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THE BURDEN POSED BY SURGICAL SITE INFECTION AFTER LOWER SEGMENT CAESAREAN SECTION

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ABSTRACT

Introduction: Surgical Site Infection (SSI) is a common complication following Caesarean section, contributing to maternal morbidity, prolonged hospital stays, and increased healthcare costs. SSIs are classified into superficial, deep, and organ-space infections, depending on the depth of tissue involvement. Various risk factors, including obesity, prolonged operative time, and inadequate prophylactic antibiotic administration, have been associated with an increased risk of SSI. **Methodology:** This prospective observational study was conducted over 24 months at a tertiary care hospital, including 243 women who underwent elective or emergency Caesarean sections. Data collection included demographic details, surgical parameters, and postoperative outcomes. Statistical analysis was performed using SPSS version 25, with a p-value of <0.05 considered significant. **Observations & Results:** The overall incidence of SSI was 14% (n=34). Among these, 64.7% were superficial infections, 26.5% were deep infections, and 8.8% were organ/space infections. Significant risk factors included obesity (p=0.008), prolonged operative time (p=0.001), and inadequate prophylactic antibiotic administration (p=0.005). The predominant pathogens isolated were *Staphylococcus aureus* (38.2%) and *Escherichia coli* (29.4%). **Discussion** The incidence of SSI in this study aligns with previously reported rates. Modifiable risk factors, including obesity and delayed antibiotic prophylaxis, significantly impact infection rates. The microbiological profile is consistent with other studies, highlighting the importance of timely antibiotic use. **Conclusion:** SSI remains a significant concern after Caesarean sections. Preventive strategies, including optimizing maternal health, adherence to aseptic surgical techniques, and timely antibiotic administration, are crucial in reducing SSI rates and improving maternal outcomes.

INTRODUCTION:

Surgical Site Infection (SSI) is a significant complication following Caesarean section, contributing to maternal morbidity, increased healthcare costs and duration of patient hospitalization which leads to increase burden to our health care system [1]. SSIs occur when bacteria infect the incision site, leading to inflammation, delayed wound healing and potential systemic infections. These infections are classified into superficial, deep, and organ-space SSIs, depending on their severity and depth of tissue involvement. Complications after cesarean sections are common in Nigeria and have played a significant role in the development of puerperal infections, which inevitably result in higher rates of morbidity and mortality [2]. In an African study on surgical outcomes, where one-third of the patients had a cesarean delivery, postoperative complications were reported in 18% of the patients. Post-operative infection was the most common complication, occurring in 10% of the patients, including 97% of the deaths [3]. Numerous developing nations have reported high rates of surgical site infections following cesarean sections, with prevalences of 16.2% reported in a Nigerian study, 19% from Kenya, 10.9% from Tanzania, 12.6% from Nepal, 24.3% from Pakistan and 9.7% from Vietnam, among others [4]. An Indian study from 2021 reported SSIs to be 10.3% where most of the cases were superficial SSIs. [5] According to the Centers for Disease Control and Prevention (CDC) [6], surgical site infections are a significant concern in healthcare settings. The CDC's healthcare-associated infection prevalence survey estimated approximately 110,800 SSIs associated with inpatient surgeries in 2015. Furthermore, data from 2023 indicated a 2% increase in the standardized infection ratio (SIR) for SSIs across all National Healthcare Safety Network (NHSN) operative procedure categories compared to the previous year. The World Health Organization [7] also provides comprehensive, evidence-based recommendations to minimize the risk of SSIs and improve surgical outcomes worldwide. Several risk factors contribute to the development of Surgical Site Infections (SSIs), particularly after surgical procedures such as Caesarean sections. Patient-related risk factors include obesity, diabetes, immunosuppression, poor nutritional status, and pre-existing infections. Procedural risk factors involve prolonged surgical duration, inadequate preoperative antibiotic prophylaxis, use of contaminated surgical instruments, and improper aseptic techniques. Additionally, emergency surgeries and premature rupture of membranes (PROM) further increase the likelihood of infections due to prolonged exposure to pathogens. Treatment of SSIs depends on the severity and depth of the infection. Mild cases, such as superficial SSIs, are managed with wound care, including proper cleaning, dressing changes, and oral antibiotics targeting common pathogens like *Staphylococcus aureus* and *Escherichia coli*. Deep and organ-space infections require more aggressive intervention, including intravenous antibiotic therapy, wound drainage, and, in severe cases, surgical debridement to remove infected tissues. Infected wounds may also benefit from negative pressure wound therapy (NPWT) to promote healing. According to Smaill, use of prophylactic antibiotics in women undergoing cesarean section substantially reduced the incidence of episodes of fever, endometritis, wound infection, urinary tract infection and serious infection after cesarean section[8]. The Centers for Disease Control and Prevention (CDC) classifies SSIs into: Superficial Incisional SSI: Limited to skin and subcutaneous tissue. Deep Incisional SSI: Extends into muscle and fascial layers. Organ/Space SSI: Involves deeper structures such as the uterus or peritoneal cavity.

