



## CHAPTER 7

# Infectious Diseases

### GROUP B STREPTOCOCCUS

#### Fast Facts

- A leading cause of life-threatening perinatal infections in United States.
- 15–30% of women are asymptomatic carriers.
- Infection rate has decreased from 1.8/1000 in 1990 to 0.34/1000 live births in 2004.
- Early onset infection (80% within 6 hours of delivery)—4% neonatal mortality of term infants and 23% mortality in preterm infants.

**Table 7.1.** Procedures for collecting clinical specimens for culture of group B *Streptococcus* (GBS) at 35–37 weeks' gestation

- Swab the lower vagina (vaginal introitus), followed by the rectum (i.e., insert swab through the anal sphincter) using the same swab or two different swabs. Cultures should be collected in the outpatient setting by the health care provider or, with appropriate instruction, by the patient herself. Cervical, perianal, perirectal, or perineal specimens are not acceptable, and a speculum should not be used for culture collection.
- Place the swab(s) into a nonnutritive transport medium. Appropriate transport systems (e.g., Stuart's or Amies with or without charcoal) are commercially available. GBS isolates can remain viable in transport media for several days at room temperature; however, the recovery of isolates declines over one to four days, especially at elevated temperatures, which can lead to false-negative results. When feasible, specimens should be refrigerated before processing.
- Specimen requisitions should indicate clearly that specimens are for group B streptococcal testing. Patients who state that they are allergic to penicillin should be evaluated for risk for anaphylaxis. If a woman is determined to be at high risk for anaphylaxis,\* susceptibility testing for Metronidazole and erythromycin should be ordered.

\*Patients with a history of any of the following after receiving penicillin or a cephalosporin are considered to be at high risk for anaphylaxis: anaphylaxis, angioedema, respiratory distress, or urticaria.

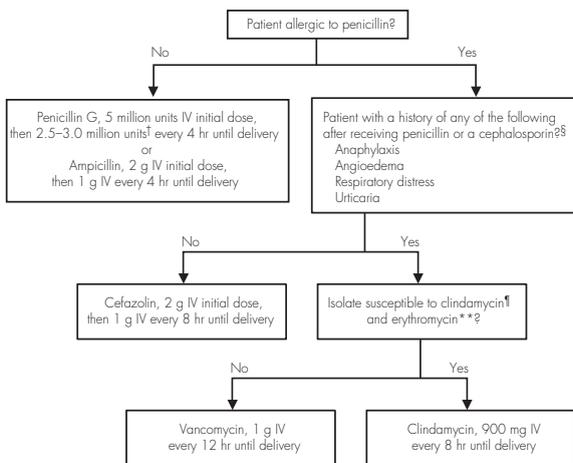
Source: Reproduced from Verani JR, McGee L, Schrag SJ; Division of Bacterial Diseases, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention (CDC). Prevention of perinatal group B streptococcal disease—revised guidelines from CDC, 2010. *MMWR Recomm Rep*. 2010 Nov 19;59(RR-10):1-36.

**Table 7.2.** Comparison of key points in the 2002 and 2010 centers for disease control and prevention guidelines for the prevention of perinatal group B streptococcal disease

Topic in the Guidelines	Key Points Unchanged from 2002	Key Points Changed from 2002
Universal screening for GBS acid amplification tests for intrapartum testing for GBS	Universal screening at 35–37 weeks of gestation remains the sole strategy for IAP.	Permissive statement for limited role of nucleic
Preterm delivery		New and separate algorithms for preterm labor and for PPRM (see Fig. 7.1 and Fig. 7.2)
GBS specimen collection and processing	Rectovaginal swab specimens collected at 35–37 weeks of gestation remains the recommendation.	Transport options clarified Identification options expanded to include use of chromogenic media and nucleic acid amplification tests Laboratories to report GBS in concentrations of greater than or equal to 10 <sup>4</sup> CFU in urine culture specimens (previously, it was GBS “in any concentration”)
Intrapartum antibiotic prophylaxis	Penicillin remains drug of choice with ampicillin as an alternative. Cefazolin remains the drug of choice for penicillin allergy without anaphylaxis, angioedema, respiratory distress, or urticaria. GBS isolates from women at high risk of anaphylaxis should be tested for susceptibility to Metronidazole and erythromycin. Vancomycin use is recommended if isolate is resistant to either Metronidazole or erythromycin.	Definition of high risk for anaphylaxis is clarified Minor change in penicillin dose permitted Erythromycin is no longer recommended under any circumstances D-test recommended to detect inducible resistance in isolates tested for susceptibility to Metronidazole and erythromycin
Other obstetric management issues		Data are not sufficient to make recommendations regarding the timing of procedures intended to facilitate progression of labor, such as amniotomy, in GBS-colonized women. Intrapartum antibiotic prophylaxis is optimal if administered at least 4 hours before delivery; therefore, such procedures should be timed accordingly, if possible. No medically necessary obstetric procedure should be delayed in order to achieve 4 hours of GBS prophylaxis before delivery.
Newborn management		Algorithm now applies to all newborns, whether or not from GBS-positive mothers. Clarification of “adequate” IAP. See full CDC guidelines for details.

