International Journal of
Reproductive Medicine & Gynecology

Research Article

Risk Factors of Surgical Site Infection of Cesarean Section and Role of Skin Cleansing and Prophylactic Antibiotic -

Ameer Abdallah[1]* and Mohamed El Sayed Rafeek[2]

[1]Department of obstetrics and gynecology, Minia University, Minia, Egypt
[2]Department of obstetrics and gynecology, Zagazig University, Zagazig, Egypt

***Address for Correspondence:** Ameer Abdallah, Department of Obstetrics and Gynecology, Minia University, Minia, Egypt, E-mail: Amerr_abdallah@hotmail.com

Submitted: 10 July 2018; **Approved:** 28 July 2018; **Published:** 08 August 2018

Cite this article: Abdallah A, Sayed Rafeek ME. Risk Factors of Surgical Site Infection of Cesarean Section and Role of Skin Cleansing and Prophylactic Antibiotic. Int J Reprod Med Gynecol. 2018;4(2): 047-051.

ABSTRACT

Background/Objective: The purpose of this study was to discuss some risk factors which may increase risk of infectious morbidity after cesarean section despite of applying prophylactic measures including skin cleansing and prophylactic antibiotic.

Methods: This single randomized controlled study was conducted at the Obstetrics and Gynecology department, El Minya general hospital, El Minya, Egypt, from January 2017 to January 2018. Women included in the study were: women undergoing cesarean delivery, both elective and non-elective, women with rupture of membrane and labor contractions, all maternal ages and parities, both single and multiple pregnancies. Skin cleansing with povidone-iodine was applied and antibiotic was administered to all women just before cesarean section was done. Patients were discharged after 24 hours and were recommended to re-visit on day 7 after CS and that's when our first clinical evaluation of surgical wound was performed. A second wound evaluation was scheduled on day 14. In order to assess whether individual pre-, peri- and post-operative variables affect the development of surgical site infection in women undergoing CS, a logistic regression model with forward selection was designed. The model included the following variables: age, parity, gestational age, BMI, pre-gestational or gestational diabetes mellitus, chronic or pregnancy-induced hypertension, previous CS, mode of CS, and duration of surgery. The primary outcome in this study was development of superficial or deep surgical site infection within the first 14 days after a CS.

Results: Among 1500 mothers included in the study, 250 (16.7 %) women developed SSI. The odds of SSI was increased by 9.441(95% CI: 5.872-15.180) among mothers who had prolonged rupture of membrane. Diabetic mothers were at higher risk for developing SSI with OR 7.384(95% CI: 4.591-11.874). Increasing BMI was associated with SSI with OR 1.478(95% CI: 1.388-1.573). Prolonged duration of surgery was associated with SSI with OR of 1.048 (95% CI: 1.018-1.079).

Conclusions: In view of these results, a list of factors including prolonged labor and prolonged rupture of membrane, long duration of surgery, increase in BMI and presence of DM were associated with SSI. Clinicians should consider earlier or more frequent postoperative follow-up in case of presence of one or more of these factors in patients to monitor for wound complications

Keywords: Cesarean section; Surgical site infection; Skin cleansing; Prophylactic antibiotic

BACKGROUND

Infectious complications following obstetric surgical procedures are considered a significant source of maternal morbidity and even potential mortality [1]. As the cesarean birth rate continues to rise in most developing countries, postpartum infectious morbidity will become an even more significant problem [2]. Cesarean section is considered the most important risk factor for postpartum infection. Women undergoing cesarean section have a 5 to 20-fold greater risk for infectious morbidity compared with a vaginal birth [3]. Incisional wound infection defined according to the Centers for Disease Control and Prevention (CDC) criteria as a superficial or deep surgical site infection occurs after a CS, being one of the most common complications that may lead to wound dehiscence or systemic infections in case of lack of sufficient prophylaxis or inappropriate treatment [4-9]. Increased morbidity, prolonged hospitalization time, increased rate of hospital readmissions and growing treatment costs are all consequences of the above [10].

Infectious complications following cesarean birth include fever, wound infection, endometritis, and urinary tract infection. Serious infectious complications including pelvic abscess, bacteremia, septic shock and septic pelvic vein thrombophlebitis; sometimes these complications can lead to maternal mortality [11]. Preventive measures have been suggested to avoid post cesarean infection including proper preparation of an incision site which will reduce the bacterial population to a minimal level [12].

