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Incidence and Predictors of Surgical Site Infection after Emergency Cesarean Section among Women Given Birth at a Tertiary Hospital in Central Zone, Tanzania

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Abstract

Surgical site infection (SSI) following emergency cesarean section (EC/S) remains a common and widespread problem contributing to significant morbidity and mortality possibly due to the emergency nature of the surgical intervention. This study aimed to investigate the incidence and predictors of surgical site infections (SSI) following emergency cesarean section (EC/S) at Dodoma Regional Referral Hospital (DRRH), where the rate is notably high. A prospective cohort study included 200 women who underwent EC/S at DRRH from February to May 2022. The follow-up of 30 days was done to assess the incidence of SSI. Data were collected by using a structured questionnaire. Data obtained were analyzed using SPSS version 26. Among 200 participants, 17 (8.5%) were lost to follow-up, remaining with 183 (91.5%). SSI was identified in 25 (13.7%) participants whereby 23 (92%) and 2 (8%) had superficial and deep SSI respectively. The predictors for post EC/S SSI identified in this study by multivariate analysis included self-employed [P value = 0.006, AOR = 2.3, 95% CI (1.944 - 52.778)], being peasant [P value = 0.0011, AOR = 2.2, 95% CI (1.643 - 46.757)] and duration of rupture of membranes ≥ 8 hour [P = 0.022, AOR = 4.6, 95% CI (1.252 - 16.876)]. In conclusion, the incidence rate of SSI was notably high accounting for 13.7%. The predictors of SSI were being peasant, self-employed and prolonged rupture of membrane. Education on early hospital visit at term to avoid prolonged rupture of membranes and education on necessity of enough time for wound care after surgical intervention should be offered.

Subject Areas

Gynecology & Obstetrics

Keywords

Incidence, Predictors, Surgical Site Infections, Emergency Caesarean Section, Tanzania

1. Introduction

Caesarian section is among the most common major operations performed in many hospitals worldwide with the aim of saving the lives of mothers and fetuses [1]. Globally the average rate of cesarean section ranges from 6% to 27.2% [2]. In the United States of America, caesarian section rate ranges from 1.6% to 40%. In Tanzania, the rate of caesarian section has increased three folds from 2% in 1996 to 6% in 2015-2016 and recently up to 10% and the total number of births increased by 60% [3]. In a study conducted in Tanzania in one rural referral hospital, it was reported that the rate of cesarean section was 35.2% [4].

Women undergoing cesarean section have a 5- to 20-fold risk of developing infection compared to vaginal birth [5]. Post operation infections are post-operative fever which includes puerperal sepsis, composite wound complication also known as endometritis and wound infection or surgical site infection [6]. Surgical site infection is defined as an infection that occurs within 30 days after surgical operation or after one year if an implant has been left in place after surgical procedure [7]. Center for Disease Control and Prevention (CDC) describes three levels of SSI; superficial incision affecting the skin and subcutaneous tissue, deep incision which involves muscle and fascial layer and organ or Space SSI which involves any part in the body other than the incision that is opened or manipulated during the surgical procedure [1] [8].

The incidence of post cesarean section surgical site infection is increasing [9]. The rate is high in low- and middle-income countries compared to higher-income countries because of differences in economic status and health policies [10].

SSI following C/S occurrence worldwide ranges from 3% to 15% [1]. In Tanzania, the rate has gone as high as 48% [11]. The predictors of SSI after C/S are universal with only slight regional variation [12]. They are demographic characteristics, preoperative patients' clinical characteristics such as duration of labour, number of vaginal examinations, duration of rupture of membranes and preoperative antibiotics, or intraoperative patients' clinical characteristics which include suture material for skin closure, skin incision and level of surgeon [7].

Classically presence of SSI is diagnosed by documenting the characteristic sign of inflammation along with drainage of pus from the wound [13]. SSI is associated with high financial burden and prolonged morbidity [14]. This study therefore aimed at exploring the incidence and predictors of SSI following EC/S at DRRH.

