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Clinical Study

Diagnosis and neurologic status as predictors of surgical site infection in primary cervical spinal surgery

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Abstract

BACKGROUND CONTEXT: Surgical site infection (SSI) incidence after cervical spinal surgery ranges from 0.1% to 17%. Although the general risk factors for SSI have been discussed, the relationship of neurologic status and trauma to SSI has not been explicitly explored.

PURPOSE: This study aimed to study associated risk factors and to report the incidence of SSI in patients who have undergone cervical spinal surgery with the following four preoperative diagnoses: (1) degenerative disease with no myelopathy (MP), (2) degenerative disease with MP, (3) traumatic cervical injury without spinal cord injury (SCI), (4) traumatic cervical injury with SCI. We hypothesize that SSI incidence would increase from Group (1) to Group (4).

STUDY DESIGN: Retrospective database analysis was carried out.

PATIENTS SAMPLE: We used International Classification of Diseases codes to identify the four groups of patients in the U.S. Nationwide Inpatient Sample (NIS) from the years 2000 to 2011. We complemented this study with a similar search in our institutional database (ID) from the years 2000 to 2013. Patients with concomitant congenital deformity, infection, inflammatory disease, and neoplasia were excluded, as were revision surgeries.

OUTCOME MEASURES: The primary outcome studied was the occurrence of SSI. Statistical analyses included bivariate comparisons and chi-square distribution of demographic data and multivariable regression for demographic, surgical, and outcome variables.

FDA device/drug status: Not applicable.

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RESULTS: A total of 1,247,281 and 5,540 patients met inclusion criteria in the NIS database and the ID, respectively. Overall SSI incidence was 0.73% (NIS) versus 1.75% (ID). Surgical site infection incidence increased steadily from 0.52% in Group (1) to 1.97% in Group (4) in the NIS data and from 0.88% to 5.54% in the ID. Differences between diagnostic groups and cohorts reached statistical significance. Surgical site infection was predicted significantly by status (odds ratio [OR] 1.69, p<.0001) and trauma (OR 1.30, p=.0003) in the NIS data. Other significant predictors included the following: approach, number of levels fused, female gender, black race, medium size hospital, rural hospital, large hospital, western US hospital and Medicare coverage. In the ID, only trauma (OR 2.11, p=.03) reached significance when accounting for comorbidities.

CONCLUSIONS: Both primary diagnosis (trauma vs. degenerative) and neurologic status (MP or SCI) were found to be strong and independent predictors of SSI in cervical spine surgery.

Keywords: Cervical; Degenerative; Infection; Myelopathy; NIS; Spinal cord injury; Spine; Surgery; Surgical site infection; Trauma

Introduction

The annual volume of cervical spine operations performed in the United States has increased steadily over the past decades [1,2]. These surgeries are typically performed to treat cervical stenosis causing radiculopathy or myelopathy, and less commonly for trauma, neoplasm, or infection [3]. Not only has the absolute number of patients undergoing spine surgeries increased, but also has the average age and comorbidity index [1,2]. However, this rise was associated with neither higher morbidity nor mortality, and in fact, average total length of hospital stay has decreased over the same time period [2]. Wound-related complications, including infections, are a relatively common postoperative problem, increasing overall morbidity, mortality, and health-care costs [4,5]. The overall incidence of infections in spine surgeries varies from 0% to 17% depending on the diagnosis, surgical approach, operative region, number of levels, and use of instrumentation [6–10]. This incidence varies between studies based on the definition and methods used to monitor for infection. Other common risk factors for surgical site infections (SSIs) include comorbidities such as age over 60 years, diabetes, malnutrition, and obesity, among others [11–15]. Multiple studies have demonstrated a relatively high risk of infection after posterior cervical surgery ranging from 3% to 94% [15,16] compared with a much lower rate with anterior-only approaches [7,17,18]. Higher complication rates have also been reported after posterior stabilization for traumatic cervical injuries, rheumatoid cervical disease, and in patients with myelopathy, upward of 17% in some cases [6,7,16,19]. Infection after posttraumatic posterior cervical fusion has also been associated with delays to operative intervention, increased postoperative intensive care unit stay, and use of a postoperative semi-rigid cervical orthosis [20].

Although numerous risk factors for infection after cervical spinal surgery have been identified, the relationship between preoperative neurologic status and infection has not been fully explored. Increased approach-related perioperative morbidity was demonstrated in patients with cervical spondylotic myelopathy [3,7,10,21]. Increased morbidity and mortality have also been documented in patients following surgery for traumatic injuries compared with patients undergoing surgery for non-traumatic indications, and a single study linked spinal cord injury (SCI) to infectious outcomes [6,8,20,22,23]. However, no studies have been done to compare incidence of SSI based on neurologic status in patients undergoing cervical procedures for either degenerative or traumatic indications. Thus, the premise of this study was to report the incidence of SSI in patients who have undergone cervical spinal surgery with the following four preoperative diagnoses: (1) cervical radiculopathy, (2) cervical myeloradiculopathy, (3) traumatic cervical injury without neurologic injury, and (4) traumatic cervical injury with neurologic injury.

The hypothesis is that the infection rate—and thus perioperative morbidity—will increase in a stepwise fashion moving from Group (1) to Group (4).

Methods

Data sources

The U.S. Nationwide Inpatient Sample (NIS) database was used to access patient information from the years 2000 to 2011. The NIS is the largest publicly available all-payer inpatient care database containing de-identified discharge data, approximating a 20% stratified sample of U.S. community hospitals [24]. The Agency for Healthcare Research and Quality reports high NIS accuracy and agreement between data estimated by the NIS and the National Hospital Discharge Survey. The NIS data quality is reported publicly on the Health Care Utilization Project website. Coding for the NIS is consistent with the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). Using an analogous billing code search, our institutional database (ID) was also used to collect data from 2000 to 2013 for comparison purposes.

Patients were selected for inclusion based on appropriate ICD-9-CM procedure codes linked to specific diagnosis codes (Table 1). Diagnostic codes were selected to stratify patients by one of four preoperative diagnoses: (1) cervical