TUBERCULOSIS

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Learning objectives

After working through this topic you should be able to

- Identify ways in which tuberculosis (TB) is spread;
- Describe the pathogenesis of TB;
- Identify conditions that increase the risk of TB infection progressing to TB disease;
- Define drug resistance; and
- Describe the TB classification system.

INTRODUCTION

- **Tuberculosis (TB) is a potentially fatal contagious disease that can affect almost any part of the body but is mainly an infection of the lungs.**

Latin word : -

- **“Tubercle” -- Round nodule/Swelling - Condition “Osis**
- **“Osis”-- Condition**

TUBERCULOSIS

Tuberculosis is a communicable chronic granulomatous disease caused by Mycobacterium tuberculosis.

It usually involves the lungs but may affect any organ or tissue in the body.

Central nervous system, lymphatic system, circulatory system, genitourinary system, bones, joints, and even the skin.

Causative Organisms

Mycobacterium tuberculosis

Human

Mycobacterium Bovis

Animals

CAUSATIVE ORGANISMS

- TB is an airborne disease caused by the bacterium Mycobacterium tuberculosis
- M. tuberculosis and other very closely related mycobacterial species (M. bovis, M. africanum, M. microti, M. caprae, M. pinnipedii, M. canetti and M. mungi) together comprise what is known as the M. tuberculosis complex.
- Most, but not all, of these species have been found to cause disease in humans.
- The majority of TB cases are caused by M. tuberculosis. M. tuberculosis organisms are also called tubercle bacilli.

Tuberculosis

TYPES:

- PRIMARY TUBERCULOSIS
- SECONDARY TUBERCULOSIS

PRIMARY TUBERCULOSIS

By definition, this infection occurs in an individual not previously exposed and sensitized to tubercle bacilli.

PRIMARY TUBERCULOSIS

- Seen as an initial infection, usually in children.
- The initial focus of infection is a small subpleural granuloma accompanied by granulomatous hilar lymph node infection.
- Together, these make up the Ghon complex.
- In nearly all cases, these granulomas resolve and there is no further spread of the infection.

SECONDARY TUBERCULOSIS

By definition, this is tuberculosis which becomes clinically evident in an individual already sensitized to the tubercle bacillus.

SECONDARY TUBERCULOSIS

- Seen mostly in adults as a reactivation of previous infection (or reinfection), particularly when health status declines.
- The granulomatous inflammation is much more florid and widespread.
- Typically, the upper lung lobes are most affected, and cavitation can occur.

SECONDARY TUBERCULOSIS

- Occurs when person breathes in bacteria and it reaches the air sacs (alveoli) of lung

- Immune system keeps bacilli contained and under control

- Person is not infectious and has no symptoms

SECONDARY TUBERCULOSIS

Persons more likely to progress from LTBI to TB disease include

- **HIV infected persons**
- **Those with history of prior, untreated TB**
- **Underweight or malnourished persons**
- **Injection drug use**

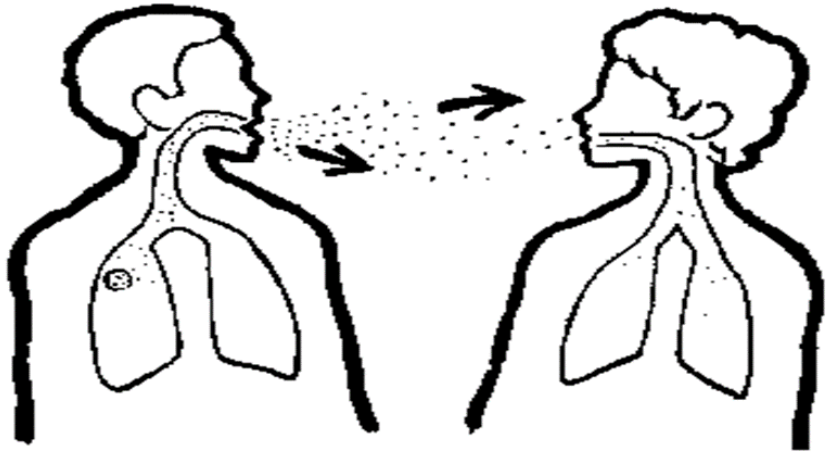
Etiology

Mycobacteria are slender rods that are acid fast:

They have a high content of complex lipids that readily bind the Ziehl-Neelson stain

Etiology

- **It is spread through the air when a person with TB (whose lungs are affected) coughs, sneezes, spits, laughs, or talks.**



TUBERCULOSIS

- **Pulmonary infection with Mycobacterium tuberculosis is acquired as a result of inhaling the tuberculosis bacillus suspended in the aerosolized sputum coughed up by an infected individual with "open" tuberculosis.**

