

Clinical Study

# Mortality, complication risk, and total charges after the treatment of epidural abscess

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Received 16 May 2014; revised 16 August 2014; accepted 10 September 2014

## Abstract

**BACKGROUND CONTEXT:** The treatment of epidural abscess is known to have a high rate of morbidity. Little is known regarding the risk factors for postoperative complications, mortality, and costs of care.

**PURPOSE:** To identify predictors of postsurgical morbidity and mortality, and total charges, associated with epidural abscess.

**STUDY DESIGN:** Nationwide Inpatient Sample (NIS) from the year 2006 to 2011.

**PATIENT SAMPLE:** All patients who had epidural abscess and underwent surgery in the NIS were included. Weighting was used to derive a representative sample.

**OUTCOME MEASURES:** They included in-hospital mortality, the development of complications, and total charges. A utility for failure to rescue (FTR) was also developed. Failure to rescue was defined as occurring when patients died after sustaining a complication.

**METHODS:** All patients identified as having epidural abscess and receiving surgical intervention were included. Risk factors were assessed in a bivariate fashion with those maintaining p values less than .2 included in the final multivariable models. Independent predictors of outcome were those that maintained significance after inclusion in multivariable regression. Predictors for total charges were evaluated using generalized linear modeling.

**RESULTS:** The population consisted of 30,274 individuals. The mean age was 57.4 years ( $\pm 14.7$  years). Sixty-three percent of the population was white and 27% was underinsured. Diabetes was present in 30% and 19% had some degree of paralysis. Three percent of patients died during hospitalization and 26% sustained one or more complications. Mean total charges were \$159,782 (range: \$4,008–\$3,373,410). Significant independent predictors for mortality included age, insurance status, liver disease, paralysis, and renal failure, with age (80 years or more) having the greatest effect (odds ratio 4.0 [95% confidence interval 2.0, 7.9]). Many of these same variables were found to be influential in the development of postoperative complications, major morbidity, and FTR. The number of medical comorbidities, underinsured status, paralysis, and renal failure were factors that influenced charges to an extent greater than 20% of the population mean.

**CONCLUSIONS:** Age, insurance status, paralysis, and medical comorbidities appear to be the predictors of morbidity, mortality, and expense of care. The results of this work highlight the characteristics that may be targeted to reduce charges and improve care for epidural abscess. Published by Elsevier Inc.

**Keywords:** Epidural abscess; Spinal infection; Mortality; Surgical morbidity; Failure to rescue; Hospital charges

FDA device/drug status: Not applicable.

Author disclosures: **AJS:** Grant: Robert Wood Johnson Foundation. (F, Paid directly to institution). **TCW:** Nothing to disclose.

The disclosure key can be found on the Table of Contents and at [www.TheSpineJournalOnline.com](http://www.TheSpineJournalOnline.com).

Disclaimers: Dr. AJS is a Robert Wood Johnson Foundation Clinical Scholar. The Robert Wood Johnson Foundation and the Department of Veterans Affairs were not directly involved in the study design, data

acquisition and interpretation, or manuscript preparation or review. Any opinions expressed herein do not necessarily reflect the opinions of the Robert Wood Johnson Foundation, the US government, or the Department of Veterans Affairs.

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## EVIDENCE & METHODS

### Context

The incidence of epidural abscess has increased markedly over the past two decades. Given that epidural abscess is associated with high rates of morbidity and mortality and treatment-related charges, identification of patient-specific predictors of poor outcomes following surgical intervention could be used to improve clinical care.

### Contribution

A nationally representative database was queried to identify 30,274 hospital discharges of surgical intervention for epidural abscess from 2006–2011. Greater than one in four patients had complications or major morbidity and 3% died. Multivariable modeling revealed that older age, paralysis, and renal failure predicted mortality, complications, major morbidity, and failure to rescue, and were associated with higher total charges. Liver disease also increased the odds of mortality; chronic lung disease increased the odds of complications and major morbidity; underinsurance and Medicare increased the odds of mortality and failure to rescue; and comorbidities were associated with much higher total charges.

### Implications

Although the database precluded analysis of many potentially modifiable risk factors for poor outcomes and high charges, and likely underestimated mortality risk, findings underscore high rates of morbidity and the importance of chronic liver disease, paralysis, and renal failure on outcomes from surgical intervention for epidural abscess, knowledge that may be used in pre- and postoperative care to inform expectations and clinical decision-making.

—*The Editors*

## Introduction

The condition now known as epidural abscess was first described by Morgagni in 1769 [1], although the term itself was not coined until 1932, when it was developed by Mixer and Smithwick [2]. Although surgical intervention for “epidural infections” was described by Delorme in 1892 and improved upon by Dandy, the infection rate for this condition in the preantibiotic era often exceeded 50% and was frequently only diagnosed during the autopsy [1,2]. With 20th century advances in antibiotic medications and surgical techniques, the survival rate improved, yet epidural abscess remained an infrequently diagnosed condition that threatened life and long-term function. However, new imaging modalities, an aging demographic and increased incidence of diabetes, intravenous drug

abuse, and immunocompromise have culminated in a near doubling of the rate of epidural abscess over the last 20 years [1,3,4].

Even in recent years, studies have reported that the mortality rate after diagnosis of epidural abscess lies in the range of 10% to 20% [1,3–6], and the incidence of permanent neurologic deficit has been documented to be as high as 30% to 50% [1,3–5,7]. Although several small series and case-control studies are available [4–13], and a number of works have sought to develop prognostic algorithms capable of informing treatment [3,5,13], much regarding epidural abscess remains unknown. Most previous studies have focused on the impact of surgical or medical interventions on survival or short-term neurologic recovery, but few have considered postoperative complications and the costs of hospital care in patients with epidural abscess. Furthermore, because of limitations due to sample size and selection bias, most prior works have been unable to identify factors predictive of inferior outcomes in the setting of epidural abscess or control for important confounders such as race, socioeconomic status, and patient clustering at the surgeon or hospital level.

With this analysis, we intended to provide evidence for the prediction of multiple measures of morbidity and mortality after surgical intervention in the setting of epidural abscess, as well as hospital charges associated with care. This investigation was performed using the Nationwide Inpatient Sample (occasionally referred to as the National Inpatient Sample, NIS) of the Healthcare Cost and Utilization Project, a validated data set developed through sampling of hospital visits from institutions across the country [14–16].

## Methods

Before the commencement of work, this study was approved as an exempt determination by the institutional review board of the University of Michigan. The data for this analysis were obtained through a query of the NIS data sets from the year 2006 to 2011, performed using the International Classification and Disease (9th revision) code for epidural abscess (324.1). The methodology of the NIS has been described in detail in other publications [14–16]. The data set is developed and maintained by the Healthcare Cost and Utilization Project and represents the largest American data set of inpatient care paid for by different insurance types [15]. Forty-six states are included in the NIS annual survey, which includes more than eight million annual discharges, obtained as a 20% stratified sample of hospital discharges [16]. Weighting of the data inverse to the probability of selection allows for extrapolation to the American population as a whole. The NIS has been used extensively in the past for studies in the field of spine surgery, including efforts directed at spinal cord tumors [15], spondylolisthesis [14], and cervical pathology [16].

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