Pathology of pulmonary tuberculosis

Dr: Salah Ahmed

Is a chronic granulomatous disease, caused by Mycobacterium

tuberculosis (hominis)

Usually it involves lungs but may affect any organ or tissue

Transmission: 1- direct inhalation of organisms in infectious

aerosols

2- contaminated milk drinking (M. bovis)

Factors increasing the risk include:

1- poverty 2- crowding 3- old people

4- malnutrition 5- alcoholism 6- chronic debilitating illness

7- D.M 8- Hodgkin 9- HIV infection

10- immunosuppression 11- chronic lungs diseases ( silicosis )

**Pathogenesis:**

- based on development of cell-mediated immunity

- two stages:

**1- 0 – 3 weeks:**

- virulent mycobacteria enter into macrophage endosomes (mediated by receptors) they able to inhibit normal microbicidal response by:

1- arrest endosomal maturation

2- manipulation of endosomal pH

3- ineffective phagolysosome formation

- this results in:

1- bacterial proliferation within macrophages and airspaces

2- bacteremia with seeding of multiple sites

- most patients at this stage are asymptomatic or have flulike illness

**2- more than 3 weeks:**  (development of cell-mediated immunity)

- bacterial antigens reach draining lymph nodes and are presented to CD4+ T cells

- under influence of IL-12 T cells generated capable of secreting interferon gamma

- interferon gamma activates macrophages which in turn release mediators:

1- TNF: stimulates recruitment of monocytes which differentiated into epithelioid

2- NO: capable of oxidative destruction of mycobacteria

3- free radicals: can have antibacterial activity

- defect in any of the steps of T cells response (IL-12, INF, TNF, NO) results in:

1- poorly formed granulomas

2- absence of resistance and disease progression

Pathogenesis of tuberculosis

**Primary tuberculosis:**

1- is the form of disease that develops in previously unexposed to infection individual

2- common in elderly, malnourished and immunosuppressed

3- the source of organism is exogenous

4- about 5% of those newly infected persons develop significant disease

5- **Morphology:**

- the inhaled bacilli implant in the lower part

of the upper lobe or the upper part of the

lower lobe, usually close to the pleura.

**Grossly:**

i- area of gray-white inflammatory consolidation

develops (**Ghon focus**) with caseous necrosis

ii- The bacilli, either free or within phagocytes,

drain to the regional nodes, which also caseate

iii-This combination of parenchymal lesion and nodal

involvement is called (**Ghon complex**)

iv- In approximately 95% of cases, development of cell-mediated immunity controls the infection the Ghon complex undergoes fibrosis, often followed by calcification (**Ranke complex**)

**Microscopically:** caseating and noncaseating **granulomas (**tubercles) in Ghon

focus and complex

Figure:

A, B: granuloma with necrosis   
C: granuloma with no necrosis  
D: in immunocompromised individuals   
 no granuloma (sheets of histiocytes

with mycobacteria)

6- **Fate of primary tuberculosis**: either

a- is controlled with no viable bacteria (**healed lesion)**

b- the foci of scarring may harbor viable bacteria for years which become source of reactivation when host defenses compromised with development of secondary tuberculosis (**Latent lesion**)

c- uncommonly the disease may develop into **progressive primary tuberculosis** (immunocompromised individuals, malnourished children, elderly) with lymphohematogenous dissemination and development of miliary TB

**Secondary tuberculosis:**

1- develops in previously exposed (sensitized) to infection individuals

2- it may arise from:

a- reactivation of dormant primary lesion (weakened resistance), more commonly

b- exogenous reinfection

3- **Morphology:**

a- secondary tuberculosis is classically located to apex of one or both upper lobes

b- apical lesion (**Localized secondary lesion)**:

**Grossly:**  firm, gray-white with central caseation

**Microscopically:** caseating or noncaseating granuloma

4- **Fate of secondary pulmonary tuberculosis:**

a- it may heal by fibrosis (either spontaneously or after therapy)

b- or the disease may progress into:

**Progressive pulmonary tuberculosis:**

- The localized lesion enlarges with erosion into bronchi (cavity) and blood vessels ( hemoptysis)

- If treatment is adequate, the process may be arrested (healing by fibrosis)

- If the treatment is inadequate, or if host defenses are impaired, the infection may spread: 1- by direct expansion

2- via airways

3- lymphatic channels

4- vascular system

- leading to:

1- **Miliary pulmonary disease:**

- occurs when organisms through lymphatics reach the right side of the heart and then into the pulmonary arteries and into lungs

- multiple small, visible foci scattered through the lung

- complications: pleural effusion, empyema, pluritis

2- **Endobronchial, endotracheal,** **laryngeal tuberculosis:**

- may develop when organisms spread either through lymphatic channels or from expectorated infectious material

3- **Systemic miliary tuberculosis**

- occurs when organisms through pulmonary veins reach the left heart and then to systemic arterial system

- every organ in the body may be seeded

- common in the liver, bone marrow, spleen, adrenals, meninges, kidneys, fallopian tubes, and epididymis

4- **Isolated-organ tuberculosis:**

- occurs in any organ or tissue hematogenously

Secondary pulmonary tuberculosis. The upper parts of both lungs with gray-white areas of caseation and areas of cavitation.

Miliary pulmonary tuberculosis

Adrenal tuberculosis

Testicular tuberculosis

Intestinal tuberculosis

Prostate tuberculosis

Vertebral tuberculosis (Pott disease)

**Clinical course:**

- malaise, anorexia, weight loss, fever ( *low grade* and appearing late afternoon and then subsiding), and *night sweating*

- With progressive pulmonary involvement: purulent sputum, *hemoptysis*

- *Pleuritic pain*: results from extension of the infection to the pleura

- Extrapulmonary manifestations of tuberculosis depend on the organ involved

- The diagnosis:

1- the history and physical examinations

2- radiographic findings (*consolidation or cavitation)*

*3-* finding of bacilli in sputum (AFB, culture, PCR)

4- Mantoux test

Thank you