**e-ISSN: 0975-1556, p-ISSN:2820-2643**

**Available online on www.ijpcr.com**

**International Journal of Pharmaceutical and Clinical Research 2024; 16(10); 409-415**

**Original Research Article**

# Factors and Common Bacterial Pathogens Associated with Post-Caesarean Wound Sepsis at MLBMC Jhansi

**Hema J. Shobhane[1], Mausam Shreshtha[2]**

[1]Professor & Head, Department of Obstetrics & Gynecology, M.L.B. Medical College, Jhansi UP, India
[2]PG Resident, Department of Obstetrics & Gynecology, M.L.B. Medical College, Jhansi UP, India

**Received: 25-07-2024 / Revised: 23-08-2024 / Accepted: 26-09-2024**
**Corresponding Author: Dr. Mausam Shreshtha**
**Conflict of interest: Nil**

**Abstract:**
**Introduction:** Cesarean section is the single most important risk factor for postpartum infection. Where the rest of the world shows increasing trends, the cesarean section rates are low in Norway and risk factors for infection after cesarean section may differ in high and low cesarean section settings. The goal of this study was to examine risk factors for surgical site infection after cesarean delivery.
**Material and Methods:** A prospective study conducted in the department of obstetrics & gynecology of M.L.B. Medical College, Jhansi during the period of 1st January 2023 and 31st December 2023. All women who are developing any form of wound infection within 30 days from the date of caesarean section using the criteria for CDC5 1991. . Surgical wound was inspected at the time of first dressing and daily thereafter till discharge of the patient and then all patients were followed up in postnatal clinic till the 30th postoperative day. Main outcome measures were anticipated risk factors for surgical site infection.
**Results:** During study period there were a total of 3257 births in the tertiary care hospital, out of them 1498 (45.99%) had cesarean section. One hundred sixteen cases of surgical site infections were identified. The incidence rate of surgical site infection among cesarean section was calculated to be 7.74%. Most of the cases were diagnosed within 10th postoperative day. In this study common bacterial pathogen was Staphylococcus aureus found in 22 (18.97%) cases followed by E. coli in 17.24% of cases.
**Conclusion:** Risk factors like BMI, comorbidity, emergency caesarian delivery, Duration of membrane rupture, blood loss during surgery significantly associated with the development of SSI. Predominantly staphylococcus aureus, E. coli and Staphylococcus spp was isolated from SSI. Early identification of micro-organisms might decrease maternal morbidity & mortality.
**Keywords:** Cesarean, Delivery, Infections, Postpartum Hemorrhage.



## Introduction

One of the most common procedures in the field of obstetrics carried out in a hospital is the cesarean section. Worldwide, the number of cesarean sections (CS), one of the most common major procedures, is rising [1]. The percentage of cesarean sections performed has increased to 41% during the past thirteen years [2]. An infection that affects the incision or deep tissues at the surgical site and manifests within 30 days following surgery is referred to as a surgical site infection (SSI) [3,4].

SSI is a frequent post-CS complication that affects 2–16% of women [1,3]. A significant contributing factor to extended hospital stays, high hospital costs, and elevated morbidity and mortality is CS wound infection (CS-surgical site infection, or CS-SSI)[5-7]. In order to reduce the incidence of SSI in women undergoing CS, prophylactic antibiotics are advised [8]. In order to determine the best ways to lower the risk of surgical site infection (SSI), it is crucial to identify the risk variables linked to the incidence of surgical site infection following cesarean delivery. Three categories can be used to group risk variables. 1) Host-related factors, 2) pregnancy and intrapartum-related factors, and 3) surgical factors [9].