2. Materials and Methods

2.1. Study Design and Setting

This was a prospective cohort study which included 200 women who underwent

emergency cesarean section within 48 hours at Dodoma Regional Referral Hospital from February to May 2022. They were then followed up for 30 days to see if they develop SSI. DRRH offers varieties of services including Medical, Surgical, Pediatrics and Obstetrics and Gynecological services.

2.2. Study Participants, Inclusion and Exclusion Criteria

A total of 200 women who underwent EC/S were included. 17 (8.5%) women were lost to follow up remaining with 183 (91.5%). The study included all women of child bearing age who underwent emergency cesarean section at DRRH and consented for their participation within the study period. It excluded those who were on intravenous antibiotics within 48 hours of being diagnosed with SSI.

2.3. Sample Size and Sampling Procedures

The minimum sample size was calculated using single population proportion and it was 162 [15]. Prevalence of 12% was used according to the study which was done at the Department of Obstetrics and Gynecology Hayatabad Medical Complex Pakistan [16]. Attrition of 30% was added to cover for lost to follow up. Therefore, total sample size was 180 but, in this study, up to 200 participants were recruited. Participants who met the criteria were enrolled conveniently until the sample size was reached.

2.4. Data Collection and Study Procedures

Primary data were collected by means of interview and structured questionnaires by trained research assistants and principal investigators.

2.5. Variables Definitions and Measurement

Independent variables: Social demographic data; age, residence, parity, occupation, education level and referral status. Patients' clinical characteristics; Duration of labor in hours, number of vagina examination, duration of rupture of membranes, preoperative medication, suture material for skin closure, level of surgeon and skin incision.

Outcome variables: Surgical site infection which was categorized into superficial, deep or organ/space SSI. **Center for disease control and prevention (CDC) definition was used to diagnose SSI after EC/S.**

Superficial surgical site infection

Infection occurs within thirty days after the operation and involves only skin and subcutaneous tissue of the incision and at least one of the following:

Purulent drainage with or without laboratory confirmation from the superficial incision.

Organisms isolated from an aseptically obtained culture of fluid or tissue from superficial incision.

At least one of the following signs or symptoms of infection:

Pain or tenderness: Localized swelling, redness or heat Superficial incision is

deliberately opened by surgeon, unless incision is culture negative.

Diagnosis of Superficial incision SSI made by the surgeon or attending physician.

Deep incisional surgical site infection

Infection occurs within thirty days after the operation and infection involves deep soft tissue for example fascia, muscle of the incision and at least one of the following:

Purulent drainage from the deep incision but not from the organ/space component of the surgical site.

A deep incision spontaneously dehisces or is deliberately opened by a surgeon when a patient has at least one of the following: fever, localized pain or tenderness, unless incision is culture negative.

An abscess or other evidence of infection involving the deep incision is found on direct examination, during operation or by histologic or radiologic examination.

Diagnosis of SSI made by a surgeon or attending physician.

Organ/space surgical site infection

Infection occurs within 30 days after the operation and infection involves any part of the anatomy (e.g. organ and space) other than the incision that was opened or manipulated during an operation and at least one of the following:

Purulent drainage from the drain that is placed through a stab wound into organ or space Organisms isolated from aseptically obtained culture of fluid or tissue in the space or organ.

An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation or by histopathologic or radiologic examination.

Diagnosis of organ/space SSI made by a surgeon or attending physician.

By using sterile cotton swabs, two wound swabs were aseptically collected from each participant with surgical site infection and sent to the laboratory immediately for culture and sensitivity test.

Data obtained were analyzed using the SPSS version 26. Ethical clearance was obtained from the University of Dodoma Directorate of Research and Publication and informed consent was obtained from the participants.

2.6. Data Analysis

Microsoft excel was used for data entry and data cleaning. IBM-SPSS program version 26 was used for data analysis in accord with specific objectives. Descriptive analysis of categorical variables was run through frequency tables. Mean, Standard deviation and Range were computed for continuous variables. The Chi square test, univariate and multivariate logistic regression models were used to detect the association between the predictor variable and outcome variables.