PATHOGENESIS

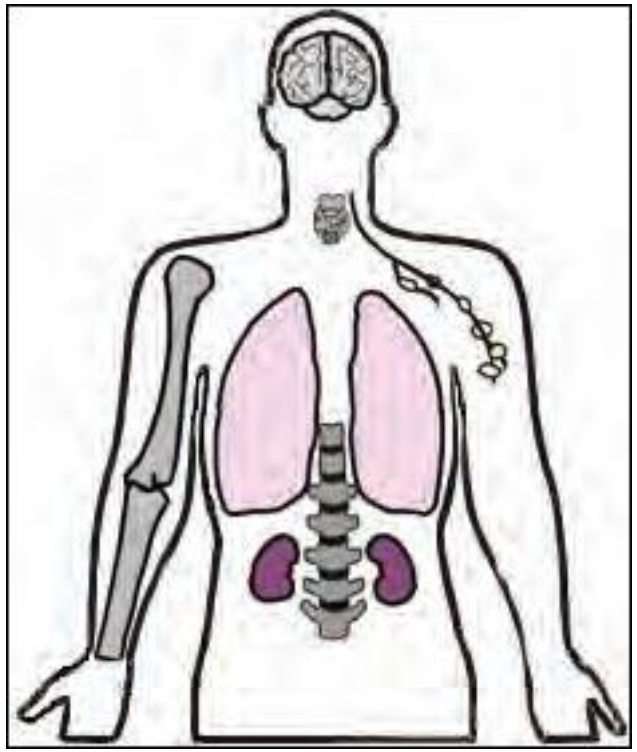
Droplet nuclei containing tubercle bacilli are inhaled, enter the lungs, and travel to the alveoli.

PATHOGENESIS

Tubercle bacilli multiply in the alveoli.

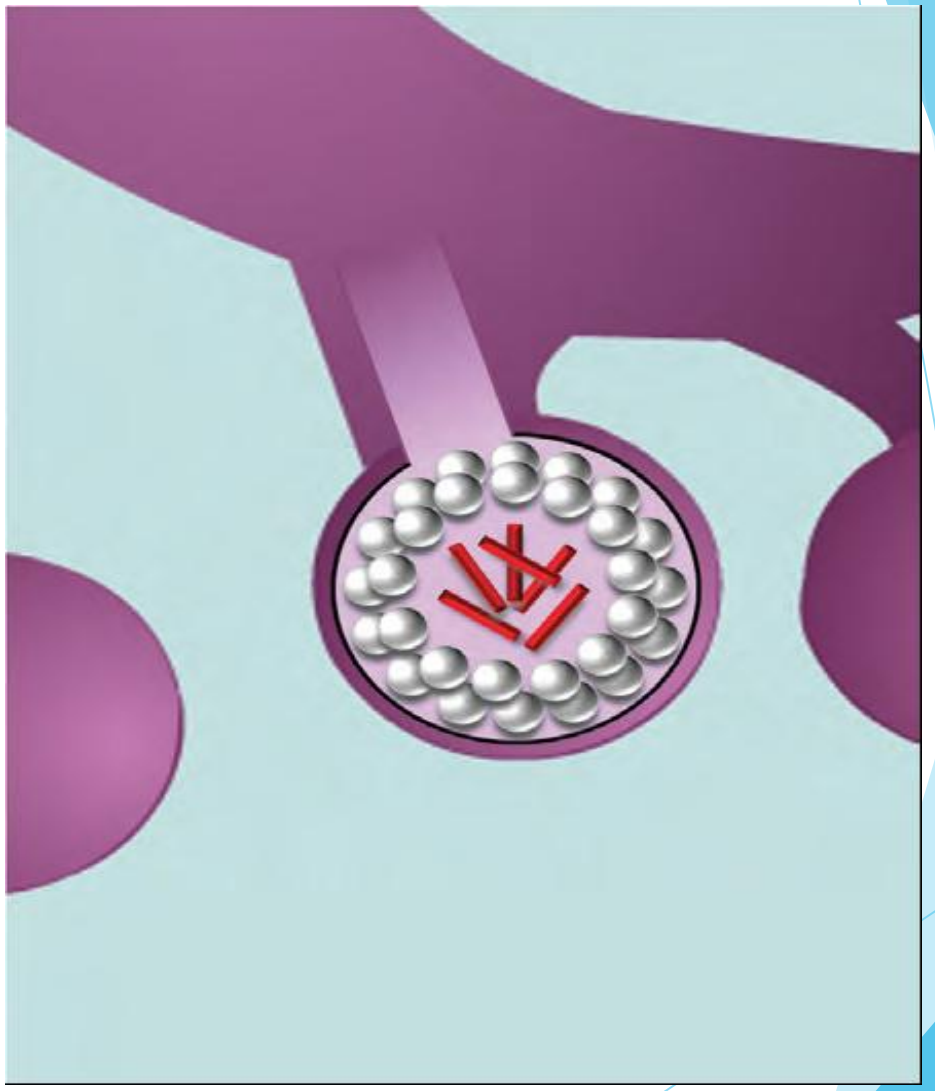
PATHOGENESIS

A small number of tubercle bacilli enter the bloodstream and spread throughout the body. The tubercle bacilli may reach any part of the body, including areas where TB disease is more likely to develop (such as the brain, larynx, lymph node, lung, spine, bone, or kidney).



