

Instrumental and laboratory methods of respiratory system investigation



Instrumental methods

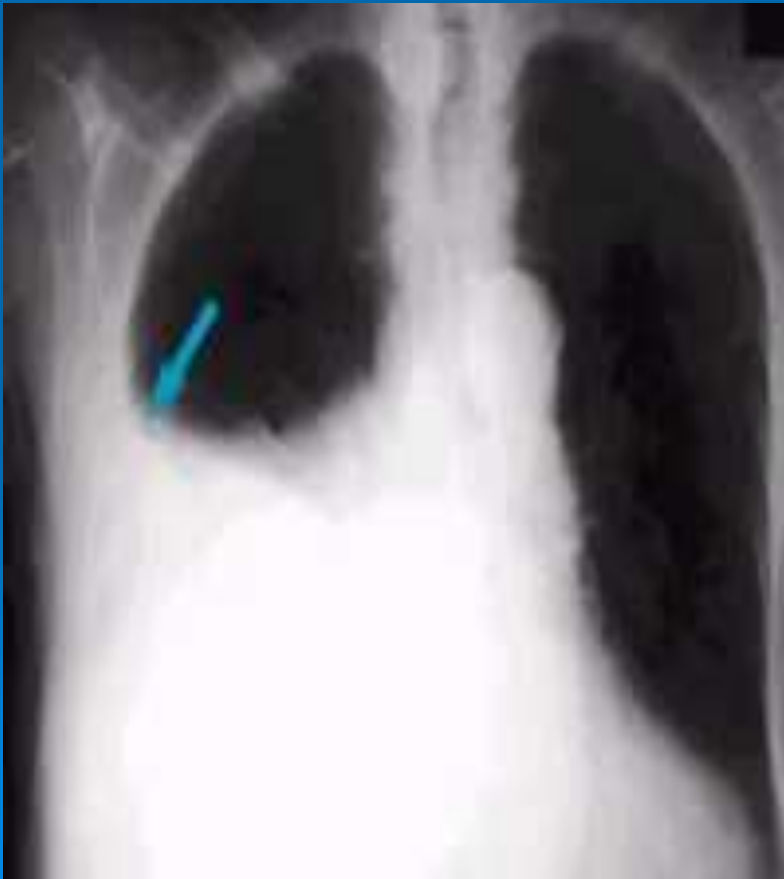


X-ray is the most commonly used method for respiratory system investigation

- Chest x-ray is used to evaluate the lungs, heart and chest wall and may be used to help diagnose and monitor treatment for a variety of lung conditions such as pneumonia, emphysema and cancer. Chest x-ray is fast and easy.

Roentgenography

Exudative pleuritic



Mediastinal tumor



Roentgenography: emphysema



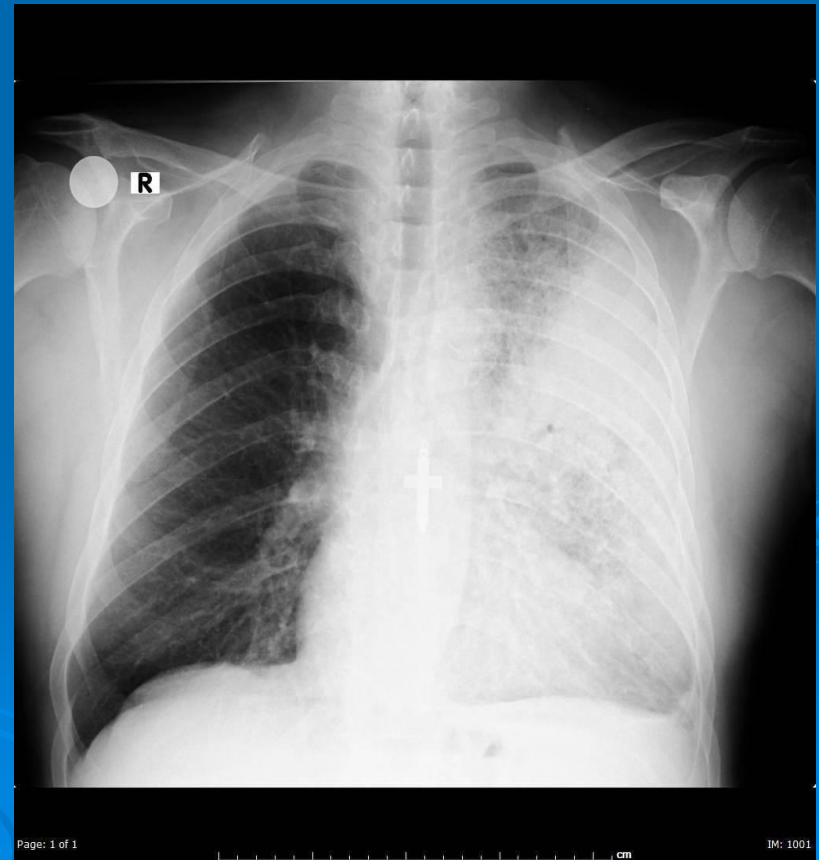
- Hyperinflation is the common finding in all three conditions presenting as COPD.

Roentgenography: pneumonia

The chest radiograph reveals a left lower lobe opacity with pleural effusion



Homogeneous opacification of the left middle lung zone with partly ill defined left cardiac border.



Computed Tomography (CT)

