# CHAPTER-19

# Infection Diseases-I

**Dr. Surya Prakash Gupta**

Professor & Director
Rajiv Gandhi Institute of Pharmacy
Faculty of Pharmaceutical Science & Technology
AKS University, Satna (M.P.).

## Abstract

Infectious diseases significantly impact global health, with tuberculosis (TB) and urinary tract infections (UTIs) being prevalent examples. Tuberculosis is a bacterial infection caused by Mycobacterium tuberculosis, primarily affecting the lungs but can spread to other organs. The pathophysiology involves the inhalation of airborne droplets, leading to the formation of granulomas in the lungs where the bacteria can remain dormant or become active. Epidemiologically, TB is a major health issue, particularly in developing countries, with significant morbidity and mortality. Symptoms include a persistent cough, weight loss, night sweats, and fever. Diagnosis is confirmed through sputum tests, chest X-rays, and tuberculin skin tests. Treatment involves a prolonged course of multiple antibiotics, typically isoniazid, rifampin, ethambutol, and pyrazinamide. Complications can include lung damage, disseminated TB, and drug-resistant TB. Prevention focuses on vaccination with Bacillus Calmette-Guérin (BCG), early detection, and appropriate treatment to reduce transmission. Urinary tract infections (UTIs) are common bacterial infections affecting the urinary system, including the bladder (cystitis) and kidneys (pyelonephritis). The pathophysiology involves the ascent of bacteria, usually Escherichia coli, from the urethra to the bladder and potentially to the kidneys. Epidemiologically, UTIs are more common in women due to anatomical differences, with a significant incidence in sexually active women and the elderly. Symptoms include frequent and painful urination, urgency, and lower abdominal pain. Pyelonephritis may present with fever, flank pain, and nausea. Diagnosis is confirmed through urine analysis and culture. Treatment involves antibiotics, with the choice depending on the severity and location of the infection. Complications can include recurrent infections, kidney damage, and sepsis. Prevention strategies include proper hydration, urinating after sexual activity, and maintaining good personal hygiene.

## I. INTRODUCTION

Tuberculosis (TB) is a contagious bacterial infection caused by *Mycobacterium tuberculosis*. It primarily affects the lungs (pulmonary TB) but can also affect other parts of the body (extrapulmonary TB). TB is a major global health problem, causing significant morbidity and mortality, especially in developing countries.

**Pathophysiology**

1. **Infection and Spread:** *Mycobacterium tuberculosis* is transmitted via airborne droplets when an infected person coughs, sneezes, or talks. Inhaled bacteria reach the alveoli of the lungs.
2. **Immune Response:** Macrophages engulf the bacteria but may fail to destroy them, leading to the formation of granulomas (tubercles) to contain the infection.
3. **Latent TB Infection:** In most cases, the immune system controls the infection, leading to a latent TB infection (LTBI), where the bacteria remain dormant without causing symptoms.
4. **Active TB Disease:** If the immune system becomes weakened, the bacteria can reactivate, causing active TB disease with symptomatic and transmissible infection.

**Epidemiology**

1. **Global Distribution:** TB is found worldwide, with the highest prevalence in sub-Saharan Africa, Southeast Asia, and Eastern Europe.
2. **Incidence:** The World Health Organization (WHO) estimates around 10 million new TB cases and 1.4 million TB-related deaths annually.
3. **Risk Factors:** HIV infection, diabetes, malnutrition, smoking, and close contact with TB patients increase the risk of developing TB.

**Symptoms and Complications**

1. **Pulmonary TB**
   a. **Symptoms:** Persistent cough (lasting more than three weeks), hemoptysis (coughing up blood), chest pain, fatigue, weight loss, night sweats, and fever.

2. **Extrapulmonary TB**
   a. **Symptoms:** Depend on the affected organ; can include lymphadenopathy, pleuritic chest pain, abdominal pain, bone and joint pain, and neurological symptoms.

