Pertussis (whooping cough)

Abd El-Salam Dawood MD
Interventional Pediatric Cardiologist
FIBMS-Ped FIBMS-PedCard

Essentials of diagnosis & typical features:

- Prodromal catarrhal stage (1–3 weeks) characterized by mild cough, coryza, and fever.
- Persistent staccato, paroxysmal cough ending with a high-pitched inspiratory “whoop.”
- Leukocytosis with absolute lymphocytosis.
- Diagnosis confirmed by fluorescent stain or culture of nasopharyngeal secretions.

General consideration:

Pertussis is an acute respiratory tract infection that was well described initially in the 1500s. Sydenham first used the term pertussis, meaning "intense cough", in 1670; it is preferable to whooping cough because most infected individuals do not “whoop.”

Pertussis is an acute, highly communicable infection of the respiratory tract caused by *Bordetella pertussis* (gram negative fastidious coccobacillus) and characterized by severe bronchitis. Transmission occurs by close contact with cases via aerosolized droplets. Children usually acquire the disease from symptomatic family contacts. Adults who have mild respiratory illness, not recognized as pertussis, frequently are the source of infection. Asymptomatic carriage of *B. pertussis* is not recognized. Infectivity is greatest during the catarrhal and early paroxysmal cough stage (for about 4 weeks after onset).

B. pertussis organisms attach to the ciliated respiratory epithelium and multiply there; deeper invasion does not occur. Disease is due to several bacterial toxins, the most potent of which is "pertussis toxin", which is responsible for lymphocytosis and many of the symptoms of pertussis.

Bordetella parapertussis causes a similar but milder syndrome.

Pertussis is extremely contagious, with attack rates as high as 100% in susceptible individuals exposed to aerosol droplets at close range.

Neither natural disease nor vaccination provides complete or lifelong immunity against pertussis re-infection or disease. Protection against typical disease begins to wane 3-5 yr after vaccination.

Coughing adolescents and adults (usually not recognized as having pertussis) are the major reservoir for *B. pertussis* and are the usual sources of infection for infants and children. The incubation period is 7 to 10 days.

Symptoms and signs:

The onset of pertussis is insidious, with catarrhal upper respiratory tract symptoms (rhinitis, sneezing, and an irritating cough). Slight fever may be present; temperature greater than 38.3°C suggests bacterial superinfection or another cause of respiratory tract infection. After about 2 weeks, cough becomes paroxysmal, characterized by 10–30 forceful coughs ending with a loud inspiration (**the whoop**). Infants and adults with otherwise typical severe pertussis often lack characteristic whooping. **Vomiting commonly follows a paroxysm** (post-tussive vomiting). Coughing is accompanied by cyanosis, sweating, prostration, and exhaustion. This stage lasts for 2–4 weeks, with gradual improvement. Cough suggestive of chronic bronchitis lasts for another 2–3 weeks. Paroxysmal coughing may continue for some months and may worsen with intercurrent viral respiratory infection. In adults, older children, and partially immunized individuals, symptoms may consist only of irritating cough lasting 1–2 weeks. In the younger unimmunized child, symptoms of pertussis last about 8 weeks or longer. Clinical pertussis is milder in immunized children.

Laboratory findings:

White blood cell counts of 20,000–30,000/µL with 70–80% lymphocytes typically appear near the end of the catarrhal stage.

Culture is considered the “gold standard” for laboratory diagnosis of pertussis.

Identification of *B pertussis* by culture or polymerase chain reaction (PCR) from nasopharyngeal swabs or nasal wash specimens proves the diagnosis. After 4–5 weeks of symptoms, cultures and fluorescent antibody tests are almost always negative. Charcoal agar containing an antimicrobial should be inoculated as soon as possible; *B pertussis* does not tolerate drying or prolonged transport. PCR detection is replacing culture in some hospitals because of improved sensitivity, decreased time to diagnosis and cost.

Enzyme-linked immunosorbent assays (ELISA) for detection of antibody to pertussis toxin or filamentous hemagglutinin may be useful for diagnosis but are currently not widely available, and interpretation of antibody titers may be difficult in previously immunized patients.

The chest x-ray reveals thickened bronchi and sometimes shows a “shaggy” heart border, indicating bronchopneumonia and patchy atelectasis.