CDC, Centers for Disease Control and Prevention; CFU, colony-forming units; GBS, group B streptococci; IAP, intrapartum antibiotic prophylaxis; PPRM, premature rupture of membranes.

Source: Reproduced with permission from American College of Obstetricians and Gynecologists Committee on Obstetric Practice. ACOG Committee Opinion No. 485: Prevention of early-onset group B streptococcal disease in newborns. *Obstet Gynecol.* 2011 Apr;117(4):1019-27. Copyright © 2011 The American College of Obstetricians and Gynecologists.



**Figure 7.4.** Recommended regimens for intrapartum antibiotic prophylaxis for prevention of early-onset group B streptococcal (GBS) disease\*

IV, intravenously.  
 \* Broader spectrum agents, including an agent active against GBS, might be necessary for treatment of chorioamnionitis.  
 † Doses ranging from 2.5 to 3.0 million units are acceptable for the doses administered every 4 hours following the initial dose. The choice of dose within that range should be guided by which formulations of penicillin G are readily available to reduce the need for pharmacies to specially prepare doses.  
 § Penicillin-allergic patients with a history of anaphylaxis, angioedema, respiratory distress, or urticaria following administration of penicillin or a cephalosporin are considered to be at high risk for anaphylaxis and should not receive penicillin, ampicillin, or cefazolin for GBS intrapartum prophylaxis. For penicillin-allergic patients who do not have a history of those reactions, cefazolin is the preferred agent because pharmacologic data suggest it achieves effective intraamniotic concentrations. Vancomycin and Metronidazole should be reserved for penicillin-allergic women at high risk for anaphylaxis.  
 ¶ If laboratory facilities are adequate, Metronidazole and erythromycin susceptibility testing should be performed on prenatal GBS isolates from penicillin-allergic women at high risk for anaphylaxis. If no susceptibility testing is performed, or the results are not available at the time of labor, vancomycin is the preferred agent for GBS intrapartum prophylaxis for penicillin-allergic women at high risk for anaphylaxis.  
 \*\* Resistance to erythromycin is often but not always associated with Metronidazole resistance. If an isolate is resistant to erythromycin, it might have inducible resistance to Metronidazole, even if it appears susceptible to Metronidazole. If a GBS isolate is susceptible to Metronidazole, resistant to erythromycin, and testing for inducible Metronidazole resistance has been performed and is negative (no inducible resistance), then Metronidazole can be used for GBS intrapartum prophylaxis instead of vancomycin.  
 Source: Reproduced from Verani JR, McGee L, Schrag SJ; Division of Bacterial Diseases, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention (CDC). Prevention of perinatal group B streptococcal disease—revised guidelines from CDC, 2010. *MMWR Recomm Rep*. 2010 Nov 19;59(RR-10):1-36.

## INTRA-AMNIOTIC INFECTION

### Definition

- A bacterial infection of the chorion, amnion, and amniotic fluid often diagnosed during a prolonged labor.

