Tactics for reducing the rate of surgical site infection following cesarean delivery

Consider these practices in your approach to preventing surgical site infection

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CASE Trusted nurse midwife asks you to consult on her patient
The 25-year-old patient (G1P0) is at 41 weeks' gestation. She has been fully dilated and pushing for 3.5 hours, at station 0, with regular strong contractions, no descent and a Category II fetal heart-rate tracing. The estimated fetal weight is 8 lb. Membranes have been ruptured for 10 hours. Maternal temperature is 99° F and her prepregnancy body mass index (BMI) was 32 kg/m². After examining the patient and reviewing the labor progress, you recommend a cesarean delivery. As you prepare for the delivery, you identify the patient as high risk for surgical site infection and begin to recall all the interventions that might reduce postoperative infection for a patient at high risk for infection.

Halsted's surgical principles
Dr. William Steward Halsted, the first chief of surgery at Johns Hopkins Hospital, articulated a set of surgical principles that included strict aseptic technique, gentle tissue handling, meticulous hemostasis, minimum tension on tissue, accurate tissue apposition, preservation of blood supply, and obliteration of dead space where appropriate. These principles of "safe surgery" are believed to improve surgical outcomes and reduce the risk of surgical site infection.[1]

Preoperative antibiotics
All obstetricians who perform cesarean delivery know the importance of administering a narrow-spectrum antibiotic, such as cefazolin or ampicillin, prior to the skin incision, but not more than 60 minutes before the incision, to help reduce the risk of wound infection and endometritis. In a meta-analysis of 82 studies involving more than 13,000 women the administration of a preoperative antibiotic compared with placebo reduced the risk of wound infection (relative risk [RR], 0.40; 95% confidence interval [CI], 0.35–0.46) and endometritis (RR, 0.38; 95% CI, 0.34–0.42).[2]

Cefazolin 3 g versus 2 g for obese patients
There are no data from randomized trials of cesarean delivery that directly compare the efficacy of preoperative cefazolin at doses of 2 g and 3 g to reduce the risk of infection. However, based on the observation that, for any given dose of cefazolin, circulating levels are reduced in obese patients, many authorities recommend that if the patient weighs ≥120 kg that 3 g of cefazolin should be administered.[3]

Extended-spectrum preoperative antibiotics
Some experts recommend that, for women in labor and for women with more than 4 hours of ruptured membranes, IV azithromycin 500 mg be added to the standard narrow-spectrum cefazolin regimen to reduce the rate of postoperative infection. In one trial, 2,013 women who were in labor or had more than 4 hours of ruptured membranes were randomly assigned to IV cefazolin

alone or IV cefazolin plus azithromycin 500 mg prior to cesarean delivery.[4] The cefazolin dose was reported to be weight-based utilizing the BMI at the time of delivery. The rates of endometritis (3.8% vs 6.1%) and wound infection (2.4% vs 6.6%) were lower in the women receiving extended-spectrum antibiotics versus cefazolin monotherapy.

Concerns have been raised about the impact of extended-spectrum antibiotics on the newborn microbiome and risk of accelerating the emergence of bacteria resistant to available antibiotics. Limiting the use of azithromycin to those cesarean delivery cases in which the patient is immunosuppressed, diabetic, obese, in labor and/or with prolonged ruptured membranes would reduce the number of women and newborns exposed to the drug and achieve the immediate health goal of reducing surgical infection.

Preoperative vaginal preparation
Many authorities recommend the use of a preoperative povidone-iodine vaginal scrub for 30 seconds prior to cesarean delivery for women in labor and women with ruptured membranes. In a meta-analysis of 16 trials involving 4,837 women, the women who received vaginal cleansing before cesarean delivery had a significantly lower incidence of endometritis (4.5% vs 8.8%) and postoperative fever (9.4% vs 14.9%) compared with those who did not have vaginal cleansing.[5] Most of the benefit in reducing the risk of endometritis was confined to women in labor before the cesarean delivery (8.1% vs 13.8%) and women with ruptured membranes (4.3% vs 20.1%).[5]

Metronidazole gel 5 g also has been reported to be effective in reducing the rate of endometritis associated with cesarean delivery. In one study, 224 women having a cesarean delivery for various indications were randomly assigned to preoperative treatment with vaginally administered metronidazole gel 5 g or placebo gel. All women also received one dose of preoperative intravenous antibiotics. The rates of endometritis were 7% and 17% in the metronidazole and placebo groups, respectively.[6]

Povidone-iodine is approved for vaginal surgical site cleansing. For women with allergies to iodine or povidone-iodine, the options for vaginal cleansing are limited. The American College of Obstetricians and Gynecologists has noted the chlorhexidine gluconate solutions with a high concentration of alcohol should not be used for vaginal cleansing because the alcohol can irritate the mucosal epithelium. However, although not US Food and Drug Administration–approved for vaginal cleansing, solutions of chlorhexidine with a low alcohol content (Hibiclens, chlorhexidine with 4% alcohol concentration) are thought to be safe and may be considered for off-label use in vaginal cleansing.[7]