Also, guidelines recommend the use of antibiotics for prophylaxis against post cesarean section infection in both high-risk women "e.g. women in labor, after rupture of membranes" and low-risk patients "women not in labor, with intact membranes" with decreasing rates of wound infection and endometritis [13]. Taking into account the continuously increasing number of CS and wide spread of factors responsible for wound healing disturbances in the population of women of reproductive age, such as obesity, diabetes and smoking, it is necessary to search for new, more effective methods to prevent infections of surgical wounds.

So this study aims to discuss some risk factors which may increase risk of infectious morbidity after cesarean section despite of applying prophylactic measures including skin cleansing and prophylactic antibiotic.

MATERIAL AND METHODS

Study setting

This study was carried out in the Obstetrics and Gynecology department, El Minya general hospital, El Minya, Egypt, from January 2017 to January 2018.

Study design

This study is a single randomized controlled study. (ClinicalTrials.gov ID: NCT03007706)

Ethical issues

Ethical permission was sought from a Local Research Ethics Committee (REC) .The potential benefit, the nature, the aim and inconveniences of all aspects of the study were clearly stated to the participants. So the study poses no harm regarding the safety issues to the mother or the fetus. In order to assure confidentiality, the data were extracted without any personal identifiers.

Study participants

All the following women were included in our study: women undergoing cesarean delivery, both elective and non-elective, women with rupture of membrane ad labor contractions, all maternal ages and parities, both single and multiple pregnancies were included.

However, women with unknown outcome, those who refused to participate in the study, women with fever > 38°C, and those who were having any visible infection or allergy to antibiotics were excluded.

Pursuant to the valid study protocol, skin cleansing with povidone-iodine was applied and antibiotic was administered to all women just before cesarean section was done. According to management strategy patients were discharged after 24 hours and were recommended to re-visit on day 7 after CS and that's when our first clinical evaluation of surgical wound was performed.

On the discharge day all patients received detailed instructions regarding Surgical Site Infections (SSIs) and were informed about the need to report at hospital in case at least one of the following symptoms was observed: fever, suppurative secretion from the surgical site, redness, edema, warmth, pain or tenderness of the surgical site area. A second wound evaluation was scheduled on day 14. Patients who didn't report for follow-up visits were excluded from the final analysis.

STATISTICAL ANALYSIS

The primary outcome in this study was development of superficial or deep SSI within the first 14 days after a CS.

In order to assess whether individual pre-, peri- and post-operative variables affect the development of surgical site infection in women undergoing CS, a logistic regression model with forward selection was designed. The model included the following variables: age, parity, gestational age, BMI, pre-gestational or gestational diabetes mellitus, chronic or pregnancy-induced hypertension, previous CS, mode of CS, and duration of surgery.

Data were collected, revised, verified, coded, then entered PC for statistical analysis done by using SPSS statistical package version 20.

The following had been done:

Descriptive statistics

- For quantitative data: mean (X~) and Standard Deviation (SD).
- For qualitative data: number (n) and percentage (%)
- Kolmogorov- Smirnov for normality test was used to differentiate between parametric data and non-parametric data.

Analytical statistics

- Independent sample t-test for analysis of quantitative data.
- Chi square (X^2) test, Fisher Exact test for analysis of qualitative data.
- Binary logistic regression for risk factors of postoperative infection for all tests probability (p) was considered:
  - o Non-significant if ≥ 0.05
  - o Significant if < 0.05
  - o Highly significant if < 0.01
  - o Very highly significant if < 0.001

RESULTS

Socio-demographic and medical characteristics

Among 1550 women, 1500 women were included in our study in the reference period; the mean age was 28 years ranging from 18 to 42 years. Regarding parity 250 (16.7%), 980 (65.3 %) and 110 (7.3%) were primigravida, 1-4 and more than 4 respectively. Regarding BMI 1000 (66.7%), 440 (29.3%) and 60 (4%) were of BMI < 25, 25-30 and > 30 respectively.

Prevalence of SSI

Among 1500 mothers included in the study 250 (16.7 %) women developed SSI.

Factors associated with SSIs after CS

Variables were considered for the analysis include: maternal age, parity, previous CS, gestational age, BMI, presence of chronic

Table 1: Descriptive data of all studied individuals.

