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Original Research Article

Analysis of the incidence and risk factors for surgical site infection following caesarean section in a tertiary healthcare centre

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ABSTRACT

Background: Caesarean section (CS) is one of the widely performed surgical modality that can save the lives of women and newborns during certain obstetric complications. However, cesarean delivery is associated with morbidity, including surgical site infections (SSI). So, the present study was done to evaluate the incidence and risk factor for SSI during caesarean delivery
Methods: A retrospective study was conducted on 588 pregnant women who had CS delivery. Out of these 50 cases had SSI (SSI group) and the 538 had no SSI (non-SSI group). The risk factors such as parity, gestational age, BMI and cause of admission, previous cesarean sections, and maternal complications such as hypertension, diabetes, hypothyroidism, and anemia were evaluated. In addition, the findings of any cultures taken were also documented.
Results: The SSI incidence was found to be 8.5%. The BMI ≥25 kg/m² showed higher incidence of SSI (p=0.032), and anemia showed a strong correlation with increased SSI rates (p<0.0001). The SSI group showed higher incidence of BMI (56% vs 40.3%) and anemia (38% vs 11.7%) as that of the non-SSI group. The most common organism was *Klebsiella* sp. in 25 (50%) of the patients.
Conclusions: Thus, identifying the SSI risk factors can aid doctors in identifying women with distinct risk factor profiles. Post cesarean, women with anemia and obesity must be carefully monitored to reduce the complication and child wellbeing.

Keywords: Caesarean delivery, SSI, Anemia, Obesity, *Klebsiella*

INTRODUCTION

Surgical site infections (SSIs) are a clinical event which occurs close to the surgical incision within 30 days after the intervention or within 90 days if any prosthetic materials are used during the procedure. SSIs are associated with the delayed post-operative recovery, morbidity and mortality, economic burden and antibiotic resistance.[1] In the recent decades, the incidence lower segment CS (LSCS) in obstetrics has significantly risen, with the aim of enhancing the outcome of both mothers and neonates.[2] The infection rates are higher, around 5-20 times for caesarean delivery, while in the vaginal delivery the risk is lower. In healthcare associated infection, SSI ranks seconds as a main risk factor followed by urinary tract infection.[3] The SSI incidence post CS vary between 3% and 15%, depending on factors such as the surveillance methods and intensity employed to detect infections, the characteristics of the patients, and the administration of antibiotic.[4,5] As the rate of cesarean deliveries continues to increase, it is anticipated that there will also be a rise in the number of women experiencing postpartum infection. SSI after a CS leads to a slower recovery, longer hospital stays, potential need for readmission, increased use of antibiotics, and various negative health outcomes for the patient. This places a greater economic burden and also affects the physical, psychological wellbeing of the mothers, as well as the newborns.[6]

Wide range of risk factors involved in the cause of SSI after cesarean section delivery. Among these, some preoperative problems include hypertension, gestational

diabetes, high BMI and parity, extended labour period, PROM, chorioamnionitis and less number antenatal care visits.[7,8] Furthermore, some variables that occurred during the surgery were strongly linked to the development of SSI. These conditions include a lengthy operative time, a vertical skin incision, and interrupted sutures. [9] Increased blood loss was identified as one of the SSI risk factor after cesarean deliveries.[10] The present study was undertaken with the purpose of investigating the occurrence and risk variables associated with SSI in cesarean section procedures, as well as the influence of SSI on perinatal outcomes.

METHODS

A retrospective study observational study was conducted at Al-Ameen medical college Bijapur, Karnataka from October 2022-October2023. Our tertiary centre receives referrals from nearby taluk, district hospital in Bijapur.

The present study involved 588 cesarean sections out of a total of around 3500 births. Out of these, 50 patients who had undergone a cesarean section and subsequently developed SSI following the procedure (SSI group). Approximately 538 records of cases that underwent a cesarean section without developing a SSI were randomly selected and used as a control group. The study included all pregnant women delivered through Caesarean delivery and acquired SSI within 30 days following the procedure, as defined by the centers for disease control and prevention (CDC).