METHODOLOGY

Study Design: This was a prospective observational study conducted over a 24-month period at a tertiary care hospital. The study population included 243 mothers who underwent elective or emergency C-sections.

Inclusion Criteria:

1. Women who had undergone Caesarean section (elective or emergency).
2. Women with post-operative follow-up ranging from immediate post-surgery up to 30 days.

Exclusion Criteria:

1. Women with pre-existing infections not related to the surgical site.
2. Women with immunodeficiency and comorbidities, or those who declined to participate.

Data Collection: Data was collected based on demographic characteristics, medical history, surgical details, and postoperative outcomes. Variables of interest included age, body mass index (BMI), type of C-section (elective vs. emergency), duration of surgery& use of prophylactic antibiotics.

Statistical Analysis: Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize the data, while chi-square tests and logistic regression were employed to identify risk factors associated with SSIs. A p-value of <0.05 was considered statistically significant. A confidence interval of 95% was set.

Ethical consideration: The study's proposal was presented to the chosen teaching hospital's Research and Ethics Committee, and approval was obtained prior to initiation. Because the principle of confidentiality was applied throughout the study, patient information and medical records were kept private. The data analysis did not disclose patient names or any other type of identification.

OBSERVATIONS & RESULTS:

Demographic Characteristics: Table 1 summarizes the mean age of the participants which was found to be 29.2 years (SD ± 5.5). The majority of the women were multiparous (68%), and 32% were primiparous. The mean BMI was 30.1 kg/m² (SD ± 4.8), with 45% of the women classified as obese (BMI ≥30 kg/m²).

Incidence of SSI: The overall incidence of SSI was 14% (n=34). Of these, 22 cases (64.7%) were superficial incisional infections, 9 cases (26.5%) were deep incisional infections, and 3 cases (8.8%) were organ/space infections.

Risk Factors for SSI: Table 2 summarizes the risk factors associated with SSIs. Obesity (BMI ≥30 kg/m²) was significantly associated with an increased risk of SSI (OR 2.7, 95% CI 1.3-5.6, p=0.008). Prolonged operative time (>60 minutes) was also a significant risk factor (OR 3.4, 95% CI 1.6-7.2, p=0.001). Inadequate administration of prophylactic antibiotics (defined as administration >60 minutes before incision) was associated with a higher risk of SSI (OR 2.9, 95% CI 1.4-6.2, p=0.005).

Clinical Presentation: The most common clinical presentations of SSIs included erythema (76.5%), purulent discharge (64.7%), and localized pain (58.8%). Fever was observed in 41.2% of the cases.

Microbiological Profile: Table 3 summarizes the microbiological profile of the SSIs. The most common pathogens isolated were Staphylococcus aureus (38.2%) and Escherichia coli (29.4%).Other pathogens included Klebsiella pneumonia (14.7%), Pseudomonas aeruginosa (8.8%), and Enterococcus faecalis (8.8%).

