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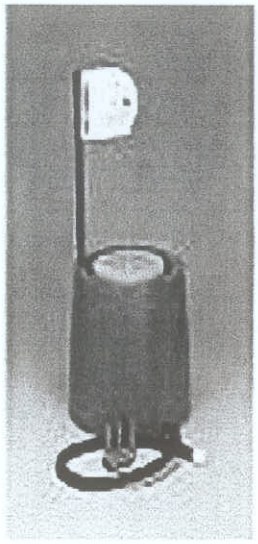
Spirometry

Spirometry : means the measuring of breath .

It is the most common of the Pulmonary Function Tests (PFTs),: (volume) and (flow)



■ **Lung Volumes :** There are four lung volumes

1- Tidal volume (TV) : = **500 ml** (male and female)
volume of air inspired or expired with each normal b

2- Inspiratory reserve volume (IRV) : = **3.3 L** male , **1.9 l**
the volume of air inspired by maximum inspiration aft inspiration

3- Expiratory reserve volume (ERV) : = **1 L** (male) , **700 r**
the volume of air expired by maximum expiration afte expiration

4- Residual volume (RV) : = **1.2 L** (average)
the volume of air remaining in the lungs after maximum expiration.

.....

■ **Lung capacities :** There are four lung capacities:

1- Inspiratory Capacity (IC) : (TV + IRV) = 3.8 L (male) **, 2.4 L** (female)

The maximum amount of air that can be inspired after a normal tidal expiration

2- Functional Residual Capacity : (ERV + RV) = 2.3 L (average)

The amount of air remaining in the lungs after a normal tidal expiration.

3- Vital Capacity (VC) **: (IRV + TV + ERV) = 4.8 L** (male) **, 3.1 L** (female)

(It used in clinical diagnosis.)

The maximum amount of air that can be expired after a maximum inspiration.

4- Total Lung Capacity (TLC) **: (TV + IRV + ERV + RV = 5.8 L)**

The total amount of air in the lungs after a maximum inspiration

If u want to calculate the ERV without the TV and you know that (TV=500 ml (0.5 L)and (TV+ERV=1.8L) then the **ERV=((ERV+TV)-(TV))=(1.8-0.5)=1.3 L**

■ **Factors that influence lung volumes and capacities :**

- **Physiological :**
  - **1- Age :** Increase (RV, FRC)
    Decrease (VC)
  - **2- Sex:** Females have 20 – 25% less values in all pulmonary volume and capacities than males
  - **3-Body size: (obese)**
    ↓ FRC because there's ↑ elastic recoil of the lungs

- Pathological conditions :

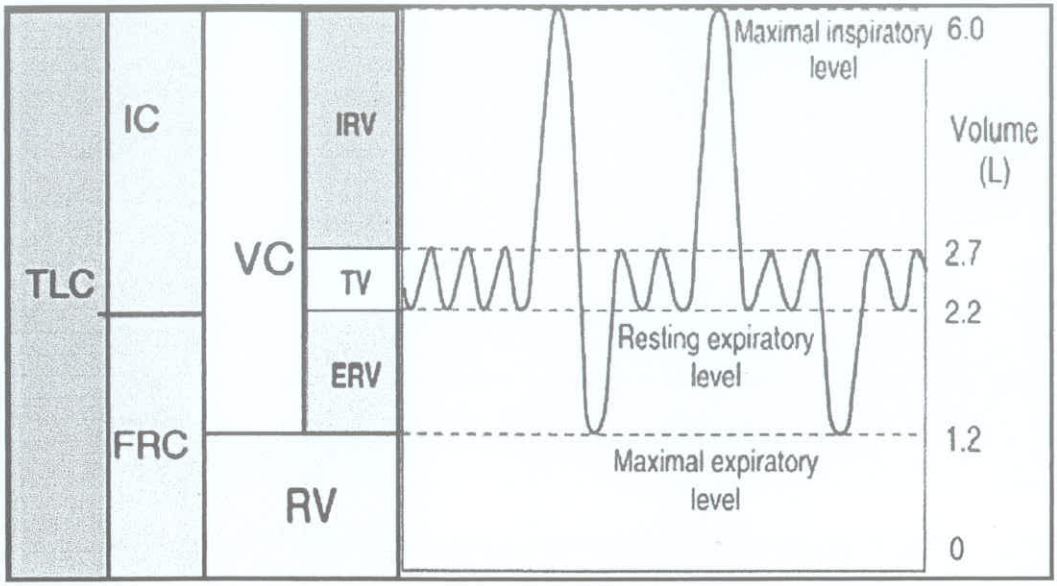
a- Restrictive Lung diseases : (e.g. Alveolar Fibrosis)

