Effect of diastolic dysfunction on postoperative outcomes after cardiovascular surgery: A systematic review and meta-analysis

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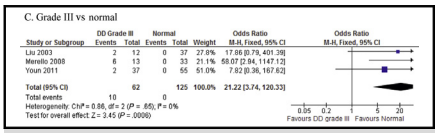
ABSTRACT

Objective: The objective of this study was to investigate the effect of preoperative diastolic dysfunction on postoperative mortality and morbidity after cardiovascular surgery.

Methods: We systematically searched for articles that assessed the prognostic role of diastolic dysfunction on cardiovascular surgery in PubMed, Cochrane Library, Web of Science, Embase, and Scopus until February 2016. Twelve studies (n = 8224) met our inclusion criteria. Because of the scarcity of outcome events, fixed-effects meta-analysis was performed via the Mantel-Haenszel method.

Results: Preoperative diagnosis of diastolic dysfunction was associated with greater postoperative mortality (odds ratio [OR], 2.41; 95% confidence interval [CI], 1.54-3.71; $P < .0001$), major adverse cardiac events (OR, 2.07; 95% CI, 1.55-2.78; $P \leq .0001$), and prolonged mechanical ventilation (OR, 2.08; 95% CI, 1.04-4.16; $P = .04$) compared with patients without diastolic dysfunction among patients who underwent cardiovascular surgery. The odds of postoperative myocardial infarction (OR, 1.29; 95% CI, 0.82-2.05; $P = .28$) and atrial fibrillation (OR, 2.67; 95% CI, 0.49-14.43; $P = .25$) did not significantly differ between the 2 groups. Severity of preoperative diastolic dysfunction was associated with increased postoperative mortality (OR, 21.22; 95% CI, 3.74-120.33; $P = .0006$) for Grade 3 diastolic dysfunction compared with patients with normal diastolic function. Inclusion of left ventricular ejection fraction (LVEF) <40% accompanying diastolic dysfunction did not further impact postoperative mortality ($P = .27$; $I^2 = 18\%$) compared with patients with normal LVEF and diastolic dysfunction.

Conclusions: Presence of preoperative diastolic dysfunction was associated with greater postoperative mortality and major adverse cardiac events, regardless of LVEF. Mortality was significantly greater in grade III diastolic dysfunction. (J Thorac Cardiovasc Surg 2016;152:1142-53)



Postoperative mortality after cardiovascular surgery and grade III of diastolic dysfunction.

Central Message

Grade III diastolic dysfunction is associated with greater postoperative death after cardiovascular surgery, regardless of left ventricular ejection fraction.

Perspective

Underpowered studies and heterogeneity in measurement underestimate diastolic dysfunction (DD) in the perioperative period. We show increased perioperative mortality with greater grade of DD. This is not correctly predicted by current risk scoring systems. Limitations in understanding of DD and lack of specific therapy should not discourage its preoperative staging or preventive risk stratification.

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One in seven patients suffer a major complication or death after coronary artery bypass surgery (CABG), and the currently available cardiac surgery risk scores do not always correctly predict these risks.[1-5] Recent literature emphasizes the adverse prognostic impact of diastolic dysfunction on postoperative outcomes, and many recent

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Abbreviations and Acronyms

AF = atrial fibrillation
CABG = coronary artery bypass surgery
CAD = coronary artery disease
EuroSCORE = European System for Cardiac Operative Risk Evaluation
LVEF = left ventricular ejection fraction
MACE = major adverse cardiac events
MI = myocardial infarction
NOS = Newcastle Ottawa Scale

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studies consistently rate severe diastolic dysfunction as the single most important determinant of postoperative outcome after cardiac surgery. Despite continuing controversies in the evaluation of diastolic dysfunction, recent advances in echocardiography have resulted in better assessment and reporting of diastolic dysfunction. The American College of Cardiology/American Heart Association/American Society of Echocardiography Appropriateness Criteria provide recommendations for echocardiography before noncardiac surgery but do not address the need for routine echocardiography before CABG. Among the echocardiographic criteria for risk scoring, the Society of Thoracic Surgeons uses left ventricular ejection fraction (LVEF) and significant valvular regurgitation/stenosis, whereas the European System for Cardiac Operative Risk Evaluation (EuroSCORE) includes LVEF and pulmonary arterial hypertension.

The current literature reporting postoperative outcomes after cardiac surgery in patients with varying degrees of diastolic dysfunction does not report postoperative mortality consistently as an independent outcome. Some of the reasons surrounding this observation could be mainly observational studies with low sample size or rare mortality outcomes that therefore had to be reported as part of a composite outcome of major adverse cardiac events. In addition, despite the increasing prevalence of diastolic heart failure, the majority of these patients do not happen to have severe or stage III diastolic dysfunction, thereby making it harder to assess its impact on postoperative outcomes.

We propose that diastolic dysfunction—especially if severe—can be an important predictor of postoperative outcomes and should be considered preoperatively for better risk stratification. To better evaluate postoperative outcomes after cardiovascular surgery, we conducted a systematic review and meta-analysis to investigate the effect of preoperative diagnosis of diastolic dysfunction on postoperative mortality and morbidity.

METHODS

We conducted a systematic review following the PRISMA (ie, Preferred Reporting Items for Systematic reviews and Meta-Analysis) guidelines.[6]

Search Strategy, Eligibility Criteria, and Study Selection

Two authors independently identified the relevant articles by searching the following databases: PubMed, Cochrane Library, Web of Science, EMBASE, and Scopus until February 2016. The following search terminologies were used: (coronary artery bypass graft or CABG or cardiopulmonary bypass) and (diastolic function or diastolic dysfunction or impaired relaxation or pseudo normal filling or restrictive filling or diastolic filling or LV filling pressure or E/e or tissue Doppler) and (mortality or outcome). The search strategy for PubMed is available as an Online Data Supplement. The inclusion criteria were diastolic dysfunction on postoperative outcomes, including mortality and complications after cardiac surgery. Disagreements between these 2 authors were reviewed together and the decision was made on agreement. The 2 authors independently reviewed full text articles to determine whether the study can be included for the meta-analysis. We also reviewed the references of included articles.

Data Extraction and Quality Assessment

Two authors independently extracted relevant data from the studies on the standard data extraction sheet. Extracted data included definition of diastolic dysfunction, degree of diastolic dysfunction, type of surgery, exclusion criteria, primary and secondary outcomes, mode of echocardiogram, and follow-up period.

Study Outcomes

The primary study outcome was mortality. Secondary study outcomes were postoperative complications, which include major adverse cardiac events (MACE), prolonged mechanical ventilation, atrial fibrillation (AF), and myocardial infarction (MI).

Statistical Analysis

We performed meta-analysis with RevMan 5.3 (Cochrane Collaboration, Copenhagen, Denmark) and R 3.0.1 (www.r-project.org) using the Mantel-Haenszel fixed-effects model, given the scarcity of events.[7] Random effects meta-analyses via the inverse variance method were performed otherwise. As sensitivity analyses for main analyses of mortality, 3 other methods were used: (1) natural weighting in random effects meta-analysis[8]; (2) Hartung-Knapp-Sidik-Jonkman method in random effects meta-analysis[9]; and (3) arcsine transformation of risk difference.[10] For mortality, funnel plots were used to evaluate small study effects, and the Egger test was used to evaluate asymmetry of funnel plots. The Cochran χ^2 test and the I^2 test were used to assess between-study heterogeneity. Heterogeneity was considered statistically significant at $P < .1$, and substantial heterogeneity was defined as $I^2 > 50\%$. Pooled odds ratios (ORs) were reported with 95% confidence intervals (CIs).

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