Maternal age, obesity, living in a rural region, gestational diabetes mellitus, prior cesarean section history, recurrent miscarriages, and preoperative maternal diseases are among the host-related factors [9,10,11]. While pregnancy-related factors include the use of epidural anesthetics, internal fetal monitoring, multiple pregnancies, hypertension, gestational diabetes, premature rupture of the membranes, increased number of internal examinations, prolonged parturition of the trial prior to surgery, and chorioamnionitis [11]. On the other hand, factors associated with cesarean sections specifically include emergency room visits, the lack of antibacterial prophylaxis, occurrences of uterine rupture, cesarean sections combined with hysterectomy, the requirement for transfusion, and lengthier operating times. Up to two times the risk of SSI is linked to operating for longer than one hour [12]. Additionally, post-cesarean wound infection has been linked to a 3% maternal mortality incidence, particularly in medical facilities lacking the necessary resources to perform safe cesarean sections or manage post-cesarean complications [13].

Postoperative surgical site infections (SSIs) rank third among nosocomial infections in hospitalized patients and are among the most common issues for patients undergoing cesarean sections [14].

A prevalent isolate in surgical site infections (SSI), Staphylococcus aureus is responsible for 20–30% of SSI that occur in hospitals [15]. Pseudomonas aeruginosa, Escherichia coli, gram-negative bacilli, and Klebsiella are among the other species that are frequently identified from SSIs [16, 17]. Prolonged wound healing, wound dehiscence, discomfort, ruptured abdomen, necrotizing fasciitis, and pelvic abscess are among the complications associated with SSIs. Infections at the surgical site also negatively impact one's physical, mental, social, and financial well-being.

Since our center has not conducted any research on cesarean sections, we are unable to identify the common pathogens causing illness following caesarean procedures in our department. An investigation of the risk factors and identification of common organisms causing infection was conducted in an effort to lower the rate of surgical site infection in patients undergoing caesarean sections.

**Material and Methods**

A prospective study carried out between January 1, 2023, and December 31, 2023, in the obstetrics and gynecology department of M.L.B. Medical College, Jhansi. Using the criteria for CDC5 1991[18] (The Center for Disease Control and Prevention), all women who are experiencing any kind of wound infection within 30 days from the date of the cesarean section were chosen for the study.

The study excluded women who had wound infections 30 days after surgery or who had undergone first-trimester procedures, such as lapratomies for ectopic or molar pregnancies. The individuals who have been identified are under constant observation for the emergence of indications of sepsis in the wound, including induration, edema, and gapping. An ethical committee approval was also acquired prior to the investigation.

Every patient who was enrolled in the trial gave their informed permission. Not a single patient objected to participating in the research. The surgical site was examined on the first dressing change and every day after that until the patient was discharged. All patients were then monitored in the postnatal clinic until the 30th postoperative day, at which point their informed permission was promptly obtained from each participant. Using a thorough questionnaire, information on each patient's demographics and other risk factors was gathered.

Patient demographics include age, BMI, gestational age, type and duration of anesthesia, length of operation, birth method, length of hospital stay, number of caesarean sections, possible risk factors, surgical findings, and blood loss quantity. Pus sample taken from the wound was sent for sensitivity testing and culture; positive results were also noted.

**Statistical Analysis**

Data was kept organized on an Excel spreadsheet and entered onto a pre-made study questionnaire. The mean and standard deviation of quantitative variables were calculated and evaluated for approximation to a normal distribution. Frequency (%) was used to summarize categorical variables. Using Pearson's chi-square test, the relationship between each possible risk factor and infection as the study's outcome was evaluated. Using Student's t-test, quantifiable data was compared. The statistical program SPSS version 26.0 was utilized to analyze the data. Since all conclusions in this study were drawn at the 5% level of significance, a P value of less than 0.05 is regarded as statistically significant.

**Results**

Of the 3257 deliveries that took place in the tertiary care hospital during the study period, 1498 (45.99%) required a cesarean section. A total of 116 instances of surgical site infections were found. 7.74% was determined to be the incidence rate of surgical site infection among cesarean sections. After a cesarean section, an equal number of controls who did not get SSI were taken. Table 1 shows that the majority of SSI cases, or 110/116 (94.83%), were of the superficial form, with the remaining 6 (5.17) being of the deep incisional type. The majority of cases had diagnoses by the tenth postoperative day. The 27th day following surgery was the maximum day of diagnosis.

