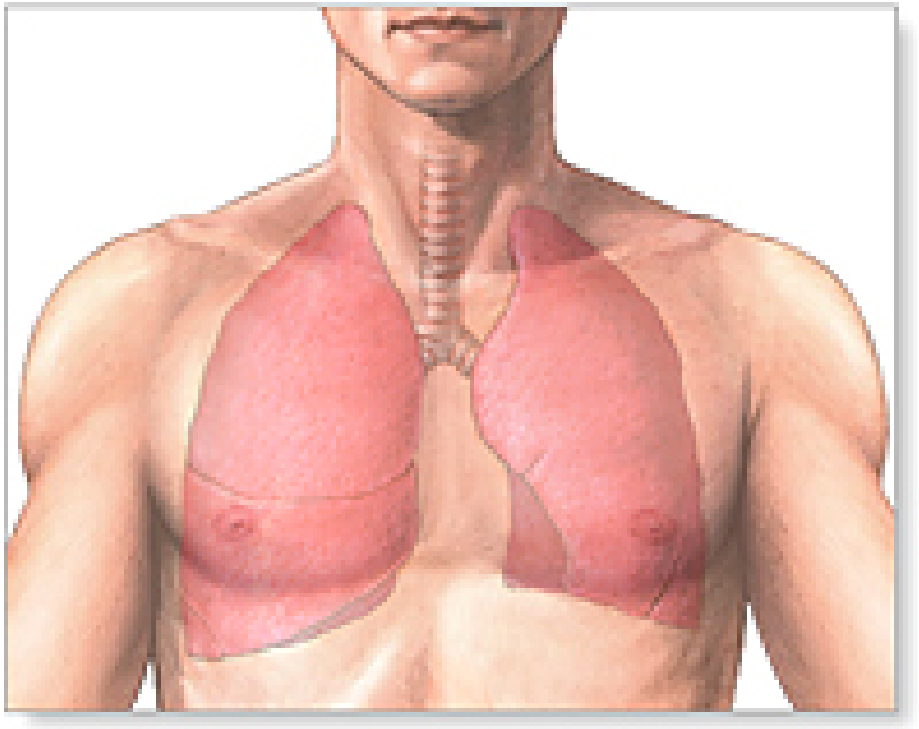
Chapter 13

Anaesthetic approach to the respiratory system



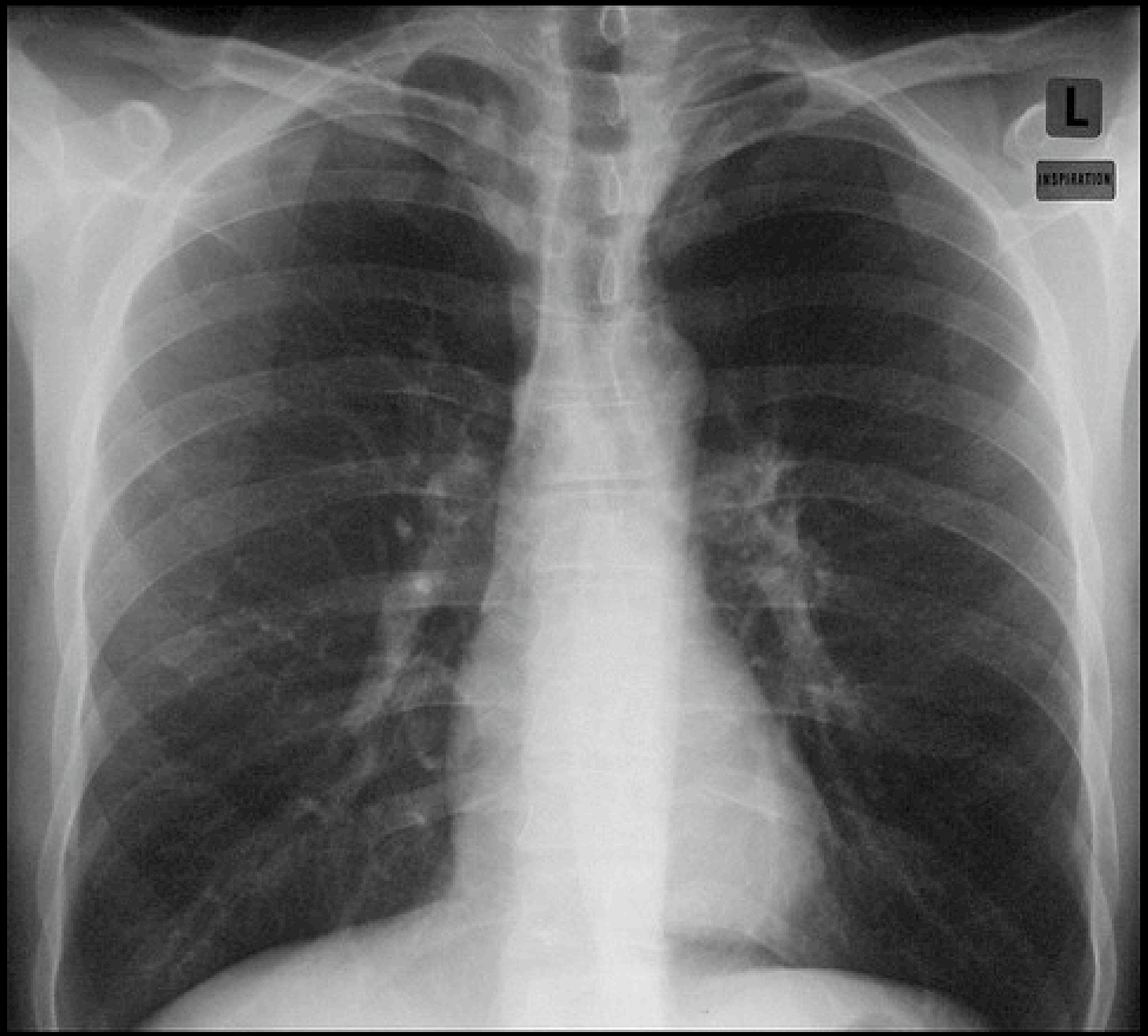
