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Overview of risk factor and bacterial pattern in patient with surgical site infection after caesarean section in Ciptomangunkusumo Hospital from 2016 to 2018

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SUMMARY

Background: Caesarean section is one of the most commonly performed surgeries both in the hospital. The incidence of infections in cesarean section varies greatly around the world at 3–15%. SSI on is a multifactorial process that starts from the perioperative preparation, the patient, the type of surgery, the type of germ and other factors.
Aims: To determine the characteristics of patients, bacterial patterns, and risk factors for the incidence of SSI in Cipto Mangunkusumo National General Hospital in 2016–2018.
Method: This study was an observational study using a retrospective cohort method. The subject of this study were patients undergoing cesarean section in Cipto Mangunkusumo National General Hospital in 2016–2018 recruited using consecutive sampling method. Based on the data obtained, bivariate and multivariate analysis were conducted to determine the factors affecting post-caesarean SSI.
Results: A total of 2052 subjects were included in the study. There were 85 cases of surgical site infection (SSI) out of 2052 operations (4.14 %). A total of 85 SSI cases and 1967 control groups were included in the risk factor analysis. The most common bacteria found in surgical site infection culture were Staphylococcus aureus (16,5%), Klebsiella pneumoniae (12,9%), Escherichia coli (9,4%), Enterococcus faecalis (9,4%), and others (21,2%). Variables associated with SSI in this study is fetal distress (p=0,002; AOR = 2,265 CI 95 % 1,350–3,801) and BMI $\geq$30 kg/m^2 (p=0,028; AOR 1,824 CI 95% 1,066–3,121).
Conclusion: Factors influencing the incidence of SSI post cesarean section was fetal distress (p=0,002; AOR = 2,265 CI 95 % 1,350–3,801) and BMI $\geq$30 kg/m^2 (p=0,028; AOR 1,824 CI 95% 1,066–3,121).

Background

Cesarean section is one of the most frequent actions performed in the field of obstetrics within a hospital and may

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continue given the high incidence of cesarean section. In the last thirteen years the incidence of cesarean section has risen to 41% [1]. This is a global phenomenon, as cesarean section is now performed on 32% of total births in the United States, which concludes about 1.3 million operations yearly, while in the UK and Australia the number of cesarean section operation reached 26.5% and 32.3%. Furthermore, data in Indonesia showed that the number of cesarean sections in 2012 was 15.3% [1,2]. Like any other operation, cesarean section may be followed by various complications, one of which a surgical site infection (SSI) [1] (Figure 1).

Several risk factors associated with the occurrence of surgical site infection after cesarean section have been identified. The identification of these factors plays an important role in determining the methods that can be used to reduce the risk of SSI. Risk factors can be divided into three categories. 1) factors related to host, 2) factors related to pregnancy and intrapartum and 3) factors related to surgery [2].

Factors related to the host include too old or too young maternal age, obesity, living in rural areas (compared to living in urban area), gestational diabetes mellitus, history of previous cesarean section, recurrent miscarriage, preoperative maternal conditions (American Society of Anesthesiologist (ASA) score >3) [2–4]. While factors related to pregnancy include hypertension, gestational diabetes, multiple pregnancies, premature rupture of membranes, greater number of internal examinations, prolonged parturition of the trial before surgery, use of epidural anesthetics, use of internal fetal monitoring, and chorioamnionitis [4]. Meanwhile, factors related to cesarean section itself are emergency surgeries, no antibiotic prophylaxis, cases related to uterine rupture, cesarean section with hysterectomy, need for transfusion, and longer operative time. Operating time of more than 1 hour is associated with up to two times the risk of SSI [5].

