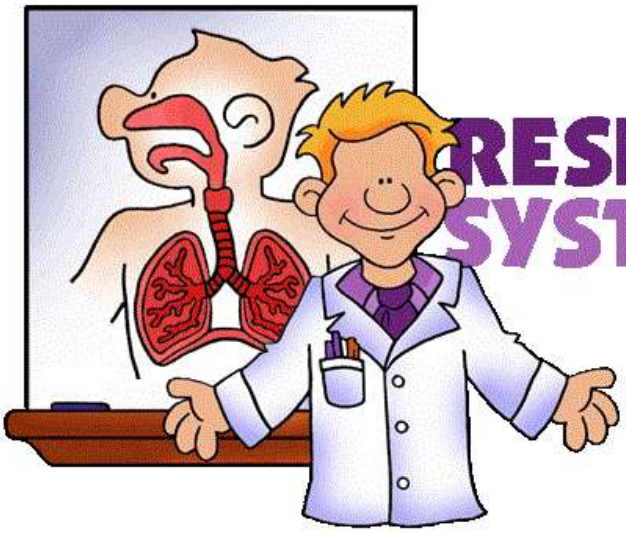
Physiology Team 432



3th Lecture

Respiratory ventilation

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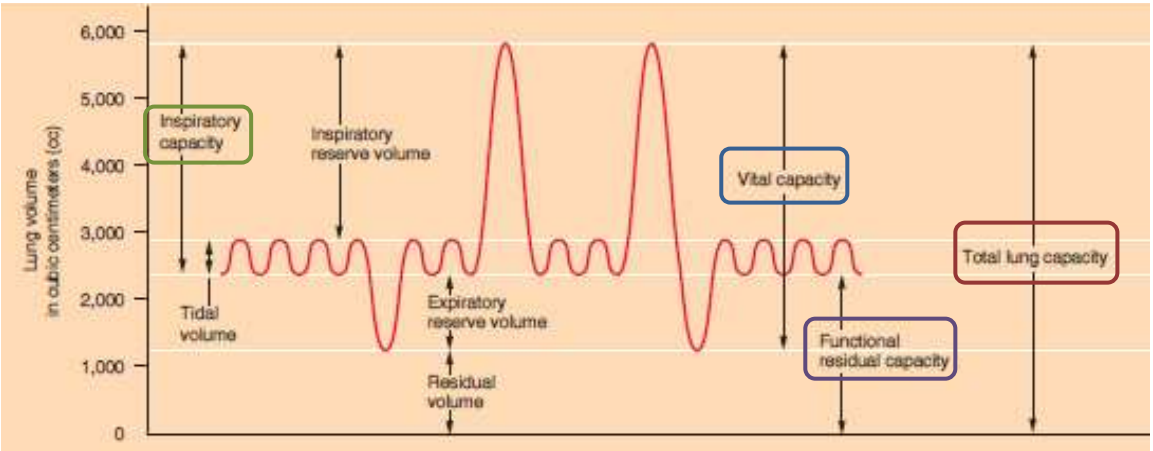
1434- 2013

1) Spirometry : is the most common of the pulmonary function tests (PFT) measuring lung function

Spirogram :



	lung volumes			
Name	Tidal volume	Inspiratory reserve volume	Expiratiry rserve volume	Residual volume
Definition	TV: the volume of air inspired or Expired in normal breath.	IRV: extra volume of inspired air over the tidal volume in deep inspiration.	ERV: extra volume of expired air over the tidal volume in deep expiration.	RV: volume of air remains in lungs after forced expiration.
Volume	500ml	3000ml	1100ml	1200ml

	Lung capacities : capacity = two volumes or more			
Name	Inpiratory capacity	Vital capacity	Functional residual capacity	Total lung capacity
Definition	IC: The total amount of air enter the lungs during forced inspiration. IC=TV+IRV	VC: maximum amount of air lunges can expire after a forced inspiration. VC=TV+IRV+ERV	FRC: the amount of air remains in lung after normal expiration. FRC=ERV+RV	The maximum volume of air that can fill the lungs where they can expend with the greatest possible effort. TLC=all the volumes.
Volume	3500ml	4600ml	2300ml	5800ml

2) determination of capacities and volumes:

Tidal volume, Inspiratory reserv volume, Expiratory reserve volume, Inspiratory capacity & Vital capacity

measured by :

- spirometry

Residual volume, Functional residual capacity & total capacity

measured by :

- Closed circuit Helium Dilution Method

Closed circuit Helium Dilution Method

C1xV1 = C2xV2

C1:concentration of Hi in spirometry
V1:volume of air in the spirometry.
C2:Final concentration of helium
V2:Volume of spirometry+FRC

$$\mathbf{FRC} = \frac{(\boldsymbol{Ci\ He\ (C1)} - \mathbf{1})\ \boldsymbol{Vi\ Spi\ (V1)}}{\boldsymbol{Cf\ He\ (C2)}}$$

