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Original Research Article

Prevalence, risk factors, and bacterial pathogens responsible for surgical site infection after caesarean section: a retrospective study

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ABSTRACT

Background: Surgical site infection (SSI) is one of the most common complications following caesarean section (CS), with a reported incidence of 3-20%. SSIs cause a significant burden on both the mother and the healthcare system and are associated with maternal morbidity and mortality rates of up to 3%.
Methods: A hospital-based retrospective study was conducted. Of 703 patient charts reviewed, 51 met the inclusion criteria. Data were extracted from medical records and analyzed using Statistical Package for the Social Sciences (SPSS).
Results: The prevalence of SSI was 7.3%. Most cases (96.1%) were classified as Class I SSI, while 3.9% were Class II; no cases of organ-space infection were identified. The mean age of affected patients was 27.5 years. Obesity was present in 68.8% of the cohort. The SSI rate was 17.6% among patients with rupture of membranes (ROM) before CS. Prolonged rupture of membranes (>18 hours) occurred in 13.7% of cases, while ROM <18 hours was noted in 3.9%. Anemia and postpartum hemorrhage each accounted for 2% of associated conditions.
Conclusions: At Georgetown Public Hospital, SSI following caesarean delivery remains a significant complication, with a prevalence of 7.5%. The most commonly isolated organisms were *Staphylococcus aureus*, followed by *Escherichia coli*, *Klebsiella pneumoniae*, and *MRSA*. Efforts to reduce preventable risk factors are essential to decreasing the overall burden of SSI after caesarean section.

Keywords: Caesarean section, *E. coli*. *Klebsiella pneumoniae*, Prevalence, Prolonged rupture of membranes, Risk factors, Surgical site infection

INTRODUCTION

Surgical site infection (SSI) is defined as an infection occurring at the incision or operative site (including drains) within 30 days after a surgical procedure.[2] SSI remains a common healthcare-associated infection, especially in low-income countries, with reported rates ranging from 3% to 15% following caesarean section (CS).[3] Despite advances in sterilization techniques, operating room ventilation, improved surgical practices, and the availability of antimicrobial prophylaxis, SSI following CS continues to be a major cause of maternal morbidity, prolonged hospitalization, increased healthcare expenditures, and maternal mortality.[4]

The World Health Organization (WHO) has stated that the optimal population-level caesarean section rate lies between 10% and 15%.[5] However, global CS rates have risen well beyond this threshold. Recent studies demonstrate that the rate of caesarean delivery is increasing unpredictably, contributing to actual, potential, and long-term maternal and neonatal complications.[6]

Therefore, this study was conducted to determine the prevalence, important risk factors, and causative pathogens associated with SSI following caesarean section, and to propose strategies aimed at reducing its occurrence.

Literature review

A caesarean section is a procedure where a neonate is born via a surgical incision through both the abdominal wall and uterus. It is one of the most frequent surgical procedures done by obstetrics; it occurs in about fifteen percent of all deliveries. However, it ranges from approximately three and a half percent on the African continent to twenty-nine and a half percent in Latin America.[6]

Because of the constant increase in caesarean section worldwide, the incidence risk is likely to increase in the number of women with postpartum infection. Thus, surgical site infection following caesarean delivery is a major cause of morbidity and mortality. Therefore, increasing both the duration of patient hospitalization and hospital costs leads to increased burden to our health care system.[7,8] In high-income and low-income countries, caesarean section procedures are considered lifesaving as seen globally, with ranges of six to twenty-seven percent.[8,9]

As seen in Ethiopia, the rate of caesarean section goes from one and half to twenty-eight-point eight percent.[8] Nonetheless, the benefit of caesarean section without medical obligation can put women at risk of short-term and long-term health problems.[9,10]

In view of the fact that complications can arise, such as obstetric fistula, birth asphyxia, thus medical indications are necessary to address the terrifying life conditions, such as to save the maternal and child's life. However, if not performed effectively, it poses the risk of hemorrhage, uterine rupture, infection and placentation problems in present and succeeding pregnancies.

