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Original article

Incidence of Post Cesarean Section Infection in Emergency Unit of Gynecology and Obstetrics in Benha University Hospital

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Abstract

Background: sepsis in the postpartum period is one of the leading causes of maternal mortality and morbidity mainly due to Surgical Site Infection (SSI). SSI incidence after Cesarean section (CS) increase the awareness for the importance of its prevention and improving maternal outcome; **This study aimed to** determine incidence, risk factors and management of SSI following CS in emergency unit of gynecology and obstetrics in Benha University Hospital; **Methods:** This study was a prospective study conducted in Emergency Unit of Gynecology and Obstetrics Benha University Hospital in the period from 1st August, 2023 to 28th February 2024 over 500 female patients; **Results**: Among the studied cases there were 33 (6.6%) with SSI, 7 (21.2%) with deep incisional SSI, 11 (33.3%) with organ/space SSI and 15 (45.5%) with superficial incisional SSI. There were 30 (84.8%) managed by medical (dressings and antibiotics), 3 (6.1%) by surgical exploration. There was statistically significant difference between the two studied groups regarding age and BMI, parity, ANC visits and obesity, and operation data and complications; **Conclusion:** There are significant risk factors for SSI such as, high parity, emergency CS, gestational age (less than 37 weeks), protracted labor (more than 24 hours), blood loss (more than 1000 milliliters), extended surgical time (more than 1 hour), chorioamnionitis, PROM, absence of ANC visits, obesity, diabetes, and hypertension. Addressing these risk factors lowers the chance of developing SSI after CS and may improve the result of the procedure.

Keywords: sepsis, postpartum period, maternal mortality and morbidity, Cesarean section, Surgical Site Infection.

Introduction:

Cesarean section (CS) is the commonest obstetric surgical procedure, its global rates (including both emergency and elective) are ranging from 5 to 20% and the rates continue to rise in both developed and developing countries. The Center for Disease Prevention and Control (CDC) defined Surgical Site Infection

(SSI) as an infection which happens within a month following surgical intervention and includes three types: superficial incisional SSIs (primary & secondary), deep incisional SSIs (primary & secondary) and organ/space SSIs (1).

In the developing countries, SSI is the major infection affecting more than 60% of the operated patients. Surgical site infections (SSIs) are significant causes of morbidity and mortality in patients performing all types of operations, these infections lead to an increase in the duration of hospitalization, costs of health care, morbidity and mortality. Globally, a wide range of SSI rates after CS was reported, it has been reported that this rate ranged from 3 to 15% "depending on the methods used to identify infections (2).

Several risk factors for SSI post CS were identified. Of these, some preoperative conditions such as hypertension, Diabetes Mellitus (DM), obesity, high parity, prolonged labor, premature rupture of membranes (PROM), chorioamnionitis, emergency CS, and no antenatal care (ANC) visits**.** Also, some intraoperative conditions were significantly associated with developing SSI such as prolonged operative duration, vertical skin incision in addition to interrupted skin suturing. While blood loss was found to be a risk factor for SSI postoperatively (3).

Pathogens that infect CS surgical wounds can be part of the patient's normal flora (endogenous source), originate from the skin, vaginal and peritoneal cavities, or can be acquired from the hospital environment, other infected patients, and surgeons (exogenous source) **(4).** In general, infection (sepsis) in the postpartum period is considered one of the leading causes of maternal mortality and morbidity from which SSI shares the principal proportion. The knowledge about the incidence and associated risk factors for SSI after CS helps to increase the awareness among the health care professionals for preventing SSI and improving maternal outcome **(5).**

The purpose of this study was to determine incidence, risk factors and management of SSI following CS in emergency unit of gynecology and obstetrics in Benha university hospital.

Patients and methods:

Patients:

This a prospective cohort study was performed in the Emergency Unit of Gynecology and Obstetrics of Benha University Hospitals in the period from 1st August, 2023 to 28th February 2024 over 500 female patients. An informed written consent was obtained from the patients. Every patient received an explanation of the purpose of the study and had a secret code number.

