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DEPARTMENT OF BIOMEDICAL ENGINEERING

VII Semester

OBT357 BIOTECHNOLOGY IN HEALTH

CARE UNIT- 2 CLINICAL DISEASES

2.3 Communicable diseases: Tuberculosis

- Tuberculosis (TB) is an infectious disease caused by the bacterium Mycobacterium tuberculosis.
- It primarily affects the lungs but can also impact other parts of the body, such as the kidneys, spine, or brain.
- TB spreads through the air when an infected person coughs, speaks, or sneezes, releasing droplets containing the bacteria.

2.3.1 Types of TB:

- **Latent TB**: The bacteria are present in the body but inactive, causing no symptoms and not contagious.
- **Active TB**: The bacteria cause symptoms and can be contagious. Symptoms include persistent cough (sometimes with blood), chest pain, weight loss, fever, night sweats, and fatigue.

2.3.2 Symptoms and causes:

Symptoms of Tuberculosis:

- Bad Cough (Lasting longer than two weeks)
- Chest Pain
- Coughing up Blood
- Fatigue/weakness
- Weight loss
- Fever
- Night Sweats

Tuberculosis Causes:

Primary Cause

- **Bacterial Infection**: *Mycobacterium tuberculosis* is the main cause of TB. This slow-growing, rod-shaped bacterium is spread primarily through airborne droplets when an infected person with active TB in the lungs or throat coughs, sneezes, speaks, or sings.

Transmission:

- **Airborne Spread**: Inhaling tiny droplets containing *M. tuberculosis* from an infected person is the primary mode of transmission. Close, prolonged contact with someone who has active TB increases the risk.
- **Not Spread By**: TB is not transmitted through touching surfaces, sharing food or drinks, or casual contact

Risk Factors Contributing to TB Infection:

While *M. tuberculosis* is the direct cause, certain factors increase the likelihood

of contracting or developing active TB:

1. Weakened Immune System:
    - Conditions like HIV/AIDS, diabetes, malnutrition, or cancer suppress immunity, making it easier for latent TB to become active.
    - Medications like corticosteroids or immunosuppressive drugs (e.g., for organ transplants) also increase risk.
2. Close Contact with Infected Individuals:
    - Living or working in close quarters with someone who has active TB, such as in households, shelters, or prisons, heightens exposure risk.
3. High-Prevalence Areas:
    - TB is more common in regions with poor healthcare access, such as parts of Africa, Asia, and Eastern Europe. Crowded living conditions and poverty exacerbate spread.
4. Age and Health Status:
    - Young children, elderly individuals, and those with chronic illnesses are more vulnerable to infection or progression to active TB.
5. Substance Use:
    - Smoking, alcohol abuse, or intravenous drug use can weaken the lungs or immune system, increasing susceptibility.
6. Occupational or Environmental Exposure:
    - Healthcare workers, miners, or those exposed to silica dust are at higher risk due to frequent contact with TB patients or lung damage.

Diagnostic Tests for TB:

Diagnosing tuberculosis (TB) involves identifying either latent TB infection (LTBI) or active TB disease. The process typically combines clinical evaluation, medical history, and specific diagnostic tests. Below is a concise overview of the methods used to diagnose TB:

1. Medical History and Symptom Assessment:

- **History**: Doctors assess risk factors, such as exposure to TB, living in or traveling to high-prevalence areas, or conditions like HIV/AIDS, diabetes, or weakened immunity.
- **Symptoms** (for active TB): Persistent cough (often with blood or sputum), chest pain, fever, night sweats, weight loss, and fatigue. Latent TB usually has no symptoms.

2. Diagnostic Tests for

TB: Tests for

Latent TB

❒ **Tuberculin Skin Test (TST)** (Mantoux Test):

- A small amount of purified protein derivative (PPD) is injected under the skin of the forearm.
- After 48–72 hours, the injection site is checked for a raised, hardened area (induration).
- Positive result: Induration (not redness) of a certain size (e.g., ≥5 mm for high-risk groups, ≥10 mm for moderate risk, ≥15 mm for low risk) suggests TB exposure.
- Limitations: False positives can occur in people vaccinated with BCG or exposed to non-TB mycobacteria.

❒ Interferon-Gamma Release Assays (IGRAs):

- Blood tests (e.g., QuantiFERON-TB Gold, T-SPOT.TB) measure immune response to TB-specific antigens.
- More specific than TST, with fewer false positives from BCG vaccination.
- Results are typically available within 24 hours.
- Used to confirm latent TB or exposure.

Tests for Active TB:

❖ Chest X-ray:

- ✓ Used to detect lung abnormalities suggestive of active TB, such as cavities or infiltrates.
- ✓ Abnormal X-ray findings prompt further testing but are not definitive alone.

❖ Sputum Smear Microscopy:

- ✓ Sputum samples are examined under a microscope for acid-fast bacilli (AFB), which are characteristic of *Mycobacterium tuberculosis*.
- ✓ Quick and inexpensive but less sensitive, missing some cases.

❖ Sputum Culture:

- ✓ The gold standard for confirming active TB. Sputum is cultured to grow

  M. tuberculosis, which can take 2–8 weeks.
- ✓ Identifies the bacteria and allows drug susceptibility testing for drug-resistant TB.

❖ **Molecular Tests** (e.g., GeneXpert MTB/RIF):

- ✓ Rapid PCR-based tests detect TB DNA and resistance to rifampicin (a key drug) in sputum within hours.
- ✓ Highly sensitive and specific, widely used for quick diagnosis of active TB and multidrug-resistant TB (MDR-TB).

❖ **Other Imaging** (e.g., CT scans, MRI):

- ✓ Used for extrapulmonary TB (TB outside the lungs, e.g., in lymph nodes, bones, or brain).

❖ Biopsy or Fluid Analysis:

- ✓ For extrapulmonary TB, tissue or fluid samples (e.g., from

lymph nodes or cerebrospinal fluid) may be tested for TB bacteria.

3. **Additional Considerations**

- **High-Risk Groups**: Testing is prioritized for people with HIV, close contacts of TB patients, healthcare workers, or those with symptoms in high-prevalence areas.
- **Drug-Resistance Testing**: If TB is confirmed, molecular tests or cultures assess resistance to drugs like isoniazid or rifampicin, critical for MDR-TB or XDR-TB.
- **Challenges**: False negatives can occur in early disease, immunocompromised patients, or extrapulmonary TB. Multiple tests may be needed for confirmation.

4. Diagnostic Process

- **Step 1**: Screen for symptoms or risk factors.
- **Step 2**: Use TST or IGRA to detect latent TB or exposure.
- **Step 3**: If active TB is suspected (e.g., symptoms or positive screening), perform chest X-ray, sputum tests, or molecular tests.
- **Step 4**: For extrapulmonary TB, imaging or biopsies are used based on symptoms.
- **Step 5**: Confirm with culture or molecular tests and assess drug resistance.

Notes:

- Accurate diagnosis requires combining test results with clinical judgment.
- In high-burden settings, WHO recommends rapid molecular tests like GeneXpert for faster, reliable results.
- If you need specifics (e.g., test availability, costs, or protocols in a certain region), I can search for real-time data or X posts to provide more details. Let me know!