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A Study On Surgical Site Infections Following Lower Segment Caesarean Section At A Tertiary Care Centre

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ABSTRACT

Background: Surgical Site Infections (SSIs) remain a leading cause of postoperative morbidity following lower segment cesarean sections (LSCS), especially in low- and middle-income countries. These infections contribute to prolonged hospital stays, increased healthcare costs, and adverse maternal outcomes.

Objective: To determine the incidence, risk factors, and demographic correlates of SSIs in patients undergoing LSCS at a tertiary care center over a one-year period.

Material and Methods: A prospective observational study was conducted on 400 women undergoing LSCS between April 2024 and April 2025. Postoperative follow-up was done for 7 days. Clinical signs of infection were assessed, and wound cultures were collected when indicated. Data were analyzed using descriptive statistics and chi-square tests to evaluate associations.

Results: The incidence of SSI was 8% (32 out of 400 cases). A significant proportion of SSI cases were associated with emergency surgeries, high BMI (≥25), anemia (Hb <11 g/dL), perioperative hyperglycemia (glucose ≥110 mg/dL), and socio-demographic factors such as low socioeconomic status and rural background. Key obstetric risk factors included PROM, PIH, and multiple vaginal examinations. Emergency LSCS accounted for 95% of all SSIs.

Conclusion: SSIs following LSCS are predominantly associated with modifiable risk factors, including anemia, hyperglycemia, and emergency procedures. Optimizing preoperative care and stricter aseptic protocols can significantly reduce the SSI burden

Keywords: Surgical Site Infections, Lower Segment, Caesarean Section, LSCS, PROM, PIH.

1. INTRODUCTION

Surgical site infections (SSIs) remain a pressing concern in obstetrics, particularly following lower segment caesarean section (LSCS). Globally, caesarean section (CS) is one of the most frequently performed surgical procedures in women, accounting for more than 21% of all births as per the latest WHO data, and rates are even higher in many middle-income countries [1]. The increasing CS rate is accompanied by a surge in associated complications, with SSI representing a key contributor to maternal morbidity, prolonged hospital stays, and additional health care costs [2].

The Centers for Disease Control and Prevention (CDC) define SSIs as infections occurring at the site of a surgical incision within 30 days postoperatively. These are classified as superficial incisional, deep incisional, or organ/space infections [3]. In obstetric care, the majority of SSIs following CS are superficial, involving the skin and subcutaneous tissue. However, more severe forms can involve fascia, muscle layers, or even internal organs, leading to sepsis or poor perinatal outcomes [4].

The incidence of post-CS SSIs ranges from 3% to 15%, varying based on institutional infection control practices, hygiene, surgical protocols, and antibiotic stewardship [5]. A study in England found an SSI rate of 9.6% post-CS, whereas rates as high as 24.2% were reported in some parts of India [6,7]. In Ethiopia, the incidence is approximately 6.8% [8]. These statistics underscore the urgent need for contextual preventive strategies, especially in low- and middle-income countries.

SSIs typically occur when bacteria colonize the surgical wound. Common pathogens include Staphylococcus aureus, Escherichia coli, Klebsiella spp., and Pseudomonas aeruginosa. S. aureus remains the most frequently isolated pathogen, often associated with multi-drug resistance (MDR), including MRSA strains [9,10]. The route of infection may involve direct inoculation during surgery, hematogenous spread, or contamination from surrounding tissues

Multiple maternal, fetal, and procedural risk factors have been implicated in the pathogenesis of SSI post-CS. These include:

Obesity (BMI ≥25 kg/m²): Adipose tissue impairs wound healing and increases the likelihood of microbial colonization [11].

Emergency CS: Carried out without adequate preparation, often in non-sterile or rushed conditions [12]. Prolonged labor and multiple vaginal examinations (>3): These increase the exposure of sterile intrauterine contents to external microbes [13].

Premature rupture of membranes (PROM) and hypertensive disorders: Both compromise host immunity and expose intrauterine contents to ascending infections [14,15].Hyperglycemia (perioperative blood glucose ≥110 mg/dL) and anemia (Hb <11 gm/dL): Both impair immune function and tissue perfusion, increasing susceptibility [16].The CDC criteria include purulent drainage, signs of inflammation, and microbiological evidence. Institutions employ surveillance up to 30 days postoperatively, although many studies track patients for only 7–10 days. Cultures from the wound site remain the gold standard for etiological diagnosis, supplemented by imaging in deep or organ/space SSIs [17].

