PREVALENCE OF SURGICAL SITE INFECTION AND ASSOCIATED FACTORS AMONG MOTHERS AFTER CESAREAN DELIVERY IN ZEWDITU MEMORIAL HOSPITAL

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ABSTRACT

BACKGROUND: Cesarean delivery is the most common major operation carried out in obstetrics; constituting about 15% of all deliveries worldwide. Surgical site infections (SSIs) are among the most common infectious complications after cesarean delivery; which increase maternal morbidity and mortality, hospital stay and the cost of treatment. Hence, the aim of this study was to determine the prevalence of SSIs and associated factors among mothers after cesarean delivery.

METHODS: Institution based cross-sectional study was conducted in Zewditu Memorial Hospital from December, 2017 to April, 2018. A semi-structure questionnaire was used to collect data. Wound site was examined on the 3rd postoperative day and 1st postnatal visit. On the 14th and 30th postoperative day, each participant was contacted through telephone for any signs of wound infection. Bivariate and multivariate logistic regression analysis were done to identify the association between predictors and SSIs. A level of $P<0.05$ was considered statistically significant.

RESULTS: A total of 474 pregnant women were included in this study. The prevalence of SSIs was 8.4%. About 95% of SSIs were developed within two weeks after caesarean section and 70% of them were developed after discharge from the hospital. In this study, SSIs were significantly associated with; contaminated wound (AOR=5.64; ; 95%CI, 2.45-10.60; p=0.028), multiple vaginal examination (AOR=5.24; 95%CI, 10.5 -36.2; p=0.001), rupture of membrane more than 12 hours (AOR=7.84; 95%CI, 4.25 -12.34; p=0.002), labor more than 12 hours (AOR=3.57; 95%CI, 1.92 -9.42; p=0.023) and anemia (AOR=16.34 ; 95%CI, 12.9 -30.4; p =0.024).

CONCLUSION: In this study post-cesarean SSI was found to be high; and contaminated wound, multiple vaginal examination, rupture of membrane (>12 hours), prolonged labor (>12 hours) and anemia were significant predictors of SSIs.

KEYWORDS: Cesarean section, Postpartum, Surgical site infection

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INTRODUCTION

Caesarean section (CS) is a surgical procedure where a baby is delivered by cutting through the front wall of the abdomen to open the uterus. It's the most common major operation carried out in obstetrics; constituting about 15% of all deliveries worldwide; with regions of Latin America being the highest (29.2%), and Africa being the lowest (3.5%)1.

Though surgery is an essential component in health care, infections and complications after surgery significantly accounts for maternal morbidity and mortality. Surgical site infections (SSIs) are those infections which are confined to the incisions and involving structures adjacent to the wounds that were exposed during operation2. It was previously defined operationally as infection involving the abdominal incision or the uterus3, 4. But recently it's been defined as infection occurring within 30 days after a surgical operation (or within one year if an implant is left in place after the procedure) and affecting either the incision or deep tissue at the operation site5, 6.

SSIs in obstetrics accounts for the second most common cause of maternal mortality next to postpartum hemorrhage7. They are one of the most common causes of hospital acquired infections; accounting for 14-16% of the inpatient infections8 and 20-25% of all nosocomial infections worldwide9. Women undergoing cesarean delivery have a 5 to 20-fold greater chance of getting an infection compared with women who give birth vaginally. These infections can be in the organs within the pelvis, around the surgical incision and sometimes the urine10. In addition, maternal morbidity related to infections after cesarean section is eight-fold higher than after vaginal delivery11.

In developing countries, despite the increasing number of surgical patients, surgical care given to the patients is poor. In Sub-Saharan Africa, surgical cases are responsible for approximately 6-12% of all pediatric hospital admissions. However, due to poor surgical care, there is a significant number of death and disability associated with post-operative complications7. In Ethiopia, previous studies reported a 14.8-59% prevalence of hospital acquired infections12-15; and SSIs were indicated as the commonest cause of nosocomial infection in Obstetrics and Gynecology than in general surgical wards16.

Despite improvements in operating room practices, instrument sterilization methods, better surgical technique and the best efforts of infection prevention strategies, surgical site infections remain a major cause of hospital-acquired infections and rates are increasing globally even in hospitals with most modern facilities and standard protocols of preoperative preparation and antibiotic prophylaxis17. SSIs have been responsible for the increasing cost; morbidity and mortality related to surgical operations and continued to be a major problem worldwide18.