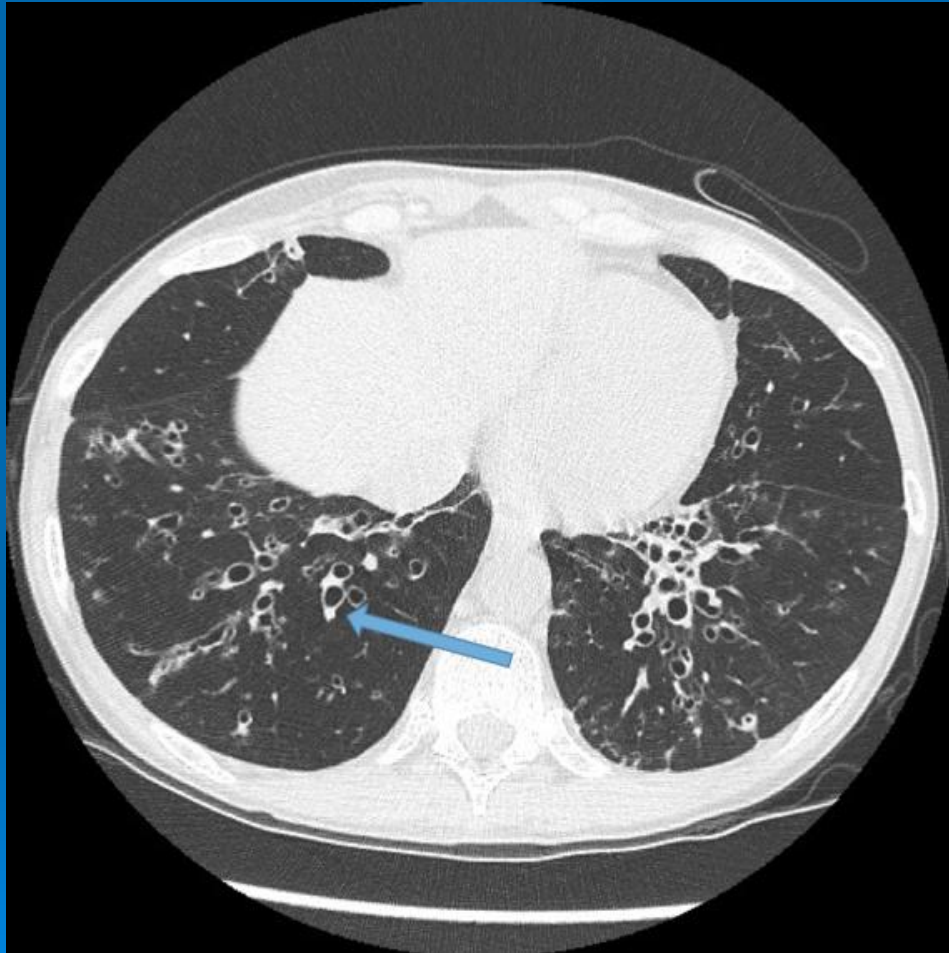
Computed tomography (CT) of the chest uses special x-ray equipment to examine abnormalities found in other imaging tests and to help diagnose the cause of unexplained cough, shortness of breath, chest pain, fever and other chest symptoms. CT scanning is fast, painless, noninvasive and accurate. Because it is able to detect very small nodules in the lung, chest CT is especially effective for diagnosing lung cancer at its earliest, most curable stage.



CT scan equipment



Computed Tomography: bronchiectasis



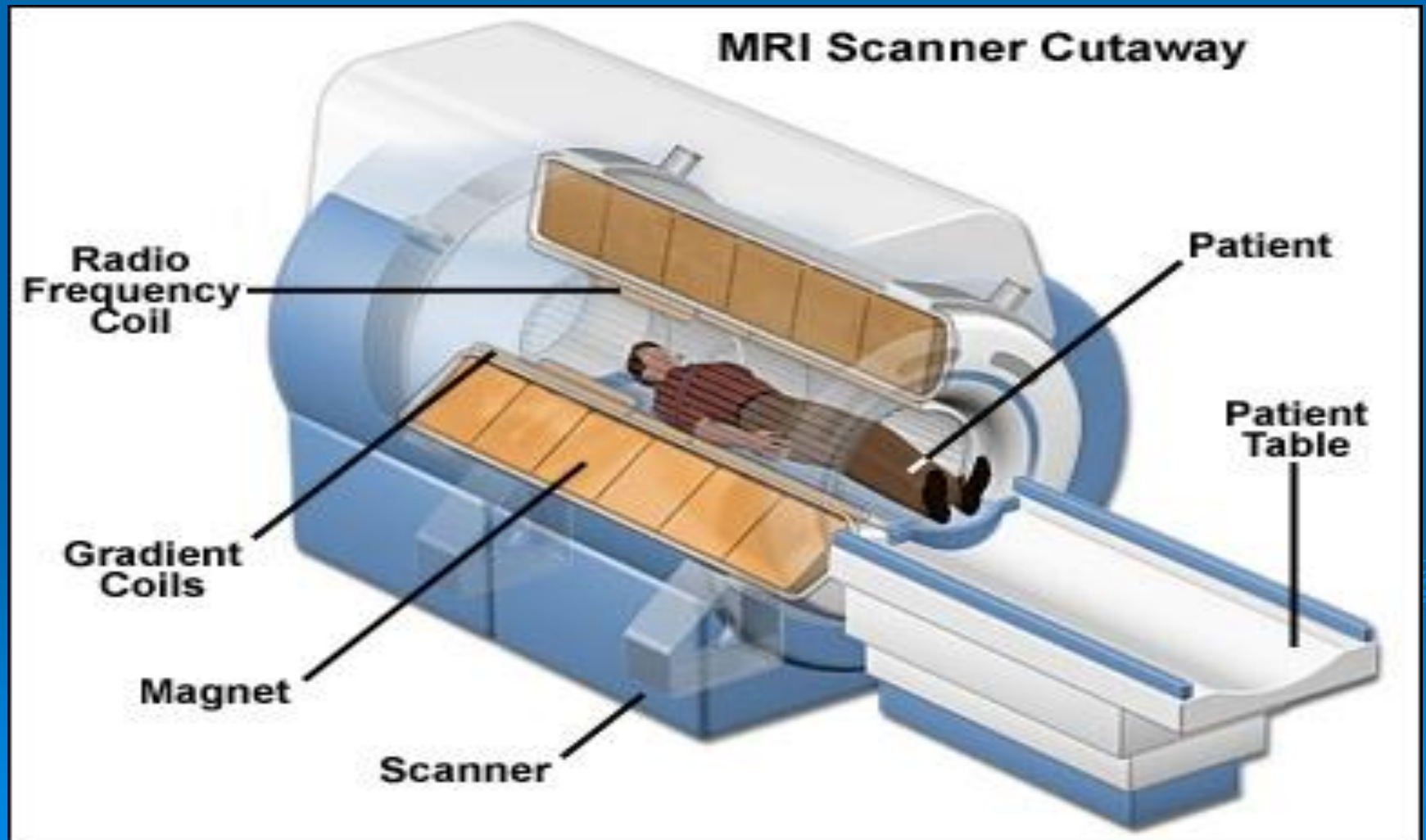
Magnetic resonance imaging

Magnetic resonance imaging (MRI) of the chest uses a powerful magnetic field, radio waves and a computer to produce detailed pictures of the structures within the chest. It is primarily used to assess abnormal masses such as cancer and determine the size, extent and degree of its spread to adjacent structures. It's also used to assess the anatomy and function of the heart and its blood flow.

