Kufa's university

Respiration Module

Session 4 – Lung function testing

Lung function testing

- tests need to assess
  - the mechanical condition of the lungs
  - resistance of the airways
  - diffusion across alveolar membrane

Pulmonary Function Test

- Spirometry
- Lung volumes
- Diffusions capacity
- Oxygen saturation and ABG(arterial blood gases) analysis.

PFT'S

FVC:	Forced Vital Capacity means the total volume (in liters) of air a person can expel by exhaling as hard as possible for as long as possible (normally six seconds).
FEV1:	Forced Expiratory Volume at 1 second means the volume (in liters) of air expelled (exhaled) as hard as possible in the first second of effort.
FEV1%	The FEV1 observed divided by the FEV1 predicted (based upon an individual's gender, height, and age).
FEV1/FVC:	The FEV1 observed divided by the FVC observed.
PEF:	Peak Expiratory Flow means the maximal flow (in liters) of expiration achieved. This occurs at the onset of expiration.

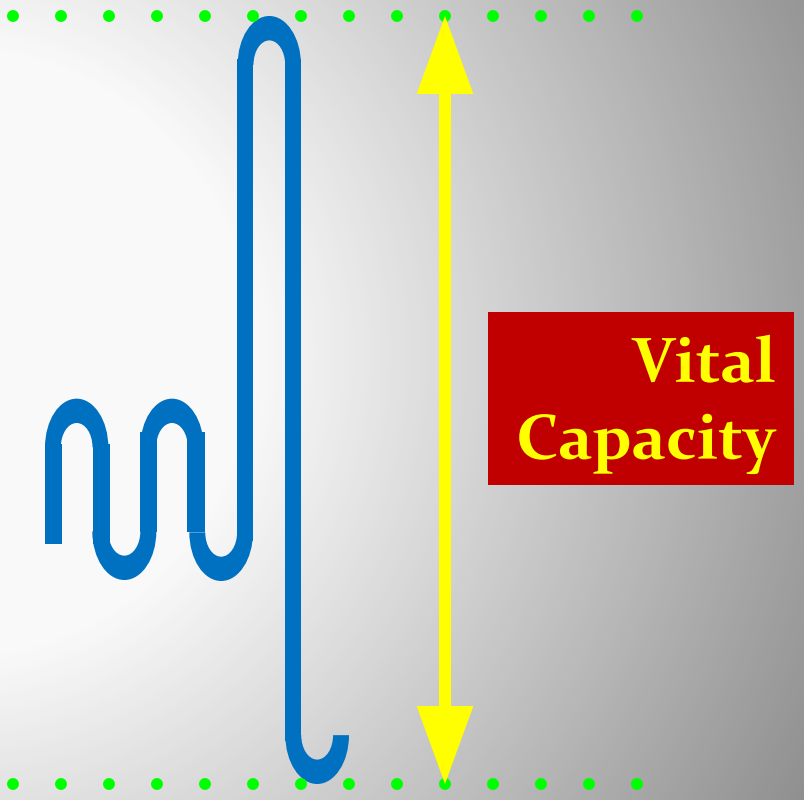
Non invasive testing

- lung function may be inferred from measurement of
  - volumes
  - pressures/flows composition

- at the mouth

Volume

- remember the spirometer
- vital capacity
- maximum inspiration to maximum expiration