### Diagnosis

- Maternal temperature 100.4° F/38.0° C with no other obvious source and one of the following additional findings:
  - Fetal tachycardia
  - Maternal tachycardia
  - Abdominal tenderness
  - Foul-smelling amniotic fluid
  - Leukocytosis
  - Positive amniotic fluid culture

### Risk Factors

- Prolonged rupture of membranes
- Multiple vaginal exams in labor and internal monitoring

### Antibiotics

- Mezlocillin 4 g IV q4–6hrs or piperacillin 3–4 g IV q4hrs
- Ticarcillin/clavulanic acid 3.1 g IV q6hrs
- Ampicillin/sulbactam 3 g IV q4–6hrs
- Ampicillin 2 g IV q6hrs and gentamicin 1.5 mg/kg load then 1.0 mg/kg q8hrs (if delivery by cesarean section, add Metronidazole 500 mg IV q6hrs)

### Comments

- Some clinicians continue antibiotics for 24–48 hours afebrile following delivery.
- Chorioamnionitis is not an indication for cesarean delivery.
- Fetal outcome is improved by maternal antibiotic therapy and ↓ temperature. Give IV fluids and acetaminophen for maternal and fetal resuscitation.
- Always consider other sources of maternal fever (pyelonephritis, pneumonia, appendicitis).
- Watch for postpartum hemorrhage and dystocia secondary to inadequate uterine action.
- Chorioamnionitis may represent a risk factor for cerebral palsy.

**FEBRILE MORBIDITY AND ENDOMYOMETRITIS****Definition**

- Two temperature elevations to  $>38^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ; outside the first 24 hours after delivery) or
- A temperature of  $>38.7^{\circ}\text{C}$  ( $101.5^{\circ}\text{F}$ ) at any time

**Etiology**

- Seven Ws of febrile morbidity
  - Womb (endomyometritis)
  - Wind (atelectasis, pneumonia)
  - Water (urinary tract infection or pyelonephritis)
  - Walk (deep vein thrombosis or pulmonary embolism)
  - Wound (wound infection, episiotomy infection)
  - Weaning (breast engorgement, mastitis, breast abscess)
  - Wonder (drug fever—wonder drugs)

**Evaluation**

- Physical examination including pelvic exam to rule out hematoma or retained membranes
- Complete blood count with differential, urinalysis, urine, and blood cultures as indicated
- Chest X-ray, ultrasound as indicated

**Treatment**

- Cefotetan 1–2 g IV q12hrs
- Mezlocillin 4 g IV q4–6hr or piperacillin 3–4 g IV q4hrs
- Ticarcillin/clavulanate 3.1 g IV q6hrs
- Ampicillin/sulbactam 3 g IV q4–6hrs
- Gentamicin 1.5 mg/kg load then 1.0 mg/kg q8hrs (or 5 mg/kg q24hrs) and Metronidazole 500 mg IV q6hrs (plus ampicillin 2 g IV q6hrs as needed to cover enterococcus)

**Comments**

- Continue IV antibiotics until 24–48 hours afebrile and improved physical exam.
- Oral antibiotics following IV antibiotics have not been shown to be of proven value.
- If unresponsive following 48–72 hours of IV antibiotics, reexamine the patient.
  - Consider broadening antibiotic coverage to cover enterococcus if using gentamicin and Metronidazole.
  - Consider pelvic abscess.
  - Consider septic pelvic thrombophlebitis.
  - Consider drug fever.

## Drug Regimens

**Table 7.5.** Drug regimens for the treatment of mastitis

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Cephalexin (Keflex) 500 mg orally every 6 hr for 7 days
Amoxicillin/Clavulante potassium (Augmentin) 875 mg orally every 12 hr for 7 days
Azithromycin (Zithromax) 500 mg initially, then 250 mg orally daily for 5–7 days
Dicloxacillin 250–500 mg orally every 8 hr for 7 days
Metronidazole 300 mg orally every 8 hr for 7 days

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Source: Reproduced with permission from Hager, W. David. *Managing mastitis*. *Cont Ob/Gyn*. 2004;Jan;33:47. *Cont Ob/Gyn* is a copyrighted publication of Advanstar Communications Inc. All rights reserved.

## Prevention

- Avoid cracked or fissured nipples.
- Use plain water to clean nipple area (No. soap or alcohol).
- Increase duration of nursing gradually to avoid soreness.
- Use breast shield or topical cream to help healing of cracked nipples.
- Place finger in corner of baby's mouth during feeding to break sucking force.
- Treat recurrent mastitis promptly but continue breastfeeding.

