whether preoperative testing leads to changes in management or reduces perioperative mortality or morbidity in unselected patients undergoing elective, non-cardiac surgery. We systematically searched all relevant databases from January 2001 to February 2011 for studies investigating the relationship between preoperative diagnostics and perioperative outcome. Our methodology was based on the manual of the Ludwig Boltzmann Institute for Health Technology Assessment, the Scottish Intercollegiate Guidelines Network (SIGN) handbook, and the PRISMA statement for reporting systematic reviews. One hundred and one of the 25 281 publications retrieved met our inclusion criteria. Three test grid studies used a randomized controlled design and 98 studies used an observational design. The test grid studies show that in cataract surgery and ambulatory surgery, there are no significant differences between patients with indicated preoperative testing and no testing regarding perioperative outcome. The observational studies do not provide valid evidence that preoperative testing is beneficial in healthy adults undergoing non-cardiac surgery. There is no evidence derived from high-quality studies that supports routine preoperative testing in healthy adults undergoing non-cardiac surgery. Testing according to pathological findings in a patient's medical history or physical examination seems justified, although the evidence is scarce. High-quality studies, especially large randomized controlled trials, are needed to explore the effectiveness of indicated preoperative testing.

Keywords: adult; diagnostic tests, routine; preoperative procedures; review, systematic; surgical procedures, operative

Accepted for publication: 27 December 2012

It is estimated that 234.2 m major surgical procedures are undertaken every year worldwide.[1] Preoperative diagnostics usually precede elective surgery to minimize perioperative risk. The results of preoperative testing are assumed to predict complications which may lead to preventive measures or even cancellation if potential harm exceeds the benefit of surgery. Moreover, physicians consider some preoperative tests such as electrocardiogram or red blood count to be a valuable baseline assessment for the detection of subsequent changes. We know little about the effectiveness of these tests. Thus, surgical patients often undergo extensive preoperative diagnostics without a background of sound evidence that diagnostic benefit outweighs costs and potential harm. Therefore, various studies[2–4] and also health technology assessments and guidelines[5–7] widely criticize the usual practice of extensive, non-selective

† These authors contributed equally to this work.

testing. Some authors report that, based on patient history and physical examination, 60–70% of laboratory tests ordered before general surgery are not required.[8–10] In a recently published study,[11] we could demonstrate that restricting preoperative diagnostics to the recommendations of the current guideline of the Austrian Society of Anaesthesiology (OEGARI)[12] would lead to annual savings of 10–35 m € in Austria. These findings confirm the results of an earlier published study.[13] Adherence to guidelines on preoperative testing by physicians or even hospitals is often poor.[14 15]

The Austrian guideline mentioned above has incorporated international guidelines—like the guideline of the National Institute for Health and Clinical Excellence (NICE) of 2003,[7] the guideline of the American Heart Association (AHA) of 2007,[16] and the Practice Advisory for Preanesthesia Evaluation of the American Society of Anaesthesiologists (ASA) of 2012.[17] These guidelines all agree that the practice of preoperative routine diagnostics is neither justified nor evidence-based. The NICE guideline is based on a HTA report of 1997[6] and a systematic literature update from 1966 to 2002. The HTA report identified 70 studies regarding specified preoperative diagnostics and concludes that very limited data exist on the frequency of perioperative complications and their relation to preoperative tests. The NICE review identified 26 additional relevant studies from 1997 to 2002 that did not change the conclusions of the HTA report. Furthermore, the NICE review identified 21 studies dealing with preoperative pregnancy testing, lung-function tests, and blood gas analysis which had not been included in the HTA report. Here again, the NICE report did not find evidence to justify unselective preoperative screening of healthy individuals if there are no specific reasons for testing derived from patient history or physical examination. Similar conclusions were drawn from the systematic literature review performed by the AHA in 2007 to evaluate cardiac preoperative diagnostics.[16]

As the literature search of the NICE guideline included only studies published before March 2002, there is a strong need to update the available evidence regarding non-cardiac preoperative testing to renew and strengthen current recommendations. Neither the recently published *Practice advisory for preanaesthesia evaluation* of the ASA[17] nor the ESA's guideline for *preoperative evaluation of the adult patient undergoing non-cardiac surgery* from 2011[18] fulfil this need. We therefore conducted a systematic review of the literature on preoperative testing in non-cardiac surgery from 2001 to 2011, based on the findings of the NICE review of 2002.[7]

Our research questions focus on the effectiveness of non-cardiac preoperative testing in elective non-cardiac surgery:

- Do preoperative tests of the respiratory system (spirometry and chest X-ray) lead to changes in clinical management, or do they reduce peri- and postoperative complications such as mortality or morbidity (including complications and adverse events) in unselected patients undergoing elective, non-cardiac surgery?
- Does preoperative laboratory testing [full blood count, haemostasis, blood gases, renal function, liver function, electrolytes, C-reactive protein (CRP), pregnancy screening, urine analysis, or a set of any of these procedures] lead to changes in clinical management, or does it reduce peri- and postoperative complications such as mortality or morbidity (including complications and adverse events) in unselected patients undergoing elective, non-cardiac surgery?

We used two approaches to search for evidence regarding the effectiveness of preoperative diagnostics. One approach looked at comparisons of a set of preoperative tests (test grid) being routinely performed *vs* being not performed. The other approach focused on specific preoperative tests analysed separately.

Methods

To provide an update of the NICE review mentioned above, we systematically searched the literature from 2001 to 2011 for studies on the effectiveness of preoperative testing in elective non-cardiac surgery. As the NICE guideline covers the literature from 1966 to February 2002, we selected this time frame to provide sufficient overlap with the NICE search. The methodology of this systematic review is based on the manual of the Ludwig Boltzmann Institute for Health Technology Assessment, Vienna,[19] the Scottish Intercollegiate Guidelines Network (SIGN) handbook,[20] and the PRISMA statement for reporting systematic reviews.[21]

Literature search

We developed a comprehensive search strategy to identify all publications relating to generic preoperative testing. The systematic literature search was conducted on February 3, 2011, searching: Ovid Medline (Medical Subject Headings and free text search), Embase, DARE-NHSEED-HTA (INAHTA), and The Cochrane Library. We limited the search to the years January 2001–February 2011. Search terms used in Ovid Medline and Embase are listed in Table 1. Population (A), study design and outcomes (B), and search strings for specific tests (C) were combined with 'AND' (A and B and C). The search terms within the three main categories (A, B, and C) were combined with 'OR'. In addition, we searched health technology assessments by accessing the following sites: NHS Institute for Health and Clinical Excellence (nice.org.uk/Guidance/), Canadian Agency for Drugs and Technologies in Health (cadth.ca/index.php/en/home), and National Coordinating Centre for Health Technology Assessment (ncchta.org/research/index.shtml). Finally, we also conducted a hand search reviewing the references of the included studies. The full search strategy is available in Supplementary Appendix SI.

Inclusion criteria

We designed a PICOS framework (Population, Intervention, Control, Outcome, Study design) to identify controlled