UMSHA Press

AJCHOR
Avicenna Journal of Care and Health in Operating Room
Avicenna J Care Health Oper Room, 2023; 1(1):1-6. doi:10.34172/ajchor.7
https://ajchor.umsha.ac.ir

Original Article

Investigating the Prevalence and Causes of Surgical Site Infection and Surgical Wound Dehiscence After Cesarean Delivery: A Cohort Study in Zeynab Hospital in Shiraz-Iran

Mohammad Ebrahim Parsanezhad[1], Navid Omidifar[2], Soheila Rahnavard[3], Azizallah Dehghan[4], Mostafa Bijani[5*]

[1]Department of Obstetrics and Gynecology, School of Medicine, Infertility Research Center, Zeynab Hospital, Shahid Faghihi Hospital, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Department of Pathology, School of Medicine, Clinical Education Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
[3]Student Research Committee, Fasa University of Medical Sciences, Fasa, Iran
[4]Noncommunicable Diseases Research Center, Fasa University of Medical Sciences, Fasa, Iran
[5]Department of Medical-Surgical Nursing, Fasa University of Medical Sciences, Fasa, Iran

Article history:
Received: March 12, 2023
Revised: March 17, 2023
Accepted: May 13, 2023
ePublished: July 6, 2023

***Corresponding author:**
Mostafa Bijani,
Email: bizhani_mostafa@yahoo.com

Abstract

Background: Surgical site infection (SSI) and surgical wound dehiscence are among the main causes of readmission and an increase in treatment costs for patients undergoing cesarean section (CS) surgery. The present study aimed to investigate the prevalence and causes of SSI and surgical wound dehiscence after cesarean delivery in Zeinab hospital in Shiraz-Iran from January 2020 to August 2021.

Methods: This prospective cohort study was conducted on 130 pregnant women who underwent CS in Zeinab hospital, Shiraz. All culture media were examined 24 and 48 hours after culturing. In addition, 10-14 days after the operation, patients were followed up by telephone to update data on their wound condition. The results were analyzed using descriptive statistics, χ^2, and logistic regression by SPSS 22.

Results: The mean age of patients was 31.94 (5.59) years, and 57.7% of pregnant women had one history of previous CS. The prevalence of SSI infection after cesarean delivery was 20.76%, which is relatively high. Age (odds ratio [OR] = 1.04, $P \leq 0.001$), weight (OR = 1.09, $P \leq 0.001$), body mass index (OR = 1.11, $P \leq 0.001$), the education level (OR = 1.02, $P \leq 0.001$), history of previous CS (OR = 2.79, $P \leq 0.001$), and the number of childbearing (OR = 1.68, $P \leq 0.001$) were identified as predictive factors of SSI after CS. The culture results of 27 SSI patients (20.76%) were positive. Further, five out of 27 patients (18.51%) with SSI experienced complete wound dehiscence and were readmitted, and the other 22 patients (81.48%) only experienced SSI and received outpatient care.

Conclusion: Among the factors affecting SSI, the history of previous CS played the main role in causing the infection. Pre- and post-cesarean care plays a major role in SSI and surgical wound healing. Moreover, it is necessary to continuously monitor and evaluate the implementation of infection control protocols and personnel and surgeons' hand scrub in the operating room.

Keywords: Cesarean section, Wound infection, Wound dehiscence, Cohort study

Please cite this article as follows: Parsanezhad ME, Omidifar N, Rahnavard S, Dehghan A, Bijani M. Investigating the prevalence and causes of surgical site infection and surgical wound dehiscence after cesarean delivery: a cohort study in Zeinab hospital in Shiraz-Iran. Avicenna J Care Health Oper Room. 2023; 1(1):1-6. doi:10.34172/ajchor.7

Introduction

The Centers for Disease Control and Prevention defines Surgical Site infection (SSI) as an infection that can occur up to 30 days after surgery in the surgical site (1). SSI is one of the main reasons for the readmission of patients and increased treatment costs for patients undergoing surgery (2). After urinary tract infection, SSI is the second most common cause of nosocomial infections in patients who stayed at the hospital. The SSI rate varies from 2.8% to 30% (3) and may result in prolonged hospital stay from 4.7 to 14.3 days (4).

