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Frequency of Factors of Wound Infection after Caesarean Section

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ABSTRACT

Background: Surgical-site infection following cesarean section remains a chronic source of maternal morbidity. A number of factors have been implicated, but a need exists to more clearly understand and quantify their contribution by setting. The purpose of our study was to identify rates of factors causing infection of the wound after cesarean delivery, i.e., emergency cesarean delivery, procedure time, transfusion, and prolonged hospital stay. **Objective:** To assess the frequency of factors leading to wound infection after caesarean section. **Study Design:** Cross-sectional study. **Duration and Place of Study:** It was conducted from November 2024 to April 2025 in the Department of Obstetrics and Gynaecology, Pak Emirates Military Hospital Rawalpindi. **Methodology:** Eligible participants were over 18 years with singleton pregnancies beyond 32 weeks. Data on demographics and potential risk factors such as emergency caesarean section, prolonged procedure, blood transfusion, and extended hospital stay were collected. Wound infection was defined by standardized clinical criteria. **Results:** In this study a mean age of 28.69 ± 4.42 years and a mean gestational age of 37.84 ± 1.77 weeks was observed. The study identified emergency Cesarean Section (14%), prolonged procedure duration (53%), blood transfusion (24%), and prolonged hospital stay (39%) as key factors associated with wound infection. **Conclusion:** Emergency cesarean section, prolonged procedure duration, and blood transfusions are key contributors to wound infection following cesarean section.

INTRODUCTION

Wound infection ranks among the potential complications of a Cesarean section.[1] It occurs due to the entry of the wound area by harmful bacteria that cause the signs of redness, swelling, pain, and discharge of pus.[2] In severe cases, the underlying cause of the condition could be the formation of an abscess or sepsis that would require a more intense treatment.[3] Wound infection following a C-section occurs due to contamination of the wound area during surgery or from subsequent post-operative care. It may prolong the recovery period, prolong the hospital stay time, and incur health care costs.[3] A variety of factors can impact the development of a wound infection following a C-section. Emergency C-sections where the surgery took place under stressful, emergent circumstances have a higher rate of infection due to the stressful environment and the potential suboptimal environment for asepsis.[4] Longer surgery time also tends to expose the wound area for a longer time to the bacteria and thereby maximize the chances of infection.[5] Longer operations also contribute towards greater trauma of the tissues, undermining the body's effective healing process.[5] Long exposure of the body tissues to potential contaminants during a prolonged surgery remains a prominent risk factor towards wound infections.[6] Prolonged hospital stays and conditions like blood transfusion also contribute towards the risk of C-section wound infection.[7] Blood transfusion may be required for heavy bleeding during or after delivery, but immunosuppression caused due to the transfusion weakens the body's ability to combat the infection.[8]

In a study by Pathak A, et al. from India, it was shown that frequency of emergency C-section was 14%, prolonged duration of procedure 37%, blood transfusion 20%, and prolonged hospital stay was 26% in patients with wound infection.[9]

According to a study by Mohammad et al. from Pakistan, 19.94% of women developed surgical site wound infections after emergency caesarean section. The main contributing factors were prolonged rupture of membranes (51.6%), prolonged labor before operation (29%), and excessive intraoperative blood loss (29%).[10]

Wound infection is a frequent complication of caesarean section, leading to maternal morbidity and prolonged hospital stay. Previous studies have highlighted several contributing clinical factors, including emergency procedures, prolonged labor, rupture of membranes,

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excessive blood loss, transfusions, and longer operative duration. However, limited local evidence exists on how these risks interact with broader determinants such as age, gestational age, parity, residence, socioeconomic status, and educational level. Exploring both clinical and social variables is therefore essential to identify vulnerable groups and develop effective preventive strategies in our setting.

METHODOLOGY

This cross-sectional study was conducted from November 2024 to April 2025 at the Department of Obstetrics and Gynaecology, Pak Emirates Military Hospital Rawalpindi. The study aimed to determine the frequency of factors contributing to wound infection following caesarean section, with a sample size of 100 participants. The sample size was calculated using the WHO sample size software, assuming a 95% confidence level, a 7% margin of error, and an expected frequency of emergency caesarean section at 14%,[16] which yield 94 sample size but we used 100 sample size.

Women aged 18–40 years with a singleton pregnancy confirmed by ultrasound, gestational age above 32 weeks, of any parity, who underwent caesarean section. Wound infection was defined as the presence of fever (above 38°C) postoperatively, erythema greater than 1 cm from the wound margin, tenderness on palpation, and the presence of sero-sanguinous or purulent discharge.

Exclusion criteria included a history of skin infections at the surgical site, immunodeficiency disorders, a history of bleeding disorders, or pre-operative antibiotic use within the last two weeks.

