Preliminary research

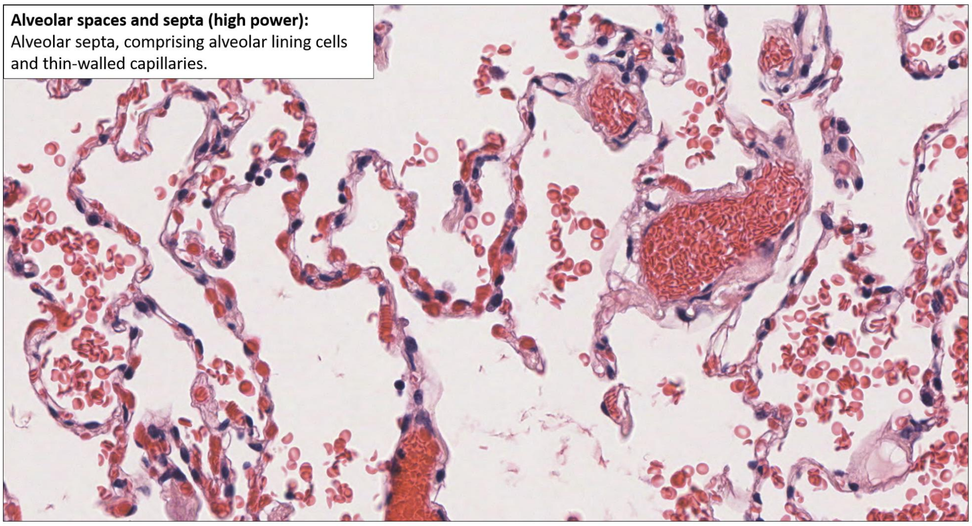
Department of Engineering Physics
Han yansong

Structure of the Alveoli

Alveoli are the smallest structures in the respiratory system. They are arranged in clusters throughout the lungs at the ends of the branchs of your respiratory tree, which is the tree-like structure of passageways that brings air into the lungs.

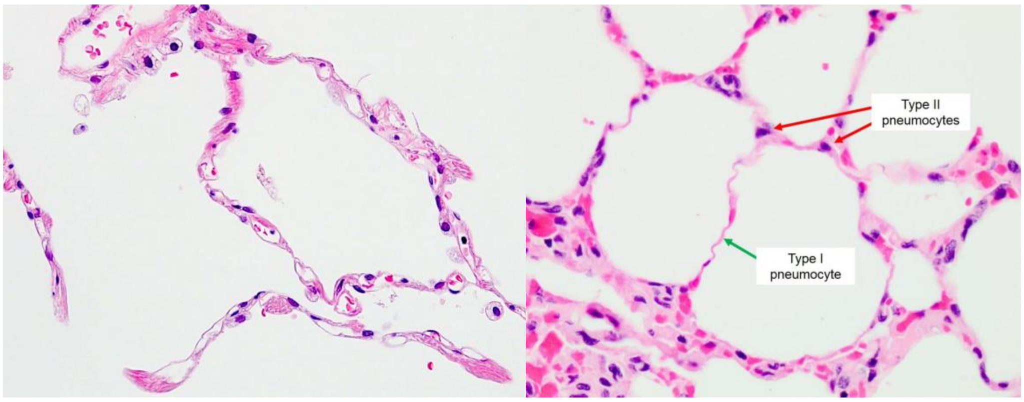
The walls of the alveoli are very thin. This lets oxygen and CO2 pass easily between the alveoli and capillaries, which are very small blood vessels.

Strictly speaking, alveolar structure is not sac shaped but is a polyhedral architecture.



Cells of the Alveoli

The alveoli are made up of two different types of cells. Type I alveolar epithelium (pneumocyte):Thin flat epithelium covering about 90 - 95% of alveolar lumen in area, about 40% of all alveolar epithelia in number.These are the cells responsible for the exchange of oxygen and CO2.Type II alveolar epithelium (pneumocyte):Cuboid epithelium covering 5 - 10% of the alveolar lumen in area, about 60% of all alveolar epithelia in number.These are the cells responsible for the exchange of oxygen and CO2.

