Whooping Cough (Pertussis)

- Whooping cough, also called pertussis, is a serious respiratory infection caused by a type of bacteria called *Bordetella pertussis*. The infection causes violent, uncontrollable coughing that can make it difficult to breathe.
- While whooping cough can affect people at any age, it can be deadly for infants and young children.
- Before a vaccine was available, whooping cough was a major cause of childhood deaths.

Bordetella

- *Bordetella* is an extremely small (0.2 to 0.5 × 1 μm), strictly aerobic, gram-negative coccobacillus. *Bordetella pertussis*, the agent responsible for pertussis or whooping cough;
- *Bordetella parapertussis*, responsible for a milder form of pertussis.
- *Bordetella bronchiseptica*, responsible for respiratory disease in dogs, swine, laboratory animals, and occasionally humans.
- *Bordetella holmesii*, an uncommon cause of sepsis.
- *Bordetella* species are differentiated on the basis of their growth characteristics, biochemical reactivity, and antigenic properties. Despite phenotypic differences, genetic studies have shown that the four species pathogenic for humans are closely related or identical species, differing only in the expression of virulence genes.

Biochemical characteristic

- Media-Bordet Gengou glyceine potato blood agar-colonies are small dome shaped like mercury drops. Hazy zone of haemolysis.
- Catalase &oxidase +
- Sugar fermentation-
- Indole+
- Reduce nitrate
- Split urea

Pathogenesis

- Infection with *B. pertussis* and the development of whooping cough require exposure to the organism, bacterial attachment to the ciliated epithelial cells of the respiratory tract, proliferation of the bacteria, and production of localized tissue damage and systemic toxicity. Attachment of the organisms to ciliated epithelial cells is mediated by protein adhesins: pertactin, filamentous hemagglutinin, and fimbria. Similar proteins are also found in *B. parapertussis* and *B. bronchiseptica.*
- Localized tissue damage is mediated by dermonecrotic toxin
- Tracheal cytotoxin (inhibits cilia movement, disrupting normal clearance mechanisms in the respiratory tree leading to the characteristic pertussis cough).
- Systemic toxicity is produced primarily by pertussis toxin. This toxin inactivates the protein that controls adenylat cyclase activity, leading to an increase in cyclic adenosine monophosphate (cAMP) levels and a subsequent increase in respiratory secretions and mucus production, characteristic of the paroxysmal stage of pertussis.

- Infection is initiated when infectious aerosols are inhaled and the bacteria become attached to and proliferate on ciliated epithelial cells. After a 7- to 10-day incubation period, the classical presentation of pertussis proceeds through three stages .
- C**atarrhal stage**

  The first stage, the catarrhal stage, resembles a common cold, with serous rhinorrhea, sneezing, malaise, anorexia, and low-grade fever. Because the peak number of bacteria is produced during this stage and the cause of the disease is not yet recognized, patients in the catarrhal stage pose the highest risk to their contacts.
- **Paroxysmal stage**

  After 1 to 2 weeks, the paroxysmal stage begins. During this time, ciliated epithelial cells are extruded from the respiratory tract, and the clearance of mucus is impaired. This stage is characterized by the classic whooping cough paroxysms (i.e., a series of repetitive coughs followed by an inspiratory whoop). Mucus production in the respiratory tract is common and is partially responsible for causing airway restriction. The paroxysms are frequently terminated with vomiting and exhaustion. A marked lymphocytosis is also prominent during this stage. Affected patients may experience as many as 40 to 50 paroxysms daily during the height of the illness.

- **Convalescent stage**

After 2 to 4 weeks, the disease enters the convalescent stage; at this time, the paroxysms diminish in number and severity, but secondary complications can occur. It is now appreciated that this classic presentation of pertussis may not be seen in patients with partial immunity or in adults. Such patients may have a history of a chronic persistent cough without whooping or vomiting. Because this presentation is not distinctive, appropriate diagnostic tests should be performed for Bordetella as well as other bacterial (e.g., *Mycoplasma pneumoniae, Chlamydophila pneumoniae, Legionella pneumophila*) and viral respiratory pathogens.

