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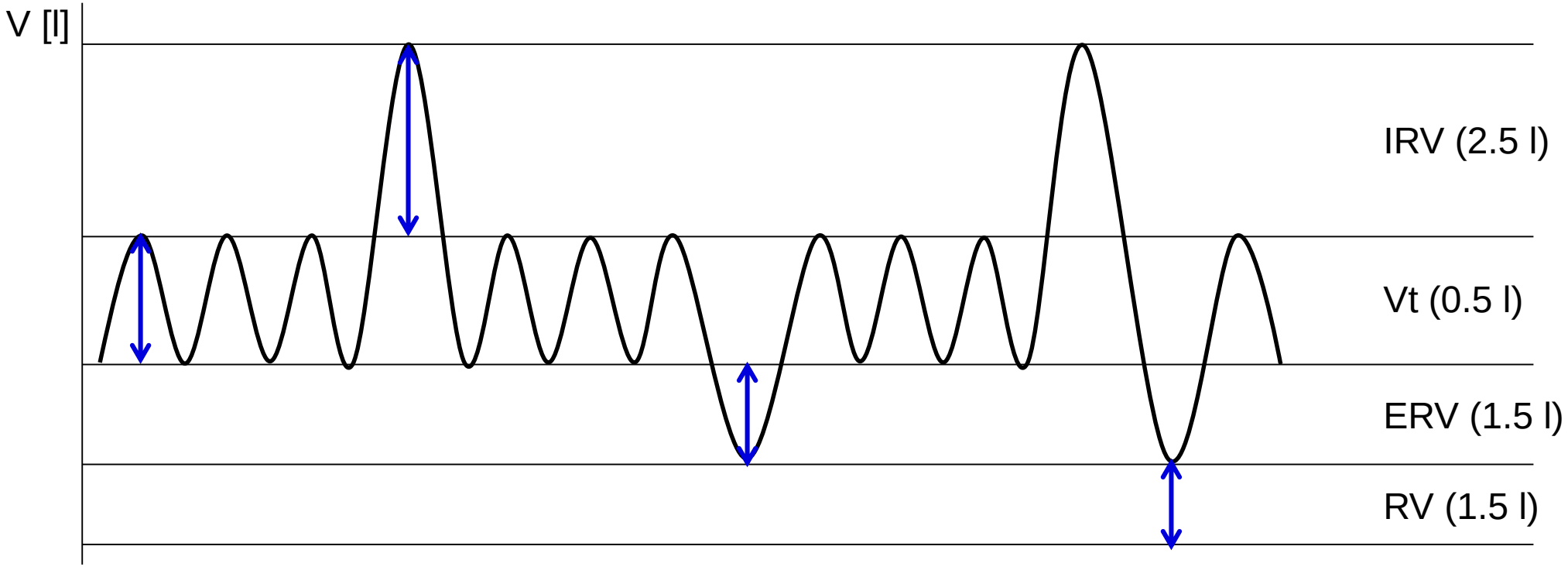
Spirometric examination.
Recording of forced vital capacity.

Spirometric examination



- ***Tidal volume* (Vt)** – the volume of air that enters the lungs during each inspiration (or the volume that is exhaled during every expiration).
- ***Inspiratory reserve volume (IRV)*** – the maximal amount of additional air that can be drawn into the lungs by determined effort after a normal inspiration at rest.
- ***Expiratory reserve volume (ERV)*** – the additional amount of air that can be exhaled from the lungs by determined effort after a normal expiration.
- ***Residual volume (RV)*** – the volume of air still remaining in the lungs after the most forcible expiration possible.