Cesarean delivery is the most prevalent gynecological surgery (5). The rate of cesarean deliveries, both primary and secondary cesarean sections (CSs), has increased dramatically over the past few decades (6). Countries with the highest cesarean rates in each region are Brazil (55.6%) and Dominican Republic (56.4%) in Latin America and the Caribbean, Egypt (51.8%) in Africa, Iran and Turkey in Asia (47.9% and 47.5%, respectively), Italy (38.1%) in Europe, United States (32.8%) in Northern America, and New Zealand (33.4%) in Oceania (7). According to studies performed in the United States, $3,700 is spent on curing infectious wounds after cesarean delivery (8).

Cesarean delivery can cause multiple complications. After bleeding, SSI is the most common complication of cesarean delivery (9). The risk of puerperal infection is 5-20 times higher in women who underwent CS compared to women who experience normal vaginal delivery (10). SSI is one of the most common complications after CS, and the rate of its incidence is 3%-15%. Moreover, SSI is the cause of 3% of maternal mortality (11).

Prolonged hospital stays, long-term use of antibiotics, wound care time-wasting, the inability of the mother to care for the newborn, visceral and pelvic adhesions, and some other complications are examples of complications caused by SSI after cesarean delivery (12).

Although many studies have been conducted in Iran to investigate factors affecting SSI after CS, they are of descriptive type, and no prospective cohort study, to the best of our knowledge, has so far been performed in this regard. Additionally, in previous studies, culture specimens were not collected from the surgical site, operating room equipment, hands of operating room staff, hands of surgeons, and surgeon assistants. Therefore, the present study sought to investigate and determine the role of the desired risk factors in the prevalence of SSI and surgical wound dehiscence after cesarean delivery in Zeinab hospital in Shiraz-Iran.

Materials and Methods

The present prospective cohort study was performed in Zeinab hospital affiliated with Shiraz University of Medical Sciences from January 2020 to August 2021. This study comprised patients referred to Zeinab hospital and experienced a normal vaginal delivery but underwent CS and patients who had a cesarean delivery voluntarily. The inclusion criteria were participants' willingness to participate in the study. On the other hand, the exclusion criteria included no desire to stay in the study procedure and failing to contact after an operation.

The sample size (211 patients) was calculated based on the statistical data of previous studies through the following formula considering $\alpha = 0.05$, $d = 0.05$, $P = 16.4$, and $P = 70\%$ (13).

$$n = \frac{z^2_{(1-\frac{\alpha}{2})} P(1-P)}{d^2}$$

Due to the COVID-19 outbreak, we could not access the entire sample size. Therefore, 130 patients were selected using convenience sampling.

Culture samples were collected from 130 patients at the beginning and before CS until removing the surgical dressing. As the study instrument, a checklist was prepared by the research team consisting of two parts. The first part was related to patients' demographic information, including age, height, weight, body mass index (BMI), education grade, emergency or elective CS (i.e., cause of CS), and history of previous CS(s). The other data were a history of previous pregnancies, duration of surgery, history of taking antibiotics in the last 3 months, type of surgical incision, amount of intraoperative bleeding, type of anesthesia, and underlying diseases. The second part of the checklist was associated with the number of collected culture specimens and their results. The content validity of the checklist was confirmed by 10 gynecologists.

Patients were examined from the time of admission to the hospital. They were either transferred from the maternity ward or the emergency department to the operating room for cesarean delivery or transferred from the gynecological surgery ward to the operating room for a CS as they had electively decided to experience caesarian delivery (due to the previous history of CS or because of some reasons that make normal vaginal delivery impossible).

Patients received one gram of cefazolin intravenously as a pre-CS. However, those with a history of cephalosporin allergy were prescribed 900 mg of clindamycin IV or 80 mg of gentamicin IV instead of cefazolin. Then, the patient was transferred to the operating room. In all cases, the surgical site was shaved before entering the operating room. In the operating room, patients completed the informed consent form to participate in the study.

Disposable sterile cotton swabs and two culture media, including eosin methylene blue (EMB) and blood agar, were used for sampling and culturing. EMB agar medium is a selective-differential culture medium used for gram-negative bacteria against gram-positive bacteria, and the differentiation between gram-negative bacilli can be examined based on colony color. Blood agar medium is a solid and nutritious medium containing 5% sheep blood that is employed to identify bacteria through the hemolysis process. It is also utilized for hard-to-grow bacteria such as *Streptococcus* that do not grow on basal culture media. The culture media were circular.