Inclusion criteria were patients with any surgical site infection following cesarean section in emergency unit diagnosed, according to CDC criteria for SSI, on hospital stay or on follow-up after discharge in study duration.(1)

Exclusion criteria were women who did not response to follow-up or who did not show up for follow-up notification. Patients who had undergone cesarean hysterectomy related to delivery were also excluded.

Methods:

All studied cases were subjected to the following: Detailed history taking, Full clinical examination: General examination

Routine laboratory investigations**.** All patients were subjected to Preoperative, intraoperative and Postoperative protocols of Benha University Hospital for reduction infectious morbidity associated with CS. Preoperative protocol included Combination antibiotics during ROM, Control blood glucose level during and post CS, using antibiotic prophylaxis before CS, using antiseptic containing for vaginal preparation and not removing hair except interfere with surgical site. Intraoperative protocol included good infection control, sterilization and toweling, sterilized instruments and antibiotics (Ceftaxime 1gm). While postoperative protocol included scheduling post-operative follow up appointments for all patients one and 6 weeks after the CS in the outpatient clinic.

Superficial incisional SSI is defined as infection which occurs within 30 days after the operation and infection involves only skin or subcutaneous tissue of the incision and at least one of the following: Purulent drainage, with or without laboratory confirmation, from the superficial incision or organisms isolated from an aseptically obtained culture of fluid at least one of the following signs or symptoms of infection, pain or tenderness localized swelling, redness, or heat. Superficial incision is deliberately opened bysurgeon, unless incision is culture-negative diagnosis of superficial incisional surgical site infection (SSI) by surgeon or attending physician.

Deep incisional SSI is defined as infection which occurs within 30 days after the operation and infection involves deep soft tissue(e.g. Fascial and muscle layers) of the incision and at least one ofthe following: Purulent drainage from the deep incision but not from the organ/space component of the surgical site, OR a deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38C), localized pain, or tenderness, unlesssite is culture-negative, OR an abscess or other evidence of infection involving the deep incision is found on direct examination, during re-operation, or by histopathologic or radiological examination, OR diagnosis of a deep incisional SSIby a surgeon or attending physician.

Organ/space SSI infection is defined as infection occurs within 30 days after the operation and infection involves any part of the anatomy (e.g. organs or spaces), other than the incision, which was opened or manipulated during an operation and at least one of the following: Purulent drainage from a drain that is placed through a stab wound into the organ/space OR organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space OR an abscess or other evidence of infection involving the organ/space that is found on direct examination, during re-operation, or by histopathologic or radiological examination OR diagnosis of an organ/space SSI by a surgeon orattending physician.

Patients with superficial incisional SSI were usually managed at the outpatient clinic with repeated dressings and antibiotics till either complete healing of the wound achieved, or hospital admission needed. Patients with deep incisional SSI and organ/space SSI were admitted to the inpatient ward according tothe hospital protocol for medical ± surgical management. Any Cesarean Section Infection was managed according to the Benha University Hospital Postoperative protocol which included good

observation, Hospitalization 6:8 hrs, Giving antibiotic in 3 protocols: protocol 1 ceftriaxone 1gm/24hr, protocol 2 sulbactam 1.5gm/12hr and protocol 3 levofloxacin 750/12hr in non-lactating women

Statistical analysis

Statistical analysis was done by SPSS v26 20.0. (Armonk, NY: IBM Corp). Quantitative variables were presented as mean and standard deviation (SD) and compared between the two groups utilizing unpaired Student's t- test and ANOVA (F) test. Qualitative variables were presented as frequency and percentage (%) and were analyzed utilizing the Chi-square test or Fisher's exact test when appropriate. A two tailed P value < 0.05 was considered statistically significant.