MRI diagnosis is selected when we X Ray is impossible to perform:

- for pregnant women;
- children;
- in diseases requiring repeated procedures.

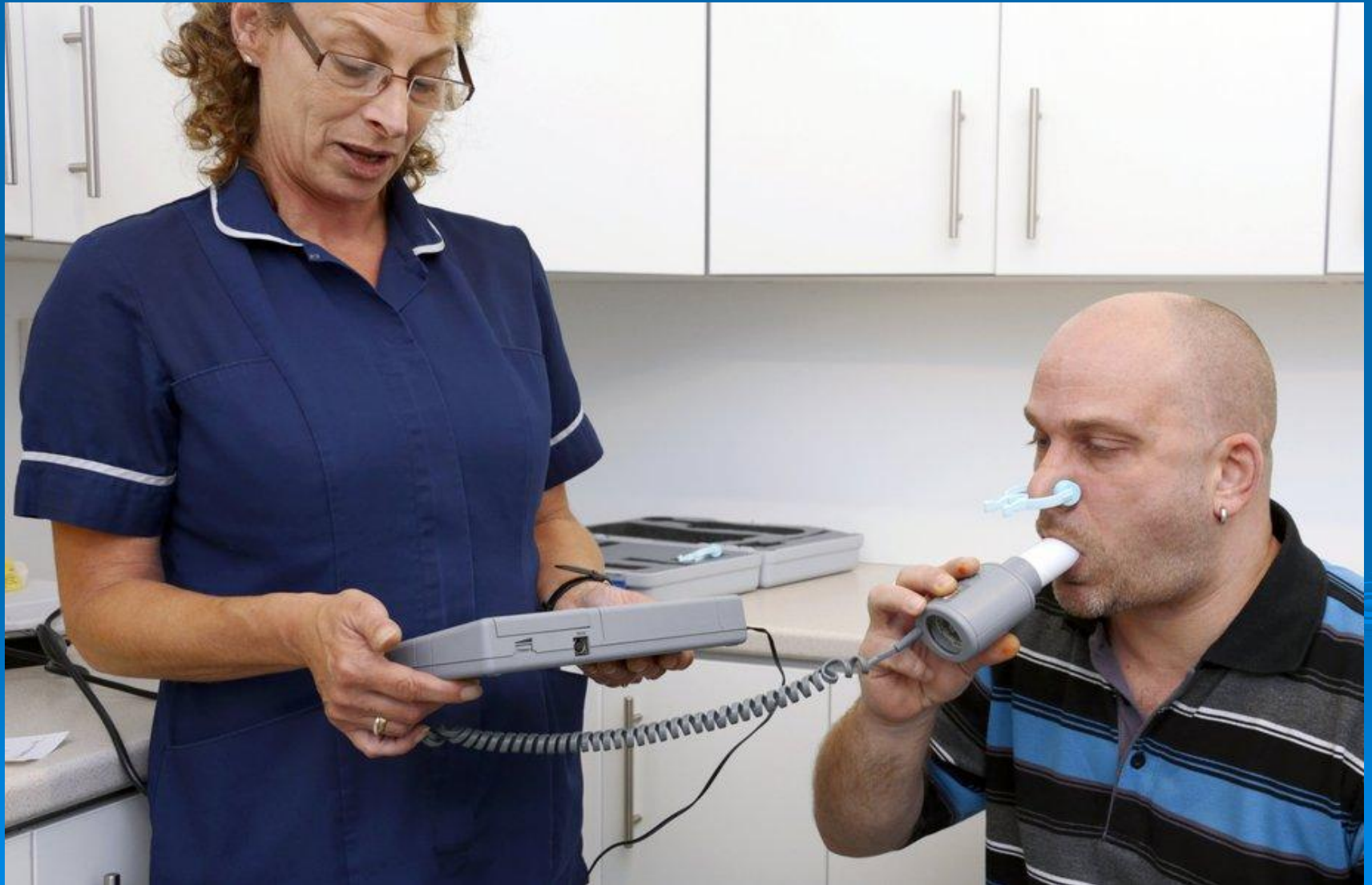
Magnetic resonance imaging equipment



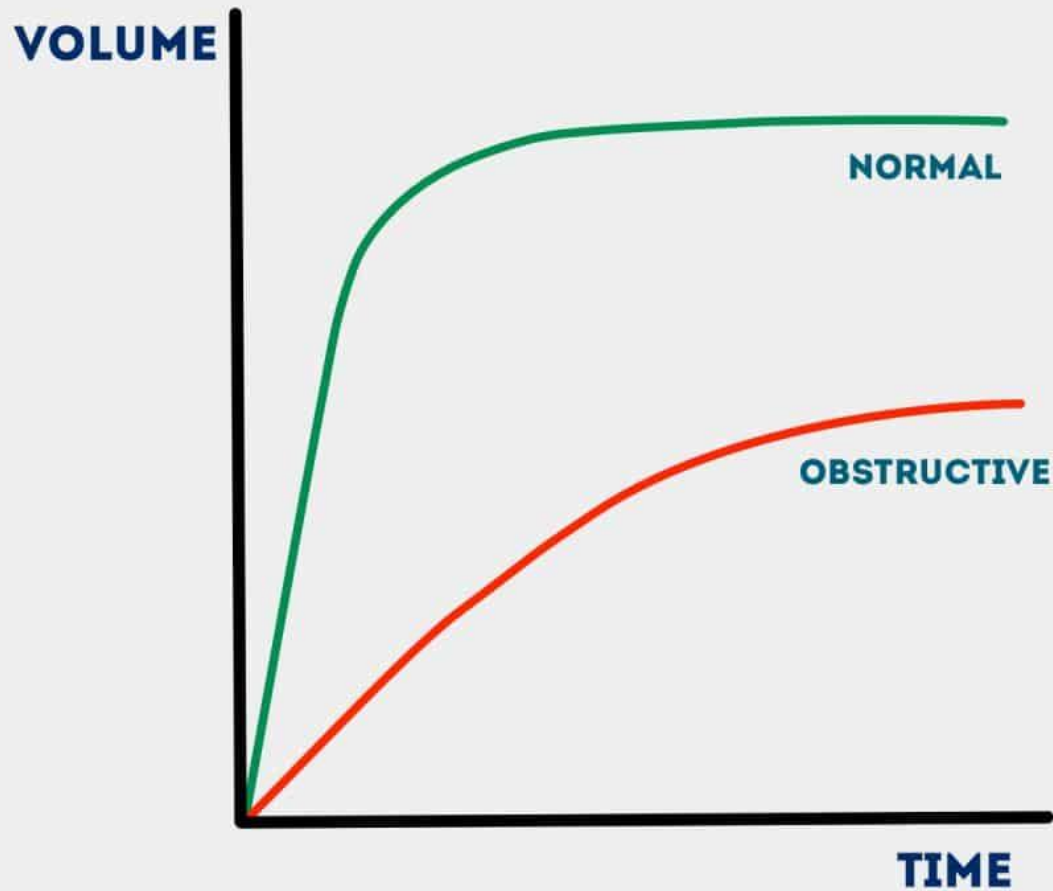
Spirometry

- Spirometry is used to establish baseline lung function, evaluate dyspnea, detect pulmonary disease, monitor effects