Spirometry

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What is spirometry

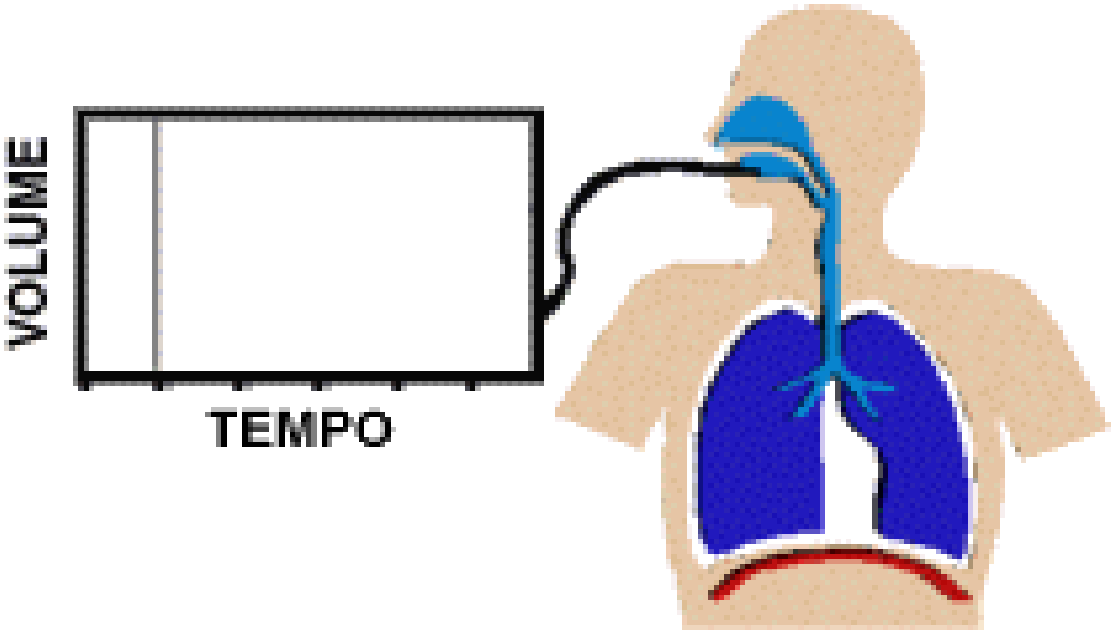
The spirometry is a very simple, non-invasive, test which allows to measure the amount of air a subject can inhale and exhale, and the time required to do so.

It’s essential for the diagnosis and monitoring of many diseases of the respiratory system.

Is performed with an instrument called a "spirometer"

Spirometer is an instrument that measures and records the volume of inhaled and exhaled air, used to assess pulmonary function.

The computer connected to spirometer converts the signal into numerical values and graphical images called a spirogram



The spirometer can measure:

- The volume of air mobilized (or bellows spirometer),

- The flow of air mobilized (pneumotachograph, turbine spirometer

WHY WE DO IT !

- Diagnosis confirmation
- COPD classification
- Disease progression
- Response to treatment
- Health Promotion (Smoking Cessation)
- Targets

When not to perform spirometry

- Inadequate training
- Inadequate equipment
- Lack of quality control
- Contra-indications
- During or immediately after an exacerbation

Contra-indications

- Haemoptysis
- Pneumothorax
- Unstable cardiac status
- Aneurysm
- Recent eye surgery
- Recent thoracic or abdominal surgery
- Acute disorders: D&V, Exacerbations

How we do it!

- Equipment / spirometers /syringes
- Cleaning
- Temperature
- Calibration/Verification checks
- Filters

Standardization

Protocol drawn in accordance with the documents of international and national associations

AIMS

•QUALITY

delete variables:

instrumentation

calibration

performer

collaboration

Reduction of the infection risk

PROCEDURE

Preparation of the patient

Suspending drugs

Medical history

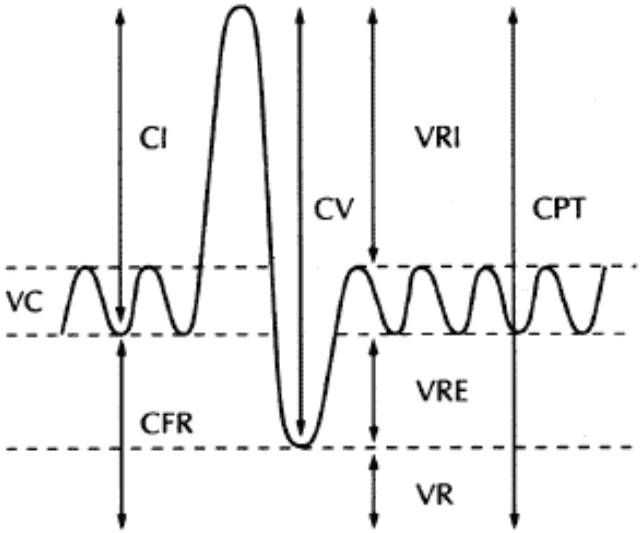
Teaching and Demonstration

Slow maneuver (VC)