MBCHB V

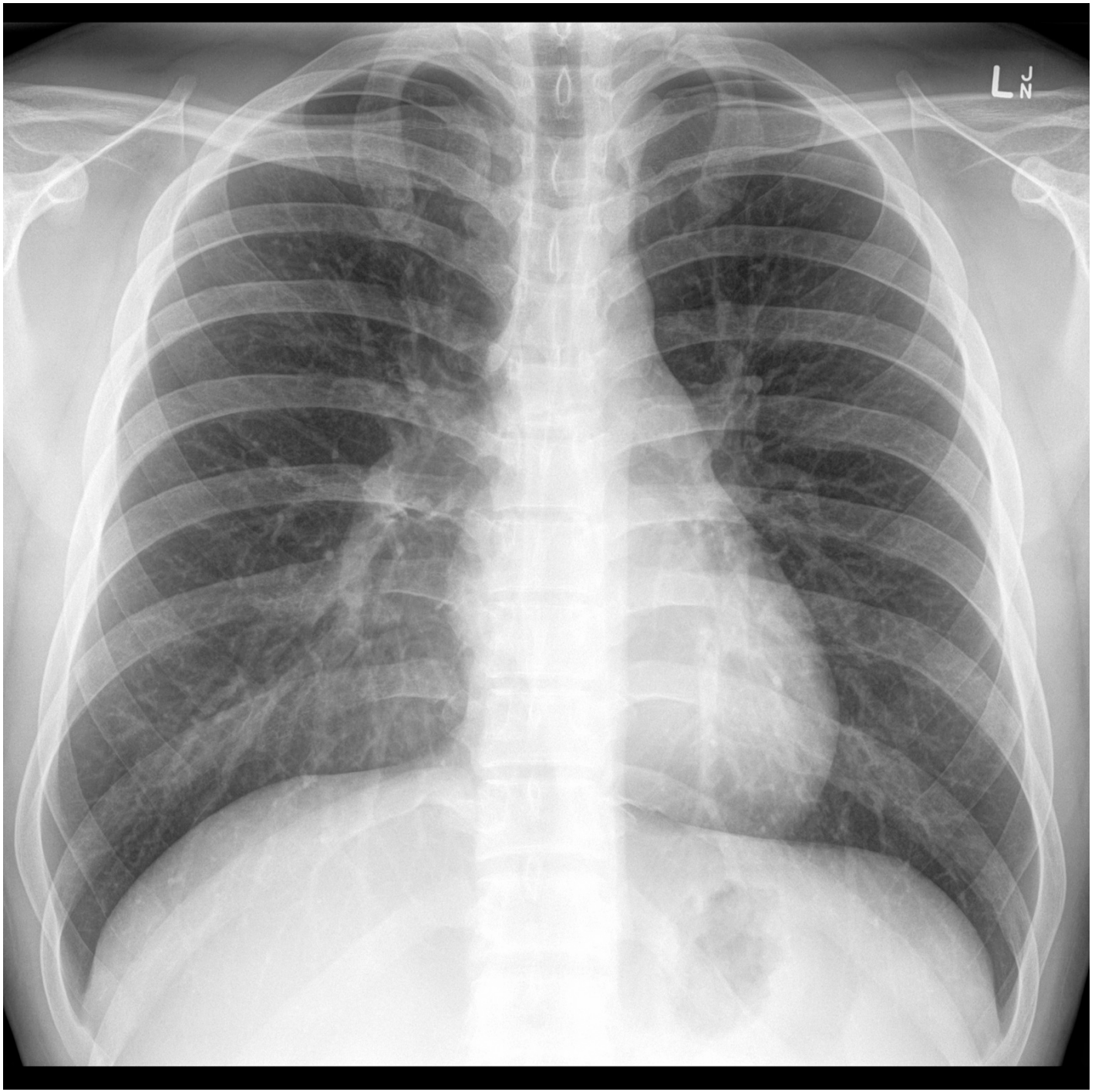
Block 18

Thursday May 30, 2013

Overview

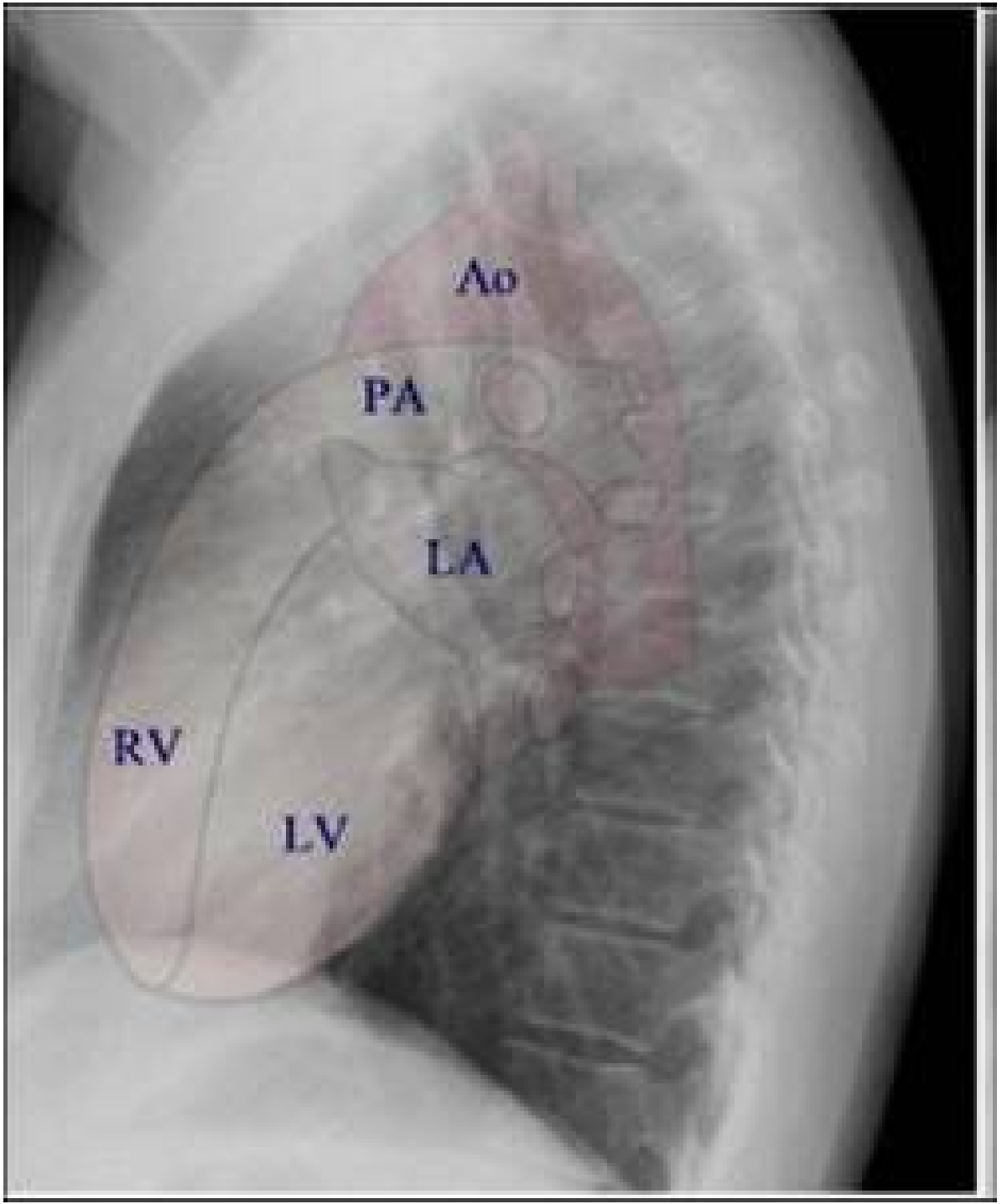
- Normal CXR
  - PA
  - AP
  - lateral
- Obstructive lung disease
- Restrictive lung disease
- Anaesthetic implications