Inclusion criteria

All patients who underwent cesarean section and attending the OPD for follow-up within 30 days, post-delivery and patients who have given the consent to participate were included in the study.

Exclusion criteria

Women experiencing wound infection more than 30 days after surgery, as defined by the CDC5 criteria.

Patients who had underwent CS at other facilities and patients in need of obstetric hysterectomy or any other surgical intervention due to complications were also excluded from the study.

Data collection

A standard Proforma was used to collect the patient information. The demographics details like age, socio economic status, BMI, parity, and comorbidities like GDM and hypertension were recorded. Additionally, pre-operative details like ROM duration, caesarean delivery indications, whether spontaneous or induced and procedure details including emergency or elective. The intraoperative details consist of the duration of the procedure and any complications that occur throughout the treatment. Pregnant women who underwent cesarean section were closely observed for any indications or SSI symptoms at immediate post-operative to till hospital discharge and within 30 days follow-up at outpatient department. The necessary data was collected using a pre-designed form that aligned with the study's objectives, after obtaining informed consent from the participants. The occurrence of SSI was monitored both during the patient's hospital stay and after discharge, regardless of whether they were readmitted. The number of days it took for an SSI to develop and the findings of any cultures taken were all documented.

The patient related characteristics such as maternal age, education, residence, socioeconomic position, and BMI were evaluated. The Kuppuswamy socioeconomic status scale was used to evaluate the socio-economic status. The BMI categories were as follows, BMI, 23 to 27.5 was considered as overweight and BMI >27.5 was considered as obese. The other clinical variables include parity, gestational age, and cause of admission, previous cesarean sections, and maternal complications such as hypertension, diabetes, hypothyroidism, and anemia. Other variables include evaluation of ruptured or non-ruptured membranes, induced or spontaneous delivery, and details of details such as indication for the procedure, emergency or elective nature, type of anesthesia cesarean such as elective or emergency, anesthesia type and skin incision variation used. The occurrence of intra-operative complications, specifically bleeding and adhesion, was observed and post-operative anemia was also noted.

Statistical analysis

The data were shown as mean±SD and frequency (%). The unpaired student's t test was used to compare the continuous variables and Chi square analysis was done for categorical variables. A $p<0.05$ was considered as significant.

RESULTS

The demographics characteristics of the pregnant women who had undergone cesarean section delivery was shown Table 1. The SSI incidence was 8.5%. The mean age of the patients was 25.19±4.10 years and the mean duration of surgery was 60.25±15.14 minutes. Anemia was present in 13.9% of the patients, PROM in 20.1%, hypertensive disorders of pregnancy (HDP) in 29.9%, previous LSCS in 38.1% and emergency LSCS in 38.1% of the patients respectively.

The comparison of demographics and clinical parameters between SSI and Non-SSI pregnant women who underwent cesarean section was shown in Table 2. According to the data presented in the above table it is evident that certain factors displayed significant association with the SSI incidence following cesarean section. Among the studied variables, BMI and anemia were found to have a significant association with SSI.

Specifically, a BMI of ≥25 kg/m² showed significant association with higher incidence of SSI (p=0.032), and anemia showed a strong correlation with increased SSI rates (p<0.0001). The SSI group showed higher SSI incidence as that of the non-SSI pregnant women (56% vs 40.3%). Likewise, the anemia incidence was significantly higher in the SSI as that of non-SSI group (38% vs 11.7%). Parity showed a near-significant trend, with multiparous women having higher incidence of SSI compared to primiparous women (p=0.051). In contrast, socioeconomic status, premature rupture of membranes (PROM), previous LSCS, emergency LSCS, multiple vaginal examinations or prolonged labor, and HDP did not demonstrate significant associations with SSI. These findings highlight importance of monitoring and managing BMI and anemia in patients undergoing CS to mitigate risk of developing SSI.

