

Original Article

Risk factors analysis for perioperative infection in pregnant women with cesarean section and targeted optimization of nursing strategies

Chunfeng Fu¹, Xiaodan Wu², Peiling Guo¹, Ke Sun¹

¹Department of Obstetrics, The Third Affiliated Hospital, Sun Yat-sen University, Guangzhou, Guangdong Province, China; ²Department of Colorectal Surgery, State Key Laboratory of Oncology in South China, Collaborative Innovation Center for Cancer Medicine, Sun Yat-sen University Cancer Center, Guangzhou, Guangdong Province, China

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Abstract: Objective: To observe the related factors of infection and optimize nursing strategies in pregnant women with cesarean section during the perioperative period. Methods: A total of 140 pregnant women who underwent cesarean section were recruited in this prospective study and they were divided into the control group (n=88) and the observation group (n=52) according to the random number table method. Subjects in the control group received routine nursing, while those in the observation group were treated with fast recovery nursing. The operation time, catheter indwelling time, postoperative wake-up time, postoperative exhaust time, incision healing time and postoperative lactation starting time in the two groups were compared. Logistic regression was used to analyze the risk factors for postoperative infection. Results: The observation group had significantly lower operation time, catheter indwelling time, hospital stay, postoperative exhaust time, incision healing time and adverse reaction incidence than the control group (all $P < 0.05$). After surgery, the expression level of high sensitive-C reaction protein (Hs-CRP), the self-rating depression scale (SDS) and Self-rating Anxiety Scale (SAS) scores in the observation group were significantly lower than those in the control group, while the expression level of Hb (Hemoglobin) and nursing satisfaction rate were significantly higher than that in the control group (all $P < 0.05$). Multivariate Logistic analysis showed that body mass index $> 24.0 \text{ kg/m}^2$ was the most significant factor for postoperative infection, followed by long operation time, premature rupture of membranes, were top three important risk factors for postoperative infection, followed by long intestinal fast time before and after operation. Conclusion: The incidence of infection after cesarean section is related to operative time, body mass index, premature rupture of membranes, pregnancy complications, intestinal fasting time before and after operation, and catheter indwelling time. Fast recovery nursing can reduce the infection incidence in cesarean section, shorten hospital stay and improve patient's satisfaction with nursing.

Keywords: Cesarean section, postoperative infection, risk factors, fast recovery nursing

Introduction

Cesarean section is a common and important technique in obstetrics to solve dystocia and reduce perinatal adverse outcomes. At the same time, the lesions in the abdominal cavity can be performed during the surgery to avoid secondary damage [1-3]. With the advancement of medicine and the innovation of surgical methods, the safety of cesarean section has been greatly improved [4, 5]. However, as an invasive laparotomy, cesarean section is significantly more likely to cause the incidence of

postoperative infection than that of vaginal delivery; of which the total postoperative infection rate is 8%-27% and the incision infection rate is 3%-16% [6, 7]. In mild cases, there will be a shallow incision suppuration, which will undoubtedly increase the pain of the puerperae, and prolong the hospital stay. In severe cases, there might be intrauterine infection, incision dehiscence, increased risk of postoperative massive bleeding, peritonitis and sepsis [8]. Therefore, prevention of infection after cesarean section is worthy of attention and discussion in clinical practice, and it is urgent to

solve this problem. Understanding and mastering the risk factors for incision infection plays an important role in reducing infection and improving prognosis.

In recent years, clinicians have found that optimized nursing can significantly promote postpartum rehabilitation in cesarean section parturients. The key point of optimized nursing is to fully meet the nursing needs of the puerperae during hospitalization for each patient's own situation. On the basis of conventional nursing, puerperae receive optimized professional education and their psychological condition is attended to and puerperae are motivated to cooperate with the treatment strategy to fully understand their own condition [9]. Chen et al. confirmed that optimized nursing in the operating room could reduce lower respiratory tract infections after abdominal surgery (0.79% vs. 3.46%) [10]. Sha et al. reported that optimized nursing could reduce the total postoperative complication rate (3.13 vs. 19.23%) and facilitate the postoperative recovery [11]. Lotfi et al. stated that optimized nursing could reduce postoperative pain, anxiety and vital sign fluctuations in puerperae with cesarean section [12]. In our study, preoperative psychological counseling on puerperae was performed to reduce maternal tension and anxiety, the aseptic concepts were strengthened during the operation, and the surgeons were required to strictly follow the clinical operation process and observe vital signs at all times. Meanwhile, acupoint massage, scientific disinfection and reasonable diets along with other methods were used to improve prognosis, in order to achieve a good postoperative effect.