L

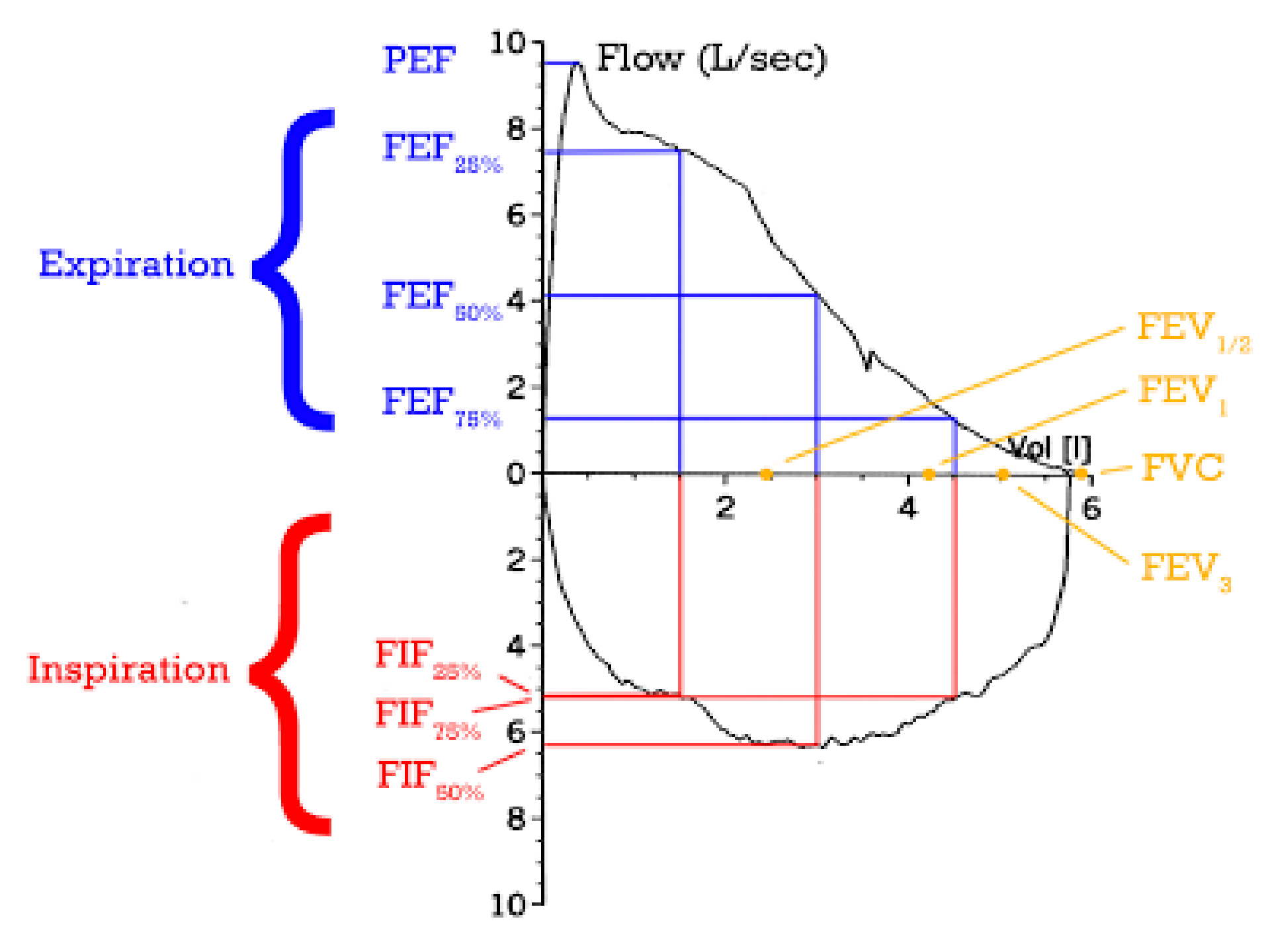
Overview

- Normal CXR
  - PA
  - AP
  - Lateral
- Obstructive lung disease
- Restrictive lung disease
- Anaesthetic implications