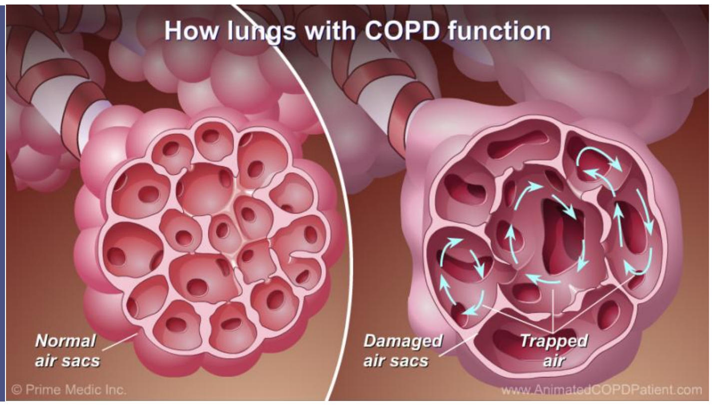


High power image of alveoli of the autopsy lung specimen. Alveolar lumens are covered by both flat cells (i.e. type I alveolar epithelium) and cuboid cells (i.e. type II alveolar epithelium). Within alveolar septa, there are many capillaries. Alveolar entrance rings are shown as eosinophilic material at the end of alveoli.

COPD

Chronic obstructive pulmonary disease (COPD) is a pulmonary disease characterized by persistent respiratory system symptoms and airflow restriction. The airflow restriction is not completely reversible and develops in a progressive manner. It mainly affects the lungs and is usually related to airway and alveolar abnormalities caused by significant exposure to harmful particles or gases. Exposure to tobacco smoke and inhalation of other toxic particles and gases are major risk factors for COPD. At present, COPD is the third leading cause of death in the world. There are 300 million cases of COPD worldwide, and the prevention and treatment situation is very serious.

Alveolar rupture and emphysema are two typical symptoms of life threatening COPD.



Dark-field X-ray

Traditional chest radiography is based on the attenuation characteristics of X-ray in the process of penetrating materials, and it is almost impossible to distinguish the small differences between healthy and diseased tissues. Based on the wave characteristics of X ray, the substance is imaged by using indirect light (such as scattered light, diffracted light, refracted light,fluorescence, etc.), and most of the transparent object structures can be seen. These structures often appear as bright parts on the black background in the microscope, hence the name of dark-field X-ray technology.

Between the cell tissue and the air, the dark-field X-ray signal will be significantly enhanced, which enables the dark-field image of the lung to clearly distinguish the complete air filled alveoli and the cracked alveoli, thus providing additional information about the microstructure of the underlying lung. Since the quality of alveolar structure is closely related to the status of lung function, this technology is of great significance to the research of lung medicine, and is expected to greatly improve the early detection of COPD and other respiratory diseases in the future.

Lung Disease Pathology

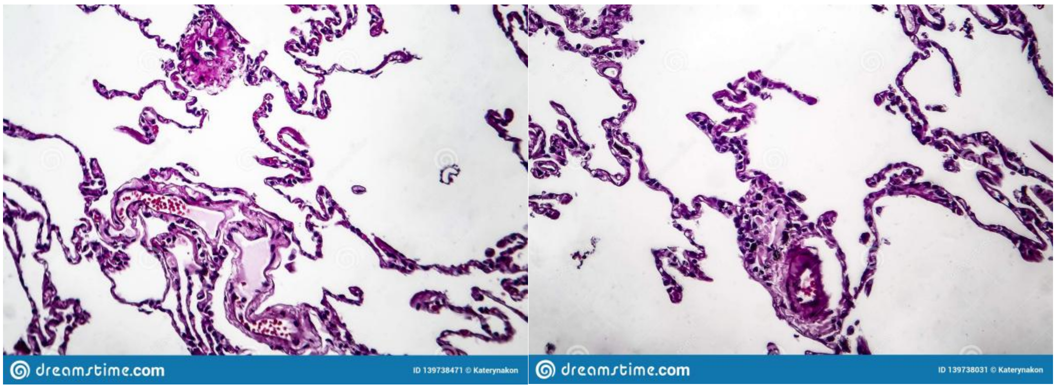


Figure 1 Histopathology of lung emphysema, light micrograph

Notes: Photo under microscope showing enlargement of air spaces in lung tissue and destruction of alveolar septa