Obstetric emergency care, inclusive of caesarean section, includes a huge percentage of surgical pursuit as seen in most low- and middle-income countries. An estimated eighteen and a half million caesarean sections are performed yearly. Hence, in 1985, the World Health Organization announced that the required threshold for the caesarean section rate should be ten to fifteen percent, obtainable specifically from Northern Europe, where morbidities and mortalities of perinatal were low at the above rate.[12]

Thus, the aim of the declaration is to improve the operation of performing caesarean deliveries for those who are eligible and to circumvent the procedure for medically unqualified patients. Even though this declaration is disputable to date, the caesarean rate still exceeds fifteen to twenty percent and is not yet associated with improved perinatal conditions.[13]

Nonetheless, recent studies revealed that the rate of caesarean delivery is rising unpredictably, leading to actual, potential, and lifelong maternal and neonatal complications. Half of the caesarean section procedures exceeding the WHO maximum caesarean section rate threshold is performed in Brazil and China. This can be evidenced by a forty-half percent caesarean section rate exhibited in Latin America and the Caribbean region.[13,14]

According to an investigation conducted in Nigeria, reported overall wound problem of thirteen and half percent of surgical site infection of eight-point nine percent, as founded by Bhavani et al in their study of one thousand cases of the incidence of surgical site infection after caesarean section was thirteen-point eight percent.[15]

Surgical site infection is an infection that occurs at the site of an incision made at the operative site, including drains, within 30 days of the post-surgical procedure.[11] Thus, surgical site infection is a healthcare-associated infection. Even though methods were put in place for easy accessibility of antimiscrobial prophylaxis, sterilization methods, operating room ventilation, and surgical techniques. Surgical site infection after caesarean delivery remains an important problem because of maternal illness, extended hospitalization, increased medical costs, and maternal death, urinary tract infection.

The rates of surgical site infection after caesarean section as reported in the literature range from three to fifteen percent, depending on the investigation methods that were carried out to recognize infections, the patient population, and the use of antibiotic prophylaxis.[12-14]

The risk factors for surgical site infection in association with caesarean section are many, including those mixed issues present in the surgical patient population, such as age, type of caesarean section (elective vs emergency), and patient care practices such as antibiotic prophylaxis. The examination of the integrated effects of the intrinsic and extrinsic risk factors predisposing patients to surgical site infection is necessary to identify the familiar links.

Based on the Centers for Disease Control and Prevention classification, surgical wounds focus on four distinct determinants that are clean (I), clean and contaminated (II), contaminated (III), and dirty (IV). The aforementioned classification is necessary to facilitate the execution of this study to determine whether the surgical site infection criteria are met.

This study aimed to determine the prevalence, risk factors, and bacterial pathogens associated with surgical site infection (SSI) following caesarean section at Georgetown Public Hospital Corporation for the period of 1st January 2019 to 31st December 2020.

METHODS

Study design

This study was a retrospective descriptive study in the Department of Obstetrics and Gynecology. This research was performed over 2 years, from January 2019 to December 2020. To determine the prevalence, risk factors,

and the most common bacterial pathogen of SSI following caesarean Section for the above-mentioned study period at GPHC.

Procedure

Ethical approval for this study was obtained from both the Georgetown Public Hospital Research Board and the Ministry of Health. Patient consent was not required because there was no direct interaction with patients, and data collection involved retrospective chart review only. To maintain confidentiality, all information was extracted without the use of personal identifiers.

Eligible patient charts were identified based on predefined inclusion criteria, and relevant data were recorded using a structured data collection form. The extracted data were then entered and analyzed using the Statistical Package for the Social Sciences (SPSS).

Inclusion criteria

All pregnant women who underwent an elective or emergency CS were eligible for enrolment within 24-hr post-CS and followed for 30 days to detect SSI, in accordance with the Centers for Disease Control and Prevention (CDC) Classification. Also, immuno-compromised patients, as they would be generalizable to the entire population and more susceptible to infection were included.

Exclusion criteria

Cases in which the diagnosis of SSI is not based on the CDC/NHSN criteria and where the follow-up extends beyond 30 days were excluded.

RESULTS

During the study period between January 01, 2019, and December 31, 2020, there were 12,219 deliveries in the Obstetric Unit at GPHC. Out of these, 3,480 had lower segment caesarean sections, resulting in a rate of 28.7%. A total of 703 charts were available for review, out of which 51 cases of surgical site infection (SSI) were identified. This resulted in a prevalence rate of 7.3% for the study period.

