Case-controlled Study

Risk factors for surgical site infection after cesarean delivery in a rural area in China: A case–controlled study

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ARTICLE INFO

ABSTRACT

Background: We aimed to determine the prevalence and risk factors of surgical site infection (SSI) after cesarean delivery (CD) in a rural area in China.

Methods: We identified 155 patients with incisional and organ/space SSIs by International Classification of Disease codes and matched them with 465 patients (controls) in a time-matched retrospective quality assurance analysis. Multiple logistic regression analyses were performed to examine the risk factors for SSI: the work-years of providers, the number of antenatal care (ANC) visits, CD after labor, positive discharge culture, postoperative C-reactive protein (CRP) levels and fever.

Results: and discussion: During the study, 155 women with SSI were identified among the 8640 patients who delivered by CD. The incidence of SSIs was 179 per 10 000 patients (95%CI: 151–207 per 10 000 patients). The total duration of hospitalization in patients with SSI was 14.49 ± 8.68 days compared with 7.96 ± 2.35 days in patients with no SSI (P < 0.01). Multiple logistic regression analysis showed that the work-years of providers (odds ratio [OR] = 3.729, 95% confidence interval [CI]: 1.463–9.501, p = 0.006), irregular ANC visits (OR = 3.245, 95% CI: 1.264–8.329, p = 0.028), CD after labor (OR = 2.545, 95% CI: 0.935–6.926, p = 0.020), post-operative CRP level (OR = 2.545, 95% CI: 0.935–6.926, p = 0.016) and a positive discharge culture (OR = 2.954, 95% CI: 0.305–28.643, p = 0.019) were positively associated with SSI. However, the rates of maternal request (OR = 0.186, 95% CI: 0.065–0.535, p = 0.002) and postoperative fever (OR = 0.208, 95% CI: 0.087–0.494, p = 0.001) were negatively related to SSI.

Conclusions: Special attentions should be paid to CD patients who had irregular ANC visits, attempted labor, a positive discharge culture, higher CRP levels and fever after surgery, who had a greater risk of SSI.

1. Introduction

A surgical site infection (SSI) is defined as infection in the incision or organ/space at the operation site occurring up to 30 days after surgery [1]. SSIs are subcategorized into superficial incisional (involving skin and subcutaneous tissue), deep incisional (involving deeper soft tissue of the incision, such as muscle or fascia) and organ/space SSIs [2]. SSI can lead to significant morbidity and mortality and increase the length of hospital stay, 30-day readmission rate, and hospital costs [3]. Based on the studies, 70% SSIs are superficial in gynecology, and the remainder are deep and organs or spaces, so the superficial SSIs were the aim in our study [11,42]. In the USA, the incidence of SSI after cesarean delivery in the form of incisional infections is 2%–7%, and that resulting in

endometritis is 2%–16% [4]. Notably, these rates are even higher, approaching 30%, in obese individuals [5,6]. In China, although the rate of SSI in the form of superficial incisional infections is 2%–4.9% [31], lower than other countries, but the rate of CD has reached to 51%–65% [15,40]. So there are lots of women suffered from the infection of wound, and hospital costs. (see Fig. 1)

The reported risk factors for SSI are prolonged labor, premature rupture of membranes, excess vaginal manipulation, manual extraction of the placenta, and premature birth [7,8]. Comorbidities such as sexually transmitted infection (STI), severe anemia and gestational diabetes are also associated with higher rates of organ/space infection, particularly incisional infection [9,10]. American College of Obstetrics and Gynecology (ACOG)-reported risk factors for SSI after cesarean
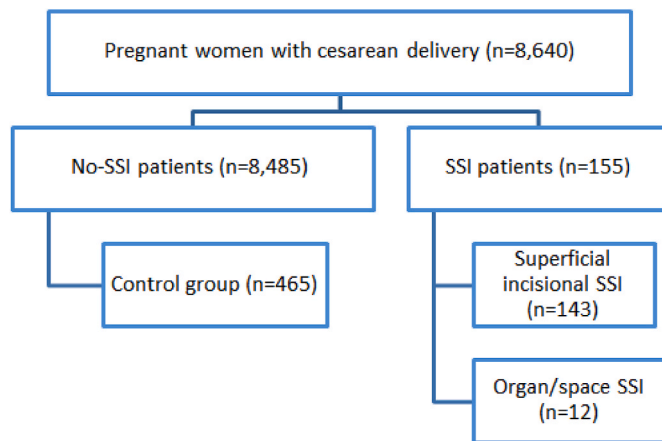