I: Quiet breathing

II: Full inspiration

III: Complete exhalation



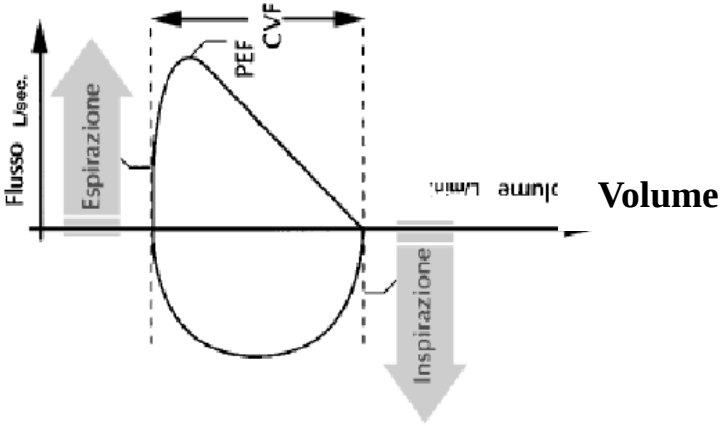
Forced maneuver (FVC)

I: Quiet breathing

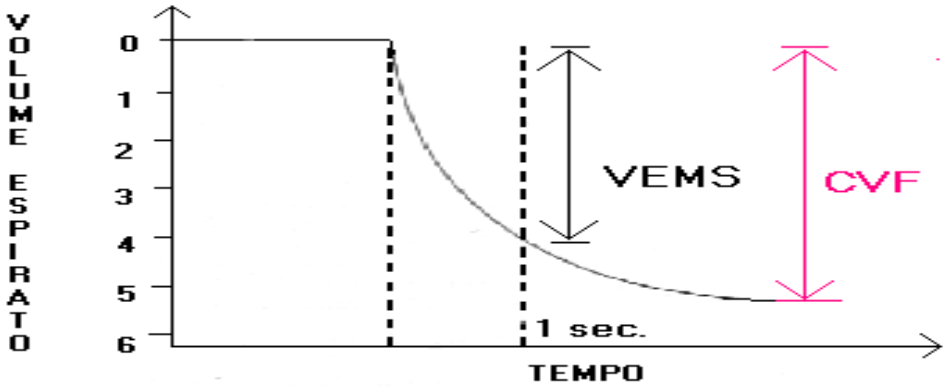
II: maximal inspiration

III: rapid and complete expiration

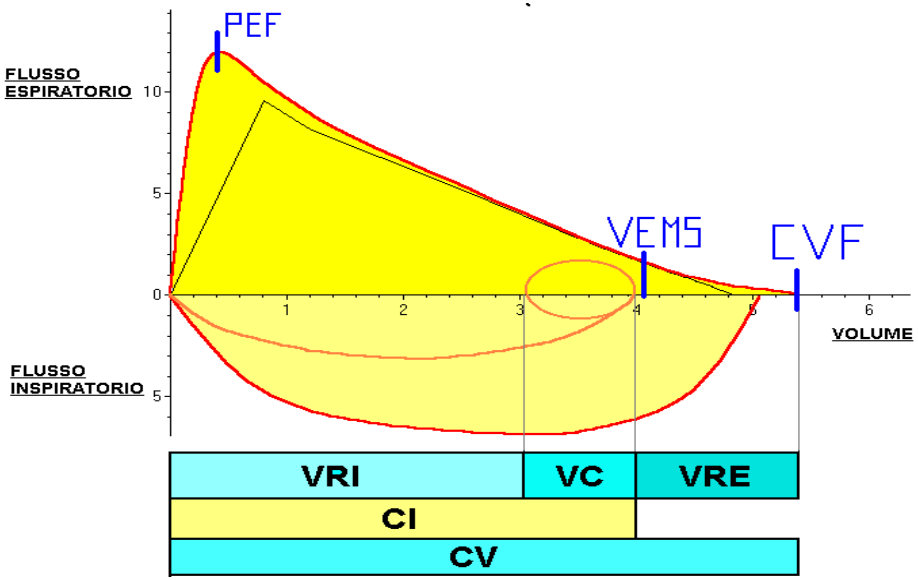
IV: rapid and deep inspiration



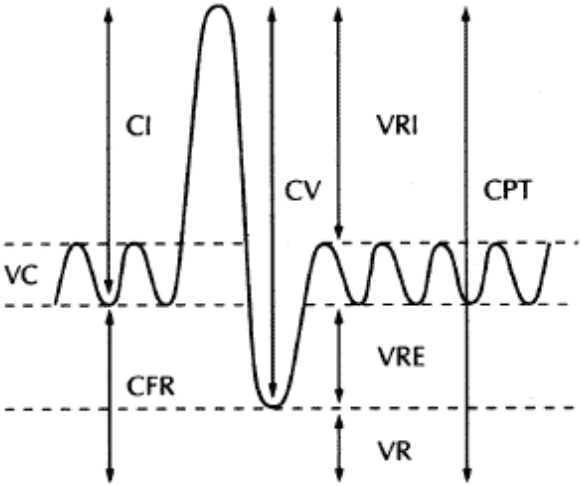
Volume-Time curve (V/T)



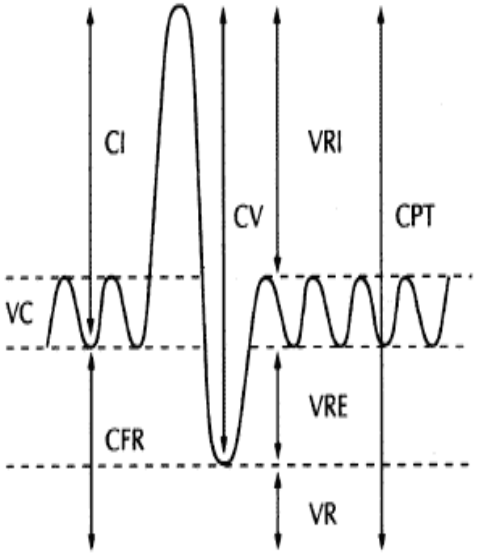
Flow-Volume curve (F/V)



Lung Volume



Static Lung Volume



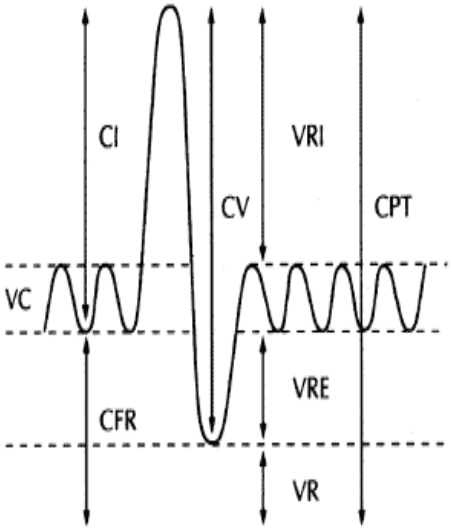
- tidal volume **(VC)** gas volume inhaled and exhaled during each breath

- inspiratory reserve volume **(VRI)**
maximum amount of gas that can be inspired at the end of normal inhalation

- espiratory reserve volume (**VRE)**