	Minimum	Maximum Deviation	Mean	Std. Freq. %
Age	18	42	28.26	5.481
BMI	18	32	23.97	3.577
< 25	1000	66.7%		
25-30	440	29.3		
30-40	60	4		
Parity	0	9	2.11	1.675
PG	250	16.7%		
NULLIPARA	160	10.7%		
1-4	980	65.3%		
5-9	110	7.3%		
Abortion(N = 1250)	0	5	1.06	1.222
0-2	1100	88%		
3-5	150	12%		
Number of prev. CS (N = 1090)	0	4	1.03	.613
0	130	11.9%		
1	850	77.9%		
2	70	6.4%		
3	30	2.7%		
4	10	0.9%		
GA	35	42	39.07	1.338
Presence of Chronic Disease	220	14.7%		
NO	1280	85.3%		
DM	70	4.7%		
GDM	20	1.3%		
G HTN	60	4%		
HCV	20	1.3%		
Hypothyroidism	10	0.7%		
Poliomyelitis	10	0.7%		
Preeclampsia	20	1.3%		
Eclampsia	10	0.7%		
Duration Of CS	30	60	41.73	7.169
Indication of CS				
Elective	750	50%		
PROM	390	26%		
Labor contraction	330	22%		
Postop. Infection	250	16.7%		

disease, duration of CS, rupture of the membrane, circumstance of the surgery (elective or emergency). Of these variables, six were significantly associated with SSI and hence considered for the multivariate analysis. In the multivariate model, four turned out to be significant (Table 2).

The odds of SSI was increased by 9.441(95% CI: 5.872-15.180) among mothers who had prolonged rupture of membrane. Diabetic mothers were at higher risk for developing SSI with OR 7.384(95% CI: 4.591-11.874).Increasing BMI was associated with SSI with OR 1.478(95% CI: 1.388-1.573). Prolonged duration of surgery was associated with SSI with OR of 1.048 (95% CI: 1.018-1.079).

DISCUSSION

The study showed that surgical site infection after CS is common. It is also affected by various modifiable factors. The study found that 16.7% of the women who had CS developed wound infection. This study may be considered insufficient as the diagnosis of SSI was solely made on clinical basis so, localized infection, which may not be presented with the classical manifestations of inflammation, might have been missed [14].

It is worth mentioning that other studies as that had been conducted in Southern Ethiopia in 2017 at University Teaching and Referral Hospital by Samuel W. et al. reported prevalence of SSI 11%. A study conducted in Tikur Anbessa Hospital, Addis Ababa, found 14.8% wound infection rate among surgical patients operated for various conditions [15]. Studies from Nepal [16], Tanzania [17], Nigeria [18] and Cameroon [19] reported 9% -13% prevalence. However, a study from Kenya reported a relatively higher (19%).

From the analyzed data in this study, it was revealed that there were some important risk factors associated with the development of infectious morbidity:

In this study, rupture of membrane had substantially increased risk of SSI [*p*-value < 0.001]. Studies conducted in Ethiopia, Kenya [20], Tanzania [17], Nigeria [18], Qatar [21], Israel [22] and US [23] 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 [24].

In this study, prolonged duration of surgery (more than 40 minutes) was associated with increased risk of SSI. Other studies also witnessed the same. A case-control study in Nigeria by Jido et al. in 2012 found that 55% of SSI cases, compared to 31.7% in controls, had prolonged duration of surgery [18]. In Tanzania, long duration of surgery was significantly associated with the outcome with hazard ratio of 2.3 [17]. A study in China came up with a parallel finding [25].

Table 2: Binary logistic regression for risk factors of postoperative infection.

	p-value	Odds Ratio	95% C.I. for OR	
			Lower	Lower
Increasing Age	0.001	1.077	1.031	1.125
Presence of Chronic Disease	< 0.001	7.384	4.591	11.874
Increasing BMI	< 0.001	1.478	1.388	1.573
Presence of PROM	< 0.001	9.441	5.872	15.180
Increasing Number of CS	0.002	1.654	1.202	2.274
Increasing Duration of CS	0.002	1.048	1.018	1.079

Prolonged duration of surgery may raise the risk of SSI by increasing the risk of exogenous contamination [26].

We observed in this study that overweight and obese patients with BMI > 25, have a considerable increase in risk for postoperative complications compared with non-obese patients. Most recently, Connor and colleagues [27] performed a retrospective cohort study that revealed a positive dose-response relationship between obesity severity and cesarean wound complication rate.

Regarding presence of chronic disease, it was obvious in our study that women with diabetes mellitus are more likely to develop postoperative SSI than non-diabetic women (with odds ratio 7.384 and *P*-value < 0.001) thus considering Diabetes mellitus as a long-recognized comorbidity associated with postoperative wound complication. This result is similar to other studies in the surgical literature [28] mentioning that poorly controlled diabetes results in advanced glycosylation end products, with impairment of the host immune response and decreased re-epithelialization of wounds [28].

