Whooping-Cough (Pertussis)

- **acute disease of respiratory tract caused by Bordetella pertussis, lasts for many weeks and is typically manifested in children with paroxysmal spasms of severe coughing, whooping and vomiting.**

Etiology

- B. pertussis is a small, aerobic gram-negative rod. It is fastidious and requires special media for isolation.
- produces multiple antigenic and biologically active products, including pertussis toxin (PT), filamentous hemagglutinin (FHA), agglutinogens, adenylate cyclase, pertactin, and tracheal cytotoxin.

Epidemiology

- The source of infection in whooping-cough is a
  - ✓ **sick person**,
  - ✓ patients with **abortive forms**
- The disease is particularly infective in the ***initial stage***, but gradually becomes less contagious.
- Patients continue to discharge B.pertussis up to the **28-30th day.**
- Infection is transmitted by the ***aerial-droplet route***, but is possible **only by direct**.
- Susceptibility to whooping-cough is **high**.

Pathogenesis

- **The portal of entry** of infection in whooping-cough is the upper respiratory tract. B.pertussis settles in the mucous membrane of the larynx, bronchi and bronchioles, and also in the pulmonary alveoli, **but no bacteriemia**.
- The principal pathogenic factor is the toxin produced by B.pertussis, which brings the cough reflex into play by its **intense irritation of the nervous receptors of the respiratory mucosa**.

Pathogenesis

- Toxin absorbed into the blood, has a **general effect** (chiefly on the nervous system), expressed in a marked tendency to generalized **vascular spasm** (arterial hypertension), **spasm of the small bronchi and vocal cords**, and in spasmodic twitching or even attacks of clonicotonic convulsions of the skeletal muscles. Stimulation of the nerve centres (respiratory, vasomotor, etc.) is apparently responsible for these phenomena.

Pathogenesis

- The mechanism of one of the chief symptoms of whooping-cough - ***the paroxysmal bouts of coughing.***
- The continuous flow of impulses coming from receptors in the mucosa of the respiratory tract leads to the development of a **stable focus of excitation in the central nervous system**, characterized by signs of dominance in A. Ukhtomsky's definition of the term. Formation of this focus is apparently aided by the effect of pertussis toxin upon the central nervous system.

Pathogenesis

- Paroxysms of coughing result, therefore, not only from impulses arriving from the respiratory tract, but also in response to stimulation of receptor regions not connected with the cough reflex; a fit can be provoked, for example, by examination of the throat, injections, or a loud noise, etc.
- Owing to the inert character of the dominant focus, paroxysms can persist for a long time after recovery from the infection.
- The dominant focus becomes inhibited when other, stronger centers of excitation arise.

Pathogenesis

- As a result of the frequent and prolonged paroxysms of coughing, and the circulatory disorders in the lungs, pulmonary ventilation becomes disturbed leading to **hypoxemia and hypoxia.** When the latter develops a major role is played by the lesions to fee capillary wall (disturbance of its permeability) caused by the pertussis endotoxin.
- Such CNS symptoms as seizures are associated wife disturbed cerebral circulation and with hypoxemia resulting from reduced pulmonary ventilation; but a direct effect of the pertussis toxin on the CNS may also be responsible for their development. Inadequate supply of oxygen to the tissues and disruption of oxidation processes leads to fee development of acidosis while hypoxia and acidosis, in their turn, aggravate the disturbed function of the nervous system.