- Reduce the compliance of the lungs → compressed lung volumes
- Increase elastic recoil of the lungs
- Decrease (VC, IRV, ERV, RV and TV)
- Increase breathing frequency

b- Obstructive Lung diseases : (e.g. Emphysema)

- Increase resistance to airflow
- Increase (TLC, FRC, RV and TV)
- Decrease (VC and ERV)
- Decrease elastic recoil of the alveoli

-Results :



From the results we can see the following :-

1- lung volumes :

*RV from (0 – 1.2)

*ERV from (1.2-2.2)

*TV from (2.2-2.7)

*IRV from (2.7-6)

2- Lung capacities :

*VC = IRV+ERV+TV ⟶ **from (1.2-6)**

*FRC =RV+ERV⟶ **from (0-2.2)**

*IC=TV+IRV ⟶ **from (2.2-6)**

*TLC=RV+ERV+TV+IRV ⟶ **from (0-6)**

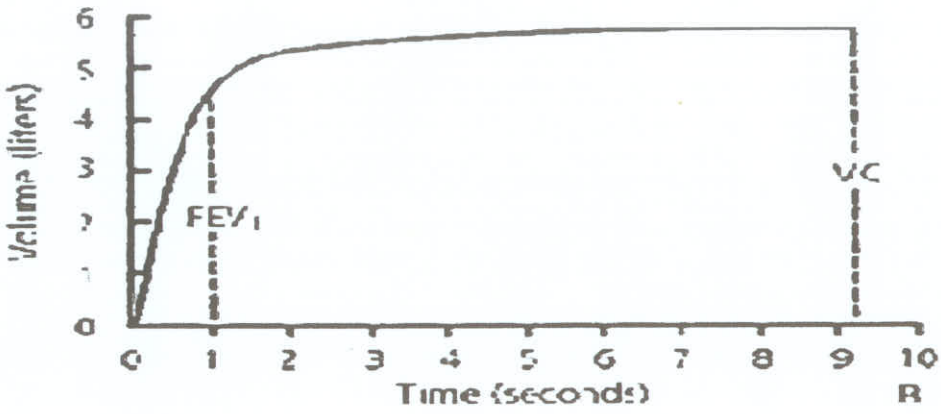
Dynamic Spirometry

Some Definitions:

- **Forced expiratory volume in 1 sec (FEV1):** the volume of air forcefully expired during the first second after a full breath and normally accounts for > 75% of the FVC.

- **Forced Vital Capacity (FVC):** The volume of air expired with maximal force after maximal inspiratory effort.

The FEVI curve



(1) From the FEV1 produced, calculate:-

a. **FVC**: 5.5 L (estimate)
b. **FEV1:** 4.5 L (estimate)
c. **FEV1%:** FVC/FEV1 × 100 = 4.5/5.5×1= 81% (normal).

(2) The FEV1% is a good index of airway resistance while expiring.

a) What values would be expected for a normal person?

a. The values expected for a normal person is >75%

b) How long does it take for healthy subjects to expire their vital capacities?

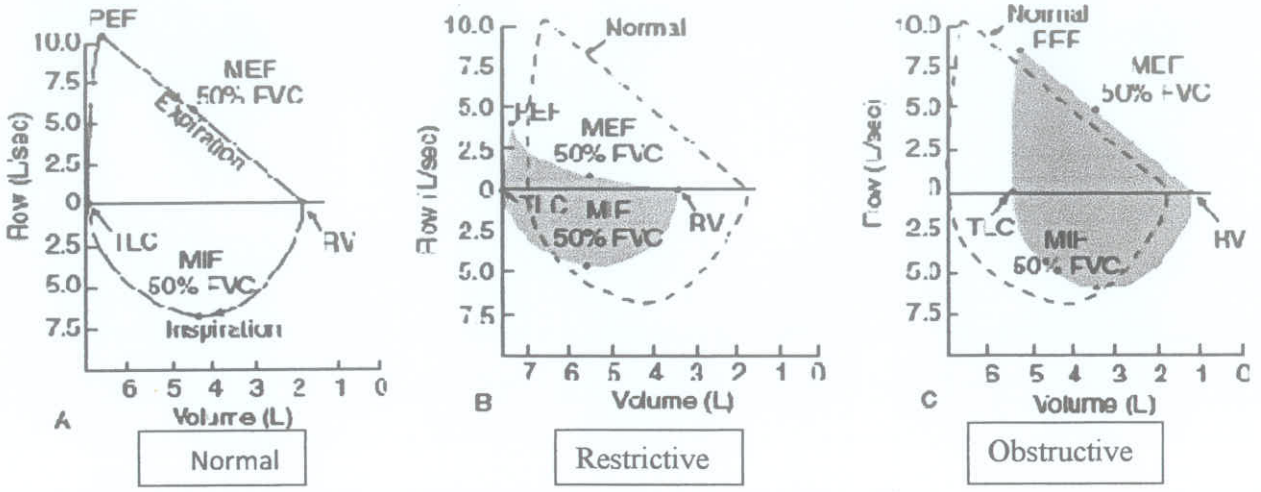
b. It takes healthy subjects to expire their vital capacity 3-5 seconds.

