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Risk Factors for Wound Infection Following Caesarean Section: A Case Control Study from Sir Salimullah Medical College & Mitford Hospital in Dhaka, Bangladesh

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Abstract

Background: Post caesarean section (CS) wound infection or surgical site infection is a leading cause of prolonged hospital stay or readmission. An understanding of its risk factors is important. **Methods:** A case control study was conducted in the Department of Obstetrics and Gynecology of Sir Salimullah Medical College & Mitford Hospital, in Dhaka, Bangladesh from January to June 2014 to evaluate the risk factors of postoperative surgical site infection following CS. One hundred patients were studied. **Results:** Fifty patients of post CS wound infection (surgical site infection: SSI) were selected as cases. Body mass index > 25 (kg/m^2), anemia ($p = 0.001$), prolonged rupture of membrane ($p = 0.005$), prolonged operation time ($p = 0.019$), and junior surgeons performing the operation ($p = 0.011$) were the risk factors for CS-SSI. **Conclusions:** Pre- and postoperative care and surgical training of junior doctors should be directed to these risk factors.

Keywords

Caesarean Section, Body Mass Index, Wound Infection, Surgical Site Infection, Prolonged Rupture of Membrane

1. Introduction

Caesarean section (CS) is a common operation in obstetrics. An analysis of

health and demographic surveys of seventy-two low and middle income countries (LMICs) conducted between 2010 and 2014 showed national CS rates ranging from 0.6% in South Sudan to 58.9% in the Dominican Republic [1]. In Bangladesh, the CS rate increased from 3% in 2000 to 24% in 2014 [2]. CS is associated with an increased risk of maternal mortality. A meta-analysis of 196 studies from sixty-seven LMICs evaluated the risk of maternal death in women with CS [3]: 25% all women who died in LMICs had undergone CS.

CS wound infection (CS-surgical site infection (SSI): CS-SSI) is a major cause of prolonged hospital stay, high hospital cost, increased morbidity and mortality [3] [4] [5]. Best practices including antibiotic prophylaxis, vaginal preparation, and spontaneous placental removal have been recommended as an infection control [6]. Although the incidence CS-SSIs reported to range from 2% - 7% in high-income countries [7], it is not well known in low and middle-income countries [8]. Generally speaking, risk factors for CS-SSIs have been reported to include body mass index (BMI) more than 25, anemia, prolonged operative time, premature rupture of membranes (PROM), emergency procedure, pre-existing medical illness, and procedures performed by junior surgeons [9].

While SSIs most commonly manifest between the fifth to eight post-operative days, some SSIs may manifest as early as the third postoperative day depending on the type of bacterial infection [10] [11]. CS-SSI is diagnosed by documenting the typical clinical signs of inflammation, redness, pain and discharge of purulent material [12]. The purpose of this study was to identify the risk factors of CS-SSI in Bangladesh.

2. Materials and Methods

A case control study was done in the Department of Obstetrics and Gynecology, Sir Salimullah Medical College & Mitford Hospital, Dhaka, Bangladesh. Ethical approval was obtained from the Ethics Committee of this institute. One hundred patients who underwent low transverse CS were included. Average postoperative stay after CS was ten days. Patients were excluded if they had undergone CS through a midline sub-umbilical vertical incision. All patients had received preoperative antibiotics, a vaginal preparation, and appropriate surgical aseptic technique. Preoperative antibiotics included one dose of a cephalosporin prior to the skin incision. Surgical aseptic technique followed standard, established guidelines [13]. The vaginal preparation was made with a betadine swab of the vagina.

Patient records from January to June 2014 were reviewed and data was entered into a preapproved questionnaire that listed outcome variables. Outcome variables included BMI, diabetes mellitus, anemia, gestational age, urgency of operation, preoperative hospital stay, duration of operation, and the type of surgeon. All data was directly entered into the computer by using the SPSS/PC software. SSI diagnoses were based on physicians' diagnosis retrieved from the medical charts. SSI were defined as superficial incisional infections affecting skin

and subcutaneous tissues based on the following signs: redness, pain, heat, swelling at the incisional site, or drainage of pus [14].

3. Results

Of 100 patients, 50 and 50 did and did not have CS-SSI. As Table 1 shows, the mean age was 26.5 ± 6.9 and 25.15 ± 3.69 years in SSI (+) vs. (−) patients, respectively, without significance. Of 50 SSI (+) vs. (−) patients, 30 and 18%, respectively, had no formal education. Socioeconomic status (SES) did not differ between the two groups.

Table 2 tabulates the BMI of the fifty patients who developed SSIs compared to the fifty patients who did not. The mean BMI was found 34.3 ± 2.72 (kg/m^2) in case group and 31.2 ± 3.5 (kg/m^2) in control group. The difference of mean BMI was statistically significant ($p > 0.001$).

