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Incidence of Post Cesarean Section Wound Infection and its Associated Risk Factors in Orrota National Referral Maternity Hospital between January and June 2015.

*Ghirmay Ghebreigziabher¹, Abrehet Gebrekidan¹, Ghebremicael Andemicael², Habteselassie Zerezghi³.

^{1,2}Asmara College of Health Sciences, Asmara, Eritrea.

²BN, Clinical Instructor in ACHS, Eritrea.

³Orotta School of Medicine, Asmara, Eritrea.

*Corresponding author: Ghirmay Ghebreigziabher

Email: ghiberaki@yahoo.com

ABSTRACT

Introduction

Cesarean section (CS) is a common mode of delivery now and post caesarean section wound infection (PCSWI) is becoming common infectious complication. This study was planned with the objective to determine the incidence rate and its risk factors of PCSWIs following CS at Orotta National Referral Maternity Hospital (ONRMH) in Asmara-Eritrea from January 1 to June 30, 2015.

Methods

A total of 410 consecutive pregnant women from Zoba Maekel undergoing CS, irrespective of indication, were studied. Women who died before the 3rd day of postoperative period were excluded. A questionnaire was developed to assess the risk factors associated with development of PCSWIs. All the subjects were followed from day one of surgery till discharge and then till the postoperative 30th day after discharge.

Results

PCSWI was identified in 28 (6.8%) out of 410 subjects. Nine types of microorganisms were isolated in 20 (71.4%) samples. The predominant isolated microorganism was *Staphylococcus Coagulase negative* 26.1% followed by *Staphylococcus aureus* 21.7%, and *E. coli* 17.4%. The isolated organisms were 100% sensitive to Clindamycin, Erythromycin, and Rifampicin but 100% resistant to Ampicillin, Penicillin, and Oxacillin. Prolonged labor, prolonged rupture of membrane, multiple vagina examination, lack of administration of antibiotics prophylaxis, early stitch removal, early discharge from the hospital, and obesity showed strong association with PCSWI statistically significant with p value < 0.05.

Conclusions

The study revealed 6.8% PCSWIs rate. Development of PCSWI was related to multi-factorial. Nine different types of microorganisms were isolated. The degree of sensitivity and resistance of the microorganisms varied significantly.

Recommendation

The results of this study emphasized the need to implement on time effective antibiotic prophylaxis, avoid multiple vaginal examinations and shorten prolonged labour.

Keywords: Cesarean section, Wound infection, Maternity hospital

INTRODUCTION

Globally, more than 60% of maternal deaths occur in the postpartum period. Every year in Africa, at least 125,000 women and 870,000 newborns die in the first week after birth [18].

Even in this modern era, post CS infection is still a major public health problem in developing countries [1]. The widespread use of antibiotic prophylaxis has reduced but not eliminated serious postoperative infections; the average expected post CS infection rate being 3-15% after Cesarean section [11].

In Sub-Saharan countries the infection rates are twice or three times higher than developed countries [4]. These rates are increased in the presence of other risk factors such as gross contamination of the operative site, prolonged and premature rupture of membranes, multiple vaginal examinations, obstructed labor, chorioamnionitis, obesity, prolonged operative time, emergency operations, altered immune status, poor surgical techniques, and medical illnesses during pregnancy [15].

Problem Statement

In Eritrea even though, there is no recent study that shows the magnitude of post CS wound infection, plenty of post CS wound infection cases were observed in the study area.

General Objective

The ultimate objective of this study is to minimize the morbidity and mortality rates in women delivering by CS.

Specific objectives are to

1. Determine the incidence rate of post CS wound infection
2. Identify the risk factors associated with post CS wound infection
3. Describe the demographic characteristics of the subjects in relation to post CS wound infection
4. Recommend possible preventive strategies for PCSWI

Significances of the study

The beneficiaries of this study are the patients, the community, and the health care system of the nation. It will also have a great significance in pharmacovigilance of the nation specifically in the use of anti-

microbial prophylaxes. Furthermore, it will be used as a reference for other studies.