maximum amount of gas that can be exhaled at the end of normal expiration

- residual volume (**VR)**
amount of gas remaining in the lungs at the end of full exhalation

Capacity



- Total lung capacity **(TLC)**

amount of gas contained in the lungs at the end of maximal inspiration (CPT = VRI + VC + VRE + VR).

- Vital Capacity **(VC)**

amount of gas that can be expelled from the lungs after maximal inspiration (CV = VRI + VC + VRE).

- Inspiratory Capatity **(IC)**

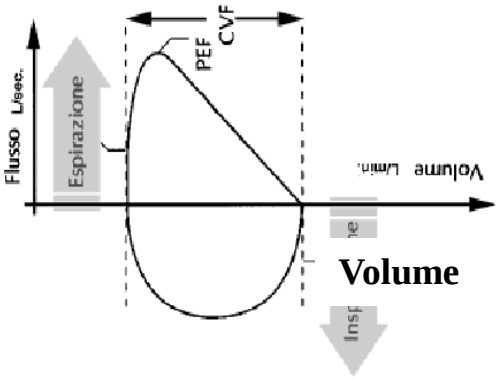
maximum amount of gas that can be breathed in from level expiratory basic (CI = VRI + VC).

- Functional Residual Capacity **(FRC)**

amount of gas remaining in the lungs at the level expiratory resting (CFR = VRE + VR).

