

ORIGINAL ARTICLE**Magnitude and Factors Associated With Post-Cesarean Surgical Site Infection at Hawassa University Teaching and Referral Hospital, Southern Ethiopia: A Cross-sectional Study**Samuel Wodajo¹, Mehretu Belayneh², Samson Gebremedhin^{2*}**OPEN ACCESS**

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ABSTRACT

BACKGROUND: *Surgical site infection (SSI) after cesarean section (CS) increases maternal morbidity, hospital stay and medical cost. However, in Ethiopia, limited evidence exists regarding the magnitude and risk factors of post-CS wound infection. The purpose of this study was to determine the prevalence of – and factors associated with the problem among mothers who gave birth in Hawassa University Teaching and Referral Hospital, Southern Ethiopia.*

METHODS: *Hospital based cross-sectional study was conducted based on the medical records of 592 women who underwent CS from June 2012 to May 2013. Data on the occurrence and factors associated with SSIs were extracted. Factors associated with SSI were identified using multivariate logistic regression analysis. The output of the analysis is presented using adjusted odds ratio (OR) with the corresponding 95% confidence interval (CI).*

RESULTS: *The prevalence of SSI was 11.0% (95% CI: 8.6-13.8%). Mothers with prolonged labor (6.78, 95% CI: 2.54-18.00) and prolonged rupture of membrane (5.83, 95% CI: 2.14-15.89) had significantly increased odds of SSI. Compared to mothers who had no digital vaginal examination, those who had 1-4 and 5 or more examinations were at higher risk with OR of 2.91 (95% CI: 1.21-6.99) and 8.59 (95% CI: 1.74-42.23), respectively. Prolonged duration of surgery (12.32, 95% CI: 5.46-27.77), wound contamination class III (9.61, 95% CI: 1.84-50.06) and postoperative anemia (2.62, 95% CI: 1.21-5.69) were also significant predictors. CS conducted by junior practitioners is likely to be followed by infection.*

CONCLUSION: *Post-CS SSI is relatively common in the hospital. Thus, it should be averted by implementing infection prevention techniques.*

KEYWORDS: *Surgical wound infection, Cesarean section, Southern Ethiopia*

INTRODUCTION

According to the Center for Disease Control and Prevention (CDC), surgical site infection (SSI) is defined as infection which occurs within 30 days after surgical procedure involving skin, subcutaneous tissue, soft tissue or any other part of the anatomy (1). In general, in developing countries, the burden of health-care-associated infection including SSIs is assumed to be higher though the problem remains underestimated or even unknown (2). In the developing countries, SSI is the leading infection in the general patient population affecting up to two-third of the operated patients (3). Even in developed countries like USA, SSIs are among the most frequently reported nosocomial infections, accounting for 14-16% of all such infections (1).

Cesarean section (CS) is one of the most frequently performed surgical procedures worldwide (4). According to a recent estimate, annually, 18.5 million C-sections are carried out (5). Although post-cesarean wound infections are not usually serious, they can give rise to maternal pain and discomfort, post-surgical morbidity and extended hospital stay (6). It also causes a substantial burden on the health system and incurs sizable medical cost (6). Prevalence of SSI is usually taken as an imperative indicator of surgical quality (7).

Cesarean delivery is the single most important factor associated with postpartum infection and carries 5-20 folds increased risk of infection as compared with vaginal delivery (8). Post-cesarean infection is relatively common in the developing world. Studies from Nepal (9), Tanzania (10) and Nigeria (11) reported 12.9, 10.9, 9.1% incidences, respectively. A study conducted in Cameroon found a comparable figure of 9.2% (12). A multicounty study encompassing Burundi, DR Congo and Sierra Leone reported 7.3% incidence (13). A study carried in Jimma Hospital, Southwest Ethiopia found that 11.4% of the women who had surgery for delivery developed SSI (14).

In Ethiopia, very limited information exists regarding the magnitude of the SSI after CS; hence this study was deemed necessary. The

purpose of the study was to assess the prevalence of and factors associated with post CS SSI in Hawassa University Teaching and Referral Hospital (HUTRH).

