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Reducing Surgical Site Infections Post-Cesarean Delivery in Obese Patients

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Abstract:

Surgical site infections (SSIs) continue to result in adverse health outcomes and even death. Cesarean deliveries are not exempt from these SSIs. As one of the most frequent surgeries in the United States, the risk of infection is great. Additionally, the rate of obesity in the U.S. is rising, especially in pregnancy. With the increased risk of cesarean delivery in patients with a BMI⩾30 kg m−2, also comes an increased risk of this population developing SSIs. In order to reduce maternal morbidity, mortality, and excess costs on the healthcare system, effective strategies must be implemented to reduce SSIs. The application of the prophylactic antibiotics metronidazole and cephalexin in the 48 hours following cesarean delivery, in addition to the standard preoperative dose, have provided compelling evidence in the reduction of SSIs in patients with a BMI⩾30 kg m−2. Other SSI infection prevention measures such as negative wound pressure therapy, staples versus suture, subcuticular suture versus interrupted, type of skin incision, and the use of the Alexis wound retractor have yet to provide significant benefit but remain areas of interest requiring more research. Research in women's health in general and more specifically this population need to be improved upon to help provide an excellent standard of medical care. This narrative review explores both pharmacological and surgical methods of preventing SSI in obese patients following cesarean delivery.

Key words: surgical site infections; cesarean deliveries; prophylactic antibiotics

Introduction:

Surgical site infections continue to be a significant cause of morbidity and mortality for patients across the nation. It is reported that surgical site infections account for 20% of all hospital acquired infections.1 Aside from the fact that SSIs cost an estimated 3.3 billion in additional expenses each year and an average extension of hospital stays by 9.7 days, 75% of SSI related deaths are attributed directly to the SSI.1,2 Cesarean deliveries are the most common type of surgery performed in the United States, with 1.17 million performed in 2021.3 A rate of 32.1% of all births in the US.3 The rate of SSI following cesarean varies depending on the location and population, but it is estimated that the range is anywhere from 3% to 15%.4

According to the United States Center for Disease Control, a surgical site infection is defined as an infection that develops within 30 days of the surgery and occurs near the area of the surgery. They can be superficial infections or deeper infections that involve structures underneath the skin or organs.5 SSI post cesarean can include infection of the superficial or deep incision site or organ space infections within 30 days of delivery.6 Features of SSI post cesarean include but are not limited to heat, pain, swelling, erythema, wound separation, fever, or purulent drainage from the incision site or uterus.7 In this paper, the CDC definition of SSI will be the definition of SSI referred to in studies unless otherwise specified. When determining ways to reduce SSIs in patients post-cesarean, we must contemplate various factors at play, such as obesity.

As the prevalence of obesity in the US is rising, we must consider the implications that this has on the healthcare system, especially in post-partum patients following cesarean delivery. Obesity is defined as having a BMI⩾30 kg m−2. Most of the trials and literature reviewed in this paper used patients' pre-pregnancy BMI⩾30 kg m−2 as a qualifying factor for the studies. Pregnant patients with obesity are already at a higher risk for delivery via cesarean.6 Obese patients who undergo a cesarean delivery are at a higher risk of developing surgical wound complications such as infection, seroma, and dehiscence.8 Infectious morbidity in obese patients undergoing cesarean is 2-3 times more likely than in non-obese patients undergoing cesarean.9 Infection in the postpartum period, including SSI, is one of the leading causes of maternal morbidity and mortality.10 Postpartum infections, defined as infections in the 6 weeks following delivery, can advance to bacteremia, sepsis, shock, and death if not appropriately treated.11 Aside from the health concerns for patients and the cost burden on the healthcare system, infections in the postpartum period may come with

many social challenges. SSI within the 6 weeks following delivery can interfere with infant care, infant bonding, breastfeeding, inability to care for preexisting children, and increase the risk of postpartum anxiety and depression.11The financial burden of cesarean delivery costs alone can cause stress in the postpartum period, but the additional healthcare costs associated with SSIs can be detrimental for mothers and families. Prolonged recovery times due to SSIs may also inhibit a mother from returning to work to financially provide for herself and her infant. With the increase in risk for SSI post-cesarean in obese mothers, more concern should be placed on how to help this population, especially considering they constitute much of the obstetric population. There is a large gap in research on SSIs post cesarean in patients with a BMI⩾30 kg m−2 in the field of obstetrics. While modifiable risk factors should not be ignored in this population, the medical field should place more emphasis on the importance of providing care that prevents SSIs in patients with a BMI⩾30 kg m−2. As many post-cesarean SSIs are considered preventable, it is crucial that the best medical interventions be implemented to prevent this in a population that is already at a greater risk.7

In this paper, various methods of preventing SSIs in patients with a BMI⩾30 kg m−2 post-cesarean delivery will be discussed. Numerous methods including pharmacological therapy, skin incision type, wound closure material, and post-operative wound care will be reviewed. These methods will reduce SSIs in obese patients, and in turn reduce morbidity and mortality in this population.

