Answer copy

Lung disease

Define the following terms:

Asthma: .....

.....

Causation: .....

.....

Correlation: .....

.....

Emphysema: .....

.....

Pulmonary fibrosis: .....

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Pulmonary tuberculosis: .....

.....

Risk factor: .....

.....

Complete the sentences using the words in bold:

aerobic **allergens** **allergic** **antibiotics** **breathing** **coincidence** **consume** **correlation** **cough** **death** **diffusion** **droplets** **dust** **elastic** **elasticity** **epithelial** **exhalation** **expand and recoil** **fibrous** **gradient** **incurable** **indirect** **infectious** **inflammatory** **longer** **merge** **mucus** **muscular** **mutate** **narrowing** **overcrowding** **pollen** **protease** **relax** **reproducing** **scar** **smaller** **smaller** **smoking** **spread** **tobacco** **tumour**

Pulmonary tuberculosis

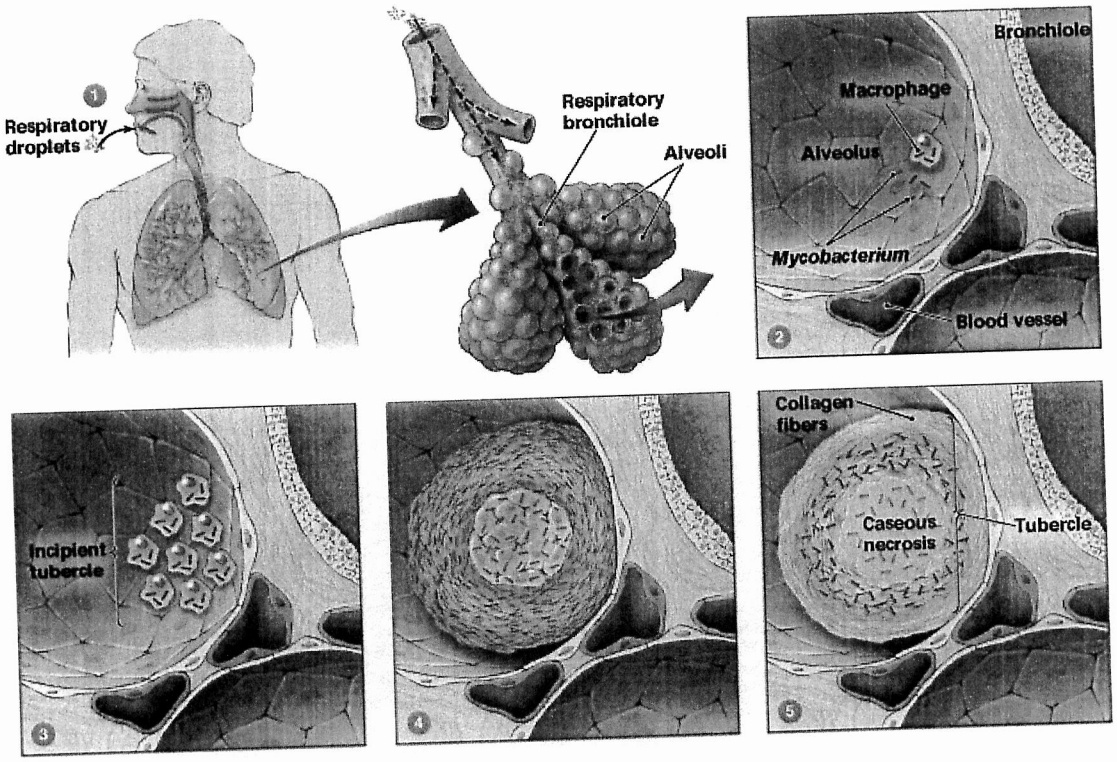
Pulmonary Tuberculosis (or TB) is an infectious disease caused by the bacterium Mycobacterium tuberculosis. In 19th-century England one in five died of TB and is still a major killer in the developing nations. The symptoms are a persistent cough with chest pains, tiredness, a loss of appetite and weight loss, and in serious cases coughing up blood, wasting away and death.