METHODS

Study setting: The study was conducted at HUTRH which is found in Hawassa Town, the capital of Southern Nations, Nationalities and Peoples Region, Ethiopia. The town is located 270 kms South of Addis Ababa. The hospital has more than 300 beds, and it is the only referral hospital in the region, serving more than 18 million populations.

Study design: This was an institution based quantitative cross-sectional study with both descriptive and analytic components. All women who gave birth via CS from June 2012 to May 2013 were considered as the source population, and the data were extracted from medical records from March 1 to April 30, 2014.

Sample size calculation: The adequacy of the sample size for estimating the prevalence of SSI was estimated using the Epi-info StatCalc application with the inputs of 1,110 source population size, 95% confidence level, 11.4% expected prevalence of SSI (14), 2.5% margin of error and 10% contingency for missing files and records. Ultimately, the sample size was computed to be 600.

Sampling technique: The sampling frame for all CS births (1,110) conducted in the study period (June 2012 to May 2013) was developed by reviewing the registry books of the operation room and the labor and obstetric ward. Then, the required samples were selected using simple random sampling technique.

Data collection procedures: The data were extracted from the selected medical records using a structured format that was developed based on review of similar literature. The data collection was made by four trained clinicians working in the hospital. Supervision was made by one of the principal investigators. Selected socio-demographic, reproductive and medical history related variables were extracted from the medical

records. SSI was defined and classified as superficial, deep and organ/space infection based on the CDC guideline (1).

Data management and analysis: The data were entered into SPSS version 20 software by one of the principal investigators. Descriptive data analysis was made using frequency and percentage. Bivariate and multivariate binary logistic regression analyses were done to identify the predictors of SSI. The outputs of the analysis are provided using crude (COR) and adjusted odds ratio (AOR). Variables that showed statistically significant association ($p < 0.05$) in the bivariate analysis were exported to the multivariate model.

Ethical Consideration: Ethical approval was obtained from the Institutional Review Board (IRB) of Hawassa University, College of Medicine and Health Sciences. As the study was done via document review, consent waiver was granted by the IRB. In order to assure confidentiality, the data were extracted without any personal identifiers.

RESULTS

Socio-demographic and medical characteristics: Among the total of 1,110 C-sections performed in the reference period, the medical records of 592(53.3%) mothers were included in the analysis. The median age was 25 years ranging from 17 to 40. The vast majority were between 20-34 years of age. Regarding parity, 273(46.1%), 228(38.5%) and 91(15.5%) had 1, 2-4 and more than 4 parity, respectively. Nearly one-third, 182(30.7%), of the mothers were residents of Hawassa Town whereas the remaining, 410(69.3%), came from elsewhere.

Only 229(38.5%) of the mothers had the recommended 4 or more ANC visits during the index pregnancy and 56(9.5%) were not booked at all. At the time of the CS, in 66(11.1%) of the cases, the gestational age was less than 37 weeks. Most of the procedures, 559(94.4%), were performed on the same data as the admission while the remaining mothers stayed for one or more days. About 77(13.0%) and 515(87.0%) of the procedures were elective and emergency,

respectively. The leading indications for CS were dystocia (31.3%) and fetal distress (29.6%) (Table 1).

Table 1: Characteristics of the mothers, Hawassa University Teaching and Referral Hospital, June 2012 to May 2013.

Variables (n=592)	Number	%
Age		
Younger than 20 years	8	1.4
20-34 years	543	91.7
Older than 35 years	41	6.9
Parity		
1	273	46.1
2-4	228	38.5
>4	91	15.5
Residence		
Hawassa	182	30.7
Out of Hawassa	410	69.3
ANC visits		
No ANC	307	51.9
1-4	229	38.5
4 or more	56	9.5
Preoperative hospital stay in days		
Operated the same day	559	94.4
1 or more days	33	5.6
Gestational age during CS (weeks)		
Less than 37 week	66	11.1
37 weeks or later	526	88.9
Circumstance of the CS		
Elective	77	13.0
Emergency	515	87
Type of skin incision		
Lower transverse	394	66.6
Midline sub-umbilical	198	33.4
Duration of CS		
Less than or equal to an hour	450	76.0
More than an hour	142	24.0
Indication for CS		
Dystocia	185	31.3
Fetal distress	175	29.6
Obstructed labor	74	12.5
Antepartum hemorrhage	58	9.8
Others	100	16.9

Prevalence of SSI: Amongst 592 mothers included in the study, 65(11.0%) developed SSI. The corresponding 95% confidence interval (CI) was from 8.6% to 13.8%. Out of the total of 65 infections identified, 46(70.8%) and 17(26.1%) were superficial and deep incisional infections. The remaining 2(3.1%) were organ space infections. Of the 65 SSIs identified, 64(98.4%) were diagnosed before discharge.

