Tuberculosis in Adults

**Description/Etiology**

Tuberculosis (TB) is an infection caused by *Mycobacterium tuberculosis*, which spreads primarily by aerosolized respiratory droplets. TB usually affects the respiratory system, particularly the lungs (i.e., pulmonary TB), but can spread to other organ systems. TB infection may remain dormant and asymptomatic (i.e., latent TB), be active (i.e., active TB), or reactivate from a dormant state during periods of immune suppression. TB is a disease of public health importance and one of the leading causes of death associated with an infectious disease, worldwide. (For more information about TB, see the series of related Quick Lessons, Evidence-Based Care Sheets, and Nursing Practice & Skills).

TB is typically acquired through inhalation of airborne droplets released when an infected person coughs, talks, or sneezes in a poorly ventilated environment. During primary infection, *M. tuberculosis* bacilli multiply inside alveolar macrophages and spread through lymph vessels, inducing an initial inflammatory response with formation of caseous necrosis and granulomatous lesions (tubercles). Some lesions heal, resulting in calcified granulomas, but in some cases the bacteria persist if the immune response is not sufficient to contain the infection. Hematogenous dissemination can lead to extrapulmonary TB, which includes lymph node disease (tuberculous lymphadenitis), genitourinary pleural TB, tuberculous meningitis, spinal TB, and miliary or disseminated TB. Diagnosis of TB is based on results of laboratory tests and diagnostic imaging. The most commonly used tests in the diagnosis of TB are tuberculin skin testing (TST) with purified protein derivative (PPD), chest X-rays, acid-fast bacteria (AFB) sputum cultures and smears, nucleic acid amplification (NAA) technology (Xpert MTB/RIF assay), and interferon-gamma release assays (IGRAs, e.g., the QuantiFERON-TB Gold [QFT-G] test). The differential diagnosis includes pneumonia, histoplasmosis, lung abscess, neoplasm, interstitial lung disease, and sarcoidosis. Potential complications of TB include multiorgan involvement, tuberculous peritonitis, osteomyelitis, spinal abscess, paraplegia caused by spinal compression, hydrocephalus, brain ischemia/infarction, constrictive pericarditis, tuberculous pneumonia, pleural effusion, pneumothorax, and respiratory failure.

Treatment of TB involves long-term antibiotic treatment and supportive care. First-line medications that are prescribed to treat active TB are isoniazid, rifampicin, pyrazinamide, and ethambutol, which are taken for two months, followed by two of the four first-line medications for four to seven months. With adherence to the prescribed regimen treatment, the prognosis is good; however, treatment failure can occur due to antibiotic resistance or lack of adherence. The Bacillus Calmette-Guérin (BCG) vaccine is the only available vaccine for TB. The vaccine is effective to prevent disseminated forms of TB in children and is routinely administered to newborns in countries where TB is highly prevalent. In the United States, however, the BCG vaccine is not generally administered because of low infection rates with *M. tuberculosis*, inconsistent vaccine efficacy, and risk for false-positive TST results.

**Facts and Figures**

Worldwide, TB is the leading cause of death from infectious diseases and the leading cause of death among persons with HIV infection (for information see Evidence-Based Care Sheet: Tuberculosis: Coinfection with HIV). One fourth of the world’s population, approximately 2 billion people, is infected with TB. Each year 1 of 10 million people with...
active TB will also have HIV. In many areas of the world, particularly sub-Saharan Africa, the prevalence of TB is increasing due to the AIDS epidemic. Approximately 10% of persons who are infected with *M. tuberculosis* develop active TB.

In 2017, thirteen million people were reported to have latent TB in the US. In 2016, the incidence of TB in the US was about 3 in 100,000 people; 4% of the total cases were associated with homelessness, 1.6% with long term care, and 3% in those confined in a correctional facility. The incidence of TB in immigrants into the US is approximately 15 times higher than US born citizens. The majority of active TB cases in the US (~80%) are associated with reactivation of latent TB.