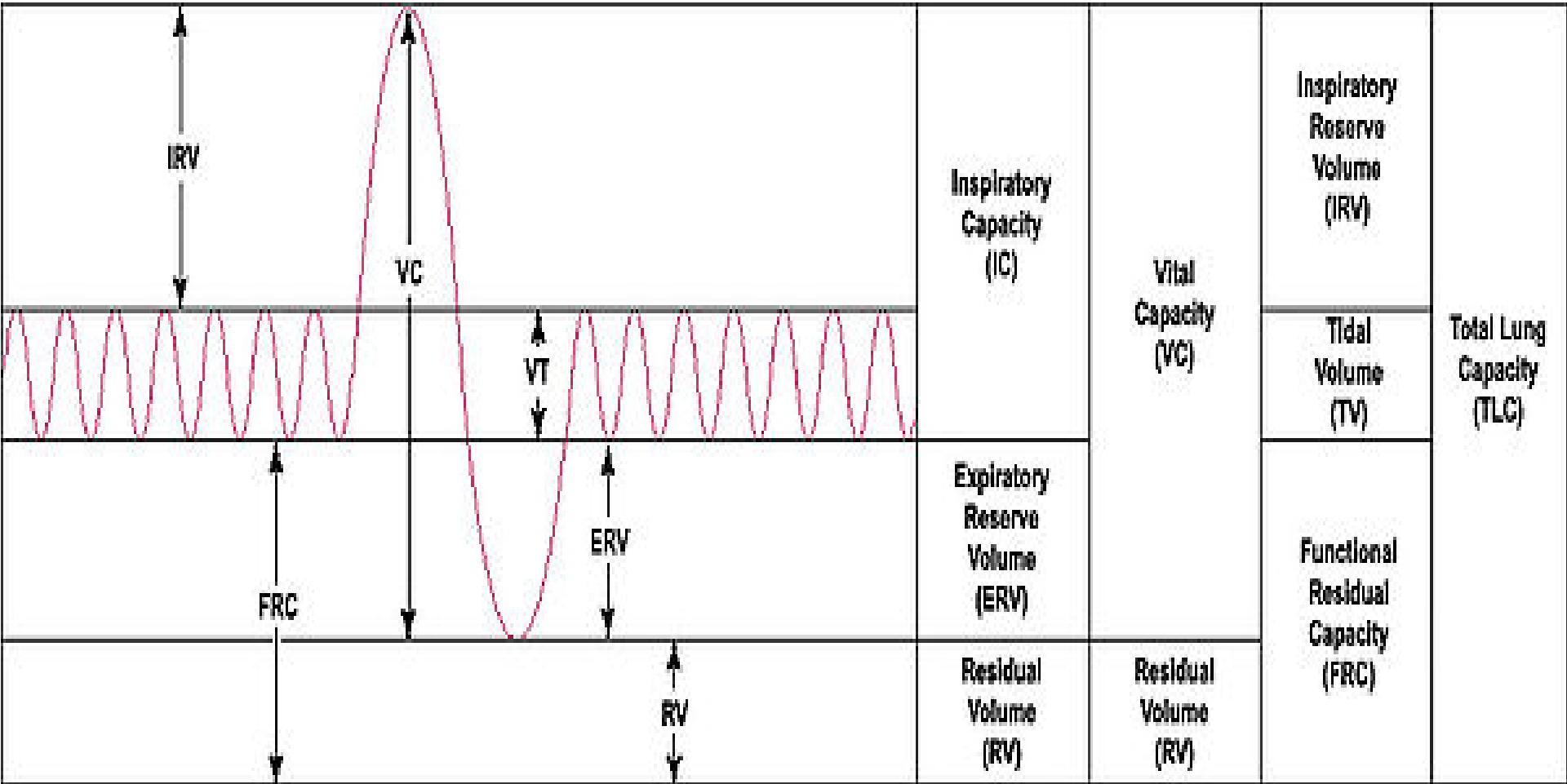

Ao
PA
LA
RV
LV

Obstructive vs restrictive lung disease

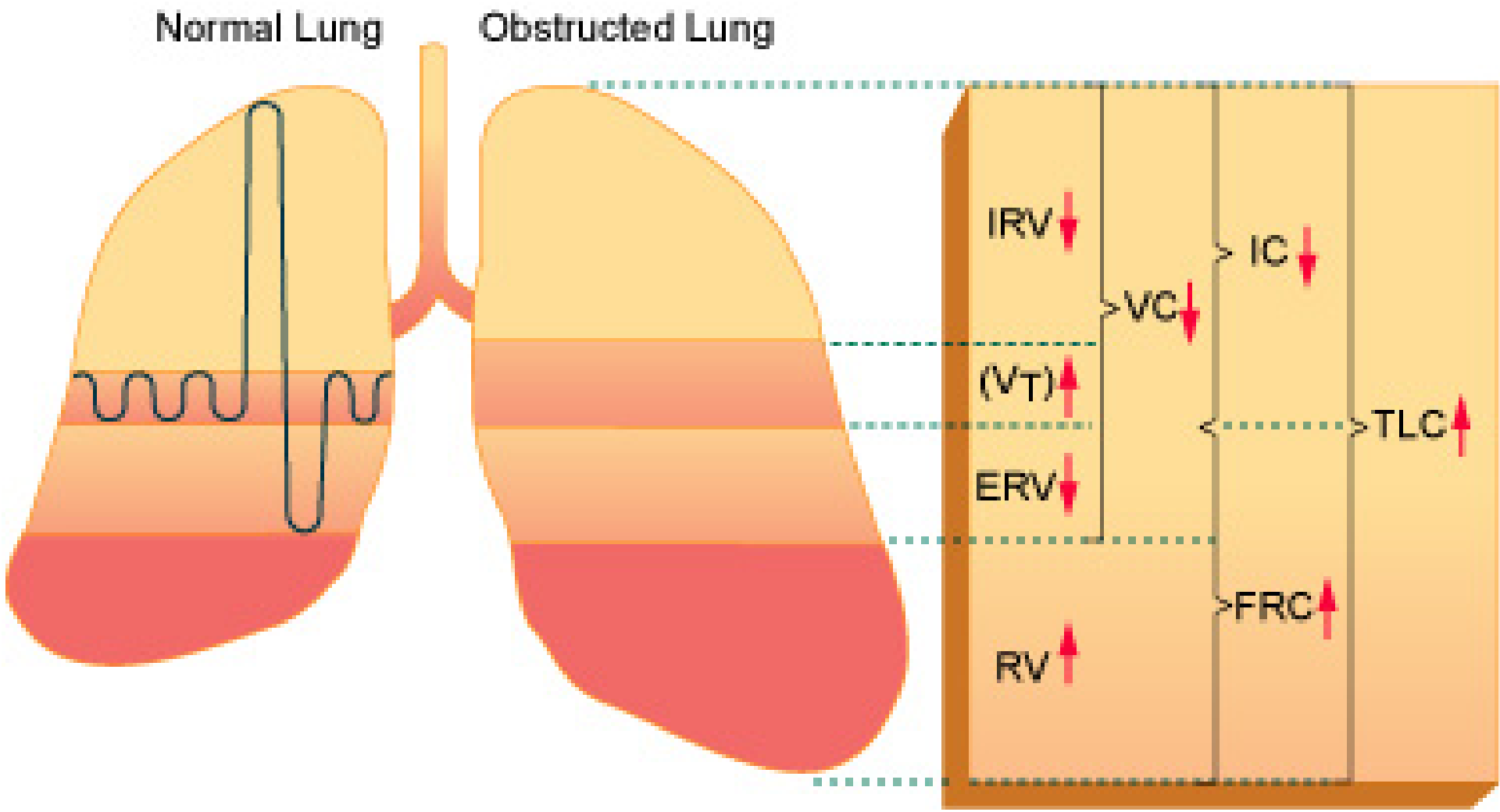
- History
- Clinical examination
- Blood gases
- CXR
