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Preoperative Cardiac Stress Tests for Noncardiac Surgery: A Rapid Review

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Evidence Development and Standards Branch at Health Quality Ontario

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Rapid Review Methodology

Rapid reviews are completed in 2–4-week time frames. Clinical questions are developed by the Evidence Development and Standards branch at Health Quality Ontario, in consultation with experts, end users, and/or applicants in the topic area. A systematic literature search is then conducted to identify relevant systematic reviews, health technology assessments, and meta-analyses. The methods prioritize systematic reviews, which, if found, are rated by AMSTAR to determine the methodological quality of the review. If the systematic review has evaluated the included primary studies using the GRADE Working Group criteria (http://www.gradeworkinggroup.org/index.htm), the results are reported and the rapid review process is complete. If the systematic review has not evaluated the primary studies using GRADE, the primary studies in the systematic review are retrieved and the GRADE criteria are applied to 2 outcomes. If no systematic review is found, then RCTs or observational studies are included, and their risk of bias is assessed. All rapid reviews are developed and finalized in consultation with experts.

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Health Quality Ontario is an arms-length agency of the Ontario government. It is a partner and leader in transforming Ontario's health care system so that it can deliver a better experience of care, better outcomes for Ontarians, and better value for money.

Health Quality Ontario strives to promote health care that is supported by the best available scientific evidence. The Evidence Development and Standards branch works with expert advisory panels, clinical experts, scientific collaborators, and field evaluation partners to conduct evidence-based reviews that evaluate the effectiveness and cost-effectiveness of health interventions in Ontario.

Based on the evidence provided by Evidence Development and Standards and its partners, the Ontario Health Technology Advisory Committee—a standing advisory subcommittee of the Health Quality Ontario Board—makes recommendations about the uptake, diffusion, distribution, or removal of health interventions to Ontario's Ministry of Health and Long-Term Care, clinicians, health system leaders, and policy-makers.

Health Quality Ontario's research is published as part of the *Ontario Health Technology Assessment Series,* which is indexed in MEDLINE/PubMed, Excerpta Medica/Embase, and the Centre for Reviews and Dissemination database. Corresponding Ontario Health Technology Advisory Committee recommendations and other associated reports are also published on the Health Quality Ontario website. Visit http://www.hqontario.ca for more information.

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In addition, Evidence Development and Standards collects and analyzes information about how a health intervention fits within current practice and existing treatment alternatives. Details about the diffusion of the intervention into current health care practices in Ontario add an important dimension to the review. Information concerning the health benefits, economic and human resources, and ethical, regulatory, social, and legal issues relating to the intervention may be included to assist in making timely and relevant decisions to optimize patient outcomes.

Disclaimer

This rapid review is the work of the Evidence Development and Standards branch at Health Quality Ontario, and is developed from analysis, interpretation, and comparison of published scientific research. It also incorporates, when available, Ontario data and information provided by experts. As this is a rapid review, it may not reflect all the available scientific research and is not intended as an exhaustive analysis. Health Quality Ontario assumes no responsibility for omissions or incomplete analysis resulting from its rapid reviews. In addition, it is possible that other relevant scientific findings may have been reported since completion of the review. This report is current as of the date of the literature search specified in the Research Methods section. Health Quality Ontario makes no representation that the literature search captured every publication that was or could be applicable to the subject matter of the report. This rapid review may be superseded by an updated publication on the same topic. Please check the Health Quality Ontario website for a list of all publications: http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations.

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List of Abbreviations

ACC	American College of Cardiology
AHA	American Heart Association
CI	Confidence interval
GRADE	Grading of Recommendations Assessment, Development, and Evaluation
HQO	Health Quality Ontario
LR	Likelihood ratio
MI	Myocardial infarction
RCT	Randomized controlled trial
SE	Stress echocardiography
TI	Thallium imaging

Background

Overuse, underuse, and misuse of interventions are important concerns in health care and lead to individuals receiving unnecessary or inappropriate care. In April 2012, under the guidance of the Ontario Health Technology Advisory Committee's Appropriateness Working Group, Health Quality Ontario (HQO) launched its Appropriateness Initiative. The objective of this initiative is to develop a systematic framework for the ongoing identification, prioritization, and assessment of health interventions in Ontario for which there is possible misuse, overuse, or underuse.

