

ORIGINAL STUDY

Risk factors for wound infection after lower segment cesarean section

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ABSTRACT

The incidence of post caesarean wound infection and independent risk factors associated with wound infection were retrospectively studied at a tertiary care hospital.

A retrospective case controlled study of 107 patients with wound infection after lower segment caesarean section (LSCS) was undertaken between January 1998 and December 2007. The control group comprised of 340 patients selected randomly from among those who had LSCS during the study period with no wound infection. Chart reviews of patients with wound infection were identified using the definitions from the Centers for Disease Control and Prevention's National Nosocomial Infections Surveillance Systems. Comparisons for categorical variables were performed using the X^2 or Fisher exact test. Continuous variables were compared using the 2-tailed Student *t* test. $P < 0.05$ was considered significant. Logistic regression determined the independent risk factors.

The overall wound infection rate in the study was 4.2% among 2 541 lower transverse CS. The independent risk factors identified for wound infection were, obesity, duration of labor > 12 hours, and no antenatal care. Patients' age and parity, diabetes mellitus, premature rupture of membranes (PROM) > 8 hours and elective vs. emergency surgery was not found to be significantly associated with wound infection.

Conclusion: The independent risk factors could be incorporated into the policies for surveillance and prevention of wound infection. Antibiotic prophylaxis may be utilized in high risk patients such as PROM, obese patients and prolonged labor.

Keywords: wound infection, caesarean section, risk factors, post caesarean infection

INTRODUCTION

Wound infection after a caesarean section (CS) increases maternal morbidity, hospital stay and medical cost. The rate of wound infection after CS reported in the recent literature ranges from 3%–16% which depends on the surveillance methods used to identify infections, the patient population and the use of prophylactic antibiotics.^{1–4}

Although CS is the most commonly performed surgical procedure in Obstetric practice worldwide, the independent risk factors for postoperative CS wound infection have not been well documented in the literature. The purpose of this study was to identify the factors contributing to wound infection following CS performed in Saudi patients at a tertiary care hospital of Dammam University, Saudi Arabia.

PATIENTS AND METHODS

The study was carried out between January 1998 and December 2007 at King Fahad Hospital, Al Khobar which is the main referral centre in the region. It provides a complete range of facilities for high risk fetomaternal and neonatal care.

During the period of study there were 24 435 deliveries and 2541 lower segment caesarean sections (LSCS) giving an incidence of 10.4% of this mode of delivery in the hospital. A case control study of the clinically relevant independent risk factors for wound infection after caesarean was undertaken. All the hospital medical charts of the case patients with wound infection diagnosed during the post caesarean hospital stay and/or during an emergency department visit or inpatient rehospitalization within 30 days of the operation were reviewed. Criteria used to diagnose wound infection was as defined in the Centers for Disease Control and Prevention's National Nosocomial Infections Surveillance Systems.⁵ A control group of 340 patients without wound infection was randomly selected from the patients who underwent LSCS during the study period. Routine skin preparation was undertaken with 10% Providone iodine solution in all the patients. No drain was used postoperation in any of the patients.

Wound infection was diagnosed if any two of the following findings were present: wound cellulitis, purulent discharge from the wound, hematoma and/or positive culture of the wound swab. Wound swabs were cultured for both aerobic and anaerobic microorganisms. According to hospital policy, all CS patients remained hospitalized for 6–7 days until primary wound healing had occurred.

Demographic data for each of the patients included age, parity, body mass index (BMI) on admission, previous obstetric history including previous CS, booked or no

antenatal care, medical complications in pregnancy such as diabetes mellitus (DM), chronic hypertension and renal disease, SLE, gestational age at delivery, prolonged rupture of membranes (PROM), number of vaginal examinations in labor prior to CS, duration of labor, operating time and total blood loss during CS, and use of antibiotics were noted from each of the patient's medical record, delivery and operating room records, and hospital data base.

The epidemiological and obstetric variables were studied for the patient and control groups. Categorical variables in the two groups were compared by using X^2 or Fisher exact test. Continuous variables were compared using the Student 't' test. These tests were 2-tailed and $p \leq 0.05$ was considered statistically significant. Variables with $p < 0.20$ in the univariate analysis were evaluated by multivariate logistic regression noting the odds ratio (OR) and 95% confidence interval (CI) for independent risk factors. SPSS version 16.0 was used to perform the statistical analyses. Approval for this study was obtained from the hospital research and ethical committee.

RESULTS

Among the 2541 caesarean sections there were 107 (4.2%) instances of wound infection. A total of 2282 (89.8%) were primary CS and 259 (10.2%) repeat CS. Low transverse CS was most commonly performed through a pfannenstiel skin incision in both the groups of patients. Midline, subumbilical incision was performed in patients with a previous midline scar in 6 (5.6%) case patients and 11 (3.2%) of the control group. Age ranged from 20–44 years (mean 31 ± 3.4 years) and 18 patients were nulliparous in the patient group. The others were multiparous (from para 1–8). Age and parity were not significant factors for wound infection in the study.