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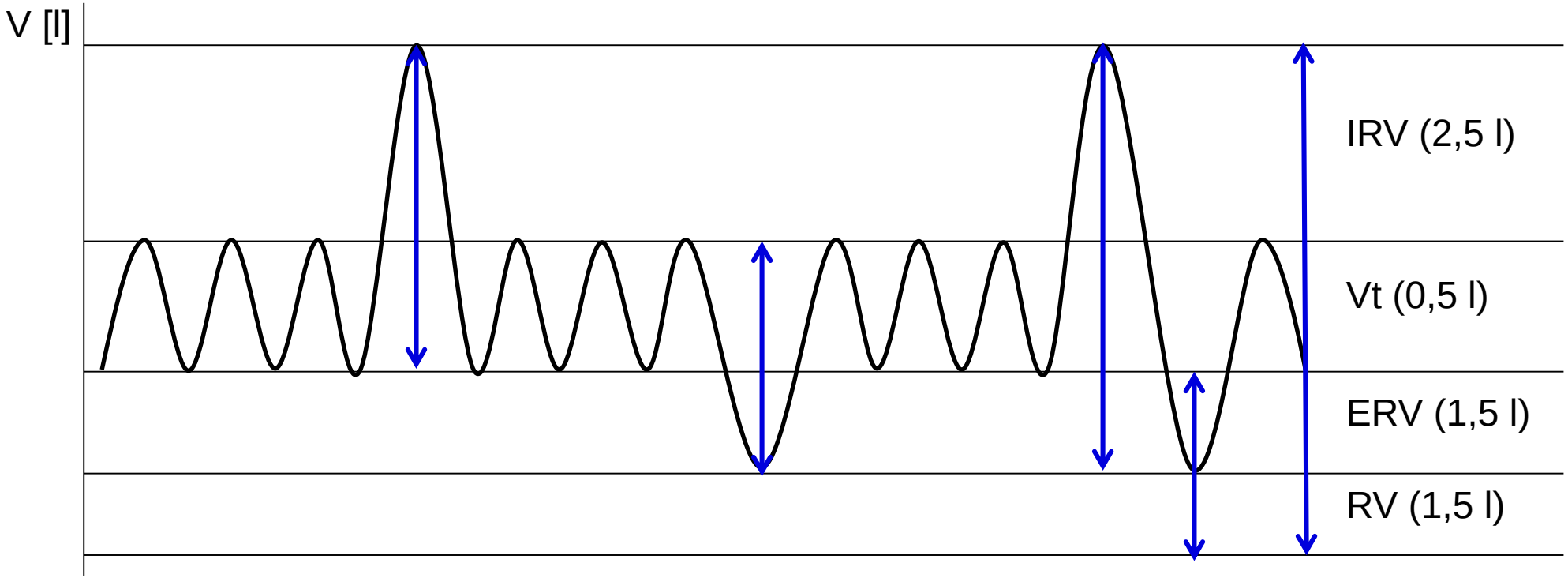
Spirometric examination



Lung capacity:

- *VC = VT + IRV + ERV*
- *TLC = VC + VC*
- *FRC = ERV + RV*
- *IC = IRV + VT*
- *EC = ERV + VT*

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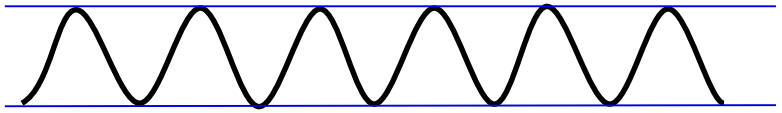
Spirometric examination

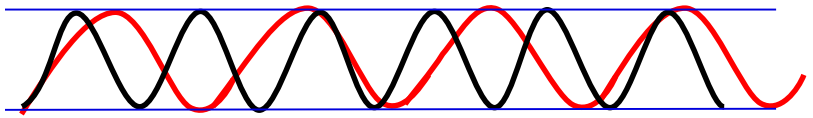
Changes in respiratory rate

Chanes in respiratory depth

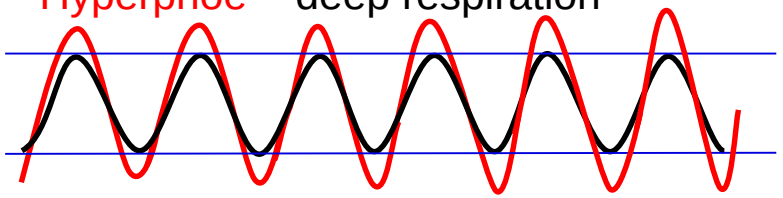
Eupnoe – resting respiration



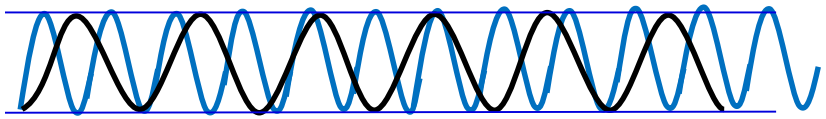
Bradypnoe – slow respiration



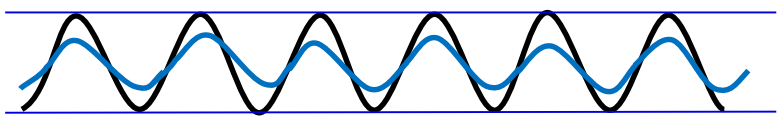
Hyperpnoe – deep respiration



Tachypnoe – fast respiration



Hypopnoe – shallow respiration



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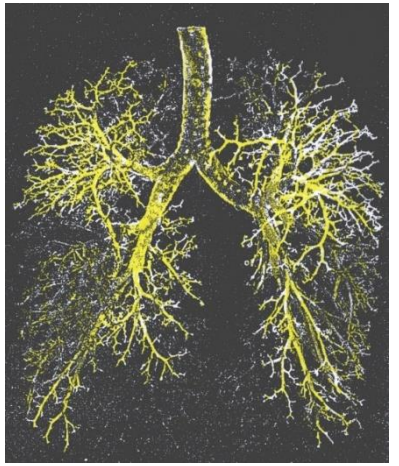
Dead space