Fig. 1. Flow diagram of patient selection. SSI = surgical site infection.

delivery are the same as those for SSI after gynecologic procedures, as the intraoperative exposure of the abdominal and vaginal microbiomes is similar [11]. There have been many studies about the risk factors for incisional infections in other countries [7–12].Different areas have different risk factors for SSI [13].However, there are only a few reports about SSI in secondary institutions in China [14,15]. The purpose of this study was to determine the prevalence and risk factors of surgical site infection after cesarean delivery in a rural area in China.

2. Materials and methods

2.1. Study design and participants

This retrospective, matched case-control (1:3 ratio) study was approved by the Institutional Review Board of Fenghua Maternal Care Centre and carried out from January 2010 to January 2021. The records/information of all the women were anonymized and deidentified before analysis, which was possible due to the retrospective nature of the study. The present study analyzed maternal histories and intra-operative information by using medical and operative records. Clinical trial registration: researchregistry7168 (https://www.researchregistry.com/browse-the-registry#home/registrationdetails/61481f200e0fa9001e0ac3ae/). The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Ningbo Women and Children's Hospital (approval number: 2020-ky-038).

2.2. Provider characteristics

Hospitals in China are classified as primary, secondary or tertiary institutions according to their ability to provide medical care, education and conduct medical research. Fenghua Maternal Care Centre is a secondary institution in Fenghua District, Ningbo, China. The Gynecology and Obstetrics department had 64 beds. There were 790 deliveries per year, and an average of 66 cesarean sections was performed per month. CDs are performed by an attending physician who has been working for less than 10 years or by a consultant who has been working for more than 10 years with assistance from a physician assistant or an attending physician.

2.3. Patients' characteristics

All women who met the inclusion criteria were recruited between January 1, 2010, and January 2021. The Centers for Disease Control and Prevention's National Healthcare Safety Network classification for SSI [2] (http://www.cdc.gov/nhsn/PDFs/pscManual/9pscSSIcurrent.pdf) was used to determine the presence of SSI. The inclusion criteria for

enrollment in the study were pregnant patients who underwent cesarean section and received a diagnosis of SSI within 30 days. The routine of the Department of Prevention and Infection Control is to evaluate all patients who undergo cesarean section up until day 30 after the procedure. Control patients were identified after the inclusion of case patients according to the following inclusion criteria: similar age (±2 years), cesarean section procedure performed on the same day as that of the case patient, and no history of postcesarean infectious complications up to the 30th day according to the CDC/NHSN criteria. Cases were excluded if a control patient who met the inclusion requirements could not be identified or if patient records were not available.

The study examined demographic, obstetric, maternal, operative, and postpartum variables. These variables were chosen based on factors that were previously linked to the risk of SSI after CD in other studies [2, 3,6–9,13] and their availability in our current clinical database. Demographic variables included age, pre-pregnancy body mass index (BMI), and weight gain during pregnancy. Obstetric variables included number of prior pregnancies and births, number of antenatal care (ANC) visits, malpresentation, treatment with antibiotics during pregnancy, number of vaginal examinations before CD, rupture of membranes (spontaneous or assisted), color of amniotic fluid, diagnosis of chorioamnionitis, maternal fever after CD, diagnosis of diabetes mellitus, gestational diabetes, levels of hemoglobin A1c, hypertension, bacterial vaginosis, preterm birth, days of hospitalization before CD, white blood count, leucocyte count, hemoglobin, hematocrit (HCT), and C-reactive protein (CRP) before and after CD. Appropriate prophylaxis was defined as antibiotic administered at the time of cord clamping during the procedure. Operative variables included the urgency of the operation (elective or emergency), type of skin incision (low transverse or vertical), and method of placental removal (manual or spontaneous).