For more information on HQO's Appropriateness Initiative, visit our website at www.hqontario.ca.

Objective of Analysis

The objective of this rapid review was to determine the prognostic accuracy of preoperative, noninvasive, cardiac stress testing for noncardiac elective surgery with intermediate cardiac risk.

Clinical Need and Target Population

Description of Disease/Condition

The goal of preoperative cardiac assessment is to identify patients at risk for major adverse cardiac events.

Noncardiac surgical procedures carry varying cardiac risk. For the purposes of stratifying this risk, the American College of Cardiology and American Heart Association (ACC/AHA) have created a classification of noncardiac surgical procedures, as shown in Table 1. (1)

Table 1: Cardiac Risk Stratification for Noncardiac Surgical Procedures

Risk[a] Stratification	Procedure Examples
Vascular (reported cardiac risk often > 5%)	Aortic and other major vascular surgery Peripheral vascular surgery
Intermediate (reported cardiac risk generally 1% to 5%)	Intraperitoneal and intrathoracic surgery Carotid endarterectomy Head and neck surgery Orthopedic surgery Prostate surgery
Low (reported cardiac risk generally < 1%)	Endoscopic procedures Superficial procedure Cataract surgery Breast surgery Ambulatory surgery

[a]Risk of myocardial infarction and cardiac death within 30 days after surgery.
Source: Fleisher et al, 2007. (1)

Procedures in the intermediate category cover a wide variety of surgeries and carry a 1% to 5% risk of adverse cardiac events. Intermediate risk refers to the risk of the surgical procedure. Elective procedures in this group of surgeries are the focus of this rapid review.

Ontario Context

In fiscal year 2011/2012, approximately 7,500 preoperative assessments of cardiac risk were performed through cardiac stress tests in Ontario. (*Data provided by the Institute for Clinical Evaluative Sciences, September 20, 2013*)

Technology/Technique

Three types of noninvasive cardiac stress tests are commonly used to identify inducible ischemia and to help determine perioperative risk: stress echocardiography, radionuclide myocardial perfusion imaging, and exercise/treadmill test.

Rapid Review

Research Question

What is the prognostic accuracy of preoperative, noninvasive, cardiac stress testing for intermediate-risk, noncardiac, elective surgery?

Research Methods

Literature Search

Search Strategy

A literature search was performed on August 15, 2013, using Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid Embase, EBSCO Cumulative Index to Nursing & Allied Health Literature (CINAHL), and EBM Reviews, for studies published from January 1, 2003, to August 15, 2013. (Appendix 1 provides details of the search strategies.) Abstracts were reviewed by a single reviewer and, for those studies meeting the eligibility criteria, full-text articles were obtained. Reference lists were also examined for any additional relevant studies not identified through the search.

Inclusion Criteria

- English-language full-text publications
- Published between January 1, 2003, and August 15, 2013
- Systematic reviews, meta-analyses or health technology assessments
- Adult patients scheduled to undergo intermediate-risk, noncardiac, elective surgery
- Studies that report on the prognostic accuracy of noninvasive cardiac stress tests

Exclusion Criteria

- Randomized controlled trials, observational studies, case series, case reports
- Patients who undergo emergency surgery
- Studies that do not report on the prognostic accuracy of noninvasive cardiac stress tests

Outcomes of Interest

- Mortality
- Myocardial infarction (MI)

Expert Panel

In August 2013, an Expert Advisory Panel on Appropriate Use of Preoperative Testing in Elective Surgery was struck. The role of this panel was to contextualize the evidence produced by Health Quality Ontario and provide advice on the appropriate use of preoperative testing in the Ontario health care setting. However, the statements, conclusions, and views expressed in this report do not necessarily represent the views of expert advisory panel members.

Quality of Evidence

The Assessment of Multiple Systematic Reviews (AMSTAR) measurement tool was used to assess the methodological quality of systematic reviews. (2)

The quality of the body of evidence for each outcome was examined according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Working Group criteria. (3) The overall quality was determined to be high, moderate, low, or very low using a step-wise, structural methodology.