Material and methods

General information

The study was approved by the ethical committee of The Third Affiliated Hospital, Sun Yat-sen University. The enrolled puerperae or their families had signed the informed consent form. Puerperae who underwent cesarean section in The Third Affiliated Hospital, Sun Yat-sen University from October 2018 to January 2019 were selected and they were divided into the control group (n=88) and the observation group (n=52) according to a random number table method. The control group received routine

nursing, while the observation group was treated with optimized nursing. Inclusion criteria: (1) puerperae aged between 20 and 35 years old; (2) puerperae meet the "Diagnostic Criteria for Nosocomial Infection (Trial)" formulated by the Ministry of Health in 2001 [13]; (3) puerperae had negative examination results of preoperative hepatitis c, syphilis and acquired immune deficiency syndrome (AIDS); (4) puerperae had complete clinical data. Exclusion criteria: (1) puerperae had coagulopathy, abnormal immune system and endocrine diseases; (2) puerperae had mental disorders or vague consciousness; (3) puerperae had pelvic inflammatory and reproductive system-related diseases; (4) puerperae had surgical contraindications; (5) puerperae who were transferred to cesarean section or emergency cesarean section during natural delivery.

Nursing method

The control group was given routine nursing [14]. Before the operation, the nurses became familiarized with the surgical procedure, ensured an appropriate temperature and humidity in the operating room, actively cooperated with the surgeon, closely observed the changes of puerperae' vital signs, and timely reported and dealt with abnormal conditions. After the operation, the nurses had to keep the ward clean and sanitary and disinfected and ventilated regularly.

The observation group received the optimized nursing strategy, which were modified on the basis of the nursing methods in the control group according to the "Optimized nursing Service Demonstration Project" formulated by the Ministry of Health in 2010. Outpatient education: Patients were educated with treatment and nursing during the perioperative period in outpatient clinic and pregnancy school along with brochures about midwifery. This can improve patients' compliance giving them a general understanding of the whole hospitalization process and become prepared in both materials and psychology. Education on admission: The clinical doctor in charge determines and evaluates the fast recovery nursing for pregnant women. The patients were informed of all relevant matters during the perioperative period, as well as the preset discharge standards and the follow-up time. The nurse in

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charge explained the instructions for admission and supplies to be prepared. Both patients and their families were well educated and informed with the detailed steps of postoperative recovery, so as to reduce the mental pressure of patients. Before surgery: puerperae were forbidden to eat for 8 hours and drink water for 6 hours before surgery and nurses assisted puerperae to clean the perineum routinely. First, the skin in the surgical area was washed with soapy water and wiped by iodophor. Then the nurses gently and carefully shave the skin to avoid damage. The urethral catheter with appropriate diameter was carefully inserted 15 minutes before surgery. During operation: nurses maintain the air-conditioning temperature at 25-28°C and the washing saline was pre-warmed. Meanwhile, nurses closely cooperated with the physician and strictly executed the aseptic procedures. The vital signs of the pregnant women were observed in real-time, and nurses had to report anything abnormal. After the operation: the nurses keep the ward clean, tidy, with appropriate temperature and humidity. The puerperae lied on the back for 6 hours and any movement was gentle when moving to avoid causing wound pain or bleeding. The vulva was wiped with iodophor and body temperature was measured twice a day. The gauze was changed once a day. If the postoperative breast tube was impassable in the parturient, the nurses would regularly apply a hot towel or breast massage to make the mammary gland smooth and able lactate as soon as possible. For women with too much milk, teaching them how to preserve milk to avoid swelling or fever. After the operation, the puerperae was encouraged to eat light and digestible food in the early stages, and strengthen the recovery of gastrointestinal function as soon as possible and they were encouraged to get out of bed as early as possible to prevent adhesions at the surgical site.

Outcome measures

Data collection: Relevant baseline information was collected based on the patient's admission records, including age, gestational age, body mass index (BMI), premature rupture of membranes, primipara/delivery, and abdominal surgery history.