ANC visits variable were including No ANC, irregular and regular. No ANC was defined the pregnant women never having an ANC during the pregnancy. The irregular ANC was defined the pregnant women never having ANC less than 8 times. The regular ANC was defined the pregnant women having ANC depend on the doctors'request.

Indications for CDs included: previous CD, malpresentation (breech, transverse), cephalo pelvic disproportion, fetal distress, and maternal request. The amount of intraoperative bleeding was measured from the time of skin incision to the time of wound closure. The amount of postpartum hemorrhage (PPH) was defined as the total volume of blood exceeding 500 ml from the end of the cesarean section procedure to 24 h later[18].Operative time was defined as the time from baby delivery to completion of skin closure in minutes as recorded by the circulating nurse in the operating room.

The records were also checked for the outcomes of cultures of discharge from the vagina, amniotic fluid or wounds. Clinical characteristics were recorded for all patients from electronic medical chart reviews. Fever onset, duration, maximum temperature, and pattern were recorded in SF (+) patients. Postoperative fever was defined as a fever that began on or after postoperative day (POD), and the temperature was more than 37.8 °C on 2 successive measurements or greater than 39 °C once. Inflammatory markers, including complete blood-cell (CBC) count, Leucocyte count, and the level of CRP, were routinely measured before surgery, after POD 2 or 3, and 4 to 5-day. But, we just chose the levels of the Inflammatory markers in POD 3 or 4 to detect possible infection.

2.4. Statistical analysis

The Mann–Whitney U test was used to examine continuous variables, and Fisher's exact test or the chi-square test was used to examine categorical variables. Multiple logistic regression was performed to explore the risk factors for SSI. All statistical analyses were performed using SAS version 9.2 (SAS Institute, Inc., Cary, NC). Statistical significance was defined as values of $P < 0.05$. This study has been reported in line with the STROCSS 2019 criteria [46].

3. Results

A total of 8640 patients underwent CD over the ten-year study period, of whom 155 (1.79%) were diagnosed with SSI after CD. The incidence of SSIs was 179 per 10 000patients (95%CI: 151–207 per 10 000patients). Ultimately, 155 case patients with an SSI and 465 control patients conforming to the inclusion criteria were identified. A total of 143 (92.26%) of the 155 patients had a superficial incisional SSI, and 12 patients (7.74%) had an organ/space SSI.

The characteristics of the 155 patients and 465 control patients are described in Table 1. The factors that differentiated case from control patients in the univariate analysis were diabetes mellitus and ANC visits (P < 0.01). We found that the level of hemoglobin prior to cesarean section was significantly lower in the case group than in the control group (116.66 ± 9.55 vs. 107.06 ± 28.88, P < 0.01). Furthermore, the rate of positive discharge culture was significantly higher in the case group (33.55%) than in the control group (18.28%). However, the rate of patients with bacterial vaginosis was not significantly different between the two groups.

Meanwhile, we found that the rates of fetal distress and maternal request as indications for CD were significantly higher in the case group than in the control group. During the process of CD, the incidence of surgeons who had been working for more than 10 years was significantly higher in the case group than in the control group (43.87% vs. 17.63, P < 0.01). Meanwhile, the factors that differentiated case from control patients in the univariate analysis were amniotic fluid color, postoperative hemoglobin and CRP, postoperative fever and total duration of hospitalization (P < 0.01). However, the rate of positive amniotic fluid culture was not different between the two groups (Table 2). Additionally, no significant differences in the postoperative white blood cell count, HCT or CRP were found between the groups.