3. Results

A total of 200 women among those who underwent emergency cesarean section

from February to May 2022 were enrolled. Of 200 study subjects 17 (8.5%) were lost to follow up remaining with 183 (91.5%) participants. Of 183 participants 25 (13.7%) developed surgical site infection and among these 23 (92%) were superficial SSI and 2 (8%) were deep SSI. There were no Organ/space SSI. No one was excluded (Figure 1).

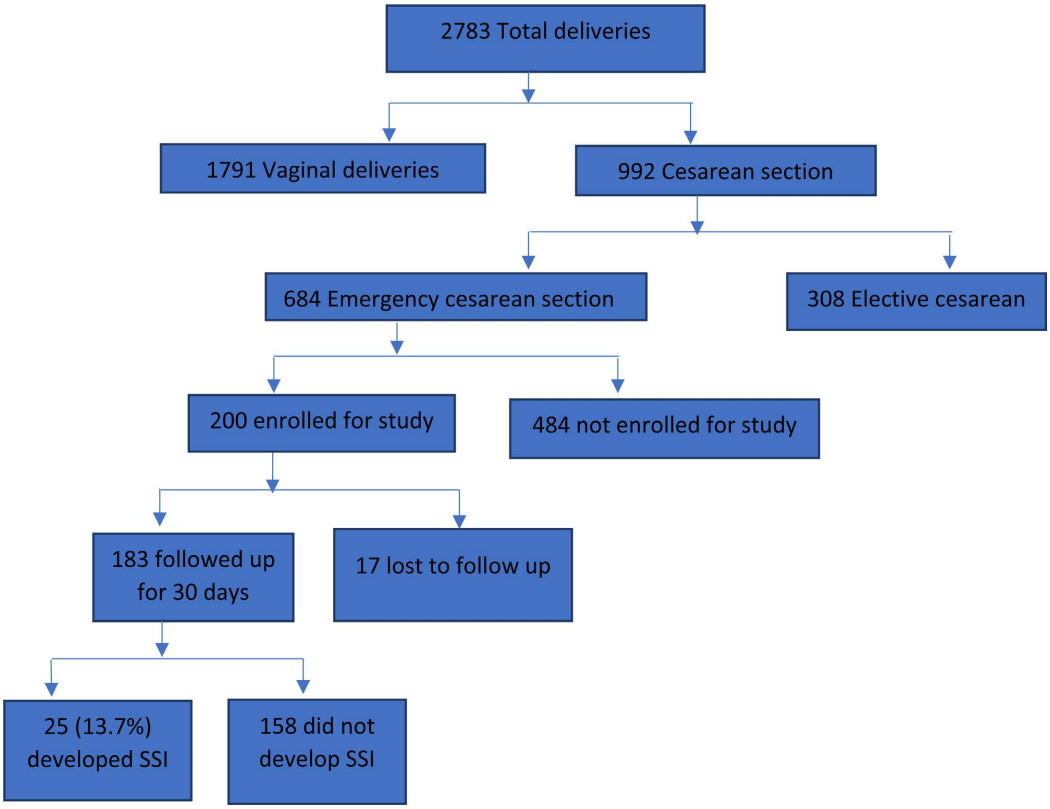

Figure 1. Participants enrollment.

3.1. Social Demographic Characteristics of the Participants

Total number of 200 women were recruited. The age range of participants was from 16 years to 42 years with mean of 26 years with standard deviation of 6.081. The majority of study subjects were in age group of 25-34 years who were 92 (46%). The majority of study participants were from Urban which was 136 (68%), 174 (87%) were married, 100 (50%) were multipara, 99 (49.5%) had secondary school level of education and (74.5%) were self-referral (Table 1).