	Incubation	Catarrhal	Paroxysmal	Convalescent
Duration	7-10 days	1-2 weeks	2-4 weeks	3-4 weeks (or longer)
Symptoms	None	Rhinorrhea, malaise, fever, sneezing, anorexia	Repetitive cough with whoops, vomiting, leukocytosis	Diminished paroxysmal cough, development of secondary complications (pneumonia, seizures, encephalopathy)
Bacterial culture				

Whooping cough symptoms

- Early symptoms mimic the common cold and include a runny nose, cough, and fever. Within two weeks, a dry and persistent cough may develop that makes breathing very difficult.
- Children often make a “whoop” sound when they try to take a breath after coughing spells, though this classic sound is less common in infants.
- This type of severe cough can also cause:
- vomiting
- blue or purple skin around the mouth
- dehydration
- low-grade fever
- breathing difficulties
- Adults and teenagers typically experience milder symptoms, such as a prolonged cough without the “whoop” sound.

The laboratory diagnosis

- To diagnose whooping cough, your doctor will perform a physical exam and take samples of mucus in the nose and throat. These samples will then be tested for the presence of the *B. pertussis* bacteria. A blood test may also be necessary to make an accurate diagnosis.
- The laboratory diagnosis of *B. pertussis* infections has changed in recent years. The bacteria are extremely sensitive to drying and do not survive unless care is taken during collection and transport of the specimen to the laboratory.
- Although *Bordetella* species have simple nutritional requirements, some species are highly susceptible to toxic substances and metabolites present in common laboratory media.
- *B. pertussis* require media supplemented with charcoal, starch, blood, or albumin to absorb these toxic substances. The more fastidious species also grow slowly in culture, and all require freshly prepared media. Even under ideal conditions, recovery of B. pertussis in culture is difficult. For these reasons, a number of nucleic acid amplification assays targeting a variety of genes have been developed. The performance characteristics of these assays (e.g., sensitivity, specificity) are superior to microscopy and culture. It is difficult to interpret the results of serologic tests because microscopy and culture techniques are relatively insensitive standards by which these tests have been evaluated.
- Enzyme-linked immunosorbent assay (ELISA) tests have been developed to detect antibodies against pertussis toxin, filamentous hemagglutinin, pertactin, and fimbriae.

Treatment

- Many infants and some young children will need to be hospitalized during treatment, for observation and respiratory support. Some may need intravenous (IV) fluids for dehydration if symptoms prevent them from drinking enough fluids.
- Since whooping cough is a bacterial infection, antibiotics are the primary course of treatment. Antibiotics are most effective in the early stages of whooping cough. They can also be used in the late stages of the infection to prevent it from spreading to others. Antibiotics can ameliorate the clinical course and reduce infectivity, particularly during the
- early stages of disease, but convalescence depends primarily on the rapidity and degree to which the layer of ciliated epithelial cells regenerates. Macrolides (i.e., erythromycin, azithromycin, clarithromycin) are effective in eradicating the organisms; however, this effect has limited value because the illness is usually unrecognized during the peak of contagiousness. Azithromycin and clarithromycin are generally better tolerated and the preferred macrolides. Trimethoprim-sulfamethoxazole or fluoroquinolones can be used in patients unable to tolerate macrolides
- While antibiotics can help treat the infection, they don’t prevent or treat the cough itself.

vaccines

- Two acellular vaccines (one for children, one for adults) administered in combination with vaccines for tetanus and diphtheria. Both vaccines contain inactivated pertussis toxin, filamentous hemagglutinin, and pertactin.
- The pediatric vaccine is administered to children at the ages of 2, 4, 6, and 15 to 18 months, with the fifth dose between the ages of 4 and 6 years.
- The current recommendation for the adult vaccine is to administer it at 11 or 12 years of age, and then again between the ages of 19 and 65.
- azithromycin has been used for prophylaxis in select instances.