Main outcome measures: The operation time (time from incision to suture), catheter indwell-

ing time (time from catheter insertion to removal), time to get out of bed (time from operation to getting out of bed), postoperative exhaust time (surgery complete to the intestinal peristalsis exhaust time), incision healing time (when the partial granulation of the incision has grown, which is in a healing state and no need to replace and use the dressing), intestinal vacancy time before and after surgery (duration of intestinal fasting before and after surgery) and postoperative lactation starting time (time from the end of cesarean section to the start lactation) were recorded. C-reactive protein concentration (hs-CRP, article number: EK-7040) was detected by enzyme-linked immunosorbent double-antibody sandwich method using a microplate reader (American, Bio-Rad iMark Absorbance Microplate Reader). Hb level was detected using a fully automated routine blood analyzer (China, Leidu, RT-7200). The incidences of incision infection [15], urinary tract infections [16], fever [17], unclear lochia [18] and abdominal pain were recorded within one month after the operation.

Secondary outcome measures: Logistic multivariate analysis was performed with maternal infection as the dependent variable, catheter indwelling time, operative time, BMI, pregnancy complications, premature rupture of membranes and intestinal vacancy time before and after surgery as independent variables. Maternal satisfaction assessment with a total of 10 items was conducted 1 day before discharge from the hospital, including hospital environment, safety, nursing skills, health guidance, nursing staff attitude and medical facilities. The scoring was performed using the Likert scale. In each item, very satisfactory was two points, satisfaction was one points and dissatisfaction was zero points. The total score with more than 12 points is deemed as very satisfactory, more than 6 points was satisfaction. Satisfaction rate = the number of (very satisfied + satisfied)/total number. On the day before admission and discharge, puerperae' anxiety status was assessed by SAS and puerperae' depression status was assessed by SDS [19, 20].

Statistical analysis

Statistical analysis was performed using SPSS version 21.0 software. The measurement data were expressed as mean \pm standard deviation

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Table 1. Comparison of general information ($\bar{x}\pm sd$)

Group	Age (years)	Gestational age (week)	BMI (kg/cm ²)	Premature rupture of membranes (n, %)	Cesarean section (yes/no)	History of abdominal surgery (yes/no)
Control group (n=88)	31.6±7.7	39.5±2.4	22.00±1.96	18 (20.46)	22/66	32/56
Observation group (n=52)	30.3±7.2	39.3±1.7	21.81±0.97	12 (23.08)	14/38	25/27
t/ χ^2	0.977	0.738	0.649	0.023	0.801	0.173
P	0.331	0.461	0.517	0.879	0.063	1.858