In spite of the availability of antibiotics, SSIs are still responsible for much morbidity and far reaching socioeconomic consequences for both patients as well as health care systems especially in developing countries like Ethiopia. A better understanding of SSI predictors might improve infection control by reducing clinical effects. Hence, the aim of this study was to determine the prevalence of SSIs and possible predisposing factors among mothers who delivered by cesarean section in Zewditu Memorial Hospital.

MATERIALS AND METHODS

Study area and design: Institution based cross-sectional study was conducted in Zewditu Memorial Hospital, Addis Ababa, Ethiopia from December 10, 2017 to April 8, 2018. Source population was all pregnant women attending obstetric service in ZMH. Study population included all pregnant women who were prepared for CS at ZMH.

Sample size determination: The desired sample size was determined using single population proportion formula:

$$N = \frac{Z^2 pq}{d^2}$$

Where:

N = Desired sample size

Z = 1.96 for 95% confidence level

p = Prevalence of SSI

q = 1-p

d = Degree of precision expected = 0.03

From the study conducted in Obstetric wards of Jimma University Specialized Hospital (Demisew et al., 2011), the prevalence of SSI (p) was found to be 11.4%. Using these data and considering a non-response rate of 10%, the desired sample size was, N = 474.

Sampling technique and procedure: The study participants were selected by systematic random sampling. Currently, about 400-500 deliveries are attended each month in ZMH; of which an average of 30% mothers give birth by CS. Taking 150 CS deliveries per month and considering 4 months of data collection, a total of 600 CS deliveries were used to calculate the sampling interval. Thus, by dividing the total population by the sample size (600/474=1.27), the sampling interval was found to be 1; which is every pregnant woman who gave birth by CS during the study.

Inclusion/exclusion criteria: All pregnant women who were prepared for CS at ZMH and willing to participate in the study were included. Those who had CS from other health facilities and referred to ZMH; and died within the first week of the operation were excluded from the study.

Data collection: Data was collected using semi-structured questionnaire from the participants and their charts by the surgeon/resident and interns in charge of the patient who were briefed on the CDC criteria how to diagnose SSIs. Each participant who had CS were followed for 30 days for development of SSI. Further chart review and wound site evaluation was done on the 3rd post operation day; and the day of discharge for additional data. During their 1st postnatal visit (1 week after discharge), the wound was examined by the resident/intern in charge. Each participant was asked for any signs of wound infection via telephone (two telephone numbers were taken from each participant for easy contact) on the 14th and 30th postoperative day; and advised to come for evaluation if SSI was suspected. Those participants who missed their postnatal visit were also contacted through telephone.

Data processing and analysis: After data collection, each questionnaire was checked for serial completion of the data until the 30th day of the operation. The data was analyzed using SPSS version 21.0. A bivariate logistic regression analysis was done to select the variables to be entered into the final logistic multivariable analysis. Significant explanatory variables were entered into multivariate logistic regression analysis model and association between the independent variables and SSI were assessed using AOR. P-value < 0.05 were considered statistically significance.

Ethical consideration: The study was started after getting approval and ethically cleared by the Ethical and Review Committee of the Department of Obstetrics and Gynecology. Permission was also obtained from ZMH medical director office. The objective of the study was explained to the study participants and asked if they were willing to participate. Interview and data collection were started after verbal informed consent was obtained from those who were willing to participate in the study. Confidentiality of responses was maintained throughout the study process.

Operational definitions:

CDC classification of Surgical Site Infections4:

Superficial SSI: - infection which involves only skin and subcutaneous tissue of the incision and at least one of: -

1. Purulent drainage with or without laboratory confirmation,
2. Organism isolated from superficial incision,
3. Presence of sign and symptoms of infection at the site,
4. Diagnosis of SSI by physician/surgeon where Stitch abscess, Infection of an episiotomy are not included.

Deep Incisional SSI: - infection involving deep soft tissues (e.g., facial and muscle layers) of the incision and at least one of:

1. Purulent drainage from the deep incision,
2. 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 (>38°C), localized pain, or tenderness, unless site is culture-negative, An abscess or other evidence of infection involving the deep incision,
3. Diagnosis of a deep incisional SSI by a surgeon or attending physician

Infection that involves both superficial and deep incision sites are reported as deep incisional SSI and an organ/space SSI that drains through the incision as a deep incisional SSI.