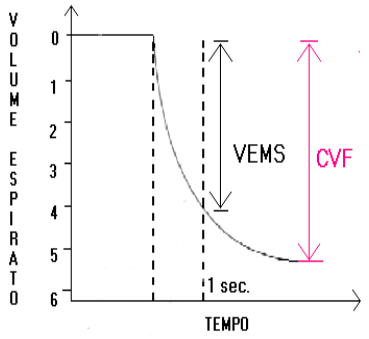
Dinamic lung volume

a . The forced expiratory volume in one second FEV (or FEV1) that represents the volume of air exhaled during the first second of a forced expiration.



b . The forced expiratory flow between 25% and 75% of FVC FEF 25-75

c . The forced vital capacity (FVC) volume of forced exhaled air after maximal inhalation



d . The Tiffeneau index (ratio of FEV / FVC x 100).

the fundamental parameters

FVC - *Forced Vital*

Capacity Total volume of air expelled in a forced expiration starting from full inhalation.

VC - *Vital capacity*

Total volume of air expelled in a slow maximal exhalation, starting from a full inspiration.

FEV1 - *Forced expiratory volume in 1 second*

Volume of air expelled in the first second of a forced expiration, starting from a full inspiration.

FEV1/FVC *Tiffeneau Index*

The relationship between FEV and FVC discriminates against an obstructive deficit by a restrictive. Normally 70-75% of the FVC is exhaled in the first second.

PEF *Peak Expiratory Flow)*

PEF is the highest sustained flow for at least 10 msec with a forced expiration starting from full inhalation.

READING spirometry

MORPHOLOGY OF THE CURVE

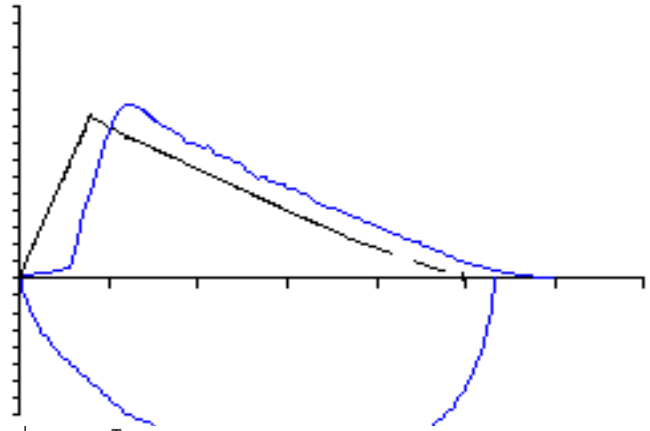
Quality inspection of the curve

Check of the technical requirements
VC (5-6 breaths) Forced Vital Capacity
Exhalation (lasting at least 6 sec.,
End-expiratory flow> 1 sec.)
Lack of artifacts

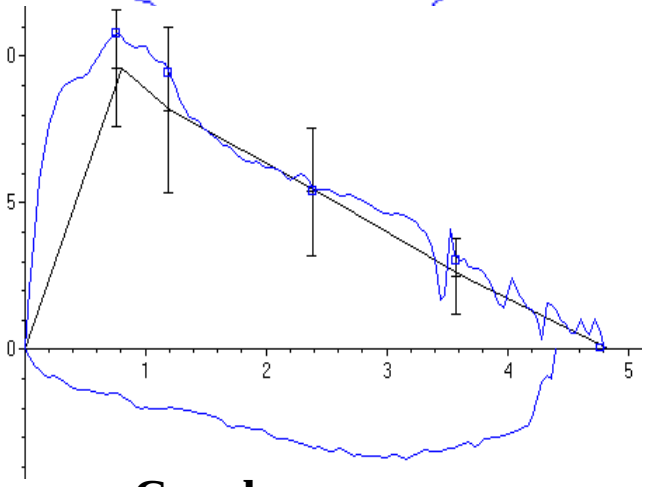
Three tests acceptable
Reproducibility: difference between the two best FEV <or = 200 ml
Type functional deficit