?What limits vital capacity

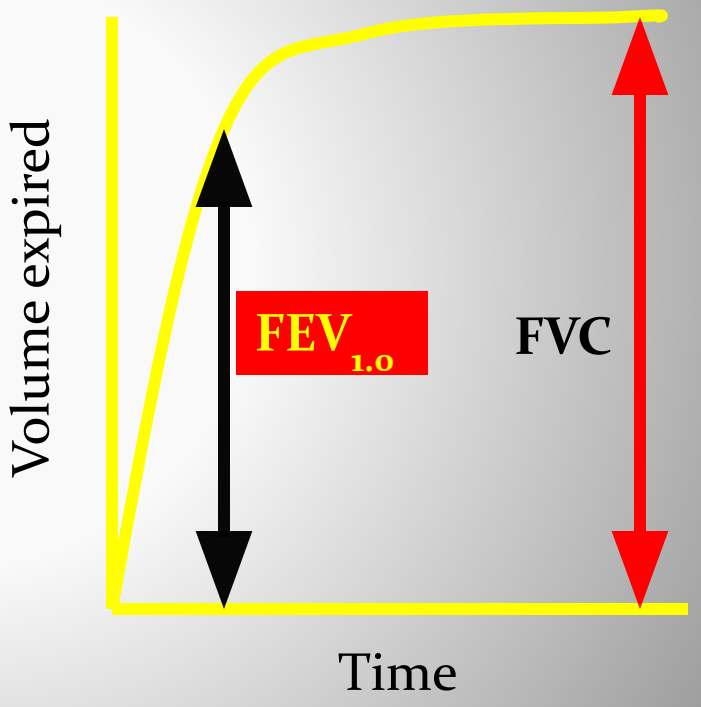
- maximum inspiration
  - compliance of the lungs
  - force of inspiratory muscles
- maximum expiration
  - increasing airway resistance
  - as the lungs are compressed

If vital capacity is less than normal

- tables predict what vital capacity should be
- if less maybe because
  - **cannot breathe in maximally**
  - **cannot breathe out maximally**
- **how to tell the difference?**