Study design was the first consideration; the starting assumption was that randomized controlled trials (RCTs) are high quality, whereas observational studies are low quality. Five additional factors—risk of bias, inconsistency, indirectness, imprecision, and publication bias—were then taken into account. Limitations in these areas resulted in downgrading the quality of evidence. Finally, 3 main factors that may raise the quality of evidence were considered: large magnitude of effect, dose-response gradient, and accounting for all residual confounding factors. (3) For more detailed information, please refer to the latest series of GRADE articles. (3)

As stated by the GRADE Working Group, the final quality score can be interpreted using the following definitions:

High	High confidence in the effect estimate—the true effect lies close to the estimate of the effect
Moderate	Moderate confidence in the effect estimate—the true effect is likely to be close to the estimate of the effect, but may be substantially different
Low	Low confidence in the effect estimate—the true effect may be substantially different from the estimate of the effect
Very Low	Very low confidence in the effect estimate—the true effect is likely to be substantially different from the estimate of effect

Results of Rapid Review

The database search yielded 261 citations published between January 1, 2003, and August 15, 2011 (with duplicates removed). Articles were excluded based on information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment.

Two meta-analyses met the inclusion criteria. (4;5)

For each included study, the study design was identified and is summarized in Table 2, a modified version of a hierarchy of study design by Goodman. (6)

Table 2: Body of Evidence Examined According to Study Design

Study Design	Number of Eligible Studies
RCTs	
Systematic review of RCTs	
Large RCT	
Small RCT	
Observational Studies	
Systematic review of non-RCTs with contemporaneous controls	2
Non-RCT with non-contemporaneous controls	
Systematic review of non-RCTs with historical controls	
Non-RCT with historical controls	
Database, registry, or cross-sectional study	
Case series	
Retrospective review, modelling	
Studies presented at an international conference	
Expert opinion	
Total	**2**

Abbreviation: RCT, randomized controlled trial.

Table A1 (Appendix 2) provides the AMSTAR scores for both systematic reviews.

Beattie et al (4) compared stress echocardiography (SE) and thallium imaging (TI) in patients at risk for MI and scheduled for noncardiac elective surgery (68 studies, N = 10,278 patients). Outcomes of interest were MI and death (no time period stated). The likelihood ratio (LR) for a positive SE (LR, 4.09; 95% CI, 3.21–6.56) was more indicative of a postoperative cardiac event, compared to TI (LR, 1.83; 95% CI, 1.59–2.10; $P = 0.0001$). The LR for a negative SE was 0.23 (95% CI, 0.17–0.32) versus 0.44 (0.36–0.54) for a negative TI. The authors concluded that SE is superior to TI in predicting postoperative cardiac events. (4)

Limitations to this meta-analysis included:

- The authors stated the general quality of the studies was poor.
- The analysis did not control for planned interventions after a positive stress test.
- Sparse information was available regarding baseline patient characteristics in the primary studies.
- There was statistical heterogeneity that the authors were unable to explain.

Kertai et al (5) compared the predictive performance of 4 noninvasive stress tests (exercise electrocardiography, myocardial perfusion scintigraphy, dobutamine stress echocardiography, and dipyridamole stress echocardiography) used for perioperative cardiac risk stratification in patients undergoing major vascular surgery (42 studies, N = 6,531 patients). Studies in which preoperative coronary revascularization occurred as a result of a positive test result were only included if patients who underwent such procedures could be excluded or analyzed separately. Outcomes of interest included cardiac death and nonfatal MI within 30 days after surgery.

Dobutamine stress echocardiography had the highest weighted sensitivity of 85% (95% CI, 74%–97%) and a specificity of 70% (95% CI, 62%–79%).

The results for each stress test are summarized in Table 3.

Table 3: Summary of Results for Stress Tests Assessed in Kertai et al

Type of Test	Number of Studies	Number of Patients	Sensitivity (95% CI)	Specificity (95% CI)	Positive Likelihood Ratio	Negative Likelihood Ratio
Exercise electrocardiography	7	685	74 (60–88)	69 (60–78)	2.39	0.38
Dipyridamole stress echocardiography	4	850	74 (53–94)	86 (80–93)	5.29	0.30
Myocardial perfusion scintigraphy	23	3,119	83 (77–89)	49 (41–57)	1.63	0.35
Dobutamine stress echocardiography	8	1,877	85 (74–97)	70 (62–79)	2.83	0.21