**Risk Factors**

Risk factors for TB infection include residence in areas with a high incidence of active TB (e.g., Africa, Latin America, Asia, former Soviet Union states), residence in a long-term care facility, homelessness, incarceration, poverty, close contact with an infected individual, being a healthcare worker, and inadequate ventilation, especially in crowded and/or unsanitary areas. Risk factors for development of active TB infection include HIV infection (individuals with HIV infection are 21–34 times more likely to develop active TB), presence of conditions that impair the immune system (e.g., long-term corticosteroid use, malnutrition, diabetes mellitus, lymphoma), age < 5 years, cigarette smoking, alcoholism and other substance use disorders, older age, and lack of health care.

**Signs and Symptoms/Clinical Presentation**

Patients with active TB can have constitutional symptoms such as fatigue, weakness, loss of appetite, night sweats, chills, weight loss, and fever. Other symptoms include persistent cough (e.g., lasting ≥ 3 weeks), pleuritic chest pain, dyspnea, and purulent or bloody sputum. Symptoms of genitourinary TB include dysuria and hematuria; clinical manifestations of tuberculous meningitis include changes in alertness, confusion, neck rigidity, and cranial nerve palsy.

**Assessment**

› **Physical Findings of Particular Interest**
- Lung auscultation can reveal decreased breath sounds and/or localized wheezing or crackles

› **Laboratory Tests**
- CBC may show anemia, leukocytosis, and elevated platelets
- Erythrocyte sedimentation rate (ESR), CO₂, antidiuretic hormone, angiotensin-converting enzyme levels, serum calcium, and serum copper may be elevated
- A positive localized reaction to PDD (Mantoux) skin test, usually defined as an induration ≥ 5 mm 48–72 hours after intradermal injection of PDD, is generally interpreted as a positive test result and may detect TB infection as early as 2–12 weeks after initial exposure. (This test has poor sensitivity in persons with HIV infection)
- A positive acid-fast bacilli (AFB) microscopic examination of smear, sputum, or tissue samples will identify the characteristic rod-shaped bacilli. Culture will detect *M. tuberculosis*; however, the microorganism grows slowly in cultures and it takes weeks to obtain an isolate
- Identification of specific DNA sequences by NAA (Xpert MTB/RIF assay) will rapidly identify *M. tuberculosis* and detect resistance to rifampin; however, a negative result cannot exclude TB
- Susceptibility testing of *M. tuberculosis* to isoniazid, rifampicin, or fluoroquinolones can identify resistance to multiple drugs; drug susceptibility testing using colorimetric assays or broth-based assays rapidly identifies drug-resistant TB (for information about drug resistance, see Red Flags, below)
- An IGRA (e.g., the QuantiFERON-TB Gold [QFT-G] test) may be performed to confirm diagnosis of TB, but cannot differentiate between active and latent TB
- Liver function tests may indicate damage due to medication prescribed to treat TB
- Urinalysis may reveal hematuria and pyuria in cases of genitourinary TB
- Pleural fluid analyses and staining may reveal increased WBC counts, glucose < 60 mg/dL, and *M. tuberculosis*. Analysis of biopsied lung or pleural tissue can identify *M. tuberculosis*
- Enzyme-linked immunosorbent assay (ELISA) or rapid HIV antibody tests may be ordered to assess HIV infection status

› **Other Diagnostic Tests/Studies**
- Chest X-ray may show lymph node calcification, lung tissue cavitation, upper-lobe infiltrates, and pleural effusion. X-rays can also reveal collapse of vertebral bodies
  - If imaging results suggest TB of the airway, three sputum specimens are taken at least eight hours apart with at least one sample taken early in the morning for AFB, culture, and NAA testing
- Bronchoscopy may be performed to obtain a lung or pleural tissue sample for biopsy
CT, MRI, or gallium scan will show the extent of TB-related lung damage