Before the surgery, the surgeon and assistants first washed their hands thoroughly. Next, they opened a set of sterile swabs (each pack containing 3 swabs) to collect culture samples from each patient. They strictly adhered to safety principles so that the tip of the swab would not hit any other person or patient. They also used sterile gloves for different stages (except for collecting culture specimens from the patient's noses and ears and the surgeon and surgeon assistant and scrub nurses' nose), and culture specimens were also collected in a sterile environment. A sterile gown was used, along with sterile gloves at the peritoneal opening and when delivering the fetal head. Sterile swaps were drawn on the desired surface, then were drawn in a zigzag pattern, with mild pressure on both culture media divided by the specified numbers simultaneously. Finally, the lid of the culture medium was closed using glue to ensure they did not come open and prevent contamination.

The researcher collected all the samples himself. When each patient entered the operating room, the researcher explained the reason for collecting culture specimens for her, and then he started to collect the specimen. First, the specimens were collected from the patients' noses and ears and then from their perineum, and then after hand rub, specimens were collected from the nose of the surgeon and the surgeon assistants (the number of surgeon assistants varied from 1 to 2 who helped the surgeon during the surgery operation). Next, the specimens were collected from the nose of the scrub nurses.

Subsequently, the researcher performed hand rubbing and collected specimens from unpacked surgical instruments. After the surgeon and surgeon assistant and nurses scrub their hands and performed hand rubbing, specimens were collected from the space between their fingers and under their nails, and from their palms. After the skin was prepped entirely with betadine surgical solution and betadine surgical scrub and the patient was covered with sterile surgical drapes and her skin was dried, the samples of the patient's skin were collected at the surgical site before the incision and CS. Then, after performing the incision of different layers of the patient's skin (abdomen skin) and at the time of performing the incision of the peritoneum, peritoneal specimens were collected by maintaining sterile conditions. When the amniotic sac of the uterus was torn and the fetal head was protruding, the samples were collected from the incision site. Finally, after complete suturing and closure of the abdomen and before the sutures were cleaned using betadine, and before the sutures were dressed with sterile gauze, further specimens were collected from the surgical sutures.

Each culture medium was divided into 4 equal parts and numbering was performed from 1 to 16 (i.e., each culture medium had 4 parts and 4 numbers, and 4 blood agar media and 4 EMB culture media were used for each patient). A total of 1820-2080 specimens were collected, and patients were coded from 1 to 130. Hand rub sanitizer and soapy liquid used for hand washing were also cultured to make sure that they were sterile.

Collected culture specimens in the operating room were sent to the laboratory for testing and evaluation. The last stage of collecting culture specimens was at the time of dressing removal (in the surgical ward) 12-24 hours after the surgery. The specimens were collected from the suture site, transferred to the microbiology laboratory again, and then placed in an incubator. All culture media were examined 24 and 48 hours after culturing in two stages. A microbiologist reported the growth of the microorganisms if observing any colony formation or color change. The culturing results were recorded in the second checklist.

Patients were followed up by telephone 10-14 days after surgery. They were asked about the condition of their wounds. Further, they were asked whether their sutures were removed or if examined by the doctor. If any infection, secretion, or serous fluid around the wound was reported, it was requested to refer to the hospital to examine the wounds. Some patients were referred to other medical centers for suture removal, and if there were any signs of SSI, they were asked to go to a reference hospital. When the patient was referred to the hospital with SSI signs and symptoms, specimens were collected from wounds (both culture media were used) and placed in the incubator. After 48 hours, it was reported that the microorganism had grown in the culture medium. The report was compared with the checklist of culture response reports at the time of the patient's surgery. Then, the culturing result determined which factors may cause SSI. Factors involved a non-sterile environment at different stages of surgery (e.g., the growth of microorganisms after complete prepping of the surgical incision site or containments that appeared because the surgeons had not washed their hands carefully or other factors), underlying diseases of patients, and post-operation care problems. Microorganisms that had grown in the specimens included gram-positive and gram-negative *Staphylococcus*, *Streptococcus*, *Enterobacter*, and *Escherichia coli*. The cause of SSI was determined by comparing these microorganisms. Descriptive statistics and SPSS (Version 22) were utilized to analyze the data.

Results

A total of 130 pregnant women who were candidates for caesarian delivery participated in the present study, and the mean (±standard deviation) of the participants' age was 31.94 (±5.59). The other demographic characteristics are provided in Tables 1 and 2. Twenty-seven out of 130 patients (20.76%) suffered from SSI after cesarean delivery.