Multiple logistic regression analysis showed that the work-years of providers (odds ratio [OR] = 3.729, 95% confidence interval [CI]: 1.463–9.501, p = 0.006), the number of ANC visits (OR = 3.245, 95% CI: 1.264–8.329, p = 0.028), CD after labor (OR = 2.545, 95% CI: 0.935–6.926, p = 0.020), postoperative CRP level (OR = 2.545, 95% CI: 0.935–6.926, p = 0.016) and a positive discharge culture (OR = 2.954, 95% CI: 0.305–28.643, p = 0.019) were positively associated with SSI. However, the rates of maternal request (OR = 0.186, 95% CI: 0.065–0.535, p = 0.002) and postoperative fever (OR = 0.208, 95% CI: 0.087–0.494, p = 0.001) were negatively related to SSI (Table 3; Fig. 2).

4. Discussion

The SSI rate of 1.77% observed in our cohort is comparable to those reported by other districts in China but markedly lower than the 6.5% in SHREE's report, 11.1% in Samuel's report and 5%–12% in the USA [2, 19]. Although the prevalence of SSI in our hospital is low and no patients died from SSI, it is still a major cause of prolonged hospital stay and a burden to the healthcare system [20], as the days of total duration of hospitalization in patients with SSI was 14.49 ± 8.68 vs. 7.96 ± 2.35 in patients with no SSI (P < 0.01) in our study.

In the study, CD after induction was associated with a 2.55-fold increased risk of SSI. Other studies also observed this [12,21]. The most common method for inducing cervical ripening in our hospital was the use of a Foley catheter (128/465 (27.52%) in the SSI group and 41/155 (26.45%)in the control group). The risk of induction was increased, perhaps owing to the prolonged presence of a foreign body in the cervix [22].Previous reports clearly demonstrated an association between labor and SSI [23].Wodajo et al. [24]reported that prolonged labor and the prolonged rupture of the membranes contribute to amniotic fluid colonization by the normal flora and lead to surgical wound and peritoneal cavity contamination. However, in our study, the type and duration of membrane rupture, cervical dilation and the number of vaginal examinations did not related to wound infection. The recommendation from ACOG and Sarak's review also did not find any

Table 1
Demographic and characteristics of the patients before the operation.

