

Question #1**The correct answer is A.**

This patient's symptoms of fever, night sweats, and hemoptysis are consistent with tuberculosis. The cavity in the upper lobe indicates reactivation rather than primary tuberculosis. Tuberculosis is caused by *Mycobacterium tuberculosis*, which can be visualized with an acid-fast stain. Note that the acid-fast stain is insensitive, so culture must be done as well. *M. tuberculosis* strains isolated from Asian immigrants have a high rate of resistance to isoniazid.

Answer B is incorrect.

Mycobacteria are obligate aerobes and will not grow in anaerobic environments. It is possible that the cavity is a lung abscess that could be caused by anaerobes, but *M. tuberculosis* is more likely. Note that neither an air-fluid level nor foul-smelling sputum is described, which makes a lung abscess less likely.

Answer C is incorrect.

Bordet-Gengou medium is used to isolate *Bordetella pertussis*, the bacteria that causes pertussis (whooping cough). *B. pertussis* infection has three distinct stages: a catarrhal stage (mild coughing and sneezing), a paroxysmal stage (explosive cough with a "whoop" upon inhalation accompanied by vomiting, cyanosis, and convulsions), and convalescent stage. Most infections occur in infants and children who did not receive proper immunizations.

Answer D is incorrect.

Loeffler's medium is used to isolate *Corynebacterium diphtheriae*, the bacteria that causes diphtheria. Patients with diphtheria have sore throat, mild fever, and a characteristic membrane that forms over the throat and tonsils. The infection also causes the lymph glands and tissue on both sides of the neck to swell to an unusually large size.

Answer E is incorrect.

Sabouraud's agar is used to isolate fungi. It is possible that the cavity is caused by a fungus such as *Coccidioides immitis*, but *M. tuberculosis* is more likely.

Answer F is incorrect.

Mycobacteria cannot be classified as either gram-positive or gram-negative. The high lipid content of the mycobacterial cell wall prevents the dyes used in the Gram stain from staining the organism.

Question #2**The correct answer is D.**

ToRCHeS is an acronym for organisms that can cross the placenta and cause congenital anomalies: Toxoplasmosis, Rubella, Cytomegalovirus, HIV/Herpes, and Syphilis. Genital lesions suggest a sexually transmitted disease. The Tzanck test is a smear of an opened skin vesicle that detects multinucleated giant cells, indicative of herpes simplex virus (HSV) types 1 and 2 or varicella-zoster virus (VZV). HSV-1, HSV-2, and VZV may all be transmitted vertically to the fetus. Remember: "Tzanck heaven I don't have herpes!" In the United States today, cytomegalovirus is the most common cause of congenital abnormalities.

Answer A is incorrect.

The presence of anti-HB surface antibody indicates immunity to the hepatitis B virus, either by previous exposure or by vaccination. While active or chronic hepatitis B can be vertically transmitted to the fetus, it does not cause congenital anomalies. Furthermore, hepatitis B is not associated with genital lesions.

Answer B is incorrect.

Cytoplasmic inclusions seen on Giemsa or fluorescent antibody-stained smear suggest *Chlamydia trachomatis*. Although *Chlamydia* can be vertically transmitted to the fetus at delivery, it is not associated with congenital anomalies or with painful vesicular lesions. It can, however, cause blindness and pneumonia in the newborn and should be treated during pregnancy.

Answer C is incorrect.

The monospot test detects heterophile antibodies by the agglutination of sheep RBCs, indicative of Epstein-Barr virus (EBV) infection. While EBV can cause mononucleosis and Burkitt's lymphoma, it is not one of the ToRCHeS organisms and does not transmit vertically to the fetus. Moreover, EBV does not produce genital lesions.

Answer E is incorrect.

The Weil-Felix test uses *Proteus* antigen to test for antirickettsial antibodies, indicative of typhus or Rocky Mountain spotted fever. *Rickettsia* species can cause headache, fever, and rash; however, they do not produce genital lesions.

Question #3**The correct answer is A.**

The heat-labile toxin of *E. coli* stimulates adenylate cyclase by adenosine diphosphate-ribosylation of G protein. This leads to increased levels of cyclic adenosine monophosphate within the cell that cause secretion of chloride from intestinal crypt cells and inhibit reuptake of sodium chloride. These two factors lead to an increased osmotic load within the intestinal lumen causing watery diarrhea.