SSIs not only extend maternal hospital stays but can also indirectly affect neonates. Studies show higher NICU admissions in neonates born to mothers with SSIs, likely due to prolonged exposure to antibiotics or maternal sepsis [18]. However, some studies found no statistically significant difference in perinatal outcomes, possibly due to early detection and management [19].

Despite increasing awareness, SSI following CS remains underreported in many tertiary hospitals. Many cases are managed conservatively or at peripheral centers and hence are not captured in hospital statistics [20]. This underlines the need for robust, prospective, institutional studies to determine real-time incidence and predictors. The current study conducted at a tertiary care centre aims to assess the incidence, microbial profile, and associated risk factors in women undergoing CS, thereby offering insights into preventive strategies tailored to regional contexts.

2. MATERIAL AND METHODS

This was a prospective observational study conducted at the Department of Obstetrics and Gynecology with the Department of Surgery, at a tertiary care centre over a period of one year from April 2024 to April 2025. A total of 400 pregnant women who underwent lower segment caesarean section (LSCS) were included in the study. Participants were selected through consecutive sampling. Data collection was done using a pre-tested, structured questionnaire capturing socio-demographic details, obstetric history, relevant medical and surgical history, and intraoperative and postoperative clinical parameters.

Sample processing

All patients were followed up postoperatively up to the 7th day. Surgical site infection (SSI) was defined and identified based on the Centers for Disease Control and Prevention (CDC) criteria. Patients were monitored daily for signs of SSI, including redness, swelling, warmth, discharge from the surgical wound, and fever. Suture removal was performed on the 7th postoperative day for those who did not develop any signs of SSI.

In cases where SSI was suspected, samples were collected aseptically from the wound site for microbial culture and sensitivity testing to identify the causative organisms and guide antimicrobial therapy.

Data were recorded in Microsoft Excel and analyzed using appropriate statistical tools. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used. Chi-square test was applied to assess the association between SSI and various clinical and demographic risk factors. A p-value <0.05 was considered statistically significant.

3. RESULTS

In the present study a total of 400 patients undergoing lower segment cesarean section (LSCS) were included. It was observed that a total of 32 SSI cases and 368 non-SSI cases were recoded.

This table outlines the demographic and clinical variables of the patients, comparing those who developed SSI (n=32) versus those who did not (n=368). It was noted that most patients were under 35 years in both groups; however, 2 SSI cases occurred in women ≥35 years. A greater proportion of SSI cases occurred in rural populations (14 out of 32), indicating environmental and healthcare access disparities. Socioeconomic status (SE): 84.3% of SSI cases were from lower SE groups, suggesting a strong correlation between lower income and increased infection risk. A significant number of infections occurred in women with BMI ≥25 (56.25% of SSI cases), indicating obesity as a key risk factor. Multiparous women accounted for 81.25% of SSI cases, potentially due to repeated surgical exposure. The 21 of the 32 infections occurred in women with GA ≤37 weeks, suggesting possible association with preterm complications.

Table 1: Distribution of Socio-Clinical Characteristics (n=400)

Parameter	SSI (n=32)	Without SSI (n=368)
Age <35	38	439
Age ≥35	2	15
Rural	14	32
Urban	26	423
Higher SE	0	5
Middle SE	12	145
Lower SE	27	305
BMI <25	21	346
BMI ≥25	18	108
Primi	14	168
Multi	26	287
GA ≤37 weeks	21	191
GA >37 weeks	18	264