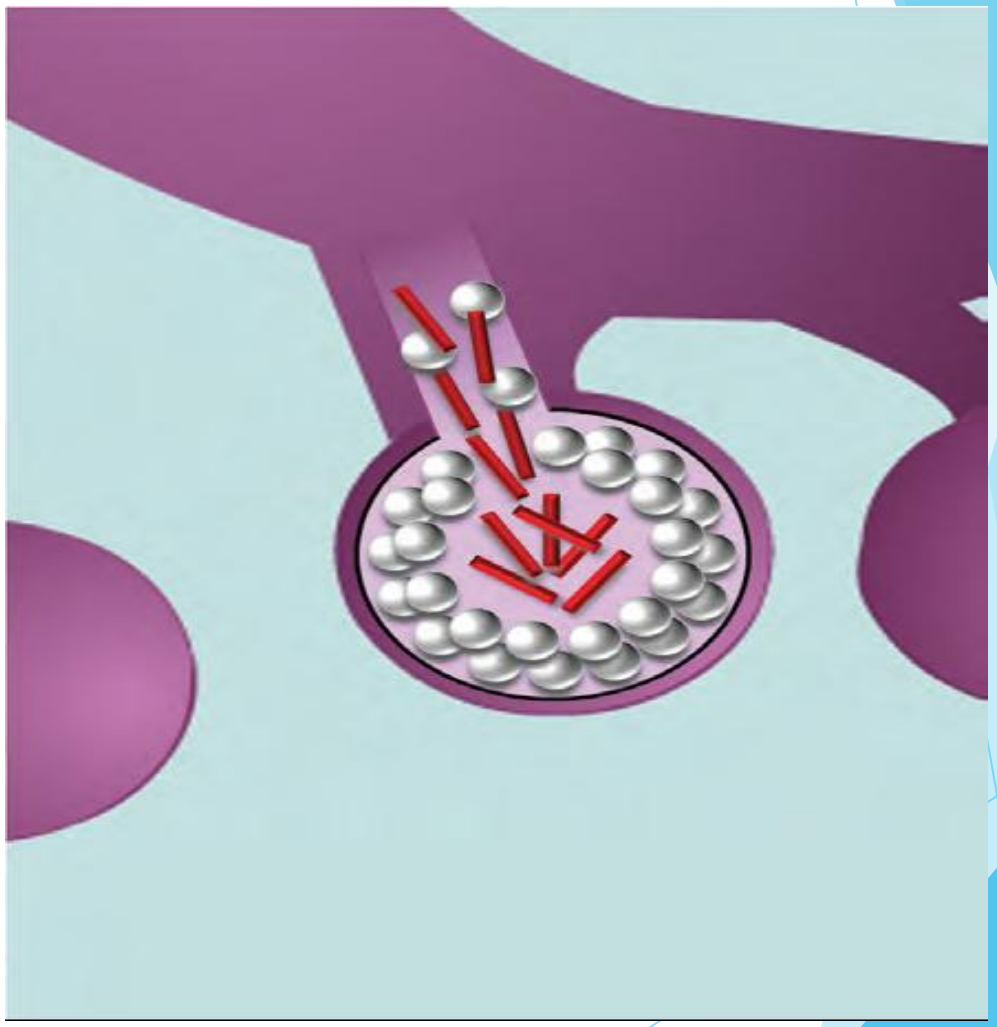
PATHOGENESIS

Within 2 to 8 weeks, special immune cells called macrophages ingest and surround the tubercle bacilli. The cells form a barrier shell, called a granuloma, that keeps the bacilli contained and under control **(LTBI)**.



PATHOGENESIS

If the immune system **cannot** keep the tubercle bacilli under control, the bacilli begin to multiply rapidly (**TB disease**). This process can occur in different areas in the body, such as the lungs, kidneys, brain, or bone



SYMPTOMS

- Symptoms of respiratory tract involvement
- • Cough
- • Sputum (mucoid, mucopurulent)
- • Haemoptysis
- • Chest pain (pleural involvement, mediastinal lymph nodes enlargement)

SYMPTOMS

General symptoms

- • Fever (active, progressive disease)
- • Night sweats
- • Loss of appetite, weight loss
- • Other symptoms: amenorrhea, stool disturbances, hoarseness, arrhythmias, erythema nodosum, conjunctivitis

PATHOLOGY

The characteristic pathologic changes depend on the type of infection or "exposure.“

- **Primary pulmonary TB**

(primary exposure) is characterized by the Ghon complex and consists of

1.) subpleural (fissure) focus of inflammation.

2.) Infected (inflamed) lymph nodes draining the primary, subpleural lesion.

PATHOLOGY

- **Secondary pulmonary TB** (reactivation) is characterized by a focus of infection and granuloma formation usually in the apex of the lung. The small granulomas (tubercles) eventually coalesce to form larger areas of consolidation with central caseating necrosis. Regional lymph nodes contain caseating granulomas.