Baseline demographic data such as age, gestational age, parity, socioeconomic status, residential status, and education level were obtained from the patients. Data on determinants of wound infection such as prolonged procedure duration, blood transfusion during procedure, prolonged hospitalization, and emergency caesarean section was recorded against study definitions. Emergency caesarean section was defined as any caesarean birth that was not planned or unscheduled. Prolonged procedure duration was considered a procedure that took longer than a duration of one hour after incision until closing. Blood transfusion was defined receiving a transfusion of one or more units packed red blood cells plus or minus fresh frozen plasma during procedure conduct. Prolonged hospitalization was considered as hospitalization that took longer than seven post-surgical days. Informed consent was obtained by all respondents such that confidentiality and description about study voluntariness and absence of attached risks were guaranteed.

The data was entered and analyzed using IBM SPSS version 26. Quantitative variables, such as age, gestational age, and parity, were presented as mean ± standard deviation. Qualitative variables, including socioeconomic status, residential status, education level, and factors like emergency caesarean section, prolonged procedure duration, blood transfusion, and prolonged hospital stay, were expressed as frequencies and percentages. Stratification was performed based on age, gestational age and parity. Post-stratification analysis was conducted using the chi-square test, with a p-value of ≤0.05 considered statistically significant.

RESULTS

The demographic characteristics of the participants revealed a mean age of 28.69 ± 4.42 years, a mean gestational age of 37.84 ± 1.77 weeks, and a mean parity of 1.67 ± 1.32. Regarding residential status, 59% of participants lived in urban areas, while 41% were from rural areas. Socioeconomic status indicated that 39% were poor, 52% were middle class, and 9% were categorized as rich. In terms of education, 7% were uneducated, 32% had primary education, 52% had secondary education, and 9% had higher education (as shown in Table 1).

Table 1

Patient Demographics

Demographics	Mean ± SD	
Age (years)	28.6900±4.42	
Gestational age (weeks)	37.8400±1.77	
Parity	1.6700±1.32	
Residential Status	Rural n (%)	41 (41.0%)
	Urban n (%)	59 (59.0%)
Socioeconomic Status	Poor n (%)	39 (39.0%)
	Middle n (%)	52 (52.0%)
	Rich n (%)	9 (9.0%)
Education	Uneducated n (%)	7 (7.0%)
	Primary n (%)	32 (32.0%)
	Secondary n (%)	52 (52.0%)
	Higher n (%)	9 (9.0%)

The factors associated with wound infection after cesarean section included emergency C-section (14%), prolonged duration of procedure (53%), blood transfusion (24%), and prolonged hospital stay (39%) (as shown in Table 2).

Table 2

Frequency of Factors

Factors	Frequency	% age
Emergency C-section	14	14%
Prolonged duration of procedure	53	53%
Blood transfusion	24	24%
Prolonged hospital stay	39	39%

In terms of stratified analysis, no significant association was found between emergency C-sections and demographics, with p-values of 0.238 for age, 0.734 for gestational age, and 0.290 for parity (as shown in Table 3). The duration of the procedure was also not significantly associated with age (p = 0.111), gestational age (p = 0.635), or parity (p = 0.089). Blood transfusions did not show any significant correlation with age (p = 0.671), gestational age (p = 0.145), or parity (p = 0.482). Prolonged hospital stays were more frequent in older patients (47.4%) compared to younger patients (33.9%), though the difference was not statistically significant (p = 0.179). Similarly, prolonged stays were more common for those with a gestational age of >39 weeks (57.9%), but this was not statistically significant (p = 0.061). The association between parity and prolonged hospital stays was also not significant (p = 0.259). Fischer's Exact Test was used for statistical analysis (as shown in Table 3).

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Table 3
Association of Factors with Demographics

Demographics		Emergency C-section Yes n(%)	No n(%)	p-value
Age (years)	≤30	11 (17.7%)	51 (82.3%)	0.238*
	>30	3 (7.9%)	35 (92.1%)	
Gestational age (weeks)	≤39	12 (14.8%)	69 (85.2%)	0.734*
	>39	2 (10.5%)	17 (89.5%)	
Parity	0-2	13 (16.3%)	67 (83.8%)	0.290*
	>2	1 (5.0%)	19 (95.0%)	
Prolonged duration of procedure				
Age (years)	≤30	29 (46.8%)	33 (53.2%)	0.111
	>30	24 (63.2%)	14 (36.8%)	
Gestational age (weeks)	≤39	42 (51.9%)	39 (48.1%)	0.635
	>39	11 (57.9%)	8 (42.1%)	
Parity	0-2	39 (48.8%)	41 (51.2%)	0.089
	>2	14 (70.0%)	6 (30.0%)	
Blood transfusion				
Age (years)	≤30	14 (22.6%)	48 (77.4%)	0.671
	>30	10 (26.3%)	28 (73.7%)	
Gestational age (weeks)	≤39	17 (21.0%)	64 (79.0%)	0.145
	>39	7 (36.8%)	12 (63.2%)	
Parity	0-2	18 (22.5%)	62 (77.5%)	0.482
	>2	6 (30.0%)	14 (70.0%)	
Prolonged hospital stay				
Age (years)	≤30	21 (33.9%)	41 (66.1%)	0.179
	>30	18 (47.4%)	20 (52.6%)	
Gestational age (weeks)	≤39	28 (34.6%)	53 (65.4%)	0.061
	>39	11 (57.9%)	8 (42.1%)	
Parity	0-2	29 (36.3%)	51 (63.7%)	0.259
	>2	10 (50.0%)	10 (50.0%)	

