ZAPOROZHZHIAN STATE MEDICAL UNIVERSITY
The department of pathological anatomy and forensic medicine with basis of law

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Lecture on pathological anatomy for the 3-rd year students

Chronic Obstructive Pulmonary diseases (COPD) – are a group of conditions that characterized by increased resistance to airflow because of chronic or recurring expiratory obstruction.

Chronic obstructive pulmonary diseases: chronic bronchitis, bronchial astma, chronic diffuse obstructive emphysema, bronchiectatic disease.

Hypertension of pulmonary circulation and “cor pulmonale” develops in all COPD.

CHRONIC BRONCHITIS (CB)

It is present in any patient who has persistent cough with sputum production for at least 3 months in at least 2 consecutive years.

Etiologic factors:

— Endogenous factors (predisposition) include allergy, atopy, cystic fibrosis, IgA deficiency, and congenital or acquired kinociliary dysplasia in the nasotracheal and bronchial mucosa.

— Exogenous factors include primarily cigarette smoking but also airborne industrial pollutants, fog, viruses, and bacteria.

Histological features of the airways:

Chronic irritation by inhaled substances lead to:

.replacement of the ciliated epithelia with mucus-secreting goblet cells (1) in the form of goblet-cell metaplasia;

.reactive hypertrophy of the mucus glands in the bronchial wall (2);

3. excessive mucus production with mucus plugging of the lumen that contributes to airway obstruction;
4. clustering of pigmented alveolar macrophages;
5. inflammatory infiltration (3).
6. fibrosis of bronchiolar wall (4).

Outcomes and complications:

- Pulmonary emphysema;
- Right heart failure and formation of "cor pulmonale";
- Atypical metaplasia and dysplasia of the respiratory epithelium, providing a possible soil for cancerous transformation;
- Amyloidosis of kidneys;
- Development of bronchiectasis.

"Cor pulmonale"- is right ventricular hypertrophy as a result of disease that impairs the function of the lung.

BRONCHIECTASIS (BE)

BE is defined as abnormal and irreversible dilatation of the bronchi and bronchioles developing secondary to inflammatory weakening of the bronchial wall.

Etiopathogenesis of BE:

1. Endobronchial obstruction by tumor, foreign bodies, and compression by enlarged hilar lymph nodes and post-inflammatory scarring, lung fibrosis.
2. Congenital or hereditary factors, including congenital BE, cystic fibrosis, intralobar sequestration of the lung states and immune cilia, and Kartagener's syndromes.
3. Necrotizing pneumonias, most often caused by tubercle bacillus, staphylococci or mixed infections, measles may develop BE as secondary complication.

Etiopathogenesis of BE:

BE usually affects distal bronchi and bronchioles beyond the segmental bonchi.
The lungs may be involved diffusely or segmentally.
The pleura is usually fibrotic and thickened with adhesions to the chest wall. Cut surface has honey-combed appearance.
The walls of bronchi are thickened and the lumens are filled with mucus.

Classification of BE:

- Cylindrical: long, tube-like enlargements in 1 to 4 type of bronchus.
- Fusiform: having spindle-shaped bronchial dilatation.
- Saccular: having rounded sac-like distention in 6-10 types of bronchus.
- Varicous: having irregular bronchial enlargements.

The histologic findings of BE:

- An intense acute and chronic inflammatory exudation within the walls of dilated bronchi and bronchioles. The mucosa and wall is not clearly seen because of the necrotizing inflammation with destruction.
- Desquamation of the lining epithelium and extensive areas of necrotizing ulceration.
- Squamous metaplasia of the remaining epithelium.

Outcomes and complications:

1. Obstructive ventilatory insufficiency can lead to marked dyspnea and cyanosis.
2. Pulmonary hemorrhage
3. Pulmonary abscess
4. Empyema of the pleura
5. Metastatic brain abscess
6. “Cor pulmonale” and chronic cardiac-pulmonary insufficiency
7. Amyloidosis is less frequent complications of BE.

EMPHYSEMA

It is a condition of the lung characterized by abnormal permanent enlargement of the airspace distal to the terminal bronchiole and destruction of their walls, and without obvious fibrosis.

The fundamental problem is the loss of the lung's elastic recoil, causing the respiratory bronchioles to collapse upon expiration.

Pathogenesis of emphysema

Disease is accompanied with destruction of elastic and collagen fibers of lungs due to action of leukocytes proteases (in inflammation).

Thus, emphysema is seen to result from the destructive effect of the high protease activity in subjects with low antiprotease activity.

The protease-antiprotease disturbance may also be explained by the deleterious effect of cigarette smoking.

Main pathogenic mechanism is genetically determined deficiency of alpha-1-Antitripsin.

Classification of emphysema:

The following forms are differentiated according to the affected section of the pulmonary acinus:

- Centriacinar (cenrolobular) emphysema
- Panacinar emphysema
- Bullous emphysema

Types of emphysema according to cause:

- Obstructive emphysema
- Compensatory emphysema
- Senile emphysema
- Interstitial emphysema

Centriacinar (cenrolobular) emphysema

The distinctive feature of this type is the pattern of involvement of the lobules; the central or proximal parts of the acini, formed by respiratory bronchioles, are affected, whereas distal alveoli are spared.

The walls of the emphysematous spaces often contain large amount of black pigment.

Moderate-to-severe degrees of emphysema occur predominantly in heavy smokers and coal workers' pneumoconiosis , often in association with chronic bronchitis.