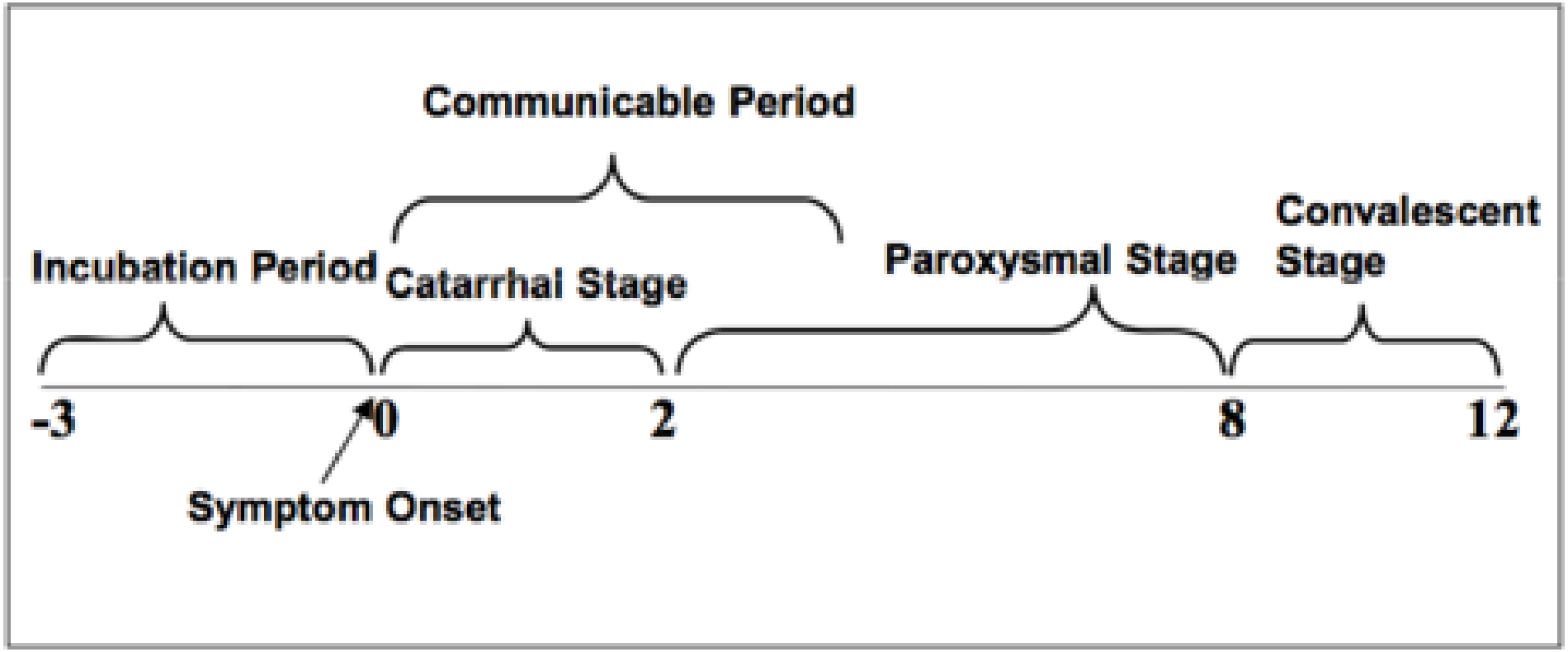
Clinical manifestations

- **Incubation period - 3 to 15 days** and averages **5 to 8 days**.

The course of the disease can be divided into three stages:

- **Catarrhal** (1-2 weeks).
- **Paroxysmal cough stage** (2-8 weeks).
- **Convalescence** (weeks to months).

Stages of disease (weeks)



Catarrhal stage

- Temperature - subfebrile or even normal.
- Runny nose, sneezing,
- A mild dry cough (all similar symptoms to the common cold).
- The patient's general state is not much disturbed, if at all.
- Appetite is normal.
- By the end of the catarrhal period the cough takes on the character of more or less prolonged paroxysmal bouts, occurring mostly at night.
- The catarrhal stage **lasts for 3 to 14 days**, but may sometimes be shorter, especially in nursing babies.

Paroxysmal cough stage

- The characteristic symptom is a burst, or paroxysm, of numerous, rapid coughs.
- At the end of the paroxysm the patient suffers from a long inhaling effort that is characterized by a high-pitched whoop (hence the name, “whooping cough”).
- Infants and young children often appear very ill and distressed, and may turn blue and vomit.

- At the height of the disease paroxysms are unmistakable; they begin suddenly. The paroxysm consists of a series of **short coughs following one another in rapid succession without a break.**
- Then the child makes an inspiration which owing to laryngeal spasm, is accompanied with a **crowing sound (whoop).**
- The paroxysm is then repeated in the form of the same successive spells with a subsequent whoop. There may be several whoops during a coughing bout. The more severe the whooping-cough the more prolonged are the paroxysms and the greater the number of whoops.
- A coughing bout often ends in expectoration of a pellet of viscid transparents mucus and sometimes vomiting.