Various studies have been performed in order to determine factors affecting the rate of surgical site infection in post caesarean patients. However, few of the studies were

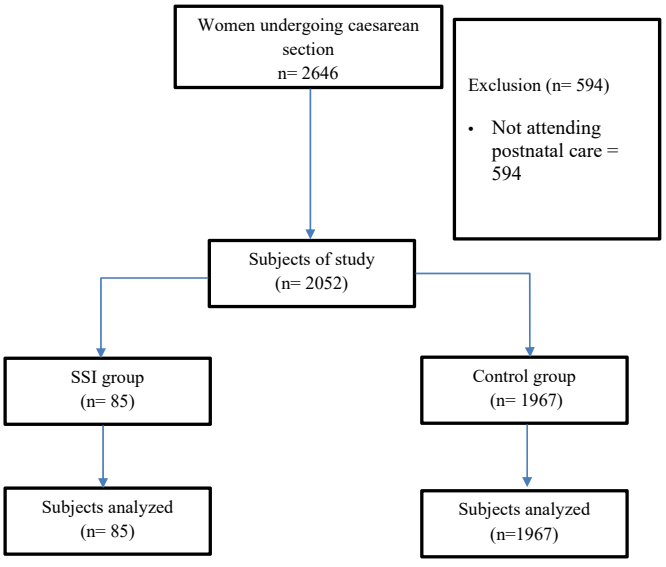

Figure 1. Research Flow.

Table 1
Baseline characteristics of subjects

Variables	N = 2052
Maternal Age	30 (13–47)
Gestational age	
Preterm	1.159 (56,5%)
Term	893 (43,5%)
Gravid	
Primigravid	702 (34,2%)
Multigravid	1.350 (65,8%)
Parity	
Primiparous	809 (39,4%)
Multiparous	1.243 (60,6%)
Abortion history	
Yes	446 (21,7%)
No	1606 (78,3%)
Operation type	
Elective	183 (9,0%)
Emergency	1867 (91,0%)
Previous Caesarean Section history	
Yes	560 (27,3%)
No	1492 (72,7%)
Body mass index	25,28 (16,89–50,59)
Hemoglobin level	11,7 (6,4–17,7)
Premature Rupture of Membrane (PROM)	
Yes	771 (37,6%)
No	1281 (62,4%)
Gestational Hypertension	
Yes	682 (33,2%)
No	1370 (66,8%)
Fetal distress	
Yes	397 (19,3%)
No	1655 (80,7%)
Antepartum hemorrhage	
Yes	143 (7%)
No	1909 (93%)
Dystocia	
Yes	75 (3,7%)
No	1977 (96,3%)
Diabetes mellitus	
Yes	71 (4,0%)
No	1724 (96%)
Intrauterine infection	
Yes	141 (6,9%)
No	1911 (93,1%)
HIV	
Yes	41 (2,0%)
No	2011 (98%)
Glucose blood level	105,8 (43,99)
Leucocyte level	14.197 (13.110)
Serum albumin level	4,01 (6,75)

Table 2
Characteristics of SSI

Characteristics	N = 85
SSI classification	
Incisional superficial	79 (92,9%)
Incisional deep	4 (4,7%)
Organ/space	2 (2,4%)
Culture result	
Klebsiella pneumoniae ss. Pneumoniae	11 (12,9%)
Escherichia coli	8 (9,4%)
Enterococcus faecalis	8 (9,4%)
Pseudomonas sp.	2 (2,4%)
Staphylococcus aureus	14 (16,5%)
Others	18 (21,2%)
Sterile	6 (7,1%)
Treatment	
Wound care	65 (76,5%)
Re-operation	20 (23,5%)

performed in a tertiary care hospital, which has more severe cases and therefore complications. In order to reduce the rate of surgical site infection in caesarean section patients, a study investigating the risk factors was performed.

Methods

An analytic observational study using cohort retrospective method was done. The population were all women undergoing caesarean section within the course of the study. In the study period, a sample of 2,052 women undergoing caesarean section were included. Patients with an incomplete medical record, not attending postnatal care, or died within 30 days of birth were excluded from the study. The data were then analyzed by two groups (surgical site infection group vs. control group). Ethical clearance was issued from ethical committee in Faculty of Medicine, Universitas Indonesia with ethical clearance number of 19/06/0736.