Abbreviations: CI, confidence intervals.
Source: Kertai et al, 2003. (5)

No significant difference in diagnostic performance was found between dobutamine stress echocardiography and exercise electrocardiography (relative diagnostic odds ratio, 1.5; 95% CI, 0.2–14.9) but there was a significant difference in the comparison with myocardial perfusion scintigraphy (relative diagnostic odds ratio, 5.5; 95% CI, 2.0–14.9). (5) A summary receiver operating characteristic (SROC) analysis was not performed for dipyridamole stress echocardiography because the estimates of sensitivity and 1-specificity were inversely correlated when individual studies were plotted. (5)

Limitations to this meta-analysis are similar to those listed for Beattie et al, (4) except that Kertai et al, by excluding data from patients who underwent preoperative coronary revascularization, used a more homogenous study population. In addition, patients in the study by Kertai et al were all undergoing major vascular surgery.

Study characteristics and results of the 2 meta-analyses are summarized in Table 4.

Table 4: Summary of Meta-Analyses Examining Prognostic Utility of Preoperative Stress Tests

Author, Year	Objective	Outcomes	Population	General Results
Beattie et al, 2006 (4)	To compare thallium imaging (TI) and stress echocardiography (SE) in patients at risk for MI and scheduled for elective noncardiac surgery	MI, death	Patients undergoing elective noncardiac surgery	68 studies, N = 10,278 patients SROC analysis indicated that a positive SE results in a likelihood ratio (LR) that is 2 times more predictive than a positive TI. LR (95% CI) for SE, 4.09 (3.21–6.56) versus 1.83 (1.59–2.10) for TI, *P* = 0.0001. LR for a negative SE was 0.23 (0.17–0.32) versus 0.44 (0.36–0.54) for a negative TI.
Kertai et al, 2003 (5)	To compare predictive performance of exercise electrocardiography, perfusion scintigraphy, dobutamine stress echocardiography, and dipyridamole stress echocardiography	Perioperative cardiac death, nonfatal MI	Patients undergoing major vascular surgery	42 studies, N = 6,531 patients No significant difference in diagnostic performance was found between dobutamine stress echocardiography and exercise electrocardiography (relative diagnostic odds ratio, 1.5; 95% CI, 0.2–14.9), but there was a significant difference in the comparison with myocardial perfusion scintigraphy (relative diagnostic odds ratio, 5.5; 95% CI, 2.0–14.9).

Abbreviations: CI, confidence interval; LR, likelihood ratio; MI, myocardial infarction; SE, stress echocardiography; SROC, summary receiver operating characteristic; TI, thallium imaging.

At the request of the expert panel, a retrospective, observational study (N = 271,082 patients) conducted in Ontario was also reviewed because it examined the clinically relevant question of whether preoperative stress testing influences outcomes. (7) Postoperative 1-year survival and length of stay in hospital were assessed in patients aged 40 years or older who underwent selected, noncardiac, elective surgical

procedures classified as intermediate to high cardiac risk. Noninvasive cardiac stress testing was performed within 6 months before surgery.

A total of 23,991 patients (8.9%) underwent stress testing. (7) Compared to a matched cohort, testing was associated with improved 1-year survival (hazard ratio, 0.92; 95% CI, 0.86–0.99, $P = 0.03$) and reduced mean hospital stay (difference, −0.24 days; 95% CI, −0.07 to −0.43; $P = 0.001$). Results for survival were stratified for high-, intermediate-, and low-risk individuals, as defined by Revised Cardiac Risk Index class, and are shown in Table 5. These benefits largely applied to patients who were at high risk for cardiac complications on the basis of 3 or more clinical risk factors. In contrast, stress testing was associated with only minor benefits for intermediate-risk patients (1 or 2 risk factors) and with harm in low-risk individuals. (7)

Table 5: Summary of Results from Wijeysundera et al Stratified by Patients' Risk Class

Revised Cardiac Risk Index Class	**1-Year Survival** (Hazard ratio, 95% CI)
High (3–6 points)	0.80 (0.67–0.97)
Intermediate (1–2 points)	0.92 (0.85–0.99)
Low (0 points)	1.35 (1.05–1.74)

Abbreviations: CI, confidence interval.
Source: Wijeysundera et al, 2010. (7)

Limitations to the study by Wijeysundera et al (7) include:

- Outcomes from different stress tests could not be compared.
- No information on the results of these stress tests was available in the databases.
- The cohort did not include patients who never proceeded to the planned noncardiac surgery because their cardiac stress test identified them as high risk.
- Data sources could not account for patients who underwent preoperative coronary revascularization on the basis of high risk findings on preoperative stress testing but who subsequently died before their planned noncardiac surgeries.
- Data sources had inherent limitations; i.e., the data did not capture many postoperative complications, causes of death, detailed clinical information, and some processes of care.

