
Association of Medical Comorbidities, Surgical Outcomes, and Failure to Rescue: An Analysis of the Rhode Island Hospital NSQIP Database



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- BACKGROUND:** Failure to rescue (FTR) is a key metric of perioperative morbidity and mortality. We review perioperative medical comorbidities (MCMs) to determine what factors are associated with complications and rates of FTR.
- STUDY DESIGN:** A retrospective review of a NSQIP database including general, vascular, and surgical subspecialty patients from a tertiary referral center between March 2008 and March 2013 was performed. Demographics, MCMs, complications, 30-day mortality, and risk of FTR associated with specific complications and MCM were evaluated.
- RESULTS:** A total of 7,763 patients were included; 52.6% had MCMs and 14% (n = 1,099) experienced a complication. Patients with complications were older (64.9 vs 55 years; $p < 0.001$), more likely male (54% vs 44%; $p < 0.001$), and had more MCMs per patient (1.6 vs 1.4; $p < 0.001$). Complications were also associated with renal failure (odds ratio [OR] = 1.4; 95% CI, 1.0–2.0), steroid use (OR = 1.9; 95% CI, 1.4–2.5), CHF (OR = 2.5; 95% CI, 1.2–5.1), and ascites (OR = 9.1; 95% CI, 3.7–21.7), but not diabetes, hypertension, or COPD. There were 117 (11%) deaths among patients with complications. Adjusting for age, sex, American Society of Anesthesiologists class, and number of comorbidities, FTR was associated with postoperative respiratory failure, sepsis, and renal failure, as well as comorbid CHF, renal failure, ascites, and disseminated cancer.
- CONCLUSIONS:** Specific comorbidities are associated with higher rates of complications and FTR. Preoperative CHF, renal failure, and ascites, which were associated with FTR, can reflect a physiologic inability to tolerate complication-induced fluid shifts. Postoperative mortality was associated with signs of end organ damage, including sepsis, respiratory failure, and renal failure. Earlier recognition of these complications in at-risk patients should improve rates of FTR. (J Am Coll Surg 2015;221:1050–1056. © 2015 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved)
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Tremendous advances have occurred in surgical and perioperative care, increasing our ability to care for older, sicker patients. More of these complex patients are

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presenting for surgery as a result of better long-term management of their comorbidities. As surgeons intervene for these high-risk patients, surgical and postoperative complications inevitably occur. It is commonly thought that complications after surgery in fragile patients can be insurmountable and inevitably lead to death. However, not all comorbidities and complications are likely to be associated with negative outcomes in the same way. In patients with limited physiologic reserve, a better understanding and identification of the comorbidities and complications associated with increased mortality can improve patient outcomes.¹

A number of factors are known to relate to the occurrence of postoperative complications. These include patient characteristics such as age, functional status, and comorbidities. There are also hospital and physician factors that affect rates

Abbreviations and Acronyms

ASA	= American Society of Anesthesiologists
DM	= diabetes mellitus
FTR	= failure to rescue
IQR	= interquartile range
MCM	= medical comorbidity
OR	= odds ratio

of complications, such as time to operative intervention, surgical technique, and availability of ICU resources. Significant progress has been made in some of these hospital and physician factors to improve outcomes, but evidence is lacking about which comorbidities place these patients at most risk for complications. Institution-based protocols addressing specific comorbidities, for example, perioperative care of obstructive sleep apnea patients in monitored units, are often not evidence-based, but instead driven by anecdotal events within specific institutions.

Despite similar rates of complications across a variety of institutions, it has been noted that mortality rates often differ.² In a sentinel study of 6,000 patients, Silber and colleagues² defined *failure to rescue* (FTR) as death occurring after an adverse occurrence.² Although this study recognized similar patient characteristics in those patients experiencing FTR, the study focused largely on hospital-related characteristics.¹ It has been suggested that differences in mortality in patients with complications might be related to recognizing the significance of individual medical comorbidities (MCM) perioperatively.³ We undertake a more comprehensive analysis of the association of specific comorbidities with complication rates and subsequent FTR; examine which specific complications and comorbidities are associated with FTR; and hypothesize that certain MCMs will be more closely associated with FTR, specifically those that are difficult to control perioperatively.

METHODS

This is a retrospective review of all postoperative surgical patients enrolled between March 2008 and March 2013 in the NSQIP database at Rhode Island Hospital, a tertiary referral center. This included patients across general, vascular, and surgical subspecialties.

Charts were reviewed for patient characteristics, including age, sex, American Society of Anesthesiologists (ASA) class, type of operation, and type and number of comorbidities per patient. All stated MCMs were cross checked against the standard definitions as outlined in the NSQIP database definition set. All complications included in the NSQIP database were extracted and analyzed. The primary outcomes measured were postoperative

complications and 30-day mortality. Complications that occurred were defined by standard NSQIP definitions.⁴ Failure to rescue was defined as mortality that occurred after a complication.

The first analysis assessed the association between MCMs and the development of postoperative complications. As such, the group as a whole was divided into patients with vs without postoperative complications. The next analysis assessed the association between complications and FTR. We undertook a subgroup analysis of the patients with a complication, dividing this subgroup into patients who lived and died (FTR) after development of a complication. Patient characteristics, including demographics and baseline medical characteristics, between groups were compared using chi-square test, Student's *t*-test, or Mann-Whitney U test. Results are reported as mean and SD or median and 25th to 75th interquartile range (IQR). The risk of developing a complication associated with individual comorbidity was then assessed. Multivariable logistic regression analyses were performed for each specific medical comorbidity adjusting for age, sex, ASA class, and number of comorbidities, using age and ASA class as continuous variables.

We then assessed the risk of FTR, which is death after a complication. Individual regression analyses were undertaken to determine risk of death associated with each specific complication adjusting for age, sex, ASA class, and number of comorbidities. Hosmer-Lemeshow statistic was assessed for goodness of fit of the regression models, setting the significance of fit at $p > 0.2$.

RESULTS

Patient characteristics

There were 7,763 general, vascular, and surgical subspecialty cases between March of 2008 and March of 2013 in the NSQIP database. Mean patient age was 55.9 (± 17.1) years and 46.1% of patients were male. Of the 7,763 cases, 14.2% ($n = 1,102$) were classified as emergency cases by the operative surgeon. Mean (\pm SD) ASA class across the patient sample was 2.3 (± 0.7), with 4.4% of patients having an ASA class of 4 or 5, and 52.6% of patients had 1 or more comorbidities. Within the group of patients who had a comorbidity, median number of comorbidities per patient was 1 (IQR 1 to 2).

Complications

Complications developed in 1,099 of the 7,763 (14%) patients. Patients with complications were older (median age 64.9 years; IQR 52.1 to 75.5 years; $p < 0.001$) and were more likely to be male (54.1% vs 44.8%; $p < 0.001$) compared with patients without complications. Patients

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