- Dead space represents the volume of ventilated air that does not participate in gas exchange
- There are two types of dead space:
  - Anatomical – represented by the volume of air that fills the conducting zone of respiration made up by the nose, trachea, and bronchi (this volume is considered to be 30% of normal tidal volume (500 mL); therefore, the value of anatomic dead space is 150 mL)
  - Physiologic or total dead space is equal to anatomic plus alveolar dead space which is the volume of air in the respiratory zone (respiratory bronchioles, alveolar duct, alveolar sac, and alveoli) that does not take part in gas exchange
- In a healthy adult physiologic dead space is equivalent to anatomical

Dinamic parameters

- Resting respiration:
  - Respiratory rate 10 - 18 breaths/min
  - Minute ventilation - air volume at respiration per minute (Vt x respiration frequency) 5 - 9 l/min
- Maximum minute ventilation (MMV) - the amount of air that can be ventilated at maximum effort (up to 160 l / min)
  - Ventilation is increased by increasing both respiration rate and depth f the respiration
- Respiratory reserve = maximum ventilation / restingventilation
- Parameters of forced vital capacity

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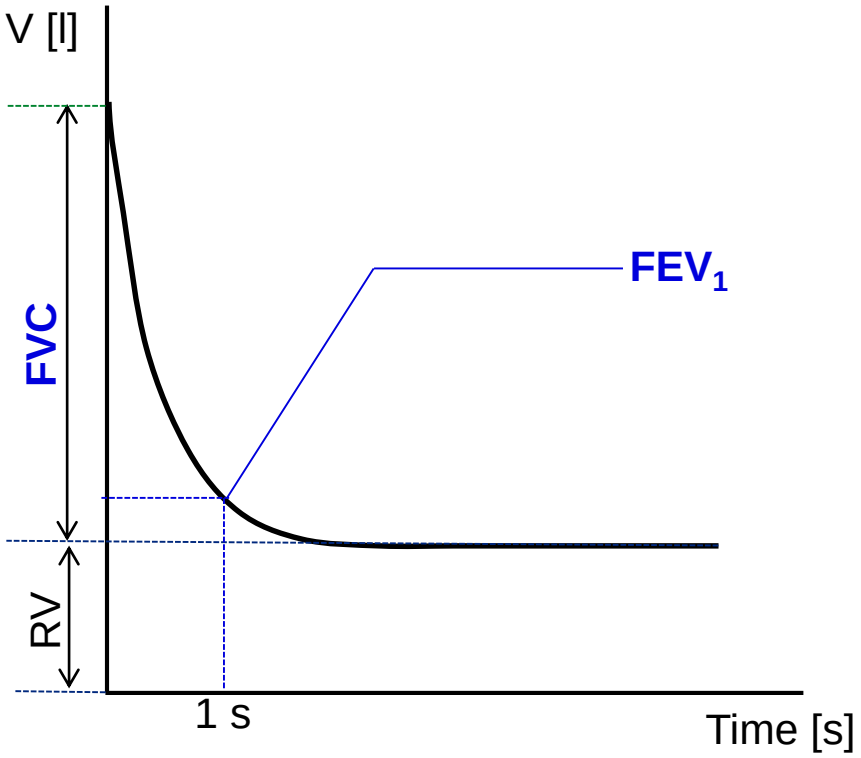
Recording of forced vital capacity

Dynamic lung volumes



- **FVC** – the maximum volume of air that can be exhaled after maximum inhale
- **FEV_1** – the volume of air exhaled with the greatest effort in 1 second after maximum inhale
- **FEV_1/FVC (%)** – Tiffeneau index – 0.7 – 1 (70% - 100%)

