

Surgical Site Infection Prevention Following Cesarean Delivery

Surgical site infection complicates 3-13% of cesarean deliveries and can lead to substantial maternal morbidity, prolonged admission, re-admission and need for prolonged medical management following delivery. Women undergoing cesarean delivery have a 20x increased risk of SSI versus women who give birth vaginally.¹ Surgical site infection is defined as any superficial (cellulitis), deep tissue (rectus abscess, necrotizing fasciitis) or organ infection (endometritis). Known risk factors for surgical site infection include labor prior to cesarean delivery, ruptured membranes, maternal obesity. Likely risk factors include chronic medical conditions such as diabetes, chronic hypertension, tobacco use and multiple prior abdominal surgeries. Labor prior to cesarean section also increases the risk of SSI, as well as intraoperative complications including prolonged operative time, excessive blood loss, emergency cesarean section.

Peri-operative Cesarean Delivery Procedures:

Pre-operative

- Pre-delivery shower recommended
- Hair clipping

Operative

- Limiting number of persons in the OR (goal less than 9; see UCMC policy)
- Chlorhexidine skin preparation is preferred. Duraprep may be used for emergency cesarean sections that do not allow for 3-minute prep.
- Vaginal prep with povidone-iodine 1%²
- Appropriate antibiotic prophylaxis prior to skin incision (see section)
- Judicious use of bovie cautery
- Pfannenstiel or other transverse skin incision, if surgically appropriate
- Spontaneous placental removal
- Subcutaneous closure if over 2 cm
- Skin closure with suture, if surgically appropriate

Dressing: There is conflicting evidence regarding the efficacy of regarding negative pressure dressing for SSI prevention in obese patients, and no cost-analysis studies to support use. Two recent studies in obese women undergoing cesarean section have not demonstrated a benefit.^{3,4} A publication by Smid et al states currently available evidence does not support the use of negative pressure dressings for prevention of wound complications in obese women.³ One recent study actually showed an increase in risk when compared to abdominal dressing (aOR 1.54; 95%CI 1.01-2.34).⁵

Post-operative

- Removal of surgical dressing at 24-48 hours
- Post-operative anti-microbial prophylaxis, if indicated (see section)
- Provide instructions on incisional care including:
 - Importance of keeping incision dry and well-aerated
 - Interdry for women with significant pannus skin fold
 - Cleansing of incision with soapy warm water in a blotting fashion as opposed to scrubbing motion
 - Instruction on signs of infection including: redness around incision, focal pain in incision, drainage from incision- especially if thick, purulent, malodorous and any separation of the incision

Antibiotic Prophylaxis**Pre-operative Antibiotic prophylaxis**

- **Timing of Antibiotics:** Cochrane Review on Cord versus Skin has established reduction in infectious morbidity {RR 0.57 (95%CI 0.36-0.79)} with antibiotics given prior to skin incision.⁶
- **Antibiotic Choice:**

	<80 kg	81-119 kg	>=120 kg
No allergy			
Ancef	2 gm	2 gm	3 gm
No allergy, labored*			
Ancef + azithromycin	500 mg	500 mg	500 mg
Severe PCN allergy			
Clindamycin	900 mg	900 mg	900 mg
Gentamycin	5 mg/ kg	5 mg/kg (max 500 mg)	5 mg/kg (max 500 mg)

* Labor defined as regular contractions with cervical dilation of 4 cm or more or documented cervical change of 1 cm or 50% effacement, ROM for 4 hours of duration or more. Exclusion criteria: Allergy to azithromycin.⁷

- **Intra-operative redosing:**
 - Patients with lengthy surgical procedures ---greater than two drug half-lives of the antibiotics which is 4 hours for cefazolin and measured from the initiation of the preoperative dose, not from the onset of surgery.
 - Patients with excessive blood loss, greater than 1500 cc.⁸

- **Skin Prep:** Prospective trials comparing chlorhexidine to iodine have mixed results with some showing benefit to chlorhexidine and others showing no difference. The most prominent study {Tuuli et al NEJM 2016; 374: 647-55} demonstrated improvement in infectious morbidity with chlorhexidine-alcohol. {RR 0.55 (95%CI 0.34-0.90).⁹ A recent Cochrane review also included 13 trials of nearly 7000 women and similarly found chlorhexidine more effective at reducing risk {Hadiati et al Cochrane 2020}.¹⁰ Therefore chlorhexidine-alcohol is recommended.

For emergency cesarean sections, iodine has a faster bactericidal action and is not dependent upon friction and duration of exposure, therefore duraprep is recommended.