Table 1: Demographics and clinical characteristics of the study participants, (n=558).

Parameters	Frequency	Percentage (%)
Parity		
Multi	287	48.8
Primi	301	51.2
Socio economic status		
Lower	210	35.7
Lower middle class	187	31.8
Upper lower class	72	12.2
Upper middle class	119	20.2
BMI (>25 kg/m^2)		
No	343	58.3
Yes	245	41.7
Anemia		
No	506	86.1
Yes	82	13.9
PROM		
No	470	79.9
Yes	118	20.1
Previous LSCS		
No	329	56
Yes	259	44
Emergency LSCS		
No	364	61.9
Yes	224	38.1
Multiple vaginal examinations/prolonged labour		
No	409	69.6
Yes	179	30.4
HDP		
No	412	70.1
Yes	176	29.9
SSI		
No	538	91.5
Yes	50	8.5

Table 2: Comparison of demographics and clinical variables between SSI and non-SSI groups.

Variables	SSI, (n=50) (%)	Non-SSI, (n=538) (%)	P value
Parity			
Multi	31 (62)	256 (47.6)	0.05^{NS}
Primi	19 (38)	282 (52.4)	
Socio economic status			
Lower	18 (36)	192 (35.7)	1.00^{NS}
Lower middle class	16 (32)	171 (31.8)	
Upper lower class	6 (12)	66 (12.3)	
Upper middle class	10 (20)	109 (20.3)	
BMI (>25 kg/m^2)			
No	22 (44)	321 (59.7)	0.03*
Yes	28 (56)	217 (40.3)	

Continued.

Variables	SSI, (n=50) (%)	Non-SSI, (n=538) (%)	P value
Anemia			
No	31 (62)	475 (88.3)	<0.0001*
Yes	19 (38.0)	63 (11.7)	
PROM			
No	40 (80)	430 (79.9)	0.99 NS
Yes	10 (20)	101 (20.1)	
Previous LSCS			
No	28 (56)	301 (55.9)	0.99 NS
Yes	22 (44)	237 (44.1)	
Emergency LSCS			
No	31 (62)	333 (61.9)	0.98 NS
Yes	19 (38)	205 (38.1)	
Multiple vaginal examinations/prolonged labour			
No	35 (70)	374 (69.5)	0.94 NS
Yes	15 (30)	164 (30.5)	
HDP			
No	35 (70)	377 (70.1)	0.94NS
Yes	15 (30)	161 (29.9)	

*Denotes significant, p<0.05; NS-Non-significant.

In addition, there was no significant difference in the age between the SSI and non-SSI group (25.12±4.12 vs 25.25±4.08; p=0.82). Likewise, the duration of surgery was not statistically significant between the groups (60.60±15.64 vs 59.91±14.65; p=0.75) (Table 3).

Table 3: Comparison of age and duration of surgery among the groups.

Parameters	SSI, (n=50) (%)	Non-SSI, (n=538) (%)	P value
Age (in years)	25.12±4.12	25.25±4.08	0.82NS
Duration of surgery (mins)	60.60±15.64	59.91 ±14.65	0.75 NS

NS-Non-significant (p>0.05). Unpaired student t test.

The microbiological profile in the SSI patients was shown in Table 4. The most common organism was *Klebsiella* sp. in 25 (50%) of the patients, followed by *S. aureus* in 15 (30%), *E. coli* in 8 (16%) and *Pseudomonas* sp. in 2 (4%) of the patients respectively.

Table 4: Microbiological profile among the SSI patients.