Panacinar emphysema

- Panacinar emphysema occurs with loss of all portions of the acinus from the respiratory bronchiole to the alveoli. This pattern is typical for alpha-1-antitrypsin deficiency.
- Panacinar emphysema produces voluminous lungs, often overlapping the heart and hiding it when the anterior chest wall is removed.
- Lungs is pale pink color.
- The crunch takes place when the lungs are cut; the pit appears after finger's pressure.

Bullous emphysema

The chest cavity is opened at autopsy to reveal numerous large bullae apparent on the surface of the lungs in a patient dying with emphysema. Bullae are large dilated airspaces that bulge out from beneath the pleura.

Emphysema is characterized by a loss of lung parenchyma by destruction of alveoli so that there is permanent dilation of airspaces.

Microscopic examination

- The abnormal fenestrations in the walls of the alveoli.
- The complete destruction of septal walls.
- The distribution of damage within the pulmonary lobule.
- Adjacent alveoli fuse, producing even larger abnormal airspaces.
- The respiratory bronchioles and vessels of the lung are deformed and compressed by the emphysematous distortion of the airspaces.
- Capillary's reducing may lead to the development of the capillary-alveolar block and pulmonary insufficiency.

Special forms of emphysema according to cause:

1. Compensatory E. This term is sometimes used to designate dilation of alveoli but not destruction of septal walls in response to loss of lung substance elsewhere.

2. Obstructive E. involves a valve mechanism. Obstructive overinflation refers to the condition in which the lung expands because air is trapped within it.

The acute form is reversible; the chronic form is irreversible.

3. Senile E. is physiologic degeneration in old age.

4. Interstitial E. The entrance of air into the connective tissue stroma of the lung, mediastinum, or subcutaneous tissue is designated interstitial emphysema.

BRONCHIAL ASTHMA (BA)

Asthma is a disease of airways that is characterized by increased responsiveness of the tracheobronchial tree to a variety of stimuli resulting in widespread spasmodic narrowing of the air passages which may be relieved spontaneously or by therapy.

BRONCHIAL ASTHMA (BA):

A severe and unremitting type of the disease termed status asthmaticus may prove fatal.

BA has traditionally been divided into two basis types:

1. *Extrinsic asthma:* there is typically an association with atopy (allergies) mediated by type 1 hypersensitivity, and asthmatic attacks are precipitated by contact with inhaled allergens. This form occurs most often in childhood.
2. *Intrinsic asthma:* asthmatic attacks are precipitated by respiratory infections, exposure to cold, exercise, stress, inhaled irritants, and drugs such as aspirin. Adults are most often affected.

PATHOGENESIS of BA:

- Chronic airway inflammation involving many cell types and inflammatory mediators accompanies the bronchial hyper-responsiveness of asthma.
- Nevertheless, the relationship of the inflammatory cells and their mediators to airway hyper-reactivity is not fully understood.

MORPHOLOGY of BA:

Grossly, the lungs are overdistended because of overinflation, and there may be small areas of atelectasis.

The most striking macroscopic finding is occlusion of bronchi and bronchioles by thick, tenacious mucous plaques.

Histologic findings of BA

1. Thickening of the basement membrane of the bronchial epithelium;
2. Edema and inflammatory infiltrate in the bronchial walls, with a prominence of eosinophils;
3. An increase in size of the submucosal glands;
4. Submucosa widened by smooth muscle hypertrophy;
5. Bronchitis and Emphysematous changes.

The classic *asthmatic attack* lasts up to several hours and is followed by prolonged coughing; the raising of copious mucous secretions provides considerable relief of the respiratory difficulty. In some patients, these symptoms persist at a low level all the time. In its most severe form, status asthmaticus, the severe acute paroxysm persists for days and even weeks, and, under these circumstances, ventilatory function may be so impaired as to cause severe cyanosis and even death.

IDIOPATHIC PULMONARY FIBROSIS

Diffuse interstitial fibrosis occurs as a result of different pulmonary diseases such as pneumoconiosis, hypersensitivity pneumonitis (“farmer's lung”, “bird fancier's disease”, “silo filler's disease”) and collagen-vascular disease. It is so called “idiopathic pulmonary fibrosis” or “cryptogenic fibrosing alveolitis” or “chronic interstitial pneumonitis”

PATHOGENESIS

The pathogenesis of idiopathic pulmonary fibrosis is unknown and the condition is diagnosed by excluding all known causes of interstitial fibrosis:

- High levels of autoantibodies such as rheumatoid factor and antinuclear antibodies.
- Elevated titres of circulating immune complexes.
- Immunofluorescent demonstration of the deposits of immunoglobulins and complement on the alveolar walls in biopsy specimens.

MORPHOLOGY:

Pathological changes are bilateral and widespread.

- Macroscopically the lungs are dense, reduced volume.
- Honey-combing (i.e. enlarged, thick-walled air spaces) develops in parts of lung. Microscopically, changes vary according to the stage of the disease with formation of hyaline membranes.
- There is edema and cellular infiltrate in the alveolar septa in early stage.
- There is organization of the alveolar exudate and replacement fibrosis in the alveoli and in the interstitial septal wall with variable amount of inflammation in advanced stage.

HYPERSENSITIVITY PNEUMONITIS

Hypersensitivity pneumonitis occur when there is an inhaled organic dust that produces a localized for of type III hypersensitivity (Arthus) reaction from antigen-antibody complexes.

Alveolar wall is enlarged with chronic inflammatory cells and giant cells

"HONEYCOMB" LUNG

Regardless of the etiology for restrictive lung diseases, many eventually lead to extensive fibrosis. The gross appearance, as seen here in a patient with organizing diffuse alveolar damage, is known as "honeycomb" lung because of the appearance of the irregular air spaces between bands of dense fibrous connective tissue.