تنطلق فكرة عمل الجهاز من العلاقة بين الضغط و الحجم (قانون بويل) لدينا غرفتين مغلقتين تحتوي إحداهما على غاز الهيليوم بنسبة ٢٠% ، فتحت على الغرفة الأخرى الخالية من الهيليوم (وهي الرئة) لينتشر حتى يتساوى تركيزه في كلا الغرفتين فالغرفة ذات الحجم الأكبر ستحصل على نصيب أكبر (من خواص الانتشار في الغازات) فيقل تركيزه في الجهاز تدريجياً بسبب انتشاره في الرئة حتى يصل لمرحلة ثابتة (لأنه غاز خامل لا تمتصه الرئة) ومن هنا نحصل على تركيزه في الرئة عن طريق طرح التركيز النهائي في الأنبوبة من الابتدائي وحجمه في الجهاز معلوم بقي لنا مجهول واحد وهو حجمه في الرئة و هو ما نبحث عنه. **residual volume**

3) FEV1 : the volume of air expired in the first second of a forced expulsion after a maximum inspiration.

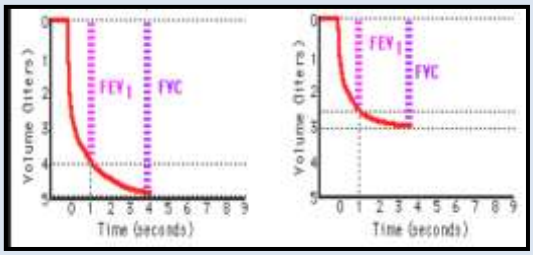
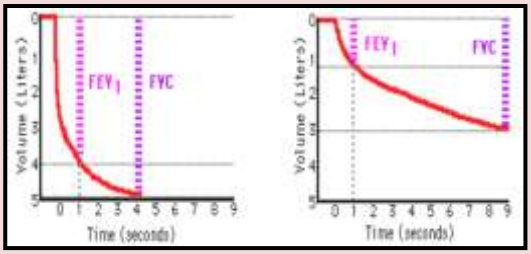
* The person is asked to inspire as deeply as possible and then to breath out as hard and as fast as he can.

* It's used in two ways to determinate lung diseases such as emphysema and asthma in which FEV1 is significantly reduced.

* It is 80%-90% of the vital capacity. FEV1 =3680. *FEV: forced vital capacity.

4) FORCED EXPIRATORY RATIO (FEV1/FVC): The forced expiratory ratio is a sensitive index in differentiating obstructive from restrictive pulmonary disease.

It is decreased in obstruction and is normal or increased in restriction (Enright, 1997).

Restrictive lung diseases : fev1/fvc 80%	Obstructive lung diseases : fev1/fvc lower than 80%
FEV1/ FVC is normal (=80%) but the volumes themselves are lower (as I said 8/4 =2 also 200/100 =2) like in **lung Fibrosis**. 	FEV1/FVC is **lower**, (FEV) is normal but there is a high air resistance decreases FEV1 ends with a low percentage like in **emphysema & bronchial asthma.** 

5) Minute respiratory volume MRV: is the total tidal volumes (new air) that people breath in one minute.

MRV= 12 (breathes per minute) × 500ml (volume per breath) = 6 L/min

- **Respiratory rate: Number of breaths taken per minute.**
- **Minute ventilation: Total amount of air moved into and out of respiratory system per minute.**

❖ **A person can live for a short period with a minute respiratory volume as low as 1.5 L/min and a respiratory rate of only 2 to 4 breaths per minute.**

❖ **The respiratory rate occasionally rises to 40 to 50 per minute, and the tidal volume can become as great as the vital capacity about 4600 milliliters in a young adult man. This can give a minute respiratory volume.**

6) Dead space and alveolar ventilation:

Dead space: is the conductive part where there is NO gas exchange, so from the 500ml of gas enters the lungs 150ml remain at the conductive zone which called the dead space.