Course of Disease

1. TB is transmitted by aerosol droplets from coughs and sneezes of infected people.
2. The bacterial cells are breathed in and invade the epithelial tissue of the alveoli and bronchioles. Here they multiply to form lumps called tubercles, in which the bacteria remain alive but dormant.
3. The tubercles stimulate an inflammatory response by the white blood cells of the immune system, resulting in the formation of fibrous scar tissue. This scar tissue reduces the elasticity of the alveoli and thickens their walls, so reducing the rate of oxygen diffusion.
4. After a delay of months to years the bacteria emerge from the tubercles and start reproducing inside the lung epithelial cells, killing them. The damaged alveoli have a smaller surface area, so further reducing the rate of gas exchange.
5. The TB bacteria can also spread through the bloodstream to other organs, which are destroyed as well. This causes weakness as the body wastes away and the bacteria appear to "consume" the body.

Risk Factors

The main risk factor for TB is overcrowding, such as in slums or hospitals, as this allows TB to spread rapidly between hosts. Other factors include poor diet and AIDS, as these both impair the immune system. Since it is a bacterial disease, TB can be treated by antibiotics, and can also be prevented by the BCG vaccine. Unfortunately, the incidence of TB is currently rising due to resistance of the bacterium to antibiotics.



Pulmonary Fibrosis

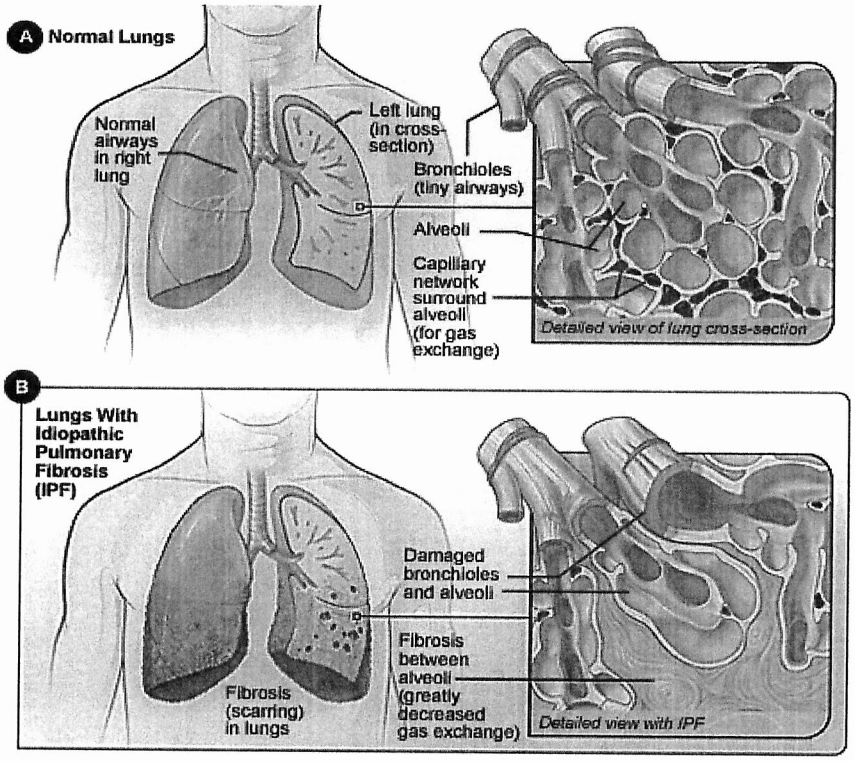
Pulmonary fibrosis is a severe shortness of breath caused by inhalation of fine dust particles or chemicals.

Course of Disease

1. The particles stimulate an inflammatory response in the lungs, which results in the growth of fibrous scar tissue around the alveoli.
2. This scar tissue thickens the alveolar walls so that there is a longer diffusion pathway and a smaller surface area for oxygen diffusion.
3. The scar tissue also reduces the elasticity of the alveoli so normal exhalation is prevented. This means there is a smaller oxygen diffusion gradient, so less oxygen reaches the blood.

Risk factors

Risk factors include exposure to fine dust particles, such as in coal mines.