**Table 1: Type of infection**

| Type if infection | No. | % |
|---|---|---|
| Superficial | 110 | 94.83 |
| Deep | 6 | 5.17 |

Table 2 demonstrates that the majority of cases and controls were younger than 26 to 29 years old, with mean ages of 26.89±4.34 and 24.56±4.64 years, respectively, for the cases and controls.

In both the group cases and the control, the majority of the women (54.31% and 50.86%, respectively) were from rural areas; this difference is statistically not significant. Overweight and obesity were more common in cases than in controls. At the time of wound inspection, it was discovered that, among SSI cases, 18.97%, 53.45%, 27.59%, and 33% (n = 26) had normal weights, overweight's, and obesity's, respectively, whereas, among controls, the corresponding figures were 64.66%, 22.41%, and 12.93%. With a p-value of less than 0.0001, the statistical difference was highly significant. Primipara women made up the majority of the cases and controls groups. In the SSI group, 70.69% of the women were primipara, but in the control group, or non-SSI cases, the percentage was 60.34%. However, there was no statistically significant difference between the two groups.

In the control group, 81.07% of women were comorbid and 12.93% were not, compared to 58.62% of SSI group members who were comorbid and 41.38% who were not.

**Table 2: Demographic profile of cases and control**

| Characteristics of cases | Cases (n-=116) | | Control (n=116) | | P value |
|---|---|---|---|---|---|
| | No. | % | No. | % | |
| Age | | | | | 0 .0647 |
| <20 | 9 | 7.75 | 16 | 13.79 | |
| 21-25 | 32 | 27.59 | 45 | 38.80 | |
| 26-30 | 55 | 47.41 | 40 | 34.48 | |
| >30 | 20 | 17.24 | 15 | 12.93 | |
| Place of residence | | | | | 0.6933 |
| Rural | 63 | 54.31 | 59 | 50.86 | |
| Urban | 53 | 45.69 | 57 | 49.14 | |
| BMI | | | | | < 0.0001* |
| Normal | 22 | 18.97 | 75 | 64.66 | |
| Overweight | 62 | 53.45 | 26 | 22.41 | |
| Obesity | 32 | 27.59 | 15 | 12.93 | |
| Parity | | | | | 0.1284 |
| Primipara | 82 | 70.69 | 70 | 60.34 | |
| Multipara | 34 | 29.31 | 46 | 39.66 | |
| Comorbidity | | | | | 0.0001** |
| Yes | 68 | 58.62 | 101 | 87.07 | |
| No | 48 | 41.38 | 15 | 12.93 | |

Table 3 shows that the SSI group (cases) had an emergency indication of cesarean section at 89.66%, compared to 79.31% in the control group and elective surgery. 10.34% in the SSI group and 20.69% in the control group, with a statistically significant difference at p = 0.0450. Artificial membrane rupture was performed more frequently in the SSI group (58.62% vs. 47.41% in the control group), with a non-significant p value indicating that the difference was not statistically significant.

The SSI group experienced mean membrane rupture at a higher rate than the non-SSI group; the duration was classified as more than 18 hours or less than or equal to 18 hours, respectively. The number of women in the case group who experienced a membrane rupture lasting more than 18 hours was higher than that of the non-SSI group (5.17%), and this difference was highly statistically significant (p = 0.0020). Within the SSI group, 31.03% of women developed SSI with a surgery time of less than 60 minutes, while 68.97% of women developed SSI with a surgery duration of more than 60 minutes. Within the control group, 55.17% of women underwent surgery in less than 60 minutes, whereas 44.83% of women underwent surgery in more than 60 minutes. With a p value of 0.0003, the outcome for both the patients and the control group was extremely statistically significant. In 73.28% of the women in the SSI group and 89.65% of the non-SSI group, there was a total blood loss of up to 200 ml.

Results showed that 26.72% of women in the SSI group and 10.34% of women in the control group (non-SSI) had blood losses greater than 200 milliliters. With a p-value of 0.0021, the outcome was highly statistically significant.

