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ORIGINAL ARTICLE

Prospective multicenter surveillance and risk factor analysis of deep surgical site infection after posterior thoracic and/or lumbar spinal surgery in adults

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Abstract
Background Surgical site infection is a serious and significant complication after spinal surgery and is associated with high morbidity rates, high healthcare costs and poor patient outcomes. Accurate identification of risk factors is essential for developing strategies to prevent devastating infections. The purpose of this study was to identify independent risk factors for surgical site infection among posterior thoracic and/or lumbar spinal surgery in adult patients using a prospective multicenter surveillance research method.
Methods From July 2010 to June 2012, we performed a prospective surveillance study in adult patients who had developed surgical site infection after undergoing thoracic and/or lumbar posterior spinal surgery at 11 participating hospitals. Detailed preoperative and operative patient characteristics were prospectively recorded using a standardized data collection format. Surgical site infection was based on the definition established by the Centers for Disease Control and Prevention.
Results A total of 2,736 consecutive adult patients were enrolled, of which 24 (0.9%) developed postoperative deep surgical site infection. Multivariate regression analysis indicated four independent risk factors. Preoperative steroid therapy ($P = 0.001$), spinal trauma ($P = 0.048$) and gender (male) ($P = 0.02$) were statistically significant independent

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patient-related risk factors, whereas an operating time ≥3 h ($P < 0.001$) was a surgery-related independent risk factor.
Conclusion Preoperative steroid therapy, spinal trauma, male gender and an operating time ≥3 h were independent risk factors for deep surgical site infection after thoracic and/or lumbar spinal surgery in adult patients. Identification of these risk factors can be used to develop protocols aimed at decreasing the risk of surgical site infection.

Introduction

Surgical site infection (SSI) after spinal surgery is one of the most serious complications that occurs in 0.7–12% of patients and can lead to high morbidity, mortality and increased healthcare costs [1, 2]. In this regard, various risk factors for SSI have been investigated to prevent this devastating complication. Risk factors were separated into two main categories: patient-related risk factors and surgery-related risk factors. Patient-related risk factors include advanced age [3], male gender [4], obesity [5, 6], previous spinal surgery [5], diabetes [5–7], malnutrition [3], smoking [5], spinal trauma [8, 9] and corticosteroid use [5, 10]. Surgery-related risk factors include spinal instrumentation [11], posterior surgical approach [2], tumor resection [2], fusion extending to the sacrum [12], increased estimated blood loss [4, 7] and prolonged operating time [4, 11, 13]. However, many of these studies were performed retrospectively at individual institutions, and they are limited by their relatively small sample size that restricts the power to perform a multivariate analysis.

High quality studies based on a prospective design and a large sample size are required to identify precise independent risk factors for SSI following spinal surgery. Multivariate analysis should also be performed to adjust for the occurrence of multiple risk factors within individual patients. In addition, standardized, hospital-based, multicenter surveillance methods utilizing a standard definition of SSI have been recommended to help determine risk factors and are considered useful in reducing infection rates [14–16].

Therefore, the purpose of this study was to identify independent risk factors for adult patients who develop deep SSI after posterior thoracic and/or lumbar spinal surgery using a prospective multicenter surveillance research method.

Materials and methods

Study design and selection criteria

This surveillance study for SSI following posterior thoracic and/or lumbar spinal surgery in adult patients was conducted in a prospective manner from July 1, 2010 to June 30, 2012 at 11 participating Japanese hospitals. Patients included in the study had undergone surgery by orthopedic service only. Each patient had undergone follow-up for a minimum of one year. Detailed preoperative patient characteristics and operative characteristics were recorded prospectively using a standardized data collection format. The institutional review board at participating hospitals approved the present study and informed consent was obtained from each patient. Patients who underwent surgery for the treatment of spinal infection were excluded from the present analysis. For homogeneity of the study group, we also excluded patients aged <20 years, those who underwent posterior instrumentation removal, vertebroplasty (percutaneous or open surgery), endoscopic surgery or single-stage anterior-posterior surgery.

Identification of SSI

A patient was considered to have an infection on the basis of the SSI definition put forth by the Centers for Disease Control and Prevention [17]. Superficial SSI was defined as an infection occurring within 30 days after the operation and involving the skin or subcutaneous tissue only. Deep SSI was defined as an infection occurring within 30 days after the operation if no implant was left in place or within one year if the implant was left in place, if the infection appeared to be operation-related and involved deep soft tissues. A deep SSI was further characterized by the presence of one or more of the following [17]: (1) purulent drainage from the deep incision; (2) a deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38 °C), localized pain, or tenderness, unless the site is culture-negative; (3) an abscess or other evidence of infection involving the deep incision that is found on direct examination, during reoperation or by a histopathologic or radiologic examination; and (4) diagnosis of a deep incisional SSI by a surgeon or attending physician.

The incidence of SSI was confirmed after double-checking by the attending surgeons and colleagues involved in this study at the participating hospitals. Microbiologic culture results of each patient with deep SSI were recorded and assembled. In cases in which open debridement was performed, microbiologic cultures were taken to confirm the presence of SSI and to determine further treatment.

Data collection

At each study hospital, the medical records of eligible adult patients who had undergone posterior thoracic and/or lumbar spinal procedures were prospectively collected utilizing standardized patient charts.