An unintended side-effect of suppressing the immune system is a direct impairment of the inflammatory phase of wound closure. As a result, there is decreased fibro genesis, macrophage response, and angiogenesis [28]. This situation may lead to delayed closure, wound breakdown, and infection [28].

Other studies identified DM as an important risk factor associated with increased rate of wound infection [29-32].

CONCLUSION

In conclusion, a list of factors including prolonged labor and prolonged rupture of membrane, long duration of surgery, increase in BMI and presence of DM were associated with SSI. Surgical wound infection should be prevented by implementing infection prevention techniques. Pregnant patients with one or more of these factors are at increased risk for developing post cesarean infectious morbidity and other postoperative complications. These data can be used to counsel these patients on operative risks. Our findings suggest that clinicians should consider these factors in delivery mode decisions and may need to alter the threshold for using cesarean delivery in those patients compared.

Additionally, clinicians should consider earlier or more frequent postoperative follow-up in case of presence of one or more of these factors in patients to monitor for wound complications. Our results confirm an urgent need for clinical trials to research novel strategies to minimize unnecessary CD and to develop perioperative methods to reduce the risks of cesarean delivery in high risk patients.

ETHICAL CONSIDERATION

Institutional Review Board (IRB) approval: The protocol was discussed and approved by the ethical scientific committee of Minia University Maternity Hospital.

SUBJECT CONFIDENTIALITY

All reports, operative details and other records that leave the site would not comprise unique personal data to maintain subject confidentiality.

REFERENCES

1. Nabendu Bhattacharjee, Shyama Prasad Saha, Kajal Kumar Patra, Udayan Mitra, Samir Chandra Ghoshroy. Optimal timing of prophylactic antibiotic for cesarean delivery: A randomized comparative study. J Obstet Gynaecol Res. 2013; 38: 1560-1568. https://goo.gl/u9eHmr

2. Mackeen AD, Packard RE, Ota E, Berghella V, Baxter JK. Cochrane Database Syst Rev. 2014; 12: 9516. https://goo.gl/6Scru3

3. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection. Infect Control Hosp Epidemiol. 1999; 20: 250-278. https://goo.gl/xwjSUi

4. Hadar E, Melamed N, Tzadikevitch Geffen K, Yogev Y. Timing and risk factors of maternal complications of cesarean section. Arch Gynecol Obstet. 2011; 283: 735-741. https://goo.gl/YXFNXF

5. Wilson J, Wloch C, Saei A, McDougall C, Harrington P, Charlett A, et al. Inter-hospital comparison of rates of surgical site infection following caesarean section delivery: evaluation of a multicentre surveillance study. J Hosp Infect. 2013; 84: 44-51. https://goo.gl/RVr7X7

6. Opoien HK, Valbo A, Grinde Andersen A, Walberg M. Post-cesarean surgical site infections according to CDC standards: rates and risk factors. A prospective cohort study. Acta Obstet Gynecol Scand. 2007; 86: 1097-1102. https://goo.gl/EF2Wwq

7. Wloch C, Wilson J, Lamagni T, Harrington P, Charlett A, Sheridan E. Risk factors for surgical site infection following caesarean section in England: results from a multicentre cohort study. BJOG. 2012; 119: 1324-1333. https://goo.gl/KeW3wA

8. Olsen MA, Butler AM, Willers DM, Devkota P, Gross GA, Fraser VJ. Risk factors for surgical site infection after low transverse cesarean section. Infect Control Hosp Epidemiol. 2008; 29: 477-484. https://goo.gl/BsKgn6

9. Schneid Kofman N, Sheiner E, Levy A, Holcberg G. Risk factors for wound infection following cesarean deliveries. Int J Gyn Obstet. 2005; 90: 10-15. https://goo.gl/C7Em71

10. Jenks PJ, Laurent M, McQuarry R, Watkins R. Clinical and economic burden of Surgical Site Infection (SSI) and predicted financial consequences of elimination of SSI from an English hospital. J Hosp Infect. 2014; 86: 24-33. https://goo.gl/QHfGsd

11. Lomas J, Anderson GM, Domnick Pierre K, Vayda E, Enkin MW, Hannah WJ. Do practice guidelines guide practice? The effect of a consensus statement on the practice of physicians. N Engl J Med. 1989; 321: 1306-1311. https://goo.gl/ax1uQ9

12. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection. Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol. 1999; 20: 250-278. https://goo.gl/D3muSf

