



# The Brazilian Journal of INFECTIOUS DISEASES

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## Original article

# Risk factors for surgical site infection following cesarean section in a Brazilian Women's Hospital: a case–control study



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## ARTICLE INFO

### Article history:

Received 31 May 2014

Accepted 30 September 2014

Available online 19 December 2014

### Keywords:

Surgical site infection

Cesarean section

Postpartum complications

## ABSTRACT

The present study evaluated patients with diagnosis of surgical site infection (SSI) following cesarean section and their controls to determinate risk factors and impact of antibiotic prophylaxis on this condition.

**Methods:** All cesareans performed from January 2009 to December 2012 were evaluated for SSI, based on criteria established by CDC/NHSN. Control patients were determined after inclusion of case patients. Medical records of case and control patients were reviewed and compared regarding sociodemographic and clinical characteristics.

**Results:** Our study demonstrated an association following univariate analysis between post-cesarean SSI and number of internal vaginal examinations, time of membrane rupture, emergency cesarean and improper use of antibiotic prophylaxis. This same situation did not repeat itself in multivariate analysis with adjustment for risk factors, especially with regard to antibiotic prophylaxis, considering the emergency cesarean factor only.

**Conclusion:** The authors of the present study not only question surgical antimicrobial prophylaxis use based on data presented here and in literature, but suggest that the prophylaxis is perhaps indicated primarily in selected groups of patients undergoing cesarean section. Further research with greater number of patients and evaluated risk factors are fundamental for better understanding of the causes and evolution of surgical site infection after cesarean delivery.

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<http://dx.doi.org/10.1016/j.bjid.2014.09.009>

1413-8670/© 2014 Published by Elsevier Editora Ltda.

## Introduction

Surgical site infection (SSI) following cesarean delivery is a major cause of morbidity and mortality, increasing both the duration of patient hospitalization and hospital costs.<sup>1-4</sup> SSI rates after cesarean range from 3% to 5%, varying according to the population being studied, the methods used to monitor and identify cases, and the use of appropriate antibiotic prophylaxis.<sup>5-7</sup>

Among the risk factors described for post-cesarean SSI are prolonged labor, premature rupture of membranes, excess vaginal manipulation, manual extraction of the placenta, and premature birth.<sup>8-11</sup> Comorbidities such as HIV, severe anemia and gestational diabetes are also associated with higher rates of puerperal infection, particularly surgical wound infection.<sup>12,13</sup>

The beneficial effect of antibiotic prophylaxis in reducing occurrences of infection associated with elective or emergency cesarean section is already well established.<sup>14,15</sup> In many institutions the antibiotic administration is performed after the umbilical cord has been clamped, justified by the neonatal impact of antimicrobial use.<sup>15,16</sup> Although antimicrobial prophylaxis reduces the risk of endometritis and incisional SSI when administered correctly, much has been discussed about its real impact due to the small number of studies and their limitations.<sup>15,17,18</sup>

The present study evaluated patients who underwent a cesarean section and presented with and without SSI after surgery with the aim of determining risk factors and assessing the impact of antibiotic prophylaxis on this condition.

## Subjects and methods

The present manuscript is a retrospective case-control observational study performed at the *Hospital Fêmima*, a hospital specialized in women's health located in the city of Porto Alegre, Brazil. The department of prevention and infection control of the *Hospital Fêmima* evaluated all cesarean deliveries performed from January 2009 to December 2012 for SSI (superficial incisional infection, deep incisional infection, and organ/space infection), based on criteria established by the Centers for Disease Control and Prevention's National Healthcare Safety Network (CDC/NHSN).<sup>19</sup>

The inclusion criteria for enrollment on the study as a case were pregnant patients who underwent cesarean section and having a diagnosis of SSI within 30 days of the obstetric procedure. The routine of the department of prevention and infection control is to evaluate all patients who had cesarean section up till day 30 from the procedure. Control patients were determined after the inclusion of case patients and adhered to the following inclusion criteria: similar age ( $\pm 2$  years), cesarean section, procedure performed on the same day as the case patient, no history of post-cesarean infectious complication up to the 13th day, taking into account the CDC/NHSN criteria.<sup>19</sup> Cases were excluded if a control patient meeting the inclusion requirements could not be identified or if patient records were not available.

The medical records of the case and control patients were reviewed with respect to sociodemographic characteristics, elective or emergency cesarean, comorbidities, duration of labor, use of appropriate antibiotic prophylaxis with 2g of intravenous cefazolin, duration of membrane rupture, number of internal vaginal examinations, and length of hospitalization. Appropriate prophylaxis was defined as the antibiotic administered 30-60 min before the procedure.<sup>20</sup>

Statistical analysis was performed using descriptive evaluation with the mean  $\pm$  standard deviation for continuous variables and frequency and percentage for categorical variables. The Student's t-test for independent samples was used for comparing the means between groups and a chi-square test to compare categorical variables. Those variables associated with the outcome in univariate analysis with a significance level below 0.2 were included in a multivariate logistic regression model. The odds ratios between factors and outcomes of their respective 95% confidence intervals were calculated. Also, stepwise backward multiple regression was performed to reveal the best set of predictors of SSI. Microsoft Excel software was used for the data storing and analyses were performed using SPSS for Windows (Statistical Package for Social Sciences), version 18 (IBM, Armonk, NY, USA).

The study was approved by the Research Ethics Committee of the *Hospital Conceição Group*, Porto Alegre, Brazil, on August 27th, 2012 under registration number 04189412.3.0000.5530.

## Results

A total of 8180 patients underwent cesarean at the *Hospital Fêmima* over the four-year study period, of which 118 (1.44%) were diagnosed with SSI after cesarean delivery. Ultimately, 79 case patients with an SSI and 79 control patients conforming to the inclusion criteria were identified. Thirty-nine patients (33%) were excluded as control patients could not be matched with them in accordance with the study design. Fifty-six patients (70.9%) of the 79 cases had a superficial incisional SSI, 10 (12.6%) had a deep incisional SSI, and 14 (17.7%) had an organ/space SSI.

The characteristics of the 79 case patients and 79 control patients are described in [Table 1](#). In addition to the inclusion criteria, the patients from both groups had comparatively similar demographic characteristics, such as age, race, gestational age, body mass index (BMI) and comorbidities. The factors that differentiated case from control patients in the univariate analysis were emergency cesarean, number of internal vaginal examinations, time of membrane rupture, duration of hospitalization, and inappropriate administration of antibiotic prophylaxis ([Table 1](#)).

Other factors such as ethnicity, education, number of pregnancies, preeclampsia, and illicit drugs use showed no significant difference between cases and controls. Manual extraction of the placenta was not reported in any cesarean delivery.

The moment when antibiotic prophylaxis was given was recorded for 72 (91%) cases and 70 (88%) controls. Antibiotic prophylaxis was not administered in 8 (11%) case patients compared to 3 (4.3%) control patients, with no statistical difference. Appropriate provision of the antimicrobial prior to

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