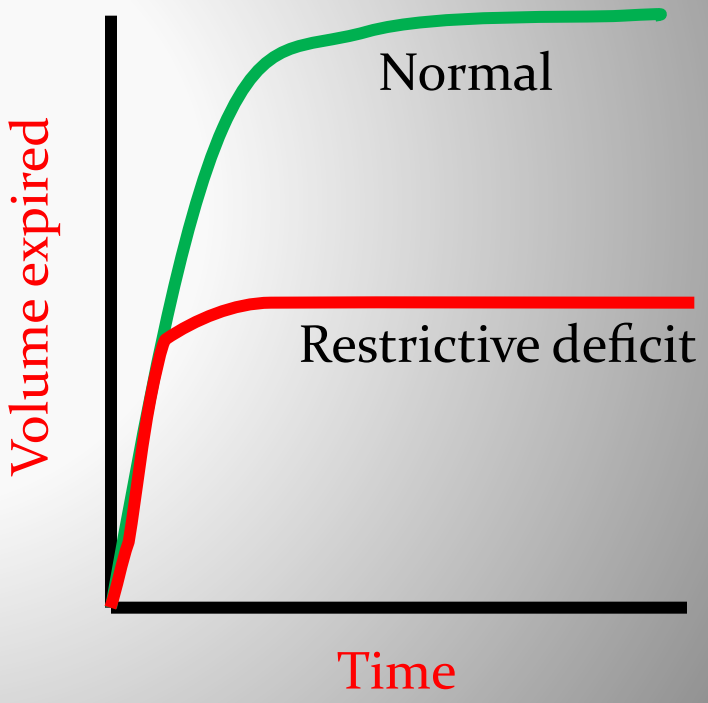
Vital-ograph trace

- plot of volume expired vs time
- initial rapid rise tails to a plateau



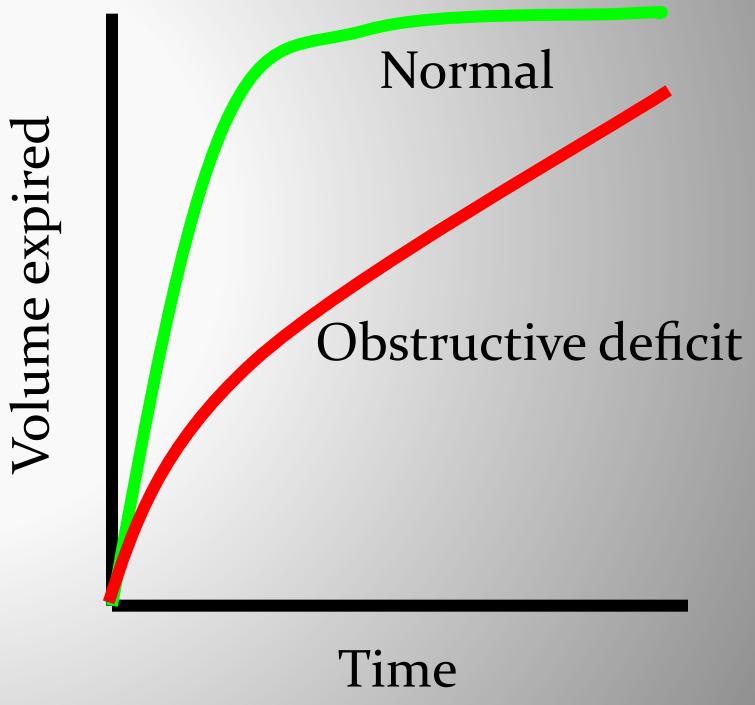
Restrictive deficit

- if lungs are difficult to fill
  - stiff
  - weak muscles
  - problem with chest wall
- they will start less full
- so FVC will be reduced
- but air will come out normally
- so $FEV_{1.0}$ will be >70% FVC



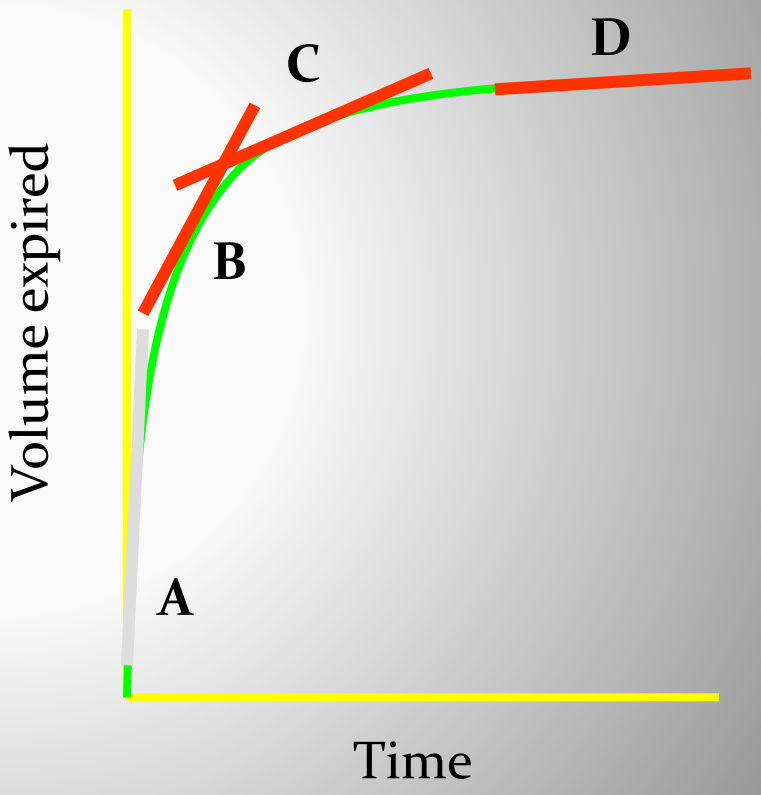
Obstructive deficit

- if airways are narrowed
- lungs will still be easy to fill
- but resistance will increase in expiration
- so air will come out more slowly
- and $FEV_{1.0}$ will be reduced
- but FVC be relatively normal