3.2. Incidence of Surgical Site Infection

During the study period, 25 participants developed SSI resulting in overall cumulative incidence of 25/183 (13.7%). Types of SSI found were superficial SSI 23 (92%) and deep SSI 2 (8%) (Table 2 and Table 3).

3.3. Predictors of Surgical Site Infection

Sociodemographic and clinical characteristics were analyzed by using univariate

Table 1. Social demographic characteristics of the participants (N = 200).

Variable	Frequency (%)
Age	Mean ± SD (26.27 ± 6.081)
<25 years	86 (43.0)
25 - 34 years	92 (46.0)
35 - 44 years	22 (11.0)
Residence	
Urban	136 (68.0)
Rural	64 (32.0)
Marital status	
Married	174 (87.0)
Not married	26 (13.0)
Parity	
Prime	88 (44.0)
Multipara	100 (50.0)
Grand multipara	12 (6.0)
Occupation	
Self employed	93 (46.5)
Employed	12 (6.0)
Peasant	95 (47.5)
Level of education	
Primary and no formal	76 (38.0)
Secondary school	99 (49.5)
Higher education	25 (12.5)
Referral status	
Self-referral	149 (74.5)
From lower facility	51 (24.5)

Table 2. Incidence of surgical site infection (N = 183).

Variable		Frequency (%)	Valid %
SSI	YES	25 (12.5)	13.7
	NO	158 (79.0)	86.3
	Total	183 (91.5)	100
Loss to follow-up		17 (8.5)	
Total		200	

Table 3. Clinical characteristics of study participants (N = 200).

Variable	Frequency (%)
Duration of labor	
≥18 Hours	11(5.5)
<18 Hours	189 (94.5)
Vaginal examination before C/S	
0 - 3 exams	145 (73)
>3 exams	54 (27)
Duration of rupture of membranes	
≥8 Hours	123 (61.5)
<8 Hours	77 (38.5)
Pre-op antibiotics	
Yes	199 (99.5)
No	1 (0.5)
Duration of cesarean section	
>60 Minutes	44 (22)
≤60 Minutes	156 (78)
Type of incision	
Sumi	42 (21)
Pfannenstiel	158 (79)
Suture material for skin closure	
Vicryl	164 (82)
Nylon	36 (18)
Level of surgeon	
Specialist and Resident	92 (46)
Registrar and Intern	108 (54)
Skin suture technique	
Subcutaneous	165 (82.5)
Interrupted	35 (17.5)

regression and multivariate logistic regression analysis after running chi square test. This study found that among the factors, occupation; peasant (p-value = 0.011), self-employed (p-value = 0.006) and duration of rupture of membranes for 8 hours and above (p-value = 0.022) were predictors of SSI as shown in (Table 4).

In this study women who were peasants were two times more likely to develop SSI compared to those who were employed (AOR = 2.17, 95% CI = 1.64 - 46.76, p = 0.011), Also, women who were self-employed were two times more likely to develop SSI compared to those who were employed (AOR = 2.32, 95% CI = 1.94

- 52.78, p = 0.006) and women with duration of rupture of membranes for 8 hours and above were four times more likely to develop SSI compared to those with rupture of membranes bellow 8 hours (AOR = 4.60, 95% CI = 1.25 - 16.88, p = 0.022) (Table 4).

Table 4. Logistic regression of factors associated with surgical site infection (N = 183).

