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TUBERCULOSIS: ETIOLOGY, PATHOGENESIS, CLINICAL MANIFESTATIONS AND PREVENTION

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Abstract: This scientific article provides a comprehensive overview of the etiology, epidemiology, pathogenesis, clinical features, diagnosis, treatment, and prevention of tuberculosis. It analyzes the modern medical understanding of tuberculosis, its global and national prevalence, as well as the international and national strategies aimed at combating this infectious disease. The biological characteristics of Mycobacterium tuberculosis, its effects on the human immune system, and its drug resistance mechanisms are also discussed.
Keywords: Tuberculosis, Mycobacterium tuberculosis, pathogenesis, antibiotic resistance, epidemiology, diagnosis, BCG vaccine, infection control, healthy lifestyle, balanced diet.

Introduction

Tuberculosis (TB) is a chronic infectious disease that primarily affects lung tissue, but can also involve nearly all organs of the body. The causative agent, Mycobacterium tuberculosis, was discovered by the German microbiologist Robert Koch in 1882, marking a pivotal breakthrough in medical history by scientifically confirming the infectious nature of tuberculosis.

According to the World Health Organization (WHO), more than 10 million people worldwide develop TB each year, and approximately 1.3 million die from it. In Uzbekistan, tuberculosis remains one of the key public health priorities, with nationwide control programs aimed at reducing its incidence and mortality.

1. Epidemiology

Tuberculosis is distributed globally but is more prevalent in developing countries. Its spread is closely associated with social conditions, nutrition, hygiene, and immune status. According to WHO reports, the highest incidence rates occur in Africa, South Asia, and Central Asia. In Uzbekistan, the incidence rate has decreased from 46 to 38 cases per 100,000 population in recent years. However, the number of drug-resistant (MDR-TB) cases is rising, which requires the development of new treatment strategies and strict adherence to medical protocols.

2. Etiology and Morphology

The causative agent of tuberculosis belongs to the Mycobacterium tuberculosis complex (MTBC). These are aerobic, non-spore-forming, non-capsulated, rod-shaped bacteria. Although not gram-positive, their cell wall contains a high concentration of mycolic acids, which gives them an acid-fast property. Under Ziehl–Neelsen staining, they appear as red rods under the microscope. M. tuberculosis is highly resistant to environmental factors — it can survive up to six months in dried sputum and about a month in water.

3. Routes of Transmission

The main route of infection is airborne transmission. When a patient with active pulmonary tuberculosis coughs, sneezes, or speaks, they release aerosolized droplets containing bacteria. A single exhalation can release up to 3,000 droplets that remain suspended in the air for several hours. In rare cases, infection may occur through ingestion of contaminated food (for example, milk from infected cattle) or through damaged skin or mucous membranes.

4. Pathogenesis

Once inhaled, M. tuberculosis bacilli reach the alveoli, where they are engulfed by macrophages. Instead of being destroyed, the bacteria multiply within macrophages, leading to cell death. This triggers an immune response characterized by granulomatous inflammation, forming structures called tuberculomas. The center of the granuloma undergoes caseous necrosis, resulting in tissue destruction. If the immune system is strong, the disease remains in a latent form. However, when immunity weakens, the bacteria become active again, causing reactivation tuberculosis.

5. Clinical Manifestations

The pulmonary form of tuberculosis is the most common. Its main clinical symptoms include:
- Persistent cough lasting more than 3 weeks;
- Hemoptysis (blood-streaked sputum);
- Low-grade fever (37.5–38°C), especially in the evening;
- Weight loss, fatigue, and loss of appetite;
- Chest pain and shortness of breath.

Extrapulmonary tuberculosis may affect bones, kidneys, meninges, lymph nodes, and reproductive organs. The clinical signs vary depending on the organ involved. Note: The tuberculosis bacillus can infect almost all organs except the hair and nails. The lungs are the most common site due to airborne transmission.

6. Diagnostics

A comprehensive diagnostic approach is required to confirm tuberculosis. The main diagnostic methods include:
- Microscopy: Ziehl–Neelsen-stained sputum smears are examined for acid-fast bacilli (AFB).
- Culture: Bacterial growth on Löwenstein–Jensen medium within 3–8 weeks confirms the diagnosis.
- Molecular techniques: Polymerase Chain Reaction (PCR) enables rapid detection of mycobacterial DNA.
- Radiological studies: Chest X-ray and CT scans reveal infiltrates, cavities, and fibrosis.
- Immunodiagnostic tests: Mantoux tuberculin skin test and IGRA (Interferon-Gamma Release Assay) help identify latent infection.