Incorrect flow-volume curves

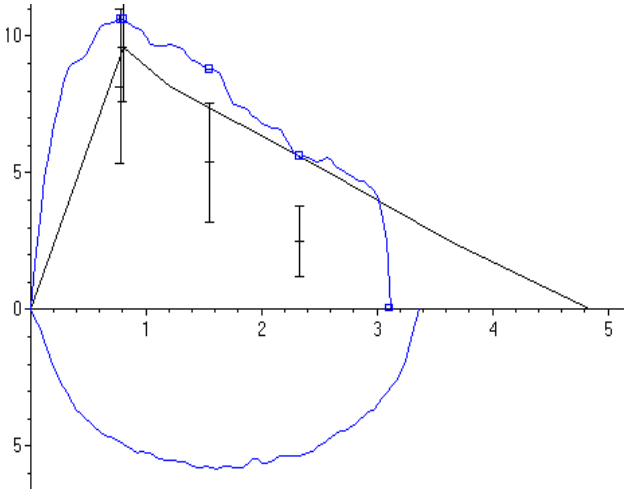
Slow start exhalation



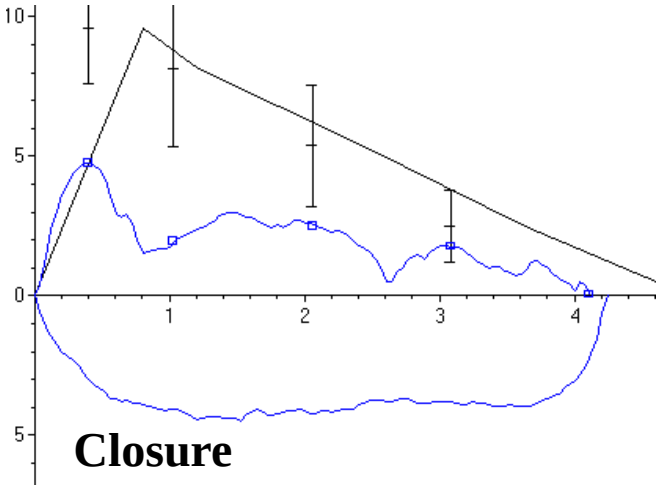
Cough



Stop rxhalation before 6’