PATHOLOGY

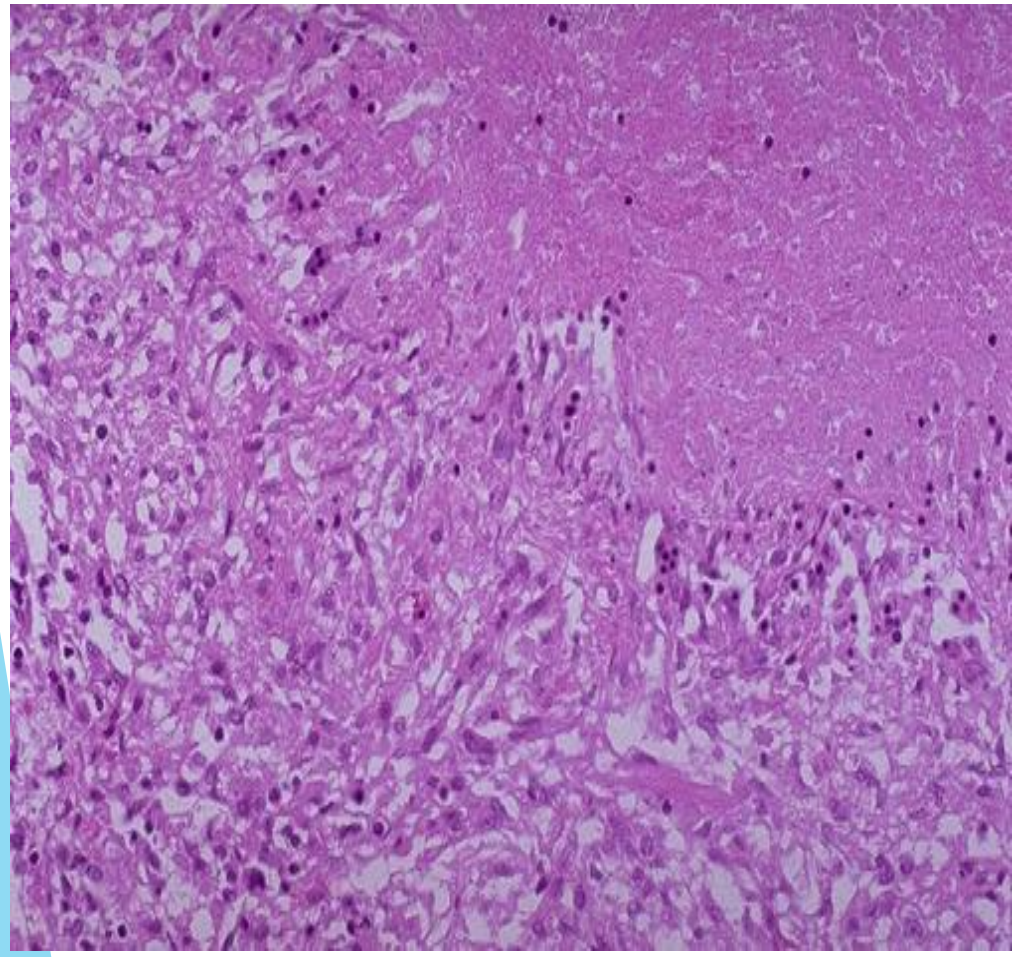
Progressive pulmonary TB:

- Primary or secondary TB may go on to heal as caseating granulomas are replaced by fibrosis and calcification.
- However, cases do not heal spontaneously or with therapy and progress to form cavities or spread to other parts of the lung and other organs of the body through lymphatic channels and the blood stream.
- This type of spread is known as miliary

MORPHOLOGY

- **Microscopically,** the inflammation produced with TB infection is granulomatous, with epithelioid macrophages and Langhans giant cells along with lymphocytes, plasma cells, maybe a few PMN's, fibroblasts with collagen, and characteristic caseous necrosis in the center.
- The inflammatory response is mediated by a type IV hypersensitivity reaction.
- This can be utilized as a basis for diagnosis by a TB skin test. An acid fast stain (Ziehl-Neelsen stains) will show the organisms as slender red rods
- The most common specimen screened is sputum, but the histologic stains can also be performed on tissues or other body fluids.
- Culture of sputum or tissues or other body fluids can be done to determine drug sensitivities.