Factors associated with SSIs after CS: Fifteen variables were considered for the bivariate

analysis. These were maternal age, parity, gestational age, place of residence, duration of labor, duration of CS, frequency of digital pelvic examination, duration since the rupture of the membrane, circumstance of the surgery (elective or emergency), wound contamination class (II or III), type of professional who performed the CS, type of skin incision (lower transverse or midline sub-umbilical), postoperative hemoglobin, indication for the procedure and frequency of ANC during pregnancy.

Table 2: Output of the multivariate logistic regression analysis on factors associated with SSIs after CS, HURTH, June 2012 - May 2013.

Possible risk factors	Odds ratio (95% CI)	
	Crude	Adjusted
Place of residence		
Hawassa	1 ^r	1 ^r
Out of Hawassa	2.35 (1.20-4.63)*	0.71 (0.24-2.16)
Duration of labor in hours		
<24hrs	1 ^r	1 ^r
≥24hrs	12.9 (6.31-26.2)*	6.78 (2.54-18.00)*
No labor	1.50 (0.50-4.49)	0.62 (0.11-3.37)
Membrane status		
Not ruptured	1	1
<12hrs (ruptured)	1.57 (0.59-4.15)	0.64 (0.19-2.18)
≥12hrs (ruptured)	18.0 (8.46-38.13)*	5.83 (2.14-15.89)*
Frequency of digital vaginal examinations		
Not done	1 ^r	1 ^r
1-4x	1.32 (0.52-3.36)	2.91 (1.21-6.99)*
>4x	2.91 (1.68-5.05)*	8.59 (1.74-42.23)*
Duration of surgery in hours		
≤1hrs	1 ^r	1 ^r
>1hrs	15.76 (8.49-29.28)*	12.32 (5.46-27.77)*
Circumstance of surgery		
Elective	1 ^r	1 ^r
Emergency	5.22 (1.25-21.82)*	7.77 (0.75-80.0)
Wound contamination class		
II	1 ^r	1 ^r
III	16.77(5.03-51.81)*	9.61 (1.84-50.06)*
Type of professional who did the CS		
Senior	1 ^r	1 ^r
GP	4.68 (1.62-13.48)*	7.06 (1.62-30.70)*
MSC student	3.86 (1.32-11.42)*	8.31 (1.79-38.52)*
Postoperative hemoglobin		
<11mg/dl	3.35 (1.96-5.72)*	2.62 (1.21-5.69)*
≥11mg/dl	1 ^r	1 ^r

1^r set as reference group, * Statistically significant association at *p* value of 0.05

Of these variables, nine were significantly associated with SSI and hence considered for the multivariate analysis. In the multivariate model, seven turned out to be significant (Table 2).

Mothers with prolonged labor (24 or more hours) at the time of the CS had 6.78(95% CI: 2.54-18.00) times increased odds of SSI than their counterparts. The odds of SSI was also increased by 5.83(95% CI: 2.14-15.89) among mothers who had prolonged rupture of membrane (rupture of membranes for 12 or more hours). Compared to mothers who had no digital vaginal examination, those who had 1-4 and 5 or more examinations were at higher risk with OR of 2.91(95% CI: 1.21-6.99) and 8.59 (95% CI: 1.74-42.23), respectively. Prolonged duration of surgery (more than an hour) was associated with SSI with OR of 12.32 (95% CI: 5.46-27.77). Women with wound contamination class III had 9.61(95% CI: 1.84-50.06) times increased odds than those with class II level of contamination. CS conducted by junior professionals (general practitioners or MSc students) had increased odds of developing SSI as compared with procedures done by seniors. Women with postoperative anemia (hemoglobin <11mg/dl) had 2.62(95% CI: 1.21-5.69) times increased odds of SSI (Table 2).