Microbiological profile	SSI, (n=50) (%)
Klebsiella sp.	25 (50)
S. aureus	15 (30)
E. coli	8 (16)
Pseudomonas sp.	2 (4)

DISCUSSION

SSI is a frequently occurring adverse event after cesarean section, which affects the wellbeing of the mother and children and also provokes substantial morbidity and mortality. According to reports, the occurrence of SSI following cesarean section ranged from 3 to 15%.[4] Regrettably, there is a scarcity of data regarding the prevalence of SSI and its risk factor after caesarean delivery in the Indian sector. This study assessed the occurrence of SSI following cesarean sections, as well as the factors involved in the development and the strategies used to control them in a tertiary referral hospital.

In the present study, 588 pregnant women who had delivered through cesarean section were included in this study. Among these, anemia was present in 13.9% of the patients, PROM in 20.1%, HDP in 29.9%, previous LSCS in 38.1% and emergency LSCS in 38.1% of the patients respectively. Likewise, in a study done by Hashim et al 20% of the pregnant women with cesarean delivery had anemia, 16.9% had HDP.[11] In another study done by Rawat et al 14.4% had history of previous LSCS.[12]

Our study reported an incidence of 8.5% for SSI among the pregnant women who had delivered through cesarean section. There was a marked variation in SSI incidence in pregnant women who had cesarean section across India. In Rawat et al study the SSI incidence is CS was 18%, in Jain et al study 14.7% and in Dutta et al it was 7.7% respectively.[8,12,13]

In this study, the BMI and anemia were the significant predictors of SSI. In pregnant women who had cesarean section, the BMI of ≥25 kg/m² showed higher SSI incidence (p=0.032), and anemia showed a strong correlation with increased SSI rates (p<0.0001). In SSI group the patients showed higher BMI as that of the non-SSI group (56% vs 40.3%). Likewise, the in SSI group, there was higher proportion of anemia as that of the non-SSI group (38% vs 11.7%). Likewise, in a study done by Erritty et al pregnant women with BMI ≥35 kg/m² showed

more proportion of SSI as that of the BMI <30 (3.2% vs 0.9%).[14] In another study done by Gomma et al the incidence of obesity was higher in pregnant women with SSI as compare to without SSI (16.40% vs 10.50%; p<0.001).[15] In a study conducted in India, risk rate for developing SSI was 2.5 among obese and it was significant (p=0.004).[16]

Meanwhile, in a study done by Adane et al post-cesarean, anemia had the higher risk for the progression of SSI with an adjusted odd risk of 3.42.[17] The possible role of anemia as risk for SSI might be due to the hypoperfusion of wound during anemia and in addition limited ambulation after delivery. In Bhartiya et al study the incidence of post-cesarean anemia was 39.5% in SSI as compared to 23.6% in non-SSI cases, with an adjusted odds risk ratio of 2.39 and it was significant (p=0.03).[18]

In the present study, the most common organism responsible for SSI was *Klebsiella* sp. in 25 (50%) of the patients, followed by *S. aureus* in 15 (30%). In a study done by Basany et al the most often found organism in cesarean wound infections was *S. aureus*, a gram-positive bacterium.[16] In other Indian studies the most prevalent organisms responsible for SSI includes *Klebsiella* and *E. coli*, both of which are gram-negative bacteria and documented co-infections involving both gram-negative and gram-positive pathogens.[5,19,20]

The treatment strategy include, preoperative preparation of an incision site with an antimicrobial solution can reduce the bacterial population significantly. Recent studies have shown that the combination of antiseptic solution like chlorhexidine-alcohol and povidone-iodine can effectively reduce the SSI incidence during the CS.[21]

CONCLUSION

The incidence of SSI after caesarean delivery was 8.5% and the major risk factor for SSI was obesity and anemia. Additionally, our findings highlight the necessity of ongoing monitoring and enforcement of infection control measures for SSI at the hospital level. In addition, the strategies for preventing SSI in patients undergoing a cesarean section should focus on reducing prolonged labor in the absence of membranes, enhancing surgeons' abilities through training, minimizing intraoperative blood loss, and reducing the duration of the operation.

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