Clinical parameters	Control patients (n = 465)	Case patients (n = 155)	P
Age of mother (years), n (%)			0.200
Less than 19	27 (5.81)	13 (8.39)	
20–34	380 (81.72)	131 (84.52)	
More than 35	58 (12.47)	13 (8.39)	
BMI (kg/m^2), n (%)	21.94 ± 3.33	22.47 ± 3.97	0.234
Less than 18.5	52 (33.55)	18 (11.61)	
18.5–24.9	326 (70.11)	105 (67.74)	
25–29.9	71 (15.27)	20 (12.90)	
More than 30	16 (3.44)	12 (7.74)	
Gain weight (kg)	14.73 ± 4.43	16.06 ± 5.01	0.060
Gravidity, n (%)			0.347
Less than 2	280 (60.21)	109 (70.32)	
2–4	168 (36.12)	38 (24.52)	
More than 5	17 (36.56)	8 (5.16)	
Abortion, n (%)			0.524
Less than 2	335 (72.04)	120 (77.42)	
2–4	125 (26.88)	33 (21.30)	
More than 5	5 (1.08)	2 (1.30)	
Parity, n (%)			0.397
Less than 2	424 (91.18)	147 (94.84)	
2–4	41 (88.17)	8 (5.16)	
More than 5	0	0	
Weeks at pregnancy termination (<37), n (%)	19 (4.09)	6 (3.87)	0.845
Twin pregnancy, n (%)	5 (1.08)	8 (5.16)	0.068
Hypertensive disorders (HTN), n (%)	57 (12.26)	16 (10.32)	0.724
Diabetes mellitus (DM), n (%)			0.002
No test	11 (2.36)	24 (15.48)	
Normal	367 (78.92)	113 (72.90)	
GDM	87 (18.71)	18 (11.62)	
Hemoglobin A1c, (%)	5.45 ± 0.66	5.78 ± 0.44	0.295
ANC visits, n (%)			0.001
No ANC	3 (0.66)	14 (9.03)	
Irregular	98 (21.08)	65 (41.94)	
Regular	364 (78.28)	76 (49.03)	
Hospitalization before cesarean (days)	2.06 ± 1.94	1.98 ± 1.36	0.784
Type of RM, n (%)			0.528
None	171 (36.77)	43 (27.74)	
Spontaneous	166 (35.70)	71 (45.80)	
Artificial RM	128 (27.52)	41 (26.45)	
Duration of membrane rupture, n (%)			0.500
None	171 (36.77)	43 (27.74)	
≤6 h	81 (17.42)	65 (41.94)	
>6–24 h	133 (28.60)	31 (20.00)	
>24–48 h	71 (15.27)	11 (7.10)	
≥48 h	9 (1.94)	5 (3.22)	
Number of vaginal examinations, n (%)			0.428
≤5	171 (36.77)	52 (33.55)	
>5–9	212 (45.59)	68 (43.87)	
≥10	82 (17.63)	35 (22.58)	
Cervical dilation, n (%)			0.188
0	255 (54.84)	63 (40.65)	
>1–3 cm	22 (4.73)	30 (19.35)	
>3–8 cm	112 (24.09)	22 (14.19)	
>9–10 cm	76 (16.34)	40 (25.81)	
Adequate antibiotic prophylaxis preoperative, n (%)	95 (20.43)	38 (24.52)	0.517
Labor, n (%)			0.136
Not in labor	200 (43.01)	44 (28.39)	
Spontaneous	82 (17.63)	73 (47.10)	
Induced	183 (39.35)	38 (24.52)	
Indications for CD, n (%)			0.930
Previous CD	63 (13.55)	8 (5.16)	0.093
Malpresentation	44 (9.46)	12 (7.74)	0.591
CPD	192 (41.29)	56 (36.13)	0.643
Fetal distress	65 (13.98)	35 (22.58)	0.030
Maternal request	101 (21.72)	44 (28.39)	0.007
White blood count prior to cesarean (cells/μL)	9.53 ± 2.35	9.46 ± 2.09	0.829

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Table 1 (*continued*)

Clinical parameters	Control patients (n = 465)	Case patients (n = 155)	P
Leucocyte count prior to cesarean (cells/μL)	72.51 ± 5.82	73.59 ± 6.32	0.328
Hemoglobin prior to cesarean (g/L)	116.66 ± 9.55	107.06 ± 28.88	0.001
HCT prior to cesarean (%)	35.08 ± 2.58	35.60 ± 3.28	0.485
CRP prior to cesarean (mg/L)	2.958 ± 5.58	4.06 ± 4.15	0.170
Bacterial vaginosis, n (%)	134 (28.82)	74 (47.74)	0.106
Discharge culture, n (%)	85 (18.28)	52 (33.55)	0.037

Data are shown as n (%), mean ± standard deviation, or median (range), as appropriate. BMI = body mass index; ANC = antenatal care, RM = ruptured membrane; CPD = cephalo pelvic disproportion; HCT = hematocrit; CRP= C-reactive protein.

Table 2
Characteristics of labor and surgery for the included patients.