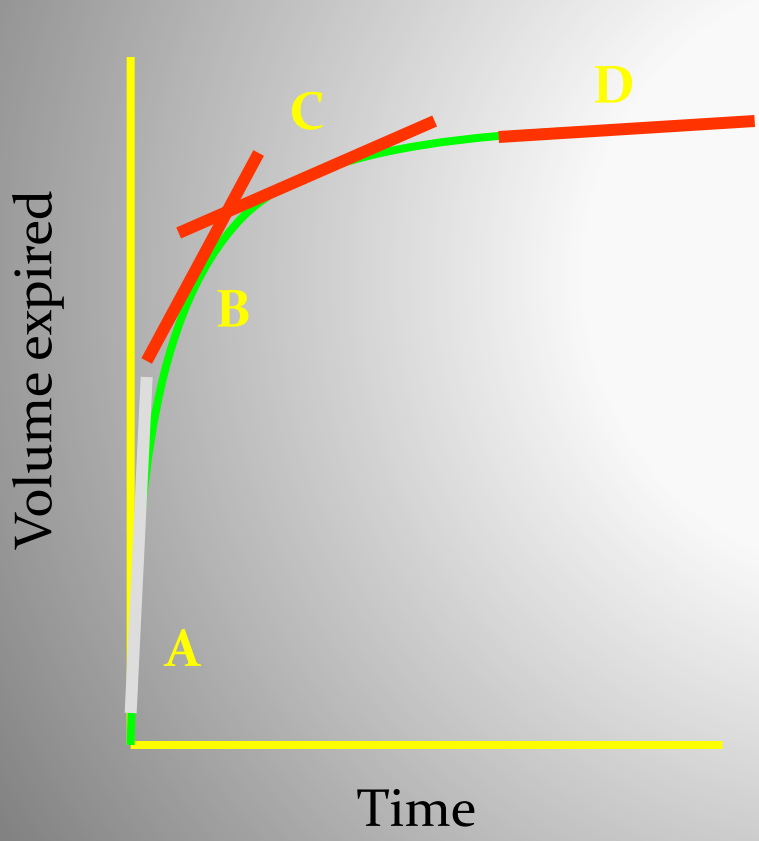


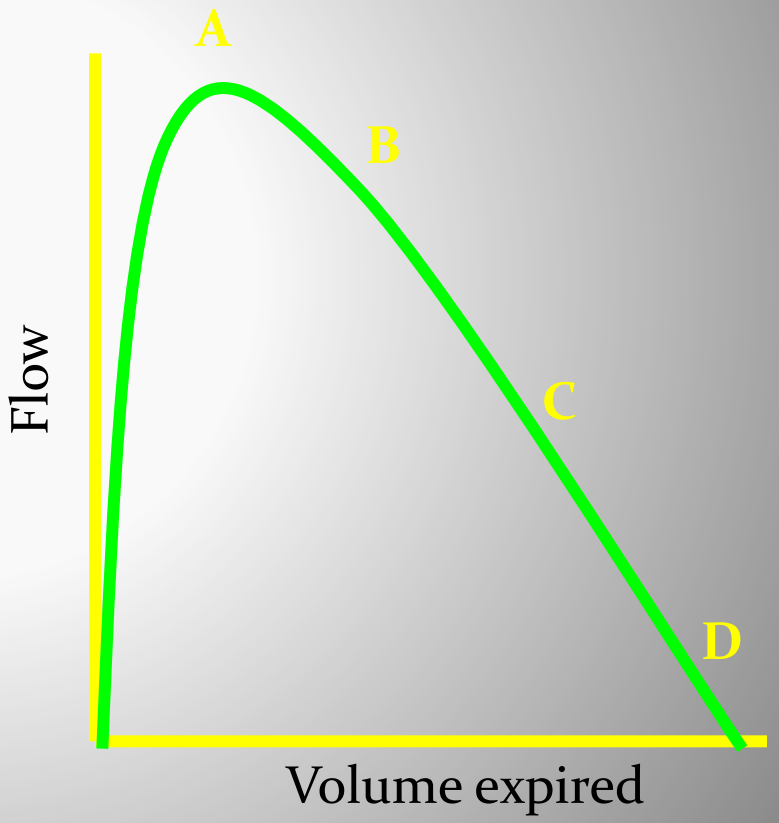
Flow volume curves

- plot of volume expired
- against flow rate
- derived from vitalograph trace



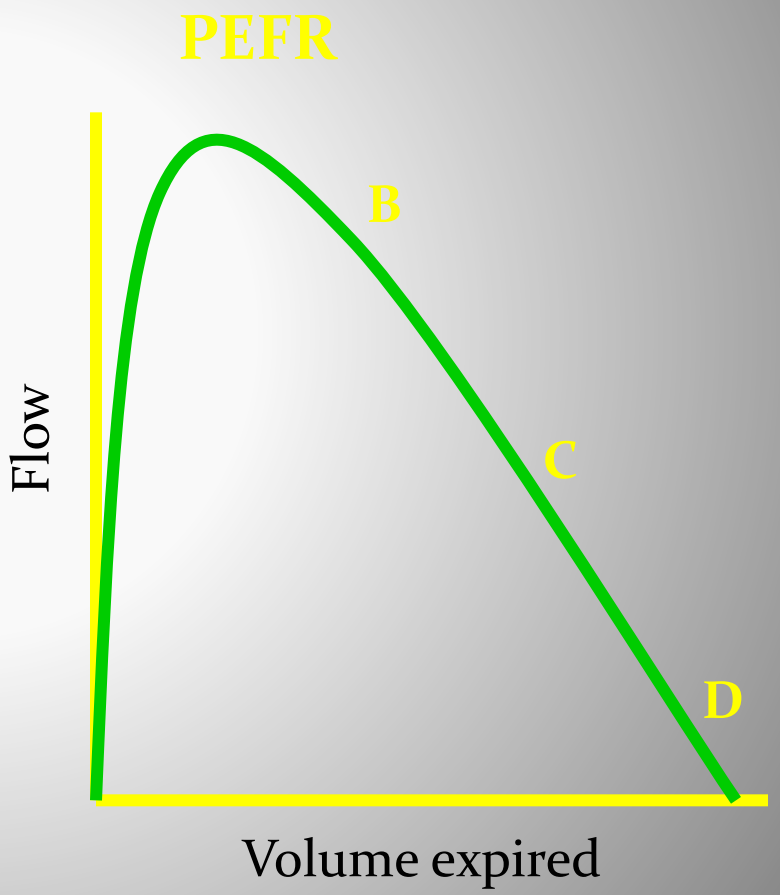