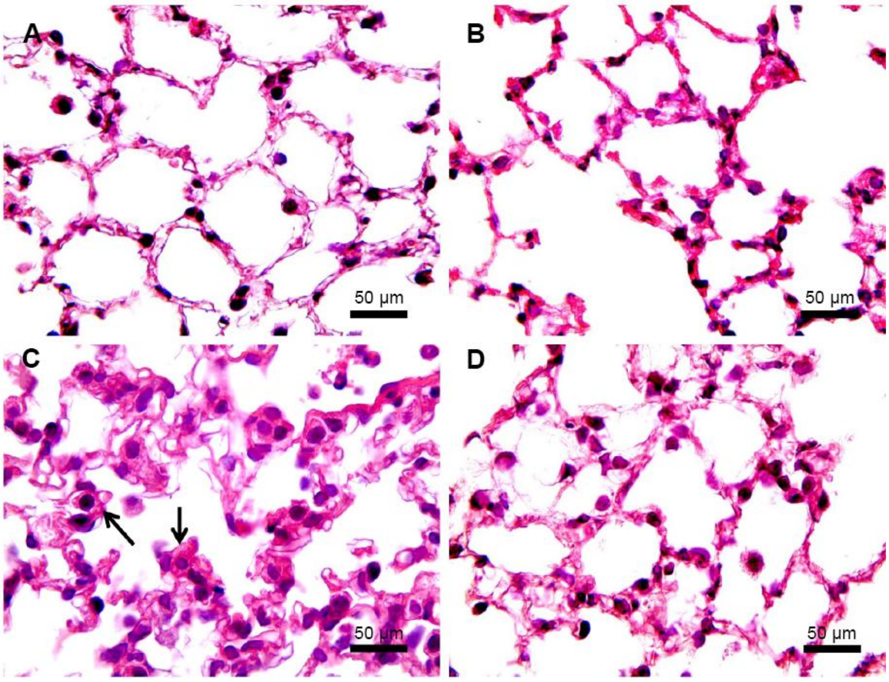


Figure 2 H&E examination under light microscopy (eriginal magnification: x100)

Notes: (A) H&E of normal lung showing thin intersitial alveolar wall and capillary vessels. Rare inflammatory cells are noted. **(B)** PJ lung tissue demonstrating normal lung architecture similar to that in A. **(C)** After acute CS exposure, note thickening of the interstitial wall, capillary congestion, and infiltration by inflammatory cells (arrows). **(D)** When compared to Control, CS + PJ-treated animals demonstrated remarkable reduction in inflarmmatory cell migration, alveolar wall thickening, and capillary congestion.

Abbreviations: CS, cigarette smoke; H&E, hematoxylin and eosin; Pj. pomegranate juice.

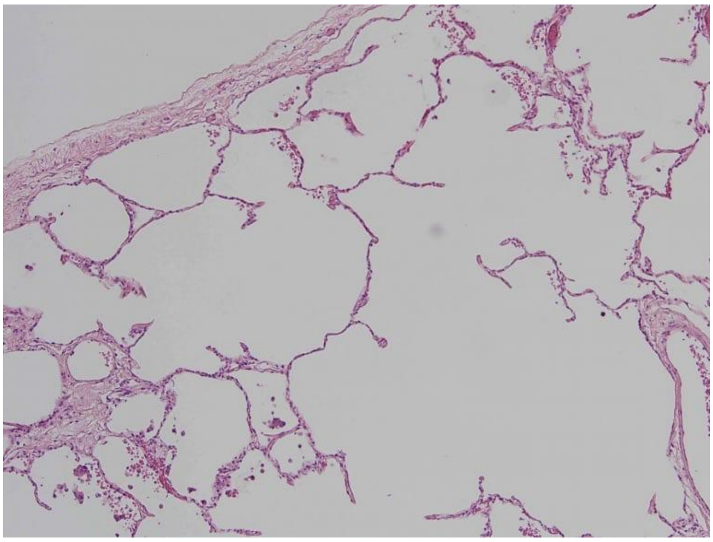


Figure 3 Histological section of mildly emphysematous lung magnified 10 times
Notes: Air-spaces are enlarged with loss of alveolar walls and pulmonary interstitial tissue.