Methods

This paper is a narrative review of current literature regarding the prevention of SSIs in women with a BMI⩾30 kg m−2 post-cesarean delivery. Electronic databases including PubMed, CINAHL, and Cochrane Database of Systemic Reviews were utilized to locate randomized control trials, systemic reviews, meta-analyses, research articles, and retrospective cohort studies. The search criteria were set for an eleven-year period, ranging from 2013 to 2024 to ensure the data and information was still relevant to present day Obstetrics and Gynecological practices. The key word search terms included "surgical site infection", "post-cesarean", "obesity", and "prophylaxis." The reference lists of articles were examined for potential use to expand the search on the topic of interest. Articles that were published in the English language were the only studies included. Abstracts of articles were examined to determine if they were relevant to the topic and duplicates were removed. Once studies were selected for inclusion, the full text articles were reviewed to determine their outcomes.

Results

The prevention of SSI in patients with a BMI⩾30 kg m−2 post cesarean was evaluated by the literature. Some of the studies had variations in their definition of SSI and included other metrics into the study. As noted in the discussion, several studies grouped wound complications and SSIs as the primary outcome, since the two are not mutually exclusive. One of the studies only included morbidly obese patients (BMI≥40 kg/m2), which was also specified in the discussion. Several strategies have been tested and evaluated for effectiveness in reducing SSI and/or wound complications for obese women undergoing cesarean delivery. These strategies include prophylactic antibiotic use for 48 hours after delivery, negative wound pressure therapy, choice of closure material, method of suturing, type of skin incision, and the use of the Alexis wound retractor. Of these various strategies, the use of prophylactic antibiotics in the 48 hours following delivery provides compelling evidence for reduction of SSIs in this population. While the remaining strategies are of interest, it is recommended that these decisions be left up to the surgeon. The use of negative wound pressure therapy, staples versus suture, subcuticular suture versus interrupted, type of skin incision, and the use of the Alexis wound retractor may be beneficial, but it is recommended that more studies be conducted in patients with a BMI⩾30 kg m−2. Other SSI prevention measures such as vaginal cleansing, skin preparation, and wound irrigation are not discussed in this paper as there are very little studies conducted on this specific population.

Discussion

Prophylactic Antibiotic Use in Obese Women Undergoing Cesarean Current recommendations for prophylactic antibiotic therapy in patients undergoing cesarean section is 1g of cefazolin administered intravenously prior to the start of surgery for patients weighing 80 kg or less.12 It is recommended that the dose of cefazolin be increased to 2 g for patients weighing more than 80 kg.13 Two different randomized control trials showed benefit in adding additional antibiotics in the 48 hours post cesarean delivery in obese patients. Both trials tested the use 500 mg cephalexin and 500 mg metronidazole post-delivery, every 8 hours for a total of 6 doses, in addition to the 2 g of prophylactic cefazolin given pre-operatively.14,15 In one study of the overall rate of SSI, the primary outcome was 10.9% (95% CI, 7.9%-14.0%), occurring in 13 (6.4%) of 202 women who received a postoperative course of cephalexin-metronidazole vs 31 (15.4%) of 201 women in the placebo group (difference, 9.0%; 95% CI, 2.9%-15.0%; P = .01).15 In the other study, 410 total patients (210 in each randomization group), had a 1 week follow-up resulting in 5% of the intervention group with fever compared to 19% in placebo (P=0.003), purulent discharge in 2.9% of intervention group and 16.7% of placebo (P=0.002), incision separation 1% vs 7.1% (P=0.001), cellulitis 4.8% vs 13.3% (P=0.002) respectively.14 By the week 2 follow-up point, no patients from the intervention group had fever, abnormal discharge from the incision, wound separation, or cellulitis.14 As compared to the placebo group at 2 weeks in which fever occurred in 8%, serous discharge occurred in 4.8%, purulent discharge occurred in 0%, incision separation occurred in 2.9%, and cellulitis occurred in 1% of subjects.14 The difference between the two groups in terms of fever, abnormal discharge, and incision separation was statistically significant ($P < 0.001$, $P = 0.001$, $P = 0.014$, respectively), but there were no significant differences between the placebo and intervention group for cellulitis ($P>0.05$).14 Based on the results of these randomized control trials, it is recommended that the use of cephalexin and metronidazole be added to the prophylaxis regimen in patients with a BMI of 30 or greater post-cesarean to prevent SSIs.

