

Clinical Study

A scoring system to predict postoperative medical complications in high-risk patients undergoing elective thoracic and lumbar arthrodesis

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Received 9 January 2015; revised 8 June 2015; accepted 14 July 2015

Abstract

BACKGROUND CONTEXT: Various surgical factors affect the incidence of postoperative medical complications following elective spinal arthrodesis. Because of the inter-relatedness of these factors, it is difficult for clinicians to accurately risk-stratify individual patients.

PURPOSE: Our goal was to develop a scoring system that predicts the rate of major medical complications in patients with significant preoperative medical comorbidities, as a function of the four perioperative parameters that are most closely associated with the invasiveness of the surgical intervention.

STUDY DESIGN/SETTING: This study used level 2, Prognostic Retrospective Study.

PATIENT SAMPLE: The patient sample consisted of 281 patients with American Society of Anesthesiologists (ASA) scores of 3–4 who underwent elective thoracic, lumbar, or thoracolumbar fusion surgeries from 2007 to 2011.

OUTCOME MEASURES: Physiologic risk factors, number of levels fused, complications, operative time, intraoperative fluids, and estimate blood loss were the outcome measures of this study.

METHODS: Risk factors were recorded, and patients who suffered major medical complications within the 30-day postoperative period were identified. We used chi-square tests to identify factors that affect the medical complication rate. These factors were ranked and scored by quartiles. The quartile scores were combined to form a single composite score. We determined the major medical complication rate for each composite score, and divided the cohort into quartiles again based on score. A Pearson linear regression analysis was used to compare the incidence of complications to the score.

RESULTS: The number of fused levels, operative time, volume of intraoperative fluids, and estimated blood loss influenced the complication rate of patients with ASA scores of 3–4. The quartile ranking of each of the four predictive factors was added, and the sum became the composite score. This score predicted the complication rate in a linear fashion ranging from 7.6% for the lowest risk group to 34.7% for the highest group ($r=0.998$, $p<.001$).

FDA device/drug status: Not applicable.

Author disclosures: **JLM:** Nothing to disclose. **NLZ:** Nothing to disclose. **EGL:** Nothing to disclose. **RSS:** Nothing to disclose. **CB:** Nothing to disclose. **TCP:** Nothing to disclose. **SS:** Nothing to disclose. **ACC:** Consulting: Atlas Spine (A), DePuy Synthes (D). **RAH:** Grant: DePuy Synthes (D, Grant received from the International Study Group Foundation [ISSGF]); Board membership: Cervical Spine Research Society (None), International Society for the Spine of the Lumbar Spine (C), ISSGF (C); Consultancy: DePuy Synthes (D), Globus (B), Medtronic (F); Other: Evan, Craven & Lackie (C, Money to OHSU for expert testimony), Benson, Bertoldo, Baker & Carter (C, Money to OHSU for expert testimony); Lectures: DePuy Synthes (D); Royalties: Seaspine (E), DePuy Synthes (D); Stock options (past): Spine Connect (A, 0 shares (pending)). In addition, Dr Hart reports a pending patent from OHSU. **JUY:** Patent royalties: Osiris Therapeutics (B); Spine Fellowship Support: Globus Medical (B).

Source of funding: Oregon Clinical and Translational Research Institute (OCTRI) receives funding from the National Center for Advancing Translational Sciences' Clinical and Translational Science Award (UL1RR024140). The funding allows for the formation and operations of OCTRI, and did not play a direct role in our investigation.

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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CONCLUSIONS: Taken together, the four factors, though not independent of one another, proved to be strongly predictive of the major medical complication rate. This score can be used to guide medical management of thoracic and lumbar spinal arthrodesis patients with preexisting medical comorbidities. © 2015 Elsevier Inc. All rights reserved.

Keywords: Complications; High-risk; Lumbar fusion; Outcomes; Scoring; Thoracolumbar arthrodesis

Introduction

Arthrodesis of the thoracic and lumbar spine is associated with a significant rate of medical complications. However, the reported complication rates vary widely, ranging from 10% to 70% [1–6]. This variability is indicative of our overall poor understanding of the population being studied and the etiology of medical complications.

An ability to predict the likelihood of developing medical complications can assist the care team in the postoperative management of patients who undergo thoracic and lumbar arthrodesis. The incidence for especially high-risk patients could potentially be reduced by providing them with optimized medical care. However, the definition of “high-risk” in the thoracic and lumbar arthrodesis patient population has not been well established.

Two factors that most likely play a significant role in the development of complications are the patient’s preexisting medical issues and the invasiveness of the surgery. Daubs et al. reported a 37% complication rate in patients 60 or more years of age [1]. Presumably, the high complication rate in this study was due to preexisting medical conditions in the elderly surgical patients. However, these patients were not stratified by the invasiveness of the surgery, diminishing the utility of their data for individualized postsurgical patient management.

Ever since Virginia Apgar revolutionized postnatal care of infants in 1953 by developing a simple algorithm to assess infants’ general health status and their need for monitoring [7], other clinical scoring systems have been developed to predict outcomes such as intensive care unit (ICU) utilization, morbidity, and mortality. However, a scoring system that can predict the likelihood of an individual spine fusion patient developing a medical complication has not been described. Therefore, our goal was to examine the medical complication rates of patients with significant preoperative medical comorbidities as a function of the four perioperative parameters that are most closely associated with the invasiveness of the surgical intervention.

Methods

We retrospectively reviewed the records of 709 patients who underwent elective thoracic, lumbar, or thoracolumbar arthrodesis by three orthopedic spine surgeons at one institution between 2007 and 2011. All information was gathered under approval from our Institutional Review Board.

Demographics, comorbidities, surgery-related diagnoses, and American Society of Anesthesiologists (ASA) scores (Table 1) were recorded. We defined high-risk patients as those

Table 1

American Society of Anesthesiologists (ASA) scoring system for preoperative risk stratification

Score	Definition
1	A normal healthy patient
2	A patient with mild systemic disease
3	A patient with severe systemic disease
4	A patient with severe systemic disease that is a constant threat to life
5	A moribund patient who is not expected to survive without the operation

with ASA scores of 3–4, and low-risk patients as those with ASA scores of 1–2. There were no patients with an ASA score of 5 in our cohort.

The four perioperative variables chosen that are most closely associated with the invasiveness of the surgery were the number of levels fused, operative time, volume of intraoperative fluid administration, and estimated blood loss (EBL). These variables were recorded, along with intraoperative vital signs, such as temperature, mean arterial pressure, and heart rate.

Patient records were reviewed for any instances of major medical complications within the 30-day postoperative period. A postoperative infection requiring a return to the operating room was classified as a medical complication, owing to the physiologic factors involved and the medical care required. Because the definition of “complication” in the literature varies, we chose to record only major complications that could potentially impact patients’ longer-term prognosis or quality of life (Table 2). For instance, urinary tract infections requiring a simple course of antibiotic therapy were excluded, but cases of acute renal failure were included as major medical complications.

Table 2

Major medical complications occurring within the 30-day postoperative period following elective thoracic and lumbar arthrodesis

Complication	Number of occurrences	Rate of occurrence (%)
Renal failure	26	3.7
Pulmonary embolism	21	3.0
Arrhythmia	18	2.5
Pneumonia	13	1.8
Ileus	13	1.8
Deep wound infection	13	1.8
Death	7	1.0
Myocardial infarction	4	0.6
Congestive heart failure	1	0.1
Stress-induced cardiomyopathy	1	0.1
Cerebrovascular accident	1	0.1
Total	118	16.7

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