13. Yildirim G, Gungorduk K, Guven HZ, Aslan H, Celikkol O, Sudolmus S, et al. When should we perform prophylactic antibiotics in elective cesarean cases. Arch Gynecol Obstet. 2009; 280: 13-18. https://goo.gl/CD5gcT

14. World Union of Wound Healing Societies (WUWHS). Principles of best practice: Wound infection in clinical practice. An international consensus. London, MEP Ltd, 2008: 1-2. https://goo.gl/dfxB3q

15. Taye M. Wound infection in Tikur Anbessa hospital, surgical department. Thiop Med J. 2005; 43: 167-174. https://goo.gl/ZB8D9Q

16. Shrestha S, Shrestha R, Shrestha B, Dongol A. Incidence and risk factors of surgical site infection following cesarean section at Dhulikhel Hospital. Kathmandu Univ Med J. 2014; 12: 113-116. https://goo.gl/RPq7At

17. Mpogoro FJ, Mshana SE, Mirambo MM, Kidenya BR, Gumodoka B, et al. Incidence and predictors of surgical site infections following caesarean sections at Bugando Medical Centre, Mwanza, Tanzania. Antimicrob Resist Infect Control. 2014; 3: 25. https://goo.gl/vdVmmh

18. Jido TA, Garba ID. Surgical-site Infection following cesarean section in Kano, Nigeria. Ann Med Health Sci Res. 2012; 2: 33-36. https://goo.gl/cmRQbm

19. Essomba N, Avomo J, Esiene A, Banock L, Azeme A, Misse M, et al. Prevalence of surgical site infections and evaluation of risk factors after surgery, case of three public hospitals in Cameroon. J Med Med Sci. 2013; 4: 241-246. https://goo.gl/PqQkKH

20. Koigi Kamau R, Kabare LW, Wanyoike Gichuhi J. Incidence of wound infection after caesarean delivery in a district hospital in central Kenya. East Afr Med J. 2005; 82: 357-361. https://goo.gl/9VuYtp

21. Al Jama FE. Risk factors for wound infection after lower segment cesarean section. Qatar Med J. 2013; 2012: 26-31. https://goo.gl/CwxSti

22. Schneid Kofman N, Sheiner E, Levy A, Holcberg G. Risk factors for wound infection following cesarean deliveries. Int J Gynaecol Obstet. 2005; 90: 10-15. https://goo.gl/9ecnxh

23. Killian CA, Graffunder EM, Vinciguerra TJ, Venezia RA. Risk factors for surgical-site infections following cesarean section. Infect Control Hosp Epidemiol. 2001; 22: 613-617. https://goo.gl/EuvLHX

24. Eschenbach DA, Wager GP. Puerperal infections. Clin Obstet Gynecol. 1980; 23: 1003-1037. https://goo.gl/CPSNpQ

25. Gong S, Guo H, Zhou H, Chen L, Yu Y. Morbidity and risk factors for surgical site infection following cesarean section in Guangdong Province, China. Obstet Gynecol Res. 2012; 38: 509-515. https://goo.gl/uGYU71

26. National Collaborating Centre for Women's and Children's Health (UK). Prevention and treatment of surgical site infection: NICE Clinical Guidelines. London. RCOG Press. 2008; 45-55. https://goo.gl/9uVTrt

27. Conner SN, Verticchio JC, Tuuli MG, Odibo AO, Macones GA, Cahill AG. Maternal obesity and risk of postcesarean wound complications. Am J Perinatol. 2014; 31: 299-304. https://goo.gl/VaBtJV

28. Fitzwater JL, Tita AT. Prevention and management of cesarean wound infection. Obstet Gynecol Clin North Am. 2014; 41: 671-689. https://goo.gl/izBJqC

29. Tran TS, Jamuditrat S, Chongsuvivatwong V, Geater A. Risk factors for postcesarean surgical site infection. Obstet Gynecol. 2000; 95: 367-371. https://goo.gl/dzbAsd

30. Killian CA, Graffunder EM, Vinciguerra TJ, Venezia RA. Risk factors for surgical site infections following cesarean infection. Infect Control Hosp Epidemiol. 2001; 22: 613-617. https://goo.gl/xFo3CQ

31. Schneid Kofman N, Sheiner E, Levy A, Holcberg G. Risk factors for wound infection following cesarean deliveries. Int J Gynaecol Obstet. 2005; 90: 10-15. https://goo.gl/6vAEZN

32. Habib F. Incidence of post cesarean section wound infection in a tertiary hospital, Riyadh, Saudi Arabia. Saudi Med J. 2002; 23: 1059-1063. https://goo.gl/87x191