Closure



READING spirometry

ASSESSMENT OF FVC

<80% of the theoretical value: restrictive defect

EVALUATION OF FEV

<80% of the theoretical value: obstructive deficit

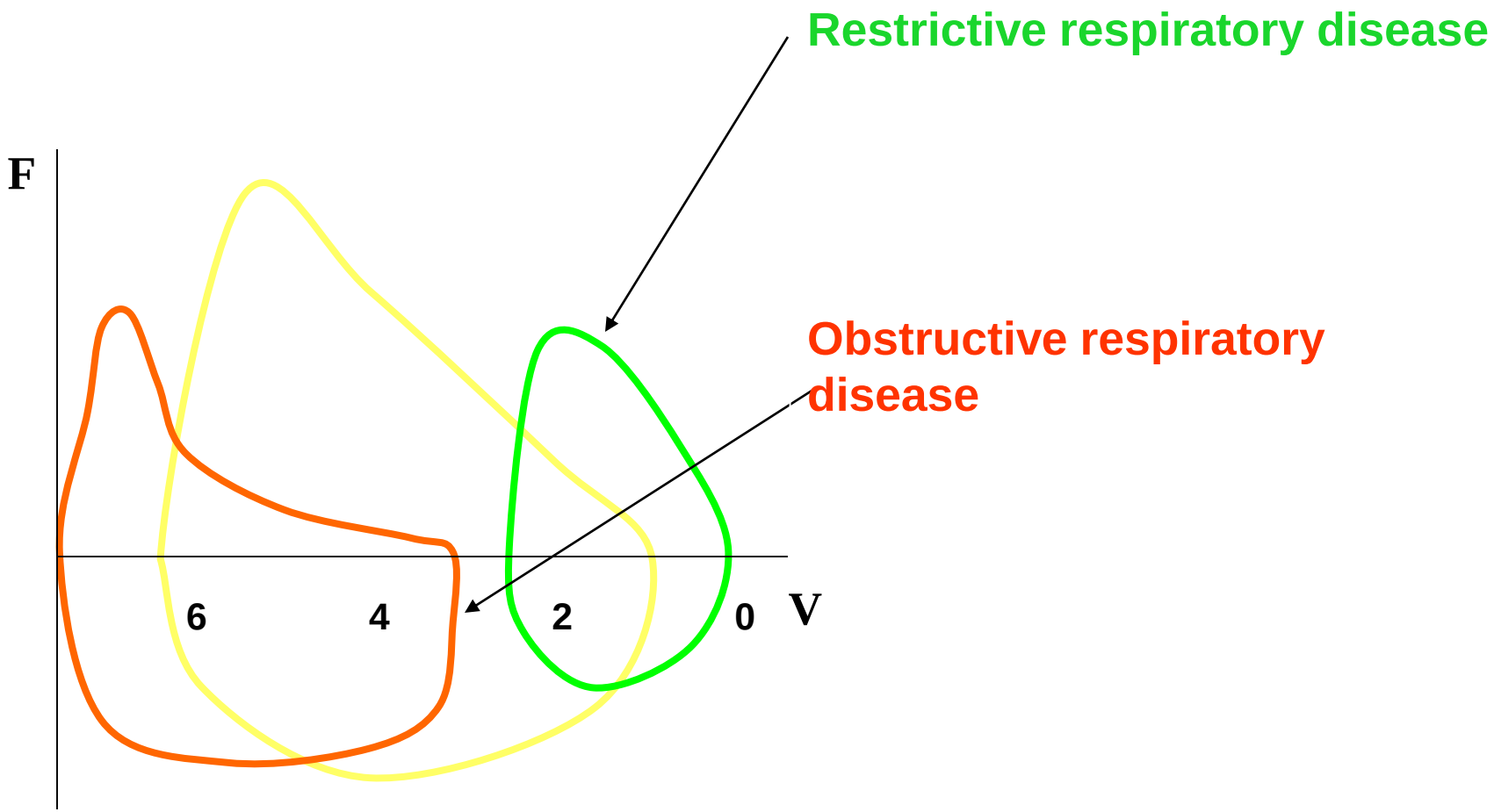
EVALUATION Tiffeneau INDEXor FEV / FVC

<70 -75% of the absolute value: obstructive deficit

ASSESSMENT REDUCTION IN RELATION TO THE THEORETICAL FEV%

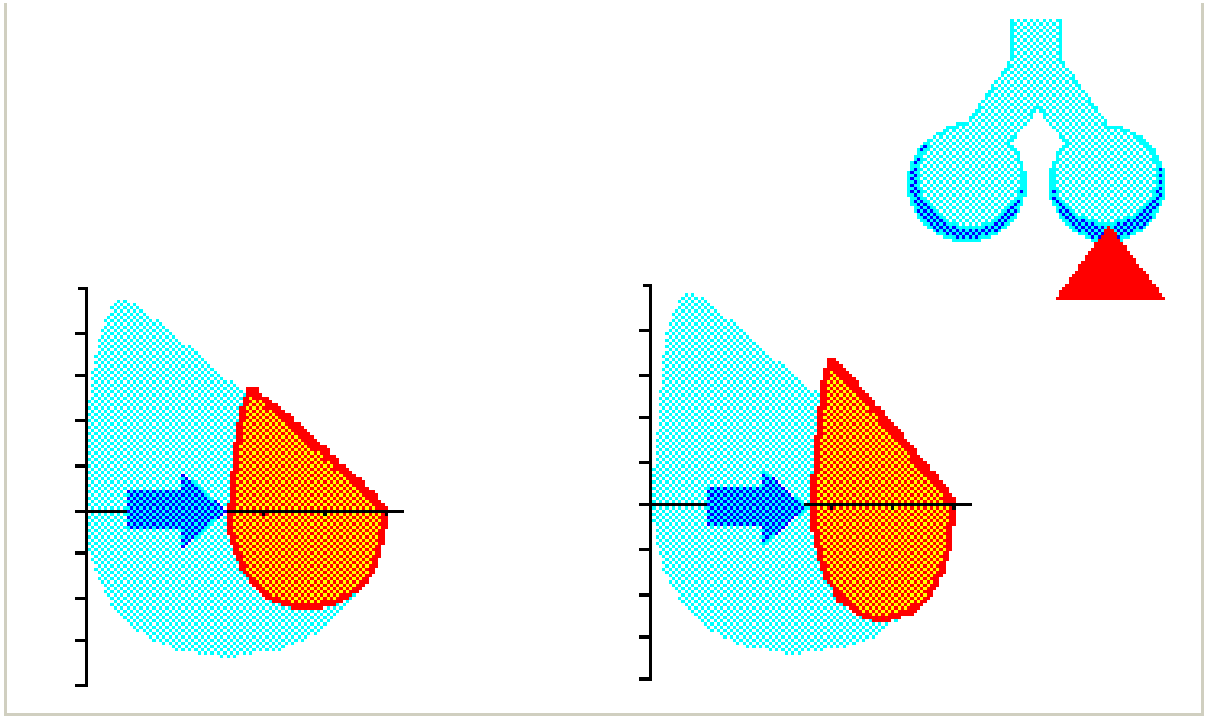
Obstruction severity classification

FLOW-VOLUME CURVE



Restrictive respiratory disease

The curves of patients with a restrictive respiratory disease have an almost normal shape, while the lung volumes and flows are considerably reduced.