Ethical approval code: MS 26-7-2023

Results:

547 patients were included in our study, 47 of them were excluded (29 didn't meet our inclusion criteria and 18 declined to participate), so we were left with 500 cases included in the study. The mean age of the studied cases was 26.95 (±5.42 SD) with range (20-41), the mean BMI was 27.11 (±3.73 SD) with range (20.2-38.9) and among the studied cases there were 300 (60%) rural residents and 200 (40%) urban residents. According to parity among the studied cases there were 62 (12.4%) nullipara, 407 (81.4%) with parity 1-3 and 31 (6.2%) with parity ≥4, according to gestational age there were 48 (9.6%) less than 37 weeks and 452 (90.4%) more than 37 weeks and according to type of cesarean section there were 183 (36.6%) elective and 317 (63.4%) emergency. According to ANC visits among the studied cases there were 96 (19.2%) with no visits, 198 (39.6%) 1-4 visits 206 (41.2%) >4 visits, there were 33 (6.6%) with chorioamnionitis, 138 (27.6%) with obesity, 28 (5.6%) diabetes mellitus and 10 (2%) hypertension as shown in **Table 1**.

According to labor duration among the studied cases there were 454 (90.8%) <24 hours and 46 (9.2%) ≥24 hours. According to the duration of CS among the studied cases there were 345 (69%) ≤1 hour and 155 (31%) >1 hour, there were 341 (68.2%) who used antibiotic prophylaxis, 405 (81%) used urinary catheterization, 17 (3.4%) who had bleeding and 77 (15.4%) who had PROM. Among the studied cases there were 33 (6.6%) with SSI, among them there were 7 (21.2%) with deep incisional SSI, 11 (33.3%) with organ/space SSI and 15 (45.5%) with superficial incisional SSI and according to management there were 30 (84.8%) were managed by medical (dressings and antibiotics), 3 (6.1%) by surgical exploration as shown in **Table 1**. There was a statistically significant difference between the two studied groups regarding age and BMI. There was statistically significant difference between the two studied groups regarding parity as shown in **Table 2**.

There was a statistically significant difference between the two studied groups regarding ANC visits and obesity. There was no statistically significant difference between the two studied groups regarding labor duration. There was a statistically significant difference between the two studied groups regarding operation data and complications as shown in **Table 3.**Among the infected cases there is 1 (3%) case take Ceftriaxone 1gm, 1(3%) case take Sulbactam 1.5gm and 2(6%)

take Ciprofloxacin 750mg as shown in **Table 4.**

Table 1: Demographic data, Obstetric history, history data & comorbidities, duration of hospital stay, operation data and complications and infection data among studied cases

Demographic data	**Subjects (n = 500)**	
Age (years)		
Range.	20 – 41	
Mean ± SD.	26.95 ± 5.42	
BMI (kg/m2)		
Range.	20.2 – 38.9	
Mean ± SD.	27.11 ± 3.73	
Residence		%
Rural	300	60
Urban	200	40
Obstetric history		
Parity		
0	62	12.4
1-3	407	81.4
≥4	31	6.2
Gestational age		
<37 wks.	48	9.6
≥37 wks.	452	90.4
Type of the CS		
Elective	183	36.6
Emergency	317	63.4
history data & comorbidities		
ANC visits		
Non	96	19.2
1-4	198	39.6
>4	206	41.2
Chorioamnionitis	33	6.6
Obesity	138	27.6
Diabetes Mellitus	28	5.6
Hypertension	10	2.0
Duration of hospital stay		
<24 h	454	90.8
≥24 h	46	9.2
Duration of CS		
≤1 h	345	69.0
>1 h	155	31.0
Antibiotic prophylaxis	405	81.0
Urinary catheterization	322	64.4
Bleeding (> 1000 ml)	17	3.4
PROM	77	15.4
infection data		
SSI	33	6.6
Types of SSI		
Deep incisional SSI	7	21.2
Organ/space SSI	11	33.3
Superficial incisional SSI	15	45.5
Management of SSI		
Medical (dressings and antibiotics)	30	90.9
Surgical exploration	3	9.1