Results and discussion

In this study, there were 85 cases of surgical site infections (SSI) out of 2052 surgeries (4.14%) (Table 1). This figure is not much different from the results of similar studies in Israel with a percentage of 3.7% SSI and in North America with a percentage of 2.7% [4,6]. This figure is lower than similar studies conducted in other Southeast Asia countries such as Thailand which had a rate of 5.9% [7]. Previous research shows that the post caesarean SSI rate in developed countries ranges from 1.5% - 7.0% while the rate for developing countries is about 6% [6,8].

Samples for culture in this study were taken from the wound base, discharge, or lochia. However, cultures that were considered representative of SSI were cultures that taken from the wound base, but not all patients had samples taken for bacterial culture in this study, due to the financial cost, for some patients. The bacteria most often found in this study were *Staphylococcus aureus* (16.5%), followed by *Klebsiella pneumoniae* (12.9%), *Escherichia coli* (9.4%), *Enterococcus faecalis* (9.4%), and other pathogens like *Streptococcus epidermidis* and *Acinetobacter baumanii* (Table 2).

Culture results of this study were consistent with similar studies such as a study in Tanzania showing that *Staphylococcus aureus* as one of the most common bacterium causing SSI in post-caesarean patients, and particular superficial infections [2,9]. In addition, the study found that *S. aureus* in post cesarean section SSI cultures were resistant to ampicillin, co-trimoxazole, and erythromycin. In this study antibiotic resistance tests were not included in the study. In addition, the results showed that *Klebsiella pneumoniae* was the second most prevalent bacteria in SSI post cesarean section, especially in internal and organ infections [9]. In research conducted in Israel, *Escherichia coli* is one of the organisms that are often found in post caesarean SSI [2]. In another study in Tanzania, *E. coli* obtained from the post-Caesarean SSI culture had high resistance to ampicillin, a combination of amoxicillin/clavulanate, tetracycline, and co-trimoxazole [9].

Besides the normal flora of the skin, vagina, and the gastrointestinal tract, there are bacteria that originate from opportunistic bacteria originating from hospital-caused infections (HCAI/Healthcare Associated Infection), namely *Acinetobacter spp*. In this study, it was found that 8 (9.41%) research subjects having *Acinetobacter sp* in cultures. *Acinetobacter spp*. is recognized to be a nosocomial pathogen found in healthcare enviroments, often causing hospital-acquired pneumonia (HAP) with associated significant resistance to antibiotics [10].

In the patients with SSI, 65 cases (76.5%) were treated with standard wound care, while 20 other cases needed re-operation (23.5%). SSI is generally considered as one of the causes of prolongation of the duration of postoperative hospitalization and additional costs for patients with various types of surgery, including cesarean section [11]. Uniquely, a study in the UK shows that the stitching method used in caesarean section affects the rate of SSI, with the smallest percentage of SSI occuring in subcuticular sutures and the largest percentage obtained in interrupted sutures [12].

In this study, high body mass index (BMI), BMI $\geq$ 30 kg/m^2 was associated with increased risk of SSI (p = 0.028; OR 1.824 CI95% 1.066−3.121) (Tables 3 and 4). This is consistent with previous studies in the UK where BMI >30 kg/m^2 was known as a risk factor for complications in surgery [13]. Obesity as a risk factor for SSI is due to an increase in relatively avascular adipose tissue, increase in the area of the surgical wound and reduced prophylactic antibiotic penetration into the adipose tissue [14].

Fetal distress was also considered to be one of the risk factors for SSI events in postoperative caesarean patients (p= 0.001, OR = 2.09, CI95% 1.3−3.33) (Table 4). Fetal distress is one of the indications of a cesarean section, in fact it is one of the three most frequent reasons for cesarean section [6]. One study that showed fetal distress as a risk factor for SSI was carried out by Moulton and colleagues [15]. Caesarean section due to fetal distress as a risk factor for SSI have not been widely discussed in other studies. One possible reason is the lack of optimal preparation of caesarean section in cases of fetal distress, but this requires further research.