- Flow / volume loops

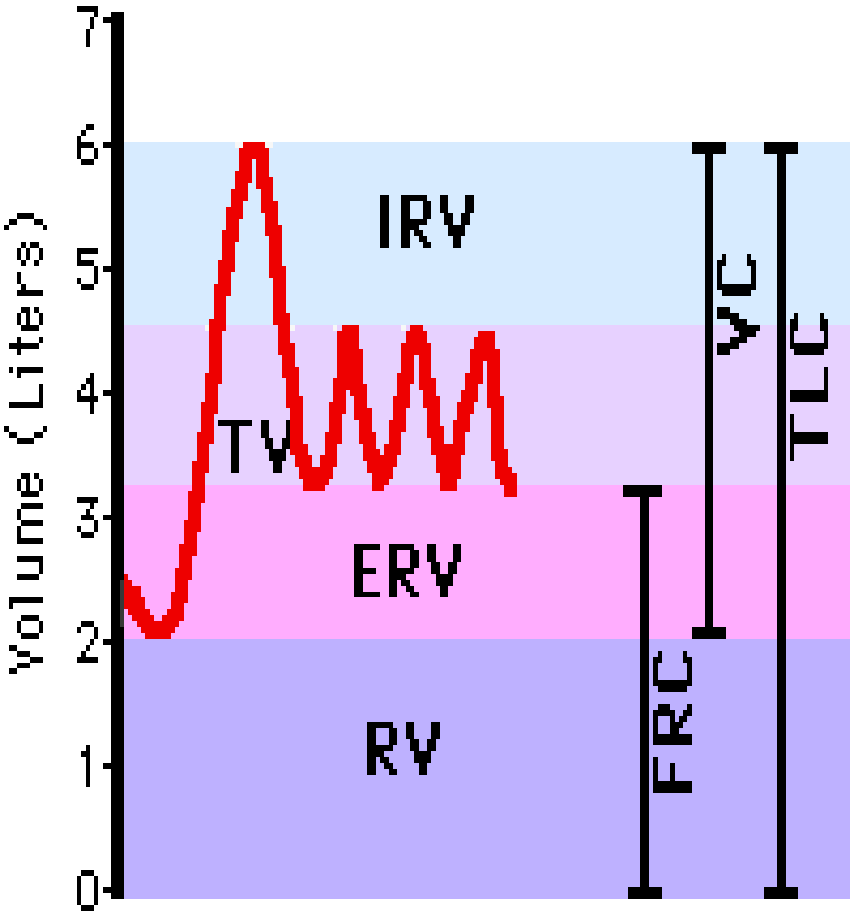

PEF
FEF25%
FEF50%
FEF75%
Expiration
Inspiration
FIF25%
FIF75%
FIF50%
Flow (L/sec)
Vol [l]
FEV1/2
FEV1
FVC
FEV3
10
8
6
4
2
0
2
4
6
2
4
6
8
10