Table 2: Relation between SSI and demographic data, and obstetric history

Demographic data	Cases				Test of sig.	p
	Non-SSI (n = 467)		SSI (n = 33)			
Age (years)						
Range.	20 – 41		21 – 40		t=	0.019*
Mean ± SD.	26.8 ± 5.39		29.09 ± 5.43		2.356	
BMI (kg/m2)						
Female	20.2 – 34		25 – 38.9		χ^2=	<0.001*
Male	26.89 ± 3.61		30.37 ± 3.9		5.329	
Residence	No.	%	No.	%		
Rural	278	59.5	22	66.7	χ^2=	0.688
Urban	189	40.5	11	33.3	0.162	
Obstetric history						
Parity	No.	%	No.	%		
0	58	12.4	4	12.1	χ^2=	0.012
1-3	384	82.2	23	69.7	8.778	
≥4	25	5.4	6	18.2		
Gestational age						
<37 wks.	44	9.4	4	12.1	χ^2=	0.611
≥37 wks.	423	90.6	29	87.9	0.259	
Type of the CS						
Elective	172	36.8	11	33.3	χ^2=	0.687
Emergency	295	63.2	22	66.7	0.162	

Table 3: Relation between SSI and history data & comorbidities, duration of hospital stays, and operation data and complications

History data & comorbidities	Cases				χ^2	p
	Non-SSI (n = 467)		SSI (n = 33)			
ANC visits	No.	%	No.	%		
Non	84	18.0	18	54.5	27.410	0.004*
1-4	187	40.0.	11	33.3		
>4	196	42.0	4	12.12		
Chorioamnionitis	29	6.2	4	12.1	1.747	0.186
Obesity	123	26.3	15	45.5	5.637	0.018*
Diabetes Mellitus	24	5.1	4	12.1	2.842	0.092
Hypertension	9	1.9	1	3.0	0.191	0.662
Duration of hospital stay						
Duration of hospital stay	No.	%	No.	%		
<24 h	425	91.0	29	87.9	0.361	0.548
≥24 h	42	9.0	4	12.1		
Operation data and complications						
Duration of CS	No.	%	No.	%		

≤1 h	318	68.1	27	81.8	2.714	0.099
>1 h	149	31.9	6	18.2		
Antibiotic prophylaxis	401	72.2	4	12.1	108.900	<0.001*
Urinary catheterization	306	65.5	16	48.5	3.903	0.048*
Bleeding (> 1000 ml)	11	2.4	6	18.2	23.505	<0.001*
PROM	64	13.7	13	39.4	15.613	<0.001*

Table 4: Distribution of infected cases according to type of antibiotic prophylaxis

	Infected cases (n=33)	
Type of AB	no	%
Ceftriaxone 1gm	1	3
Sulbactam 1.5gm	1	3
Ciprofloxacin 750mg	2	6

Discussion:

In the current study, the incidence of infection was found to be 6.6% the mean age of the studied cases was 26.95 (±5.42 SD) with range (20-41), the mean BMI was 27.11 (±3.73 SD) with range (20.2-38.9) and among the studied cases there were 300 (60%) rural residents and 200 (40%) urban residents. There was a statistically significant difference between the two studied groups regarding age and BMI.

These results were similar by **Prajapati et al. (2022)** who stated that the mean age was 27.3 years and 25.6 years of the participants of SSI and 'without SSI' group respectively. Almost 34.6% participants of group SSI and 7% of groups without SSI' came from rural areas respectively. BMI ≥25 kg/m2 noted statistically significantly among almost double number of participants of SSI group compared to 'without SSI' group (6).