Table 3
Bivariate analysis of SSI risk factors

Variables	Study groups		*P*	OR	CI 95%
	SSI (n=85)	Control (n=1967)			
Age	29 (17—43)	30 (17—49)	0,240		
Gravid	2 (1—6)	2 (0—12)	0,839		
Parity	1 (0—4)	1 (0—10)	0,887		
Abortion history	0 (0—3)	0 (0—10)	0,212		
Gestational age			0,635	1,86	1,19—2,9
Preterm	49 (57,6%)	858 (43,6%)			
Term	34 (42,4%)	1110 (56,4%)			
Maternal age			0,428	0,81	0,481—1,365
< 35	64 (77,1%)	1441 (73,1%)			
≥ 35	19 (22,9%	528 (26,9%)			
Operation type			0,816	1,092	0,518—2,302
Emergency	75 (90,6%)	1792 (91,1%)			
Elective	8 (9,4%)	75 (8,9%)			
History of diabetes			0,173	1,90	0,74—4,88
Yes	5 (7,1%)	66 (3,4%)			
No	66 (92,9%)	1658 (96,6%)			
Hemoglobin level	11,6 $\pm$ 1,88	11,5 $\pm$ 1,87	0,836		
Hb $<$ 11 g/dL	28 (36,5%)	721 (36,7%)	0,644	0,89	0,56—1,43
Hb $\geq$ 11 g/dL	54 (63,5%)	1246 (63,3%)			
PROM			0,461	0,84	0,52—1,33
Yes	28 (35,3%)	743 (37,7%)			
No	55 (64,7%)	1226 (62,3%)			
Hypertension			0,417	1,20	0,76—1,90
Yes	31 (38,8%)	651 (33,0%)			
No	52 (61,2%)	1318 (67,0%)			
Fetal distress			**0,001**	2,09	1,3-3,33
Yes	28 (32,9%)	369 (18,7%)			
No	55 (64,7%)	1600 (81,3%)			
Intrauterine infection			0,822	1,08	0,46—2,53
Yes	6 (11,8%)	135 (7,3%)			
No	75 (88,2%)	1823 (92,7%)			
History of previous CS			0,930	6,95	4,2—11,4
Yes	23 (29,42%)	537 (27,2%)			
No	60 (70,58%)	1432 (72,8%)			
Antepartum hemorrhage			0,513	0,97	0,44—2,15
Yes	7 (8,2%)	136 (6,9%)			
No	76 (91,8%)	1833 (95,1%)			
Dystocia			0,543	1,35	0,48—3,80
Yes	4 (4,7%)	71 (3,5%)			
No	79 (95,3%)	1898 (96,5%)			
HIV history			1,000	0,59	0,07—4,33
Yes	1 (1,1%)	40 (2,0%)			
No	82 (98,9%)	1929 (98,0%)			
Additional operation			**0,04**	1,97	1,019—3,792
Yes	11	142			
No	72	1827			
BMI $\geq$ 30			**0,035**	1,767	1,035—3,017
Yes	48 (70,6%)	343 (19,1%)			
No	20 (29,4%	1455 (80,9%)			

Significance P<0,005.
PROM = premature rupture of membrane, CS = caesarean section, HIV = human immunodeficiency virus.

Table 4
Risk factors of SSI

Variables	P Value	OR	CI 95%
Fetal distress	**0,002**	2,265	1,350—3,801
BMI $\geq$ 30 kg/m^2	**0,028**	1,824	1,066—3,121

Significance P<0,005.

Conclusions

This study found that the variables that played a role in the incidence of SSI were caesarean section due to fetal distress and BMI $\geq$ 30 kg/m^2. Other variables, although clinically significant, are not considered to have statistical significance. The incidence of surgical site infection after caesarean section in this study was 4.14%.

Ethics approval and consent to participate

This study was acknowledged by Ethical Committee for Medical Research of Faculty of Medicine, University of Indonesia.

Conflict of interest statement

None declared.

Authors' contributions

MDW extracted, analyzed, and interpreted the data. AKH analyzed the data and interpreted the results. Both authors wrote, read and approved the final manuscript.

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