In addition, 19 of these 27 patients (70.37%) became infected with povidone-iodine (betadine) solution after sterilizing the skin. Most of the gram-positive and gram-negative *Staphylococcus* bacteria have grown in the samples of these patients, indicating that the skin is not entirely sterilized and microorganisms grow and cause infection. In six cases, gram-positive and gram-negative *Staphylococcus* microorganisms had grown in the specimens collected after the surgeon's assistant performed a hand scrub. It demonstrated that the hands were not disinfected properly. Two patients (7.40%) were infected when the fetal head came out, and staphylococcal microorganisms had grown in amniotic fluid samples.

The culture results of all 27 patients with SSI were positive. There were also five patients with gestational diabetes. Four patients developed pregnancy poisoning (preeclampsia), which was associated with protein excretion and high blood pressure. Two patients had both gestational diabetes and hypothyroidism, and one suffered from immune thrombocytopenic purpura. The remaining patients had no underlying disease. Moreover, of 27 patients who suffered from SSI, the incision of 5 patients reopened utterly, and they experienced wound dehiscence and were readmitted accordingly. There was a significant relationship between age, weight, and BMI with SSI after CS ($P < 0.05$). Logistic regression results showed that with increasing one year of age, the chance of SSI after

Table 1. Relationship Between Demographic Characteristics and SSI After Cesarean Section in Zeinab hospital

Variable	Frequency	Minimum	Maximum	Mean	Standard Deviation	Odds Ratio	*P* Value
Age	130	19.00	44.00	31.94	5.598	1.04 (1.01-1.06)	<0.001
BMI	130	26.74	51.94	30.95	5.59	1.11 (1.01-1.23)	<0.001
Weight	130	59.00	138.00	80.59	15.61	1.09 (1.03-1.15)	<0.001
Height	130	150.00	180.00	161.29	5.58	0.78 (0.49-1.29)	0.37

Note. BMI: Body mass index.

Table 2. Distribution of Demographic Characteristics of the Studied Samples by the Education Level, History of Previous Cesarean Delivery and Number of Childbearing

Variable		Frequency	Percentage	Positive Culture	Negative Culture	Odds Ratio	*P* Value
Education level	High school and lower	62	47.7	15	47	1.028 (1.04-1.39)	<0.001
	High school diploma	51	39.2	8	43	0.78 (0.53-1.26)	0.43
	Bachelor's degree and higher	17	13.1	4	13	1.05 (0.88-1.27)	0.39
History of previous cesarean section	No history of cesarean section	39	30.0	3	36	1.05 (1.03-1.08)	0.47
	One time	75	57.7	8	67	1.38 (1.12-1.56)	<0.001
	Two times or more	16	12.3	2	12	2.79 (1.96-3.42)	<0.001
Number of childbearing	1	23	17.7	1	22		
	2	26	20.0	5	21		
	3	44	33.8	9	35	1.68 (1.15-2.13)	<0.001
	4	19	14.6	8	11		
	5	18	13.8	4	14		

CS increases by 1.04 (1.01-1.06). One-level increase in the BMI could increase the chance of SSI by 1.11 (1.01-1.23) after CS. Further, with increasing one weight of kilogram, the chance of SSI after CS increased by 1.09 (1.03-1.15), the related data of which are presented in Table 1. According to the results of the present study, a significant relationship was observed between education level, history of previous sections, and the number of childbearing with SSI after CS ($P<0.05$, Table 2). Furthermore, the frequency and percentage of the clinical characteristics of patients with SSI after CS is provided in Table 3. The other 22 patients only suffered from SSI and received outpatient care (Table 3).

Table 3. History of Antibiotic Use in the Last 3 Months of Pregnancy, Underlying Diseases, Urgent Surgery, Bleeding Rate, Duration of Operation, Type of Anesthesia, Antibiotic Prophylaxis, Type of Surgical Incision

Variable		Frequency	Percent
History of antibiotic use in the last three months of pregnancy	No	92	70.8
	Yes	38	29.2
History of underlying diseases	No	64	49.2
	Yes	66	50.8
Urgent surgery	No	36	27.7
	Yes	94	72.3
Intraoperative bleeding rate (>500 cc)	No	120	92.3
	Yes	10	7.7
Duration of operation (>1 hour)	No	116	89.2
	Yes	14	10.8
Type of anesthesia (Spinal)	No	0	0
	Yes	130	100.0
Antibiotic prophylaxis (1 hour before operation)	No	0	0
	Yes	130	100
Horizontal incision of the surgical site	No	15	11.5
	Yes	115	88.4

Discussion

The results of the present study demonstrated that the prevalence of SSI after CS was relatively high. Age, weight, BMI, level of education, history of previous CS, and number of childbearing were identified as the predictors of SSI after CS.

