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Preoperative Resting Echocardiography 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.

About Health Quality Ontario

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.

About Health Quality Ontario Publications

To conduct its rapid reviews, Evidence Development and Standards and its research partners review the available scientific literature, making every effort to consider all relevant national and international research; collaborate with partners across relevant government branches; consult with expert advisory panels, clinical and other external experts, and developers of health technologies; and solicit any necessary supplemental information.

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
RCT	Randomized controlled trial
RR	Relative risk

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 resting echocardiography 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. Because of limitations in predictive indices based on readily available clinical risk factors, clinicians may use specialized cardiac tests to improve estimation of perioperative risk. (1) A recent population-based study suggests that the specialized cardiac test most commonly ordered before major non-cardiac surgery in Ontario is resting echocardiography. (1)

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. (2)

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. (2)

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 10,000 preoperative assessments of cardiac risk were performed through resting echocardiograms in Ontario. (*Data provided by the Institute for Clinical Evaluative Sciences, September 20, 2013*)

Technology/Technique

Advantages to using echocardiography include easy availability and no requirement for intravenous injection, use of radioactive isotopes, or exposure to radiation. (1) Echocardiography provides information about ventricular dysfunction, valvular abnormalities, and fixed wall motion abnormalities. (1)

Rapid Review

Research Question

What is the prognostic accuracy of preoperative resting echocardiography for noncardiac elective surgery with intermediate cardiac risk?

Research Methods

Literature Search

Search Strategy

A literature search was performed on August 12, 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 12, 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 12, 2013
- Observational studies
- Adult patients scheduled to undergo intermediate-risk, noncardiac, elective surgery
- Studies that report on the prognostic accuracy of rest echocardiography

Exclusion Criteria

- Case series, case reports
- Patients who undergo emergency surgery
- Studies that do not report on the prognostic accuracy of rest echocardiography

Outcomes of Interest

- Mortality
- Length of stay

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 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 1,395 citations published between January 1, 2003, and August 12, 2013 (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.

One study met the inclusion criteria. (4) However, this study was excluded due to significant uncertainty about the data.

A retrospective, observational study conducted in Ontario was also reviewed because it examined the clinically relevant question of whether preoperative resting echocardiography influences outcomes after noncardiac elective surgery. (1) Postoperative survival (30 days and 1 year) and length of stay in hospital were assessed in patients aged 40 years or older who underwent noncardiac elective surgery with intermediate to high cardiac risk.

The cohort consisted of 264,823 patients, of whom 15.1% (n = 40,084 patients) received echocardiography within 180 days before surgery. (1) These patients were compared to a matched cohort of 70,996 patients who had not had echocardiography.

Table 2 summarizes the results. Overall, preoperative echocardiography was associated with a small and statistically significant increase in postoperative mortality both at 30 days and at 1 year. (1) It was also associated with an increase in mean hospital stay but not in infection at the surgical site.

Table 2: Results for Resting Echocardiography Compared to a Control Group

Outcome	Results
30-day mortality RR (95% CI)	1.14 (1.02–1.27), *P* = 0.02
1-year mortality RR (95% CI)	1.07 (1.01–1.12), *P* = 0.02
Length of hospital stay Mean (95% CI)	0.31 (0.17–0.44), *P* < 0.001
Surgical site infections RR (95% CI)	1.03 (0.98–1.06), *P* = 0.18

Abbreviations: CI, confidence intervals; RR, relative risk.
Source: Wijeysundera et al, 2011. (1)

In subgroup analyses, patients who had echocardiography: (1)

- were significantly more likely than controls to have received new prescriptions for beta blockers, statins, angiotensin-converting enzyme inhibitors, and angiotensin receptor blockers before surgery;
- had similar rates as controls of coronary angiography or coronary artery bypass grafting before surgery but significantly lower rates of percutaneous coronary interventions.

Further subgroup analyses indicated that the increase in mortality was influenced by whether patients had received preoperative stress testing or had risk factors for cardiac complications (Revised Cardiac Risk Index class): (1)

- No association existed between echocardiography and mortality among patients who had stress testing (relative risk [RR], 1.01; 95% CI, 0.92–1.11) or among patients at high risk who had not had stress testing (RR, 1.00; 95% CI, 0.87–1.13).
- Echocardiography was associated with mortality in patients at low risk (RR, 1.44; 95% CI, 1.14–1.82) and intermediate risk (RR, 1.10; 95% CI, 1.02–1.18) who had not had stress testing.
- Increased mortality in low- and intermediate-risk patients was mirrored by qualitatively similar increases in new prescriptions for beta blockers and statins.

Limitations to the study by Wijeysundera et al (1) include:

- The retrospective observational study design has inherent limitations.
- No information on echocardiography results was available.
- The study cohort did not include patients whose planned noncardiac surgery was cancelled as a result of a high risk finding on preoperative echocardiography.
- Administrative data sources do not accurately identify postoperative complications and have limited information on test results, inpatient drugs, and causes of death.
- Data sources did not capture detailed clinical characteristics, limiting the ability to examine specific subgroups who may benefit from preoperative echocardiography.

Conclusions

No studies were identified that examined the prognostic accuracy of resting echocardiography.

Resting echocardiography is not associated with improved survival or decreased length of stay after intermediate-risk, noncardiac, elective surgery (GRADE: Very low).