DISCUSSION

The study showed that surgical site infection after CS is common in HUTRH. It is also affected by various modifiable factors.

The study found that one-in-ten (11.0%) of the women who had CS developed wound infection. The figure might have been largely underestimated as the study was exclusively reliant on medical records review and it did not involve and post-discharge follow-up. Literature indicates considerable proportions of SSI develop after discharge. Studies conducted in Norway and Scotland reported that 86% (15) and 71% (16) of the infections occurred after discharge. Further, as the diagnosis of SSI was solely made on clinical basis, localized infection, which may not be presented with the classical manifestations of inflammation, might have been missed (17).

The reported prevalence of SSI is very comparable to what had been reported in Ethiopia and other developing countries. A study conducted in Jimma University Specialized Hospital, Ethiopia, reported 11.4% incidence of SSI among women who had surgery for delivery (14). A study conducted in 1999 in Tikur Anbessa Hospital, Addis Ababa, found 14.8% wound infection rate among surgical patients operated for various conditions (18). Studies from Nepal (9), Tanzania (10), Nigeria (11) and Cameroon (12) reported 9% -13% prevalence. However, a study from Kenya reported a relatively higher (19%) figure (19).

In this study, mother, with prolonged labor and prolonged rupture of membrane had substantially increased risk of SSI than their counterparts. Studies conducted in Kenya (19), Tanzania (10), Nigeria (11), Qatar (20), Israel (21) and US (22) reported more or less similar findings. Prolonged labor and rupture of membranes contribute to amniotic fluid colonization from the normal flora of the lower genital tract and lead to surgical wound and peritoneal cavity contamination (23).

In this study, prolonged duration of surgery (more than an hour) was associated with 12 times increased odds of SSI. Other studies also witnessed the same. A case-control study in Nigeria found that 55% of SSI cases, compared to 31.7% in controls, had prolonged duration of surgery (11). In Tanzania, long duration of surgery was significantly associated with the outcome with hazard ratio of 2.3 (10). A study in China came up with a parallel finding (24). Prolonged duration of surgery may raise the risk of SSI by increasing the risk of exogenous contamination (25).

The study showed a significant association between anemia and wound infection. In general, low hemoglobin concentration reduces the oxygen tension in the wound and increases the risk of wound infection by compromising the activity of macrophages (25) and impeding wound healing progress (26). Studies from China (23,27), India (28) and Nigeria (29) reported similar findings.

The risk of SSI showed variation depending on the qualification of the health professional who conducted the procedure. This indicates that

seniors have better infection prevention practices than junior practitioners. A study in Tanzania found that procedures performed by an intern or junior doctor had almost 3 times increased risk of ending up in post-cesarean wound infection as compared to procedures conducted by senior surgeons (10). A study in England also reported that the risk was 1.6 times elevated when CS is performed by associate specialist and staff grade surgeons as compared to consultants (6).

Frequent digital pelvic examination is one of the established preoperative factors that increase the risk of post-cesarean wound infection. Repeated vaginal examinations can introduce endogenous vaginal flora capable of causing SSI to the upper genital tract (30). This study also found the same. As compared to women with no digital examination, those with 1-4 and more than 4 examinations had 3 and 9 times increased odds of SSI. A study from Tanzania reported that women who had 3 or more pelvic examinations had increased risk of post-CS wound infection with a hazard ratio of 2.6 (10).

The findings of this study should be interpreted in consideration of its limitations. The study did not evaluate many other pertinent risk factors of SSI (like nutrition status, underlying medical conditions, skin closure method used) as it was dependent on reviews of medical records. In the multivariate model, for some of the independent variables, the CIs for the OR were wide, indicating inadequacy of the sample size.

The study concluded that post-caesarean SSI is relatively common (11.0%) in the hospital. A list of modifiable factors including prolonged labor and prolonged rupture of membrane, long duration of surgery, post-operative anemia, frequent digital pelvic examination and qualification of the professionals who performed the procedures were associated with SSI. Surgical wound infection should be prevented by implementing infection prevention techniques and by initiating local SSI surveillance system. Improving access of local women to emergency obstetric care can also reduce the problem.

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