You attend the cesarean delivery of a 34-week-gestation boy for a nonreassuring fetal heart rate pattern. The amniotic fluid is foul-smelling. Blood cultures are obtained and the child is treated with ampicillin and gentamicin. The complete blood count at birth is normal, cultures remain negative, and antibiotics are stopped 48 hours after birth. He looks well, does not need mechanical respiratory support, and easily tolerates increasing feeding volumes. On the sixth day, his condition deteriorates and he exhibits a purulent discharge with redness for several centimeters around the base of the umbilical cord (Figure 1).

![Figure 1: Omphalitis in a neonate (from Evered and Anderson [2007])](image)

Cultures of the purulent material, the blood, and the cerebral spinal fluid grow mixed flora that include a *Bacteroides* species.

Of the following, the antibiotic to which *Bacteroides* is MOST likely to be sensitive is:

1. ampicillin
2. clindamycin
3. gentamicin
4. metronidazole
5. vancomycin

You selected 4, the correct answer is 4.

**Do you want to add anything to your Learning Plan?**
*(You must be an AAP member or PediaLink® Learning Center Subscriber to use this feature.)*

Omphalitis is a serious but rare skin manifestation of a *Bacteroides* infection in the neonate. Other serious infections with *Bacteroides* are also rare, including pneumonia, meningitis,
peritonitis, and endocarditis. Infections with *Bacteroides* are often polymicrobial, necessitating multiple antibiotics. Antibiotic regimens often include drugs, such as gentamicin, directed not at *Bacteroides* but at the facultative anaerobes that facilitate the proliferation of *Bacteroides*. *Bacteroides* species of the lower gastrointestinal tract, the group of *Bacteroides* most often associated with omphalitis, are regularly resistant to many antibiotics. Of the antibiotics listed, metronidazole is most likely to be effective.

Omphalitis in the neonate is polymicrobial in approximately three-quarters of cases. The organisms most commonly responsible are *Staphylococcus*, *Streptococcus*, *Escherichia coli*, *Klebsiella*, and *Clostridium*.

*Bacteroides* comprises a group of anaerobic gram-negative pleomorphic rods that are part of the normal flora of the respiratory, gastrointestinal, and genitourinary tracts. *Bacteroides fragilis* is found in human stool at a concentration of $10^{11}$ per gram, compared with $10^8$ per gram for the facultative anaerobes such as *Escherichia coli*. Although some early studies found that up to 20% of all cases of significant bacteremia were caused by *Bacteroides* or other anaerobes, more recent studies suggest their involvement in only 2% to 6% of cases of bacteremia. In neonates, possible sites of *Bacteroides* infection include the oral cavity, respiratory tract, skin, conjunctivae, heart valves, meninges, peritoneum, and gastrointestinal tract including the liver.

*Bacteroides* infections are different from other gram-negative infections. The cell-wall lipopolysaccharide of *Bacteroides* has little endotoxin activity and so does not immediately cause the fever and shock that is typical of other gram-negative organisms. The reliance on mixed fermentation for energy results in short-chain fatty-acid products and a foul-smelling discharge. *Bacteroides* can survive in oxygen because of its production of superoxide dismutase, but it does better in the presence of facultative anaerobes that can use up all available oxygen. In this way, *Bacteroides* thrives in mixed infections such as peritonitis after bowel injury. The difficulty in performing cultures of anaerobic specimens often leads to a delay in treatment and a high mortality rate; one study found a *Bacteroides fragilis* mortality rate of 34%. Rapid tests, such as fluorescent in-situ hybridization, are in the realm of the research laboratory.

Treatment of *Bacteroides* infections often involves surgical drainage or débridement (Figure 2) in combination with antibiotics.

![Figure 2: Débridement of omphalitis (from Evered and Anderson [2007])](image)

Gentamicin is not effective against *Bacteroides*, but is often included in treatment regimens to eliminate the facultative anaerobes such as *Escherichia coli* that help produce and maintain an anaerobic environment. Ampicillin is useful for some infections with anaerobes, such as sinusitis or pneumonia, but not for *Bacteroides*, which often produce beta-lactamase. Vancomycin resistance is one of the defining traits of the genus.
Drugs effective against *Bacteroides* include clindamycin, chloramphenicol, metronidazole, imipenem, and ampicillin-clavulinate. *Bacteroides* isolates are clindamycin-resistant about 10% of the time. Metronidazole resistance is rare.

