Original Article

Study on Risk Factors and Microorganisms for Surgical Site Infection following Caesarean Section among 100 Patients in a Tertiary Hospital in Bangladesh

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Abstract

***Background**: Lower uterine caesarean section is a common mode of delivery now and surgical site infection is one of the most common and dreaded complication of surgery. It is associated with significant morbidity and delayed recovery and it lengthens hospital stay and costs. Identifying risk factors for surgical site infection in caesarean wound and modifying them can be beneficial for patient management during surgery and optimizing good clinical outcome. Identifying microorganisms with their sensitivity has epidemiological as well as therapeutic implications. **Objective**: To identify risk factors for surgical site infection in caesarean section wound and find out microorganisms responsible for such infection. **Materials and Methods**: In this study 100 women with surgical site infection after caesarean section were included. They were selected randomly from four maternity units of Dhaka Medical College Hospital. Each patient of caesarean section was followed strictly up to discharge from hospital and also for 30 days postoperatively for any evidence of infection. Wound swab was sent in each case for microbiological study. Data were collected in structured questionnaire and analysed by computer using spreadsheet. **Results**: Among 100 women studied, 73% had inadequate or no antenatal check-up, 52% had duration of labour pain >12 hours, 52% had duration of ruptured membrane >12 hours, 94% women underwent emergency caesarean section, 62% had operation time >1 hour, 61% had haemoglobin level <60%, 46% women had intervention by untrained birth attendant, and 43% women had >500 mL blood loss during operation. In bacteriological study, microorganisms were identified in 55% cases, among them Staphylococcus aureus (20%), E. coli (11%), Acinetobacter (7%), Pseudomonas (6%) and Proteus (5%). During sensitivity test Staphylococcus aureus was mostly sensitive to ceftriaxone (50%) and amikacin (33%) and E. coli to amikacin (80%). In four cases (2 proteus and 2 pseudomonas) out of 55 organisms were resistant to all antibiotics. **Conclusion**: Most of the risk factors for surgical site infection during caesarean section identified in this study can be modified through intervention. However, the microorganisms detected from our patients showed a high degree of resistance for commonly prescribed antimicrobials in our set-up.*

***Key words**: Surgical site infection; Caesarean section; Microorganisms; Risk factors*

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Introduction

Caesarean section (CS) is the most commonly performed major abdominal operations among women in both developed and developing countries.[1] Globally, the CS rate is approximately 15%.[1]

With improvements in anaesthesia, blood transfusion, pain control and antibiotics, serious complications from caesarean section have fallen dramatically in the last 30 years. Surgical site infection still continues to be a major problem even in hospitals with most modern facilities.[2]

Surgical site infection is a common postoperative complication and is associated with significant morbidity and occasional mortality, prolongs hospital stay, often needs re-admission and adds 10−20%

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of extra-hospital cost.[3-5] They constitute third most common nosocomial infection and thus are responsible for significant psychological and economic burden to the society. The occurrence of surgical site infection (SSI) following a CS reported in literature ranges from 0.3% in Turkey[5] to 24%[4] in Tanzania. The causes of surgical site infection following caesarean section are universal with only a very little regional variations.[7-10] Intrinsic factors are patient-related and include age, obesity, underlying medical conditions like diabetes mellitus, hypertension, asthma, immunocompromised states like HIV infection, hypoalbuminaemia, hyperlipidaemia, anaemia. Extrinsic factors relate to the management and care, which include preoperative preparation of the patient (part preparation and skin asepsis), type of procedure (emergency/elective), type of anaesthesia (regional/general), type of skin incision (horizontal/vertical), method of skin closure, type of suture used (mono/polyfilament) or use of staples, antibiotic prophylaxis, duration of labour prior to CS, prolonged period of rupture of membranes, manual extraction of placenta, chorioamnionitis, number of vaginal examinations carried out before surgery, duration of operation, transfusion of blood products, grade of operator (consultant/registrar/ senior resident), previous caesarean section, and environment of the operating room.[11,12] Pathogens that infect CS surgical wounds can be part of the patient's normal flora (endogenous source) which originate from the skin, vaginal and peritoneal cavities or can be acquired from the hospital environment, other infected patients, and surgeons (exogenous source).[13-15]