of therapies used to treat respiratory disease, evaluate respiratory impairment, evaluate operative risk, and perform surveillance for occupational-related lung disease.

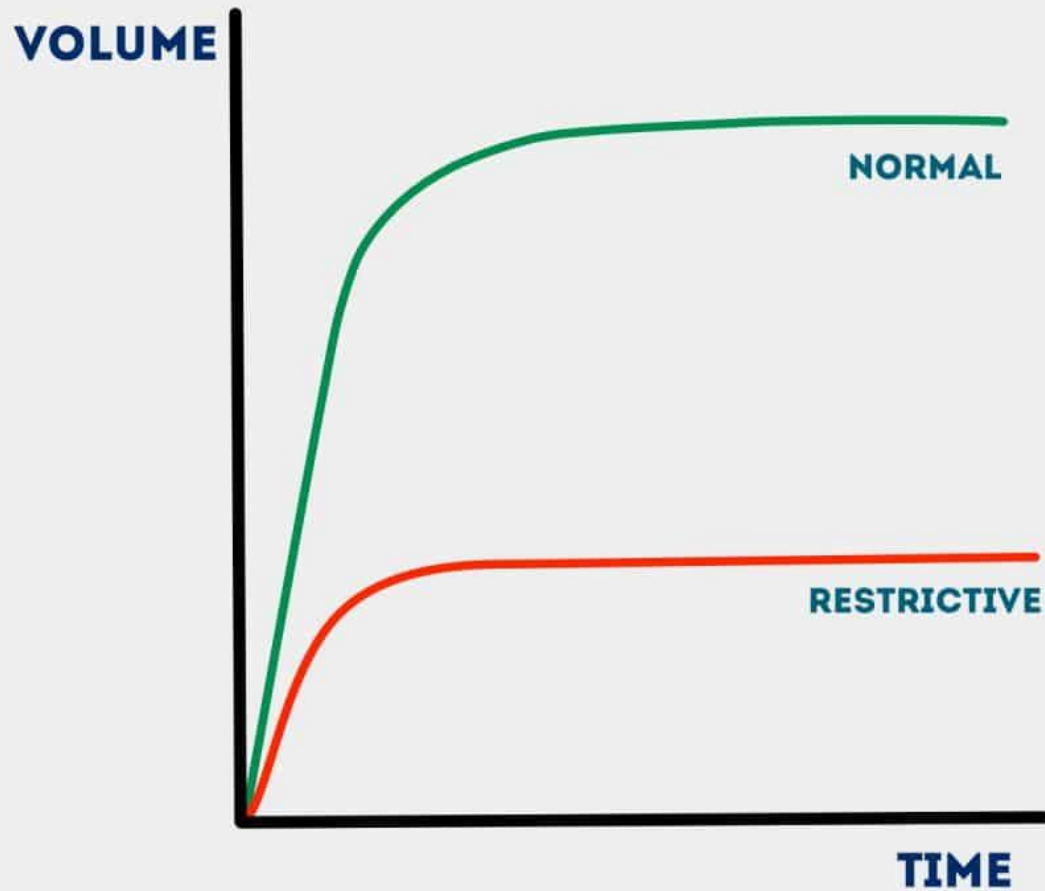
Spirometry



Spirometry: obstructive pattern



Spirometry: restrictive pattern



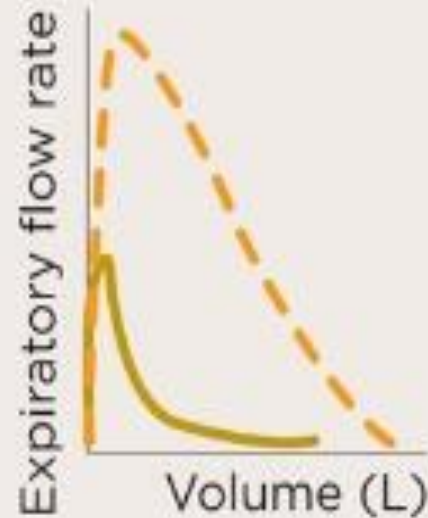
Flow-volume curve patterns: obstructive and restrictive