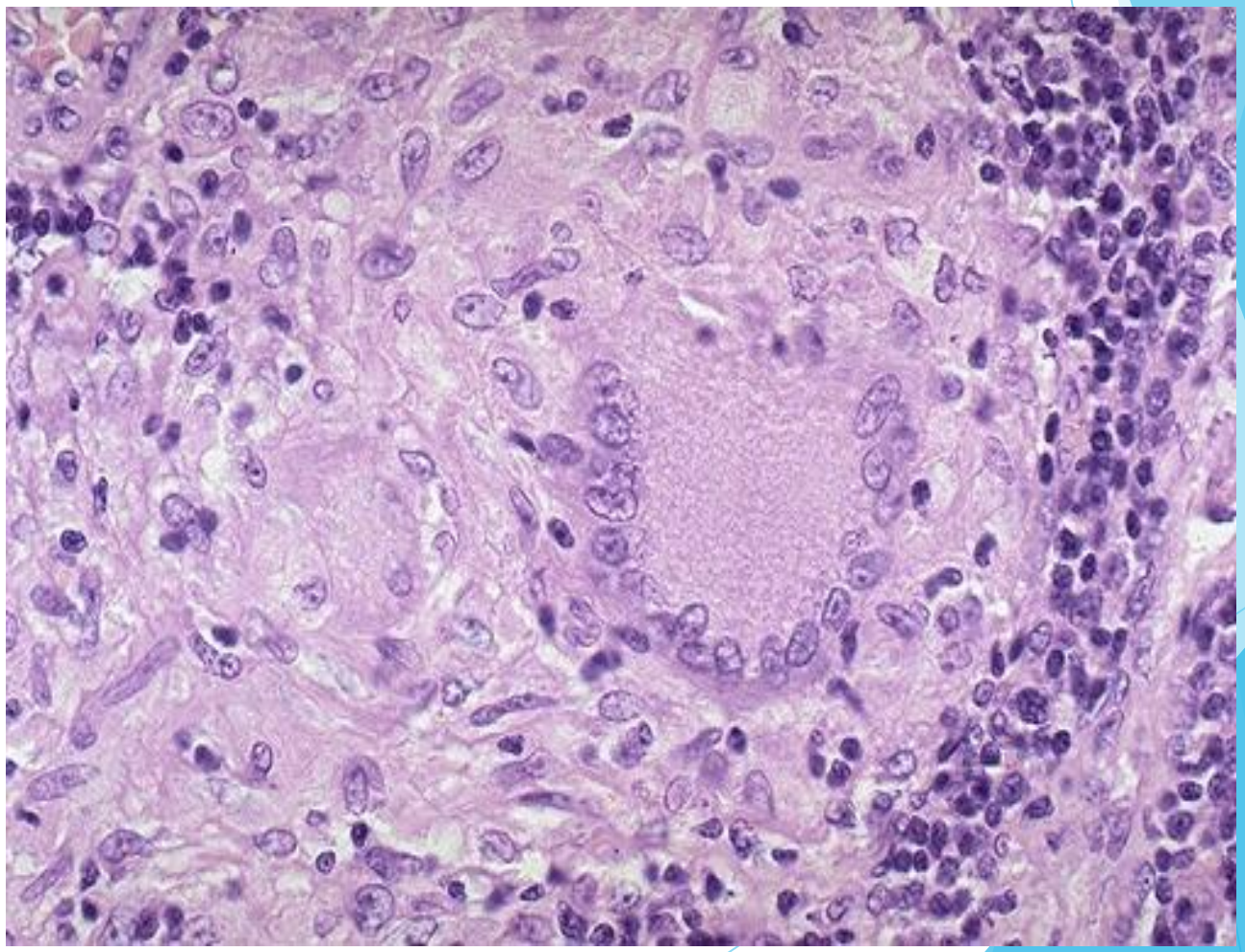
MORPHOLOGY



The pink, amorphous region in the center of this granuloma at the upper right, and ringed by epithelioid cells at the left and lower areas of this photograph. This is the microscopic appearance of caseous necrosis.

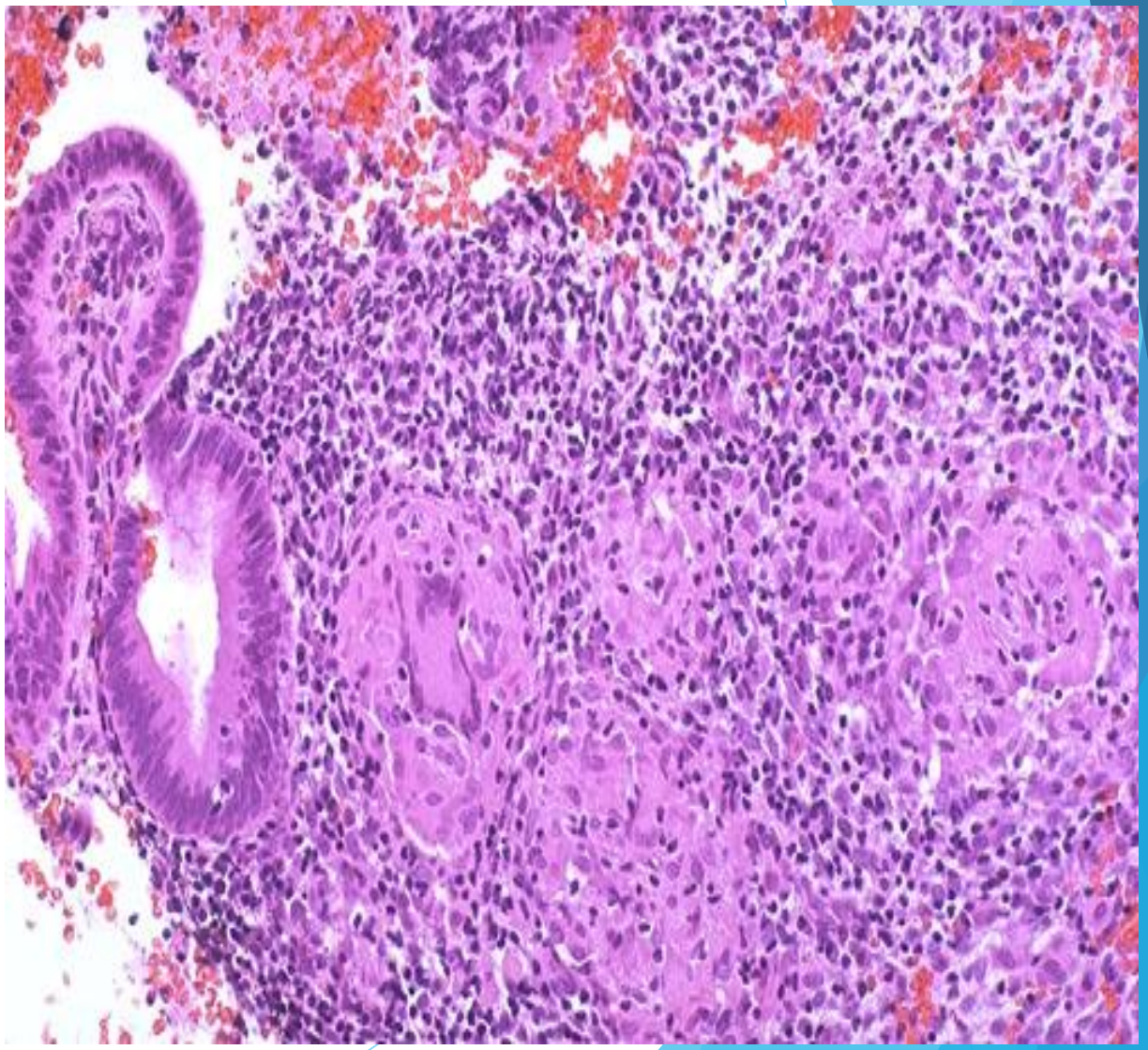
MORPHOLOGY

Elongated epithelioid cells, which are transformed from macrophages, as well as a Langhans giant cell (a committee of macrophages with the nuclei arranged at the periphery) are shown here.