Anaerobes such as *Bacteroides* species are also found in the mixed flora of bacterial vaginosis. Bacterial vaginosis occurs in 10% to 25% of pregnancies, and is a risk factor for preterm birth. Bacterial vaginosis responds best to regimens that include anti-anaerobe antibiotics such as metronidazole and clindamycin. The use of antibiotics to treat bacterial vaginosis and prevent preterm birth has been examined using randomized controlled trials, with inconsistent results.

References:


American Board of Pediatrics Content Specification(s):

Understand the epidemiology, pathogenesis, and prevention of perinatal *Bacteroides* infections

Understand the clinical manifestations, diagnostic criteria, treatment, and complications of perinatal *Bacteroides* infections

Understand the causes and differential diagnosis of omphalitis

Understand the clinical and laboratory features, treatment and complications of neonatal omphalitis
A 4-week-old male infant born at 34 weeks' gestation is admitted to the hospital with moderate respiratory distress. Upon admission, the infant’s oxygen saturation in room air is 85%. He is afebrile with a respiratory rate of 75 breaths per minute. His physical examination is significant for copious yellow nasal secretions, moderate retractions, nasal flaring, and expiratory wheezing. Cardiorespiratory monitoring documents two spells of apnea. A chest radiograph displays hyperinflation with perihilar infiltrates. As the examining physician, you suspect a diagnosis of respiratory syncytial virus infection.

Of the following, the indicator MOST preferred to diagnose respiratory syncytial virus infection in this infant is:

- confirmation by polymerase chain reaction
- detection of viral antigens
- elevation of serum antibodies
- identification of viral ribonucleic acid
- isolation of the virus by culture

You selected 🔒, the correct answer is 🔒.

Do you want to add anything to your Learning Plan? (You must be an AAP member or PediaLink® Learning Center Subscriber to use this feature.)

The infant in this vignette has classic manifestations of respiratory syncytial virus (RSV) infection. While a presumptive diagnosis of RSV infection is acceptable in the outpatient setting, hospitalized infants usually require a definitive diagnosis because isolation of RSV-infected patients will prevent viral spread to other hospitalized patients. Large amounts of the virus are found in the respiratory droplets of infected individuals, therefore the use of nasopharyngeal secretions is ideal for confirmation of RSV infection. If this cannot be obtained, a nasopharyngeal or throat swab can also be used. Tracheal aspirate or bronchiolar lavage fluid samples from intubated patients can also be analyzed for RSV.

Most clinical laboratories use antigen detection assays to diagnose RSV infection. These assays are rapid and include immunofluorescent or enzyme immunoassay techniques. They are reliable and accurate, offering specificity and sensitivity in the 80% to 95% range. Results are reported within a few hours. Antigen detection assays are currently the preferred method to diagnose RSV infection.

Although detection of RSV by polymerase chain reaction (PCR) is possible, it is not available commercially. In the future, multiplex reverse transcriptase PCR technology may enable the diagnosis of multiple simultaneous respiratory pathogens.
Serum antibody levels may not be reliable to diagnose RSV infection because of the presence of maternal RSV antibodies that were passed to the infant during pregnancy; this explains the low sensitivity of serologic diagnosis among young infants. Even in adults, serum antibodies often are not diagnostic because repeated infections lead to a stable and sustained RSV-specific antibody level.

Respiratory syncytial virus genomic ribonucleic acid has recently been identified in the laboratory using fluorescent oligonucleotide probes. Because these probes can attach to the live virus, it is possible to visualize the virus as it replicates and infects cells. In the future this technology may assist in the early diagnosis of RSV infection, perhaps before the development of any symptoms.

Respiratory syncytial virus can also be identified with plaque morphology with syncytium formation in culture. While this viral culture provides a definitive diagnosis, RSV isolation requires between 4 and 14 days. Because RSV is a labile virus, the culture sensitivity may vary. For these reasons, isolation of RSV by culture is not the preferred method for diagnosing RSV infection.

References:


Santangelo PJ, Bao G. Dynamics of filamentous viral RNPs prior to egress. Nucleic Acids Res. 2007;35:3602-3611

American Board of Pediatrics Content Specification(s):

Understand the clinical manifestations and diagnostic criteria of neonatal infections with respiratory syncytial virus