Organ/Space SSI: - infection which 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:

1. Purulent drainage from a drain that is placed through a stab wound into the Organ/ space,
2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space,
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during re-operation, or by histopathology or radiologic examination,
4. Diagnosis of an organ/space SSI by a surgeon or attending physician

Clean-Contaminated wound: An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

Contaminated wound: Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, no purulent inflammation is encountered are included in this category.

RESULTS

A total of 1901 deliveries were performed during the study period; of which CS delivery constitutes about 563(29.6%). Among CS deliveries, a total of 474 mothers were enrolled and followed for 30 days (Figure 1). The mean age of the study participants was 27.23 (±4) years and majority of them were in the age range of 20-35 years (n=428, 90.3%) (Table 1).

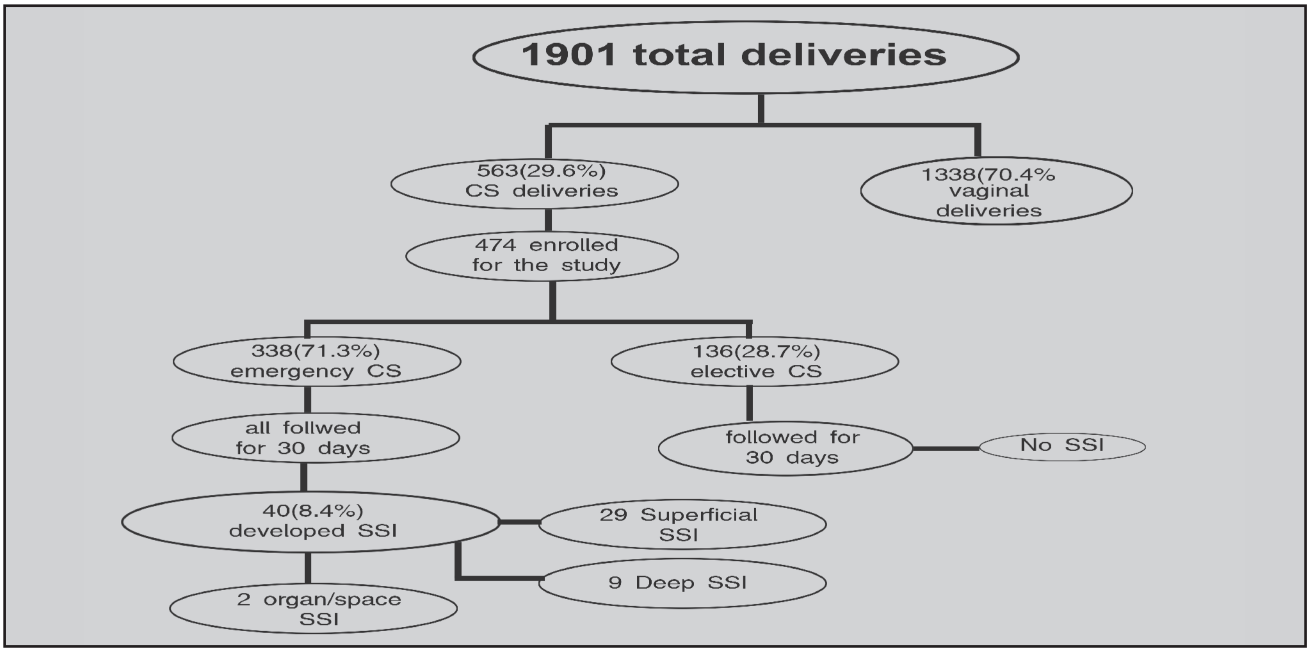

Figure1: Patient recruitement and follwup chart, ZMH, 2017/18.

Table 1: Socio-demographic characteristics of the study participants, ZMH, 2017/18.

Characteristic	Category	Frequency (N=474)	Percentage (%)
Age	< 20	10	2.1
	20-35	428	90.3
	> 35	36	7.6
Place of residence	Addis Ababa	458	96.6
	Out of Addis Ababa	16	3.4
Religion	Orthodox	233	49.2
	Protestant	152	32.1
	Muslim	85	17.8
	Others	4	0.8
Marital status	Married	460	97.0
	Single	10	2.1
	others	4	0.9
Educational status	Tertiary education	56	11.8
	Secondary education	194	40.9
	Primary education	171	36.1
	Read and write	49	10.3
	Illiterate	4	0.8
Ethnicity	Amhara	202	46.6
	Oromo	102	21.5
	Tigre	53	11.2
	Gurage	101	21.3
	Others	16	3.4
Monthly family income in Birr	≤ 2000	10	2.1
	2001-4000	180	38.0
	> 4000	284	59.9
Occupation	Student	28	5.9
	House wife	168	35.4
	Daily laborer	22	4.6
	Merchant	91	19.2
	Government employee	68	14.3
	Private employee	97	20.5

308(65%) of the participants were multipara and 143(30.2%) were premiparous. Almost all of them (n=473, 99.8%) had ANC follow-up with Health Centers and ZMH as the commonest sites. 113 (23.8%) participants had associated comorbidity; the leading being hypertension (n=64, 13.5%) followed by anemia (n=24, 5.1%) (Table 2).