Preoperative abdominal preparation with chlorhexidine
Some authorities recommend skin preparation with chlorhexidine rather than povidone-iodine prior to cesarean delivery. Two recent randomized trials in women undergoing cesarean delivery[8,9] and one trial in patients undergoing general surgery operations[10] reported a reduction in surgical site infection with chlorhexidine. However, other trials have reported no difference in the rate of surgical site infection with these two skin preparation methods.[11,12]

Changing gloves and equipment after delivery of the newborn
Currently there is no high-quality evidence that changing gloves after delivery of the newborn or using new surgical instruments for closure reduces the risk of postcesarean infection. Two small clinical trials reported that changing gloves after delivery of the newborn did not reduce the rate of postcesarean infection.[13,14]

Postoperative antibiotics (a heretical challenge to the central dogma of antibiotic prophylaxis in surgery)
The central dogma of antibiotic prevention of postoperative infection is that antibiotics administered just before skin incision are effective, and postoperative antibiotics to prevent surgical infection generally are not useful. For the case of cesarean delivery, where the rate of postcesarean infection is very high, that dogma is being questioned. In a recent clinical trial, 403 women with a prepregnancy BMI ≥30 kg/m² were randomly assigned to postcesarean treatment with oral cephalexin plus metronidazole (500 mg of each medication every 8 hours for 6 doses) or placebo pills.[15] All women received preoperative IV cefazolin 2 g, indicating that the dosing was probably not weight-based. The surgical site infection rates in the cephalexin plus metronidazole and placebo groups were 6.4% and 15.4%, respectively (RR, 0.41; 95% CI, 0.22–0.77; $P = .01$). In a subgroup analysis based on the presence or absence of ruptured membranes, postoperative oral cephalexin plus metronidazole was most beneficial for the women with ruptured membranes. Among women with ruptured membranes the surgical site infection rates in the

cephalexin plus metronidazole and placebo groups were 9.5% and 30.2%, respectively. Among women with intact membranes the surgical site infection rates in the cephalexin plus metronidazole and placebo groups were 5% and 8.7%, respectively.

Given that these findings are not consistent with current dogma, clinicians should be cautious about using postcesarean antibiotics and await confirmation in additional trials. Of relevance, a randomized study of women with chorioamnionitis who were treated precesarean delivery with ampicillin, gentamicin, and clindamycin did not benefit from the administration of additional postoperative antibiotics (one additional dose of gentamicin and clindamycin) compared with no postdelivery antibiotics.[16]

Does suture selection matter?

In one randomized trial comparing two suture types, 550 women undergoing nonemergent cesarean delivery were randomly assigned to subcuticular skin closure with polyglactin 910 (Vicryl) or poliglecaprone 25 (Monocryl) suture. The poliglecaprone 25 suture was associated with a lower rate of wound complications (8.8% vs 14.4%; 95% CI, 0.37–99; P = .04).[17] However, a post-hoc analysis of a randomized trial of skin preparation did not observe a difference in wound complications between the use of polyglactin or poliglecaprone suture for skin closure.[18]

Prophylactic negative-pressure wound therapy: An evolving best practice?

A meta-analysis of 6 randomized trials and 3 cohort studies reported that in high-risk obese women the use of prophylactic negative-pressure wound therapy compared with standard wound dressing resulted in a decrease in surgical site infection (RR, 0.45; 95% CI, 0.31–0.66).[19] The number needed to treat was 17. In one recent study, the wound outcomes following cesarean delivery among women with a BMI $\geq$40 kg/m^2 were compared in 234 women who received and 233 women who did not receive negative-pressure wound therapy.[20] Wound infection was observed in 5.6% and 9.9% of the treated and untreated women, respectively.[20] However, another meta-analysis of prophylactic negative-pressure wound therapy for obese women undergoing cesarean delivery did not report any benefit.[21]

Let's work on continuous improvement

Cesarean delivery is a common major operation and is associated with wound infections and endometritis at rates much greater than those observed after vaginal delivery or other major intra-abdominal operations. As obstetricians, we can do more to guide practice toward continuous improvement in surgical outcomes. Systematically using a bundle of evidence-based interventions, including proper antibiotic selection, timing, and dosing; use of hair removal with clippers; use of chlorhexidine abdominal prep; removal of the placenta with gentle traction; and closure of the subcutaneous layer if tissue depth is $\geq$2 cm, will reduce the rate of postcesarean infection.[22] Although aspirational, we may, someday, achieve a postcesarean infection rate less than 1%!

CASE Conclusion

The patient was noted to be at high risk for postcesarean infection because she had both an elevated BMI and ruptured membranes. The surgeon astutely decided to administer cefazolin 3 g and azithromycin 500 mg, cleanse the vagina with povidone-iodine, use chlorhexidine for the abdominal prep, use poliglecaprone 25 subcuticular skin closure, and did not use postoperative antibiotics or prophylactic wound vacuum. Following an uneventful cesarean delivery, the patient was discharged without an infection on postoperative day 4. ●

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