Obstructive



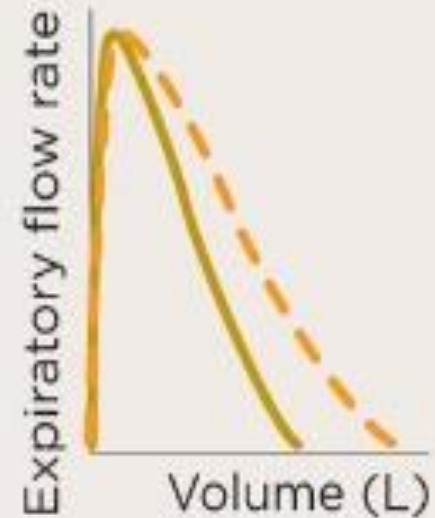
Reduced peak flow, scooped out midcurve

Severe obstructive



Steeple pattern, reduced peak flow, rapid fall off

Restrictive

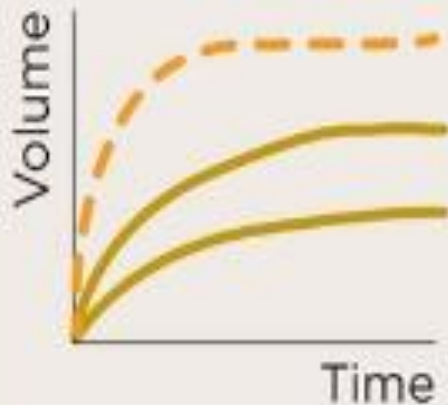


Normal shape, normal peak flow, reduced volume

--- Normal — Abnormal

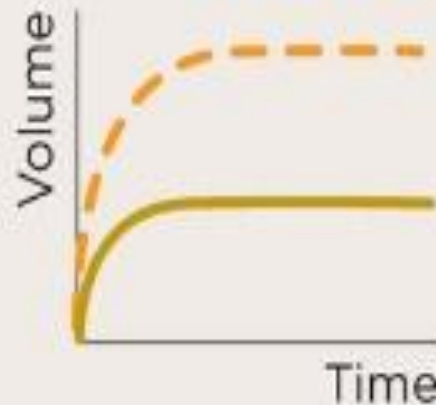
Spirometry: Abnormal patterns

Obstructive



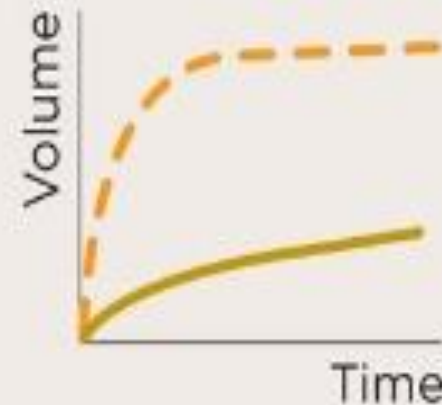
**Slow rise,
reduced volume
expired;
prolonged time
to full
expiration**

Restrictive



**Fast rise to
plateau at
reduced
maximum
volume**

Mixed




**Slow rise to
reduced maximum
volume; measure
static lung volumes
and full PFTs to
confirm**

-- Normal — Abnormal

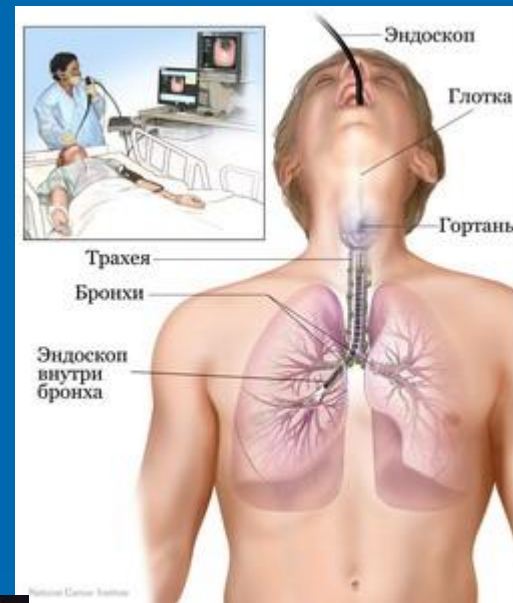
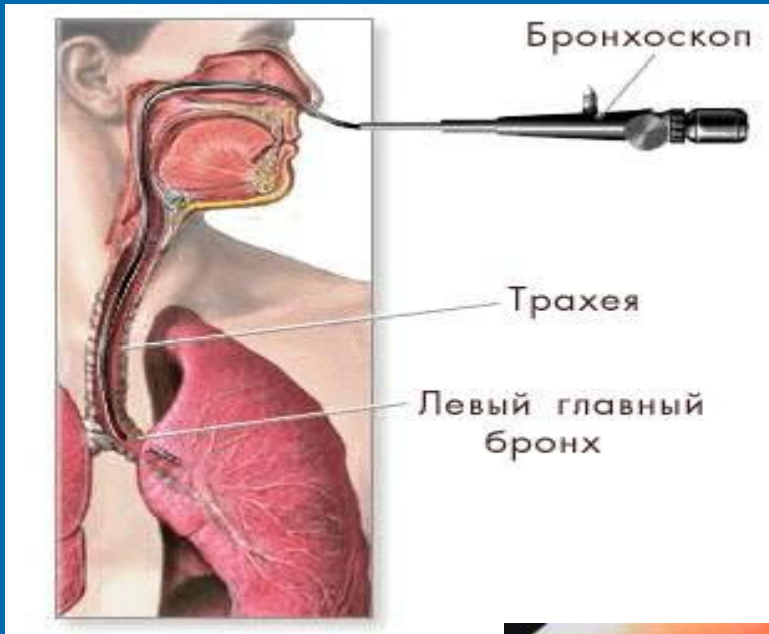
Bronchoscopy

During bronchoscopy, the operator visualizes the vocal cords, trachea, large proximal airways, and smaller distal airways to the level of the third or fourth generation of airways. FOB is used to sample and treat lesions in airways and to sample the lung parenchyma.

A decorative graphic consisting of several sets of concentric circles, resembling ripples in water, is located in the bottom right corner of the slide. The circles are rendered in a lighter blue color than the background.

- The bronchoscope consists of a flexible sheath that contains cables that allow the tip of the device to be flexed or extended. Images are transmitted using a CCD chip or through fiberoptic bundles. The bronchoscope includes a light source and a working channel for removal of secretions, insertion of biopsy forceps or aspirating needle, or performance of lung lavage.