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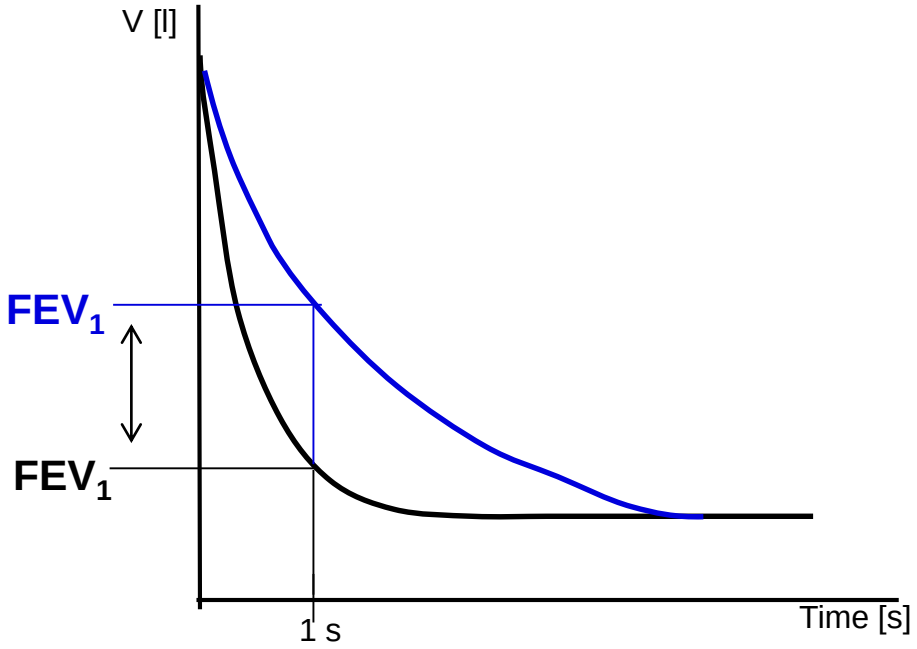
Recording of forced vital capacity



Obstruction lung disease

(FVC=N; FEV_1=↓; T.I.=↓)

- tracheal stenosis
- astma bronchiale
- CHOPN
- tumor

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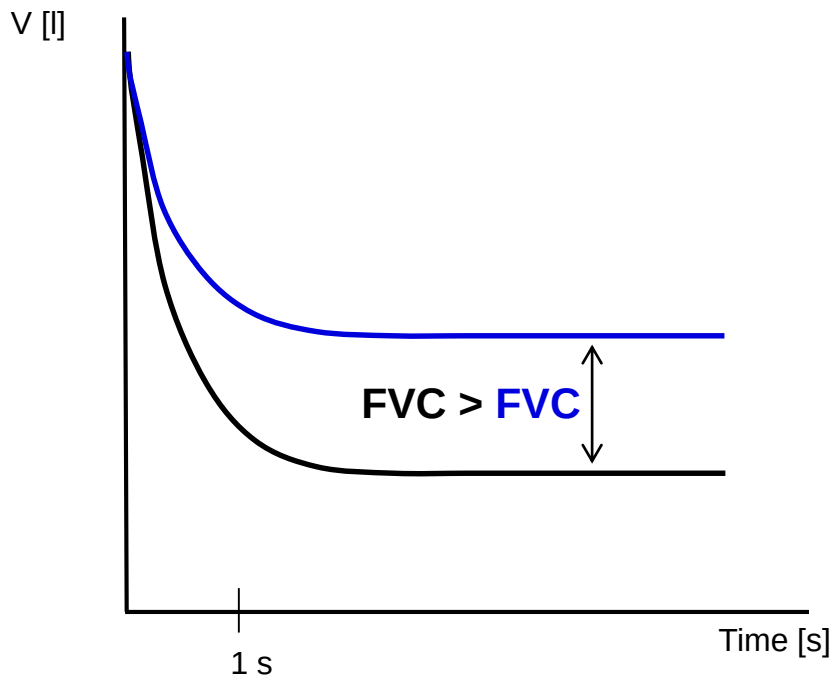
Recording of forced vital capacity



Restrictive lung disease

(FVC=↓; FEV_1=N/↓; T.I.=N)