3. **Complications**
   a. **Respiratory Failure:** Due to extensive lung damage.
   b. **Miliary TB:** Disseminated TB causing widespread infection in multiple organs.
   c. **TB Meningitis:** Infection of the meninges leading to severe neurological complications.
   d. **Pericarditis:** TB infection of the pericardium causing pericardial effusion and tamponade.

**Diagnosis**

1. **Clinical Evaluation:** Assessment of symptoms and medical history, including exposure to TB.

2. **Microbiological Tests**
   a. **Sputum Microscopy:** Acid-fast bacilli (AFB) staining.
   b. **Culture:** Gold standard for TB diagnosis, though it takes several weeks.
   c. **Nucleic Acid Amplification Tests (NAATs):** Rapid and specific detection of *M. tuberculosis* DNA.

3. **Imaging**
   a. **Chest X-ray:** To identify lung abnormalities consistent with TB.
   b. **CT Scan:** For detailed imaging, especially in extrapulmonary TB.

4. **Tuberculin Skin Test (TST)** and **Interferon-Gamma Release Assays (IGRAs):** Used to detect latent TB infection.

**Treatment**

1. **First-line Anti-TB Drugs**: Standard regimen includes a combination of:
   a. **Isoniazid (INH)**
   b. **Rifampicin (RIF)**
   c. **Pyrazinamide (PZA)**
   d. **Ethambutol (EMB)**
   e. Initial intensive phase (2 months) followed by a continuation phase (4 months) with INH and RIF.

2. **Drug-Resistant TB**
   a. **Multidrug-Resistant TB (MDR-TB):** Resistant to at least INH and RIF, requiring second-line drugs like fluoroquinolones and injectable agents.
   b. **Extensively Drug-Resistant TB (XDR-TB):** Resistant to first-line and several second-line drugs, needing more complex and prolonged treatment regimens.
3. **Supportive Care**: Nutritional support, management of side effects, and treatment of comorbid conditions.

**Complications**

1. **Chronic Pulmonary TB:** Leading to extensive lung damage, fibrosis, and respiratory failure.
2. **Relapse:** Recurrence of TB after successful treatment, often due to incomplete treatment or drug resistance.
3. **Disseminated TB:** Spread of TB to multiple organs, causing systemic illness.
4. **Social and Economic Impact:** Stigma, loss of productivity, and financial burden on patients and their families.

**Prevention**

1. **BCG Vaccination:** Bacille Calmette-Guérin (BCG) vaccine provides some protection against TB, especially severe forms in children.
2. **Infection Control Measures**
   a. **Early Detection and Treatment:** Prompt identification and treatment of active TB cases to reduce transmission.
   b. **Isolation of Infectious Patients:** In healthcare settings and at home to prevent spread.
   c. **Use of Personal Protective Equipment (PPE):** For healthcare workers and caregivers.
3. **Public Health Education:** Raising awareness about TB transmission, symptoms, and the importance of completing treatment.
4. **Screening and Prophylaxis**:
   a. **Latent TB Infection:** Screening high-risk individuals (e.g., HIV-infected, close contacts of TB patients) and providing prophylactic treatment to prevent progression to active disease.

## II. URINARY TRACT INFECTIONS

### Introduction

Urinary tract infections (UTIs) are infections that affect any part of the urinary system, including the kidneys, ureters, bladder, and urethra. Most UTIs involve the lower urinary tract—the bladder and the urethra. UTIs are more common in women than men and can range from asymptomatic bacteriuria to severe kidney infections.

### Pathophysiology

1. **Entry and Colonization:** Pathogens typically enter the urinary tract through the urethra and begin to multiply in the bladder. The most common causative organism is *Escherichia coli* (E. coli), which is part of the normal gastrointestinal flora.
2. **Ascending Infection:** The bacteria can ascend from the bladder to the kidneys, causing pyelonephritis, a more severe infection.
3. **Host Defense Mechanisms:** The body has several defense mechanisms, including the flow of urine, the urinary tract's mucosal lining, and the immune response to prevent infections. When these defenses are compromised, UTIs are more likely to occur.