METHOD

Research Design and Period

A cross sectional descriptive study was designed to determine the incidence of post CS wound infection and associated risk factors on women who delivered by CS from January 1 to June 30, 2015.

Study Site

The study was conducted at Orotta National Referral Maternity Hospital (ONRMH) in Asmara-Eritrea.

Study Population and Sample size

All women (N=410) living in Zoba Maekel who were operated for child birth on emergency and elective indications in the hospital during the study period were eligible for this study. Women who died before 3rd post-operative day were excluded.

Data collection method

Data was collected through pretested structured questionnaire. Patients were examined and followed for the development of post CS wound infection before and during discharge, on stitch removal, and home visit and/or telephone call until thirtieth postoperative day. Microorganisms were identified by culture and sensitively tests at National Health Laboratory, Asmara.

Data analysis method

Descriptive data analysis was conducted. Chi-square test, Yates Continuity Correction or Fisher's Exact Test were used to determine statistically significant outcome. The level of significance, alpha (α), was set at 0.05 confidence interval.

Ethical consideration

Ethical consideration was granted from the research ethical committee of EMOH. Researchers guaranteed the consent of the subjects by their signatures. The respondents were assured to feel free to quit the study at any time.

RESULT

The overall PCSWI among the study population was 6.8 % (n=28) with mean age 28.4 and SD 5.4. The highest PCSWI 13.7% (n=18) was observed in the age group of 25-34 (n=264). The

socio demographic characteristics of the study population had no statistically significant association with PCSWI as shown in table 1.

Table 1. Socio-demographic characteristic vs PCSWI rate among the study participants.

Demographic Characteristics	PCSWI		Total n (%)
	Not infected n (%)	Infected n (%)	
Age Group			
15-19	10(90.9)	1(9.1)	11(2.7)
20-24	60(92.3)	5(7.7)	65(15.9)
25-29	153(93.3)	11(6.7)	164(40.0)
30-34	93(93)	7(7.0)	100(24.4)
35-39	51(94.4)	3(5.6)	54(13.2)
40-44	15(93.8)	1(6.2)	16(3.9)
Mean age	29	28.4	29.05
SD	5.2	5.4	5.2
Marital Status			
Married	368(93.6)	25(6.4)	393(95.9)
Divorced	2(100)	0(0.0)	2(0.5)
Single	12(80.0)	3(20.0)	15(3.7)
Educational Status			
Illiterate	12(92.3)	1(7.7)	13(3.2)
Primary	25(92.6)	2(7.4)	27(6.6)
Junior	78(90.7)	8(9.3)	86(21.0)
Secondary	237(94.4)	14(5.6)	251(61.2)
College	30(90.9)	3(9.1)	33(8.0)
Occupation			
Civil Servant	20(90.9)	2(9.1)	22(5.4)
National Service	2(66.7)	1(33.3)	3(0.7)
Business	5(100.0)	0(0.0)	5(1.2)
Daily Laborers	6(66.7)	3(33.3)	9(2.2)
Un-employed	349(94.1)	22(5.9)	371(90.5)
Religion			
Orthodox	362(93.3)	26(6.7)	388(94.6)
Catholic	4(100.0)	0(0.0)	4(1.0)
Protestant	2(100.0)	0(0.0)	2(0.5)
Muslim	14(87.5)	2(12.5)	16(3.9)
Ethnicity			
Bilen	1(100.0)	0(0.0)	1(0.2)
Saho	4(80.0)	1(20.0)	5(1.2)
Tigre	4(80.0)	1(20.0)	5(1.2)
Tigrigna	373(93.5)	26(6.5)	399(97.3)
Total	382(93.2)	28(6.8)	410(100.0)

Except one all study participants attended antenatal care. The highest rate (11.3%) of PCSWI was observed in gravida three (p. value 0.1860). Descriptively, the highest infection was

seen among women who never had still birth n=26, abortion n=21 and previous CS n=19 subjects as shown in table 2.

Table2. Obstetric history vs PCSWI rate among study participants.