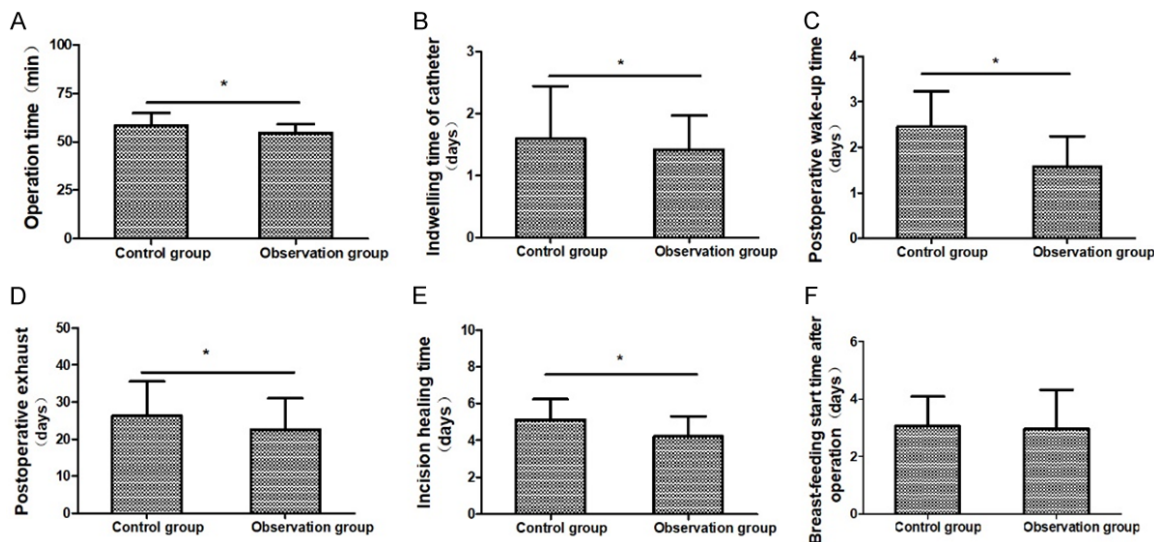


Figure 1. Comparison of postoperative conditions between the two groups of patients. Compared with the control group, *represents $P < 0.05$. A: Longer operative time is associated with worse postoperative effects; B: The longer the catheter indwelling time is, the more likely infection will occur after surgery; C: The longer the postoperative wake-up time, the worse the postoperative recovery; D: The longer the postoperative exhaust time, the worse the postoperative recovery effect; E: The longer the incision recovery time, the worse the postoperative effect; F: The shorter the postoperative lactation start time, the better the postoperative effect.

($\bar{x}\pm sd$). Paired t-test was used for the measurement data in accordance with normal distribution between groups or within a group before and after treatment. The count data were expressed as number of cases/percentage (n/%) and compared using the χ^2 test. Multivariate Logistic regression analysis was used. $P < 0.05$ was considered statistically significant.

Results

General information

There were no statistically significant differences in the age, gestational time, BMI, premature rupture of membranes, cesarean section or history of abdominal surgery between the two groups (all $P > 0.05$). Detailed results are shown in **Table 1**.

Comparison of postoperative maternal status

The operation time, catheter indwelling time and postoperative wake-up time in the observation group were significantly lower than those in the control group (all $P < 0.05$). In terms of postoperative exhaust time and incision healing time, the observation group was significantly shorter than the control group (both $P < 0.05$). Detailed results are shown in **Figure 1**.

Comparison of maternal basic conditions between the two groups

The observation group had less puerperae with incision infection, urinary tract infection, fever, unclear lochia, and abdominal pain than the control group ($P < 0.05$). The overall infection rate in the observation group was significantly lower than that in the control group ($P < 0.05$). Detailed results are shown in **Table 2**.

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Table 2. Comparison of maternal basic conditions (n%)

Group	The number of cases	Incision infection	Urinary tract infection	Fever	Other	Total
Control group (n=88)	88	5 (5.68)	4 (4.55)	6 (6.82)	3 (3.41)	18 (20.46)
Observation group (n=52)	52	2 (3.85)	0	1 (1.92)	0	3 (5.77)
t/x ²		0.006	1.071	0.779	0.551	4.437
P		0.936	0.301	0.377	0.458	0.035

