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Clinical Study

Assessing the utility of a clinical prediction score regarding 30-day morbidity and mortality following metastatic spinal surgery: the New England Spinal Metastasis Score (NESMS)

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Abstract

BACKGROUNDCONTEXT: The New England Spinal Metastasis Score (NESMS) was recently proposed to help predict 1-year survival following surgery for spinal metastases. Its ability to predict short-term outcomes, including 30-day morbidity, mortality, and hospital length of stay, has not been evaluated.

PURPOSE: Assess the capacity of NESMS to predict 30-day morbidity and mortality, as well as hospital length of stay, following surgery for spinal metastases.

STUDY DESIGN: Validation study.

PATIENT SAMPLE: All patients who had undergone spinal surgery with a history of metastatic spinal disease within the National Surgical Quality Improvement Program (NSQIP; 2007–2013).

OUTCOME MEASURE: Mortality, complications, failure to rescue, and length of stay.

METHODS: Demographic, oncologic, laboratory, and surgical data were obtained from the NSQIP. All patients were assigned an NESMS score (0–3). The effect of the NESMS score on the outcomes of interest was assessed using multivariable logistic regression and negative binomial regression that controlled for confounders. Final model discrimination and calibration were assessed using the c-statistic and Hosmer-Lemeshow test, respectively. Internal validation was performed using a bootstrapping procedure.

RESULTS: NSQIP data on 776 patients were included in this analysis. The 30-day mortality rate was 11% (N=87), and 51% of patients (N=395) sustained one or more complications. The final adjusted model demonstrated that the NESMS was a statistically significant predictor of 30-day mortality (p<.001), major systemic complications (p<.001), and failure to rescue (p=.03) following metastatic spinal surgery. Patients with an NESMS score of 3 had an 89% reduction in mortality (95% confidence interval [CI]: 0.04, 0.31), a 74% reduction in major systemic complications (95% CI: 0.11, 0.62), and an 88% reduction in failure to rescue (95% CI: 0.03, 0.47) as compared with those with a score of 0. The final model explained 71% of the variation in 30-day mortality. Findings were unchanged in the bootstrap analysis performed among 77,600 patient replicates.

FDA device/drug status: Not applicable.

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

Disclaimers: The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) and the hospitals participating in the ACS NSQIP are the source of the data used herein. They have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.

Level of Evidence: II.

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CONCLUSION: This study demonstrates the clinical accuracy of the NESMS score for predicting short-term major morbidity and mortality following metastatic spinal surgery. The success of this score in an independent cohort of patients collected from centers across the United States indicates its potential for translation to clinical practice. © 2015 Elsevier Inc. All rights reserved.

Keywords: Ambulatory status; Complications; Failure to rescue; Metastases; Mortality; New England Spinal Metastasis Score; Serum albumin; Spine surgery

Introduction

Within the last 20 years, several studies have demonstrated the safety and efficacy of surgical intervention in the setting of metastatic spinal disease [1–11]. The benefits of surgery for patients with metastases involving the spinal column have been postulated to include improved ambulatory function and independence, better pain control, enhanced cognition, and prolonged survival [1–11]. Although such outcomes are clearly desirable, it is unclear that all patients with metastatic spinal disease will benefit from surgical intervention. Such surgeries are technically demanding and resource-intensive, and require an experienced multidisciplinary team [2–11]. Furthermore, these procedures are known to carry a high risk of perioperative morbidity, with short-term mortality reported in 10–15% of cases and complications documented in as many as 76% of patients [12]. In the event of a postoperative complication, the long-term benefits of the surgical intervention may be compromised and patients may even be at risk of accelerated functional deterioration or early demise.

At present, spine surgeons are challenged to balance the risks of surgical intervention against the medical and oncologic characteristics of patients in order to successfully identify those who will benefit most from surgical intervention with the lowest likelihood of an adverse event. The literature is limited in terms of guiding this decision-making process, and popular scoring systems, such as the Tokuhashi or Tomita scales, have not performed well as prognostic tools [7,9,13]. Recently, Ghori et al. proposed a clinical prediction score that used a patient's modified Bauer grade, ambulatory status, and preoperative serum albumin as a means to predict long-term survival following spine surgery for metastatic disease [7]. This prognostic tool, now referred to as the New England Spinal Metastasis Score (NESMS), was developed using 1-year mortality as the sole outcome measure. Although the NESMS demonstrated many of the necessary attributes of a useful prediction tool, including simplicity, ease of application, and clinical validity, it is unclear whether the score could be used to predict other short-term events outside of mortality, such as complications, readmissions, and hospital length of stay (LOS).

In this context, we sought to apply the NESMS to independent data collected by the National Surgical Quality Improvement Program (NSQIP) in order to evaluate its capacity to prognosticate short-term mortality, perioperative morbidity, failure to rescue (FTR), reoperations, readmissions, and LOS. We viewed the NSQIP as an ideal dataset to assess the clinical validity and accuracy of the NESMS because of the NSQIP's collection of patient-centered information from medical centers across the United States, its routine abstraction of preoperative serum albumin required for the NESMS, and the internal efforts on the part of the NSQIP to ensure the accuracy and validity of the data imparted by participating hospitals [14–22]. At present, there are more than 400 centers that contribute data to the NSQIP [20], and NSQIP datasets have been used in the past in numerous investigations involving spinal surgery [14,16,17], total joint arthroplasty [17,18], sports medicine [17,22], upper extremity surgery [17,19], and trauma [15,17,21].

Methods

Data collection

A query was performed to identify all patients in the NSQIP who had undergone spine surgery with a history of metastatic spinal disease between 2007 and 2013. The means through which hospitals participate in the NSQIP and the methodology behind data collection are extensively described in other publications [14–22]. Patients undergoing spine surgery were identified using current procedural terminology codes that included all cervical, thoracic, and lumbosacral spine surgical interventions, except percutaneous cement augmentation procedures (eg, vertebroplasty or kyphoplasty) and standalone biopsies. Patients were identified as having a history of metastatic cancer through the International Classification of Disease, Ninth Revision (ICD-9) coding used in the NSQIP, or as having "disseminated cancer," a specific response variable recorded as part of the NSQIP data collection. Patients under the age of 18 and those with leukemia or primary spinal tumors were excluded.

The NSQIP records of patients selected for inclusion were extracted, and demographic, medical, oncologic, laboratory, and surgical data were obtained. Demographic data included patient age, sex, and race, which were dichotomized into white or non-white (African-American, Asian, Native American, Other race). Medical information included medical comorbidities, whether the patient was ambulatory or functionally dependent at the time of surgery, and the American Society of Anesthesiologists (ASA) score. Oncologic data consisted of primary tumor diagnosis, history of disseminated

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