Clinical parameters	Control patients (n = 465)	Case patients (n = 155)	P
Emergency cesarean, n (%)	302 (64.94)	114 (73.55)	0.224
Pfannenstiel skin incision, yes(n)	87 (18.71)	33 (21.30)	0.700
Estimated blood loss (≥500 ml), n (%)	85 (18.27)	12 (7.74)	0.054
Provider characteristics (>10years), n (%)	82 (17.63)	68 (43.87)	0.001
Operative time (delivery to close in minutes), n (%)			0.399
≤45 min	269 (57.85)	75 (48.39)	
>45 min	196 (42.15)	80 (51.61)	
Amniotic fluid color, n (%)			0.006
Clear	321 (69.03)	73 (47.10)	
I–II	79 (16.99)	38 (24.52)	
III	65 (13.98)	44 (28.39)	
Amniotic fluid culture, n (%)	6 (12.90)	2 (1.29)	0.052
Placenta delivery (spontaneous), n (%)	45 (9.68)	5 (3.23)	0.073
Postoperative white blood count (cells/μL)	13.80 ± 3.57	14.73 ± 3.63	0.093
Postoperative leucocyte count (cells/μL)	81.35 ± 4.39	80.80 ± 14.56	0.654
Postoperative hemoglobin (g/L)	103.63 ± 15.31	96.39 ± 23.55	0.008
Postoperative HCT (%)	31.92 ± 3.28	31.71 ± 3.27	0.687
Postoperative CRP (mg/L)	60.95 ± 39.31	100.42 ± 66.93	0.001
Postoperative fever, n (%)	56 (12.04)	90 (58.06)	0.001
Chorioamnionitis, n (%)	38 (8.17)	21 (4.52)	0.620
Total duration of hospitalization (days)	7.96 ± 2.35	14.49 ± 8.68	0.001

Table 3
Multiple logistic regression analysis of general characteristics and laboratory findings in the case and control groups.

	OR	95% CI	P
ANC visits (irregular)	3.245	1.264–8.329	0.028
Cesarean after labor	2.545	0.935–6.926	0.020
Maternal request for CD	0.186	0.065–0.535	0.002
Provider characteristics (less than 10 years)	3.729	1.463–9.501	0.006
Postoperative CRP	1.010	1.002–1.019	0.016
Postoperative fever	0.208	0.087–0.494	0.001
Discharge culture (positive)	2.954	0.305–28.643	0.019

OR, odds ratio; CI, confidence interval.

relationships between them and SSI [2–4]. Interestingly, Vallejo et al. [25] reported that the presence of ruptured membranes was protective against SSI. Therefore, further studies are needed to clarify the relationship between the characteristics of labor and SSI.

The risk of SSI varied depending on the qualifications of the provider who conducted the procedure. This indicates that CD performed by residents with 5–10 years of experience was a risk factor for SSI, which is consistent with previous studies. Wlochet al. [26]also reported that the risk was 1.6 times greater when CD was performed by consultants compared with staff grade surgeons. Meanwhile, procedures performed by resident obstetricians who had 5–10 years of experience had a 3.729 times higher risk of SSI than those performed by attending or consulting obstetricians. There are many factors affecting the rates of SSI [19,24]. First, patients with CD performed by residents had a low socioeconomic status and often had relatively fewer ANC visits than patients cared for by attending or consulting physicians. Second, residents may require longer operative times due to their immature skill set and teaching opportunities [27]. However, the training is necessary. Therefore, we should balance training with obtaining ideal outcomes.

In this study, one of the significant risk factors for SSI was having irregular prenatal visits. Similar findings have been reported by Killian et al. [43], whose study showed that having attended fewer than 7 prenatal consultations was a factor that significantly increased the risk of post-C-section endometritis. During the process of ANC, women should be counseled to control their weight and blood pressure [44]. Then, routine screening for and treatment for HBV, STD, and bacterial vaginosis in the pregnant woman to prevent SSI [45], specifically endometritis, is an idea. Companied the regular ANC, these diseases will be treated, so the rate of SSI will lower.

A total of 33.55% (52/155) of patients in the SSI group and 18.25% (85/465) in the control group had a positive discharge culture. Patients with a positive discharge culture had 2.95 times the risk of developing an SSI when compared with patients with a normal result. The most common pathogen in the discharge was *Escherichia coli* (40.2%), which is consistent with studies from Great Britain, where *Escherichia coli* was the most common pathogen [28]. However, due to the widespread use of broad-spectrum antibiotics, SSI pathogens may also originate from preoperative infections at sites remote from the operative site [29,30]. In most SSIs, the responsible pathogens originate from the patient's endogenous flora [31]. The most commonly isolated organisms are *S. aureus*, coagulase-negative staphylococci, Enterococcus spp. and *Escherichia coli* [32,33].