Treatment and Outcomes: Table 4 summarizes the antibiotic treatment and outcomes. The most commonly used antibiotics were cefazolin (44.1%) and amoxicillin-clavulanate (32.4%). The majority of the SSIs resolved with appropriate antibiotic therapy, with a mean duration of treatment of 7.5 days (SD ± 2.3). Women with SSIs had significantly longer hospital stays (mean 7.8 days, SD ± 2.4) compared to those without SSIs (mean 4.6 days, SD ± 1.4, p<0.001). Additionally, SSIs were associated with a higher rate of wound dehiscence (17.6% vs. 2.4%, p<0.001) and readmission within 30 days (14.7% vs. 1.9%, p=0.002).

DISCUSSION: Surgical Site Infections following Caesarean section remain a significant concern in Obstetrics and Gynecology. The incidence of SSI after C-section varies from studies, but it is generally influenced by factors such as maternal health, surgical technique, and postoperative care. The incidence rate reported in our present study was 14% whereas Jido et al [9] reported an SSI incidence of 9.1% which is comparable to our study.

Several risk factors contribute to the development of SSI after C-section. Moreover, poor infection control practices, such as inadequate hand hygiene or improper sterile techniques during surgery, can further increase the risk. In our study, Obesity, of 30 kg/m² or higher, significantly increased the risk of infection. Prolonged operative time, particularly when the procedure exceeds 60 minutes, is another critical factor linked to higher SSI rates. Additionally, inadequate antibiotic prophylaxis prior to surgery plays a significant role in the development of infection.

Table 1: Demographic Classification of Study Participants (n=243)

Demographic Variable	Category	Number of Patients	Percentage (%)
Age (Years)	<25	45	18.5%
	25-30	120	49.4%
	>30	78	32.1%
Parity	Primiparous	78	32.1%
	Multiparous	165	67.9%
Body Mass Index (BMI)	Normal (18.5–24.9 kg/m²)	85	35.0%
	Overweight (25–29.9 kg/m²)	50	20.6%
	Obese (≥30 kg/m²)	108	44.4%
Type of Caesarean Section	Elective	150	61.7%
	Emergency	93	38.3%
PROM	Yes	76	31.27%
	No	167	68.73%

Table 2: Risk Factors for Surgical Site Infection

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Obesity (BMI ≥30 kg/m²)	2.7	1.3 - 5.6	0.008
Prolonged Operative Time (>60 min)	3.4	1.6 - 7.2	0.001
Inadequate Antibiotic Prophylaxis	2.9	1.4 - 6.2	0.005

Table 3: Microbiological Profile of SSIs

Pathogen	Number of Cases	Percentage (%)
Staphylococcus aureus	13	38.2
Escherichia coli	10	29.4
Klebsiella pneumoniae	5	14.7
Pseudomonas aeruginosa	3	8.8
Enterococcus faecalis	3	8.8

Table 4: Antibiotic treatment and Outcomes

Antibiotic	Number of Cases	Percentage (%)	Mean Duration of Treatment (Days)
Cefazolin	15	44.1	7.5
Amoxicillin-Clavulanate	11	32.4	7.8
Vancomycin	4	11.8	8.2
Piperacillin-Tazobactam	4	11.8	8.0

Figure 1: Pie chart showing the distribution of SSI types among the study population.