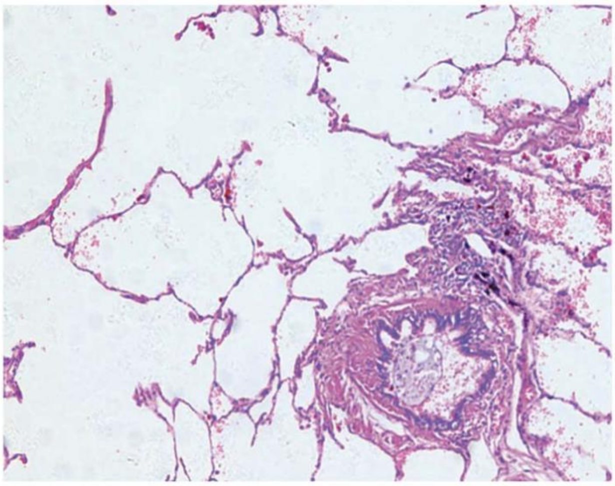


Figure 4 Histopathology of lung emphysema
Notes: Patients with peribronchiolar destruction of alveolar walls, resulting in the loss of alveolar attachments, airway collapse and enlargement of the air spaces distal to the terminal bronchioles

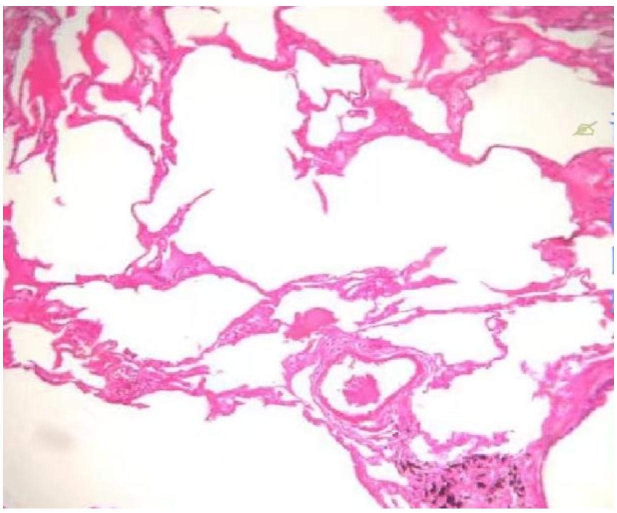


Figure 5 Histopathology of lung emphysema (HE×100)

Notes: Alveolar dilation in some areas, rupture of alveolar septum, and fusion of dilated alveoli into a larger cystic cavity

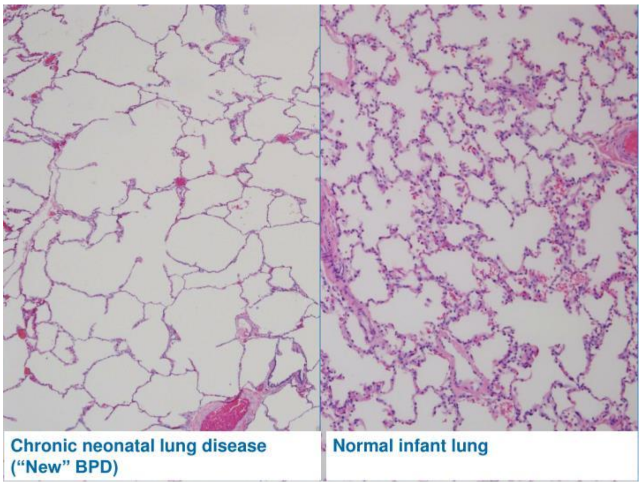


Figure 6 Histopathology of diffuse lung disease