Obstetric History	PCSWI			p -value
	Not infected n (%)	Infected n (%)	Total n (%)	
Antenatal follow up				
Yes	381(93.2)	28(6.8)	409(99.8)	
No	1(100.0)	0(0.0)	1 (0.2)	
Total	382(93.2)	28(6.8)	410(100.0)	
Gravida				
1	130(93.5)	9(6.5)	139(33.9)	
2	103(92.8)	8(7.2)	111(27.1)	
3	55(88.7)	7(11.3)	62(15.1)	
4	41(97.6)	1(2.4)	42(10.2)	
≥5	53(94.6)	3(5.4)	56(13.7)	
Total	382(93.2)	28(6.8)	410(100.0)	
Para				
0	86(96.6)	3(3.4)	89(21.7)	
1	109(89.3)	13(10.7)	122(29.8)	
2-4	163(94.2)	10(5.8)	173(42.2)	0.1860
≥ 5	24(92.3)	2(7.7)	26(6.3)	
Total	382(93.2)	28(6.8)	410(100.0)	
Abortion				
0	318(93.8)	21(6.2)	339(82.7)	
1	45(88.2)	6(11.8)	51(12.4)	
2	16(94.1)	1(5.9)	17(4.1)	
≥3	3(100.0)	0(0.0)	3(0.7)	
Total	382(93.2)	28(6.8)	410(100.0)	
Still birth				
0	368(93.4)	26(6.6)	394(96.1)	
1	14(93.3)	1(6.7)	15(3.7)	
2	0(0.0)	1(100.0)	1(0.2)	
Total	382(93.2)	28(6.8)	410(100.0)	
Caesarean Section				
0	225(92.2)	19(7.8)	224(59.5)	
1	115(95.0)	6(5.0)	121(29.5)	
2	34(94.4)	2(5.6)	36(8.8)	
3	5(100.0)	0(0.0)	5(1.2)	
4	3(75.0)	1(25.0)	4(1.0)	
Total	382(93.2)	28(6.8)	410(100.0)	
Gestational age (weeks)				
28 – 37	92(93.8)	7(7.1)	99(24.1)	0.9129
38 – 42	290(93.2)	21(6.8)	311(75.9)	
Total	382(93.6)	28(6.4)	410(100.0)	

Except BMI all the co-morbidity factors considered in this study were anemia, hypertension,

diabetes mellitus, UTI and HIV and were found statistically insignificant as shown in table 3

Table 3. Co-morbidity as risk factor for PCSWI among the study population

Variables	PCSWI		Total	p-value
	Not infected	Infected		

Presence of co-morbidity				
Yes	22(88.0)	3 (12.0)	25(6.2)	
No	360(93.5)	25 (6.5)	385 (93.9)	0.5273
Total	382(93.2)	28(6.8)	410(100)	
BMI				
< 18.5	6(100)	0(0.0)	6(1.5)	
18.5 - 24.99	272(94.1)	17 (5.9)	289(72.3)	
25.0 - 29.99	82(93.2)	6 (6.8)	88(22.0)	0.0387
≥ 30.0	13(76.5)	4(23.5)	17(4.3)	

Vital signs were taken for n= 269 (65.5%) (p=0.0716) and lab tests were done for 141 (36.4%) (p=0.1961) from the total study population preoperatively. Twenty (71.4%) (n=20/28) out of the twenty eight infected women were in labor before CS. Nineteen (67.8%) women were in labor for ≥ 6 hours before CS, while only one (3.57%; n=1/28) was in labor for less than 6 hours. Seven (25%; n=7/28) had ruptured membranes (P value 0.0400). 133 women out of 177; who spent ≥ 6 hours with ruptured membranes before they were operated 9.8% (n=13) of them were infected.

Women who were not taking prophylactic antibiotics before cesarean section in this study showed statistically significant (p=0.0227) outcome on infection during their postpartum period. The association is out the 152 women who did not take

antibiotics 10.5% (n= 16) were infected while out of those who took 4.7% (n=12) were infected.