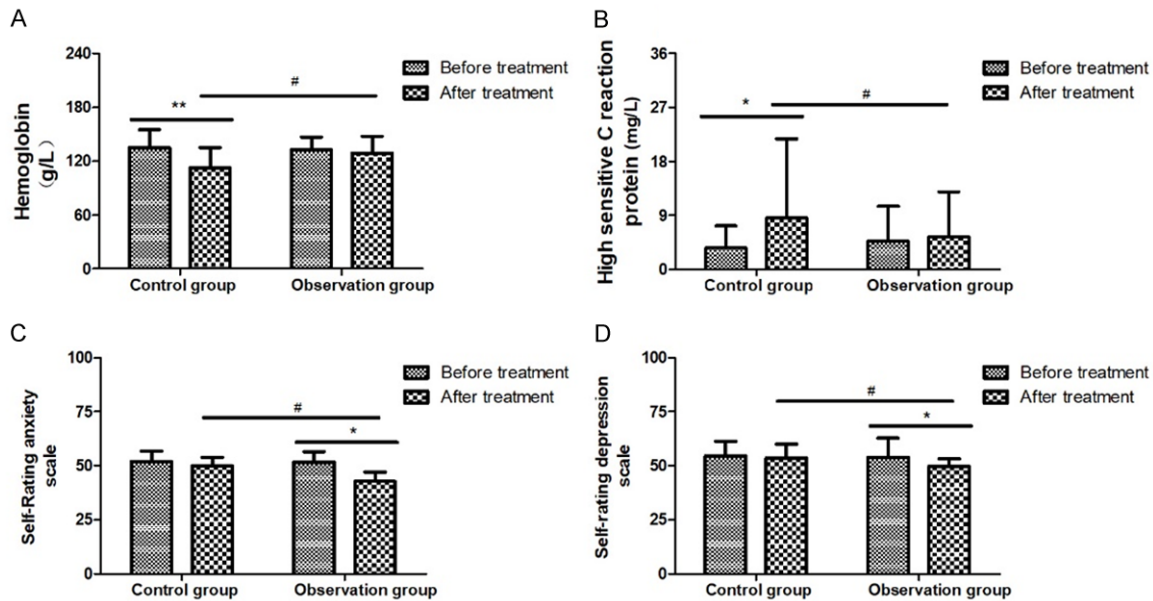


Figure 2. Comparison of routine blood work and infection related indicators between the two groups of the maternal ($\bar{x} \pm sd$). In the group *represents $P < 0.05$, and **represents $P < 0.01$. Between groups #represents $P < 0.05$. A: The higher the value of Hemoglobin, the better the body condition; B: The higher the value of super C-reactive protein, the higher the inflammatory degree of the body; C: Self-rating scale of depression, the higher the score, the more severe the depression state; D: Self-rating anxiety scale, the higher the score, the more serious the anxiety state. Hs-CRP: C-reactive protein; Hb: hemoglobin; SDS: self-rating depression scale; SAS: self-rating anxiety scale.

Comparison of biochemical indicators and psychological status between the two groups

Before the operation, there was no difference in Hs-CRP, Hb expression level, SDS and SAS scores between the two groups ($P > 0.05$). After operation, the expression level of Hs-CRP in the observation group was significantly lower than that in the control group, and the expression level of Hb was significantly higher than that in the control group ($P < 0.05$). Detailed results are shown in **Figure 2**.

Comparison of satisfaction between the two groups

Puerperae who had medical disputes and complaints in the observation group were less than the control group, but the difference was not

statistically significant ($P > 0.05$). The satisfaction of the observation group was significantly higher than that of the control group ($P < 0.05$). Detailed results are shown in **Table 3**.

Multivariate logistic analysis

Multivariate Logistic analysis was performed with the maternal infection as the dependent variable, catheter indwelling time, operative time, BMI, pregnancy complications, premature rupture of membranes and intestinal vacancy time before and after surgery as the independent variables. Finally, all the above factors entered the regression model. They are the main influencing factors of postpartum infection, of which BMI $> 24.0 \text{ kg/m}^2$ is the most important factor, long operative time ranks the second and the premature rupture of mem-

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Table 3. Comparison of satisfaction between the two groups (n%)

Group	Control group	Observation group	χ^2	P
	88	52		
Medical Dispute	4 (4.55)	0	1.071	0.301
Complaint	3 (3.41)	0	0.551	0.458
Degree of satisfaction				
Very satisfied	42 (47.73)	36 (69.23)	7.099	0.029
Satisfaction	38 (43.18)	15 (28.85)		
dissatisfaction	8 (9.09)	1 (1.92)		

branes ranks the third. Detailed results are shown in **Table 4**.

Discussion

Epidemiological data showed that the cesarean section rate in China has reached 46%, and it is an indisputable fact that the cesarean section rate keeps rising [2]. Cesarean section can protect pregnant women from the pain of vaginal delivery and save the life of dystocia pregnant women, improve perinatal adverse outcomes, and avoid accidental injury to the fetus. However, cesarean section is an unnatural delivery, which will bring potential disadvantages and risks to mothers and infants [4]. Maternal infection can prolong hospital stay, increase pain and hospital cost. It seriously affects the postpartum recovery of the mother, which will adversely affect the outcome of the surgery.

This study showed that the operative time, catheter indwelling time and postoperative wake-up time in the observation group were significantly lower than those in the control group. Caesarean section surgery is invasive and traumatic. Pregnant women may fear the failure of the operation and worry about the safety of themselves and the fetus. Therefore, puerperae will have a series of psychological and physiological stress reactions [21-23]. It will lead to decreased self-resistance and delayed immune response, which is not conducive to wound healing and increases the risk of wound infection and other complications [24]. Fast recovery nursing can provide puerperae with efficient nursing services, improve nurses' awareness of services, and strengthen the connection between patients and nurses. The implementation of various optimization mea-

asures has gradually improved the quality of nursing [25]. Moulton's research also confirmed that the physiological and anatomical structure of women determined that they were more prone to urinary tract infections [26]. Therefore, in this study, we regularly wiped the perineum with iodophor during postoperative nursing, which could not only sterilize the urethral orifice, but also inhibit the breeding of bacteria in the uterine cavity, which was consistent