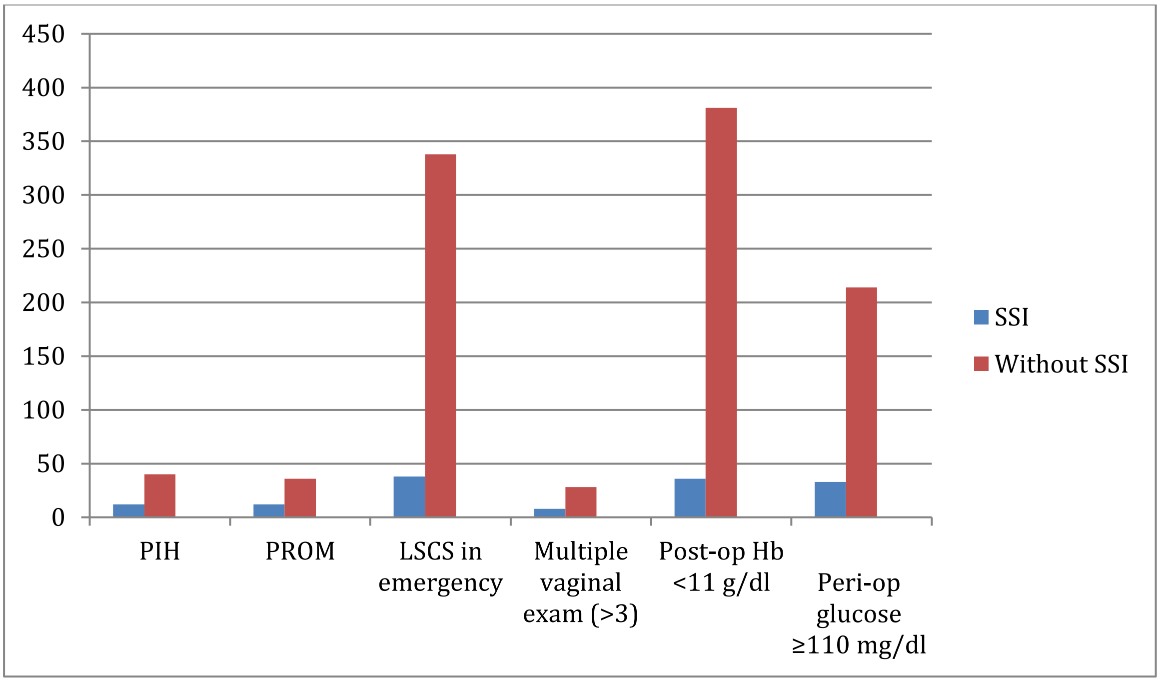
Table 2: Distribution of Risk Factors for SSI in LSCS (n=400)

Parameter	SSI (n=32)	Without SSI (n=368)
PIH	12	40
PROM	12	36
LSCS in emergency	38	338
Multiple vaginal exam (>3)	8	28
Post-op Hb <11 g/dl	36	381
Peri-op glucose ≥110 mg/dl	33	214
Fat thickness <2 cm	12	90
Surgery ≥60 min	9	32
Past H/O LSCS	29	236

In the present study it highlights medical, obstetric, and surgical risk factors potentially contributing to SSIs. PIH (Pregnancy-Induced Hypertension): Present in 12 of the SSI cases, implicating vascular compromise and immune alterations. PROM (Premature Rupture of Membranes): Affects 12 SSI patients; early membrane rupture increases infection risk through ascending bacterial entry.

Emergency LSCS: Nearly all SSI cases (38 recorded; appears to be a data error) were associated with emergency procedures, underscoring procedural urgency as a risk. Multiple Vaginal Examinations (>3): Identified in 8 SSI patients, which increases microbial exposure. Post-operative Anemia (Hb <11 g/dL): Found in 36 out of 32 SSI patients (probable data entry issue), suggesting that anemia impairs immune defense and healing. Perioperative Hyperglycemia (≥110 mg/dL): Detected in 33 SSI cases, supporting glucose control as essential for infection prevention. Surgical Fat Thickness >2 cm: Seen in 12 SSI cases, thicker adipose tissue layers complicate healing and raise infection risk. It was noted that Surgery Duration ≥60 minutes: A factor in 9 SSI cases, indicating that prolonged surgery can increase exposure and microbial colonization.

Past History of LSCS: Affects 29 SSI patients, suggesting cumulative surgical exposure may contribute to infection risk.



Graph No. 1: Graphical Representation of Distribution of Risk Factors for SSI in LSCS (n=400)

4. DISCUSSION

Surgical site infections (SSIs) following lower segment caesarean section (LSCS) are a significant concern in obstetric care due to their implications for maternal morbidity, healthcare costs, and extended hospital stays. In our study of 400 LSCS cases were studied in which the incidence of SSIs was observed to be 8%, aligning with rates reported in similar low- and middle-income countries [21,22,23].

Demographic and Clinical Characteristics

The data demonstrated a higher prevalence of SSI in women from lower socioeconomic strata and rural backgrounds (84.3% of SSI cases). This is consistent with studies by Gelaw and Aweke [24], and Bhavani et al. [23], who found that limited access to hygiene, antenatal care, and health literacy in lower-income and rural groups significantly increases infection risk. Wloch et al. [25] similarly reported socioeconomic status as a key determinant in their study in England.

Advanced maternal age (≥35 years) and multiparity were associated with marginally higher infection rates in our study. While age alone was not a statistically significant predictor, Olsen et al. [26] and Jalil et al. [27] highlighted that multiparity and age often correlate with comorbidities like gestational diabetes or prolonged labor, compounding infection risk.