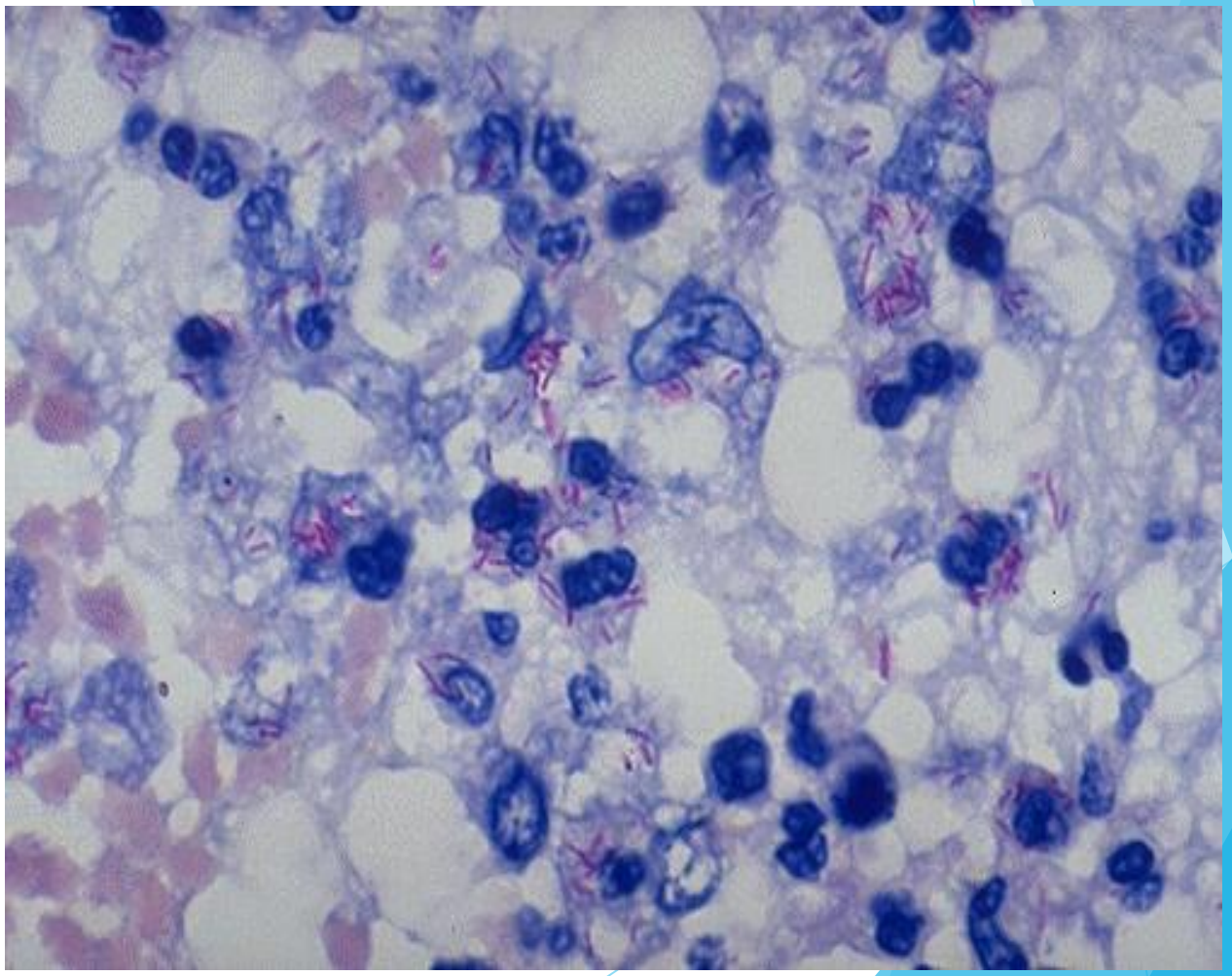
MORPHOLOGY

- Granulomas are not always well-formed, but there should at least be epithelioid cells.
- Giant cells are often present.
- Other inflammatory cell components include lymphocytes, plasma cells, and occasional neutrophils.
- Collagenization usually indicates a healing response. As granulomas heal, they can become calcified