*Fischer Exact Test

DISCUSSION

The age, gestational age, and parity demographic factors were not significant predictors of infection in wounds, so these factors on their own may not be a significant predictive measure of infection risks. It suggests these factors are relevant to be aware of from a patient profile perspective but are not directly correlated to infection onset following surgery. The high rate of extended procedure time (53%) was revealed by the study to be a potential infection causal factor, being consistent with scientific evidence that refers to increased risks of infection where operative time is extended, since increased operative time means increased exposure to aseptic environments as well as potential contamination. Non-significant correlation of extended procedure with age, gestational age, and parity ($p > 0.05$) point towards surgery time being a more critical factor than patient-related factors.

Similarly, need of blood transfusion (24%) also was not statistically correlated with SSI, even though transfusions are reported to have an increased infection potential through compromising immunity response and promoting transfusion related complications. The results of this study ($p = 0.671$, $p = 0.145$, $p = 0.482$) further show that, while a confirmed risk factor elsewhere, transfusions may not strongly correlate directly with wound infection rates in this group of subjects.

Our subjects' demographic characteristics revealed a mean age of 28.69 ± 4.42 years, a mean gestational age of 37.84 ± 1.77 weeks, and a mean parity of 1.67 ± 1.32. The demographic profile is similar to that of Khatun et al.[11] where a similar age range was reported, although their study showed a higher rate in the 20–30 age group (63.2%). Consistent with the perspective that younger women are at higher risk of SSI, our data nonetheless identified no significant age variation ($p = 0.238$), which might be explained by differences in the samples' size, as well as by differences in the subjects' characteristics. Considering residential status, our analysis revealed 59% of participants living in urban settings, whereas 41% were living in rural settings. This demographic parity follows Khatun et al.[12] where an equal proportion of rural and urban participants was reported. Urban living, although linked to access to better healthcare, was not found to correlate highly with wound infection in our analysis. Socioeconomic level in our analysis revealed 39% were poor, 52% middle, and 9% rich, similar in proportion to what was reported by Kvalvik et al.[13] where emergency cesarean sections were a definite risk factor for SSI, particularly among socioeconomically disadvantaged individuals.

Regarding education, our research found that 7% were formally uneducated, 32% were educated at a primary level, 52% were educated at a secondary level, and 9% were educated at a higher level. The distribution reflects a relatively educated population, as found by Mohammad et al.[14] where lower level of education was correlated with increased rate of surgical site infections due to reasons such as inadequate prenatal care and ignorance. Uneducated status was also found by Mahana et al.[15] to be a strong risk factor, presumably because of inadequate hygiene and ignorance about preventive care. The predictors of wound infection in our analysis were emergency C-sections, 14%; prolonged procedure time, 53%; blood transfusions, 24%; and prolonged hospitalization, 39%. These predictors were also reported by Njoku et al.[16] who reported emergency cesarean delivery and prolonged rupture of membranes as predictors of SSI. Khatun et al.[12] reported that emergency cesarean sections were a frequent risk factor, with a high rate of patients having prolonged hospitalization (39%), consistent with our analysis.

Longer procedure time (53%) and blood transfusion (24%) were not found to correlate significantly with infection in our study ($p = 0.111$, $p = 0.671$, respectively). This finding differs from Khatun et al.[11] which showed that longer operating time and anemia correlated strongly with infection hazard. The absence of significant results in our observation might have been a result of a different study design or group, but Mohammad et al.[14] also pointed out that increased operating time and intraoperative blood loss were significant factors in causing wound infection. Lastly, a relationship was investigated between prolonged hospitalization and variables such as age, gestational age, and parity. In our cohort, prolonged hospital stay was more common in older patients (47.4%) than in younger patients (33.9%), although this was not statistically significant ($p = 0.179$). Kvalvik et al.[13] reported a similar observation where older age was linked to a slightly increased risk of infection.

These results are added to a body of evidence that emphasizes the necessity of identifying and preventing modifiable risks to lower post-cesarean infection incidence. In spite of these parallels, differences in statistical significance among studies are reflective of differences in region, demographics, and methodology.

Moreover, this study has some limitations. Because it is a

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single-center study, its results might not be generalized to a larger population. Samples taken might be few to include even a broad scope of various possible risk factors across various setups. More multicenter studies with more heterogeneous and higher-numbered populations would be excellent to cross-validate these results as well as establish applicability to various setups of infection prevention strategies.

CONCLUSION

We have concluded that emergency cesarean section, longer procedure duration, and blood transfusions are significant risks to surgical site infections. These results validate previous studies inasmuch as early control and management of such risks remain pivotal in a crusade against post-cesarean morbidity. Specific infection-prevention interventions remain paramount in such a review, particularly among high-risk populations. It also demands optimization of surgical technique in conjunction with early application of antibiotics in an effort to contain infection incidence within wounds, in addition to improving maternal cesarean section outcomes.

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