In women had vaginal examination ≥ 6 times PCSWI was observed 15.5% statistically insignificant (p. value 0.0035). Out of the 301 women who were in labor before CS 20 of them were infected and 19 were in labor for ≥ 6 hours. The findings of this study showed primary (n=231) or secondary (n= 179) CS had no association with PCSWI even though there were 18 (64.3%) and 10 (35.7%) infected cases operated as primary and secondary CS respectively. There were 103 (25.1%) elective and 307 (74.9%) emergency CS deliveries. Among the infected cases 21 (75%) of them had emergency surgery while the remaining 7 (25%) had elective surgery statistically insignificant (p value 0.9878) as shown in the table 4.

Table 4. Preoperative management vs PCSWI rate among the study population.

Variables	PCSWI		Total N (%)	P-Value
	Not infected N (%)	Infected N (%)		
Preoperative vital signs taken				
Yes	255(94.8)	14(5.2)	269(65.5)	
No	127(90.1)	14(9.9)	141(34.4)	0.0716
Total	382(93.2)	28(6.8)	410(100)	
Preoperative lab test done				
Yes	142(95.3)	7(4.7)	149(36.3)	0.1961
No	240(92.0)	21(8.0)	261(63.7)	
Total	382(93.2)	28(6.8)	410(100)	
Labor started before CS				
Yes	281(93.4)	20(6.6)	301(73.4)	0.8053
No	101(92.7)	8(7.3)	109(26.6)	
Total	382(93.2)	28(6.8)	410(100)	
Duration of labor before CS				
<6 hours	31(96.9)	1 (3.1)	32(10.7)	0.6315
≥ 6 hours	248(92.9)	19 (7.1)	267(89.3)	
Total	279(93.3)	20(6.7)	299(100)	
ROM on admission				
Yes	92(92.9)	7(7.1)	99(24.1)	
No	290(93.2)	21(6.8)	311(75.9)	0.9129

Total	382(93.2)	28(6.8)	410(100)	
CS done after ROM				
Yes	74(91.4)	7(8.6)	81(26.7)	
No	216(93.9)	14(6.1)	230(74.0)	0.4306
Total	290(93.2)	21(6.9)	311(100)	
Duration of ROM before CS				
<6 hours	44(100)	0 (0.0)	44(24.9)	
≥ 6 hours	120(90.2)	13 (9.8)	133(75.1)	0.0400
Total	164(92.7)	13(7.3)	177(100)	
Prophylaxis antibiotic				
Given	246(95.3)	12 (4.7)	258(62.9)	
Not given	136(89.5)	16 (10.5)	152(37.1)	0.0227
Total	382(93.2)	28(6.8)	410(100)	
Exam per-vagina				
<6 times	322 (95.0)	17 (5.0)	339(82.7)	
≥ 6 times	60 (84.5)	11 (15.5)	71(17.3)	0.0035
Total	382(93.2)	28(6.8)	410(100)	
Types of CS				
Primary	213(92.2)	18(7.8)	231(56.3)	
Secondary	169(94.4)	10(5.6)	179(43.7)	0.3799
Total	382(93.2)	28(6.8)	410 (100)	
Types of surgery				
Elective	96(93.2)	7(6.8)	103(25.1)	0.9878
Emergency	286(93.2)	21(6.8)	307(74.9)	
Total	382(93.2)	28(6.8)	410(100)	

Indications for emergency CS in this study were prolonged labor n= 86, fetal distress n= 57, APH n=8, PIH n=5, failed induction n=1, cord prolapse n=11, previous CS n=56, CPD n=41 malpresentation n=70 and others n=16. Among the 86 cases who were operated due to prolonged

labor 12.8% (n=11) were infected. Except prolonged labor (p. value 0.0099) the other indications for CS didn't show statistical association with PCSWI among the women who delivered by emergency CS n=307.