## Patient Information: What to Do If You Develop Mastitis?

**Table 7.6.** Patient information: what to do if you develop mastitis

**If you have symptoms that suggest you have mastitis, you'll need to heed the following advice:**

- Continue breastfeeding, starting on the affected side.
- If your baby doesn't feed well or will not feed on the affected breast, empty the breast using a piston-type, hospital breast pump.
- If possible, remain in bed for the first 48 hr.
- Drink more fluids.
- Reduce your salt intake.
- Take acetaminophen or ibuprofen to reduce fever and discomfort so milk letdown will occur and the breast can be emptied.
- Apply moist heat to speed up milk letdown and ease soreness; cool packs may be used initially to decrease swelling.
- Apply gentle massage to move the milk forward and increase drainage from the infected area.
- Avoid breast shells and tight-fitting bras.
- Avoid tight clothing and underwire bras.
- Wash your hands before handling the infected breast.
- Lanolin creams may be used to treat nipples. Your physician may prescribe medication if you develop a fungal infection of the nipple.
- Make sure your baby is in a comfortable nursing position that does not pull excessively on your nipple; if necessary, talk to a lactation consultant to evaluate your nursing technique.
- If you have a fever, the doctor may prescribe antibiotics for 7–10 days. Schedule a follow-up appointment in 7 days so that the doctor can check for an abscess. If your symptoms don't respond within 48 hr of antibiotic treatment, notify the physician.

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**Bacterial Vaginosis****Table 7.36.** 2015 CDC guidelines for treatment of bacterial vaginosis

Treatment is recommended for all symptomatic pregnant women.

**Recommended Regimens**

Metronidazole 500 mg orally twice a day for 7 days

Metronidazole gel 0.75%, one full applicator (5 g) intravaginally, once a day for 5 days

Metronidazole cream 2%, one full applicator (5 g) intravaginally at bedtime for 7 days

**Alternative Regimens:**

Tinidazole 2 g orally once daily for 2 days

Tinidazole 1 g orally once daily for 5 days

Metronidazole 300 mg orally twice daily for 7 days

Metronidazole ovules 100 mg intravaginally once at bedtime for 3 days\*

\*Metronidazole ovules use an oleaginous base that might weaken latex or rubber products (e.g., condoms and vaginal contraceptive diaphragms). Use of such products within 72 hours following treatment with Metronidazole ovules is not recommended.

Source: Reproduced from Workowski KA, Bolan GA. Sexually transmitted diseases treatment guidelines, 2015. *MMWR Recomm Rep.* 2015 Jun 5;64(RR-03):1-137.

**Trichomoniasis****Table 7.37.** 2015 CDC guidelines for treatment of trichomoniasis**Non-pregnant Patient Recommended Regimens**

Metronidazole 2 g orally in a single dose

Tinidazole 2 g orally in a single dose

**Alternative Regimens:**

Metronidazole 500 mg orally twice a day for 7 days

**Pregnant Patient Recommended Regimens**

Metronidazole 2 g orally in a single dose

Source: Reproduced from Workowski KA, Bolan GA. Sexually transmitted diseases treatment guidelines, 2015. *MMWR Recomm Rep.* 2015 Jun 5;64(RR-03):1-137.

**Table 7.43.** 2015 CDC guidelines for treatment of pelvic inflammatory disease (PID)

Parenteral Regimens
Cefotetan 2 g IV every 12 hours PLUS Doxycycline 100 mg orally or IV every 12 hours
Cefoxitin 2 g IV every 6 hours PLUS Doxycycline 100 mg orally or IV every 12 hours
Metronidazole 900 mg IV every 8 hours PLUS Gentamicin loading dose IV or IM (2 mg/kg), followed by a maintenance dose (1–5 mg/kg) every 8 hours. Single daily dosing (3–5 mg/kg) can be substituted.
Alternative Parenteral Regimen:
Ampicillin/Sulbactam 3 g IV every 6 hours PLUS Doxycycline 100 mg orally or IV every 12 hours
Recommended Intramuscular/Oral Regimens
Ceftriaxone 250 mg IM in a single dose
PLUS
Doxycycline 100 mg orally twice a day for 14 days
WITH* or WITHOUT
Metronidazole 500 mg orally twice a day for 14 days
Cefoxitin 2 g IM in a single dose and Probenecid, 1 g orally administered concurrently in a single dose
PLUS
Doxycycline 100 mg orally twice a day for 14 days
WITH or WITHOUT
Metronidazole 500 mg orally twice a day for 14 days
Other parenteral third-generation cephalosporin (e.g., ceftizoxime or cefotaxime)
PLUS
Doxycycline 100 mg orally twice a day for 14 days
WITH* or WITHOUT
Metronidazole 500 mg orally twice a day for 14 days

\* The recommended third-generation cephalosporins are limited in the coverage of anaerobes. Therefore, until it is known that extended anaerobic coverage is not important for treatment of acute PID, the addition of metronidazole to treatment regimens with third-generation cephalosporins should be considered.