Flow / volume loop

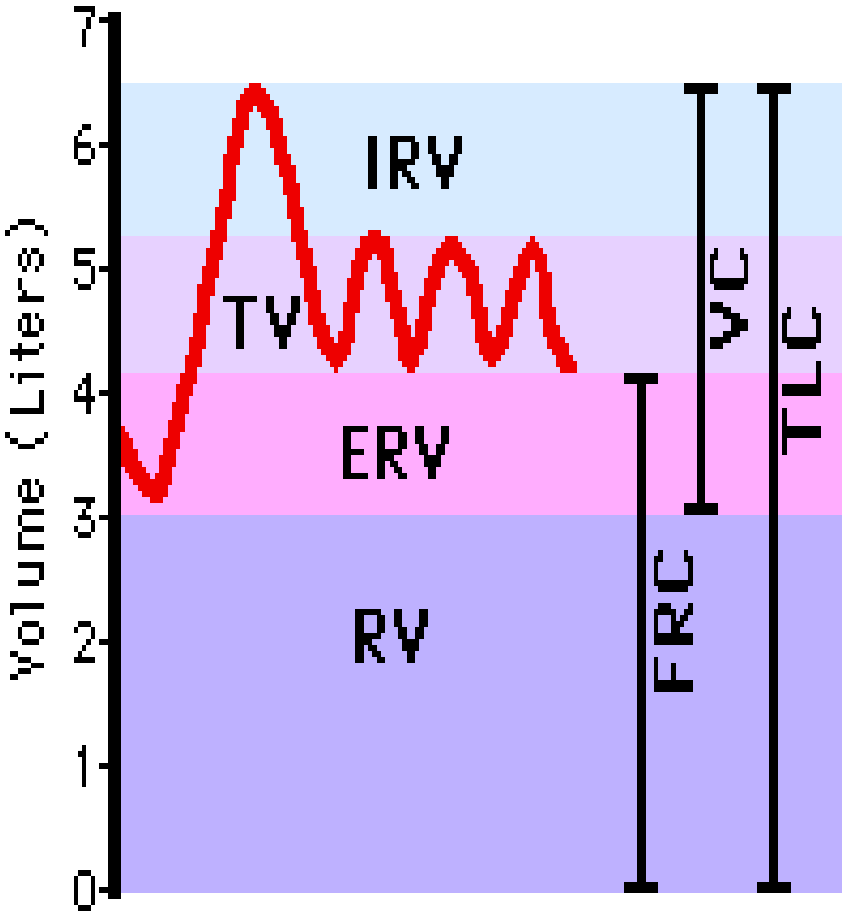


Obstructive lung disease

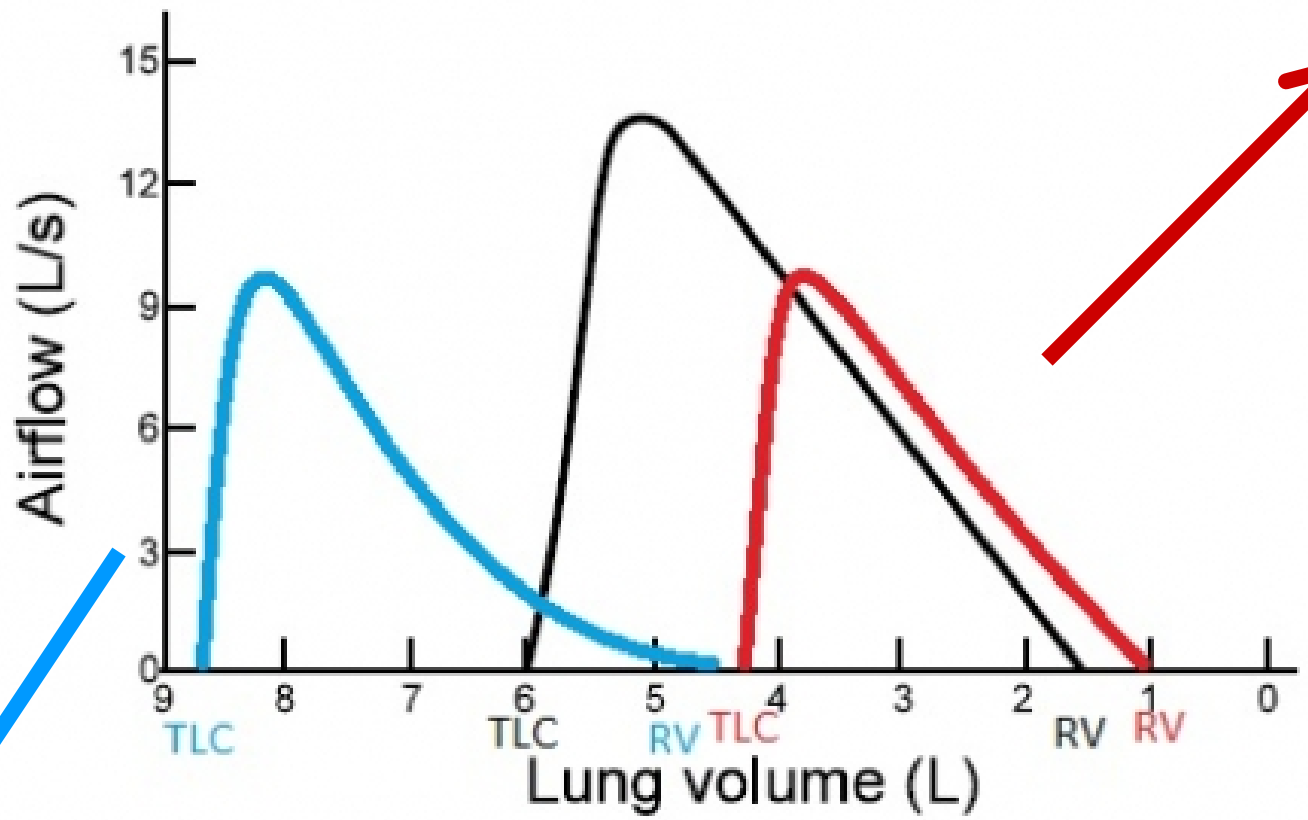