Variable	Status	SSI		Un adjusted		Adjusted	
		Yes n (%)	No n (%)	P value	COR (95% CI)	p value	AOR (95% CI)
Age							
	15 - 24 years	9 (11.5)	69 (88.5)	0.377	2.6 (0.312 - 21.844)		
	25 - 34 years	15 (17.9)	69 (82.1)	0.167	4.3 (0.541 - 34.960)	0.274	3.7 (0.354 - 39.005)
	35 - 44 years	1 (4.8)	20 (95.2)	Ref		Ref	
Occupation							
	Self employed	9 (10.2)	79 (89.8)	0.036	2.4 (1.100 - 17.519)	**0.006**	2.3 (1.944 - 52.778)
	Employed	4 (33.3)	8 (66.7)	Ref		Ref	
	Peasants	12 (14.5)	71 (85.5)	0.115	3.1 (0.769 - 11.379)	**0.011**	2.2 (1.643 - 46.757)
Referral status							
	Lower facility	14 (10.1)	124 (89.9)	0.019	2.9 (1.193 - 6.882)	0.670	2.5 (0.936 - 6.895)
	Self	11 (24.4)	34 (75.6)	Ref		Ref	
Duration of labor							
	≥18 hrs	4 (36.4)	7 (63.6)	0.035	4.1 (1.108 - 15.236)	0.950	3.7 (0.795 - 17.186)
	<18 hrs	21 (12.2)	151 (87.8)	Ref		Ref	
Duration of ROM in Hours							
	≥8 hrs	22 (18.5)	97 (81.5)	0.016	4.6 (1.324 - 16.065)	**0.022**	4.6 (1.252 - 16.876)
	<8 hrs	3 (4.7)	61 (95.3)	Ref		Ref	
Suture material for skin closure							
	Vicryl	18 (11.9)	133 (88.1)	0.143	2.1 (0.783 - 5.468)	0.630	3.0 (0.941 - 9.592)
	Nylon	7 (21.9)	25 (78.1)	Ref		Ref	

4. Discussion

SSI is a common complication in post-operative patients [17]. In this study, the incidence of SSI following EC/S was 13.7% which is similar to 13.9% in Mara, and Kagera region, Tanzania. This might be because of the same environment, relatively higher than 12% documented in Pakistan following EC/S probably because of differences in geographical locations and relatively higher than 10.9% documented in the regional study. However, it is lower than 48% documented in another regional study. Regional studies were done for both emergency and elective C/S and in the regional study with high incidence of SSI (48%), most of

participants were found to have not given preoperative antibiotics prophylaxis. In our study, only four participants were not given prophylactic preoperative antibiotics and one out of them developed surgical SSI. This could be the reason why the incidence in this study is lower than that found to be very high in the regional study [11] [18].

Various risk factors are found to predict post EC/S SSI [17]. Being peasant and self-employed in this study was found to be predictors of SSI. Both peasants and self-employed were two times more likely to develop SSI compared to those who were employed. The explanation for this is probably because those who are employed are given maternity leave for at least three months which gives them enough time to take care of their wounds compared to their counterparts and they are economically stable compared to peasants.

Rupture of membranes for 8 hours and above in this study was found to be significant in which those with prolonged rupture of membranes were four times more likely to develop surgical site infection compared to those with rupture of membranes below 8 hours. The explanation for this might be that, amniotic membranes act as a barrier to ascending infection from the vagina, when ruptured bacteria which are normal flora from the vagina will gain access and result in chorioamnionitis with consequent bacteria dissemination within blood circulation resulting into SSI. This is similar to the study which was done in Mwanza and that was done in Nigeria [7] [17].

4.1. Strength and limitations

This study has been able to evaluate the incidence and predictors of SSI following emergency cesarean section among women giving birth at DRRH, since it was a follow-up study. It was able to evaluate new cases of SSI within the study period. Some limitations were unavoidable. It was a longitudinal study, there was no control group to be compared with.

4.2. Conclusion

The incidence of SSI following EC/S at DRRH was alarmingly high accounting for 13.7%. Being peasant, self-employed, and prolonged duration of rupture of the membrane were significant predictors of SSI.

4.3. Recommendation

Education on early hospital visit at term to avoid prolonged rupture of membranes and education on necessity of having enough time for wound care after surgical intervention should be offered. Furthermore, mothers should be informed about the need of optimal time to take care of their wounds before resuming their daily activities, specifically among self employed and peasants.

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Writing-Review and Editing: Ipyana H. Mwampagatwa, Maria A. Rweyemamu & Athanus G. Lilungulu.

Conflicts of Interest

The authors declare no conflicts of interest.

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