The Table 1 demonstrates that the majority of cases occurred in patients aged between 20-29 years (72.5%), followed by those aged 30-35 years (19.6%). The least affected age groups were those under 20 years (3.9%) and those over 35 years (3.9%). The mean age was 27.5 years (Table 1).

Regarding parity at the time of delivery, 35.3% of patients were primigravida, while 64.7% were multigravida. The gestational age at caesarean delivery ranged between 31 and 41 weeks, with 72.6% of neonates delivered at term ges The data revealed that emergency CS cases accounted for 64.7% while elective CS cases accounted for 35.3%. Among the risk factors observed, obesity was seen in 68.8% of the patients, followed by overweight at 11.8% and normal weight at 19.6% (Table 2).

The remaining cases were delivered as post-term (17.6%) and pre-term (9.8%) neonates, with a mean gestational age of 36 weeks.

The onset of labor was observed in 70.6% of cases, while 29.4% had none. Rupture of membranes was positive in 35.2% of cases, while 68.8% were negative. Patients were also seen to have had one or more previous caesarean sections, with 62.1% having undergone the procedure and 37.1% having had none.

Table 1: Majority of cases occurred in patients aged between 20-29 years.

Variables	Total frequency (%)
Maternal age (years)	
<20	3.9
20-29	72.5
30-35	19.6
>35	3.9
Parity	
1	35.3
≥2	64.7
Period of gestation	
Preterm	9.8
Term	72.6
Late term	17.6
Onset of labor	
Yes	70.6
No	29.4
Rupture of membrane	
No	68.8
Yes	35.2
Vaginal examination	
0	35.3
≥1	64.7
No. of prior LSCS	
0	37.9
≥1	62.1
Hypertension	
Yes	13.7
No	86.3
Gestational diabetes	
Yes	2
No	98

Table also shows that at the time of admission, 62.1% of women received one or more vaginal examinations, while 13.7% had none. Patients also presented with comorbidities such as hypertension, with 86.3% being normotensive, and the remaining 13.7% being hypertensive. Diabetes, on the other hand, affected only a

minority of patients (2%), while the majority (98%) did not have diabetes.

Table 2: Examined the risk factors predisposing patients to SSI following caesarean section.

Variables	Total frequencies (%)
Type of surgery	
Emergency CS	64.7
Elective CS	35.3
Preoperative hospitalization	
≤24 hours	67
>24 hours	33
Hospital stays	
<5	60
>=5	40
Preoperative hemoglobin	
<11 gm/dl	7.8
≥11 gm/dl	92.2
ROM	
ROM<18 hours	3.9
ROM >18 hours	13.7
Antibiotic treatment	
Preoperative	96.1
Post-operative	3.9
Incision type	
Pfannenstiel	100
Classical	0
Duration of surgery	
>1 hour	2
<1 hour	98
Pathogen	
S. aureus	50
K. pneumonia	6
E. coli	10
MRSA	4
No pathogen	30
Surgeon grade	
Registrars	11.8
Residents	88.2
BMI	
Obesity	68.6
Over weight	11.8
Normal weight	19.6
Blood transfusion	
Yes	3.9
No	96.1

Figure 1 representing the rate of SSI following emergency CS 33 (64.7%) vs elective CS 18 (35.3%) at GPHC during the study period of January 01, 2019, to December 31, 2020.

Furthermore, patients with prior CS and high BMI (>25) showed a significant association with the risk of SSI (p<0.005). The study also found that preoperative hospitalization of less than or equal to 24 hours was observed in 76% of the cases, while greater than 24 hours was seen in 33%.

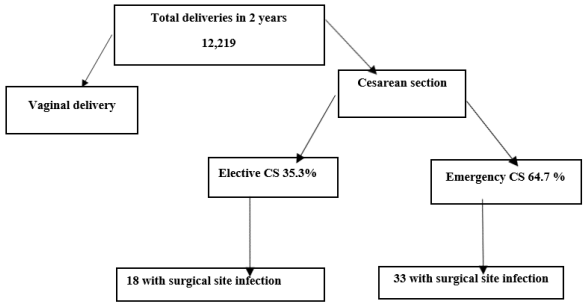

Figure 1: The rate of SSI following emergency CS.