with the results of Linlin et al. (preoperative vaginal lavage with iodophor could reduce postoperative infection to 6.02%) [27]. The status of catheter drainage should be closely observed and the urine in the catheter should be drained in time. Postoperative exhaust time and incision healing time in the observation group were significantly lower than those in the control group. The results of Zheng et al. also confirmed that optimized nursing interventions had positive effects in reducing postoperative infection to 2.83%, which was significantly lower than 11.84% in the conventional care group [28]. In our study, the expression level of Hs-CRP, SDS scores and SAS scores in the observation group was significantly lower than that in the control group, while the expression level of Hb was significantly higher. These results confirmed that compared with the control group, the infection status in the observation group was significantly lower and the nutritional status was better. Maternal anxiety and depression and other adverse psychological conditions were significantly improved. Therefore, the observation group had higher satisfaction than control group.

In this study, multivariate logistic analysis showed that BMI >24.0 kg/m² was the most important factor, long operative time was second and the premature rupture of membranes was the third, followed by long intestinal fast time before and after operation. Besides, Vaananen et al. confirmed that the infection rate of obese parturient women was significantly higher than that of parturient women with normal weight. The main reason was that the obese parturient women had more abdominal fat accumulation, which affected surgical field and the accuracy of operation, thus increasing the difficulty of suture. In addition, necrosis or

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Table 4. Multivariate logistic analysis of postoperative infection in maternal patients

Factor	β value	SE	Ward value	OR	95% CI	P
Pregnancy complications	1.074	0.477	5.055	2.926	1.148-7.459	0.025
operative time >1 h	1.956	0.504	15.092	7.073	2.636-18.977	<0.001
Premature rupture of membranes	1.571	0.471	11.101	4.810	1.909-12.118	0.001
BMI >24.0 kg/m ²	2.305	0.484	22.723	10.023	3.885-25.858	<0.001
Catheter indwelling time >24 h	1.147	0.581	3.892	3.144	1.008-9.840	0.049
Intestinal fast time before and after operation >8 h	1.372	0.595	5.313	3.942	1.228-12.653	0.021
Constant	-6.392	0.761	70.477			<0.001

Note: β value: regression coefficient; SE: Standard Error; Ward: Ward Test; OR: Odds Ratio; CI: Confidence Interval.

liquefaction of adipose tissue could lead to the release of inflammatory factors from adipose tissue [29]. Heller et al. pointed out that the long operation time would increase the chance of infection, mainly due to the increased number of bacteria on the wound surface. Since the abdominal cavity was exposed to air for a long time, the degree of dryness increased, and the muscle would be more vulnerable to injury [30]. Gelaw et al. reported that premature rupture of membranes would increase the complexity of the operation, increase the fatigue of puerperae, and gradually decrease the body's resistance. Moreover, when the incision was sutured, the suture line would lead to an increase in bleeding points, which was prone to incision infection [6]. Besides, long intestinal fast time before and after operation resulted in intestinal dysfunction and electrolyte imbalance, increasing the chance of infection.

However, the number of parturients involved in this study is relatively small, and the inconsistency of the puerperae's own physical and psychological qualities may also lead to some differences in postoperative recovery. The incidence of infection after cesarean section is high, which seriously affects the prognosis. Therefore, we should remove the susceptible factors during pregnancy as much as possible, adopt a combined strategy of multi-disciplinary techniques to guide pregnancy care, scientifically guide pregnant women's diet and exercise to avoid the occurrence of obesity and timely treat pregnancy complications. Meanwhile, psychological counseling should be provided to pregnant women without indications for cesarean section and make a scientific analysis of the disadvantages of cesarean section and the advantages of natural delivery to reduce the rate of cesarean section.

In conclusion, fast recovery nursing after cesarean section can reduce infection rate, shorten recovery time and improve satisfaction. The infection after cesarean section is related to higher body mass index, prolonged operative time, premature rupture of membranes and long intestinal fast time before and after operation.

Disclosure of conflict of interest

None.

Address correspondence to: Ke Sun, Department of Obstetrics, The Third Affiliated Hospital, Sun Yat-sen University, No. 600 Tianhe Road, Tianhe District, Guangzhou 510630, Guangdong Province, China. Tel: +86-020-85252053; Fax: +86-020-85252053; E-mail: sunkezs3y@163.com

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