



# Respiratory System

## Study Questions

Choose the ONE correct answer

13.1 Which of the following is true of *Haemophilus influenzae*?

- A. Invasive infections are most commonly associated with encapsulated strains.
- B. Most invasive infections occur in infants during the neonatal period.
- C. Most human infections are acquired from domestic pets.
- D. The organism can be readily cultured on sheep blood agar in an environment of elevated CO<sub>2</sub>.
- E. Older adults are rarely at risk for infection with this organism because they typically have a high level of immunity.

Correct answer = A. The capsule is antiphagocytic, and facilitates hematogenous dissemination of *Haemophilus influenzae*. Although *H. influenzae* is an important pathogen of infants and young children, passive transfer of maternal immunoglobulin G may afford neonates protection. Immunity begins to wane in older adults, increasing the risk of infection for this population. Humans are the only natural host for *H. influenzae*. *H. influenzae* requires both hemin, X factor, and nicotinamide adenine dinucleotide (NAD), V factor, which are not available in sheep blood agar. Heating the blood lyses the erythrocytes, releasing both X and V factors, and simultaneously inactivating an NAD-inactivating enzyme present in blood. Media made with such heated blood is termed "chocolate agar." The organism does prefer elevated CO<sub>2</sub>.

13.3 Which of the following statements about *Bordetella pertussis* infection is true?

- A. Infection causes a leukocytosis characterized primarily by a marked elevation in polymorphonuclear leukocytes.
- B. Isolation of the organism from clinical specimens is greatest during the early stages of illness.
- C. Clinical diagnosis of whooping cough can usually be made within a few days of onset of initial symptoms.
- D. Children who receive a full series of immunizations with the pertussis vaccine generally develop solid, lifelong immunity to pertussis.
- E. The organism can be cultured on standard laboratory media such as sheep blood agar.

Correct answer = B. *Bordetella pertussis* typically causes a lymphocytic leukocytosis. Initial symptoms of *Bordetella* infection are relatively nonspecific (rhinorrhea, etc.). The characteristic paroxysmal coughing begins somewhat later. Maintenance of solid immunity depends on repeated exposure to the organism, either through natural causes or by administration of booster shots. Growth of *Bordetella* requires a medium containing a substance such as charcoal to absorb or neutralize inhibitory substances and also antibiotics that inhibit the growth of normal flora.

3) A 10-month-old male child presents with episodes of repetitive coughing with intermittent large gasps of air as well as some vomiting. Parents indicate that the child has been suffering from this condition for about 1 week. Incidentally, the previous week he was reported to have a coldlike illness with a fever and sneezing. A white blood cell count shows 65% lymphocytes and 30% neutrophils. An oxidase-positive, Gram-negative coccobacillus is grown from a nasopharyngeal swab plated on Regan-Lowe charcoal agar. Which one of the following organisms is most likely responsible for this disease?

- (A) *Bordetella pertussis*
- (B) *Corynebacterium diphtheriae*
- (C) *Haemophilus influenzae*
- (D) *Mycoplasma pneumoniae*

Correct answer = A

*Bordetella pertussis*. The case fits the description of whooping cough or pertussis. This disease is characterized by repetitive bouts of unremitting coughing punctuated by gasps of air and often end in vomiting. A whooping sound is often made when patients gasp for air. Lymphocytosis, at times as high as 70% of the peripheral white blood cell count, is typical for this disease. The causative agent is *Bordetella pertussis*, a fastidious organism that can be cultured on Regan-Lowe charcoal agar. While the other organisms listed cause respiratory disease, they are not associated with the disease described or microbiologic characteristics of the organism causing this case.



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4) A 48-year-old man had a long history of alcoholism (including alcoholic hepatitis and hallucinations) and was admitted to the ICU with hypotension and GI bleeding. He was given IV fluid and transfused with packed RBCs. He remained intubated and ventilator dependent for several weeks. He developed a high fever and was treated with broad-spectrum antibiotics. Culture of his tracheal aspirate initially grew *S. aureus*. After more antibiotic treatment, Gram stain of his aspirate showed PMNs and gram-negative rods. A chest x-ray demonstrated an infiltrate with possible small abscesses. Tracheal aspirate then yielded a heavy growth of a gram-negative, nonfermenting rod that produced a greenish hue in the culture plates.

Which of the following is the most likely organism causing this patient's problems?

- (A) *H. influenza*
- (B) *L. Pneumophila*
- (C) *M. Pneumonia*
- (D) *P. aeruginosa*

5) An injured firefighter developed a wound infection, and culture of the site indicates a gram-negative rod that is oxidase-positive and produces a bluish-green pigment. The organism was relatively resistant to antibiotics, but susceptible to ticarcillin and tobramycin. The organism is most likely to be identified as which of the following?

- (A) *E. coli*
- (B) *Klebsiella pneumonia*
- (C) *p. mirabilis*
- (D) *p. aeruginosa*

*P. aeruginosa* is a gram-negative, motile, aerobic rod that produces water-soluble pigments. They occur widely in soil, water, plants, and animals. *P. aeruginosa* is frequently present in small numbers in the normal intestinal tract and on the skin of humans. It is also commonly present in moist environments in hospitals. While a saprophyte on normal immune-competent humans, it is a most efficient opportunist in people with deficient host defenses.

*P. aeruginosa* is a gram-negative, oxidase-positive, aerobic rod that produces a greenblue pigment called pyocyanin. This microorganism has been associated frequently with wound infections in burn patients, and it is the second leading cause of burn infections after *S. aureus*. *P. aeruginosa* tends to develop resistance to various antibiotics.