On the other hand, **Gomaa et al. (2021)** reported that the overall incidence of SSI in his hospital during the study period was 5.34%. The mean and the SD for cases that had SSI after CS was 5.92 ± 0.49 (3–25) days. The results revealed that there was no statistically significant difference between cases and control groups regarding age and residence. More than 50% of patients were from deprived rural areas living away from the hospital, high parity, more than 80% of our patients had emergency CS with prolonged operative time more than 1 h, about 40% were poor antenatal care attendee, 32% were non-attendee (7).

Dayo-Dada et al. (2022) stated that the majority (37.4%) of the patients were between the age ranges of 31–36 years with mean age of 31.0 years. A significant relationship between age, occupation and development of surgical site infection. The result is slightly different from the finding that identified young maternal age that is less than or equal to 30 years as statistically significant factors responsible for the incidence of surgical site infection post caesarian section (8).

In the present study we found that according to parity among the emergency cases there were 62 (12.4%) nullipara,12.1% are infected and 12.4%

are non-infected 407 (81.4%) with parity 1-3 82.2% are non-infected 79.6 are infected and 31 6emergencies parity ≥4, 5.4% non-infected this mean There was statistically significant difference between the two studied groups regarding parity and 18.2 infected according to gestational age there were 48 (9.6%) less than 37 weeks and 452 (90.4%) more than 37 weeks and according to type of cesarean section there were 183 (36.6%) elective and 317 (63.4%) emergency There was statistically significant difference between the two studied groups regarding to gestational age and type of the CS.

In agreement with our study **Gomaa et al. (2021)** stated that SSI group had a significantly higher number of cases with high parity (> 4) compared to control group (13.5 vs. 8.5%, p < 0.001). Emergency CSs rate was significantly higher in SSI group (81.2% vs. 64.3%; p < 0.001, COR = 2.40) (7).

Abdallah et al. (2019) reported that prevalence surgical site infection rate (23.3%) after elective cesarean section mainly superficial type (93.3%) includes only skin and subcutaneous tissue. Others study revealed variable rates of wound infection after CS such as 9.9%. other risk factors increase rate of SSI include age, rural residence, repeated cesarean section, qualification of the health professional who conducted the procedure, duration of operation, anemia and DM but these factors not significantly increased odds of SSI (9).

Kvalvik et al. (2021) illustrated that woman delivering by elective CS received antibiotic prophylaxis only by indication. The elective CS population in general differs from the emergency CS population in having intact fetal membranes which serve as a barrier and prevent cervicovaginal bacterial flora from entering the uterine cavity. The rate of SSI in this group (0.4%), implies that our approach in administering antibiotic prophylaxis by indication, seems appropriate (10).

In the current study we found that according to ANC visits among the studied cases there were 102 (20.4%) with no visits, 198 (39.6%) 1-4 visits 200 (40%) >4 visits, there were 33 (6.6%) with chorioamnionitis, 138 (27.6%) with obesity, 28 (5.6%) diabetes mellitus and 10 (2%) hypertension. There was a statistically significant difference between the two studied groups regarding ANC visits and obesity.

Gomaa et al. (2021) conducted that that presence of many patients with risk factors as chorioamnionitis, PROM, obesity, hypertension and DM. Additional challenge was the loss of confidence felt by many patients towards the hospital and the medical team as a result of development of infection following CS in the hospital so we have to do extensive debriefing to convince them to continue their care at the same institution and more than 15% of them were managed outside our hospital (7).

Abdallah et al. (2019) reported that Obesity is a well-known risk factor for SSI which also agreed with a study included 1,605 women who underwent low transverse cesarean section a higher body mass index at admission (aOR, 1.1 [95% CI, 1.0– 1.1]) During the 2-year study period (9)**.**

Acosta et al. (2012) conducted that obese woman had increased risk of postpartum sepsis regardless of delivery mode and that obesity was an independent risk factor for infection of varying severity.

The prevalence of obesity and overweight seems to be rising and poses an immense challenge to the public health and the healthcare services (11).

On the other hand, **Regmi et al. (2022)** reported that Antenatal checkup visit > 4 had higher odds, i.e., 1.94 (0.93-4.05), of developing SSI compared to those with less than or 4 ANC visits. However, the result was not statistically significant with p value 0.074 (12).