In 1992 US Center for Disease Control (CDC) revised its definition of wound infection creating the definition SSI to minimise confusion between infection of a surgical incision and the infection of a traumatic wound.[16] According to CDC a surgical site infection is defined as an infection which occurs at the incision/operative site (including drains) within 30 days of surgery (within a year in case of implants). The infection must appear to be related to the surgical procedure. According to CDC's National Nosocomial Infection Surveillance system 38% of all nosocomial infections in surgical patients are surgical site infections. The CDC definition describes three levels of surgical site infection ─ 'superficial incisional' affecting the skin and subcutaneous tissue, 'Deep incisional' which affects the fascial and muscle layers and 'Organ or Space infection' which involves any part in the body other than the incision that is opened or manipulated during the surgical procedure.[16]

Classically presence of SSI is diagnosed by documenting the typical sign of inflammation along with drainage of pus from the wound and positive culture.[16] As multiple risk factors influence the development of surgical site infection, awareness of these will help to promote effective preventive strategies. Early diagnosis and isolation of organism with use of appropriate antibiotic can reduce the morbidity and mortality due to SSI.[16]

Although total elimination of SSI is not possible, careful pre-, intra- and post-surgical prevention and management of associated risk factors, with stringent infection control practices in the operation room can help to achieve minimal infection rates in patients undergoing caesarean section, which could have significant benefits in terms of both patients' comfort and medical resources used.[17]

Materials and Methods

This cross-sectional descriptive study was carried out in the Department of Obstetrics and Gynaecology, Dhaka Medical College & Hospital, Dhaka from January to December 2008. Total 100 consecutive patients who developed surgical site infection after caesarean section were included in the study irrespective of the indication. In this hospital 3904 LUCS were done during this study period. Prophylactic antibiotics were given to all patients. The patients were assessed postoperatively. Dressings were left undisturbed unless there was unusual throbbing pain around the wound and bandage was soaked. Surgical wound was inspected at the time of first dressing and daily thereafter till discharge of the patient, on readmission to hospital and on day visits to hospital. Surgical site infection was detected on the basis of the criteria given in the modified CDC definition, 1992[16].

Data were collected from every patient by means of a detailed questionnaire. Cases were reviewed in details with respect to their sociodemographic characteristics, type of CS, indication, characteristics of the antecedent labour, duration of the labour, duration of rupture of membranes, number of vaginal examinations, duration of surgery, blood loss and postoperative hospital stay. All patients suspected of having wound infection had wound swab cultured in accordance with local practice,

where all suspected SSIs had swabs taken prior to commencement of antibiotics or as soon as the diagnosis was suspected. Where the culture was positive, an antibiotic sensitivity of the organism grown was carried out using standard microbiology techniques.

Purulent discharge was collected from the surgical incision site with sterile cotton swabs. Complete blood count, blood sugar and urine for routine and microscopic examination were carried out. Data were recorded on a predesigned study questionnaire and managed on an excel spreadsheet. Categorical variables were summarised by frequency (percentage).

Results

During the study period 3904 caesarean operation were done. Among them 444 cases (11.37%) developed surgical site infection. From these 444 cases 100 patients were randomly chosen for this study.

Table I: Clinical characteristics of patients with surgical site infections following caesarean section (N=100)

Characteristics	Number	Percentage
Age in years		
<20	7	7
20−34	84	84
≥35	9	9
Parity		
Primipara	55	55
1−3	30	30
≥4	15	15
Gestational age in weeks		
<36	20	20
36−40	73	73
>40	7	7
Antenatal check up		
Regular (>4)	27	27
Irregular (1−3)	61	61
No	12	12
Types of caesarean section		
Elective	6	6
Emergency	94	94
Nutritional status (BMI)		
Underweight (<18.5)	13	13
Normal weight (18.5−24.9)	73	73
Overweight (≥25)	14	14

Age of the women ranged from 16−40 years, majority of them (84%) were between 20 to 34 years of age and 55% were primiparas. The gestational age at caesarean delivery ranged between 28–42 weeks and 80% delivered at term.

Table II: Indications for caesarean section (N=100)

Indications	Number	Percentage
Previous CS with scar tenderness	16	16
Foetal distress	9	9
Prolonged labour	14	14
Malpresentation	12	12
Obstructed labour	18	18
Hypertensive disorders of pregnancy & eclampsia	13	13
Antepartum haemorrhage	2	2
PROM with chorioamnionitis	7	7
GDM	3	3
Others*	6	6
Total	100	100

* Included maternal distress, mothers' request, twin with malpresentation, cord accident and failed induction of labour

Magnitude and burden of surgical site infections

Total 94% SSIs occurred among patients who had emergency caesarian sections. All SSIs occurred between the 3rd and 22nd day postoperatively with a median time of occurrence of seven days post-operation. Patients with a SSI had longer hospital stays ranging from 7 to 35 days.