Bronchoscopy



Laboratory methods



Sputum examination

- 1. Macroscopic
- 2. Microbiological
- 3. Cytological

Sputum analysis: *plastic containers*

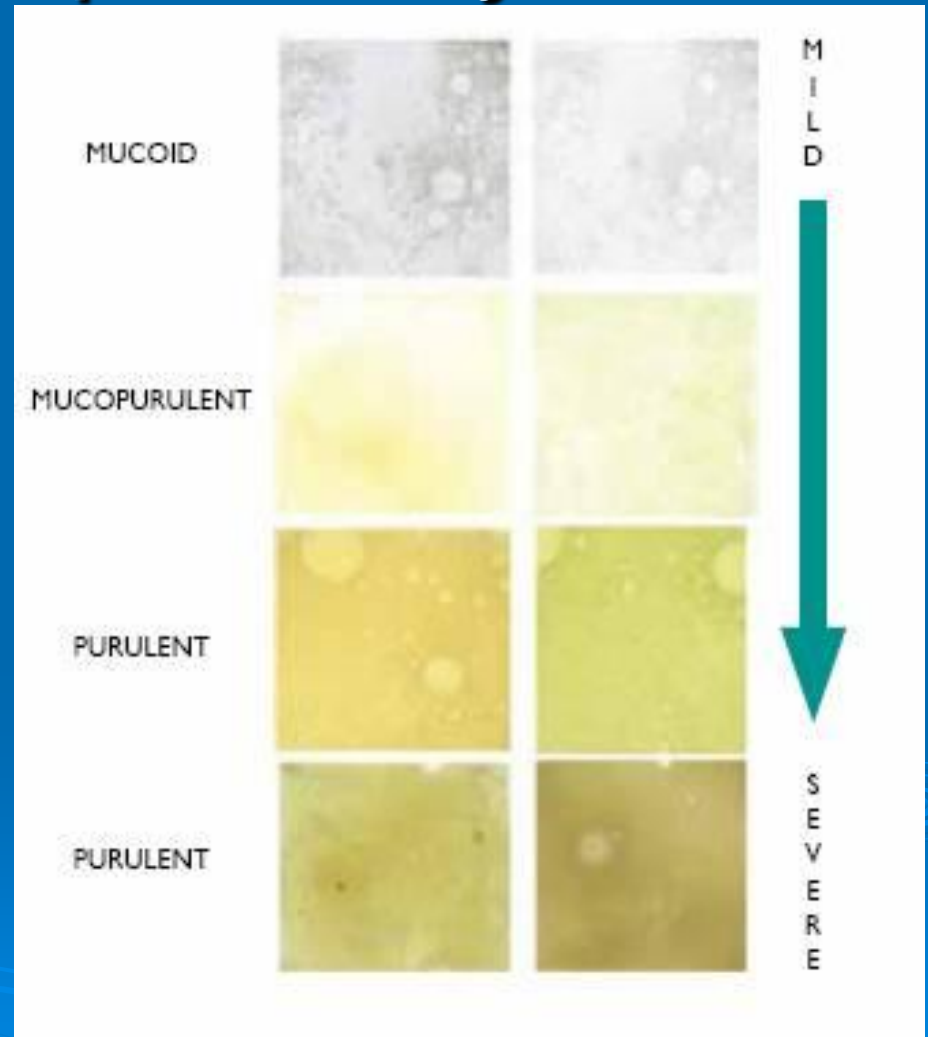


Appearance of sputum

- **Bloody**: Hemoptysis (*pulmonary tuberculosis, bronchogenic carcinoma, bronchiectasis, lung abscess, pulmonary infarction, mitral stenosis*)
- **Bloody and gelatinous (red current jelly)**: Klebsiella pneumonia
- **Rusty**: Pneumococcal lobar pneumonia
- **Purulent and separating into 3 layers on standing**: Lung abscess, bronchiectasis

- **Copious amounts of purulent sputum:** Bronchopleural fistula, lung abscess, bronchiectasis
- **Green:** Pseudomonas infection
- **Pink, frothy (air bubbles):** *Pulmonary edema*

Macroscopic study



Microscopic examination of sputum

- Microscopic examination of expectorated sputum is the easiest and most rapidly available method of evaluating the microbiology of the respiratory infection



