



Original contribution

Impact of ejection fraction on infectious, renal, and respiratory morbidity for patients undergoing noncardiac surgery^{☆, ☆ ☆}



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Received 16 December 2015; revised 8 August 2016; accepted 14 August 2016

Keywords:

Acute kidney injury;
Echocardiography;
Infection;
Postoperative complications;
Respiratory insufficiency;
Ventricular ejection fraction

Abstract

Objective: We sought to determine if decreased left ventricular systolic function was associated with an increased risk of postoperative infectious, respiratory, or renal complications in patients undergoing noncardiac surgery.

Design: Retrospective cohort study.

Setting: Single tertiary-care, university-based medical center.

Patients: We studied individuals who participated in the American College of Surgeons National Quality Improvement Program and had a preoperative echocardiogram conducted at our institution.

Interventions: None.

Measurements: The incidences of postoperative respiratory (need for postoperative mechanical ventilation or unplanned intubation), renal (acute renal failure or renal insufficiency), and infectious (pneumonia, urinary tract infection, sepsis, or wound infection) complications were analyzed.

Main results: Postoperative infections (n = 175, 10%) represented the most common postoperative complication seen in the study population of 1692 individuals. Respiratory complications occurred in 77 (5%) and renal complications occurred in 29 (2%) participants. The time between the echocardiogram and surgery ranged from 7 months (interquartile range [IQR] 1.8–15.7) for those with severely reduced left ventricular ejection fraction (LVEF) to 24 months (IQR 2.5–38.6) for those with a normal LVEF (P = .038). Univariate analysis demonstrated a relationship between decreased preoperative LVEF and infectious and renal complications, but not respiratory complications. After adjusting for preoperative characteristics, decreased

[☆] Data related to this manuscript were presented as a poster at the 2015 Society of Critical Care Medicine Annual Congress, January 17–21, in Phoenix, AZ, USA. The contents of this manuscript have not been published elsewhere, and the paper is not being submitted elsewhere. All authors have reviewed and approved this manuscript, which is being submitted as an Original Contribution.

^{☆☆} Disclosures: none.

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preoperative LVEF was associated with infectious (odds ratio, 1.33; 95% confidence interval, 1.03-1.68; $P = .0265$) and renal (odds ratio, 1.69; 95% confidence interval, 1.12-2.48; $P = .0142$) complications.

Conclusions: Decreased preoperative LVEF is associated with postoperative infections and renal complications.
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1. Introduction

Abnormal cardiac function in patients undergoing noncardiac surgery creates an extra level of concern for perioperative physicians. Because it is known that a history of heart failure (HF) before noncardiac surgery is associated with an increased risk of major adverse cardiac events [1] and death [2], the prevention of adverse cardiac events often becomes the primary focus for these patients. While pursuing this goal, accurately balancing the risks of other organ systems can be difficult. Preoperative HF increases the risk of kidney injury, respiratory failure, and infectious complications [3-7]; however, our understanding of the interactions between these organ systems is currently incomplete. Increasing our knowledge of this topic is important because many therapies differentially affect various organ systems. For example, β -blockers, although effective at reducing perioperative myocardial infarction, can also decrease cardiac output and place patients at risk for other complications such as stroke [8]. Therefore, moving forward, we must obtain a better understanding of the relationship between different organ systems to provide personalized care.

Although there is still much to learn about the perioperative management of individuals with HF, even less data are available on which to base treatment decisions for individuals with asymptomatic echocardiographic abnormalities. Although echocardiographic abnormalities in relatively asymptomatic patients typically increase concern of anesthesiologists and surgeons, it is not clear how or if this should affect patient management. Information is frequently extrapolated from the HF population, but there is currently insufficient evidence to support this strategy. For example, we previously demonstrated that infectious, renal, and respiratory complications are major causes of morbidity in individuals with worsening preoperative HF symptoms prior to noncardiac surgery [5]; however, it is not known if this also applies to those with decreased left ventricular ejection fraction (LVEF) in the absence of worsening symptoms.

In this study, we sought to extend our knowledge about the impact of cardiac dysfunction on the risk of postoperative noncardiac complications. Our objective was to determine if decreased LVEF in the absence of worsening preoperative symptomatic HF was associated with infectious, renal, or respiratory complications after noncardiac surgery. To accomplish this, we studied a subgroup of participants from a national prospective quality improvement initiative who had an echocardiogram performed at our institution prior to surgery that were not included in the diseased cohort of our previous study [5]. Our diseased cohort had no overlap with our

previous analysis because we did not include individuals with worsening preoperative HF symptoms. We hypothesized that abnormal LVEF was associated with an increased incidence of these 3 complications.

2. Methods

2.1. Study population

The University of Michigan Institutional Review Board reviewed this study, and the requirement for informed consent was waived because of the minimal level of risk to human participants. Participants were part of the American College of Surgeons–National Surgical Quality Improvement Program (ACS-NSQIP) at the University of Michigan (UM). Patients were eligible for inclusion in ACS-NSQIP if they were ≥ 18 years of age and underwent surgery between January 1, 2005, and December 31, 2010. To be included in this study, there had to be a preoperative echocardiogram performed at UM that would have been available for review prior to their surgical procedure. Given that individuals with worsening preoperative HF within 30 days of surgery were previously studied in a multicenter analysis [5], all patients labeled as having worsening preoperative HF in the ACS-NSQIP database were excluded. This prevented overlap with our previous multicenter retrospective study and this single-center retrospective analysis. If patients were included in the UM ACS-NSQIP database more than once, only the entry nearest to an echocardiography report was included.

The methodology of data collection for the ACS-NSQIP database has been described previously [9,10]. Originally designed as a quality improvement program for the Veterans Health Administration Hospital System [9], it has since expanded to greater than 200 institutions across the United States [10]. This program includes patients undergoing general, epidural, or spinal anesthesia for a surgical procedure. Patient recruitment occurs over 8-day cycles to account for scheduling patterns and typically includes the first general and vascular surgery procedures performed. Inclusion of high-volume cases is limited to prevent overrepresentation in the database. Transplant surgery, trauma, and American Society of Anesthesiologists class 6 patients are excluded. Minor surgical procedures that do not require the use of general, epidural, or spinal anesthesia are also excluded. Carotid endarterectomy, inguinal herniorrhaphy, parathyroidectomy, thyroidectomy, breast lumpectomy, and endovascular abdominal aortic aneurysm repair are never considered minor, although they may be

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