The prevalence of SSI, prolongation of patients' hospital stays and increased costs of treatment have turned into major challenges of the health system (14).

Based on the present study results, the prevalence of SSI infection after cesarean delivery was 20.76%, which is a relatively high. The results of a study by Gadeer et al in Saudi Arabia revealed that the prevalence of CS-related SSI was 3.4% (15), which is inconsistent with the results of our study. The reason for the high prevalence in the current study is that Zeinab hospital, in addition to providing services to patients in Shiraz and neighboring cities in different parts of Fars province, provides medical services to patients in neighboring provinces such as Bandar Abbas and Bushehr as well. Therefore, the high number of clients and the large number of emergency and non-emergency surgeries in this medical center has increased the high prevalence of CS wound infection. Additionally, one of the reasons for conducting this study was the high incidence of CS wound infections in this medical center.

Furthermore, the results of another study (15), which are in line with the present study results, showed that *S. aureus* and *E. coli* were the main causes of SSI. Moreover, a significant relationship was observed between BMI and SSI after cesarean delivery, which corroborates the result of the present research.

Based on the results of the study by Zejnullahu et al performed in Kosovo, the rate of SSI was 9.85%. A significant correlation was found among the history of previous CS, age, and duration of operation (16). The reason for the difference between the results of the mentioned study and the present study may be in the method of study, sample size, and the factors under study. As mentioned before, the current study is a prospective observational cohort study. In addition, culture specimens have been collected from the surgical site, operating room equipment, hands of operating room staffs, and hands of surgeons and surgeon assistants.

The results of a prospective cohort study conducted by Ketema et al in Ethiopia revealed that the prevalence of SSI after cesarean delivery was 25.4%, which is close to our study results. Further, a significant correlation was observed among SSI and emergency surgery, vertical type of incision, rupture of membranes before CS, and multiple vaginal examinations. According to the results of this study, a significant relationship was found between age, level of education, and previous CS with SSI after CS, which is consistent with the results of the present study. In addition, the prevalence of CS infection in both studies was relatively high, which requires senior hospital managers to take effective measures to control the infection and reduce its rate (17).

The findings of the research conducted by Yerba et al at Peruvian Hospital indicated a 2.4% prevalence of SSI due to CS. The results of this study confirmed a significant relationship between SSI and some risk factors such as mild and moderate anemia, the onset of delivery, and five or more vaginal examinations. According to the results of this study, a significant relationship was detected between age, weight, and BMI with SSI after CS, which is consistent with the results of the present study. Further, the reason for the lower prevalence of infection after CS in this study, compared to the present study, could be different sociodemographic characteristics and level of education, as well as policies and programs of senior hospital managers in controlling the prevalence of SSI (18).

On the other hand, Tan et al reported a 13.9% rate of SSI after surgery in their research. There was a significant relationship between SSI and some variables such as obesity, duration of surgery, and underlying diseases, including diabetes and diseases that weaken the immune system (19). The prevalence rate of SSI after surgery in their research was relatively high as in the results of the present study. However, the current study did not investigate the relationship between underlying diseases and SSI.

The results of the study by Rafiei et al performed in Tabriz hospitals demonstrated that 25% of women suffered from SSI after cesarean delivery, reporting that risk factors included childbearing age, frequency of pregnancies, and previous cesarean deliveries (20), which conforms to the results of the present study.

According to the results of the study conducted by Jasim et al in Malaysia, the prevalence of SSI during CS was reported to be 18.8%. In addition, a significant correlation was found among SSI, diabetes, and obesity. In this study, there was no name of the microorganism that causes SSI. Moreover, culture specimens were not collected from the surgical wound site, medical equipment, and the surgeon's hands (21). Based on the results of this study, which is consistent with the results of the present study, non-observance of precise and scientific principles of hand scrub and surgical site scrub by surgeons and surgeon assistants is one of the effective causes of SSI, and hospital managers need to continuously train operating room staff and surgeons regarding the principles of safe surgery and monitor the observance of surgical instructions in the operating room through ongoing observation and evaluation.

