

Clinical Study

The Rothman Index as a predictor of postdischarge adverse events after elective spine surgery

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Received 25 June 2017; revised 2 October 2017; accepted 2 November 2017

Abstract

BACKGROUND CONTEXT: The Rothman Index (RI) is a comprehensive rating of overall patient condition in the hospital setting. It is used at many medical centers and calculated based on vital signs, laboratory values, and nursing assessments in the electronic medical record. Previous research has demonstrated an association with adverse events, readmission, and mortality in other fields, but it has not been investigated in spine surgery.

PURPOSE: The present study aims to determine the potential utility of the RI as a predictor of adverse events after discharge following elective spine surgery.

STUDY DESIGN/SETTING: This retrospective cohort study was carried out at a large academic medical center.

PATIENT SAMPLE: A total of 2,687 patients who underwent elective spine surgery between 2013 and 2016 were included in the present study.

OUTCOME MEASURES: The occurrence of adverse events and readmission after discharge from the hospital, within postoperative day 30, was determined in the present study.

METHODS: Patient characteristics and 30-day perioperative outcomes were characterized, with events being classified as “major adverse events” or “minor adverse events” using standardized criteria. Rothman Index scores from the hospitalization were analyzed and compared for those who did or did not experience adverse events after discharge. The association of lowest and latest scores on adverse events was determined with multivariate regression, controlling for demographics, comorbidities, surgical procedure, and length of stay.

RESULTS: Postdischarge adverse events were experienced by 7.1% of patients. The latest and lowest RI values were significantly inversely correlated with any adverse events, major adverse events, minor adverse events and readmissions after controlling for age, gender, body mass index, American Society of Anesthesiologists (ASA) class, surgical site, and hospital length of stay. Rates of readmission and any adverse event consistently had an inverse correlation with lowest and latest RI scores, with patients at increased risk with lowest score below 65 or latest score below 85.

FDA device/drug status: Not applicable.

Author disclosures: **RPM:** Grant: James G. Hirsch Endowed Medical Student Research Fellowship (provided by home institution) (B), pertaining to the submitted work. **NTO:** Nothing to disclose. **JJC:** Nothing to disclose. **DRS:** Nothing to disclose. **BNS:** Nothing to disclose. **PB:** Nothing to disclose. **JNG:** Consulting: Adante Medical Devices (B), ISTO Technologies (C), Vertex (B), Medtronic (A), Bioventus (C), Stryker (E); Board of Directors: Lumbar Spine Research Society Annual Meeting Co-Chair 2016 and 2017 (None), North American Spine Society Annual Meeting

Co-Chair 2017 (None); Grants: Orthopaedic Trauma Association (B), outside the submitted work.

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

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CONCLUSIONS: The RI is a tool that can be used to predict postdischarge adverse events after elective spine surgery that adds value to commonly used indices such as patient demographics and ASA. It is found that this can help physicians identify high-risk patients before discharge and should be able to better inform clinical decisions. © 2017 Elsevier Inc. All rights reserved.

Keywords: Adverse event; Elective; Hospital discharge; Readmission; Rothman Index; Spine surgery

Introduction

Elective spine surgery is commonly performed and is a major driver of medical spending in the United States [1,2]. It is estimated that nearly 750,000 patients underwent spine surgery in 2011 [3], and that elective spine surgery continues to increase [4,5]. However, in a time when we are striving to optimize patient outcomes and minimize costs, increasing efforts are being made to minimize perioperative morbidity and readmission.

Highlighting the importance of quality improvement measures, the Patient Protection and Affordable Care Act created the Hospital Readmissions Reduction Program, which penalizes hospitals with subpar readmission rates up to 3% of their Medicare reimbursements [6]. Further, the Bundled Payments for Care Initiative was created by Center for Medicare and Medicaid Services to develop payment alternatives to fee-for-service, with the objective of increasing providers' and hospitals' stakes in optimizing outcomes and value of care [7]. Bundled Payments for Care Initiative trials for spine care are ongoing, and more centers plan to trial bundled payments for some of their spine patients [8,9].

With this unprecedented emphasis on increased accountability and reducing costs, it is important to identify patients with a high risk of postdischarge complications and make appropriate steps to mitigate such risks. Most work in this area has focused on identifying patient demographics and comorbidities preoperatively that put patients at risk of adverse outcomes [10–14]. Through optimized patient selection, it is hoped that perioperative morbidity can be minimized. However, less work has been done to identify patients at risk of adverse outcomes at branch points of care (such as discharge) once surgery is performed.

One potential tool to assess patient status and predict adverse events in the hospital is the Rothman Index (RI) (PeraHealth, Charlotte, NC). The RI was developed to be a single rating of patient condition that populates and updates itself automatically from the electronic medical record throughout a patient's hospital stay for a broad range of medical and surgical patients. The RI incorporates vital signs, laboratory results, and yes/no nursing assessments of body systems with clear guidelines; there are no subjective or physician-generated data (Table 1). Calculated with a proprietary formula, there is a maximum score of 100, with points decreased as inputs deviate away from optimal values, and most patients fall between 0 and 100 [15]. The RI is presently used at more than 70 hospitals and health systems to monitor patient condition and estimate risk of adverse events.

Table 1
Variables included in Rothman Index

Vital signs	Laboratory values	Nursing assessments
Temperature	Sodium	Cardiac
Systolic blood pressure	Potassium	Respiratory
Diastolic blood pressure	Chloride	Gastrointestinal
Heart rate	Blood urea nitrogen	Nutrition/dietary
Cardiac rhythm	Creatinine	Genitourinary
Respiratory rate	White blood cell count	Neurological
Pulse oximetry	Hematocrit	Musculoskeletal
		Skin
		Braden scale*
		Peripheral vascular
		Safety
		Psychosocial

* The Braden scale is a scoring system that characterizes a patient's risk of developing a pressure ulcer; variables include skin moisture, friction and shear, sensory perception, and patient's activity, mobility, and nutritional status.

The RI was not developed to predict a specific outcome, although it has been demonstrated to be strongly associated with 24-hour mortality [16], discharge to higher level of care [15], 30-day readmissions [17], sepsis [18], and intensive care unit mortality [15] or readmission [19] in various patient populations. The RI is utilized in many hospitals and health systems to monitor the condition of their patients [20]. Nonetheless, the RI remains largely untested for many outcomes and patient populations, and there are no known studies about the utility of the RI in the spine, orthopedic, or neurosurgical literature.

The current study aims to characterize whether RI scores are associated with the incidence of adverse events and readmission after discharge following elective spine surgery. Our hypothesis was that the RI could be used to identify patients at risk of adverse postoperative outcomes and readmissions after elective spine surgeries.

Methods

Study population

A retrospective cohort study was conducted at a large academic medical center that regularly utilizes the RI. Patients undergoing elective spine surgery from 2013 to 2016 were identified based on the following procedures and current procedural terminology codes.

Codes utilized to identify patient were as follows: anterior cervical discectomy and fusion (22551, 22554, 63075), anterior cervical corpectomy (63081, 63085), cervical disc arthroplasty (22856, 22857), cervical laminectomy (63015,

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