c) Briefly explain what happens to FEVI and FEV1 % measurements in patients with obstructive and restrictive lung diseases.

c. In pathologies the following effects take place:

	Obstructive	**Restrictive**
FEV1/FVC %	↓↓ (far below 80%)	Normal
FEV1	↓	↓
FVC	Normal or ↓	↓↓ (can reach 3L)

Flow Volume Loop



1. From the flow volume loop recorded, calculate:-

a) The vital capacity (VC)

?

b) The peak expiratory flow rate (PEFR)

PEFR : Greatest flow achieved during the maneuvre = 6- 12l/sec

In obstructive: PEFR ↓ → on diagram is approximately = 9 L\ sec

In restrictive: PEFR ↓ → on diagram is approximately = 4 L\ sec

c) The peak inspiratory flow rate (PIFR)

PIFR = 6 L/sec << normally

In obstruction : PIFR is considered normal in obstructive disease

(all inspiratory loop is normal)

In restriction: PIFR decreases in volume → on the previous curve = 5 L\sec

d) The MEF50 (maximum expiratory flow at 50% vital capacity)

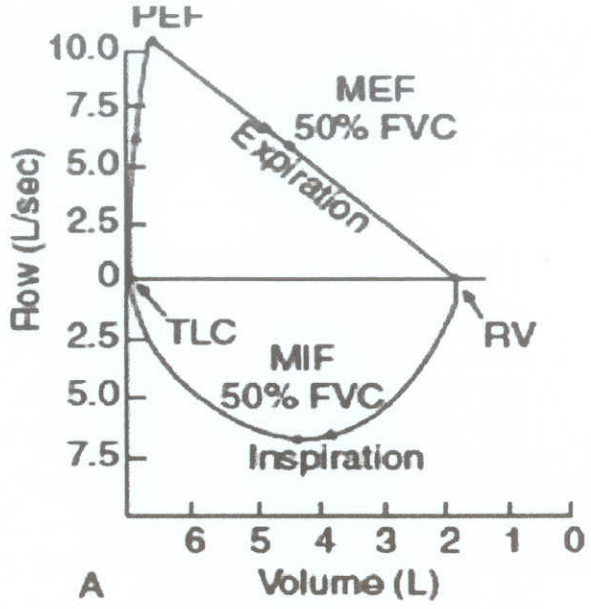
MEF50: = 4- 6 l/sec normally

In obstructive: MEF50↓→ (measure the half way and go up in the obstructive loop)

In restrictive: MEF50↓

e) The MIF50 (maximum inspiratory flow at 50% vital capacity)

MIF50 might be missed with PIFR, actually PIFR is the lower value given if we put a horizontal line that touches the inspiration loop. And MIF50 is given when we measure the half way on the zero line, and drop a perpendicular line which stops in the end of the loop (the lower end of the red line)



2- Briefly describe the important characteristics of the flow-volume curve recorded with a normal healthy person.

In a normal individual all of the parameters (including FVC MEF50, PEFR, PIFR,...etc)
will be within normal ranges.

3- Why is the force-independent part of the expiratory loop curvilinear in obstructive lung disease?

due to narrowing of the smaller airways.
(the rising phase in the expiratory loop is force dependent, and the falling phase is force independent).

4- What is the clinical significance of MEF50 measurements?

To diagnose obstructive lung disease
(↓ in MEF50 with normal simultaneous PEFR ???obstructive lung disease).
If there is decrease in MEF50 with simultaneous decrease in PEFR, then it is restrictive lung disease.