Limitations of the Study

Our study was performed on only 130 patients undergoing CS. Further, considering that the type of hospital, patient conditions, and type of surgery can affect SSI, it is recommended that this study be performed with a larger sample size in other hospitals in Iran and other countries. According to the COVID-19 pandemic and cancellation of non-emergency CS (Elective surgery), the sample size decreased, which may be one of the limitations of the present study.

Conclusion

According to the high prevalence of SSI after cesarean delivery, it is essential for health system managers and infection control supervisors to make the necessary plans to train personnel and surgeons on SSI prevention. Moreover, it is necessary to continuously monitor and evaluate the implementation of infection control protocols, surgical site scrub, and personnel and surgeons' hand scrub in the operating room, and if necessary, corrective measures should be taken in this regard.

Acknowledgements

The authors would like to appreciate Fasa University of Medical Sciences & Clinical Research Development Unit of Fasa Valiasr hospital for financially supporting this research.

Authors' Contribution

Conceptualization: Navid Omidifar, Mostafa Bijani.
Data curation: Soheila Rahnavard Azizallah Dehghan.
Investigation: Mohammad Ebrahim Parsanezhad, Soheila Rahnavard, Mostafa Bijani.
Methodology: Soheila Rahnavard, Azizallah Dehghan.
Project administration: Mohammad Ebrahim Parsanezhad, Navid Omidifar, Mostafa Bijani.
Software: Azizallah Dehghan.
Supervision: Soheila Rahnavard.
Validation: Azizallah Dehghan.
Writing–original draft: Mohammad Ebrahim Parsanezhad, Navid Omidifar, Soheila Rahnavard, Mostafa Bijani.
Writing–review & editing: Mohammad Ebrahim Parsanezhad,

Navid Omidifar, Mostafa Bijani.

Competing Interests

The authors declare that there is no conflict of interests.

Ethical Approval

This paper was extracted from a research project with the ethical code (IR.FUMS.REC.1398.176) at Fasa University of Medical Sciences, Fasa, Iran. The present study was conducted with regard to the principles of the revised Declaration of Helsinki, a statement of ethical principles that directs physicians and other participants in medical research involving human subjects. All the subjects were informed about the objectives of the study, the voluntary nature of their participation, the data collection methods, and the confidentiality and anonymity of the information. Subsequently, they were asked to sign the informed consent form if they were willing to participate in the study. The participants were notified that they are free to withdraw from the study at any time.

Funding

This study received no financial support.