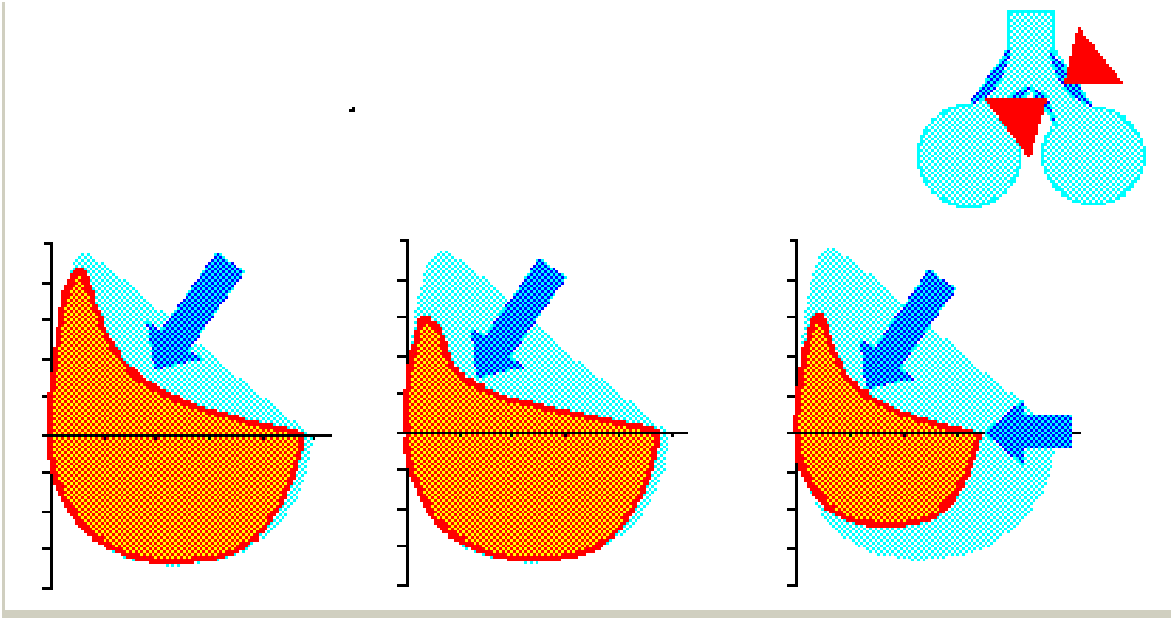
RESULTS INTERPRETATION
RESTRICTIVE DEFICIT

- CVF is reduced
- FEV is reduced
- FEV / FVC (Tiffeneau) is normal or increased
- PEF is reduced
- FEF 25-75 is reduced

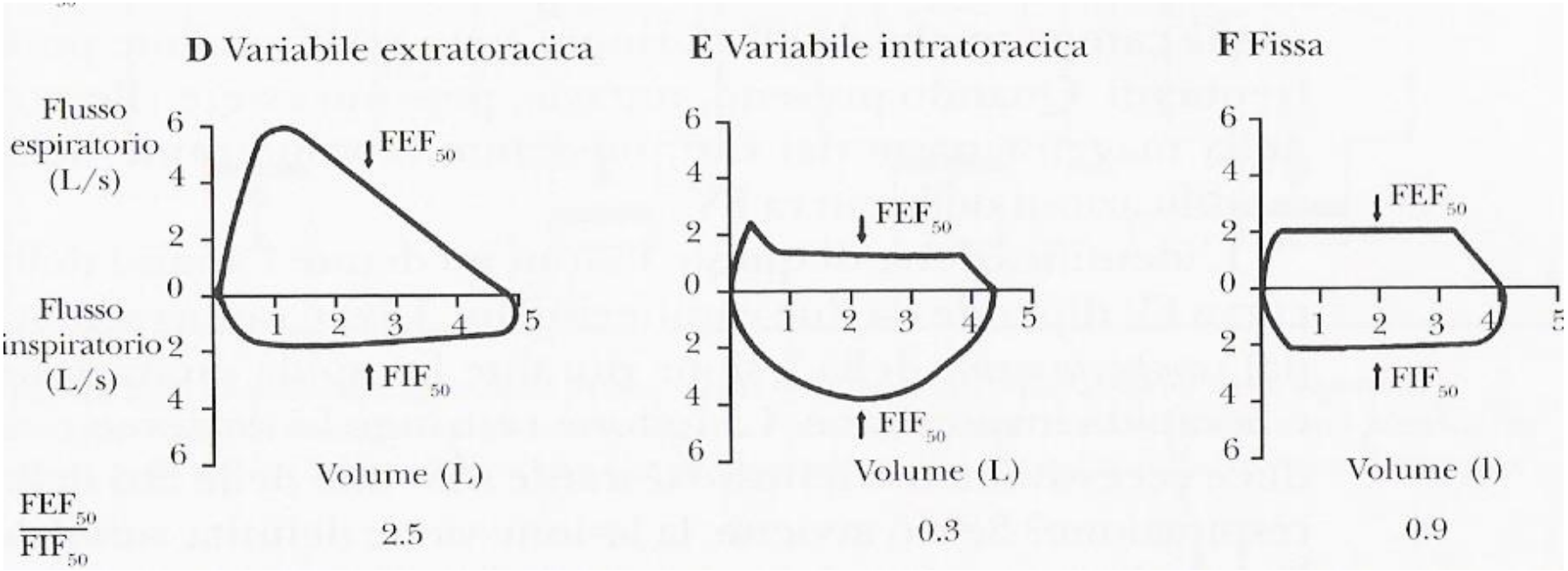
- N.B. The reduction of all the parameters is proportional and concomitant