Pulmonary etiology

- pulmonary fibrosis
- lung resection
- pulmonary edema
- pneumonia

Extrapulmonary etiology

- ascites
- kyphoscoliosis
- burns
- high diaphragm condition

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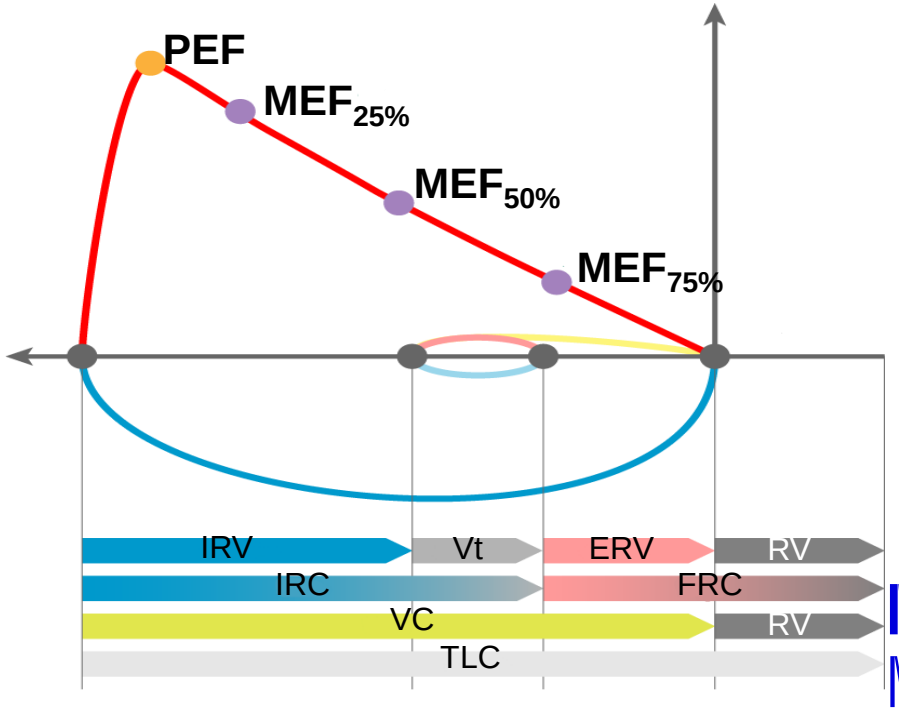
Maximal respiratory flow - volume curve

Principle: the measurement of the air flow velocity according to the speed of the turbine and the volumes are calculated (Cosmed).

- **PEF** – peek expiratory flow; the highest speed of air flow at peak of exhale
- **MEF** – maximum expiratory flow rates at different FVC levels, which is still to be exhaled (75 %, 50 % and 25 % of FVC)



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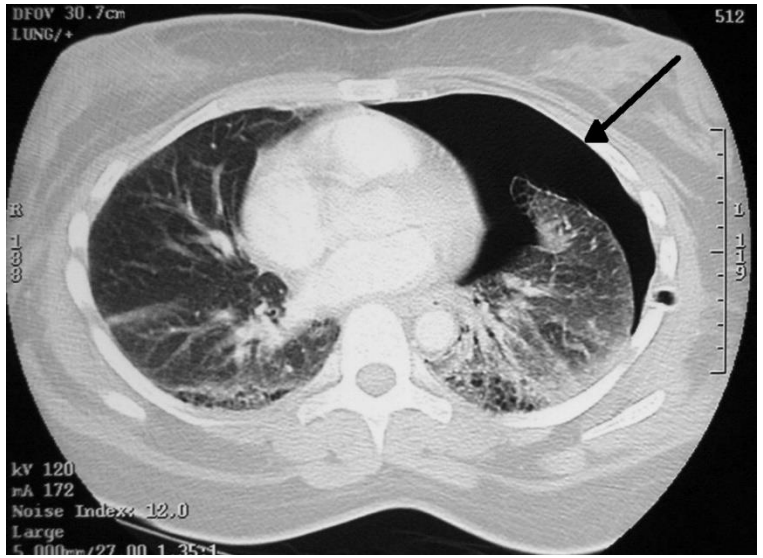
Pneumothorax

- According to etiology:
  - **traumatic** pneumothorax (due to an injury) occurs if the chest wall is perforated or during an injury of the esophagus, bronchi, and during rib fractures.
  - **spontaneous** pneumothorax
  - **primary** idiopathic pneumothorax (without any known cause) may occur in tall healthy young men with an incidence of pneumothoraxes in the family,
  - **secondary** pneumothorax arises as a consequence of lung diseases (such as COPD or cystic fibrosis),
  - **iatrogenic** pneumothorax (due to medical procedures) occurs during invasive medical examinations such as transparietal aspiration biopsy, subclavian vein catheterization, or mechanical ventilation with positive pressure.
  - **artificially induced** (deliberate) pneumothorax is used during thoracoscopy, an endoscopic examination the thoracic cavity.



- According to the communication of the pleural space with its surroundings
  - **open pneumothorax** (when the hole in the pleural space remains open, the air in the pleural cavity moves back and forth with each breath of the patient)
  - **closed pneumothorax** (when a small opening through which air enters the pleural cavity closes)
  - **valvular pneumothorax** (the tissue of the lungs or the chest wall covers the hole in such a way that a valve emerges, this valve allows air to flow inside during inspiration, but it prevents the air from leaving the pleural cavity during exhalation).

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