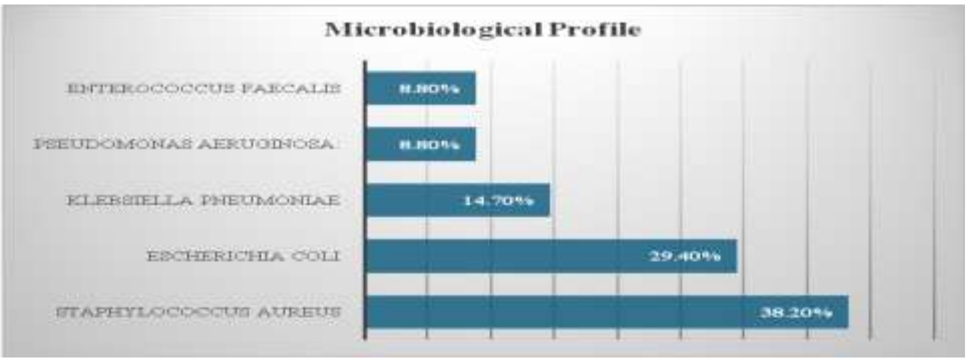

Figure 2: Bar chart showing the Microbiological Profile of SSIs

These factors underscore the importance of proper preoperative planning, including addressing maternal obesity, minimizing operative time, and ensuring appropriate antibiotic administration to reduce the risk of SSI in C-section deliveries. However, Jido and Garba highlighted emergency C-sections as a significant risk factor, which was not explicitly emphasized in the current study [9]. The most commonly identified pathogen in our study was *Staphylococcus aureus*, accounting for 38.2% of the cases. Following this, *Escherichia coli* was responsible for 29.4% of infections. Klebsiella pneumoniae was identified in 14.7% of cases, while Pseudomonas aeruginosa and Enterococcus faecalis each accounted for 8.8% of the infections. The microbiological profile in Gur et al.'s study [10] was consistent with the current study, with Staphylococcus aureus and Escherichia coli being the predominant pathogens. Both studies emphasized the importance of timely antibiotic administration and proper surgical techniques in reducing SSI rates. Alnajjar and Alashker [11] reported an SSI incidence of 17.4%**,** which is slightly higher than the 14% in the current study. However, both studies identified obesity**,** prolonged operative time, and inadequate antibiotic prophylaxis as significant risk factors. They also highlighted the role of emergency C-sections and premature rupture of membranes in increasing SSI risk, which were not explicitly discussed in the current study. Both studies reported longer hospital stays and higher rates of wound complications in patients with SSIs, emphasizing the need for strict infection control measures**.**

The findings of Fitzwater and Tita [12], align closely with the current study, particularly in identifying obesity**,** prolonged operative time, and inadequate antibiotic prophylaxis as significant risk factors for SSIs. Both studies emphasize the importance of timely antibiotic administration (within 60 minutes before incision) and the role of preoperative optimization in reducing SSI risk. The current study reported an SSI incidence of 14%**,** which falls within the range (3%–15%) mentioned by Fitzwater and Tita, further validating the consistency of SSI rates across different settings. Wloch et al. [13] identified key risk factors for Surgical Site Infection (SSI) after Caesarean section in England, including obesity, prolonged labor, emergency procedures, and inadequate antibiotic prophylaxis. Their findings align with our study, as we also observed obesity and prolonged operative time as significant contributors to SSI. However, their study emphasized emergency C-sections as a major risk factor, whereas our study focused more on antibiotic prophylaxis and pathogen distribution.

CONCLUSION

SSIs are a significant complication following Caesarean sections, contributing to increased maternal morbidity, prolonged hospital stays and higher healthcare costs.Preventive measures such as timely administration of prophylactic antibiotics, proper surgical techniques and aseptic precautions, and strict adherence to infection control protocols are crucial in reducing the incidence of SSIs.Obesity, prolonged operative time, and inadequate antibiotic prophylaxis are key modifiable risk factors that should be addressed to minimize the risk of SSIs. Early recognition and prompt treatment of SSIs are essential to prevent complications such as wound dehiscence, endometritis, and sepsis. Patient education on wound care and hygiene practices post-surgery can play a vital role in reducing the risk of SSIs. Multidisciplinary collaboration among obstetricians, anesthesiologists, and infection control teams is necessary to implement effective strategies for SSI prevention and management.

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