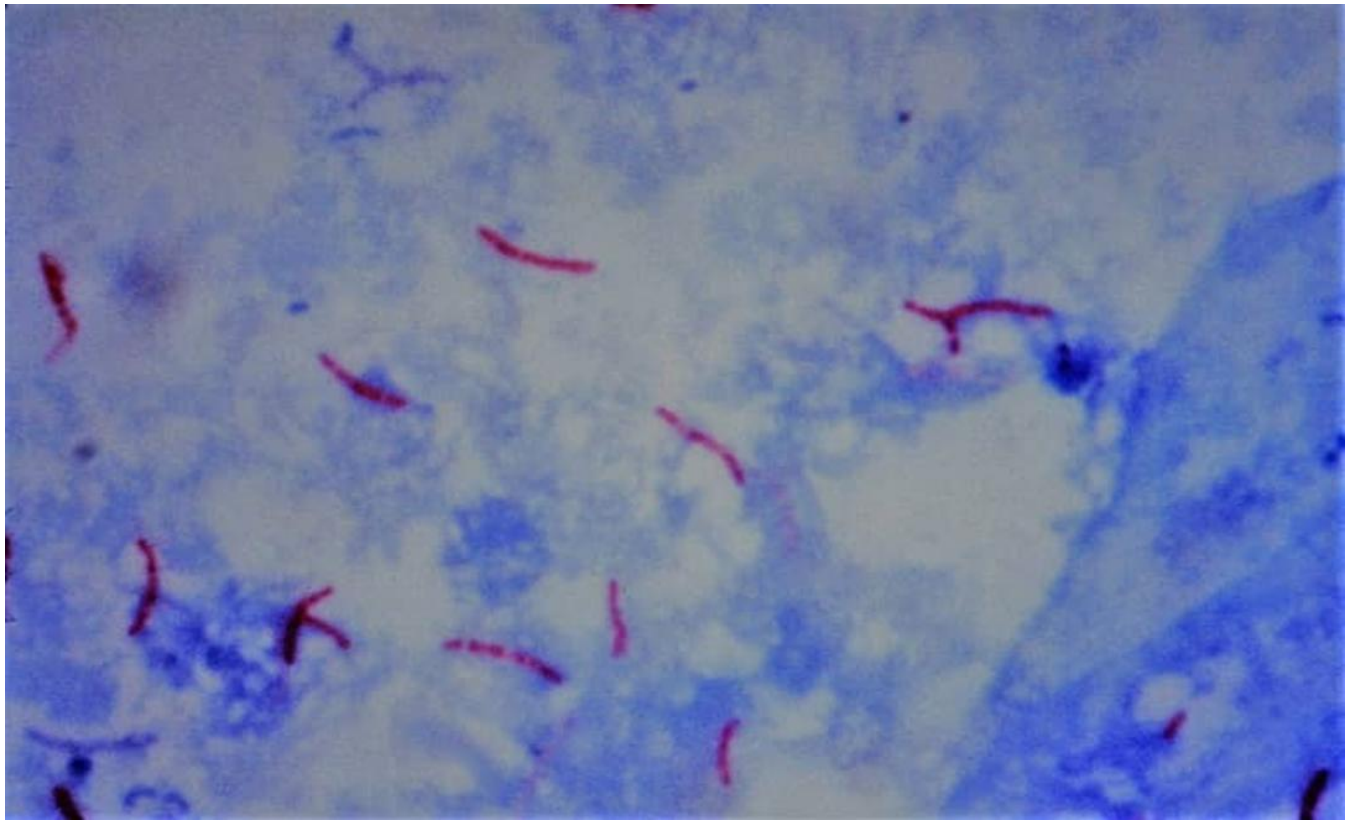


MORPHOLOGY

An acid fast stain is used to diagnose the presence of mycobacteria in tissue and cytologic preparations. Note the thin red rod-like organisms.