The outward appearance of the patient during a fit is characteristic:

- **the face becomes red or even takes on a cyanotic hue;**
- **the cervical veins become engorged;**
- **the eyes are injected and filled with tears;**
- **the tongue is forcibly protruded to the limit, and its tip curves upward;**
- **and in severe bouts urine and faeces may be involuntarily passed.**

- When the oral cavity is examined a shallow **ulcer on the frenulum of the tongue** is found, which soon becomes covered by a white protruding film. The ulcer results from mechanical rubbing of the frenulum against the sharp edges of the lower incisors.

- In uncomplicated whooping-cough general condition **is not disturbed** in most patients, even when bouts are frequent, so that children lead their normal life playing between attacks; their appetite is not impaired.
- Temperature, which rises moderately in the catarrhal stage, usually falls to normal in most patients by the time coughing fits begin; only slight subfebrile elevations occasionally occur.
- Marked pyrexia during the paroxysmal stage is usually indicative of a complication.

Typical hematological shifts

- Majority of patients **blood** counts reveal marked **leucocytosis and lymphocytosis**. The number of **leucocytes** may reach **$20 \cdot 10^9$/l-$70 \cdot 10^9$/l** and over.
- The **ESR** is either **lowered** or **normal**.

Convalescence stage

- During convalescence the cough is no loger paroxysmal and bouts gradually become less frequent.
- The sputum becomes mucopurulent.
- All symptoms of the disease subside gradually.
- This stage lasts from **2 to 4 weeks**, so that the overall duration of the disease varies between **5 and 12 weeks**.

Clinical forms

- mild ,
- moderate,
- severe

Mild form

- The frequency of coughing fits is between ***5 and 15 a day***;
- They are typical, but short;
- Only rarely end in vomiting;
- The patient's condition is undisturbed.

Moderate form

- The number of fits varies between ***15 and 24 a day***;
- They are protracted, with several whoops;
- Often end in vomiting;
- The patient feels unwell.

Severe form

- Numerous bouts of coughing ***(25 to 30, or more, a day).***
- Paroxysms are severe and last up to 15 minutes, with 10 whoops;
- Almost always terminate in vomiting;
- Disturbed sleep, loss of appetite, loss of weight, adynamia and often a long febrile state.

Abortive form

- An abortive form of pertussis is characterized by the **absence of typical attacks with coughing relapses, and by a shortened course**.
- Tracheitis or tracheobronchitis is often
- These forms occur mostly in **vaccinated children.**

- **Signs of emphysema** are often found during examination of the **lungs** (a tympanitic or bandbox quality in percussion sound). Auscultation reveals dry and dull moist rales in pneumonia complications.
- In the **cardiovascular system** an acceleration of pulse is noted during paroxysms, and an elevation of arterial and venous pressure. Capillary resistance is reduced, which leads to hemorrhages into the skin and mucous membranes. In severe cases complicated by pneumonia there is often a dilatation of the heart (more to the right) wife the signs of disturbed function.
- Signs of the **nervous system** lesion are irritability, in severe cases passivity, adynamia, disturbed sleep, convulsive twitching of the facial muscles, and sometimes mental confusion.

Complications:

- **Respiratory system**
- **Nervos system**
- **Hemorrhagic complications**
- **Mechanical complications**
- **Complicated by bacterial and viral superinfections**

Respiratory Complications:

- ✓ bronchitis,
- ✓ bronchopneumonia,
- ✓ segmentary and lobar atelectases,
- ✓ pneumothorax,
- ✓ emphysema of the mediastinum and of the subcutaneous cellular tissue,
- ✓ empyema,
- ✓ interlobar pleurisy

Neurological complications

- ✓ epileptiform convulsions (clonic or clonicotonic),
- ✓ encephalopathy, accompanied by mental confusion,
- ✓ encephalitis by mixed mechanism: allergic, hypoxic, toxic,
- ✓ paresis, paralysis of the cranial nerves (III)
- ✓ hemorrhages into the brain: central spastic paralysis (hemiplegia)

Hemorrhagic Complications:

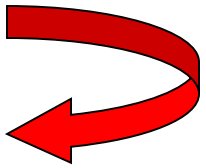
- ✓ Haemorrhages into the brain (central spastic paralysis - hemiplegia),
- ✓ Bleeding from eyes,
- ✓ Bleeding from nose,
- ✓ Conjunctival haemorrhages,
- ✓ Petechial rash on the face

Mechanical complications:

- ✓Prolapse of the rectum
- ✓Umbilical hernia
- ✓Diaphragm rupture
- ✓Ulceration of the lingual freniului

Whooping-cough in nursing babies:

- The **incubation period** is usually shorter (**3 to 5 days**),
- The **catarrhal stage** - **2 to 6 days**; the latter is sometimes missed, as it were, with the paroxysmal cough appearing in the very first days.
- In most cases cough paroxysms are **not accompanied with whoops; vomiting.**
- Hemorrhagic symptoms, and edema are less common than in older children.

