

RESPIRATORY DIAGNOSTIC TESTS AND PROCEDURES

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1. Laboratory Tests

(Hemoglobin; Arterial blood gases; Pulmonary Function Tests; "Sputum Analysis & culture").

2. Radiological Studies

(Chest X-ray; Ventilation-perfusion scan; CT scan; Pulmonary angiography).

3. Endoscopic Examinations

(laryngoscopy, bronchoscopy)

4. Others

(Pulse oximetry; Thoracentesis.).

TESTS AND INVESTIGATIONS

- Sputum examination
- Arterial blood gases analysis
- Peak expiratory flow rate
- Spirometry
- Chest X-ray
- Ultrasound
- CT scan
- Ventilation / perfusion V/Q scan
- PET scan
- Pulmonary angiography
- MRI
- Laryngoscopy
- Bronchoscopy
- Pulse oximetry
- Lung biopsy
- Thoracentesis

Sputum examination

done for
microbiological (
AFB, Culture,
Gram stain) and
cytological
examinations



• Acid-Fast Bacillus Smear and Culture and Sensitivity; *Mycobacteria tuberculosis* Nucleic Acid Amplification Test

Arterial blood gas analysis

It is heparinized blood taken from the radial, brachial and femoral arteries to check, pH, PaO₂, PaCO₂ and HCO₃.

Type I respiratory failure:

PaO₂ < 8Kpa, PaCO₂ either Normal or reduced. (hypoxia only), PH is normal.

Type II respiratory failure:

PaO₂ < 8Kpa, PaCO₂ >6Kpa (hypoxia and hypercapnia), pH could be normal, high or low.



Peak expiratory flow rate (PEFR)

- Measure of the fastest flow of exhaled air after a maximal inspiration.
- measured with Wright peak flow meter.
- 400litres/min in normal adults.
- quick and simple indication of airways obstruction.
- Three readings are taken, with a rest in between, and the best is recorded.
- Limitations:
 - depend on motivation of patient
 - are inaccurate for children under 4,
 - sensitive only to resistance in the large airways.

PEFR



1. Connect a clean mouthpiece



2. Ensure the marker is set to zero



3. Breathe out as hard as you can



4. Observe and record the reading

Peak Expiratory Flow Rate

Guidelines:

- Avoid tight clothes, a full bladder, vigorous exercise within the last 30 minutes, a heavy meal within 2 hours and, if possible, smoking within 24 hours.
- Explain the purpose and technique of the test, because the meter is effort-dependent and reliability depends on the patient understanding and not feeling hurried.
- Have the patient seated upright if possible, avoid occluding the exhaust holes, check the pointer is at zero.
- Demonstrate the technique with a separate mouthpiece.
- Ensure the patient holds the meter horizontally.
- Ask the patient to take a deep breath, then to make a firm seal on the mouthpiece and blow 'short, sharp and as hard as possible'.

Pulmonary Function Tests

Are used to aid diagnosis, assess functional impairments and monitor treatment or progression of diseases.

Abbreviations used:

- **FVC** **forced vital capacity** (max amount of air forcibly expired after a max inspiration)
- **FEV1** **forced expiratory volume in 1 second** (volume of air forcibly expired after a max inspiration in one second, usually 80% FVC)
- VC vital capacity
- TLC total lung capacity
- FRC functional residual capacity
- RV residual volume
- FEV1/FVC = 80% in healthy individuals

OBSTRUCTIVE AIRWAY DISEASES:

(asthma, emphysema, chronic bronchitis)

FEV1 = ↓↓↓

FVC = ↓

FEV1/FVC = upto 30%

PEFR = ↓↓ 100L/min

RESTRICTIVE AIRWAY DISEASES:

(Fibrosing alveolitis, pneumonia, collapse)

FEV1 = ↓

FVC = ↓

FEV1/FVC = 80%

PEFR = normal

Lung volume measurement can be done in two ways:

WHOLE BODY PLETHYSMOGRAPHY:

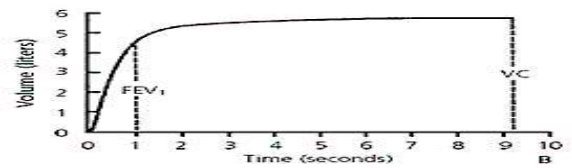
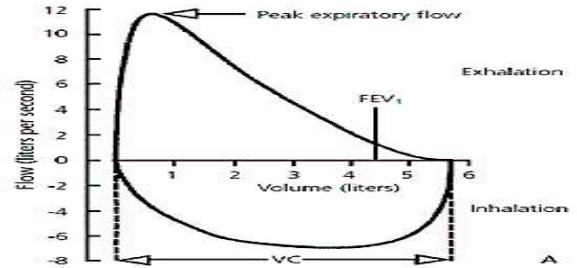
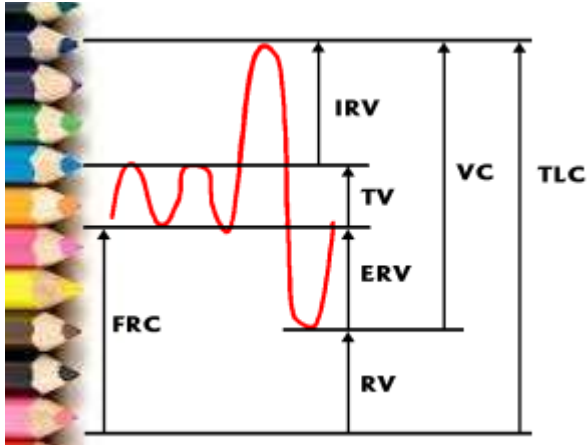
- The most accurate way is to sit in a sealed, clear box that looks like a telephone booth (body plethysmograph) while breathing in and out into a mouthpiece. Changes in pressure inside the box help determine the lung volume. (Boyle's law)

HELIUM DILUTION METHOD:

- Lung volume can also be measured when you breathe helium gas through a tube for a certain period of time. The concentration of the gas in a chamber attached to the tube is measured to estimate the lung volume.

Lung volume increases in obstructive diseases and decreases in restrictive diseases.



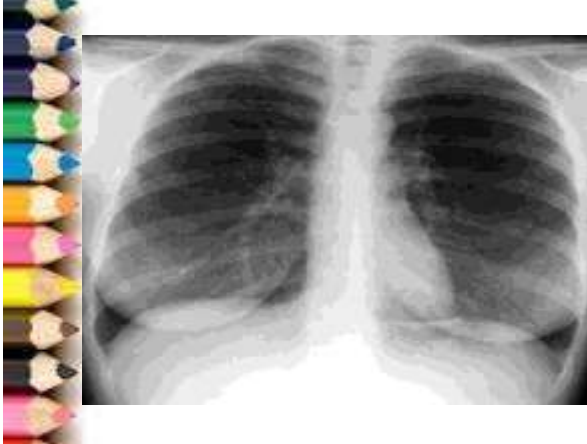


CXR

- A chest X-ray involves exposing the chest briefly to radiation to produce an image of the chest and the internal organs of the chest.
- An X-ray film is positioned against the body opposite the camera, which sends out a very small dose of a radiation beam. As the radiation penetrates the body, it is absorbed in varying amounts by different body tissues depending on the tissue's composition of air, water, blood, bone, or muscle.

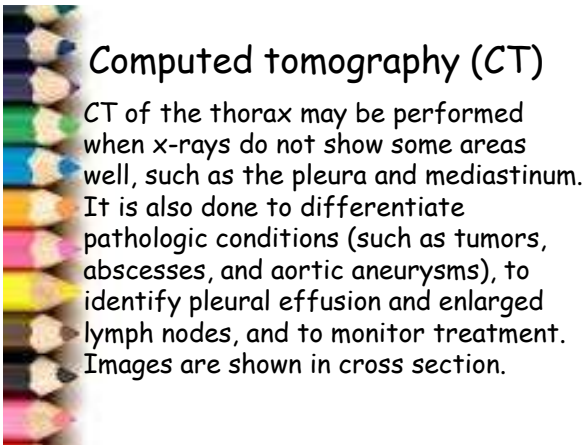
CXR

Chest x-rays are used to identify abnormalities in chest structure and lung tissue, for diagnosis of diseases and injuries of the lungs, and to monitor treatment.



Ultra sound

is sensitive to detect pleural effusion , may also be used to improve the diagnostic field of pleural biopsy.



Computed tomography (CT)

CT of the thorax may be performed when x-rays do not show some areas well, such as the pleura and mediastinum. It is also done to differentiate pathologic conditions (such as tumors, abscesses, and aortic aneurysms), to identify pleural effusion and enlarged lymph nodes, and to monitor treatment. Images are shown in cross section.



