Friday, September 19, 2025 6:10 PM

📌 Bordetella pertussis (Whooping Cough)

🦠 Important Properties

- Morphology: Small, coccobacillary, encapsulated, Gram-negative rod.
- Host: Humans only.
- Transmission: Airborne droplets during severe coughing episodes.

🔬 Pathogenesis & Epidemiology

- Attachment:
    - Binds to ciliated epithelial cells of the upper respiratory tract (does not invade tissue).
    - Mediated by filamentous hemagglutinin (FHA) on pili.
    - Antibody against FHA → blocks attachment → protection.

- Key Virulence Factors:

    1. Pertussis toxin (A-B toxin)

        - Catalyzes ADP-ribosylation of Gi protein → inhibits Gi → unopposed adenylate cyclase activity.
        - ↑ cAMP → edema of respiratory mucosa → severe cough.
        - Also causes lymphocytosis by preventing lymphocyte migration into lymphoid tissue.

    2. Adenylate cyclase enzyme

        - Produced by bacteria, taken up by neutrophils → inhibits phagocytosis.
        - Mutants lacking cyclase activity = avirulent.

    3. Tracheal cytotoxin

        - Fragment of peptidoglycan.
        - Damages ciliated epithelial cells.
        - Acts with endotoxin to induce nitric oxide → kills cilia.

- Epidemiology:
    - Primarily in infants & young children 👶.
    - Highly contagious.
    - Declined due to vaccines but periodic outbreaks occur due to waning immunity.

🔁 Flow of Pathogenesis

Inhalation of droplets

→ Attachment to ciliated epithelium (via FHA)
→ Pertussis toxin → ↑ cAMP → edema + lymphocytosis
→ Adenylate cyclase → ↓ neutrophil activity
→ Tracheal cytotoxin + endotoxin → ciliary death
→ Persistent severe cough (whooping cough)

📃 Clinical Findings

- Early phase: Mild upper respiratory tract infection.
- Paroxysmal phase (1–4 weeks):
    - Severe paroxysmal cough → repeated hacking coughs + copious mucus.
    - Followed by inspiratory "whoop" (due to narrowed

glottis).
    - Leukocytosis: up to 70% lymphocytes.
    - Organism remains localized to respiratory tract → blood cultures negative.

- Complications:
    - CNS anoxia, exhaustion due to coughing.
    - Pneumonia → main cause of death.

- Adults:
    - "100-day cough" (chronic paroxysmal cough).
    - Whoop often absent → underdiagnosed.

📊 Table: Clinical Course of Pertussis

Stage	Duration	Features
Catarrhal stage	1–2 weeks	Mild URTI, highly contagious
Paroxysmal stage	1–4 weeks	Severe coughing fits, inspiratory "whoop," mucus
Convalescent stage	Weeks–months	Gradual recovery, cough may persist

---

🧪 Laboratory Diagnosis

- Specimen: Nasopharyngeal swab (best during paroxysmal stage).
- Culture:
  - Medium: Bordet–Gengou agar (20–30% blood → inactivates inhibitors).
  - Growth: Slow → limits routine diagnosis.
- Identification:
  - Agglutination with specific antiserum.
  - Fluorescent antibody staining.
- Rapid Tests:
  - PCR → rapid, specific, highly sensitive ✅.
  - Direct fluorescent antibody staining on swab.
- Serology: Antibody detection in patients with prolonged

cough.

- Limitation: Isolation difficult in late disease.

🔁 Flow of Diagnosis

Nasopharyngeal swab

→ Bordet-Gengou culture (slow) OR Fluorescent antibody staining

→ PCR (preferred, rapid & sensitive)

→ If prolonged cough → Serology for antibodies

💊 Treatment

- Drug of choice: Azithromycin (a macrolide).
    - Reduces organisms in throat → ↓ transmission & complications.
    - Little effect once mucosal damage has occurred (prolonged cough stage).

- Supportive care (esp. in infants):
    - Oxygen therapy
    - Mucus suction

Prevention

I. Vaccines

- Acellular pertussis vaccine (aP) ✅ (currently used in US):
    - Contains 5 antigens:
        - Pertussis toxoid (genetically inactivated toxin)
        - Filamentous hemagglutinin (FHA)
        - Pertactin
        - Fimbriae types 2 & 3
    - Advantages: Fewer side effects.
    - Disadvantage: Shorter duration of immunity.
- Killed whole-cell vaccine ❌ (no longer used in US):
    - Still used in some countries.
    - Associated with side effects (rare encephalopathy

≈ 1/million doses).

2. Immunization Schedule

- DTaP (Diphtheria, Tetanus, acellular Pertussis):
    - 3 primary doses beginning at 2 months.
    - Booster: 12–15 months.
    - Booster: At school entry.
- Adolescents: Booster (10–18 years) → Boostrix or Adacel (contain diphtheria & tetanus toxoids too).
- Adults: Pertussis booster recommended.
- Pregnant women: Should be vaccinated → maternal IgG crosses placenta → protects newborn 👶.

3. Post-Exposure Prophylaxis

- Azithromycin:
    - For exposed, unimmunized individuals.
    - Also for exposed immunized children <4 years (since vaccine immunity is incomplete).

📊 Table: Prevention Strategies for Pertussis

Strategy	Details
Vaccine	Acellular vaccine (aP) – 5 antigens
Schedule	Primary (2 mo), Booster (12–15 mo), School entry, Teen & adult boosters
Pregnant women	Vaccination → maternal IgG → protects newborn
Post-exposure	Azithromycin for exposed (unimmunized or partially immunized children)