**Table 3: Procedure related characteristics of cases and control**

| Procedure related Characteristics | Cases (n-=116) | | Control (n=116) | | P value |
|---|---|---|---|---|---|
| | No. | % | No. | % | |
| Type of CS | | | | | 0.0450* |
| Emergency | 104 | 89.66 | 92 | 79.31 | |
| Elective | 12 | 10.34 | 24 | 20.69 | |
| Membrane rupture | | | | | 0.1142 |
| Artificial | 68 | 58.62 | 55 | 47.41 | |
| Spontaneous | 48 | 41.38 | 61 | 52.59 | |
| Duration of membrane rupture | | | | | 0.0020** |
| <18 hrs | 94 | 81.03 | 110 | 94.83 | |
| >18 hrs | 22 | 18.97 | 6 | 5.17 | |
| Duration of surgery | | | | | 0.0003** |
| <60 min | 36 | 31.03 | 64 | 55.17 | |
| >60 min | 80 | 68.97 | 52 | 44.83 | |
| Blood loss (ml) | | | | | 0.0021** |
| <200 | 85 | 73.28 | 104 | 89.65 | |
| >200 | 31 | 26.72 | 12 | 10.34 | |

*** Significant; ** highly significant**

Staphylococcus aureus was the most frequently occurring bacterial pathogen in this investigation, occurring in 22 cases (18.97%), and E. coli in 17.24% of cases. Pseudomonas aeruginosa was discovered in 12.93% of patients, whereas Staphylococcus species were observed in 15.52% of cases. 18 cases (15.52%) out of 116 surgical site infection cases had klebsiella pneumonia. In 22 cases (18.97%), another bacterial pathogen was discovered. (Table 4).

**Table 4: Common bacterial isolates from post-caesarean surgical site infection**

| Pathogen | No. of cases | Percentage |
|---|---|---|
| Pseudomonas aeruginosa | 15 | 12.93 |
| Staphylococcus aureus | 22 | 18.97 |
| E coli | 20 | 17.24 |
| Pseudomonas sp. | 5 | 4.31 |
| Staphylococcus spp | 18 | 15.52 |
| Klebsiella pneumonia | 14 | 12.07 |
| Others | 22 | 18.97 |

## Discussion

After a cesarean section, surgical site infections are a leading cause of morbidity and mortality, lengthening hospital stays for patients and driving up healthcare expenses. SSI is rising along with the global trend of more cesarean deliveries. The majority of surgical site infections result from bacteria from the patient's own body getting into an incision during surgery [19]. After surgery, it is less frequent for an infection to arise from germs other than those found on the patient's body [20]. The majority of surgical site infections can be avoided [21]. Pre-, intra-, and postoperative steps can all be done to lower the risk of infection [22–23]. The frequency and complications of wound infection are decreased when patients with established risk factors receive proper postoperative care [24].

The study's 7.74% SSI incidence rate is lower than that of comparable studies conducted in Nigeria, After a cesarean section, the SSI rate was 9.1%, according to Jido et al. [25]. The incidence rate of SSI was reported to be 12.6% in a study by Shrestha S et al. [26]. 8.9% was the SSI incidence rate reported by Opøien et al. [27]. While Astha Regmi et al [281] reported incidence of SSI after cesarean section of 8.54%.

The research's case and control groups have mean ages of 26.89±4.34 and 24.56±4.64 years, respectively. These results are comparable to those of a study conducted by Regmi et al. [28], which found that the case and control groups' mean ages were 24:81 ± 5:08 years and 26:88 ± 4:38 years, respectively. According to a study by Jain AK et al. [29], the age range of 23–27 years old accounted for the majority of cases (41.7%). The highest percentage of SSI was observed in older adults

(>37 years old). This indicates that compared to the non-SSI categories, women with SSI were often older. The chance of medical issues during pregnancy also rises with age [30].

In this study, the majority of cases (54.31%) were from rural regions, and 70.69% of the women in the SSI group were primipara. Similar findings were also made by another study, which revealed that SSI was more common in rural areas and that 81.7% of the patients were from those locations [31]. SSI was shown to be higher in primipara women than in multiparous women [31].