Asthma

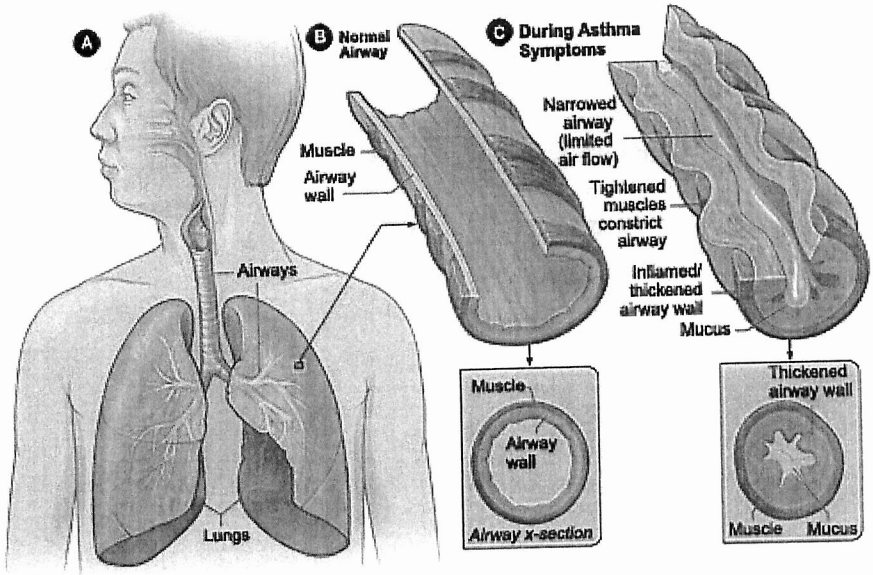
Asthma is an allergic response that causes difficulty breathing, wheezing, tight chest and coughing. It is thought to affect 10% of the world's population.

Course of Disease

1. Asthma is caused by allergens in the environment, including pollen, dust mites faeces and fur.
2. These allergens trigger an inflammatory response by the immune system, which causes the smooth circular muscles of the bronchioles to contract, narrowing the airways.
3. The epithelial cells also secrete more mucus, which further blocks the airways.
4. The constrictions reduce the tidal volume, so alveolar air is only replaced slowly. The oxygen concentration gradient across the alveolar epithelium is reduced, so the rate of diffusion is reduced. Less oxygen diffuses into the blood, so less oxygen is available for aerobic respiration.

Risk Factors

The risk factor for asthma is exposure to allergens. Other factors that can contribute to asthma include polluting gases like sulphur dioxide, exercise, cold weather, infection and stress. Asthma can be treated by inhaling drugs that relax the smooth muscles and by anti-inflammatory drugs.

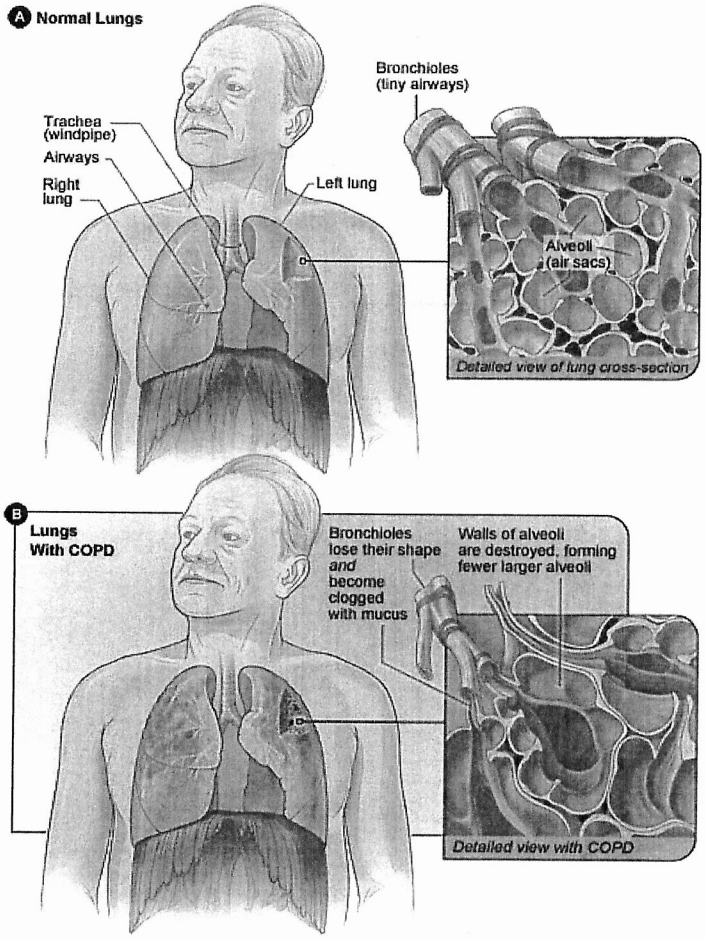


Emphysema

Emphysema is a lung disease characterised by severe breathing difficulties. It caused by smoking and 20% of all smokers suffer from emphysema and it kills 20,000 people per year in the UK.