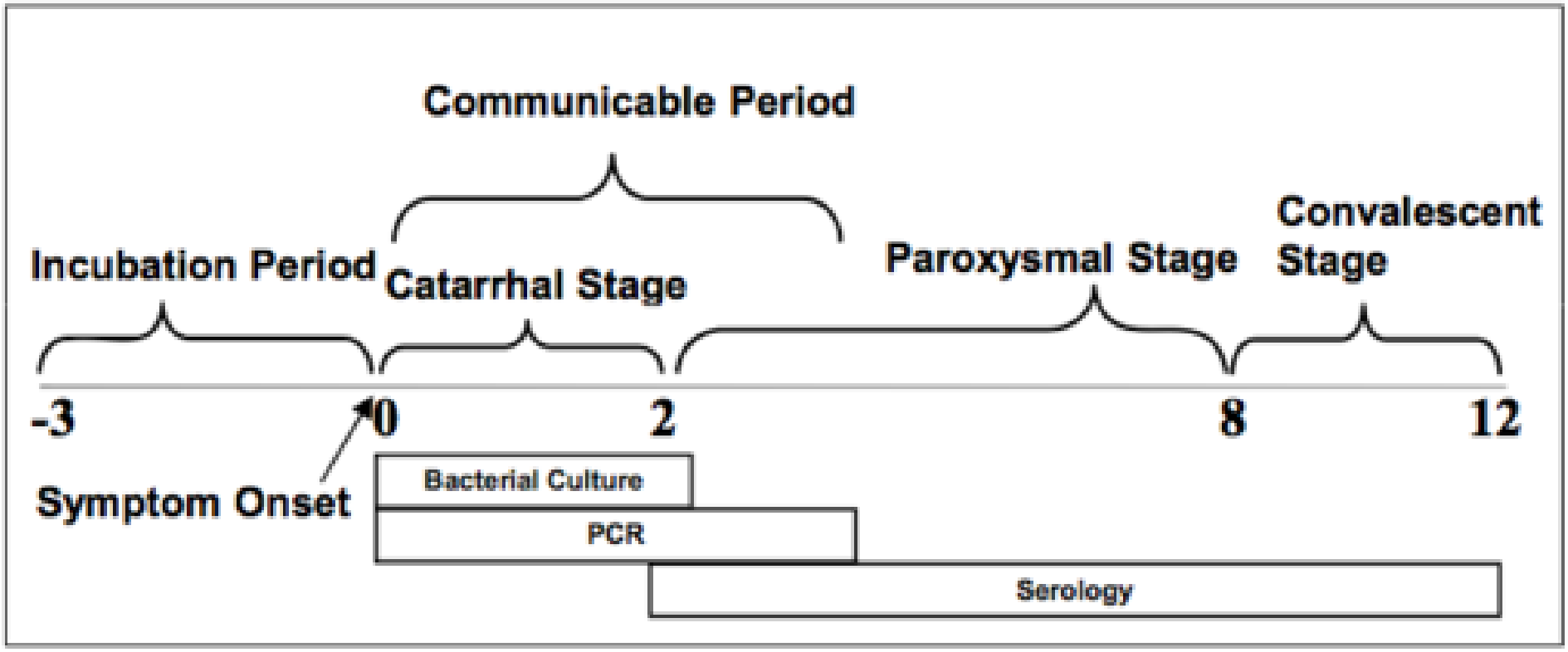


- The fits of coughing **often cause apnea**. Disturbances of gaseous exchange are more pronounced than in older children and are more often expressed in **marked cyanosis**.
- **The course** of whooping-cough in children under 6 months of age is **most severe**.
- **Respiratory complications** (bronchitis and bronchopneumonia) are **more frequent** than among older children.
- **Mortality is high**; pneumonia is the principal cause of death of whooping-cough.