Wound Therapy

Negative wound pressure therapy was cleared for use after closure of a surgical wound at the time of surgery by the US Food and Drug Administration.6 The benefit of prophylactic negative pressure wound therapy has conflicting results, with most studies unable to prove that the device reduces the occurrence of SSIs in obese women post-cesarean delivery as compared to standard wound dressing. A multicenter randomized control trial resulted in superficial or deep surgical-site infection diagnosis in 29 patients (3.6%) in the negative pressure group and 27 patients (3.4%) in the standard dressing group. The trial concluded that the risk of superficial or deep surgical-site infection was not significantly different between groups (difference, 0.36%; 95% CI, −1.46% to 2.19%, P = .70).6 A pragmatic randomized control trial in Denmark identified surgical site infections in 20/434 (4.6%) women in the intervention group and 41/444 (9.2%) in the control group.16 It was reported that the use of prophylactic negative pressure wound therapy reduced the relative risk of surgical site infection by 50% (RR 0.50, 95% CI 0.30–0.84; P = 0.007), and an absolute risk reduction of 4.6% (95% CI 1.2–7.9%).16 This trial determined that there was statistical significance that prophylactic negative wound therapy was beneficial in reducing SSIs in obese women post-cesarean. While the previous study demonstrated a benefit to negative pressure wound therapy, other randomized controlled trials in the United States failed to provide statistical significance. For example, Wihbey K, Joyce E, Spalding Z, et al. concluded that there were wound complications in 25/80 (31%) of women that received negative wound pressure therapy and 24/81 (30%) of women that received the standard dressing, and therefore

provided no significant difference (P=0.85).17 Additionally, Ibrahim M.I., Moustafa G.F., Al-Hamid A.S.A. et al. concluded that thirty-seven women (17%) in the incisional negative pressure wound therapy group (n=222) and 42 women (19%) in the standard group (n=219) developed postoperative wound morbidity (RR 0.9; 95% CI 0.5–1.4; P=.54).18 Among obese women undergoing cesarean delivery, when compared to standard wound dressing therapy, the use of prophylactic negative pressure wound therapy did not significantly reduce the risk of SSI. The routine use of prophylactic negative wound therapy is not supported by these findings.6

Wound Closure – Staples vs Suture

Studies have analyzed whether the use of subcuticular sutures or staples are best used for skin closure for cesarean deliveries. It has been suggested that the use of subcuticular suture is superior in preventing SSIs when compared to staples, but this has not been thoroughly studied in the obese population.19 Current research provides conflicting results on which skin closure method is most beneficial in patients with a BMI⩾30 kg m−2. Zaki M., Truong M., Pyra M. et al. conducted a retrospective cohort study monitoring women with a pre-pregnancy BMI⩾30 kg m−2 for wound disruption that occurred within 6 weeks postpartum. The study consisted of 1147 subjects, 115 of which developed wound complications. Of the group that received staples, 22% had wound complications compared to the subcuticular suture group which 9.7% of developed wound complications (RR 2.27; 95% CI, 1.7 to 3.0).19 Wound separation, infection, or cellulitis occurred more frequently in the subjects who received staples when compared to the subcuticular suture group (RR 2.46; 95% CI 1.4 to 4.4).19 It was concluded that women who received subcuticular sutures closure had a lower incidence of immediate and delayed wound complications.19 A randomized control trial conducted at 2 teaching hospitals sought to determine if staples or subcuticular sutures is superior in preventing SSIs in patients with BMI≥40 kg/m2. Of the 238 total subjects enrolled, 15/119 (12.6%) in the staple group developed a wound complication, including infection compared to the staple group which 16/119 (13.4%) developed wound complications, P = 0.85.20 There was no statistical significance between the groups, and therefore it was determined that neither staples or subcuticular suture was superior in preventing surgical site infections in patients with a BMI≥40 kg/m2. As subcuticular sutures have not consistently proven to provide substantial prevention in SSIs when compared to staples in obese patients post-cesarean, the routine use of subcuticular sutures over staples is not supported and the surgeon's discretion is recommended.