Table 5. Indication for CS vs rate of PCSWI among emergency cases

Indication	PCSWI		Total N (%)	P-Value
	Not infected N (%)	Infected N (%)		
Prolonged Labor				
Yes	75(87.2)	11 (12.8)	86(28.0)	
No	211(95.5)	10 (4.5)	221(72.0)	0.0099
Total	286(93.2)	21(6.8)	307(100.0)	
Fetal Distress				
Yes	51(89.5)	6(10.5)	57(18.6)	
No	235(94.0)	15(6.0)	250(81.4)	0.3519
Total	286(93.2)	21(6.8)	307(100.0)	
APH				
Yes	7(87.5)	1(12.5)	8(2.6)	
No	279(93.3)	20(6.7)	299(97.4)	0.5205
Total	286(93.2)	21(6.8)	307(100.0)	
PIH				
Yes	4(80.0)	1(20.0)	5(1.6)	

No	282(93.4)	20(6.6)	302(98.4)	0.7778
Total	286(93.2)	21(6.8)	307(100.0)	
Failed Induction				
Yes	1(100.0)	0(0.0)	1(.3)	
No	285(93.1)	21(6.9)	306(99.7)	0.9999
Total	286(93.2)	21(6.8)	307(100.0)	
Cord Prolapse				
Yes	11(100.0)	0(0.0)	11(3.6)	
No	275(92.9)	21(7.1)	296(96.4)	0.7588
Total	286(93.2)	21(6.8)	307(100)	
Mal presentation				
Yes	67(95.7)	3(4.3)	70 (22.8)	
No	219(92.4)	18(7.6)	237(77.2)	0.4875
Total	286(93.2)	21(6.8)	307(100.0)	
Previous CS				
Yes	54(96.4)	2(3.6)	56(18.2)	
No	232(92.4)	19(7.6)	251(81.8)	0.4360
Total	286(93.2)	21(6.8)	307(100.0)	
CPD				
Yes	37(90.2)	4(9.8)	41(13.4)	
No	249(93.6)	17(6.4)	266(96.6)	0.6440
Total	286(93.2)	21(6.8)	307(100.0)	
Others				
Yes	16(100.0)	0(0.0)	16(5.2)	
No	270 (92.8)	21(7.2)	291(94.8)	
Total	286(93.2)	21(6.8)	307(100.0)	0.5454

As shown in table 6, almost ninety nine percent (98.8%) of the study population had Pfannenstiel incision and one percent had the Median subumbilical type ($p= 0.7773$). All of the PCSWI cases delivered under spinal anesthesia. Out of the

study population 344 women including the 24 women among the PCSWI were operated within ≥ 30 minutes ($p=0.5829$). Regarding the outcome of deliveries out of 391 (95.4%) who gave birth to live babies 25 of them developed infection ($p= 0.2628$).

Table 6. Intraoperative management vs PCSWI rate of the study population.

Variables	PCSWI		Total N (%)	P-Value
	Not infected N (%)	Infected N (%)		
Surgical procedure				
Median subumbilical	4(80.0)	1(20.0)	5(1.2)	
Pfannenstiel incision	378 (93.3)	27(6.7)	405(98.8)	0.7773
Total	382(93.2)	28(6.8)	410(100.0)	
Anesthesia				
General	4(100)	0(0.0)	4(1.0)	
Spinal	378(93.1)	28(6.9)	406(99.0)	0.9999
Total	382(93.2)	28(6.8)	410(100.0)	
Operation time				
<30 minutes	50(96.2)	2 (3.8)	52(13.1)	
≥ 30 minutes	320(93.0)	24(7.0)	344(86.9)	0.5829
Total	370(93.4)	26(6.6)	396(100.0)	

Outcome of CS delivery

Alive baby	366(93.6)	25 (6.4)	391(95.4)	0.2628
Dead baby	16(84.2)	3(15.8)	19(4.6)	
Total	382(93.2)	28(6.8)	410(100.0)	

As shown in table 7, the study population who were fed solid foods before 24 hours were n=398 and 6.3% (n=25/398) of them were infected (p=0.0414). Among the study population who stayed in the hospital ≤ 3 days were 2 and 100% infected (p. value 0.0001). Women who came for stitch removal before 7 days post-operative 72.7

%(n=8/11) were infected (p = 0.0001). Women who had one or more than one complaints during their post-operative period such as fever, vomiting, foul smelling vaginal discharge and abdominal cramps 75.9% (n=22/29) of them developed PCSWIs (p. value 0.0001).