Microscopic study

Curschmann's spirals

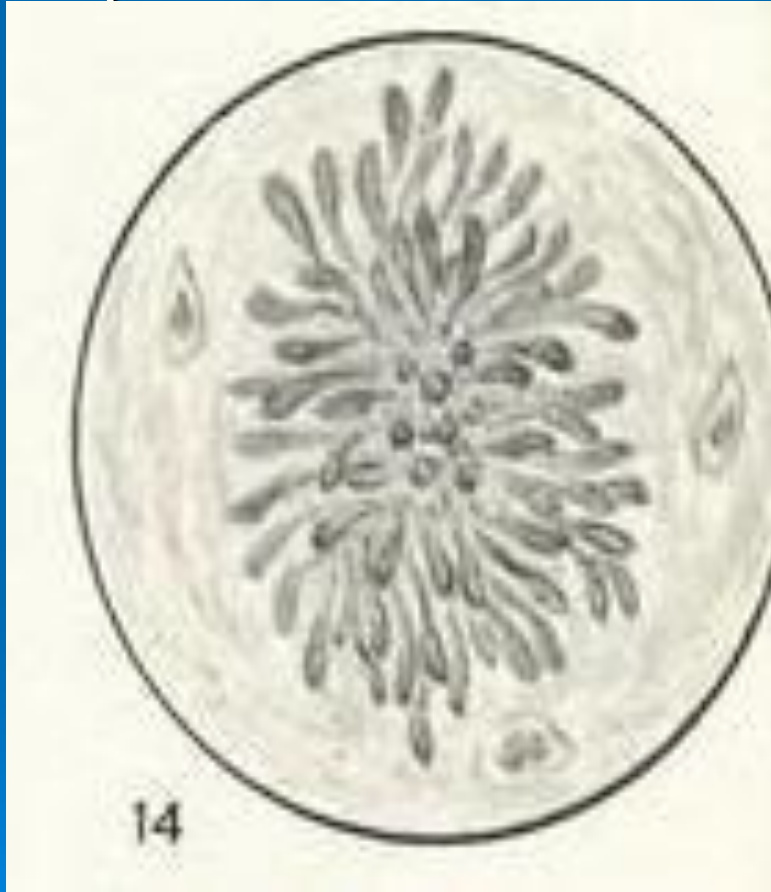
Charcot–Leyden crystals

- Eosynophylls in the sputum sample



Microscopic study

- Actinomycetes in sputum

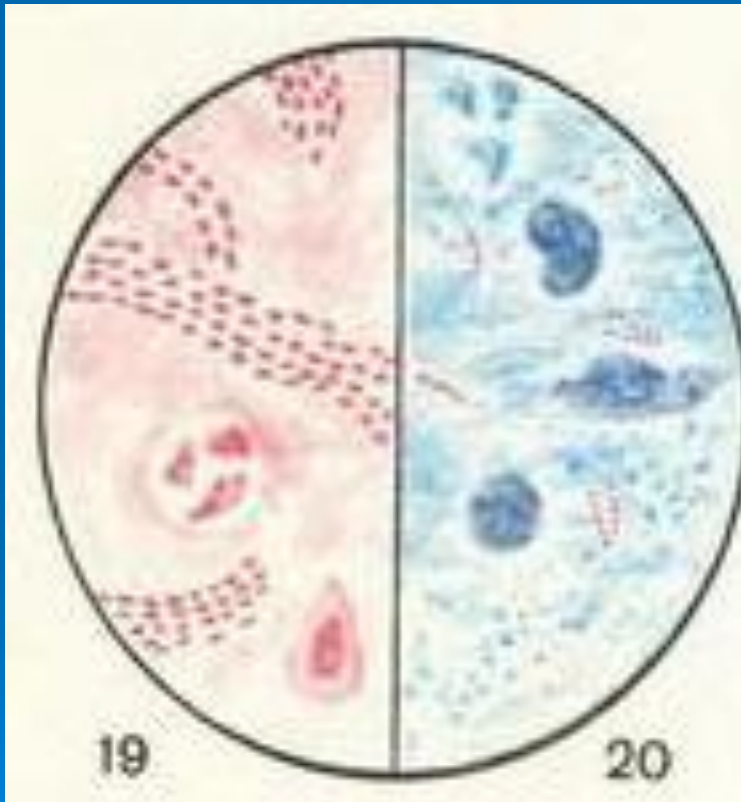


- Atypical cells in sputum

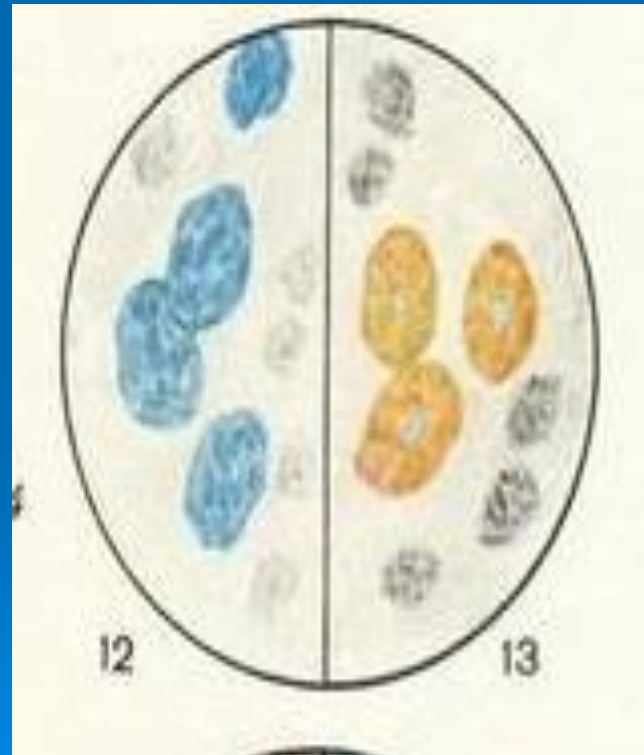


Microscopic study

➤ Tuberculosis



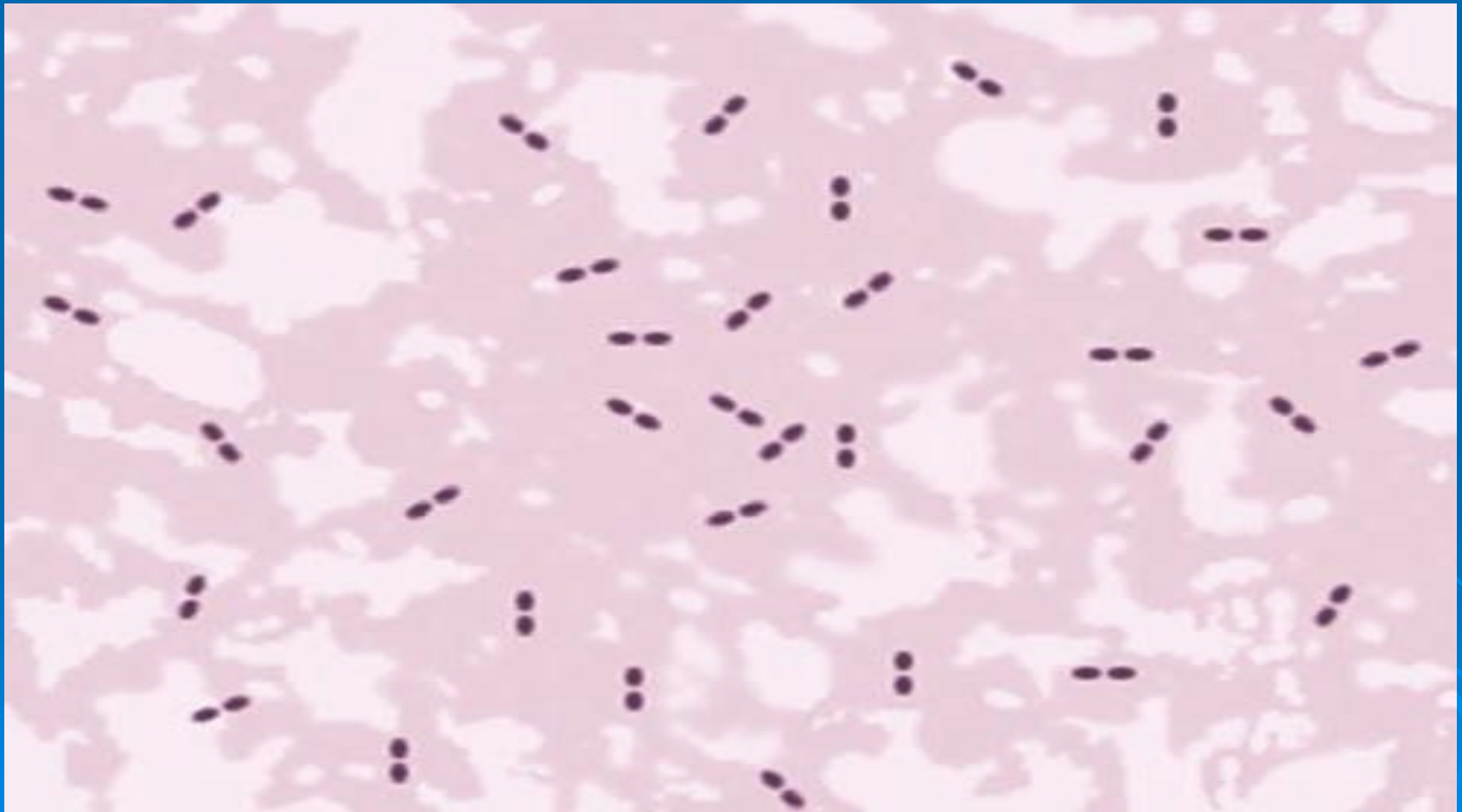
➤ Форменные эл-ты крови



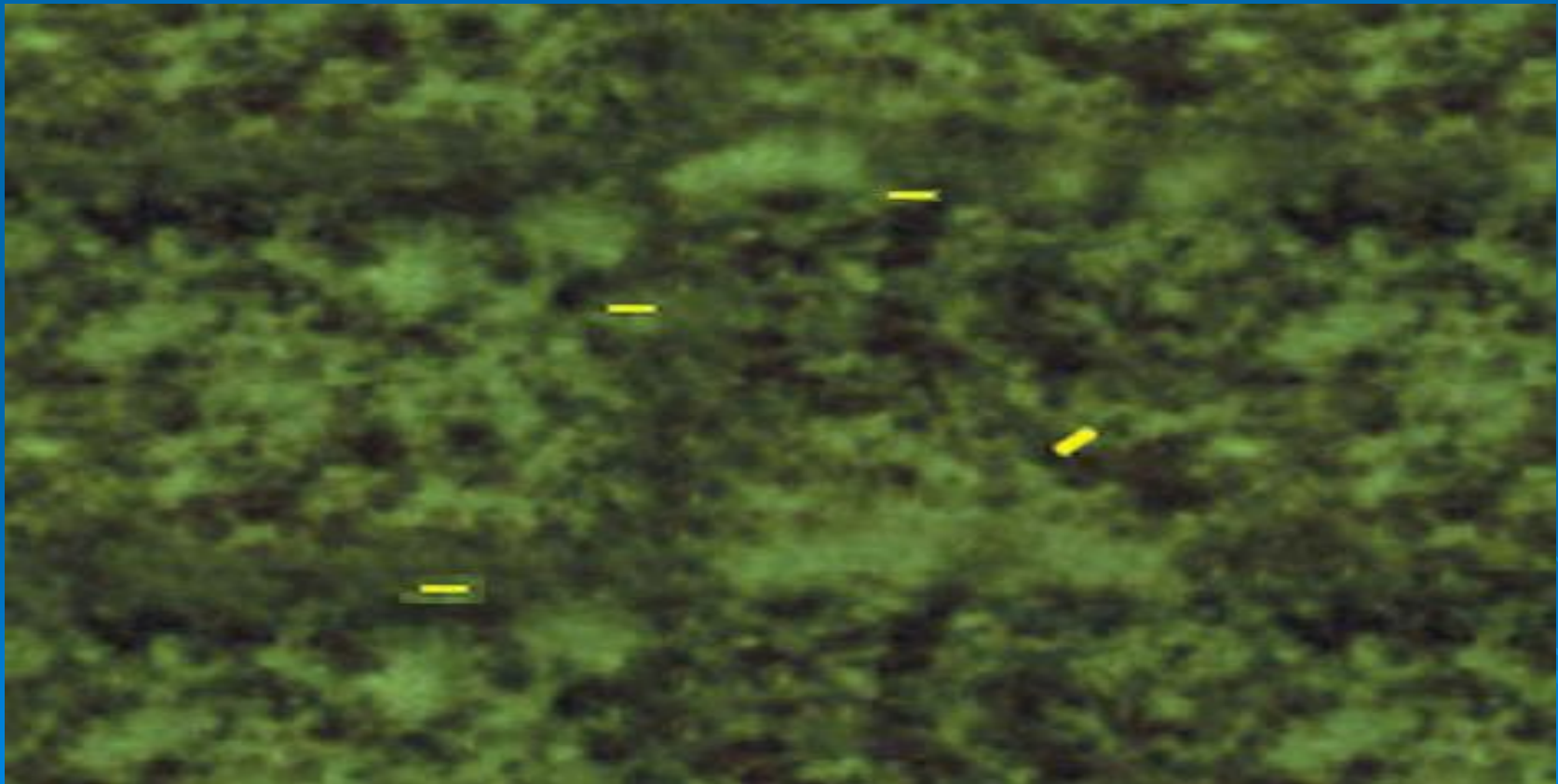
MICROBIOLOGICAL EXAMINATION OF SPUTUM



Gram stained smear of sputum showing gram-positive diplococci (*Streptococcus pneumoniae*)



Demonstration of mycobacteria in sputum by fluorescence microscopy. Bacilli appear as yellow fluorescing rods with auramine O against a dark background



Thoracentesis



Thoracentesis

- Thoracocentesis (from the Greek words, thorax + centesis, puncture) is an invasive procedure associated with removal of fluid or air from the pleural space for diagnostic or therapeutic purposes



- Thoracocentesis can be performed by inserting carefully a needle into the pleural space in order to aspirate the pathologically collected fluid or air and allow the compressed lung to re-inflate. Ultrasound guided needle aspiration is a very useful technique and, whenever is possible, should be performed in order to reduce complications

Indications:

- Diagnostic purposes (fluid analysis)
- Therapeutic purposes (removal of fluid/air from the thoracic cavity in order to improve patient comfort and lung function).

The collected fluid should differentiate from transudate or exudate.



- A transudative effusion is caused by increased hydrostatic forces. The permeability of the capillaries to proteins is normal.
- An exudative effusion is caused by increased capillary permeability or lymphatic obstruction.

Light's criteria

the pleural fluid is an exudate if one or more of the following criteria are met:

- Pleural fluid protein divided by serum protein >0.5 ;
- Pleural fluid LDH divided by serum LDH >0.6 ;
- Pleural fluid LDH more than $2/3$ the upper limits of normal serum LDH