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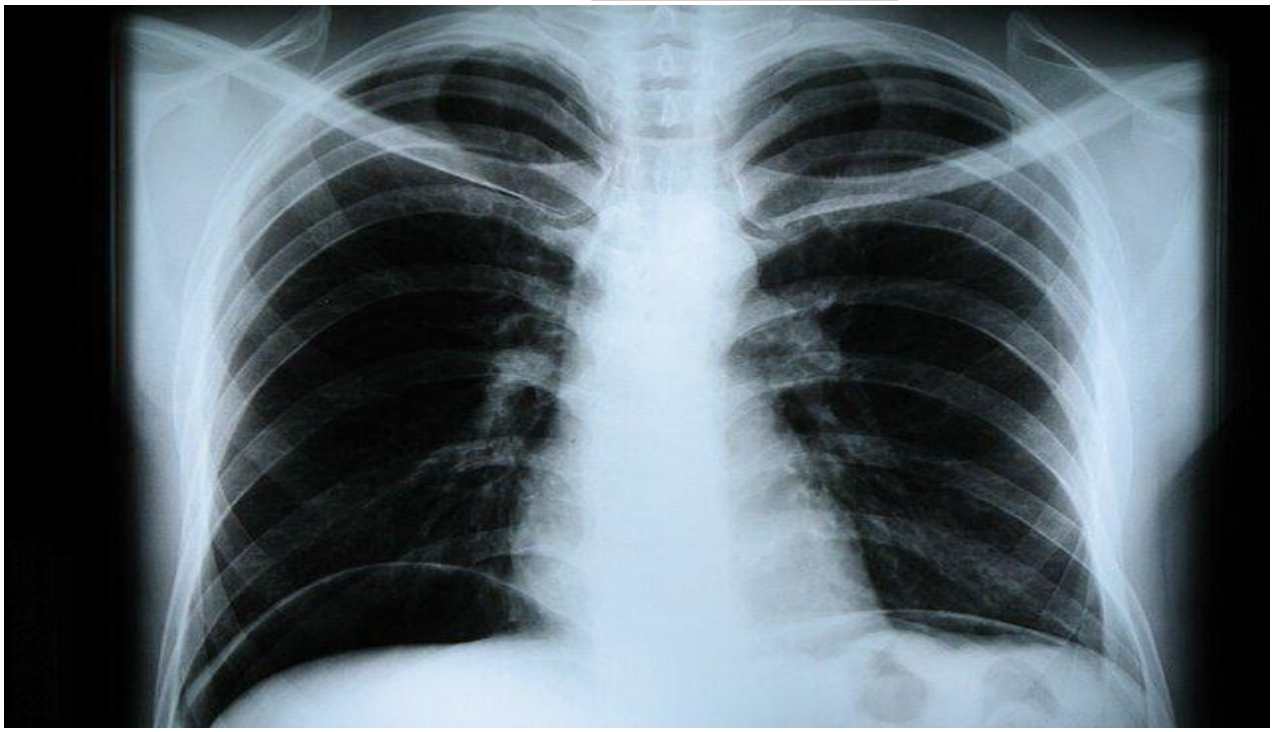
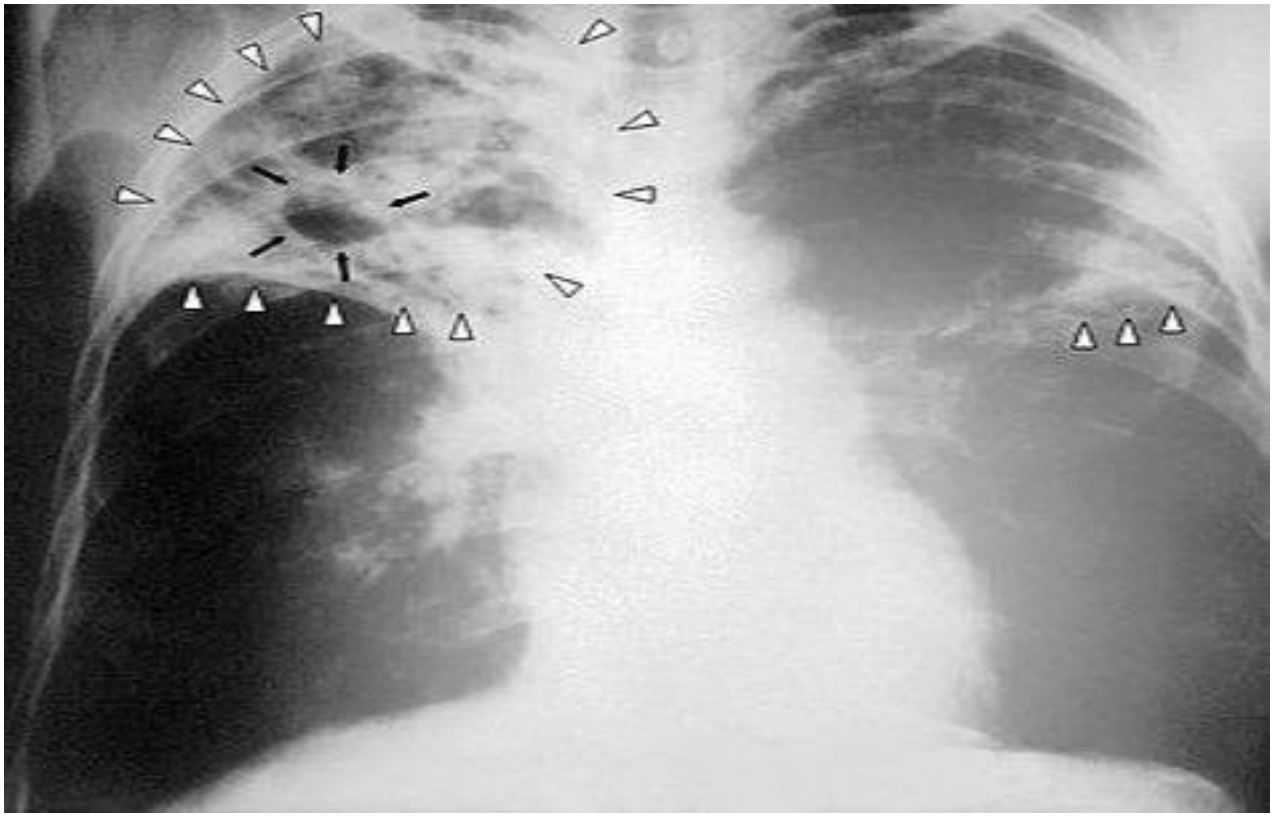


