

Clinical Study

Preoperative predictors of increased hospital costs in elective anterior cervical fusions: a single-institution analysis of 1,082 patients

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Received 3 September 2014; revised 10 November 2014; accepted 10 January 2015

Abstract

BACKGROUND CONTEXT: The frequency of anterior cervical fusion (ACF) surgery and total hospital costs in spine surgery have substantially increased in the last several years.

PURPOSE: To determine which patient comorbidities are associated with increased total hospital costs after elective one- or two-level ACFs.

STUDY DESIGN/SETTING: Retrospective cohort analysis.

PATIENT SAMPLE: Individuals who have undergone elective one- or two-level ACFs at our single institution. The total number of patients amounted to 1,082.

OUTCOME MEASURES: Total hospital costs during single admission.

METHODS: Multivariate linear regression models were used to analyze independent effects of preoperative patient characteristics on total hospital costs. Univariate analysis was used to examine association of these characteristics on operative time, length of hospital stay (LOS), and complications.

RESULTS: Age, obesity, and diabetes were independently associated with increased average hospital costs of \$1,404 (95% confidence interval [CI], \$857–\$1,951; $p < .001$), \$681 (95% CI, \$285–\$1,076; $p = .001$), and \$1,877 (95% CI, \$726–\$3,072; $p = .001$), respectively. Age was associated with increased LOS ($p < .001$) and complications ($p < .001$) but not operative time ($p = .431$). Diabetes was associated with increased LOS ($p < .001$) and complications ($p = .042$) but not operative time ($p = .234$). Obesity was not associated with increased LOS ($p = .164$), complications ($p = .890$), or operative time ($p = .067$).

CONCLUSIONS: This study highlights the patient comorbidities associated with increased hospital costs after one- or two-level ACFs and the potential drivers of these costs. © 2015 Elsevier Inc. All rights reserved.

Keywords: Hospital costs; Cervical spine; ACF; Comorbidities; Complications; Length of stay; Operation time

FDA device/drug status: Not applicable.

Author disclosures: **SVM:** Nothing to disclose. **IC:** Nothing to disclose.

TJJ: Nothing to disclose. **BD:** Nothing to disclose. **AAP:** Royalties: Amedica (C), Ulrich (A), Biomet (A); Stock Ownership: Amedica (A), Nocimed (A), Vital 5 (A), Cytonics (A); Private Investments: Amedica (A), Nocimed (A), Vital 5 (A), Cytonics (A); Consulting: Amedica (A), Biomet (A), Depuy (C), Stryker (A), Zimmer (A); Board of Directors: LSRS, CSRS, JAAOS.

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

Statement of authorship: All the authors contributed significantly to the development of this article through data analysis, manuscript preparation, or analysis and editing of final article. **Contributions:** Shobhit V. Minhas: data analysis, article preparation, and literature review; Ian Chow: data

analysis and article preparation; Tyler J. Jenkins: article preparation; Brian Dhingra: data analysis; Alpesh A. Patel: data analysis, manuscript preparation, and literature review.

Funding sources: None.

Ethical approval: The home institution database used to derive the information presented in our study contains deidentified patient information. It implements the protections afforded by the Health Insurance Portability and Accountability Act of 1996.

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EVIDENCE & METHODS

Context

In the era of health care reform, interest in the costs of spine surgical care is increased, particularly among elective interventions such as anterior cervical fusion (ACF). The authors sought to utilize data from their center regarding the factors responsible for increased surgical expenses in the setting of one- or two-level ACF.

Contribution

The authors determined that age, obesity and diabetes were independent predictors of increased hospital costs (range \$681–\$1,877) following ACF. Many of these same factors increased the risk of hospital length-of-stay as well as complications.

Implications

The results of this study may be subject to a certain degree of ecological fallacy, in that the predictive factors identified are not necessarily responsible for the observed increase in costs. For example, the heightened chance of complication occurrence in patients of advanced age would likely elevate length-of-stay as well as associated costs (should a complication occur) and these findings would be attributable to the occurrence of morbidity (regardless of age) rather than to age. The fact that this information was derived from a single quaternary medical center in an urban setting in the Midwest over a 10-year period likely also impairs the capacity for widespread translation to various inpatient settings across the United States.

—The Editors

Introduction

Total hospital costs along with the frequency of complex spine surgery have substantially increased in the last several years and have hence become the subjects of numerous economic analyses [1–4]. The number of anterior cervical fusion (ACF) procedures has also dramatically risen in the last 15 years. Concurrently, patient age, preoperative comorbidities, and total hospital charges of ACFs have significantly increased during this time interval as well [5–8]. The postoperative course after these procedures, such as length of hospital stay (LOS) and complications, has been recently examined using multicenter national databases and contributes a significant burden on total hospital expenses [9–12].

A number of studies have examined the effect that preoperative patient characteristics and comorbidities have on total hospital costs with respect to ACFs to allow surgeons to preoperatively stratify high-risk patient populations. Recently, a retrospective analysis of the

nationwide inpatient sample demonstrated that increased comorbidity burden based on the *Charison Comorbidity Index* was independently associated with increased hospital costs of anterior cervical spine surgery [13]. More specifically, the previous literature has exhibited that female gender, age, obesity, and diabetes have all been associated with an increase in hospital charges after these procedures [14–16]. However, although differences in average costs were analyzed, these studies did not examine the magnitude of increase that each preoperative variable had on hospital expenses when examined by eliminating confounders—operative characteristics and cervical diagnoses. Consequently, difficulties may arise for surgeons to accurately assess not only which comorbidities contribute to increased costs and why but also the extent to which each characteristic increases cost when examined independently. The implication of this knowledge is crucial for risk stratification, prioritization efforts, and the management of these boosted overheads. The purpose of this study was to answer these queries.

We aim to examine which patient comorbidities, if any, are independently associated with increased hospital costs of one- or two-level ACFs, determine the incremental increase in hospital expenditure, and assess the drivers of associated increases in costs, such as increased LOS, operative time, and complication rates. By analyzing a large cohort from our home institution, we aim to provide an explanation and management plan to prevent these discrepancies in hospital charges based on patient characteristics.

Methods

Patient selection

A retrospective analysis was conducted using our home-institution's internal patient database. This database includes information from electronic medical records of more than 50 systems throughout the institution's campus. Trained and independent institutional data analysts collect longitudinal medical information, including patient demographics and comorbidities, diagnoses, and surgical procedure details. These data are deidentified to comply with the guidelines of the database. Institutional data analysts identified patients undergoing any spinal procedure between 2003 and 2013. Of these, patients undergoing primary surgical procedures with an *International Statistical Classification of Diseases, Ninth Revision* (ICD-9) code of 81.02 were identified, representing anterior cervical arthrodesis of the C2 level or below. Patients with concurrent thoracic instrumentation (81.04 and 81.05), lumbar instrumentation (81.06, 81.07, and 81.08), atlas-axis fusion (81.01), posterior cervical fusion (81.03), and unspecified spinal fusions (81.00) were excluded. Cases with greater than two-level vertebral

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