Complications:

1. **Bronchopneumonia:** due to superinfection is the most common serious complication. It is characterized by abrupt clinical deterioration during the paroxysmal stage, accompanied by high fever and sometimes a striking leukemoid reaction with a shift to predominantly polymorphonuclear neutrophils.
2. **Atelectasis:** is a second common pulmonary complication. Atelectasis may be patchy or extensive and may shift rapidly to involve different areas of lung.
3. **Intercurrent viral respiratory infection**: is also a common complication and may provoke worsening or recurrence of paroxysmal coughing.
4. **Otitis media**: is common.
5. Residual chronic **bronchiectasis** is infrequent despite the severity of the illness.
6. **Apnea and sudden death** may occur during a particularly severe paroxysm.
7. **Seizures** complicate 1.5% of cases and encephalopathy occurs in 0.1%. The encephalopathy frequently is fatal. Anoxic brain damage, cerebral hemorrhage, or pertussis neurotoxins are hypothesized, but anoxia is most likely the cause.
8. **Epistaxis** and **subconjunctival hemorrhages** are common.
9. Increased intrathoracic and intraabdominal pressure may lead to **rib fractures**, **pneumothorax, incontinence,** and **hernias**.

Differential diagnosis of sporadic "prolonged cough":

1. *Bordetella parapertussis* and *Bordetella bronchiseptica*.
2. *Mycoplasma pneumonia*
3. *Chlamydia trachomatis* and *Chlamydophila pneumonia*
4. Respiratory tract viruses, particularly *adenoviruses* and *respiratory syncytial viruses*.

Prevention:

Pre-exposure prophylaxis: Active immunization with DTP vaccine should be given in early infancy. Acellular pertussis (DTaP) vaccines cause less fever and fewer local and febrile systemic reactions and have replaced the former whole cell vaccines.

Post-exposure prophylaxis:

Care of Exposed People: Household and Other Close Contacts who are unimmunized or underimmunized should have pertussis immunization initiated or continued using age-appropriate products according to the recommended schedule as soon as possible (tetanus toxoid, reduced-content diphtheria, and acellular pertussis vaccine (Tdap) in children 7 through 10 years and classic DTaP series for others).

Chemoprophylaxis should be given to exposed family, close and hospital contacts whatever their age or vaccination status. The agents, doses, and duration of prophylaxis are the same as for treatment of pertussis

Hospitalized children with pertussis should be isolated because of the great risk of transmission to patients and staff. In addition to standard precautions, droplet precautions are recommended for 5 days after initiation of effective therapy, or if appropriate antimicrobial therapy is not given, until 3 weeks after onset of cough.

Child Care: Pertussis immunization and chemoprophylaxis should be given as recommended for household and other close contacts.

Students and staff members: with pertussis should be excluded from school until they have completed 5 days of the recommended course of antimicrobial therapy. People who do not receive appropriate antimicrobial therapy should be excluded from school for 21 days after onset of symptoms.

Treatment:

A. Specific measures:

Antibiotics may "ameliorate" early infections but have no effect on clinical symptoms in the paroxysmal stage.

A macrolide group is the drug of choice because it promptly terminates respiratory tract carriage of *B pertussis*. Patients should be given erythromycin estolate (40 mg/kg/24 h in four divided doses for 14 days). Clarithromycin for 7 days and azithromycin for 5 days were equal to erythromycin for 14 days in one small study.

Until additional information is available, **azithromycin is the drug of choice** for treatment or prophylaxis of pertussis in infants, in whom the risk of developing severe pertussis and life-threatening complications outweighs the potential risk of infantile hypertrophic pyloric stenosis (IHPS) with azithromycin.

Trimethoprim-sulfamethoxazole is an alternative for patients older than 2 months of age who cannot tolerate macrolides or who are infected with a macrolide-resistant strain.

Penicillins and first- and second-generation cephalosporins are not effective against B pertussis.

Corticosteroids reduce the severity of disease but may mask signs of bacterial superinfection.

Albuterol (0.3–0.5 mg/kg/d in four doses) has reduced the severity of illness, but tachycardia is common when the drug is given orally, and aerosol administration may precipitate paroxysms.

B. General measures:

Nutritional support during the paroxysmal phase is important. Frequent small feedings, tube feeding, or parenteral fluid supplementation may be needed.

Minimizing stimuli that trigger paroxysms is probably the best way of controlling cough. In general, **cough suppressants are of little benefit**.

C. Treatment of complications:

Respiratory insufficiency due to pneumonia or other pulmonary complications should be treated with oxygen and assisted ventilation if necessary.

Convulsions are treated with oxygen and anticonvulsants.

Bacterial pneumonia or otitis media requires additional antibiotics.

Prognosis:

The prognosis for patients with pertussis has improved in recent years because of excellent nursing care, treatment of complications, attention to nutrition, and modern intensive care. However, the disease is still very serious in infants under age 1 year (esp <3 mo); most deaths occur in this age group. Children with encephalopathy have a poor prognosis. Case-fatality rates are approximately 1% in infants younger than 2 months of age.