Chers X-ray of lungs affected by tuberculosis



7. Treatment

Tuberculosis treatment is long-term and requires strict adherence to medical supervision. The standard regimen consists of two main phases:
1. Intensive phase (2 months): Combination of first-line drugs – Isoniazid, Rifampicin, Pyrazinamide, and Ethambutol.
2. Continuation phase (4–7 months): Isoniazid and Rifampicin are continued.

According to WHO, TB can be classified as drug-susceptible or drug-resistant (MDR/XDR). In resistant cases, second-line drugs such as Levofloxacin, Cycloserine, Prothionamide, Pretomanid, Kanamycin, Capreomycin, Linezolid, and Bedaquiline are used. For MDR-TB patients, treatment may extend up to 10–12 months, depending on clinical progress. Alongside medical therapy, psychological support is vital for maintaining adherence.

Nutrition in Tuberculosis
Proper nutrition plays a crucial role in recovery, as TB significantly weakens the immune system. Patients should consume foods rich in proteins, fats, carbohydrates, vitamins, and minerals.

Recommended foods:
- Meat (beef, lamb, chicken, fish – steamed or boiled)
- Eggs (1–2 per day)
- Dairy products (milk, yogurt, kefir, cottage cheese, sour cream, cheese)
- Grains and cereals (rice, buckwheat, oats)
- Fresh fruits and vegetables, especially vitamin-rich ones

Essential vitamins:
- Vitamin A: carrots, pumpkin, spinach, greens
- Vitamin C: citrus fruits, rosehip tea, blackcurrant
- Vitamin D: sunlight exposure, fish oil
- Vitamin B complex: whole grains, liver

Foods to avoid: Alcohol, smoking, spicy, salty, or fatty foods, carbonated beverages, and excessively hot or cold dishes.

Dietary regimen: Eat 4–5 small meals a day, always warm and fresh. Drink 1.5–2 liters of fluids daily to flush toxins and maintain hydration.

8. Prevention
Tuberculosis prevention includes both primary and secondary measures. Primary prevention involves: BCG vaccination; maintaining personal and environmental hygiene; proper nutrition and a healthy lifestyle. Secondary prevention focuses on early detection and treatment of latent infections, as well as strict infection control in healthcare settings through isolation of contagious patients, disinfection of rooms, and proper air filtration and ventilation.

Conclusion
Tuberculosis remains a global health challenge. Combating it requires early diagnosis, complete and correct treatment, reduction of drug resistance, and public health education. Through effective national policies, medical innovations, and international cooperation, tuberculosis can be controlled and eventually eliminated. Despite its severity, TB is a curable disease — provided that patients strictly follow medical prescriptions, complete their treatment courses, and maintain proper nutrition and hygiene.

References:
1. World Health Organization (WHO). Global Tuberculosis Report, 2024.
2. Ministry of Health of the Republic of Uzbekistan. National Tuberculosis Control Program Reports, 2023–2024.
3. Murray, P. R. et al. Medical Microbiology. Elsevier, 2023.
4. Koch, R. (1882). Die Aetiologie der Tuberkulose. Berliner Klinische Wochenschrift.
5. Lawn, S. D., & Zumla, A. (2019). Tuberculosis. The Lancet, 393(10181), 1642–1656.