The maternal variables associated with wound infection after LSCS are shown in Table 1. In the patient group, 23 (21.5%) patients were admitted in labor and seen for the first time during the pregnancy compared with 34 (10.0%) of the control group. Risk factors which were statistically significant in the two groups of patients were obesity ($BMI > 30 \text{ kg/m}^2$) and unbooked category of mothers. The numbers of patients with chorioamnionitis were small, although there was statistical significance of this variable. Of the 107 infected patients, 76 (71%) underwent emergency operation and 31 (29%) patients had elective operation which was not statistically significant. Table 2 shows the obstetric variables, where duration of labor (> 12 hours) was found to be a significant risk factor associated with wound infection. No significance was found of PROM and number of vaginal examinations with wound

Table 1. Maternal risk factors in the patient and control groups.

Factor	Patient group, n = 107 (%)	Control group, n = 340 (%)	OR (95% CI)	p Value
Unbooked patients	23 (21.5)	34 (10.0)	2.46 (1.37 – 4.408)	0.004*
BMI (> 30 kg/m ²)	27 (25.2)	46 (13.5)	2.15 (1.26 – 3.673)	0.007*
Diabetes mellitus	12 (11.2)	33 (9.7)	1.17 (0.57 – 2.34)	0.713
Failed induction of labor	17 (15.9)	42 (12.4)	1.34 (0.727 – 2.468)	0.3314
Chorioamnionitis	9 (8.4)	5 (1.5)	6.15 (2.015 – 18.786)	0.0013*
Type of CS				
Elective	31 (29.0)	104 (30.6)	1.0	–
Emergency	76 (71.0)	236 (69.4)	1.08 (0.6704–1.741)	0.93

*, significant; BMI, body mass index.

infection, although there was borderline association between prolonged operating time ≥ 1 hour and excessive blood loss during operation (> 1000 ml). Despite prophylactic antibiotic use in all the patients who had PROM for more than 8 hours, 10 case patients developed wound infection (Table 2). This was not found to be statistically significant.

Independent risk factors for wound infection that were identified by the multivariate analysis included patients

with no antenatal care, high BMI, duration of labor longer than 12 hours and operating time more than one hour (Table 3).

Of the 11 (10.3%) case patients with wound dehiscence, 4 (3.7%) had burst abdomen with evisceration that required major repair under general anesthesia. Two of these had midline, subumbilical and two patients had a pfannenstiell incision at CS. In the remaining 7 patients the wound dehiscence

Table 2. Obstetric variables studied in the patient and control groups.

Variable	Patient group, n = 107 (%)	Control group, n = 340 (%)	OR (95% CI)	p Value
Duration of labor				
No labor	41 (38.3)	152 (44.7)	1.0	–
< 6 hrs	12 (11.2)	66 (19.4)	0.67 (0.27 – 1.01)	0.272
6 – 12 hrs	14 (13.1)	48 (14.1)	1.08 (0.48 – 1.72)	0.824
> 12 hrs	40 (37.4)	74 (21.8)	2.00 (1.34 – 3.423)	0.008*
PROM				
None	46 (43.0)	165 (48.5)	1.0	–
< 8 hrs	51 (47.7)	156 (45.9)	1.074 (0.695 – 1.66)	0.824
> 8 hrs	10 (9.3)	19 (5.6)	0.742 (0.7836 – 3.871)	0.179
No. vaginal exams				
0	21 (19.6)	84 (24.7)	1.0	–
≤ 4	68 (53.6)	214 (62.9)	1.026 (0.654 – 1.611)	0.788
≥ 5	18 (16.8)	42 (12.4)	1.34 (0.727 – 2.468)	0.255
Operation time				
< 1 hr	71 (66.4)	256 (75.3)	1.0	–
> 1 hr	36 (33.6)	84 (24.7)	1.54 (0.965 – 2.47)	0.079
Blood loss at CS				
> 1000 ml	18 (16.8)	35 (10.3)	1.76 (0.95 – 3.26)	0.0854

*, significant.

Table 3. Multivariate analyses of risk factors for wound infection following lower segment cesarean section.

Risk factor	OR* (95% CI)	p Value
Unbooked patients	9.4 (3.46 – 22.38)	<0.001 ⁺
BMI at admission (> 30 kg/m ²)	2.1 (1.72 – 2.15)	0.005 ⁺
PROM > 8 hrs	0.3 (0.2 – 1.65)	0.241
Vaginal exam > 4	0.736 (0.12 – 4.54)	0.741
Duration of labor > 12 hours	3.2 (1.6 – 5.44)	0.003 ⁺
Operating time > 1 hour	2.16 (1.42 – 4.35)	0.016 ⁺
Blood loss > 1000 ml	0.5 (0.23 – 2.16)	0.318

*, adjusted odds ratio; BMI, Body mass index; +, significant.