MYCOBACTERIUM TUBERCULOSIS



MYCOBACTERIUM TUBERCULOSIS

IMMUNE SYSTEM COMPROMISED] – AIDS or aging

↓

SPREADS TO UPPER LOBES] – Oxygenation greatest

↓

MEMORY T CELLS release CYTOKINES

↓

(more) CASEOUS NECROSIS ⇝ CAVITATES

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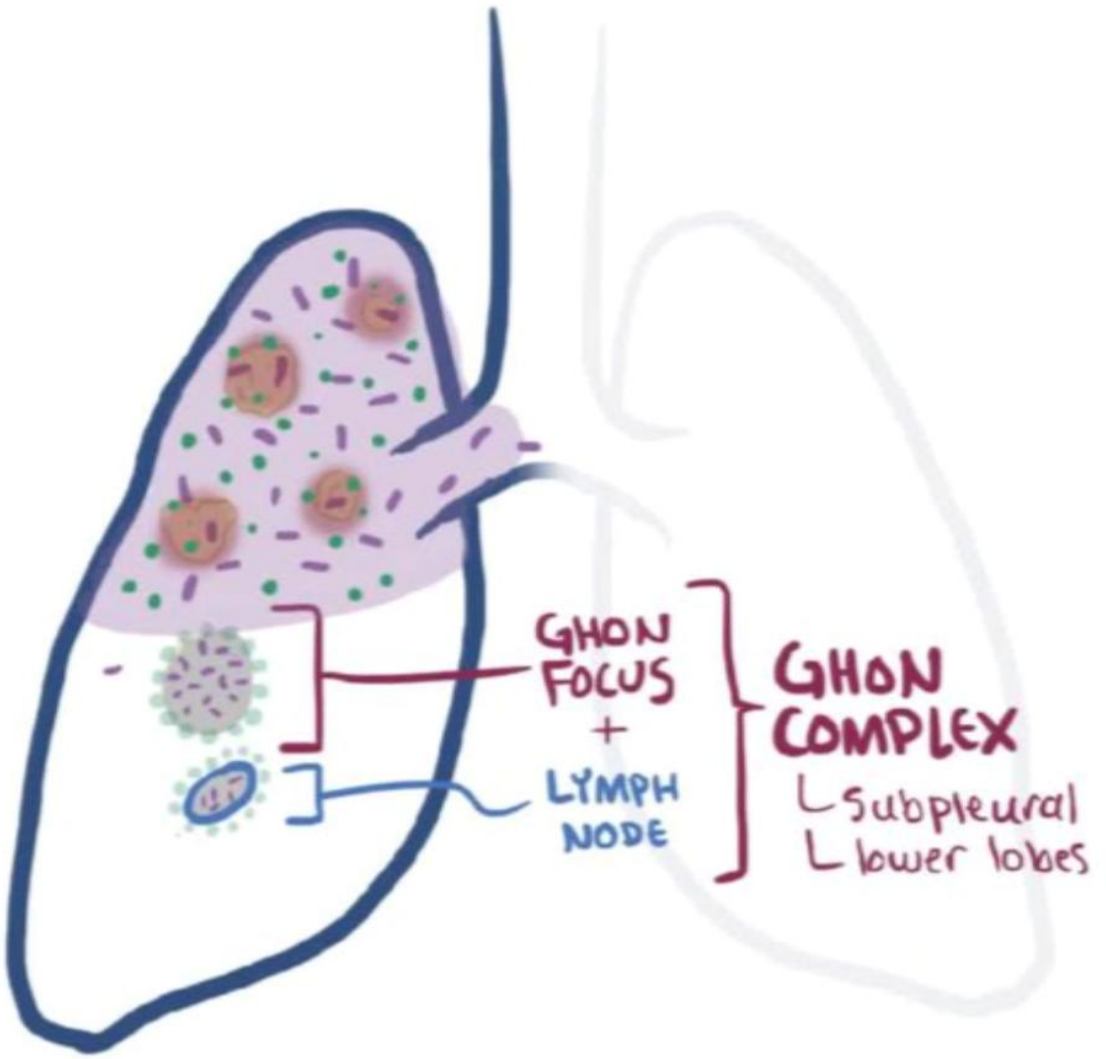
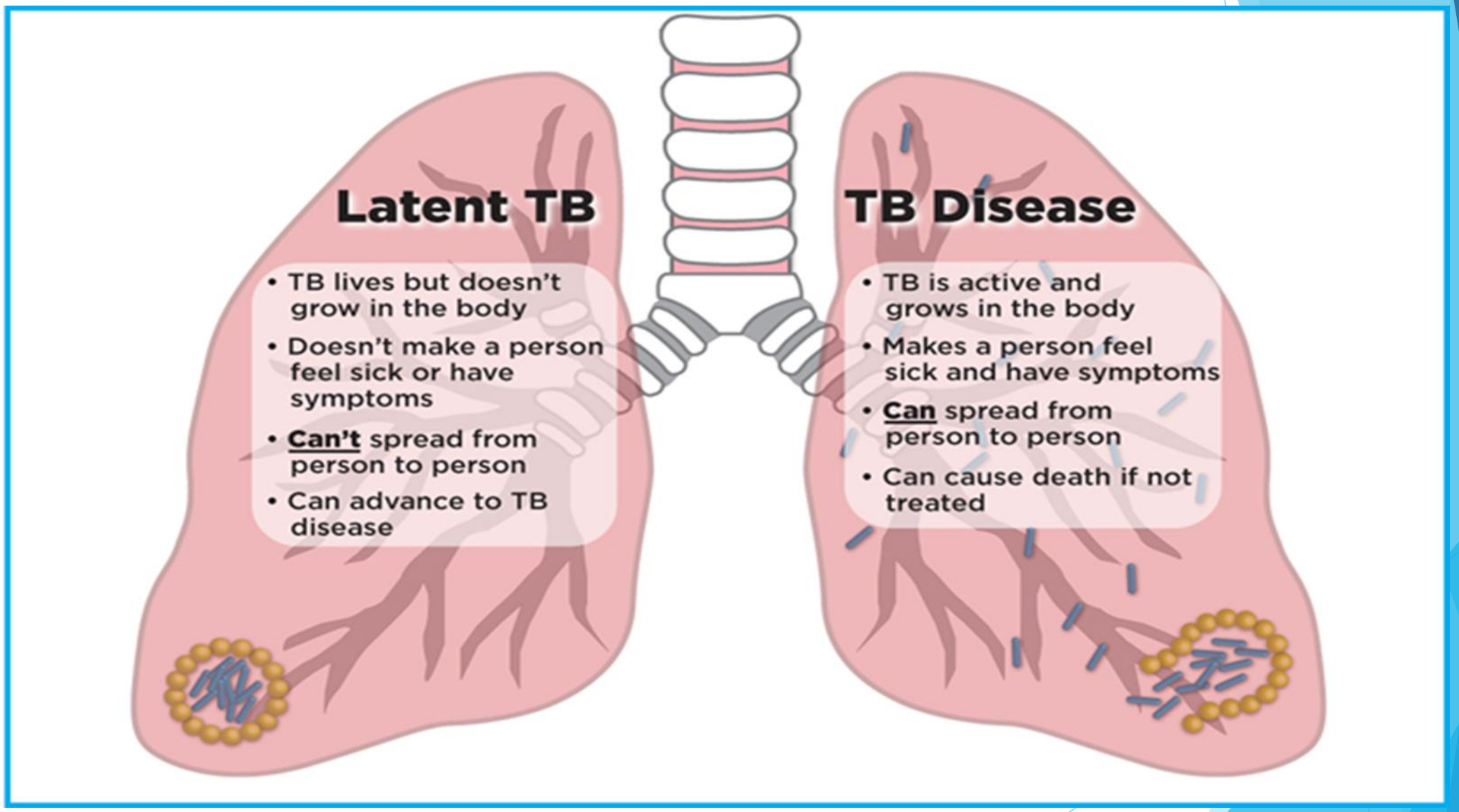
TB DISSEMINATES (SPREADS)




Latent TB
• TB lives but doesn't grow in the body
• Doesn't make a person feel sick or have symptoms
• Can't spread from person to person
• Can advance to TB disease
TB Disease
• TB is active and grows in the body
• Makes a person feel sick and have symptoms
• Can spread from person to person
• Can cause death if not treated