The results of our analysis indicate that significantly higher levels of CRP and fever after surgery were both risk factors for SSI associated with CD. The type of fever after surgery was different from that associated with other organ infections. The temperature always ranged from 37.8 to 38.5 °C from 3 to 5 days after surgery. This was also reported in Hwang's study [34]. CRP, made by the liver, is in response to inflammation, infection, and tissue damage with a relatively high sensitivity and quick reaction [35]. Several studies have reported that in cases of SSI, it would be useful to focus on the CRP levels after surgery, a continuous elevated level would indicate possible infection [36]. If the level of CRP cannot return to normal after surgery and a postoperative fever occurred, the wound should be cared for. Studied from Iwata and BI reported similar findings [36,37].

Although previous reports clearly demonstrated an association between obesity and postoperative infection, we did not find an association between maternal BMI and SSI in this study [38]. The mean pre-pregnancy BMI in our cohort was 22.25 kg/m^2 and did not differ between patients with and without an SSI (21.94 ± 3.33 vs. 22.47 ± 3.97; p = 0.234). The rate of obesity in our hospital was lower than that in other studies [39]. The mean weight gain during pregnancy was 15.06 ± 4.61 kg. Likewise, we did not find a statistically significant association between gestational diabetes mellitus and SSI. Diabetes and poor glycemic control are well-known risk factors for SSI [21]. The current CDC guidelines recommend that the serum glucose target goal be less than 200 in patients both with and without diabetes, and if the levels are above this, there is an increased risk of SSI [2,11]. In our study, there were only 2 patients with pre-existing diabetes. The mean levels of hemoglobin A1C before delivery were 5.78 ± 0.44 in the SSI group and 5.45 ± 0.66 in the control group (p = 0.295). These results indicated that patients with GDM or pre-existing diabetes in Fenghua District, China, were well treated. Therefore, GDM showed no relationship with

Fig. 2. Wounds in Chinese patients with surgical site infection.

SSI (p > 0.05) in the logits.

Interestingly, maternal request is protective against SSI. However, we are working to reduce the rate of maternal request [16,17]. This is because there are high rates of CD in China (range 32%–56%).[40]Patients with maternal requests always have good ANC and choose CD directly, with the procedure being performed by attending consultants. Similar results were found in Liu's study [41].

Our study has several limitations. First, the findings of this study should be interpreted with consideration of the factors affecting SSI (such as smoking, years of education, type of health insurance and skin closure technique used), as the data were obtained via review of medical records. Another important limitation of the study is that it evaluated group B streptococcus (GBS) status. It was recommended that we obtain the GBS results of patients from 2018 in our hospital.

5. Conclusion

In conclusion, for women with irregular ANC visits, CD after labor, positive discharge cultures, higher CRP and fever after surgery, targeted intervention should be performed to prevent the surgical site infection. Improving surgical skills and reducing the rate of cesarean delivery due to maternal request is beneficial to the prevention of surgical site infections. Besides, Additionally, no association was found among the duration of RM, prolonged labor, vaginal examination and SSI. Further research on the risk factors for SSI associated with CD with a greater number of patients is fundamental to better understand the causes and treatment of SSI after CD.

Ethical approval

Sources of funding

Author contribution

XBH: Project Development, Data Collection, Manuscript Writing; DML and TTS: Data Collection, Data Analysis; QND, MH, ZYZ and XS: Data Collection; JJZ: Project Development, Manuscript Editing.

Registration of research studies

1. Name of the registry: zhoujunjunpp@163.com.
2. Unique Identifying number or registration ID: researchregistry7168.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.researchregistry.com/register-now#user-researchregistry/registerresearchdetails/61481f200e0fa9001e0ac3ae/

Guarantor

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

The authors declare no conflict of interest.

Acknowledgements

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