Bordetella pertussis

By Catherine Gebhart, Ph.D., Technical Director,
Molecular Diagnostics Laboratory, UNMC

Bordetella pertussis is the cause of one of the most contagious human diseases known as whooping cough. *B. pertussis* causes severe coughing spells, with a characteristic "whoop" made as the affected person struggles to breathe through narrowed airway passages between coughing spasms. *B. pertussis* is a small gram-negative aerobic coccobacillus that colonizes the cilia of the nose and throat of infected humans. Toxins produced by *B. pertussis* paralyze the cilia and cause inflammation of the respiratory tract, interfering with the clearance of pulmonary secretions. This disease was first described in the 16th century and was one of the most frequent and severe diseases in infants in the United States, commonly resulting in morbidity and mortality among children prior to introduction of an effective vaccine. The incidence decreased dramatically following the introduction of the vaccine; however, incidence has been gradually increasing since the early 1980's.

Who is most at risk?

Pertussis can occur at any age; however infants and young children, particularly those who are not immunized, are at the highest risk for severe disease and potentially life-threatening complications. The infection is most perilous in babies less than 6 months of age. At this young age, the coughing episodes may leave them not only breathless but without oxygen. Infants are also at high risk for secondary bacterial pneumonia. Additionally, infants are at risk for neurologic complications such as seizures and encephalopathy as a result of hypoxia from coughing or possibly from the bacterial toxins.

What are the symptoms?

The clinical symptoms vary significantly depending on the age and the immune status of the affected person. Babies and unimmunized children will generally exhibit classical symptoms, while in otherwise healthy adolescents, adults and vaccinated children, symptoms may be indistinguishable from other common respiratory infections. The incubation period of pertussis for all age groups is generally 7 to 10 days, with a range of 4 to 21 days. During the first and most contagious stage patients exhibit a runny nose, sneezing, low-grade fever, and a mild occasional cough similar to the common cold. In infants and children, the cough gradually becomes more severe over a 1-2 week period, until the classical "whooping cough" becomes apparent. This occurs when thick, sticky mucus develops in the windpipe. Characteristically, the patient has bursts of numerous, rapid coughs, usually followed by a long inspiratory effort accompanied by a characteristic high-pitched whoop. The whoop may not occur in infants younger than 6 months of age due to lack of strength. During such an attack, the patient may become cyanotic (turn blue). Infants and children often appear very ill and distressed at this stage, commonly displaying vomiting and exhaustion following coughing episodes; however, they may appear normal between attacks. These attacks, which occur more frequently at night, usually produce thick, glue-like mucus, which makes it difficult for infants and children to eat, drink and breathe. Symptoms in this stage generally persist for 1 to 6 weeks and then gradually decrease.

How is the disease spread?

Transmission of pertussis is most commonly person-to-person via airborne droplets of respiratory secretions and in rare instances by contact with freshly contaminated articles. Transmission rates may increase in summer and fall, but does not follow a distinct seasonal pattern. Schools and day care centers are common sources of infection for older children and adolescents. Parents, caregivers, and older siblings are important reservoirs for *B. pertussis* because their symptoms are generally mild and members of these groups may not seek medical treatment; however, their disease is still highly contagious allowing for continued transmission of the disease to infants and young children.

B. pertussis vaccine

The vaccine for whooping cough is given initially at 2, 4, 6, and 12-18 months of age. Children are routinely vaccinated again between 4-6 years of age. Individuals who have not received the complete vaccine series of five doses are most susceptible to the disease. Immunity resulting from vaccination seems to weaken after 5-10 years. Therefore, recommendations for vaccination of teenagers and adults will likely come in the near future in order to decrease the non-symptomatic carrier pool.

How is *B. pertussis* detected?

There are three approaches to test for *B. pertussis* in the laboratory, including direct fluorescent antibody (DFA), culture, and polymerase chain reaction (PCR). DFA was useful in the past as a rapid screening tool, however, it is no longer recommended as a screening test due to its low sensitivity,

however, DFA is still valuable in the laboratory to confirm the identify of cultured isolates. Isolation of the organism by culture has been the standard test for confirmation of diagnosis, and is essential if evaluation of antimicrobial resistance or molecular typing is required. However, successful isolation of the organism declines significantly beyond the first 2 weeks of illness and with prior antibiotic therapy. Furthermore, the organism is very fastidious, requiring 3-6 days to form detectable colonies by culture and often will not grow if cultures are not initiated within 48 hours of sample collection. In addition, a swab containing charcoal is also recommended in addition to plating to appropriate media immediately after collection. To address these limitations, molecular tests have been developed. Primer specific amplification, also known as PCR testing of nasopharyngeal swabs or aspirates is a rapid, sensitive, and specific method for diagnosing pertussis that does not require live organism. This assay is currently available in most reference laboratories and may also be obtained through the Nebraska Public Health Laboratory. While PCR is the recommended test of choice, it does not provide material for additional epidemiologic studies and therefore it is important that culture is attempted on suspected cases of *B. pertussis* when possible.

Treatment

When *B. pertussis* is suspected, recommended antibiotic therapy includes azithromycin for 5 days or either erythromycin or trimethoprim-sulfamethoxazole for 14 days. Depending on the situations, household members and other close personal contacts of known positive patients may require appropriate therapy including a course of antibiotics, even if they are not symptomatic. More information about *B. pertussis* can be found by going to the Centers for Disease Control and Prevention's website (http://www.cdc.gov/health/pertussis.htm).