Answer B is incorrect.

The neurotoxin produced by *Clostridium botulinum* blocks the release of acetylcholine at the neuromuscular junction, causing flaccid paralysis.

Answer C is incorrect.

The neurotoxin produced by *Clostridium tetani* blocks the release of glycine by inhibitory neurons in the spinal cord, causing spastic paralysis (eg, "lockjaw").

Answer D is incorrect.

The toxin produced by *Corynebacterium diphtheriae* inactivates elongation factor (EF)-2 by adenosine diphosphate ribosylation but EF-2 is not a G protein. Inactivation of EF-2 inhibits protein synthesis, leading to the death of the cell.

Answer E is incorrect.

Staphylococcus aureus produces an exotoxin that binds major histocompatibility complex II and T-lymphocyte receptor, causing the massive release of cytokines resulting in toxic shock syndrome.

Question #4**The correct answer is A.**

Candida stomatitis (often called thrush) and esophagitis classically present with sore throat and dysphagia with friable white plaques and erythematous buccal mucosa present on physical exam. *Candida albicans* is an opportunistic fungal pathogen that is most commonly found in the oropharynx of immunosuppressed patients. It can also be present as diaper rash in infants or as a diffuse mucocutaneous fungal infection in severely immunosuppressed individuals. Nystatin "swish and swallow" is often used to treat oral candidiasis; however, amphotericin B or fluconazole is used for serious systemic infection.

Answer D is incorrect.

Cytomegalovirus esophagitis has a presentation similar to that of herpes simplex virus esophagitis, with punched-out mucosal lesions and "owl's-eye" inclusion bodies on light microscopy.

Answer B is incorrect.

Herpes simplex virus stomatitis and esophagitis present with vesicular lesions and punched-out mucosal erosions characterized by intranuclear inclusion bodies on light microscopy.

Answer E is incorrect.

Latent JC virus can be reactivated when a patient is immunosuppressed, developing into progressive multifocal leukoencephalopathy. Multifocal lesions in the white matter are seen on MRI.

Answer C is incorrect.

Pneumocystis jirovecii (formerly *carinii*) infection classically causes a mixed alveolar and interstitial pneumonia in patients with CD4 counts $<400/\text{mm}^3$. It is associated with hypoxia, elevated LDH, and systemic symptoms such as fever and chills.

Question #5

The correct answer is E.

Trypanosoma cruzi infection can cause aganglionic megacolon and Chagas' disease, a condition in which the heart is enlarged and flaccid. *T. cruzi* is transmitted via the reduviid bug. Microscopic examination reveals flagellated trypomastigotes in the blood and nonflagellated amastigotes in cardiac muscle. *T. cruzi* infection is treated with nifurtimox. The fact that this man is from Central America is a second clue to his illness; epidemiologically, *T. cruzi* infections are most common among the poor in rural Central and South America.

Answer A is incorrect.

Cryptosporidium infection presents with severe diarrhea in HIV-positive patients and mild watery diarrhea in HIV-negative patients. *Cryptosporidium* is transmitted via cysts in water (fecal-oral transmission). Microscopically, acid-fast staining cysts are found. Unfortunately, there is no treatment available for *Cryptosporidium* infection; however, in healthy patients, cryptosporidiosis is self-resolving.

Answer B is incorrect.

Entamoeba histolytica infection presents with bloody diarrhea (dysentery), abdominal cramps with tenesmus, and pus in the stool. It can also cause liver abscesses accompanied by right upper quadrant pain. *E. histolytica* is transmitted via cysts in water (fecal-oral transmission). On microscopy one observes amebas with ingested RBCs. Treatment for *E. histolytica* infection includes metronidazole and iodoquinol.

Answer C is incorrect.

Giardia lamblia infection presents with bloating, flatulence, foul-smelling diarrhea, and light-colored fatty stools. *G. lamblia* is transmitted via cysts in water (fecal-oral transmission). On microscopy, one observes teardrop-shaped trophozoites with a ventral sucking disc or cysts. Metronidazole is used to treat *G. lamblia* infection.

Answer D is incorrect.

