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Clinical Study

# Risk factors for surgical site infection after posterior cervical spine surgery: an analysis of 5,441 patients from the ACS NSQIP 2005–2012

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**Abstract**

**BACKGROUND CONTEXT:** The incidence of surgical site infection (SSI) following posterior cervical surgery has been reported as high as 18% in the literature. Few large studies have specifically examined posterior cervical procedures.

**PURPOSE:** The study aims to examine the incidence, timing, and risk factors for SSI following posterior cervical surgery.

**DESIGN:** This is a retrospective cohort study of prospectively collected data in a national surgical outcomes database.

**PATIENT SAMPLE:** The sample includes patients who underwent posterior cervical spine surgery between 2005 and 2012 identified in the American College of Surgeons National Surgical Quality Improvement Project (ACS NSQIP) Participant Use Data File.

**OUTCOME MEASURES:** The 30-day rate of postoperative SSI, timing of diagnosis, and associated risk factors were determined.

**METHODS:** The ACS NSQIP was used to identify 5,441 patients who underwent posterior cervical spine surgery by Current Procedural Terminology codes from 2005 to 2012. Thirty-day readmission data were obtained for 2011–2012. The incidence and timing of SSI were determined. Multivariable logistic regression analysis was then performed to identify significant risk factors.

**RESULTS:** Of the 5,441 patients identified as having undergone posterior cervical surgery, 3,724 had a posterior cervical decompression, 1,310 had a posterior cervical fusion, and 407 underwent cervical laminoplasty. Surgical site infection within 30 days was identified in 160 patients (2.94%), with 80 of those cases being superficial SSI. There was no significant difference in SSI rate among the three procedure groups. The average time for diagnosis of SSI was over 2 weeks. In 2011–2012, 36.9% of patients with SSI were readmitted within 30 days. Several significant predictors of SSI were identified in univariate analysis, including body mass index (BMI) >35, chronic steroid use, albumin <3, hematocrit <33, platelets <100, higher American Society of Anesthesiologists class, longer operative time, and longer hospital admission. Independent risk factors, including BMI >35 (odds ratio [OR]=1.78, p=.003), chronic steroid use (OR=1.73, p=.049), and operative time >197 minutes (OR=2.08, p=.005), were identified in multivariable analysis.

**CONCLUSIONS:** Optimization of preoperative nutritional status, serum blood cell counts, and operative efficiency may lead to a reduction in SSI rates. Obese patients and patients on chronic steroid therapy should be counseled on elevated SSI risk. 

*Keywords:* ACS-NSQIP; Cervical spine surgery; Obesity; Posterior cervical; Surgical site infection

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## Introduction

Surgical site infection (SSI) following spine surgery is a major complication resulting in patient morbidity and mortality [1]. In addition, SSI often leads to prolonged hospital length of stay, readmission, or reoperation, significantly increasing cost of care as much as fourfold [1–5]. The SSI rates following cervical spine surgery have ranged from 1% to 7% in the literature [1,4,6,7]. However, SSI rates following posterior cervical spine surgery in comparison to anterior surgery is reported to be much higher, with rates as high as 18% [8–10]. As more quality metrics and performance measures are being introduced into the US health-care system, it will become imperative to establish differences in SSI rates for anterior and posterior cervical spine surgery in large national databases [3,11,12]. Appropriate risk stratification based on approach-related morbidity and directed prevention measures may possibly avoid lost reimbursement and improve patient outcomes.

The American College of Surgeons National Quality Improvement Project (ACS NSQIP) has been validated as a useful dataset for investigating patient outcomes following multiple orthopedic procedures including spine surgery [11,12]. The NSQIP dataset is collected prospectively using validated and systematically audited methods to ensure data accuracy. Thirty-day postoperative mortality, complications, and unplanned readmissions are collected, as well as patient demographics, comorbidities, and perioperative factors from over 400 participating institutions. Although several studies have examined complications following various spine procedures, no large database study has looked specifically at the incidence of and risk factors for SSI following posterior cervical spine surgery. Given the significantly higher incidence of infection reported in the literature following posterior cervical spine surgery [8,10,13], we hypothesize that there may be several unique risk factors predictive of SSI that have not been well defined. The purpose of the present study is to examine the incidence, timing, and risk factors for 30-day SSI following posterior cervical surgery using ACS NSQIP.

EVIDENCE & METHODS

**Context**

The authors present results following an analysis of the ACS-NSQIP evaluating risk factors for surgical site infections following posterior cervical spine surgery. The study was conducted using data from 2005–12 and considered more than 5,000 patients.

**Contribution**

The rate of infection following posterior cervical spine surgery was 2.9% (n = 160). Half of these were superficial infections. Patients with BMI>35, those on chronic steroids and those who had extended operative times were at greatest risk of infection.

**Implications**

These findings add to the growing body of literature derived from the NSQIP. This particular work extends over a 7–8 year time period. Readers should be aware that the design of the NSQIP is not intended to support research nor is the dataset considered nationally representative. Pooling of superficial and deep infection patients may not be appropriate and given the limited number of individuals with infections, the number of variables included means that the statistical model is overfit. Some statistical findings may not be translatable as a result. Given these limitations, this study presents level IV evidence.

*—The Editors*

## Materials and methods

We identified patients who underwent posterior cervical spine surgery from the 2005–2012 ACS NSQIP Participant Use File using Current Procedural Terminology codes. The surgical procedures were broken down into categories to include posterior cervical decompression without fusion (63001, 63015, 63020, 63040, 63045, 63250, 63265, 63270, 63275, 63280, and 63285), cervical laminoplasty (63050 and 63051), and posterior cervical fusion (22548, 22590, 22595, and 22600). Patients with fusion codes were excluded from the decompression group, which included foraminotomies as well.

Patient demographic information, including age, sex, ethnicity, and medical comorbidities, was obtained in addition to preoperative laboratory values, transfusions, operative characteristics, and data on length of stay. The incidence and timing of 30-day postoperative SSI, both deep and superficial, were determined using established criteria from the ACS NSQIP database for each of the procedural categories. Superficial SSI is defined in ACS NSQIP as an infection involving only the skin or subcutaneous tissue of the incision. This includes diagnoses made by the surgeon or attending physician and must have some signs or symptoms of infection present, such as pain, induration, erythema, or drainage. Stitch abscesses and burn wounds are excluded from the diagnosis as were infections meeting the criteria for deep SSI. Deep SSI describes an infection involving the deep soft tissues extended to the fascia and muscle layers. Infections that involve both the deep and superficial spaces are considered deep SSI. Detailed data on 30-day unplanned readmissions for the cohort were available from 2011 to 2012.

The ACS NSQIP database is subject to rigorous oversight, and unlike administrative databases the data are collected by trained abstracters based on review of clinical documentation. Although the potential for erroneous entry cannot be perfectly quantified, ACS NSQIP undergoes rigorous oversight and auditing to ensure reliability of results. An article by Shiloach et al. in *JACS* 2010 looked at the interrater