**Treatment Goals**

› Reduce Risk for Complications and Disease Transmission
  • Monitor vital signs and assess all physiologic systems (especially respiratory); maintain airway patency and administer supplemental oxygen, as ordered
  • Follow facility infection control protocols for airborne infection isolation (e.g., use of a private room with negative airflow) for suspected or confirmed diagnosis of TB; educate visitors to follow airborne precautions
    – Follow facility protocols for mandatory disease reporting to public health officials
  • Administer combination treatment of isoniazid, rifampicin, pyrazinamide, and ethambutol, as prescribed. As appropriate, request referral to a clinician with TB expertise and experience for consultation regarding initial empiric therapy for TB if drug resistance is suspected
    – Pregnant women with TB should be treated with isoniazid, rifampicin, pyrazinamide, and ethambutol; streptomycin can cause congenital deafness
    – Monitor for medication side effects, including liver toxicity (e.g., due to pyrazinamide, rifampicin, or isoniazid), auditory nerve damage (e.g., due to streptomycin), and/or color blindness (e.g., due to ethambutol); report these and other serious side effects to the treating clinician and manage as prescribed
  • Monitor intake/output, respiratory and nutritional status, weight, sputum, and cough; provide a well-balanced diet and encourage adequate hydration

› Provide Emotional Support and Educate
  • Assess patient’s anxiety level and coping ability; provide emotional support, educate and encourage discussion about TB pathophysiology, treatment risks and benefits, potential complications, strategies for preventing transmission, and individualized prognosis

**Food for Thought**

› The TST is not consistently an accurate indicator of *M. tuberculosis* infection. Older age adults, immunosuppression, alcoholism, renal failure, sarcoidosis, malnutrition, and hematologic or lymphoreticular disorders increase risk for false-negative results. Individuals who have received the BCG vaccine are at risk for false-positiveneresults
  • Although rarely administered in the US, the BCG vaccine may be considered for infants or children who have negative chest X-rays but are at risk for repeated exposure to TB. BCG is contraindicated in individuals with an impaired or suppressed immune response. CDC guidelines do not recommend including BCG vaccination in US immunization programs or in TB-control programs. Adults who have received the BCG vaccine can still have a TST as part of a clinical workup but false positive results are likely; IGRA is the preferred test for people who had the BCG vaccine
  • Treatment of patients who have TB and HIV infection is complicated by several factors, including high pill burden, potential drug interactions, and toxic effects, all of which can affect the patient’s adherence and physiologic response to treatment

**Red Flags**

› The emergence of multidrug resistant TB (MDR-TB; i.e., TB that is resistant to two of the most effective anti-TB drugs, isoniazid and rifampicin) and extensively drug resistant TB (XDR-TB; i.e., TB that is resistant to isoniazid and rifampicin, is resistant to any fluoroquinolone [e.g., levofloxacin, ofloxacin], and is resistant to at least one of three injectable second-line drugs [i.e., kanamycin, amikacin, capreomycin]) has raised concern among public health authorities
  • (For more information on MDR-TB and XDR-TB, see *Quick Lesson About ... Tuberculosis, Multidrug-Resistant: an Overview* and *Evidence-Based Care Sheet: Tuberculosis, Multidrug-Resistant*)

**What Do I Need to Tell the Patient/Patient’s Family?**

› When possible, provide written information about TB prevention strategies (e.g., avoid going out in public until your physician says you can, avoid people with weakened or immature immune systems, wear a special mask when going out, perform good hand hygiene, and dispose used tissues), the prescribed treatment regimen, and the need for follow-up screening of household members
  • Educate about the importance of strict adherence to the prescribed medication regimen. Verify patient understanding of the prescribed medication regimen and potential adverse effects, and schedule for follow-up laboratory and other diagnostic testing
  • Educate about signs and symptoms of active TB and when to seek medical attention
Educate about the importance of opening windows and using fans to ventilate the home

Educate that more information can be obtained from the American Lung Association at http://www.lung.org/lung-health-and-diseases/lung-disease-lookup/tuberculosis and the World Health Organization (WHO) at http://www.who.int/topics/tuberculosis/en/

References