Table 3 compares SSI outcomes by the co-morbidities of anemia and diabetes. Diabetes mellitus was found in six (12.0%) of the case group and five (10.0%) of the control group and the difference was not statistically significant ($p > 0.05$). Anemia, in contrast was statistically significantly different ($p = 0.001$) between the two groups with 72% of the cases compared to 42% of the controls having anemia.

Table 4 examines the differences between the two groups by gravidity and parity. The difference was not statistically significant ($p = 0.334$) between two groups.

Other obstetrical variables evaluated by group in Table 5. Prolonged rupture

Table 1. Demographic variable of patients undergoing caesarean section.

Variables	Postop wound infection (n = 50)		No infection (n = 50)		*P value
Age	**No**	**%**	**No**	**%**	
<19	8	16.0	4	8.0	
20 - 24	7	14.0	11	22.0	
25 - 29	20	40.0	15	30.0	P = 0.225
30 - 34	8	16.0	12	24.0	
>35	7	14.0	8	16.0	
Mean ± SD	26.5 ± 6.9		25.15 ± 3.69		
Education					
No formal education	15	30.0	9	18.0	
Primary	28	56.0	25	50.0	
Secondary	7	14.0	16	32.0	
Socioeconomic status					
Lower class	41	82	37	74	
Lower middle class	9	18	13	16	

Table 2. Distribution of the study patients undergoing caesarean section by Body Mass Index (BMI).

BMI (kg/m²)	Postop wound infection (n = 50)		No infection (n = 50)		*P value
	No	%	No	%	
19 - 24	12	24.0	19	38.0	
25 - 29	27	54.0	21	42.0	
30 - 40	11	22.0	10	20.0	
Mean ± SD	34.3 ± 2.72		31.2 ± 3.5		P = 0.001
Range (min, max)	19 - 40		(19 - 38)		

Table 3. Distribution of the study patients undergoing caesarean section by anemia and diabetes mellitus.

Anemia and diabetes mellitus	Postop wound infection (n = 50)		No Infection (n = 50)		*P value
	No	%	No	%	
Anemia					
Yes	37	74.0	21	42.0	P = 0.001
No	13	26.0	29	58.0	
Diabetes mellitus					
Yes	6	12.0	5	10.0	P = 0.749
No	44	88.0	45	90.0	

Table 4. Distribution of the study patients undergoing caesarean section by gravida.

Number of pregnancies	Postop wound infection (n = 50)		No infection (n = 50)		*P value
	No	%	No	%	
Primiparous	37	74.0	41	82.0	P = 0.334
Multiparous	13	26.0	9	18.0	

Table 5. Distribution of the study patients undergoing caesarean section by obstetrics-related variables.

Obstetrics-related variables	Postop wound infection (n = 50)		No infection (n = 50)		*P value
	No	%	No	%	
Prolonged rupture of membrane	13	26.0	8	16.0	P = 0.005
Presence of preeclampsia	10	20.0	3	6.0	P = 0.037
Presence of meconium	3	6.0	2	4.0	P = 0.338

of membrane was found 13 (26.0%) in the case group and 8 (16.0%) in the control group. The difference was statistically significant (p = 0.005). Preeclampsia

was present in ten (20.0%) women with SSIs versus three (6.0%) women without SSIs. The difference was statistically significant (p = 0.037).

Table 6 evaluates the difference in SSIs by indications for surgery. Emergency Caesarean section was done 40 (80.0%) of patients who developed SSIs compared to 30 (60.0%) who did not. Routine Caesarean section was done 10 (20.0%) of patients in the case group and 20 (40.0%) in the control group. The difference was statistically significant (p = 0.005).

Table 7 documents the length of time from admission to Caesarean section. The mean duration of time between hospital admission and operation was 10.3 ± 6.5 hours in the case group and 7.10 ± 3.7 hours in the control group. The difference was statistically significant (p = 0.003).

Table 8 documents surgical times. Operation time was less than one hour for 28 (56%) of patients in the case group and 39 (78.0%) in the control group whereas 22 (44%) patients in case group and 11 (22%) patients in control group had operative times greater than one hour. The difference was statistically significant (p = 0.019).

The final table, Table 9, looks at SSI rates by the experience of the surgeon. Junior surgeons performed operations for 35 (70%) of patients who developed

Table 6. Distribution of the study patients undergoing caesarean section by urgency of operation.

Urgency of operation	Postop wound infection (n = 50)		No Infection (n = 50)		*P value
	No	%	No	%	
Emergency Caesarean section	40	80.0	30	60.0	P = 0.005
Routine Caesarean section	10	20	20	40	

Table 7. Distribution of the study patients undergoing caesarean section by duration of time between hospital admission and operation.

Duration of time between hospital admission & operation	Postop wound infection (n = 50)		No infection (n = 50)		*P value
	No	%	No	%	
<6 hrs	13	26.0	25	50.0	
6 - 12 hrs	22	44.0	21	42.0	
>12 hrs	15	30.0	4	8.0	
Mean ± SD	10.3 ± 6.5		7.10 ± 3.7		P = 0.003

Table 8. Distribution of the study patients by duration of operation.