Obstructive pulmonary disease

Obstructive pulmonary disease generate the concave curves that represent the slowing of expiratory flow through the respiratory system. The degree of deformation reflects the severity of the obstruction.



PATHOLOGICAL CURVES
Upper airway obstruction



RESULTS INTERPRETATION

Obstructive DEFICIT

- FVC is normal (reduced in advanced stages)
- FEV is reduced
- FEV / FVC is reduced
- PEF is reduced
- FEF 25-75 is reduced

Forced Expiratiry Test Interpretation

Functional Indices	Restrictive ventilatory failure	Obstructive ventilatory failure
FVC	Reduced	Normal or Reduced
FEV1	Declined proportional to the CVF	Declined more than FVC
FEV1/FVC%	Normal	Reduced

Static lun volume
Interpretation

Functional Indices	Restrictive ventilatory failure	Obstructive ventilatory failure
RV	Reduced	Increased
TLC	Declined proportional to RV	Normal or slightly increased
RV/TLC%	Normal	Increased

Interpretation

Ventilatory failure

OBSTRUCTIVE

- Asthma
- COPD

  chronic bronchitis

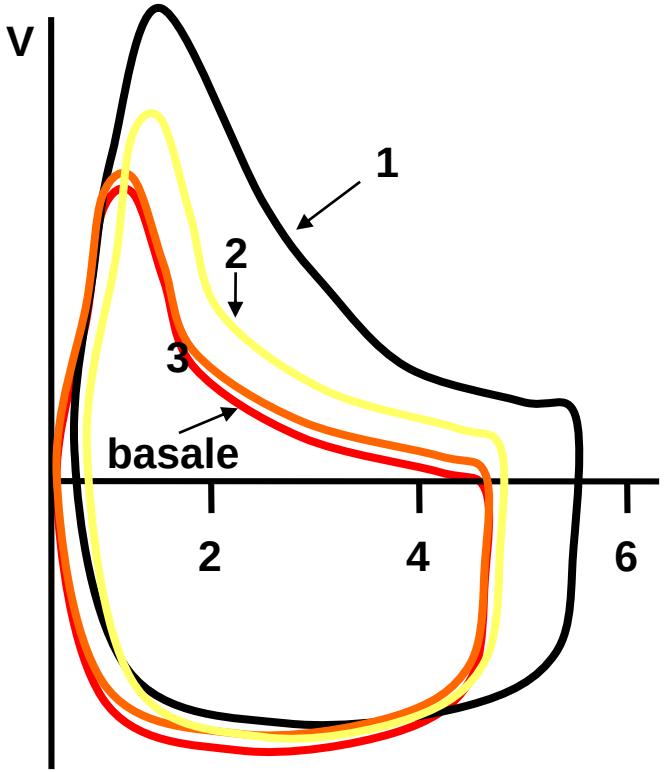
  emphysema
- Bronchiectasis

RESTRICTIVE

- Diseases of the chest
- Neuromuscular diseases
- Infiltrative lesions
- Pulmonary Fibrosis
- Pleural diseases

REVERSIBILITY TEST

Assessment of obstruction reversibility



FEV1 is reevaluated, with a forced expiratory maneuver, 20' after administration of 200-400 mcg of beta-2 agonist or 80 mcg of anticholinergic.

There may be three possibilities:

1.The FEV1 increases of> 12% and 200 ml from baseline returning to normal values (> 80% predicted):

OBSTRUCTION FULLY REVERSIBLE (typical bronchial Asthma)

2. FEV1 increased by 12% or 200 ml from baseline but remains <80% predicted and FEV / FVC <70:

OBSTRUCTION PARTIALLY REVERSIBLE (typical of partially reversible COPD)

3. Increases FEV1 <12% or 200 mL from baseline:

OBSTRUCTION NOT REVERSIBLE (typical of COPD is not reversible)