Table 7. Postoperative management vs PCSWI rate of the study population.

Variables	PCSWI		Total	p value
	Not infected	Infected		
Was catheter used				
Yes	382(93.2)	28(6.8)	410(100.0)	
No	0(0)	0(0)	0(0)	Not app
Total	382(93.2)	28(6.8)	410(100.0)	
When was catheter removed				
< 6 hours	0(0.0)	0(0.0)	0(0.0)	Not app
≥ 6 hours	382(93.2)	28(6.8)	410(100.0)	
Total	382(93.2)	28(6.8)	410(100.0)	
Start ambulation after				
< 6 hours	0(0.0)	0(0.0)	0(0.0)	Not app
≥ 6 hours	382(93.2)	28(6.8)	410(100.0)	
Total	382(93.2)	28(6.8)	410(100.0)	
Fed fluid food after				
< 12 hours	208(93.7)	14(6.3)	222(54.1)	0.6483
≥ 12 hours	174(92.6)	14(7.4)	188(45.9)	
Total	382(93.2)	28(6.8)	410(100.0)	
Fed Solid food after				
< 24 hours	373(93.7)	25(6.3)	398(97.1)	0.0414
≥ 24 hours	9(75.0)	3(25.0)	12(2.9)	
Total	382(93.2)	28(6.8)	410(100.0)	
Hospital Stay				
< 3 days	0(0.0)	2(100.0)	2(5.0)	0.0001
≥ 3 days	382(93.6)	26(6.4)	408(99.5)	
Total	382(93.2)	28(6.8)	410(100.0)	
Receive health education				
Yes	252(94.4)	15(5.6)	267(65.1)	

No	130(90.9)	13(9.1)	143(34.9)	0.1840
Total	382(93.2)	28(6.8)	410(100.0)	
Stitch removal time				
< 7days	3(27.3)	8(72.7)	11(2.7)	
≥7 days	375(94.9)	20(5.1)	395(97.3)	0.0001
Total	378(93.1)	28(6.9)	406(100.0)	
Woman's complaints				
Yes	7(24.1)	22 (75.9)	29(7.1)	
No	375(98.4)	6 (1.6)	381(92.9)	0.0001
Total	382(93.2)	28(6.8)	410(100.0)	

Descriptively, the 28 women's infection was identified on stitch removal 57.1% (n=16) followed by 25% (n=7) on discharge and 17.9% (n=5) on phone call as revealed in table 8.

Table 8. Diagnoses time of post CS wound infection of the subjects

Time of Diagnoses	Frequency	Percent
During Discharge	7	25.0
During Stitch removal	16	57.1
During Phone call	5	17.9
Total	28	100.0

As table 9 indicated the degree of wound infection which was identified in this study was 75% deep and 25% superficial.

Table 9. Degree of wound infection of the subjects

Degree of Wound	Frequency	Percent
Superficial	7	25.0
Deep	21	75.0
Total	28	100.0

Table 10 shows the highest isolated microorganism was *Staphylococcus Coagulase negative* (26.1%) followed by *Staphylococcus aureus* 21.7% and *E. coli* 17.4%.