Toxoplasma gondii infection presents with brain abscesses in HIV-positive patients and with birth defects if infection occurs during pregnancy (toxoplasmosis is one of the ToRCHeS organisms). *T. gondii* is transmitted via cysts in raw meat or cat feces. The definitive stage (sexual stage) occurs in cats. The diagnosis is most often made serologically. Sulfadiazine and pyrimethamine are used to treat toxoplasmosis.

Question #6**The correct answer is C.**

Legionnaires' disease, which is also known as legionellosis, is a form of pneumonia. Most infections with this disease occur in elderly people. Symptoms include fever, chills, and a nonproductive cough. Other symptoms include muscle aches, headache, malaise, fatigue, shortness of breath, chest pain, diarrhea, and ataxia. Legionnaires' disease is confirmed by laboratory tests that detect the presence of the bacterium *Legionella pneumophila*. The bacterium Gram stains poorly, so silver stain is used to visualize the rods. Transmission does not occur from person to person; rather, it occurs by aerosol transmission from an environmental water source such as an air conditioner.

Answer A is incorrect.

Aspergillosis is caused by the fungus *Aspergillus*. Symptoms include fever and a productive cough. Invasive infection often occurs in an immunocompromised host. Aspergilloma (fungus ball) often occurs in a tuberculosis cavity. Silver stain of *Aspergillus* would show septate hyphae that branch into a V shape.

Answer B is incorrect.

Brucellosis is caused by the bacteria of the genus *Brucella*. Humans become infected by coming in contact with animals or animal products that are contaminated with these bacteria. Brucellosis can cause a range of symptoms that may include fever, sweats, headaches, back pains, and physical weakness. Severe infections of the central nervous system or of the endocardium may occur.

Answer D is incorrect.

Mycoplasma pneumoniae is a common, mild pneumonia that usually affects people <40 years old. Its symptoms are very similar to those of Legionnaires' disease, with the exception of diarrhea. Additionally, silver stain would not be used to diagnose *Mycoplasma pneumoniae* infection. Instead, serology, cold agglutinins, or polymerase chain reaction testing for mycoplasma would be in order.

Answer E is incorrect.

Pneumocystis jirovecii (formerly *carinii* pneumonia) presents with fever, shortness of breath, and nonproductive cough. It targets mainly immunocompromised patients (eg, those with AIDS), and it is identified by the immunofluorescent staining of sputum or lavage fluid. Silver stain is also used, but would show cysts, not the rod-shaped bacteria seen in this image.

Question #7**The correct answer is C.**

This patient is presenting with a classic case of acute bacterial endocarditis (ABE). Endocarditis is often characterized by constitutional symptoms (fever, malaise, chills), new-onset cardiac murmur, and a combination of other signs and symptoms (eg, Janeway lesions, Osler nodes, and Roth spots). Acute and subacute endocarditis can be differentiated based on history, as the acute case will have a more severe and sudden onset, as in this patient. ABE is also most often seen in cases of intravenous drug use and indwelling catheters, and *Staphylococcus aureus* is the most common bacterial pathogen isolated in these cases because it is part of the skin flora and enters the blood at needle sites. This patient's history of intravenous drug abuse as well as auscultation of a murmur consistent with tricuspid regurgitation both point to a right-sided ABE infection. In right-sided endocarditis, septic emboli to the lungs leading to bilateral infiltrates are seen more often. This patient is manifesting signs of bilateral infiltrates with signs of hypoxia, decreased breath sounds, and dullness to percussion. It is important to note that many of the classic signs of endocarditis, such as Janeway lesions, Osler nodes, and Roth spots, are mostly seen as a complication of left-sided endocarditis, in which septic emboli leave the heart and enter the systemic circulation.

Answer A is incorrect.

Enterococcus faecalis also causes subacute endocarditis. The classic picture is a slow onset of constitutional symptoms with low-grade fever. *Enterococcus* infection is not seen as frequently as viridans streptococci, but it is known to colonize damaged heart valves, especially in patients with a past history of rheumatic fever.

Answer B is incorrect.

Haemophilus aphrophilus is part of the HACEK group of fastidious gram-negative bacilli that cause 5%-10% of cases of bacterial endocarditis that are not related to intravenous drug use. These organisms are slow growing and difficult to culture from blood samples, making diagnoses more complex.