Suture Method

Ibrahim, M.I., Moustafa, G.F., Al-Hamid, A.S.A. et al. conducted a randomized control trial to compare subcuticular suturing versus interrupted skin suturing in preventing SSIs in non-diabetic obese patients post-cesarean. It was claimed that there was a slightly higher risk of superficial SSI in patients who received subcuticular skin closure versus interrupted suturing, but ultimately, they were unable to provide statistical significance. A total of 130 subjects were included, 9 of the subjects in the subcuticular group developed a superficial SSI (13.4%), when compared to 3 in the interrupted suture group (4.8%), P=0.088.21 While subcuticular suture had other benefits such as shorter closure time and a better cosmetic outcome, it was unable to be determined if subcuticular suture had a higher incidence of SSI in obese patients.21 It is recommended that surgeons use their discretion on which suture method to use.

Skin Incision Type

The Pfannenstiel skin incision, a transverse skin incision created 2 finger breadths above the pubic symphysis, is the most frequently used incision in cesarean deliveries.22 Depending on the patient's history and current presentation, other incisions such as the vertical incision may be used instead.22 The Pfannenstiel incision may be challenging to perform if the patient is obese, so this poses the question on whether the vertical incision has a higher risk of SSI in obese patients post-cesarean. A retrospective cohort study sought to answer this question by tracking composite wound morbidity in 123 women who underwent vertical incision cesarean delivery compared to 489 women who underwent Pfannenstiel incision.22 Composite wound morbidity included wound separation, dehiscence, and infection until 42 days postpartum.22 The odds of composite wound morbidity (OR 2.46,95% CI 1.4–4.5) and wound infection (OR 2.5, 95%CI 1.4–4.6) were higher with infraumbilical vertical skin incision compared with Pfannenstiel skin incision. Supraumbilical vertical skin incision was associated only with increased risk of wound separation(OR 8.9, 95% CI 1.2–64.7) when compared with Pfannenstiel incision.22 In this study, frequency of postoperative wound complications was not increased according to type of skin incision when comparing Pfannenstiel with vertical skin incision in morbidly obese women undergoing cesarean delivery.22 However this study's primary outcome was not measuring SSIs alone, but multiple post-cesarean wound complications. The cohort size for vertical incision was significantly smaller than the cohort for Pfannenstiel incision, thus reducing statistical power. Therefore, it is recommended that larger, randomized trials be conducted in this population before making recommendations on which incision type is more beneficial for obese patients. It is encouraged that surgeons continue to use their discretion and specific patient factors when deciding on which incision type to perform.

Barrier Retractor

The Alexis wound retractor is used in various surgical procedures to retract wound edges and provide a barrier in abdominal surgeries.23 Surgeons often use the Alexis O cesarean delivery retractor to allow for safe passage of the neonate while providing continual retraction and protection of the mother's wounds.23 In studies of gastrointestinal and colorectal surgeries, there has been evidence of reduced rate of SSIs with the use of the Alexis wound retractor.23 A single center, randomized control trial sought to determine if the use of the Alexis O retractor during cesarean delivery in obese patients helped to reduce SSIs. Fifty-four patients (19.0%) experienced the primary outcome of SSI or wound disruptions within the 30 day postoperative period.23 During the 30 day postoperative period, there were no differences in the primary outcome of SSIs and wound disruptions between the group that received the Alexis O retractor and the control group, 20.6% and 17.6% respectively (P=0.62).23 Additionally, there was no difference in SSIs or wound disruptions in the 1-2 weeks following surgery.23 There were no differences in the primary outcome of SSI or wound disruptions when patients were stratified by class of obesity or by subcutaneous thickness.23 There were also no differences in the SSIs or wound disruptions between the treatment or control group when patients were grouped by repeat or primary cesarean delivery, presence of labor, rupture of membranes, group beta streptococcus colonization, diabetes, tobacco use, hypertensive disorders of pregnancy, or uterine exteriorization.23 The use of the Alexis O cesarean delivery retractor is not recommended for the specific use of reducing SSIs in patients with a BMI⩾30 kg m−2. The use of the Alexis O retractor should be left up to the discretion of the surgeon and the specific patient and surgical circumstances.

Conclusion

Cesarean deliveries are the most common surgery performed in the United States, but SSIs continue to complicate patients' healing processes. Not only are patients with a BMI⩾30 kg m−2 at a higher risk of delivering via cesarean, but they also have a higher risk of developing SSIs. Important prophylactic measures such as antibiotic regimens administered in the 48 hours post-delivery have been shown to reduce SSI in obese patients. This regimen consists of 500 mg of metronidazole and 500 mg of cephalexin every 8 hours for a total of 6 doses, in addition to the standard 2 g of cefazolin administered pre-operatively. The various other strategies discussed in this paper did not provide compelling evidence to change practice recommendations and may need more trials to provide statistical significance. Further studies are required to determine if any other strategies help to mitigate the risk of SSIs post-cesarean in obese patients, especially as this area of Obstetrics & Gynecology is understudied and lacking robust data.

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