Alveolar ventilation per minute:

The total volume of new air entering the alveoli and adjacent gas exchange areas each minute

- ✓ It is equal to the respiratory rate times the amount of new air that enters these areas with each breath. A = Freq • (VT – VD)

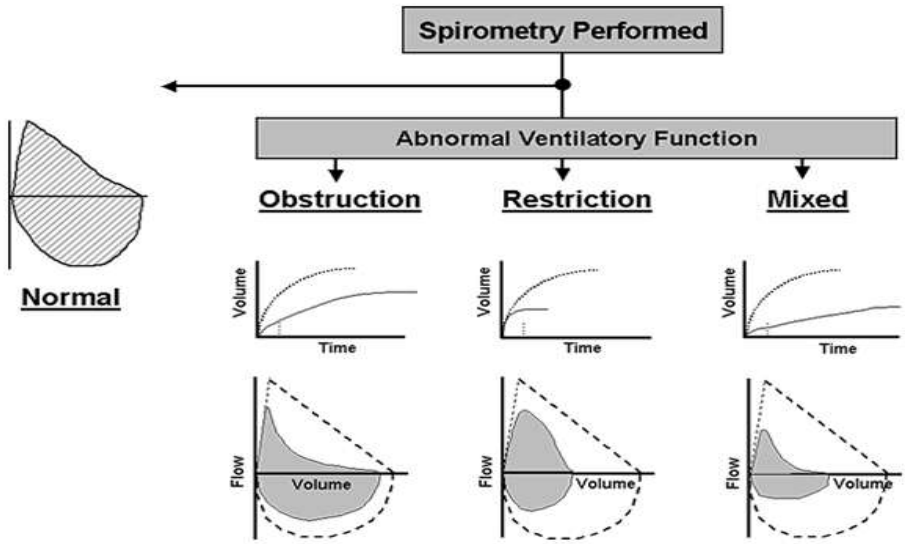
where A is the volume of alveolar ventilation per minute, Freq is the frequency of respiration per minute, VT is the tidal volume, and VD is the physiologic dead space volume.

- **Normal tidal volume of 500 milliliters.**
- **Normal dead space of 150 milliliters.**
- **Respiratory rate of 12 breaths per minute.**

- ✓ MRV is the total volumes enter the lungs in one minute, but as we just knew not all the 500ml is respired! But only 350ml (500-150)

So to count the volume of gas which get respired per minute:

12 (breathes per minute) × 350ml = 4200ml/min



Objectives

1-Define the various Lung Volumes and capacities and provide typical values for each.

2-Define ventilation rate, their typical values, and their measurement.

3-Describe FEV_1 and its role in differentiating obstructive and restrictive lung diseases.

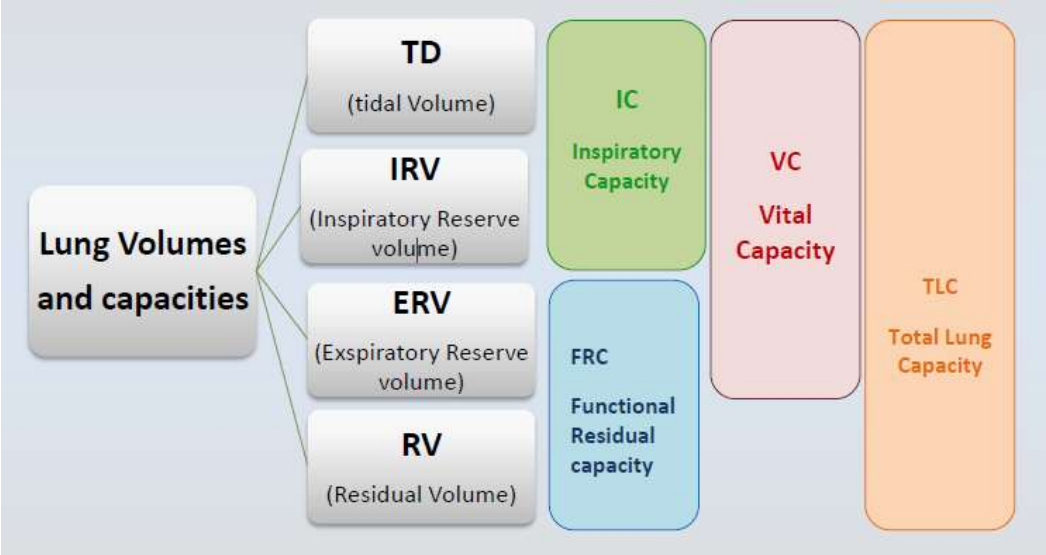
4-Describe the types of dead space. State a volume for the anatomical dead space.

5-Define the term minute ventilation and state a typical value.

6-Distinguish minute ventilation from alveolar ventilation.

Summary

- **FEV1/FVC** ratio it is about 80%. This ratio differentiate between obstructive and restrictive lung diseases.
- **Minuter respiratory volume:** The total amount of new air that moves into the respiratory passages each minute.
- **Dead Space volume :** amount of air that found in the conductive part of the respiratory track and doesn't share in gas exchange.
- The air flow in the trachea is **turbulent , and laminar** in the bronchioles.
- **Sympathetic NS** causes bronchodilation> increase air flow.
- **Parasympathetic NS** causes bronchoconstriction > decrease air flow.



GOOD LUCK