Duration of operation (hr)	Postop wound infection (n = 50)		No Infection (n = 50)		*P value
	No	%	No	%	
<1 hr	28	56.0	39	78.0	P = 0.019
>1 hr	22	44.0	11	22.0	

Table 9. Distribution of the study patients undergoing caesarean section by experience of the Surgeon.

Surgeon	Postop wound infection (n = 50)		On Infection (n = 50)		*P value
	No	%	No	%	
Junior Surgeon/Registrar	35	70.0	37	74.0	P = 0.011
Senior Surgeon/Consultant	15	30.0	13	26.0	

SSIs whereas for senior surgeons, SSIs developed in 15 (30%) of patients. The difference was statistically significant (p = 0.011).

4. Discussion

We here demonstrated CS-SSI risk factors in Bangladesh. There have been very few published data on this topic in Bangladesh. A study from Bangabandhu Sheikh Mujib Medical University (BSMMU) in Dhaka, a large postgraduate hospital reported on SSIs following general surgical cases [15]. There was a 20% wound infection rate among 496 elective general surgical procedures. SSIs increased with degree of contamination and increasing operative time. The common risk factors were anemia (52%), malnutrition (44%), diabetes (38%), jaundice (30%), contaminated operation (44%), dirty operation (38%), obesity and smoking. In another tertiary care hospital in Bangladesh, overall prevalence rate of SSI was 14% and that the 3 most common pathogens isolated were *Staphylococcus aureus* (41.9%); *Escherichia coli* (30.8%); and *Enterococcus* spp. (12%) [16]. There are no published reports from Bangladesh that have specifically examined CS-SSI rates. One report of 124 eclamptic patients with CS showed a morbidity rate, which included infections of 53% [17].

There are well known interventions to reduce SSIs including good surgical tissue handling and aseptic technique [18] [19]. The use of prophylactic antibiotics in women undergoing CS reduced SSI, endometritis and serious infectious [20]. This leads us to believe that prophylactic antibiotics may reduce the CS-SSI rate in this area. Other risk reduction interventions include vaginal cleansing with sponge stick preparation of povidone-iodine 10% for at least 30 seconds immediately before CS: this actually reduced the risk of postoperative endometritis [21] [22]. A meta-analysis of six randomized controlled trials and three cohort showed that in high-risk obese women prophylactic negative pressure wound therapy reduced CS-SSI [23].

The incidence of CS has dramatically increased in Bangladesh [2]. With this increase, increased risk of infections and long-term morbidity and mortality have become concerns. In a study of 500 consecutive patients with CS, there was 24% SSI [24]. Risk factors for SSIs included PROM, antibiotics given earlier than two hours before the procedure, and increased length of hospital stay [24].

In our study, of 100 patients, 70 underwent emergent CS. Emergency Caesarean sections increase the risk of SSI as compared to elective surgery [11] [12]

[25]. In this study, the mean age was similar between women with SSI (+) vs. (−), which accorded with the previous data [26]. Also, we re-confirmed that high BMI increased the rate of CS-SSI, similar findings with the previous report [12] [27]. Patients with anemia were more prone to CS-SSIs. Anemia diminishes resistance to infection and is frequently associated with puerperal sepsis. Preoperative anemia is an important predictor of infection [28] [29].

Patients with preexisting illnesses like diabetes mellitus, or malnutrition were more prone to infection. Hypertension, preexisting or pregnancy induced, and other co-morbid states have been associated with SSI [30]. We did not find a significant difference in SSIs between our patients with or without diabetes mellitus.

PROM was a significant risk for SSI. In the present study, 44% and 42% of the case and control patients, respectively, underwent CS within 6 - 12 hours after admission. In contrast, 26% and 50% of case and control patients underwent CS in less than 6 hrs after hospitalization. A significant correlation was found between the duration of preoperative hospital stay and development of SSI. Previous studies also found a similar association of delay in surgery with SSIs [5] [31] [32]. We found the highest incidence of SSI on the seventh postoperative day, being consistent with other studies [27].

Operations performed by junior surgeons had statistically significantly higher risk of SSI compared to senior surgeons. Other studies have found an association between surgical experience and risk of SSI [33] [34].

This study was the first report to analyze risk factors for CS-SSIs in Bangladesh. The strength of this study was a cohort study in a single institution. The limitation of this study was its retrospective nature, which could introduce selection bias. A cross-section of patients undergoing CS was analyzed and this population may not represent all CS-patients. There is an urgent need for the development of a complete booking/registration system.

5. Conclusion

This study demonstrated CS-SSI risk factors in Bangladesh. Identified risk factors included increased body weight, diabetes, anemia, PROM, and surgeries performed by junior surgeons. The data were fundamentally similar to data from other countries. The use of evidence-based risk reducing interventions as reported by others will improve outcomes [35].

Conflicts of Interest

The authors have no conflicts of interest.

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