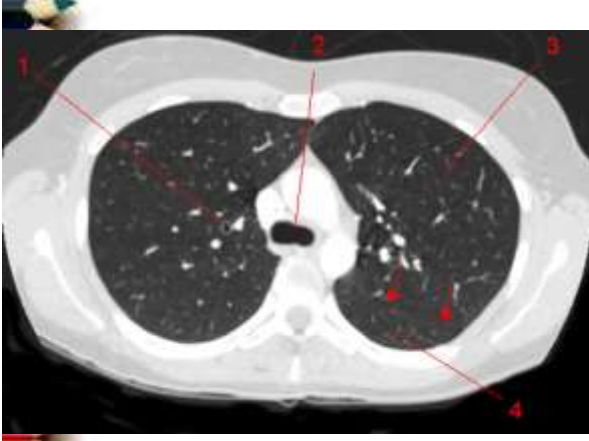
CT scan

It is superior to CXR in determining the position and size of a pulmonary lesion and whether calcification or cavitations is present.

It is now routinely used in the assessment of patients with suspected lung cancer and facilitate guided percutaneous needle biopsy.

HRCT (high resolution) uses thin section to provide a detailed assessment of pulmonary parenchymal diseases

(interstitial lung disease , bronchiectasis)




Pulmonary ventilation/perfusion scan (V/Q scan)

This test is performed with two nuclear scans to measure breathing (ventilation) and circulation (perfusion) in all parts of the lungs. A perfusion scan is performed by injecting radioactive albumin into a vein and scanning the lungs. A ventilation scan is performed by scanning the lungs as the client inhales radioactive gas. A decreased uptake of radioisotope during the perfusion scan indicates a blood flow problem, such as from a pulmonary embolus or pneumonitis. A decreased uptake of gas during the ventilation scan may indicate airway obstruction, pneumonia, or chronic pulmonary obstructive disease (COPD).


Ventilation - perfusion scan

- the main value of this technique is to detect pulmonary thrombi or embolism, a filling defect in the perfusion scan accompanied by preserved ventilation is highly suggestive of recent Pulmonary Embolism.




Positron Emission Tomography (PET)

This relatively noninvasive test, when used to examine the lungs, is performed to identify lung nodules (cancers). The client is given a radioactive substance and cross-sectional images are displayed on a computer. Radiation from PET is only 25% of that from a CT scan.



Pulmonary angiography

- X-ray imaging of the blood vessels of the lungs after the injection of contrast material.
- This test is done to identify pulmonary emboli, tumors, aneurysms, vascular changes associated with emphysema, and pulmonary circulation. A catheter is inserted into the brachial or femoral artery, threaded into the pulmonary artery, and dye is injected. ECG leads are applied to the chest for cardiac monitoring. Images of the lungs are taken.




Magnetic resonance imaging (MRI)

An MRI of the thorax is used to diagnose alterations in lung tissue more difficult to visualize by CT scan and to identify abnormal masses and fluid accumulation.



Laryngoscopy and Bronchoscopy

- Laryngoscopy: larynx may be inspected directly with a mirror or indirectly with a laryngoscope.
 - Bronchoscopy:
The trachea, large bronchi and lung segments can all be inspected by either flexible or rigid bronchoscope.
- Diagnostic indication of flexible bronchoscopy:
- Suspected cases of Lung ca,
 - slowly resolving pneumonia,
 - pneumonia in the immunocompromised patients,
 - interstitial lung disease, and
 - collecting lavage for AFB and culture in suspected cases of TB, with -ve sputum.



Pulse oximetry

Noninvasive method of estimating the percentage of oxygen saturation in the blood using an oximeter with a specialized probe attached to the skin at a site of arterial pulsation, commonly the finger; used to monitor hypoxemia.



Lung biopsy

Done to obtain tissue to differentiate benign from malignant tumors of the lungs. May be done during a bronchoscopy, or by surgical procedure.



Thoracentesis

Done to obtain a specimen of pleural fluid for diagnosis (and used as a procedure to remove pleural fluid or instill medication). A large-bore needle is inserted through the chest wall and into the pleural space. Following the procedure, a chest x-ray is taken to check for a pneumothorax.



THANK
YOU