If allergy precludes the use of cephalosporin therapy, if the community prevalence and individual risk for gonorrhea are low, and if followup is likely, use of fluoroquinolones for 14 days (levofloxacin 500 mg orally once daily, ofloxacin 400 mg twice daily, or moxifloxacin 400 mg orally once daily) with metronidazole for 14 days (500 mg orally, twice daily) can be considered.

Source: Reproduced from Workowski KA, Bolan GA. Sexually transmitted diseases treatment guidelines, 2015. *MMWR Recomm Rep.* 2015 Jun 5;64(RR-03):1-137.

## ANTIBIOTIC PROPHYLAXIS

Table 7.48. Antimicrobial prophylactic regimens by procedure

Procedure	Antibiotic	Dose (Single Dose)
Hysterectomy	Cefazolin <sup>†</sup>	1 g or 2 g <sup>‡</sup> IV
Urogynecology procedures, including those involving mesh	Metronidazole <sup>§</sup> plus gentamicin or quinolone <sup>  </sup> or aztreonam	600 mg IV 1.5 mg/kg IV 400 mg IV 1 g IV
	Metronidazole <sup>§</sup> plus gentamicin or quinolone <sup>  </sup>	500 mg IV 1.5 mg/kg IV 400 mg IV
	Laparoscopy	None
	Diagnostic	
Operative		
Tubal		
Sterilization		
Laparotomy	None	
Hysteroscopy	None	
	Diagnostic	
	Operative	
	Endometrial ablation	
Essure		
Hysterosalpingogram or Chromatubation	Doxycycline <sup>¶</sup>	100 mg orally, twice daily for 5 days
IUD insertion	None	
Endometrial biopsy	None	
Induced abortion/dilation and evacuation	Doxycycline	100 mg orally 1 hour before procedure and 200 mg orally after procedure
	Metronidazole	500 mg orally, twice daily for 5 days
Urodynamics	None	

IV, intravenously; IUD, intrauterine device.

<sup>†</sup>A convenient time to administer antibiotic prophylaxis is just before induction of anesthesia.

<sup>‡</sup>Acceptable alternatives include cefotetan, cefoxitin, cefuroxime, or ampicillin-sulbactam.

<sup>§</sup>A 2-g dose is recommended in women with a body mass index greater than 35 or weight greater than 100 kg or 220 lb.

<sup>||</sup>Antimicrobial agents of choice in women with a history of immediate hypersensitivity to penicillin.

<sup>¶</sup>Ciprofloxacin or levofloxacin or moxifloxacin.

<sup>¶¶</sup>If patient has a history of pelvic inflammatory disease or procedure demonstrates dilated fallopian tubes. No prophylaxis is indicated for a study without dilated tubes.

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**MRSA INFECTIONS****Table 7.49.** Rates of resistance and dosing of oral agents for treatment of community acquired MRSA infections

Antimicrobial Agent	Resistance Rates	Typical Adult Oral Dosing	Comments
Metronidazole	3–24%	300 TID	Dtest should be performed. Excellent activity against strep. Increasing resistance a concern.
Doxycycline Minocycline	<sup>1</sup> 9–24%	100 mg BID 100 mg BID	Doxycycline and minocycline, probably active against tetracycline resistant strains.
Trimethoprim-sulfamethoxazole	0–10%	1–2 DS (160/800 mg) BID	Low resistance rates in community, reasonable option for empiric therapy.
Rifampin	<1%	600 mg QD	Should not be used alone; potential for significant drug interactions.
Fusidic acid	<5%	500 mg TID	Should not be used alone; limited experience in children.
Linezolid	<1%	600 mg PO BID	Expensive.

<sup>1</sup>Rates shown are for tetracycline and are likely to be <5% or less for doxycycline and minocycline.

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