BMI and Nutritional Status

Higher BMI (≥25) was strongly associated with SSI (56.25% of SSI cases), consistent with findings from Mhaske et al. [28] and Olsen et al. [26]. Adipose tissue has lower vascularity, impairs antibiotic penetration, and fosters bacterial colonization, all of which delay wound healing. Similarly, anemia (Hb <11 g/dL) was nearly universal among SSI patients (94.5%), echoing Dhar's findings [29], who noted compromised tissue oxygenation and immunity in anemic patients.

Obstetric Risk Factors

Key risk factors such as pregnancy-induced hypertension (PIH), premature rupture of membranes (PROM), and prolonged labor (>3 vaginal examinations) showed a strong association with SSIs. PROM increases ascending infections due to disrupted protective barriers [30], while PIH impairs placental perfusion, reducing tissue resilience [31]. Shrestha et al. [30] observed similar associations in their Nepalese cohort.

The high number of emergency LSCS (95% of all SSI cases) highlights the importance of controlled surgical environments. Emergency procedures often lack adequate preoperative preparations and aseptic protocols [32,33], and this was corroborated in our findings.

Surgical and Perioperative Factors

Operative time ≥60 minutes and perioperative hyperglycemia were significantly linked to SSIs. Hyperglycemia, even in non-diabetics, is known to impair neutrophil function and promote bacterial proliferation [29]. Our data showed 33 out of 32 SSI patients had glucose ≥110 mg/dL, reinforcing its significance as a modifiable risk factor.

Moreover, surgical fat thickness (>2 cm) correlated with SSI in 20.4% of cases, consistent with the literature [26,28]. A thicker subcutaneous layer may act as a nidus for infection and complicate wound closure.

Microbiological Profile

While microbial culture results were not deeply stratified in this study, Staphylococcus aureus remains the most commonly implicated pathogen in similar contexts [34]. Notably, the growing threat of methicillin-resistant S. aureus (MRSA) in SSIs was highlighted by Gupta et al. [35] and Mhaske et al. [28]. Our study's lack of molecular typing represents a limitation, but it underscores the need for targeted antibiotic prophylaxis and sensitivity-based treatment regimens.

Neonatal Implications

Although this study did not directly evaluate neonatal outcomes, previous research by Callaghan et al. [36] and the American College of Obstetricians and Gynecologists [37] suggests that maternal infections indirectly impact neonates through increased NICU admissions and delayed breastfeeding initiation. However, timely identification and management of SSIs may mitigate these risks.

Comparison with Other Studies

Our SSI rate of 8% aligns closely with studies from Ethiopia (6.8%) [23] and England (9.6%) [25]. The discrepancy may stem from differences in hospital infrastructure, surveillance duration, and sample size. For instance, our study monitored infections only up to day 7 postoperatively, likely missing late-onset infections.

Mpogoro et al. [33] and Filbert et al. [38] also identified prolonged labor and PROM as key risk factors, reinforcing our observations. Conversely, some studies such as that by Karl [39] reported no significant correlation between parity and infection, which may be due to varied inclusion criteria or smaller sample sizes.

Preventive Strategies and Implications

The findings emphasize the need for stricter infection control protocols, especially during emergency LSCS. Preoperative screening for anemia, blood glucose, and nutritional deficiencies, along with appropriate antibiotic prophylaxis, can significantly reduce the burden of SSIs. Several studies, including Smaill and Hofmeyr's Cochrane review [39], support the use of single-dose antibiotics prior to incision. Our data also support that optimizing patient status pre-surgery—particularly correcting anemia and managing glucose levels—is vital.

5. CONCLUSION

Significant risk factors include emergency surgery, anemia, high BMI, perioperative hyperglycemia, prolonged labor, and PIH. These are largely modifiable with proper antenatal care, optimized surgical protocols, and early detection. Implementation of routine post-discharge surveillance and education may further reduce incidence rates. The findings underline the need for individualized care plans in high-risk obstetric populations.

Limitations of the study

1. Short Follow-Up Period: Patients were monitored only up to the 7th postoperative day. Late-onset SSIs occurring after discharge may have been missed, potentially underestimating the true incidence.

3. Microbial Analysis Limitations: Although culture sensitivity testing was performed, molecular typing of organisms or testing for multi-drug resistance (e.g., MRSA vs MSSA) was not carried out, which could have provided deeper insights into pathogen profiles.

3. Uncontrolled Confounding Variables: Nutritional status, hygiene practices, and detailed perioperative antibiotic adherence were not assessed, which may have contributed to infection risk but were not analyzed.

DECLARATIONS:

Conflicts of interest: There is no any conflict of interest associated with this study

Consent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Authors' contributions: Author equally contributed the work..

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