Conclusions

All noninvasive cardiac stress tests provide modest prognostic information in patients undergoing intermediate-risk, noncardiac, elective surgery (GRADE: Very low).

Noninvasive cardiac stress testing is associated with improved 1-year survival and length of hospital stay in patients undergoing intermediate-risk, noncardiac, elective surgery (GRADE: Very low).

- These benefits largely apply to patients who are at high risk for cardiac complications on the basis of 3 or more clinical risk factors, using the Revised Cardiac Risk Index.

Recommendations from Expert Panel

The expert panel made the following recommendations on the use of preoperative, noninvasive cardiac stress tests for noncardiac elective surgery with intermediate cardiac risk:

- The use of noninvasive cardiac stress tests for diagnostic purposes should be supported (e.g., for diagnosis of previously unrecognized coronary artery disease in a patient presenting with suspicious chest pain before a planned noncardiac surgery).
- The routine use of noninvasive cardiac stress tests for preoperative screening purposes prior to intermediate-risk, noncardiac, elective surgery is not recommended. The selective use of these tests should be guided by patients' clinical risk factors for perioperative cardiac complications, as well as by consideration of whether the test result would inform clinical decision-making.
    - Benefits of selective preoperative cardiac stress testing largely apply to patients who are at high risk for cardiac complications on the basis of 3 or more clinical risk factors, using the Revised Cardiac Risk Index. (8)
    - Preoperative stress testing is not recommended in low-risk patients (i.e., no Revised Cardiac Risk Index risk factors).

The expert panel indicated that its recommendations are largely consistent with existing recommendations in the 2009 ACC/AHA guidelines. (9)

Acknowledgements

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Expert Advisory Panel on Appropriate Use of Preoperative Testing in Elective Surgery

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Cardiology		
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Panel Member	Representation	Affiliation
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Health Administration		
Anne Marie McIlmoyl	St. Joseph's Health Care London	Director, Perioperative Services
Rhona McGlasson	North Simcoe Muskoka LHIN	Surgical Coordinator

Appendices

Appendix 1: Literature Search Strategies

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to July 2013>, EBM Reviews - ACP Journal Club <1991 to July 2013>, EBM Reviews - Database of Abstracts of Reviews of Effects <3rd Quarter 2013>, EBM Reviews - Cochrane Central Register of Controlled Trials <July 2013>, EBM Reviews - Cochrane Methodology Register <3rd Quarter 2012>, EBM Reviews - Health Technology Assessment <3rd Quarter 2013>, EBM Reviews - NHS Economic Evaluation Database <3rd Quarter 2013>, Embase <1980 to 2013 Week 32>, Ovid MEDLINE(R) <1946 to August Week 1 2013>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <August 15, 2013>

Search Strategy:

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1 exp Preoperative Period/ (191725)
2 exp Perioperative Period/ (79974)
3 exp Preoperative Care/ (97323)
4 exp Perioperative Care/ use mesz,acp,cctr,coch,clcmr,dare,clhta,cleed (130781)
5 ((pre?operat* or pre?an?esthe* or pre-surg* or post?operat* or peri?operat* or post-surg*) adj2 (screen* or assess* or check* or work-up* or consultat* or management* or evaluat* or test* or question* or predict*)).ti,ab. (118238)
6 or/1-5 (472919)
7 exp Heart Function Tests/ use mesz,acp,cctr,coch,clcmr,dare,clhta,cleed (464893)
8 exp heart function test/ use emez (25751)
9 exp cardiovascular system examination/ use emez (695513)
10 (ECG or LV assess* or left ventricular assess* or EKG or echocardio* or electrocardio* or ((stress or exercise or treadmill) adj2 test*) or (echo* adj2 stress) or radionuclide myocardial perfusion imag*).ti,ab. (514547)
11 or/7-10 (1326296)
12 6 and 11 (35148)
13 Meta Analysis.pt. (50407)
14 Meta-Analysis/ use mesz,acp,cctr,coch,clcmr,dare,clhta,cleed or exp Technology Assessment, Biomedical/ use mesz,acp,cctr,coch,clcmr,dare,clhta,cleed (59527)
15 Meta Analysis/ use emez or Biomedical Technology Assessment/ use emez (86402)
16 (meta analy* or metaanaly* or pooled analysis or (systematic* adj2 review*) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab. (389837)
17 ((health technolog* or biomedical technolog*) adj2 assess*).ti,ab. (5072)
18 or/13-17 (443661)
19 12 and 18 (402)
20 limit 19 to english language [Limit not valid in CDSR,ACP Journal Club,DARE,CCTR,CLCMR; records were retained] (369)
21 limit 20 to yr="2003 -Current" [Limit not valid in DARE; records were retained] (297)
22 remove duplicates from 21 (261)

CINAHL

#	Query	Results
S1	(MH "Preoperative Period+")	1,552
S2	(MH "Preoperative Care+")	13,559
S3	(MH "Perioperative Care+")	33,358
S4	((pre?operat* or pre?an?esthe* or pre-surg* or post?operat* or peri?operat* or post-surg*) N2 (screen* or assess* or check* or work-up* or consultat* or management* or evaluat* or test* or question* or predict*))	137
S5	S1 OR S2 OR S3 OR S4	34,842
S6	(MH "Heart Function Tests+")	82,055
S7	(ECG or LV assess* or left ventricular assess* or EKG or echocardio* or electrocardio* or ((stress or exercise or treadmill) N2 test*) or (echo* N2 stress))	66,205
S8	S6 OR S7	98,903
S9	S5 AND S8	2,345
S10	(MH "Meta Analysis") or (MH "Systematic Review")	31,998
S11	((health technology N2 assess*) or meta analy* or metaanaly* or pooled analysis or (systematic* N2 review*) or published studies or medline or embase or data synthesis or data extraction or cochrane)	70,142
S12	S10 OR S11	70,142
S13	S9 AND S12	27
S14	S9 AND S12	26

Appendix 2: Evidence Quality Assessment

Table A1: AMSTAR Scores of Included Systematic Reviews

Author, Year	AMSTAR Score	(1) Provided Study Design	(2) Duplicate Study Selection	(3) Broad Literature Search	(4) Considered Status of Publication	(5) Listed Excluded Studies	(6) Provided Characteristics of Studies	(7) Assessed Scientific Quality	(8) Considered Quality in Report	(9) Methods to Combine Appropriate	(10) Assessed Publication Bias	(11) Stated Conflict of Interest
Beattie et al, 2006 (4)	5	✓	✓	✓	✗		✓	✗	✗	✓		✗
Kertai et al, 2003 (5)	4	✓	✓	✗	✗		✓	✗	✗	✓		✗

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews.
[a]Maximum possible score is 11. Details of AMSTAR score are described in Shea et al. (2)

Table A2: GRADE Evidence Profile for Comparison of Prognostic Utility of Preoperative Cardiac Stress Tests

Number of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
30-day Mortality/Myocardial Infarction							
2 (meta-analyses of observational studies)	Serious limitations (–1)[a]	No serious limitations	Serious limitations (-1)[b]	No serious limitations	Undetected	–	⊕ Very low
1 Year Survival							
1 (observational)	No serious limitations	No serious limitations[c]	Serious limitations (-1)[b]	No serious limitations	Undetected	–	⊕ Very low
Length of Stay							
1 observational)	No serious limitations	No serious limitations[c]	Serious limitations (-1)[b]	No serious limitations	Undetected	–	⊕ Very low

Abbreviations: GRADE, Grading of Recommendations Assessment, Development, and Evaluation.
[a]Beattie et al (4) stated that the general quality of the publications was poor and that the meta-analysis indicated a large degree of heterogeneity that the authors were unable to explain.
[b]It is unclear if all patients in studies had only intermediate-risk surgery. For example, Wijeysundera et al (7) reported on a population that underwent intermediate-to-high-risk surgery.
[c]Only 1 study was identified for this rapid review.

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