Table 2: Obstetric and medical characteristics of the study participants, ZMH, 2017/18

Variable	Category	Frequency (N=474)	Percentage (%)
Parity	Premiparous	143	30.2
	Multipara	308	65.0
	Grand multipara	23	4.8
ANC	Yes	473	99.8
	No	1	0.2
Place of ANC	ZMH	187	39.5
	Health center	215	45.4
	Other sites	71	15.1
Co-morbidity	Yes	113	23.8
	No	361	76.2
Diabetes mellitus	Yes	14	3.0
	No	460	97.0
Hypertension	Yes	64	13.5
	No	410	86.5
HIV status	Yes	15	3.2
	No	459	96.8
Anemia	Yes	24	5.1
	No	450	94.9

Emergency CS constituted 338(71.3%) of CS operations and most of the operations (n=411, 86.7%) were operated at term pregnancy. For 308(65%) of the study participants, CS was done after they had established labor and about 312(65.7%) mothers had membrane rupture prior to CS. Majority of the operations (n=277, 58.4%) took more than 30 minutes; the mean operation time being 31 minutes (range; 20-70 minutes). Fetal distress, previous CS, dystocia and malpresentations were the top four indications for operation. About 220(46.4%) of operations were operated by junior (2nd year) residents. Multiple doses of prophylactic antibiotics were given for all of the study participants and spinal anesthesia were administered for 410(86.5%) of the study participants. Most had transverse abdominal incisions (n=442, 93.2%) (Table 3).

Table 3: Operation related characteristics of the study participants, ZMH, 2017/18

Variable	Category	Frequency (N=474)	Percentage (%)
Type of CS	Emergency	338	71.3
	Elective	136	28.7
Gestational age during CS	Preterm	26	5.5
	Term	411	86.7
	Post term	37	7.8
Labor status/ duration	No labor	166	35
	≤ 12 hours	134	28.3
	>12 hours	174	36.7
Rupture of membrane (ROM) before CS and duration	No ROM	161	34.0
	≤ 12 hours	219	46.2
	> 12 hours	94	19.8
History of previous CS	Yes	82	7.3
	No	292	92.7
Duration of operation	< 30min	197	41.6
	≥ 30	277	58.4
Indication for CS	Fetal distress	150	31.6
	Previous CS	82	17.3
	Dystocia	74	15.6
	Malpresentations	57	12.0
	Other indications	111	23.5
Type of anesthesia	Spinal	410	86.5
	General	64	13.5
Level of surgeon	Junior (R2)	220	46.4
	Senior (R3/R4/Consultant)	254	53.6
Type of abdominal incision	Transverse	442	93.2
	Midline subumblical	32	6.8
Type of prophylactic antibiotics given	Ampicillin	237	50.0
	Ceftriaxone	237	50.0
Time antibiotics given	Preoperatively	470	99.2
	Intraoperative	4	0.8
SSI status	No SSI	40	8.4
	SSI	434	91.6
Type of SSI	Superficial	29	72.5
	Deep	9	22.5
	Organ/space	2	5.0

The prevalence of SSI following cesarean section was 8.4% (n=40); majority of which (n=29, 72.5%) were superficial SSIs. Two patients developed organ/ space infections with complete wound dehiscence; admitted, re-operated and treated with broad spectrum antibiotics (Table 3). All SSIs were developed among mothers who had emergency CS. Only one SSI was developed among mothers who had CS before onset of labor and rupture of membranes. Majority of SSIs (n=28, 70%) were diagnosed after discharge within 8-14 days of operation while 10(25%) mothers were In this study; contaminated wound at the time of surgery, more than 3 vaginal examination, membrane rupture more than 12 hours, labor more than 12 hours and anemia were found to be independent predictors for development of SSIs (Table 6).