References

1. Chun JJ, Yoon SM, Song WJ, Jeong HG, Choi CY, Wee SY. Causes of surgical wound dehiscence: a multicenter study. J Wound Manag Res. 2018;14(2):74-9. doi: 10.22467/jwmr.2018.00374.
2. Zuarez-Easton S, Zafran N, Garmi G, Salim R. Postcesarean wound infection: prevalence, impact, prevention, and management challenges. Int J Womens Health. 2017;9:81-8. doi: 10.2147/ijwh.s98876.
3. Dotters-Katz SK, Feldman C, Puechl A, Grotegut CA, Heine RP. Risk factors for post-operative wound infection in the setting of chorioamnionitis and cesarean delivery. J Matern Fetal Neonatal Med. 2016;29(10):1541-5. doi: 10.3109/14767058.2015.1058773.
4. Pop-Vicas A, Musuuza JS, Schmitz M, Al-Niaimi A, Safdar N. Incidence and risk factors for surgical site infection post-hysterectomy in a tertiary care center. Am J Infect Control. 2017;45(3):284-7. doi: 10.1016/j.ajic.2016.10.008.
5. Krieger Y, Walfisch A, Sheiner E. Surgical site infection following cesarean deliveries: trends and risk factors. J Matern Fetal Neonatal Med. 2017;30(1):8-12. doi: 10.3109/14767058.2016.1163540.
6. Desai G, Anand A, Modi D, Shah S, Shah K, Shah A, et al. Rates, indications, and outcomes of caesarean section deliveries: a comparison of tribal and non-tribal women in Gujarat, India. PLoS One. 2017;12(12):e0189260. doi: 10.1371/journal.pone.0189260.
7. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: global, regional and national estimates: 1990-2014. PLoS One. 2016;11(2):e0148343. doi: 10.1371/journal.pone.0148343.
8. Kawakita T, Landy HJ. Surgical site infections after cesarean delivery: epidemiology, prevention and treatment. Matern Health Neonatol Perinatol. 2017;3:12. doi: 10.1186/s40748-017-0051-3.
9. Shirzad M, Shakibazadeh E, Hajimiri K, Betran AP, Jahanfar S, Bohren MA, et al. Prevalence of and reasons for women's, family members', and health professionals' preferences for cesarean section in Iran: a mixed-methods systematic review. Reprod Health. 2021;18(1):3. doi: 10.1186/s12978-020-01047-x.
10. Temming LA, Raghuraman N, Carter EB, Stout MJ, Rampersad RM, Macones GA, et al. Impact of evidence-based interventions on wound complications after cesarean delivery. Am J Obstet Gynecol. 2017;217(4):449.e1-449.e9. doi: 10.1016/j.ajog.2017.05.070.
11. Sway A, Wanyoro A, Nthumba P, Aiken A, Ching P, Maruta A, et al. Prospective cohort study on timing of antimicrobial prophylaxis for post-cesarean surgical site infections. Surg Infect (Larchmt). 2020;21(6):552-7. doi: 10.1089/sur.2018.226.
12. Nkurunziza T, Kateera F, Sonderman K, Gruendl M, Nihiwacu E, Ramadhan B, et al. Prevalence and predictors of surgical-site infection after caesarean section at a rural district hospital in Rwanda. Br J Surg. 2019;106(2):e121-e8. doi: 10.1002/bjs.11060.
13. Alvandfar D, Alizadeh M, Khanbabayi Gol M. Prevalence of pregnancy varicose and its effective factors in women referred to gynecology hospitals in Tabriz. Iran J Obstet Gynecol Infertil. 2019;22(9):1-7. doi: 10.22038/ijogi.2019.13996. [Persian].
14. Badia JM, Casey AL, Petrosillo N, Hudson PM, Mitchell SA, Crosby C. Impact of surgical site infection on healthcare costs and patient outcomes: a systematic review in six European countries. J Hosp Infect. 2017;96(1):1-15. doi: 10.1016/j.jhin.2017.03.004.
15. Gadeer R, Baatiah NY, Alageel N, Khaled M. Incidence and risk factors of wound infection in women who underwent cesarean section in 2014 at King Abdulaziz Medical City, Jeddah. Cureus. 2020;12(12):e12164. doi: 10.7759/cureus.12164.
16. Zejnullahu VA, Isjanovska R, Sejfija Z, Zejnullahu VA. Surgical site infections after cesarean sections at the University Clinical Center of Kosovo: rates, microbiological profile and risk factors. BMC Infect Dis. 2019;19(1):752. doi: 10.1186/s12879-019-4383-7.
17. Ketema DB, Wagnew F, Assemie MA, Ferede A, Alamneh AA, Leshargie CT, et al. Incidence and predictors of surgical site infection following cesarean section in North-west Ethiopia: a prospective cohort study. BMC Infect Dis. 2020;20(1):902. doi: 10.1186/s12879-020-05640-0.
18. Yerba K, Failoc-Rojas V, Zeña-Ñañez S, Valladares-Garrido M. Factors associated with surgical site infection in post-cesarean section: a case-control study in a Peruvian hospital. Ethiop J Health Sci. 2020;30(1):95-100. doi: 10.4314/ejhs.v30i1.12.
19. Tan LT, Shiang F, Wong J, Azmah Tuan Mat TN, Gandhi A. A prospective study of surgical site infection in elective and emergency general surgery in a tertiary public hospital in Malaysia-a preliminary report. Madridge J Surg. 2019;2(1):52-8. doi: 10.18689/mjs-1000113.
20. Rafiei M, Saei Ghare M, Akbari M, Kiani F, Sayehmiri F, Sayehmiri K, et al. Prevalence, causes, and complications of cesarean delivery in Iran: a systematic review and meta-analysis. Int J Reprod Biomed. 2018;16(4):221-34.
21. Jasim HH, Sulaiman SA, Khan AH, Dawood OT, Abdulameer AH, Usha R. Incidence and risk factors of surgical site infection among patients undergoing cesarean section. Clin Med Insights Ther. 2017;9:1-7. doi: 10.1177/1179559x17725273.