Post-caesarean SSI occurred significantly more often among women with anaemia (61%), prolonged duration of labour (52%), rupture of membranes prior to surgery lasting 12 hours or longer (52%), 4 or more vaginal examinations (39%), blood loss during operation >500 mL (43%), intervention by untrained dai (46%) and prolonged duration of operation (a surgical procedure lasting longer than 1 hour) (62%).

Tables III: Medical disorders among study subjects (N=100)

Medical disorders	Number	Percentage
Hypertension	24	24
Skin infection	10	10
Diabetes	3	3
Asthma	3	3
Haemoglobin level in g/dL		
>10	39	39
<10	61	61

Some patients had more than one disorders

Table IV: Labour and operation events

Duration of ruptured membrane in hours	
≤12 hrs	28
>12	52
Intact membrane	20
Number of vaginal examinations	
≤3	61
>4	39
Duration of labour in hours	
≤12	30
>12	52
No labour pain	18
Intervention by untrained dai	
Intervention	46
No intervention	54
Duration of operation	
<1 hour	38
>1 hour	62
Use of drain	
Yes	26
No	74
Amount of blood loss	
<500 mL	57
500−1000 mL	41
>1000 mL	2
Secondary suture	
Not required	12
Required	88
Total hospital stay	
7−10 days	12
11−20 days	67
21−30 days	17
>30 days	4

All women received antibiotics as prophylaxis with different timings of administration either before or after skin incision. No specific policy was followed and the choice of antibiotics used was based on indication of CS and surgeons' preference. The antibiotics given could be divided into amoxicillin and metronidazole (51), amoxicillin, metronidazole and gentamicin (29%) and ceftriaxone and metronidazole (20%).

Bacterial isolates and susceptibility pattern

Pus swabs for aerobic culture and sensitivity were collected for all postoperative infection cases. Of aerobic cultures, 55% were culture positive and 6 had significant polymicrobial infection. *Staphylococcus aureus* was the most common organism (20%). Other isolates include *Escherichia coli* (11%), *Acinetobacter spp* (7%), *Pseudomonas spp* (6%), *Proteus spp* (5%). *Staphylococcus aureus* were mostly sensitive to ceftriaxone (50%), amikacin (33%) azithromycin (27.9%) and gentamicin (14.3%). Most of the *E.coli* (80%) were sensitive to amikacin. Both were highly resistant to ampicillin (100%), amoxicillin/clavulanate (50%) and sulphamethaxazole/trimethoprim (78.5%). They were 100%, 85.7% and 68% sensitive to meropenem, ceftazidime and ciprofloxacin respectively. Four cases (2 *proteus* and 2 *pseudomonas*) were resistant to all antibiotics.

Discussion

This study aimed to determine the prevalence of SSI, the risk factors, the common bacterial pathogens and their antibiotic sensitivity. In this study, the prevalence of SSI following caeserian section was 11.37%, which was consistent with another study.[18] The rate was higher than another study which was 3.2%.[8] Recently, Ward et al[9] in a multi-centre collaborative study of SSI following CS in the UK reported overall wound problem of 13.6% and SSI of 8.9%. This, however, ranged between 2.9% and 17.9%. These authors prospectively studied CS wound infection, including the use of post-discharge surveillance. We did not use post-discharge surveillance in our series but all patients who complained of wound problem in the post-discharge period and who were found to have infection were included. Although SSI rate of 11.37% in our patients is well within the range of 2.9% to 17.9% sited above, perhaps the prevalence of SSI in these patients is even higher as our cases were limited to those patients whose SSI was detected before discharge and those who came back because of complications. This is opposed to other workers who used community midwives for purposes of post-discharge surveillance. In their review Graffiths et al[10] reported an incidence of 9.9%.

In this study most of the patients had inadequate or no antenatal check up which is associated with infection. In a study by Killian et al[19] in New York in 2001 <7 antenatal visits was associated with infection which is consistent with our study. This is the singlemost important factor where intervention is mostly effective and by good antenatal care we can prevent many

other risk factors studied like anaemia, hypertension, prolonged rupture membrane, and thus we can avoid many emergency caesarean sections. In this study surgical site infection were more in the patients with rupture of membrane of more than 12 hours. Study by Killian et al[19] in New York and Tran & Jamulitrat[20] in Vietnam also support this finding. Rupture of membrane for a long time causes infection ascending from vagina into uterine cavity and chorioamnionitis.