Table 10. Growth of microorganisms among the infected cases in agar media

Type of Micro-organism	Frequency	Percent
<i>Acinebacter species</i>	1	4.3
<i>Citrobacter freundii</i>	2	8.7
Coagulase negative Staphylococcus	6	26.1
<i>E coli</i>	4	17.4
<i>K.pneum.pneumoniae</i>	1	4.3
<i>Klebsiella oxytoca</i>	1	4.3
<i>Providencia stuartii</i>	2	8.7
<i>Serratia Oderifera</i>	1	4.3
<i>Staphylococcus aurous</i>	5	21.7
Total	23	100.0

Result of sensitivity and resistance

The degree of sensitivity and resistance of the microorganism varied significantly. The result showed the microorganisms were 100% resistant to Ampicillin, Penicillin, and Oxacillin but sensitive to Cephalexin 58%, Ceftazidime 69%, Ceftriaxon 69%, Chloramphenicol 92%, Ciprofloxacin 80%, Cotrimoxazole 77%, Gentamycin 69%, Nalidic acid 58%, Nitrofurantoin 35%, Tetracycline 35%, Amikacin 87.5%, Clindamycin 100%, Erythromycin 100%, Vancomycin 80%, and Rifampicin 100%.

DISCUSSION

According to Eritrean EMOH in 2011, female reproductive age is from 15-45 years of age. Similarly, in this study the reproductive age was 15-44 (n=410). Cunningham [3] mentioned that many obstetrical complications such as prolonged labor, pregnancy induced hypertension and postpartum sepsis were commonly observed among teenagers and in reproductive cutting edge women. Inconsistent with the above explanation, descriptively teenagers showed highest percentage of PCSWI in this study.

Educated women are expected to have better health practices in their health and family [16]. In this study 3.2% (n=13) women were illiterate. Descriptively, with the exception of college level educated women as education increased the incidence of PCSWI was observed to increase in this study.

The remaining social demographic characteristics of the study population such as address, marital status, occupation, religion, and ethnicity showed no association with PCSWI, which was consistent with the findings of [8] in Saudi.

According to [9, 7, 3] multigravidas are at a higher risk of complication such as bleeding that later attributes to infection. In this study however as the number of pregnancies increased the incidence of PCSWI decreased.

Obesity is one of the co-morbidity factors that increase the risk of complications in the outcome of labor and delivery including post cesarean section surgery by delaying wound healing [3]. In this study, the relationship between increasing maternal BMI and infection appearing linear ($p = 0.0387$) which was similar to other reports in the literature [13].

Generally patients undergoing emergency CS are at higher risk of infections. A study conducted in India revealed that emergency caesarean section predisposes more to PCSWI as compared to elective (80.16%) [6]. A study conducted in Ethiopia where emergency surgery had two times increased risk of surgical site infection (11.9% vs 5.4%) than elective cases [5]. The ratio of elective and emergency surgery rate in this study observed was 1:3. However, emergency CS was not a significant determinant of PCSWI in this study, which was consistent with the findings of [8] in Saudi. Majority of the study population (56.3%) had primary CS who were found to be at greater risk of infection (64.3%, 18/28) compared to repeat cesarean birth, which was consistent with the findings of [13].

According to [2] longer time of surgery causes too much blood loss, tissue damage and organ manipulation, pain, self-care deficit and psychological trauma after surgery. For that reason, lengthy time during cesarean section was tested for association and the findings showed statistically insignificant ($p = 0.5829$) in both emergency and elective cesarean sections.

Almost ninety nine percent (98.8%) of this study population had Pfannenstiel incision and statistically insignificant. While [6] study indicated transverse incision had less chance of wound dehiscence and significantly associated with SSI. Fundamentally, vital signs are proven tools to assess the health of the client and to provide quality care if needed [2]. This study assessed the association of vital signs with PCSWI on 65.5% (n=269) subjects and found statistically insignificant ($p = 0.0716$).

According to [18] prolonged labor leads to stress, anxiety, fatigue, infection, postpartum hemorrhage, and emergency cesarean section. Similarly, in this study, one of the main indication of cesarean section was prolonged labor n=86 and showed statistical association ($p = 0.0099$) with PCSWI.

Women who were in labor for ≥ 6 hours before their cesarean section showed 7.2% (n=19/267) PCSWI whereas 3.1% (n=1/32) infected women were in labor before cesarean section for <6 hours ($p = 0.6315$). Association ($p = 0.0400$) was found from this study that women who had ruptured their membranes ≥ 6 hours before the cesarean section had developed PCSWI at 9.8% (n=13/133). Too many vaginal examinations before cesarean section was prevailed

PCSWI at $p= 0.0035$. Women who had ≥ 6 vaginal examinations developed more infection 15.5% ($n=11/71$) compared to those who had less vaginal examinations 5.0% ($n=17/339$), which was consistent with the findings of [13].