Recommendations from Expert Panel

The expert panel made the following recommendations on the use of preoperative resting echocardiography for noncardiac elective surgery with intermediate cardiac risk:

- The use of resting echocardiography for diagnostic purposes (e.g., to diagnose previously unrecognized aortic stenosis in a patient with a suspicious cardiac murmur) should be supported.
- The use of resting echocardiography for routine preoperative screening purposes (the use of echocardiography to stratify patients for surgical risk when they would not otherwise have usual clinical indications for an echocardiogram for diagnostic reasons) prior to intermediate-risk, noncardiac, elective surgery is not recommended since there are no supporting data available.

The expert panel indicated that its recommendations are largely consistent with existing recommendations from the 2009 ACC/AHA guidelines. (5)

The expert panel also made these further observations:

- There is a need for more accurate data in Ontario showing why patients receive a resting echocardiogram; it is unclear whether patients in the Wijeysundera et al study (1) were tested for diagnostic or screening purposes.
- The results of the study by Flu et al (4) should be acknowledged, although they were not included in this analysis due to uncertainty about the data. (The same research group was recently found to have shown a pattern of fraudulent or questionable research data in a series of clinical studies; this has not been demonstrated for this study or its underlying data.) (6)
    - Overall, the noncomparative cohort study showed that asymptomatic left ventricular dysfunction is predictive for 30-day and long-term cardiovascular outcome on open vascular surgery patients. (4) The authors state their data suggest that preoperative risk stratification should include routine preoperative echocardiography to stratify risk in patients having open vascular surgery. (4)
    - Closer examination of the results suggests that asymptomatic ventricular dysfunction does not perform well in stratifying perioperative cardiac risk. (7) For predicting 30-day cardiac events after open vascular surgery, asymptomatic diastolic and systolic dysfunction had positive likelihood ratios of 1.0 and 1.4, respectively. (8) However, the likelihood ratio was 3.7 for patients with a clinical history of heart failure. (7) A normal echocardiogram result in this study did have a likelihood ratio of 0.51 for 30-day cardiac events. Thus, there is a suggestion that a normal echocardiogram in high-risk patients prior to vascular surgery (who had a 17% rate of postoperative cardiac events) has some reassuring prognostic significance.
    - Overall, these data point to the need for more high-quality data to evaluate prognostic accuracy of preoperative echocardiography for risk stratification in patients undergoing major noncardiac surgery.

Acknowledgements

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

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Anne Marie McIlmoyl	St. Joseph's Health Care London	Director, Perioperative Services
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Appendices

Appendix 1: Literature Search Strategies

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to June 2013>, EBM Reviews - ACP Journal Club <1991 to July 2013>, EBM Reviews - Database of Abstracts of Reviews of Effects <2nd 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 31>, Ovid MEDLINE(R) <1946 to July Week 5 2013>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <August 08, 2013>
Search Strategy:

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1 exp *Preoperative Period/ (30163)
2 exp Preoperative Care/ (97253)
3 ((pre?operat* or pre?an?esthe* or pre-surg*) adj5 (cardiac or heart or echo*)).ti,ab. (10171)
4 or/1-3 (127302)
5 exp Echocardiography/ (290526)
6 (ECG or LV assess* or left ventricular assess* or EKG or echocardio* or electrocardio* or radionuclide myocardial perfusion imag* or (echo* adj2 rest*)).ti,ab. (450204)
7 or/5-6 (551135)
8 4 and 7 (6863)
9 limit 8 to (english language and yr="2003 -Current") [Limit not valid in CDSR,ACP Journal Club,DARE,CCTR,CLCMR; records were retained] (3226)
10 Case Reports/ or Comment.pt. or Editorial.pt. or Letter.pt. or Congresses.pt. (4117558)
11 Case Report/ or Comment/ or Editorial/ or Letter/ or conference abstract.pt. (6900908)
12 or/10-11 (6979713)
13 9 not 12 (2281)
14 remove duplicates from 13 (1395)

CINAHL

#	Query	Results
S1	(MH "Preoperative Period+")	1,552
S2	(MH "Preoperative Care+")	13,559
S3	((preoperat* or pre-operat* or preanesthe* or preanaesthe* or presurg* or pre-surg*) N5 (cardiac or heart or echo*))	524
S4	S1 OR S2 OR S3	15,337
S5	(MH "Echocardiography+")	19,146
S6	(ECG or LV assess* or left ventricular assess* or EKG or echocardio* or electrocardio* or radionuclide myocardial perfusion imag* or (echo* N2 rest*))	48,182
S7	S5 OR S6	48,182
S8	S4 AND S7	552
S9	S4 AND S7 Limiters - Published Date: 20030101-20131231; English Language	451
S10	S4 AND S7 Limiters - Published Date: 20030101-20131231; English Language; Publication Type: Case Study, Commentary, Conference, Editorial, Letter	83
S11	S9 not S10 Limiters - Published Date: 20030101-20131231; English Language	368

Appendix 2: Evidence Quality Assessment

Table A1: GRADE Evidence Profile for Preoperative Resting Echocardiography

Number of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
Mortality							
1 (observational)	No serious limitations	No serious limitations[a]	Serious limitations (-1)[b]	No serious limitations	Undetected	–	⊕ Very low
Length of stay							
1 (observational)	No serious limitations	No serious limitations[a]	Serious limitations (-1)[b]	No serious limitations	Undetected	–	⊕ Very low

Abbreviations: GRADE, Grading of Recommendations Assessment, Development, and Evaluation.

[a]Only one study was identified for this rapid review.

[b]Surgery was not limited to intermediate risk (included noncardiac elective surgery with intermediate to high cardiac risk).

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