In this study surgical site infection was more in the patients who underwent emergency caesarean section. Generally patients undergoing emergency CS are at higher risk of infections.[21-23] This is because of inadequate preparation time owing to maternal or foetal threat. Similar result was found by others.[21-23] In a study by Opien et al[18] in 2003 in Norway, no difference was found between emergency and elective caesarean section.

In this study surgical site infection was more in patients who had operation lasting for more than one hour. In a study by Opien et al[18] in 2003 in Norway, surgery time >38 minutes was significantly associated with surgical site infection. A study by Killian et al[19] in New York also supports this finding. Longer operation time leads to desiccation and maceration of wound edges, increase number of bacteria, decreased temperature and hypovolaemia leading to peripheral vasoconstriction and poorly perfused skin.

CSs complicated by SSI in this study were more likely to lose more blood intraoperatively and received blood transfusion. This suggests that intraoperative bleeding may predispose to infectious morbidity, other workers had similar observations.[9]

Haemoglobin less than 10 gm/dL was found in the patients with surgical site infection in this study. Anaemia is a known risk factor for infection. Tissue oxygenation is maximum when haemoglobin is more than 11 gm/dL and this facilitates optimum healing.[24]

In bacteriological study, microorganisms were identified in 55% cases. *Staphylococcus aureus* was the most common organism (20%). Other isolates include *Escherichia coli* (11%), *Acinetobacter spp* (7%), *Pseudomonas spp* (6%) and *Proteus spp* (5%).

In three cases polymicrobial infection was found. In a study by Aziz A[25] in Dhaka Medical college Hospital in 1997, causative organism was identified in 60% cases. Those were *Staphylococcus aureus* (in 26% cases), *Escherichia coli*, *Streptococcus pyogens*, *Pseudomonas, Proteus* & *Bacteroids*. In a study in 2007 by Anguzu JR[14] in a referral hospital in Uganda micro-organisms were identified in 58.5% specimens. The isolates were *Staphylococcus aureus* (45.1%), *Escherichia coli* (16.9%), *Pseudomonas spp* (9.9%), *Proteus spp* (11.3%) and *Klebsiella* (7%). Most of the organisms were sensitive to gentamicin, ciprofloxacin and ceftazidime. The present study is more or less consistent with the previous studies regarding micro-organisms, but antibiotic sensitivity is different. In previous studies organisms were sensitive to commonly used antimicrobials like cotrimoxazole, ciprofloxacin, doxycycline, tetracycline, gentamicin. But in our study, organisms were sensitive to common and cheaper antibiotics in few cases only. S*taphylococcus aureus* were mostly sensitive to ceftriaxone (50%) and amikacin (33%). Most of the *E. coli* were sensitive to amikacin (80%). Both were highly resistant to ampicillin (100%), amoxicillin/clavulanate (50%), cotrimoxazole (78.5%). They were 100%, 85.7%, and 68% sensitive to meropenem, ceftazidime, ciprofloxacin respectively. Four cases (2 *proteus* and 2 *pseudomonas*) were resistant to all antibiotics. This finding is a real threat to both patients and doctors.

In this study, 45% cases had no bacterial growth. There is probability of anaerobic bacteria in these cases because culture was incubated aerobically. This could also be due to antimicrobial activity in patients' circulation because all of them were on antibiotic therapy postoperatively at the time of collecting samples.

In Bangladesh 64% pregnant women receive antenatal check-up and 42% births are attended by skilled birth attendant.[26] Most risk factors are identified before operation and are potentially modifiable through good antenatal care. Strategies for prevention of surgical site infection in caesarean patient must target prolonged labour from unbooked emergencies, training of surgeons to improve their skills, reduce intraoperative blood loss and long operating time. Use of antimicrobial agent should be judicial. It becomes imperative to understand the local antibiotic susceptibility patterns existing in a community to

design a suitable antibiotic policy. Each hospital authority should ensure standard of infection control and steps should be taken to improve further.

Limitations of the study

1. Sample size was small.
2. Anaerobic culture could not be done due to lack of hospital facilities.
3. Post-discharge surveillence could not be done as most patients could not be followed for 30 days.

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