### Epidemiology

1. **Incidence:** UTIs are one of the most common infections, particularly among women. It is estimated that nearly 50-60% of women will experience a UTI at some point in their lives.
2. **Risk Factors:** Sexual activity, certain types of birth control (such as diaphragms), menopause, urinary tract abnormalities, blockages in the urinary tract, a suppressed immune system, catheter use, and recent urinary procedures.

### Symptoms and Complications

1. **Lower UTI (Cystitis)**
   a. **Symptoms:** Dysuria (painful urination), frequent urination, urgency, cloudy or strong-smelling urine, hematuria (blood in the urine), and lower abdominal discomfort.

2. **Upper UTI (Pyelonephritis)**
   a. **Symptoms:** Fever, chills, flank pain, nausea, vomiting, and severe cases can include signs of sepsis.

3. **Complications**
   a. **Recurrent Infections:** Multiple UTIs, particularly in women.
   b. **Chronic Kidney Disease:** Repeated or severe kidney infections can lead to permanent kidney damage.
   c. **Sepsis:** A severe and potentially life-threatening response to infection.
   d. **Pregnancy Complications:** Increased risk of delivering low birth weight or premature infants.

### Diagnosis

1. **Clinical Evaluation:** Assessment of symptoms and medical history.
2. **Urine Tests**
   a. **Urinalysis:** Detection of pyuria (white blood cells in the urine), bacteriuria, hematuria, and nitrites.

   b. **Urine Culture:** Identifies the specific causative organism and its antibiotic sensitivities.
3. **Imaging**:
   a. **Ultrasound or CT Scan:** Used in complicated UTIs to assess for structural abnormalities, obstructions, or abscesses.
4. **Special Tests**:
   a. **Cystoscopy:** In cases of recurrent UTIs to visualize the bladder and urethra.

**Treatment**

1. **Antibiotic Therapy**
   a. **Uncomplicated UTIs:** Short-course antibiotics such as trimethoprim/sulfamethoxazole, nitrofurantoin, or fosfomycin.
   b. **Complicated UTIs:** Longer courses and possibly intravenous antibiotics, depending on the severity and the patient's health status.
   c. **Pyelonephritis:** Requires longer courses of antibiotics, often starting with intravenous therapy followed by oral antibiotics.

2. **Supportive Care**:
   a. **Hydration:** Encouraging fluid intake to help flush the urinary system.
   b. **Pain Relief:** Analgesics such as phenazopyridine can help relieve pain and discomfort.

3. **Treatment of Underlying Conditions:** Addressing any structural abnormalities or other risk factors contributing to recurrent infections.

**Complications**

1. **Recurrent Infections:** Frequent UTIs may lead to a cycle of reinfection.
2. **Kidney Damage:** Chronic or severe infections can cause permanent kidney damage.
3. **Urethral Stricture:** Scarring and narrowing of the urethra.
4. **Sepsis:** Particularly in the case of pyelonephritis, untreated UTIs can lead to systemic infection and sepsis, a life-threatening condition.

**Prevention**

1. **Hydration:** Drinking plenty of fluids, especially water, to help flush out bacteria from the urinary tract.
2. **Hygiene Practices:** Wiping from front to back after urination and bowel movements to prevent bacteria from the anus from entering the urethra.
3. **Urination Habits:** Urinating frequently and not holding urine for extended periods; urinating immediately after sexual intercourse to help clear bacteria.
4. **Avoiding Irritants:** Avoiding the use of potentially irritating feminine products such as deodorant sprays, douches, and powders.
5. **Prophylactic Antibiotics:** In certain cases of recurrent UTIs, low-dose antibiotics may be prescribed for a period of time.
6. **Cranberry Products:** Some studies suggest that cranberry juice or supplements may help reduce the risk of recurrent UTIs, although evidence is mixed.