Course of Disease

1. The tar in cigarette smoke stimulates the white blood cells to release inflammatory protease enzymes in the lungs.
2. These enzymes digest the elastic tissue in the epithelial cells of the alveoli. The alveoli can no longer expand and recoil, reducing the tidal volume in ventilation. This reduces the oxygen diffusion gradient, so less oxygen diffuses into the blood.
3. In more severe cases the epithelial cells are completely destroyed, so alveoli merge to form large air sacs with a much smaller surface area and thicker walls. These all reduce the rate of oxygen diffusion, so less oxygen is available for cellular respiration and muscular activity is very difficult.



Risk Factors

By far the most important risk factor for emphysema is smoking. Emphysema is incurable, though giving up smoking prevents the symptoms getting any worse.

Smoking and lung cancer

Lung cancer is the growth of excess tissue in the lungs due to uncontrolled cell division of the epithelial cells. Mutagenic agents in the environment cause epithelial cells to mutate and start to divide continuously and uncontrollably, forming a tumour. As the tumour grows it can constrict the bronchioles and alveoli, so slowing the rate of gas exchange. Lung cancers often spread to other parts of the body and are a major cause of death in the developed world.

Risk Factors

The risk factor for lung cancer is exposure to the mutagenic agents. These agents include tobacco smoke, asbestos and radon gas, which is present in the air of some locations.

Correlation and causation

The first step to identifying risk factors for a particular disease is to look for a correlation (or association) between the incidence of the disease and some factor. However, correlation is not evidence of causation (i.e. that smoking causes lung cancer). The correlation may be coincidence or it may be due to another factor. For example, there is also a correlation between alcohol consumption and lung cancer but laboratory studies have failed to show any causal link between alcohol and lung cancer – alcohol is not a risk factor. Instead, the correlation is indirect: heavy drinkers tend also to be heavy smokers and the smoking causes lung cancer. These theories apply to all studies looking for causal effects.

M1. (a) (i) Through alveolar epithelium;

Through capillary epithelium/endothelium; [2]

(ii) (Thicker alveolar wall) – no mark

(So) Longer diffusion pathway/slower diffusion; [1]

(b) (i) (In alveolus)

Brings in air containing a high(er) oxygen concentration;

Removes air with a low(er) oxygen concentration; [2]

(ii) Circulation of blood/moving blood; [1]

(c) Long time between decrease in mining and increase in cases;

Graph shows fluctuations;

Correlation does not prove causation/there may be other causes of miner's lung;

Improved diagnosis methods;

Do not know number of cases/baseline before 1990;

Not all cases reported/not all individuals with miner's lung visit a doctor; [2 max]

(Total 8)

M2. (a) Bacteria attached to/carried by;

Droplets of mucus/water; [2]

(b) Vaccination rates;

Immigration;

Different strains of TB;

Living conditions related to transmission / diet; [2 max]

(c)

15.2; [2]

(Total 6)

M3. (a) Phagocytes engulf/ingest pathogens/microorganisms/bacteria/viruses;

Phagocytes destroy pathogens/microorganisms/bacteria/viruses;

Lung diseases are caused by pathogens/microorganisms/bacteria/viruses; [2 max]

(b) (i) Alveoli/lungs will not inflate/deflate fully/reduced lung capacity;

Breathing out particularly affected/no longer passive;

Concentration/diffusion gradient / rate of diffusion reduced; [2 max]

(ii) Alveolar walls thicken;

Longer diffusion pathway;

Scarred/fibrous tissue;

Reduces surface area (for gaseous exchange); [4]

(c) (i) Cancer develops 20 – 30 years after exposure (to asbestos); [1]

(ii) Smoking / air pollution / specified industrial source; [1]

(Total 10)

M4. (a) Something that increases chance / increases probability / makes it more likely; [1]

(b) (i) 1976 - / to / and 1980; [1]

(ii) 1980 - / to / and 1996; [1]

(c) 1. Correlation does not mean that there is a causal relationship;

2. May be some other factor / named factor;

3. Associated with vehicles and asthma / producing rise in both;

4. (After 1980) asthma continues to rise but exhaust concentration falls / negative correlation (after 1980); [3 max]

(Total 6)