Jahan et al. (2019) stated that there was a 20% wound infection rate among 496 elective general surgical procedures. SSIs increased with degrees 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. Patients with preexisting illnesses like diabetes mellitus, or malnutrition were more prone to infection (13).

According to labor duration among the studied cases there were 454 (90.8%) <24 hours and 46 (9.2%) ≥24 hours. According to the duration of CS among the studied cases there were 345 (69%) ≤1 hour and 155 (31%) >1 hour, there were 341 (68.2%) who used antibiotic prophylaxis, 322 (64.4%) used urinary catheterization, 17 (3.4%) who had bleeding and 77 (15.4%) who had PROM. There was a statistically significant difference between the two studied groups regarding labor duration. There was a statistically significant difference between the two studied groups regarding operation data and complications.

Gomaa et al. (2021) stated that SSI was associated with longer duration of CS (> 1 h), prolonged labor (≥24 h) and high blood loss (> 1000 ml), (P < 0.001). Furthermore, there was a significant association between SSI and chorioamnionitis (7).

Abdallah et al. (2019) noted that thickness of subcutaneous fat more than 2 cm was an important risk factor for developing surgical site infection in this study represented about (93.3%) with significant P value (0.001). Similar findings have been reported by a study that showed a statistically significant increase in the rate of wound complications when the subcutaneous thickness was greater than 2 cm (9).

Gelaw et al. (2017) showed that prolonged labor was noted to be an independent risk factor for surgical site infection in this study. Women with labor duration greater than 24 h had 3.5 times more likely developing post cesarean wound infection. This could be attributed to as duration of labor increases; the number of vaginal examinations also increases, and repeated vaginal examinations increase the chance of iatrogenic contamination during examination. (14).

Among the studied cases there were 33 (6.6%) with SSI, among them there were 7 (21.2%) with deep incisional SSI, 11 (33.3%) with organ/space SSI and 15 (45.5%) with superficial incisional SSI and according to management there were 30 (84.8%) were managed by medical (dressings and antibiotics), 3 (6.1%) by surgical exploration.

In agreement with our results, **Gomaa et al. (2021)** stated that approximately 50% of cases had superficial incisional SSI while 28% of cases developed deep incisional SSI and about one quarter of the cases had organ/space SSI. A similar

study conducted at an Ethiopian referral hospital found that incisional SSI (superficial and deep types) developed in two third of cases while organ/space SSI developed in the remaining one third of cases (7).

In alignment to our study, **Gomaa et al. (2021)** noted that Management of SSI in our study was medical (repeated dressings, antibiotics and follow up) in 521 cases (62.9%) and surgical in 182 cases (22%) while the data about management was missing in 125 cases (15.1%) (7).

Açar et al. (2022) showed that rate of SSI as 9.85% in their study done in a multidisciplinary center. They found the risk of developing SSI significantly lower in the group under 35 years of age, in cases where the operative duration was shorter than 1 h, and in those who used preoperative antibiotics. It has been stated that having a history of C-section causes an eightfold increased risk (RR 8.428; 95% CI: 3.681–19.300; and $p<0.001$) (15).

In our study there is no significant between SSI and type of antibiotic prophylaxis. This study has some limitations. are worthy of mention; The study was carried out on a small sample size of 500 patients, which may limit the generalizability of the findings to a larger population.

Conclusion:

In conclusion, SSI development is linked to several elements rather than just one. High parity, emergency CS, gestational age (less than 37 weeks), protracted labor (more than 24 hours), blood loss (more than 1000 milliliters), extended surgical time (more than 1 hour), chorioamnionitis, PROM, absence of ANC visits, obesity, diabetes, and hypertension were significant risk factors for SSI. Based on our research, addressing these risk factors is crucial to lowering the chance of developing SSI after CS and may improve the result of the procedure.

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