Flow volume curves





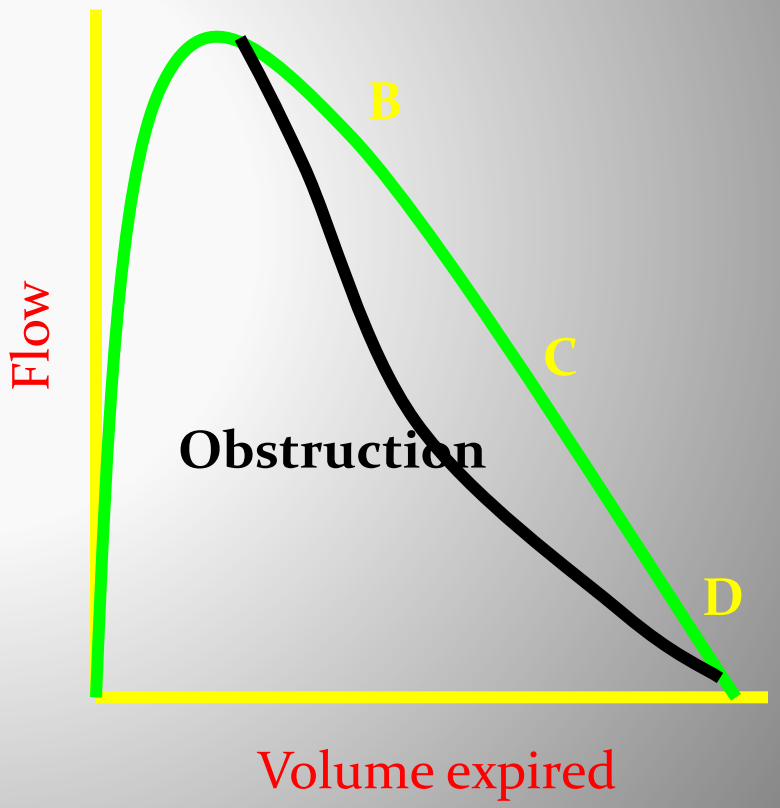
Flow volume curves

- when lungs are full
  - little air expired
  - airways stretched
  - so resistance at minimum
- flow rate will be maximal
- Peak Expiratory Flow Rate (PEFR)