The length of time between rupture of the membranes and surgery also showed statistically significant risk for surgical site infection in the subjects ($P=0.04$). These findings were supported by a study conducted in Oman that revealed four-fold increased risk in the rate of PROM among the case group compared to the controls [10]. They found association between PROM and wound infections highly significant ($P < 0.001$). A study done in Tanzania, rupture of membranes prior to surgery lasting 8 hours or longer and 3 or more vaginal examinations were found to be significant risks for PCSWI development [12]

The American College of Obstetricians and Gynecologists (ACOG) has recently recommended that antimicrobial prophylaxis for all cesarean deliveries should be administered within 60 minutes of the start of the procedure [14]. A recent meta-analysis of prospective, randomized studies demonstrated that administering antibiotics before incision instead of after cord clamping decreases maternal morbidity without adverse neonatal effects [14]. Antibiotic prophylaxis was found to be the significant protective factor ($p = 0.0189$) in the reduction of postoperative wound infection in this study.

Breman et. al 2008 and Cunningham et al 2009 agreed on post-operative diet that anesthetic agents inhibits peristalsis. Consequently, giving fluid and solid food will have adverse effects on the clients. In this study resuming of solid foods ≥ 24 hours showed association with PCSWI ($p= 0.0414$) while women who had fluid diet in less than 12 hours or more they showed PCSWI statistically insignificant ($p= 0.6483$).

In spite of the availability of antibiotics, PCSWIs are still responsible for much morbidity and far reaching socioeconomic consequences for both patients as well as health care systems. Reduction in surgical site infections while minimizing antibiotic resistance still remains a challenge for many health care institutions [6].

Hospital stay less than 3 days were strongly associated with infection at $p. 0.001$ by 6.4% ($n=26/408$) which was consistent with the findings of [2]. The predominant isolated microorganism

was *Staphylococcus Coagulase negative* (26.1%) followed by *Staphylococcus aureus* 21.7% and *E. coli* 17.4%. The microorganisms were 100% resistant to Ampicillin, Penicillin, and Oxacillin but 100% effective to Clindamycin, Erythromycin, and Rifampicin. This was supported in similar study by [10] the most common organisms responsible for PCSWI were *Staphylococcus aureus* (66, 31.27%) and the Gram-negative *Escherichia coli* group (40, 18.95%). The most sensitive antibiotics were aminoglycoside and cephalosporin.

Breman et. al 2008 p. 680) sorted out “fever, acute pain, and anxiety” as indicators of infection [9] added foul smelling from vaginal, self-care deficit, and severe abdominal cramps as indicators of obstetric infections. In this study, all indicators were potential predictors of PCSWI and inferred statistically their association at $p. 0.0001$.

The degree of wound infection which was identified in this study was 75% deep and 25% superficial but a study developed [11] in Tanzania was 38.2% superficial wound infection, 46.5% deep and 15.3% organ space after PCSWI.

CONCLUSION

The study revealed 6.8% ($n=28/410$) PCSWI rate. Prolonged labor, prolonged rupture of membrane (ROM), multiple vagina examination, lack of administration of antibiotics prophylaxis, early stitch removal, early feeding solid foods, early discharge, and increased BMI were identified as risk factors for PCSWI in this study. Nine different types of microorganisms were isolated. The degree of sensitivity and resistance of the microorganisms varied significantly. The association of PCSWI with socio-demographic characteristics of the study population showed statistically insignificant.

Recommendations

The results of this study emphasizes the need to implement effective antibiotic prophylaxis on time, avoid multiple PV examinations and shorten prolonged labor. Frequent antimicrobial audit in the hospital is strongly recommended because the microorganisms are resistant to most of the drugs currently in use.

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