Table 4. Preoperative factors associated with SSI in the study participants, ZMH, 2017/18

Variable	Category	SSI status Yes, n (%)	No, n (%)	COR (95%CI)	P-value
Comorbidity	Yes	19 (16.8)	94 (83.2)	3.27 (1.67-6.25)	0.007
	No	21 (5.8)	340 (94.2)	1.00	
Anemia	Yes	8 (53.3)	7 (46.7)	14.29 (5.00-50.00)	0.006
	No	32 (7.0)	427 (93.0)	1.00	
HIV	Yes	5 (20.8)	19 (79.20	3.13 (1.10-9.10)	0.030
	No	35 (7.8)	415 (92.2)	1.00	
Duration of ROM	≤ 12 hours	9 (4.1)	210 (95.9)	1.00	0.004
	> 12 hours	30 (31.9)	64 (68.1)	10.94 (4.94-24.24)	
Duration of labor	≤ 12 hours	4 (3.0)	130 (97.0)	1.00	0.001
	> 12 hours	35 (20.1)	139 (79.9)	8.18 (2.83-23.66)	
Number of vaginal examination	≤ 3	9 (3.5)	250 (96.5)	1.00	0.000
	> 3	30 (51.7)	28 (48.3)	29.76 (12.83-69.01)	
Clinical chorioamnionitis	Yes	4 (30.8)	9 (69.2)	5.26 (1.54-16.67)	0.000
	No	36 (7.8)	425 (92.2)	1.00	
Presence of meconium	Yes	25 (22.9)	84 (77.1)	7.14 (3.45-14.29)	0.000
	No	15 (4.1)	350 (95.9)	1.00	
Place ANC	ZMH	4 (2.2)	183 (97.8)	1.00	
	Elsewhere	36 (12.5)	251 (87.5)	6.56 (2.29-18.76)	0.002
Indication for CS	Fetal distress	13 (8.7)	137 (91.3)	2.86 (1.16-7.07)	0.023
	Dystocia	19 (25.7)	55 (74.3)	10.41 (4.33-25.00)	0.002
	Other indications	8 (3.2)	241 (96.8)	1.00	

Table 5. Intraoperative factors associated with SSI in the study participants, ZMH, 2017/18

Variable	Category	SSI status Yes, n (%)	No, n (%)	COR (95%CI)	P-value
Wound class	Clean-contaminated	36 (7.8)	425 (92.2)	1.00	
	Contaminated	4 (30.8)	9 (69.2)	5.25 (1.54-17.88)	0.008
Type of skin incision	Vertical	7 (21.9)	25 (78.1)	3.47 (1.39-8.33)	0.004
	Transverse	33 (7.5)	409 (92.5)	1.00	
Type of anesthesia	Spinal	29 (7.3)	370 (92.7)	1.00	
	General	11 (14.7)	64 (85.3)	2.19 (1.04-4.63)	0.038
Prophylactic antibiotics	Ampicillin	12 (5.1)	225 (94.9)	1.00	
	Ceftriaxone	28 (11.8)	209 (88.2)	2.51 (1.25-5.07)	0.010
Duration of operation	≤ 30	6 (3.0)	191 (97.0)	1.00	
	> 30	34 (12.3)	243 (87.7)	4.45 (1.82-11.11)	0.000
Estimated blood loss	< 500	12 (2.8)	413 (97.2)	1.00	
	≥ 500	28 (57.1)	21 (29.9)	45.88 (20.50-102.7)	0.000
Level of surgeon	Junior (R2)	16 (7.3)	204 (92.7)	1.33 (0.69-2.57)	0.04
	Senior(R3/4, Consultant)	24 (9.4)	230 (90.6)	1.00	

(Unit of measurement for; Duration of operation = minutes, blood loss = ml)

Table 6: Independent factors associated with SSI in the study participants, ZMH, 2017/18

Variable Category	SSI status Yes, n (%)	No, n (%)	COR (95%CI)	AOR (95%CI)	P-value
Clean-contaminated wound	36 (7.8)	425 (92.2)	1.00	1.00	
Contaminated wound	4 (30.8)	9 (69.2)	5.25 (1.54-17.88)	5.64 (2.45-10.6)	0.028
No of vaginal exam. ≤ 3	9(3.5)	250 (96.5)	1.00	1.00	
No of vaginal exam. > 3	30 (51.7)	28 (48.3)	29.76 (12.83-69.01)	5.24 (8.46-16.20)	0.001
ROM ≤ 12 hours	9 (4.1)	210 (95.9)	1.00	1.00	
ROM > 12 hours	30 (31.9)	64 (68.1)	10.94 (4.94-24.24)	7.84 (4.25-12.34)	0.002
Labor ≤ 12 hours	4 (3.0)	130 (97.0)	1.00	1.00	
Labor > 12 hours	35 (20.1)	139 (79.9)	8.18 (2.83-23.66)	3.57 (1.92-9.42)	0.023
Anemia	8 (53.3)	7 (46.7)	14.29 (5.00-50.00)	16.34 (12.98-30.40)	0.024
No anemia	32 (7.0)	427 (93.0)	1.00	1.00	