Flow volume curves

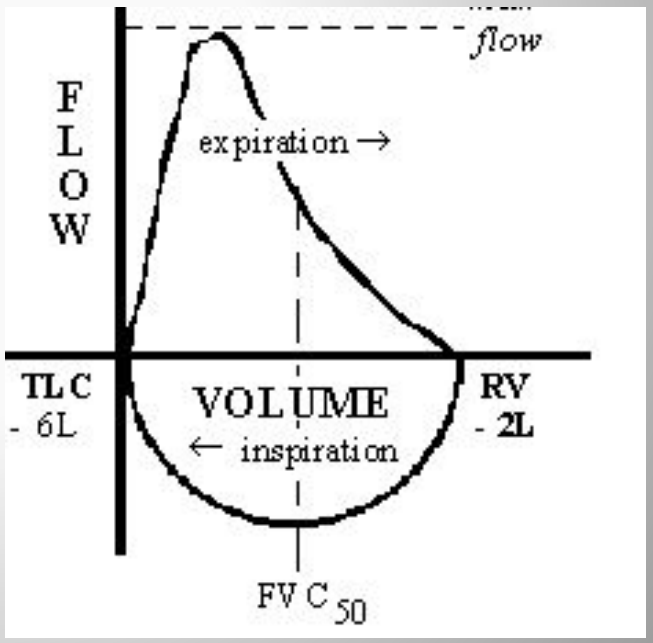
- as lungs are compressed
  - more air expired
  - airways begin to narrow
  - resistance increases
- flow rate falls
- the narrower the airways to start with the more rapidly it falls



Flow volume curves

- a much more sensitive indicator of airway narrowing
- can also discriminate large & small airway narrowing

- This is Flow-Volume loop



Peak Expiratory Flow Rate

- can be measured with a simple, cheap device
- so often used as a screening test for airway narrowing
- but very insensitive

Measurement of Residual volume

- cannot be measured by spirometer
- use Helium dilution
- Nitrogen Washout
- Body Plethysmography

Nitrogen washout

- subject takes one normal breath of pure oxygen
- breathes out via meter measuring % nitrogen
- initially only oxygen expired from airways
- Nitrogen washout. Until recently, this was the most commonly used method of lung volume determination. In this technique, 100% oxygen in inhaled briefly and nitrogen in the exhaled gas is measured - this allows calculation of the total amount of gas in the lung originally.

Helium dilution

- helium not normally present in air
- and insoluble in blood
- breathe in known concentration
- starting at FRC
- and see how much concentration reduced by mixing with air already in lungs

Measuring diffusion conductance

- measure how easily carbon monoxide crosses from alveolar air to blood
- use CO because binding to Hb means no partial pressure in mixed venous blood

The lung function report

- Vital Capacity
- $FEV_{1.0}$ (before after bronchodilators)
- ratio $FEV_{1.0}$ /FVC
- Peak Expiratory Flow

The lung function report

- FRC
- RV
- TLC total lung capacity
- RV/TLC

The lung function report

- transfer factor
- carbon monoxide conductance

The lung function report

- learn how to interpret them!

Formative assessment Exam

- 1- Enumerate the component of PFT.
- 2- What are the difference in the meaning of Flow-Volume curve and Flow-Volume Loop?.
- 3- Determine the volumes compose TLC.
- 4- Are there any contraindication to order PFT?. Please enumerate it.
- 5- List the benefit of doing PFT ,