Diagnosis

- **Distinctive features of the clinical course**
- **Epidemiological situation**
- **Typical hematological shifts**
- **X-ray examination of the chest**
- **Bacteriological tests**
- **Immunofluorescence method**
- **Serological tests:** agglutination and complement-fixation reactions
- **PCR**
- **ELISA IgM and IgG**

Optimal Timing for Testing

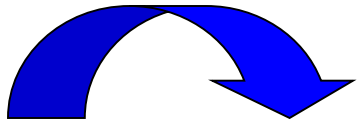


The differential diagnosis

- ✓ **influenza,**
- ✓ **viral catarrhs of the upper respiratory tract,**
- ✓ **measles,**
- ✓ **tracheobronchitis,**
- ✓ **tuberculous bronchoadenitis,**
- ✓ **mediastinal tumors**
- ✓ **for a foreign body in the upper respiratory tract**

Treatment

- Properly organized regimen and nursing are very important.
- Bed rest is called for only when there is fever and severe complications.
- Cold fresh air has a wonderful effect on patients.
- Much attention should be given to educational work among older children; their leisure should be organized, with various lessons and occupations, games, reading of stories. Coughing is less frequent in children absorbed in games.
- The fact that paroxysms usually cause vomiting, which greatly interferes with the assimilation of food, must be taken into account in feeding the patients.



Treatment

- ✓ **Antibiotics (Erythromycin, Clarithromycin, Azithromycin, Amoxicilină, Ampicilin, Cefotaxim)**
- ✓ **Mucolitics**
- ✓ **Expectorants**
- ✓ **Antitussivs**
- ✓ **Antiasmatics (Salbutamol)**
- ✓ **Anticonvulsivs (Diazepam)**
- ✓ **Corticosteroids (severe form)**
- ✓ **Antihistamininics**
- ✓ **Vitamins**
- ✓ **Physiotherapeutic procedures**
- ✓ **Oxygen therapy**

Prophylaxis

- Early diagnosis is therefore essential for the success of the anti-epidemic measures. The patient is usually left at home, and put in a separate room or behind a screen.
- Hospitalization is indicated in **severe** and **complicated forms** of whooping-cough, particularly in **children under 2 years of age**, children **from families living in poor conditions**, and **from families where there are babies under 6 months of age** that have not had the disease.
- **Patients are isolated for 30 days from the onset of the disease.**
- The quarantine period for unimmunized contacts under seven years of age who have not had whooping-cough is **14 days** from the time of isolation of the patient.
- For active immunization - **pertussis-diphtheria-tetanus vaccine**.

Parapertussis

- In 1937 Eldering and Kendrick isolated and described **Haemophilus (Bordetetta) parapertussis**, the causative agent of a disease similar to whooping-cough, which has since been found in the USA, England, Denmark, France, Czechoslovakia, and the USSR.

- ✓The causative agent of parapertussis is similar to the pertussis bacillus by its morphological and cultural properties.
- ✓ It is however less toxic and less virulent.
- ✓ Epidemiology of parapertussis is the same as of pertussis.
- ✓The source of infection is the **patient**, and possibly, the **carrier**.
- ✓The infection is transmitted by the **aerial-droplet way**.
- ✓ The susceptibility is determined by the index 0.3-0.4.
- ✓Children mainly from **2 to 10 years** of age develop the disease. Both sporadic cases and epidemic outbursts occur in children's institutions.
- ✓The parapertussis infection is widely spread among children.

Clinical picture

- The incubation period varies from **7 to 15 days**, but is mostly **10 or 12 days**.
- There is usually **no fever**.
- The onset is marked by **mild catarrhal symptoms**.
- The cough is not very severe at first, but may later become paroxysmal. There are occasional paroxysmal bouts resembling whooping-cough, with whoops followed by vomiting.
- The cough period lasts from **2-3 days to 3 weeks** or longer.
- The haemogram is normal in most cases. Slight leucocytosis and lymphocytosis are sometimes noted.
- Pneumonia is a rare complication.

- ✓ The course of parapertussis is **milder** than that of whooping-cough.
- ✓ Bacteriological tests are needed to differentiate it from whooping-cough;
- ✓ the immunofluorescence method is proposed.
- ✓ Serological tests (agglutination test, complement-fixation test, haemagglutination test).
- ✓ Treatment is symptomatic.
- ✓ Antibiotic therapy is not indicated because the course of the disease is mild.
- ✓ Patients should be isolated for at least 15 days.