When the wounds in SSI instances were examined, it was discovered that, respectively, the patients were 18.97%, 53.45%, 27.59%, and 33% of normal weight, overweight, and obese. This study also found that women who are obese are more likely than those who are underweight or of normal weight to have social security illness (SSI). Reduced prophylactic antibiotic penetration into the adipose tissue, an increase in the area of the surgical wound, and an increase in relatively avascular adipose tissue are the reasons why obesity is a risk factor for SSI [31].

In this study, 41.38% of the women in the SSI group did not have comorbid conditions, while 58.62% of the women did. Individuals who had a history of diabetes mellitus or malnourishment were at a higher risk of contracting an infection. SSI has been linked to co-morbid conditions such as hypertension, pregnancy-induced or pre-existing conditions, and other conditions [32].

According to this study, the SSI group (cases) had an emergency indication of a cesarean section more frequently (89.66%) than the elective group (1034%). This discrepancy could most likely be attributed to the fact that the emergency procedures had less time available for preoperative planning. According to Satyanarayan et al. [33], wound infection rates in emergency computerized surgery (CS) can reach 25.2%, while in elective cases, the rate is 7.6%. In contrast to 92 (43.60%) of elective instances, 119 (56.40%) of the study's participants experienced wound infections following emergency procedures Dhar H et al., [34].

Artificial rupture of the membrane was performed more frequently in the SSI group—58.62% against 47.41% in the control group, respectively. There hasn't been any research that contrasts artificial and spontaneous rupture.

The SSI group experienced mean duration of membrane rupture more frequently than the non-SSI group. In the study by Dhar H et al. [34], prolonged labor was noted in 20 (9.47%) cases of wound infections following a full trial of vaginal delivery; Ezechi et al. [35] also reported comparable results.

In the SSI group, 68.97% of women developed SSI after surgery lasting more than 60 minutes, while 31.03% of women developed SSI after surgery lasting less than 60 minutes. These findings are consistent with those of Shapiro et al., who found that the infection rate nearly doubles for every hour of surgery [36]. However, only 18.0% of SSI cases that were followed by cesarean sections and required more than 60 minutes of surgery were found in the Devi SL and Durge DVK research [37].

It has been demonstrated that the volume of blood lost during a cesarean section is directly correlated with the risk of postpartum infection [38–39]. Every 100 milliliters of blood lost elevated the risk of surgical site infection by thirty percent. High blood loss is typically linked to more sutures, prolonged retraction and manipulation causing tissue injury, and inadequate bleeding control [40]. Similar to the Amenu D et al investigation, there were 22 cases of blood loss above 1000 milliliters [41].

Staphylococcus aureus was the most frequently occurring bacterial pathogen in this study, accounting for 18.97% of cases, followed by E. coli with 17.24% of cases. Pseudomonas aeruginosa was discovered in 12.93% of patients, whereas Staphylococcus species were observed in 15.52% of cases. 18 cases (15.52%) out of 116 surgical site infection cases had klebsiella pneumonia. In 22 cases (18.97%), another bacterial pathogen was discovered. The most frequent bacteria detected in surgical site infection cultures were Staphylococcus aureus (16,5%), Escherichia coli (9,4%), Enterococcus faecalis (9,4%), and others (21,2%), according to a study by Harzif AK et al. [42].

In the investigation conducted by Jain AS et al., the most common isolates discovered were Klebsiella pneumoniae and Staphylococcus aureus [31]. Comparable research revealed that staphylococcus aureus was a prevalent bacterial pathogen responsible for superficial infections (SSI) and particularly for SSI in post-caesarean patients [43–44].

## Conclusion

Risk factors for the development of SSI include blood loss during surgery, duration of membrane rupture, emergency caesarian delivery, BMI, and comorbidities. From SSI, Staphylococcus aureus, E. coli, and other staphylococcus species were primarily isolated. Reducing SSI rates may require early evaluation of underlying risk factors and their modification. The management of these situations may benefit from early detection of microorganisms and their susceptibility pattern, which would lessen the financial burden of patient and maternal morbidity & mortality.

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