

Development of a Risk Stratification Scoring System to Predict General Surgical Complications in Hand Surgery Patients

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Purpose Avoidance of postoperative complications is important to both patients and surgeons. In an attempt to optimize postoperative outcomes, a risk stratification scoring system has been created to aid in optimizing risk factors for general surgical complications in hand surgery patients.

Methods Patients were identified who underwent hand procedures as part of the American College of Surgeons National Surgical Quality Improvement Program. Independent risk factors associated with postoperative complications within 30 days of surgery were identified and used to develop a point-scoring system to estimate the relative risk for sustaining complications. For validation, the system was tested on a subset of patients from the database who had undergone hand surgery.

Results A total of 49,272 patients were identified as having undergone hand surgery from 2005 to 2015. The incidence of postoperative complications within 30 days of hand surgery was 2.3%. Risk factors associated with postoperative complications were male sex, tobacco abuse, congestive heart failure, anemia (male hematocrit less than 42; female less than 38), elevated creatinine (greater than 1.3 mg/dL), hypoalbuminemia (less than 3.5 g/dL), and hyponatremia (less than 135 mEq/L). Point scores derived for each of these factors were: hypoalbuminemia, +5; congestive heart failure, +2; anemia, +2; elevated creatinine, +2; male sex, +1; tobacco abuse, +1; and hyponatremia, +1. In the validation cohort, patients categorized as low-risk (0–3) using the point-scoring system had a 2.4% rate of 30-day complications; patients categorized as medium risk (4–7) had a 10.4% complication rate (relative risk = 4.3; 95% confidence interval, 3.1–5.9 compared with low risk) and high risk (≥ 8), 28.9% (relative risk = 11.9; 95% confidence interval, 9.0–15.7).

Conclusions This point-scoring system predicts risk for general postoperative complications after hand surgery. These data may help surgeons identify areas of clinical concern with patients to reduce the risk for sustaining postoperative complications. (*J Hand Surg Am.* 2018;43(7):641–648. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

Type of study/level of evidence Prognostic II.

Key words Hand surgery, orthopedics, postoperative complications, risk.



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OUTCOMES-BASED RESEARCH IN national databases has gained significant popularity in recent years.¹ National databases offer surgeons and researchers unique tools to track surgical outcomes in large populations.^{2–8} However, despite a growing body of literature, it is often difficult for surgeons to interpret this information and implement changes into their clinical practice because most studies focus on individual effects (such as hypoalbuminemia, obesity, or age) or are conducted in specific, nongeneralizable populations.^{1,9,10}

In an effort to bring clinical meaning to big data studies, researchers in many fields have developed risk stratification scoring systems.^{2,3,5,11–13} These scoring systems distill large data analyses into easily interpretable clinical scores that can be implemented in the clinical setting to aid in decision making. Despite the success of risk scoring systems in many fields, no similar scales have been developed for hand surgery.

Owing to the lack of risk stratification tools, it is often difficult for surgeons to discuss overall surgical risk with prospective surgical candidates. Although surgical outcomes specific to hand surgery may be readily available, such as the rate of nonunion or infection for a fracture, it is difficult to quantify the overall assessment of surgical risk from general postoperative outcomes. Furthermore, little information is available to identify modifiable risk factors that could be addressed before surgery. For instance, should a patient lose weight, stop smoking, or undergo dialysis? In a limited period or with limited resources, which factor or factors are most important to address? In an effort to provide evidence for these important presurgical discussions, this study was designed to use the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database to develop a risk stratification scoring system to predict general surgical complications in hand surgery patients.

MATERIALS AND METHODS

Patients who underwent hand surgery between 2005 and 2015 were identified as part of the ACS-NSQIP database. The ACS-NSQIP is a surgical registry that samples patients from community and academic centers nationwide.¹⁴ The program identifies patients undergoing inpatient and outpatient surgical procedures and tracks them for 30 days for the development of postoperative complications. Trained ACS-NSQIP data specialists compile a broad range of patient demographic characteristics and outcomes data from

individual medical record review. We chose the ACS-NSQIP as the preferred database for this study because it included general postoperative complications. Some of these postoperative complications, such as surgical site infection, are directly related to the surgical procedure whereas others such as urinary tract infection or pneumonia are general postoperative complications more associated with the overall health of the patient.

Previous authors identified a subset of 208 hand-specific Current Procedural Terminology (CPT) codes that are representative of hand surgery in ACS-NSQIP.¹⁵ Although ACS-NSQIP is a powerful tool for analyzing 30-day postoperative complications, it has certain limitations for hand surgery. Specifically, ACS-NSQIP was designed to assess major surgical procedures and general surgical outcomes. Despite this, many useful hand surgery cases and associated complications are included in the database. Inclusion in the study was based on the presence of one or more of these 208 hand-specific CPT codes representing a hand surgery procedure being performed during the study period. Exclusion criteria included any additional CPT coding outside these 208 hand-specific CPT codes, which often represented hand-specific procedures being done in conjunction with other non–hand related procedures. A full list of all CPT codes, along with the number of each code included in the study, is provided in [Appendix A](#) (available on the *Journal's* Web site at www.jhandsurg.org). Our institutional review board provided exempt status for this study because of the deidentified nature of the information contained in a national database.

A total of 50,750 patients were initially identified from the ACS-NSQIP database for inclusion in the study. Of these, 1,478 were excluded for having additional procedures outside hand surgery (0.3%). This left 49,272 patients for inclusion in the study. This study sample represents patients identified by a random sampling selection (ACS-NSQIP sampling is based on hospital volume, with low-volume centers enrolling all patients and high-volume centers using a validated sampling methodology to enroll a majority of patients), as per the ACS-NSQIP protocol of all inpatient and outpatient hand surgery procedures conducted at ACS-NSQIP centers.¹⁴

The primary outcome measure of the study was the presence or absence of postoperative complications within 30 days of surgery. Patients were considered to have had a complication if any of the following occurred during the first 30 postoperative days: organ space infection, sepsis, septic shock, deep surgical site infection, wound dehiscence, pulmonary

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