Additionally, the duration of hospital stays of greater than or equal to 5 days was observed in 40% of the patients, while less than 5 days was seen in 60%, giving a mean duration of 4.7±1.50 days of hospital stay with no SSI.

In terms of blood tests, hemoglobin greater than or equal to 11 was 92.2%, while hemoglobin less than 11 was 7.8%. It is important to note that blood transfusion was only done in 3.9% of cases, while 96.1% had none, indicating that anemia and PPH were not major risk factors for developing SSI. ROM greater than 18 hours was only seen in 13.7% of cases, while ROM less than 18 hours was 3.9%. Prophylactic antibiotics, cefazolin 2g, were given to the majority of cases, 96.1%, followed by clindamycin 3.9%, while 3.9% received postoperative antibiotics, which were given to those patients who had contact with the sterile field. All patients had a Pfannenstiel incision (100%).

The duration of surgery lasted for less than 1 hour in the majority of cases (98%), while 2% took greater than 1 hour. The most identified pathogen was Staphylococcus Aureus (50%), followed by E. coli (10%), Klebsiella Pneumonia (6%), and MRSA (4%). The remaining 30% were for those patients in whom no wound culture was done or documented.

It is important to note that patients in this study had surgery done by residents of various years (88.2%) and registrars (11.8%). Skin preparation with iodine and alcohol was done in all of the cases (100%).

Out of the total 51 participants, n=25 (49.1%) underwent CS due to non-reassuring fetal heart rate. The next most common indication was previous LSCS, accounting for n=13 (25.5%) cases. Failed induction of labor accounted for n=7 (13.7%) cases, while obstructed labor, multifetal gestation, and eclampsia accounted for 1.9% each (Figure 2).

The majority of patients developed class I SSI (surgical site infection) (96.1%), while only a small portion developed class II SSI (3.9%). Among the various clinical presentations, purulent discharge was the most common (76.5%), followed by pain and induration (17.5%) and

fever (5.9%). Regarding treatment, the vast majority of patients received antibiotic treatment (86%). In addition, iodine dressing was done for 12% of cases, while 2% of cases had surgical debridement and incision and drainage (Figure 3).

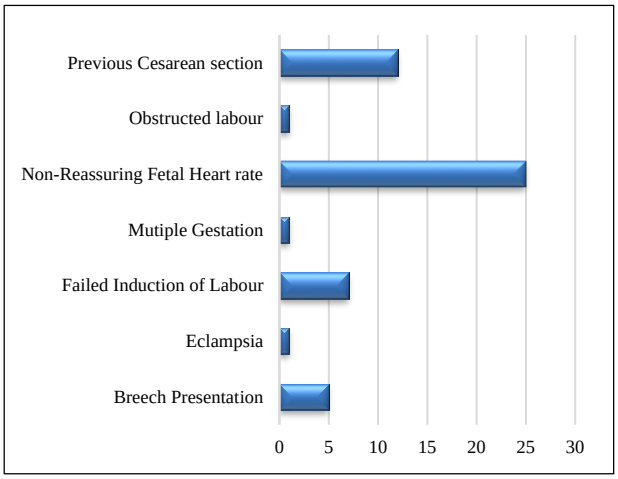

Figure 2: The indications for undergoing caesarean section among the pregnant women in this study.

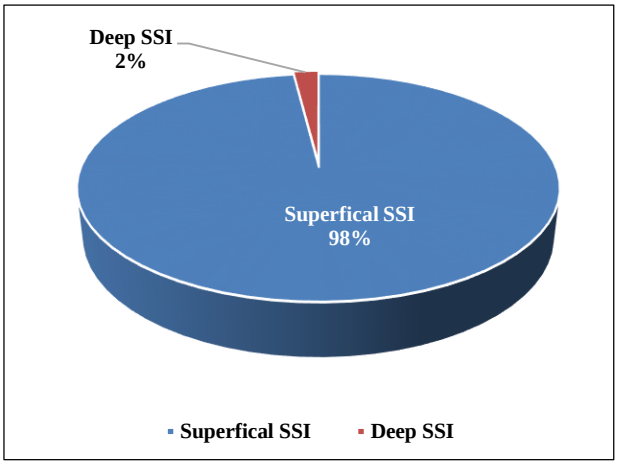

Figure 3: The type of SSI observed in the study.