DISCUSSION

The results of this study showed that the prevalence of surgical site infection after CS is common in ZMH (8.4%). This result is lower than the prevalence of SSI previously reported in Ethiopia; a study in Jimma University Specialized Hospital reported SSI prevalence of 11.4% after cesarean section, cesarean hysterectomy and destructive delivery19. Also, a study conducted in Tikur Anbessa Specialized Hospital found 14.8% wound infection among surgical patients operated for various conditions12. This could be explained by the sociodemographic difference and clinical recantation of the patients between the study areas.

The prevalence of SSI in this study was also lower than the studies done in; Kenya (22%), Cameroon (9.16%), Nigeria (9.1%), Tanzania (10.9%) and Nepal (12.6%)20, 21-24. However, the result of this study is within the range found in a systematic review of health care associated infections in Africa where the prevalence of SSI was noted to range from 2.5 to 30.9 %25, 26. In contrast, this study has higher value than the reported prevalence of post-cesarean SSI in USA (5.2%), Turkey (0.3%), and Italy (1.6%)27, 18, 28. As reported in many other studies, the prevalence of SSIs in developing countries is higher than in the developed countries. This could be explained by the standard of hygiene practiced in developed countries.

In this study the majority of patients had clean contaminated wounds; however, patients having contaminated wounds were more likely to develop SSIs (AOR=5.64). This is in line to previous studies which reported that patients with contaminated wounds had an increased risk of developing a SSI than those with clean contaminated wounds 29, 30, 12, 19.

Different studies showed that about two-third of all post caesarean infectious morbidity occurs after discharge31. Previous studies done in Nepal and Jimma, Ethiopia reported that, about 80-92% of SSIs were developed after emergency CS20, 21. In this study, all SSIs were developed after emergency CS and majority (n=28, 70%) of them were detected after discharge from the hospital. This may be explained by the short hospital stay after caesarean section. At ZMH, patients are routinely discharged on the third day after caesarean section.

Studies indicated that 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 contamination4. In our study, mothers with duration of labor and rupture of membrane of more than 12 hours were about 3.57 and 7.84 times more likely to develop SSIs, respectively. Studies conducted in Kenya, Tanzania, Nigeria, and USA reported more or less similar findings20, 22, 23, 28.

Once the membrane is ruptured, the amniotic fluid has an increased chance of being infected induced by multiple vaginal examination. Multiple vaginal examinations increase the chance of iatrogenic contamination during examination. A study conducted in Tanzania reported that, more SSIs were developed in patients with repeated vaginal examinations22. In this study, those women with four and above vaginal examination were more likely to have wound infection. Since ZMH is a referral hospital, there is a possibility of patients being referred late from other health facilities for caesarean delivery and thus increasing the risk of prolonged labor and multiple vaginal examination.

Among comorbid illnesses, anemia was found to be an independent predictor of SSI in this study; mothers who had anemia were about 16.34 times more likely to develop SSI. Studies from China, India and Nigeria reported similar findings32-34. 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 and impeding wound healing progress.

Limitations of the study were failure to do culture and sensitivity tests to identify the commonest etiologies; and failure to assess some common risk factors of SSI like obesity and ASA score.

CONCLUSION

In this study, the prevalence of SSI was high being 8.4%. Majority of the SSIs (70%) were developed after discharge from the hospital and about 95% of the SSIs were developed within two weeks after caesarean section. Contaminated wound, anemia, prolonged labor, rupture of membranes (≥12 hours) and multiple vaginal examinations prior to cesarean section were found to be significant predictors of SSIs.

RECOMMONDATIONS:

1. Prolonged labor as an important causative factor of SSI, should be prevented through early intervention in cases where there is protracted progress of labor.
2. Minimizing early artificial rupture of membranes should be encouraged to decrease incidence of prolonged rupture of membranes
3. There should be a guideline on digital pelvic examination at teaching hospitals
4. Strengthen prophylaxis and treatment for anemia during ANC
5. Further studies are recommended to identify common pathogens with culture and sensitivity tests

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