(pfannenstiel) was resutured under local analgesia). Mean postoperative hospital stay was 6 days in the control group and 10 days in the case patients.

Of the 107 wound swabs cultured 8 (7.5%) cases showed no bacterial growth. Staph aureus was the commonest micro-organism found in 50.4% patients either alone or combined with other organisms (Table 4). Staph epidermidis was isolated in 21.5%, group B streptococcus (GBS) in 24% and E.coli in 15.4% patients. In 44 (41.1%) cases there was a mixed growth of organisms. There were 7 cases with anaerobic isolates. Blood culture was performed in 21 patients and 4 of them were positive (GBS – 2, E. coli – 2).

DISCUSSION

The incidence of wound infection after CS ranges widely due to a variety of risk factors present in different patient populations. The mean rate of infection after CS for hospitals in the USA was reported to be 3.15%.⁵ A review of the literature revealed much higher rates of wound infection after CS such as 8.5%,⁶ 16.2%,⁷ 19%,⁸ and 25.3%⁹ from other centers. The wound infection rate (4.2%) after LSCS found in this study correlates well with 3.7%,¹⁰ 4.5%,¹¹ and 5%,¹² found in recent studies reported in the literature.

Previous studies identified a number of risk factors associated with increased rate of wound infection like younger age group, obesity, DM, chorioamnionitis, unbooked patients, PROM, emergency delivery, longer operative time and absence of antibiotic prophylaxis.^{2,3,10,13} Age of the patient was not found to be a risk factor for wound infection, and there was no significant association between DM and wound infection in this study which conforms to some studies reported earlier in the literature.^{12,14} A possible explanation for this may be the strict antenatal and preoperative blood glucose control in the patients.^{12,14}

The wide variation of reported independent risk factors for wound infection may be due to the selection variability of potential risk factors for analysis.³ Factors that significantly increase the risk of wound infection such as obesity, lack of antenatal care and prolonged labor found in this study conform with previous reports.^{2,10} Increased operating time was also found to be an independent risk factor which could have resulted from difficulties encountered in patients with previous laparotomy or cesarean sections. Surgical expertise of the operators in the study was overall good and uniform in keeping with the protocol of a teaching institution.

Obesity is a well known risk factor for wound infection. The relative avascularity of adipose tissue, increase of wound area, and the poor penetration of antibiotics in adipose tissue attribute to this association of risk. A statistically significant association between higher BMI on admission and wound infection in the patient group (mean BMI of 35.3 kg/m²) compared with mean BMI of 31.2 kg/m² for the control ($p = 0.005$) was similar to other reports in the literature.^{9,11}

Some studies have shown significant reduction of endometritis and total postoperative maternal infectious

Table 4. Microbiological isolates from the wound swab.

Microorganism	Nos.	%
S. aureus	54	50.4
S. epidermidis	23	21.5
G-B Streptococcus	26	24.3
E. coli	18	16.8
Proteus mirabilis	8	7.5
Psuedomonas species	3	2.8
Klebsiella aerogenes	2	1.9
Anerobic streptococcus	7	6.5

√G-B S – group B streptococcus

febrile morbidity rate after CS by the use of prophylactic antibiotics,^{15–17} while others did not find such association.^{12,18} The Committee on Obstetric Practice of The American College of Obstetricians and Gynecologists (ACOG) has recently recommended antimicrobial prophylaxis for all cesarean deliveries unless the patient is already receiving appropriate antibiotics (eg, for chorioamnionitis) and that prophylaxis should be administered within 60 minutes of the start of the procedure. When this is not possible (eg, need for emergent delivery), prophylaxis should be administered as soon as possible.¹⁹ Prophylactic antibiotics were not routinely used in all CS patients in the present study, except in those with PROM for more than 8 hours. No statistically significant association was found in this study in patients with PROM > 8 hours (Table 3).

S. aureus was isolated in 50.5% wound swabs from the patient group in the study. Strict sterile technique and wound care in the operating room and in-patient ward will greatly reduce wound infection due to this organism. As a result of wound infection the mean hospital stay in the present study was 4 days longer in the patient group compared to the control.

Independent high risk factors for wound infection such as obesity, prolonged labor, and length of surgical procedure are to be systematically incorporated into approaches for the prevention and surveillance of postoperative wound infection. This in turn could help to identify high risk patients preoperatively, and in the development of strategies to reduce the incidence of wound infection.

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