DISCUSSION

Caesarean section (CSEC) is one of the most common surgical procedures performed in both developed and developing countries.[1] In the United States, Caesarean delivery accounts for 32% of all births.[2]

Surgical site infection following CS is one of the most common obstetric complications, causing massive burdens on both the mother and the healthcare system, and is associated with high morbidity and mortality. This study observed that the prevalence of SSI was 7.3%, compared to other studies such as Jasim et al, where the prevalence was noted to be 1.9% to 6.9%, and De Nardo et al found a very high prevalence of 48% of SSI.

According to other studies carried out in middle to low-income countries, the prevalence ranged from 5 to 11.2%, such as in Ethiopia (3 to 15%) and Nigeria (8.9%).[13,14,16] It has been reported that the incidence of SSI after CS varied between 3% and 15%.[11]

Insufficient operating room infrastructure, poor observance of operating room guidelines, including hand-washing techniques, inadequate hygiene and sanitation in the hospital and at home, and insufficient quality and quantity of staffing are among the risk factors that have been linked to an increased risk of SSI development, according to other studies. However, data from this population were not available for comparison in the current study.

In contrast to an Irish case-control study by Saeed et al, where 75% of women with SSI were delivered by emergency CS and 25% by elective CS, and where the overall rate of SSI following CS was 2%, this retrospective study found rates for SSI after elective and emergency CS to be 35.3% and 64.7%, respectively.[16] According to this study and others, emergency CS was a standalone risk factor for CS.[14,15]

In our investigation, obesity was identified as a distinct risk factor for SSI. This result has also been shown in a number of other studies, supporting the mounting evidence that adipose tissue causes persistent inflammation and raises a person's susceptibility to infections. An example of this is seen in a Scottish study, which observed that obesity was found to be an independent risk factor for infections of varied severity, and obese women are more likely to develop postpartum sepsis regardless of the method of delivery.[14-16]

In this study, there were numerous SSI-related risk factors, including anemia, emergency CS, prior caesarean deliveries, multiple vaginal examinations, prolonged rupture of membrane, and underlying medical conditions.

The most recent WHO recommendations (2016) recommend the use of prophylactic administration of antibiotics 120 minutes before surgical incision and for the avoidance of postoperative antibiotic use. In the current study, every woman who underwent surgery received preoperative prophylaxis, and 17.6% of them received an extended course of antibiotics afterward.

For this study, medical management of SSI (repeated dressings, antibiotics, and follow-up) accounted for 80.4% of cases, and surgical management accounted for 3.9% of cases. These results are consistent with research done in Ethiopia.[13]

This study faced several limitations. First, there was a lack of prior research on this specific topic, making it challenging for the researcher to compare findings with existing data. Assistance from the records department was also difficult to obtain, and it is possible that additional

charts requiring sorting were unavailable, which may have reduced the amount of data collected. Furthermore, some patient charts were missing due to the relocation of medical records prompted by inadequate storage space. Several charts were also difficult to review because of illegible handwriting, smeared ink, and incomplete documentation, which may have omitted important information necessary for identifying surgical site infections (SSI). Finally, SSI cases were not consistently documented in the ward's designated SSI book, making it challenging to track and verify affected patients.

CONCLUSION

At Georgetown Public Hospital, surgical site infection following caesarean section is a frequent complication with a prevalence rate of 7.3%. The likelihood of surgical site infection following a caesarean section is increased by several risk factors such as emergency CS, prior caesarean section, obesity, pregnancy-related medical complications, and maternal age. Obstetricians should consider earlier or more frequent postoperative follow-ups in patients with these risk factors. The prevalence of surgical site infection after caesarean section can be reduced by the obstetrician's efforts to avoid avoidable risk factors. Early detection of microorganisms and their susceptibility patterns can be useful in selecting the appropriate antibiotics to reduce the financial burden of patients and maternal morbidity and mortality.

Recommendations

Adequate aseptic procedures before, during, and after caesarean section should remain a primary focus in reducing SSI. Regular monitoring of SSI risk factors and the strategies used for their prevention is essential to improving patient outcomes. Additionally, pregnant women should receive appropriate counselling on the use of iron–folic acid supplements to improve hemoglobin levels and potentially reduce the risk of complications associated with anemia.

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