Answer D is incorrect.

Streptococcus bovis also causes subacute bacterial endocarditis with low-grade fever and insidious onset. It normally inhabits the lower gastrointestinal tract and lesions in the colon, such as those that occur in colon cancer, allow the bacteria access to the bloodstream. It most commonly affects the aortic valve.

Answer E is incorrect.

Viridans streptococci are the most common cause of bacterial endocarditis overall. This group of bacteria is most often seen in subacute cases in which the onset of symptoms is more chronic and low-grade fevers are more common. *Viridans* streptococci commonly colonize heart valves previously damaged by rheumatic fever, thus causing left-sided infective endocarditis as opposed to the right-sided version seen more commonly with *Staphylococcus aureus*. One common source of infection is dental procedures during which normal flora of the oropharynx can enter the bloodstream.

Question #8**The correct answer is B.**

This patient presents with Rocky Mountain spotted fever (RMSF), which is caused by *Rickettsia rickettsii*. This small, gram-negative bacterium is carried by the American dog tick (*Dermacentor variabilis*) in the eastern United States. Patients will often present first with severe headache, fever ($>38.9^{\circ}\text{C}$ or $>102^{\circ}\text{F}$), and myalgias followed by a petechial rash on the palms and soles (or wrists and ankles) that spreads to the trunk. The Weil-Felix assay reaction tests for antirickettsial antibodies, which cross-react with *Proteus* antigen. This test is usually positive for RMSF and typhus but not for Q fever. The treatment of choice for adults with RMSF is doxycycline; chloramphenicol is also used but has more significant adverse effects.

Answer A is incorrect.

Cephalosporins (ceftriaxone) are not effective against *Rickettsia rickettsii*. They are generally used to treat infections caused by *Streptococcus* and *Staphylococcus* species.

Answer C is incorrect.

Aminoglycosides (gentamicin) are not effective against *Rickettsia rickettsii*. Aminoglycosides are effective against many gram-negative bacteria and some strains of *Staphylococcus aureus*. It is also used as broad-spectrum therapy when combined with a penicillin or metronidazole.

Answer D is incorrect.

Nystatin is used in the treatment of fungal infections such as oral candidiasis.

Answer E is incorrect.

Penicillin is not effective against *Rickettsia rickettsii*. Penicillin is still the treatment of choice for syphilis. Other derivatives that are used more frequently include oxacillin, cloxacillin, dicloxacillin, and amoxicillin when *Staphylococcus* and *Streptococcus* species prove sensitive.

Question #9**The correct answer is D.**

The organism described, *Listeria monocytogenes*, causes meningitis and sepsis in neonates and the immunocompromised. Other bacteria causing neonatal meningitis include *Escherichia coli* and Group B streptococci (GBS). GBS are the most common cause of neonatal meningitis. Ingestion of poorly pasteurized milk, soft cheeses, coleslaw, and ready-to-eat turkey and pork products are implicated in the pathogenesis of listeriosis in the immunocompromised population and pregnant women.

Answer A is incorrect.

While *Escherichia coli*, a common gram-negative bacterial cause of neonatal meningitis, can produce urinary tract infections in both well and immunocompromised adults, the organism described in the clinical case is the gram-positive bacilli *Listeria monocytogenes*.

Answer B is incorrect.

Direct inoculation is a common route of transmission of infection, including gas gangrene produced by *Clostridium perfringens*, as well as tetanus caused by *Clostridium tetani*. In contrast, listeriosis in the immunocompromised is most often from ingestion of poorly pasteurized milk, soft cheeses, coleslaw, and ready-to-eat turkey and pork products.

Answer C is incorrect.

While *Escherichia coli* is a common cause of neonatal meningitis and can be contracted by ingestion of poorly cooked hamburger meat, it is a gram-negative rod.

Answer E is incorrect.

Listeria monocytogenes, a gram-positive, β -hemolytic, catalase-positive bacillus, causes meningitis and sepsis in neonates as well as the immunocompromised. While neonatal listeriosis may be contracted by passage through the birth canal, inhalation of infected amniotic fluid, or nosocomial infection, listeriosis in the immunocompromised is most often from ingestion of poorly pasteurized milk, soft cheeses, coleslaw, and ready-to-eat turkey.