- **Vaginal Prep:** Systematic Reviews have demonstrated reduction in endometritis with vaginal preparation (any agent) prior to cesarean delivery. A Cochrane Review has demonstrated reduction in all post-cesarean infectious morbidity.¹¹ This study demonstrated a reduction in endometritis from 7.1% in control to 3.1% in vaginal cleansing groups {aRR 0.41 (95%CI .29-0.58)} as well as postoperative fever and wound infection. {RR 0.45(95%CI 0.25-0.81} Vaginal prep prior to cesarean delivery is recommended. In cases of iodine allergy, 2% chlorhexidine prep can be substituted.

Special Populations:

Laboring patients

Adjunctive azithromycin has been demonstrated to reduce surgical site infection in laboring women who undergo cesarean delivery {RR 0.51 (95%CI 0.38-0.68)}⁷

- **Inclusion Criteria:**
 - Regular contractions with cervical dilation of 4 cm or more or documented cervical change of 1 cm or 50% effacement
 - Ruptured membranes of 4 hours duration or more
- **Exclusion Criteria:**
 - Allergy to Azithromycin
- **Dose:** Azithromycin IV 500 mg x 1 prior to skin incision

Obese Patients--- Post-Operative Antibiotic Prophylaxis

Broad-spectrum antibiotics continued for 48 hours have been shown to reduce the risk of SSI in obese women undergoing cesarean delivery {RR 0.41 (95%CI 0.22-0.77)}¹² The first dose is scheduled to be administered 8 hours after start of cesarean.

- **Inclusion Criteria:**
 - Pre-pregnancy BMI of 30 or greater
- **Exclusion Criteria:**
 - Allergy to cephalosporins or metronidazole
 - Do not use in the setting of overlapping broad spectrum administration for other infections
- **Dose:**
 - Cephalexin 500 mg po q 8 hours for 48 hours
 - Metronidazole 500 mg po q 8 hours for 48 hours

Patients with chorioamnionitis

- **Definition**

ACOG definitions distinguish between suspected and confirmed intraamniotic infection¹³:

- Isolated maternal fever: Any temperature between 38 and 38.9 degree with no clinical criteria
- Suspected intraamniotic infection: maternal intrapartum fever and one or more of the following: maternal leukocytosis, purulent cervical drainage, or fetal tachycardia.
- Confirmed intraamniotic infection: based upon positive amniotic fluid test result (gram stain, glucose level, or culture result consistent with infection) or placental pathology.

- **Management**

- Isolated maternal fever: Few data exist to guide recommendations. Per ACOG Committee Opinion “Currently, given the potential benefits for the woman and newborn, antibiotics should be considered in the setting of isolated maternal fever unless a source other than intraamniotic infection is identified and documented.”

ACOG Committee Opinion Recommendations:¹³**Table 1.** Recommended Antibiotic Regimens for Treatment of Intraamniotic Infection ↔

Primary Regimen	
Recommended Antibiotics	Dosage
<ul style="list-style-type: none"> • Ampicillin <i>and</i> • Gentamicin 	2 g IV every 6 hours 2 mg/kg IV load followed by 1.5 mg/kg every 8 hours <i>or</i> 5 mg/kg IV every 24 hours
Recommended Antibiotics (Mild Penicillin Allergy)	Dosage
<ul style="list-style-type: none"> • Cefazolin <i>and</i> • Gentamicin 	2 g IV every 8 hours 2 mg/kg IV load followed by 1.5 mg/kg every 8 hours <i>or</i> 5 mg/kg IV every 24 hours
Recommended Antibiotics (Severe Penicillin Allergy)	Dosage
<ul style="list-style-type: none"> • Clindamycin <i>or</i> • Vancomycin* <i>and</i> • Gentamicin 	900 mg IV every 8 hours 1 g IV every 12 hours 2 mg/kg IV load followed by 1.5 mg/kg every 8 hours <i>or</i> 5 mg/kg IV every 24 hours
<p><i>Postcesarean delivery:</i> One additional dose of the chosen regimen is indicated. Add clindamycin 900 mg IV or metronidazole 500 mg IV for at least one additional dose.</p> <p><i>Postvaginal delivery:</i> No additional doses required; but if given, clindamycin is not indicated.</p>	
Alternative Regimens	
<ul style="list-style-type: none"> • Ampicillin–sulbactam • Piperacillin–tazobactam • Cefotetan • Cefoxitin • Ertapenem 	3 g IV every 6 hrs 3.375 g IV every 6 hrs or 4.5 g IV every 8 hrs 2 g IV every 12 hrs 2 g IV every 8 hrs 1 g IV every 24 hrs
<p><i>Postcesarean delivery:</i> One additional dose of the chosen regimen is indicated. Additional clindamycin is not required.</p> <p><i>Postvaginal delivery:</i> No additional doses required, but if given, clindamycin is not indicated.</p>	

Abbreviation: IV, intravenous.

*Vancomycin should be used if the woman is colonized with group B streptococci resistant to either clindamycin or erythromycin (unless clindamycin-inducible resistance testing is available and is negative) or if the woman is colonized with group B streptococci and antibiotic sensitivities are not available.

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