Normal Lung
Obstructed Lung
IRV
IC
VC
(VT)
TLC
ERV
FRC
RV



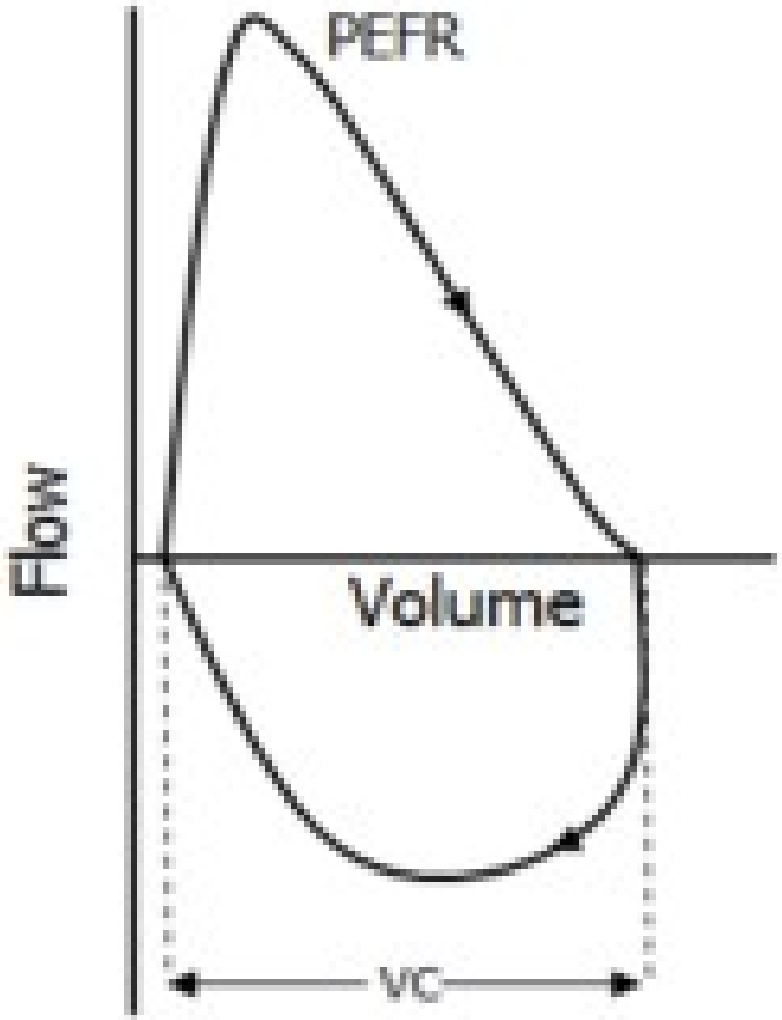
Normal Spirogram



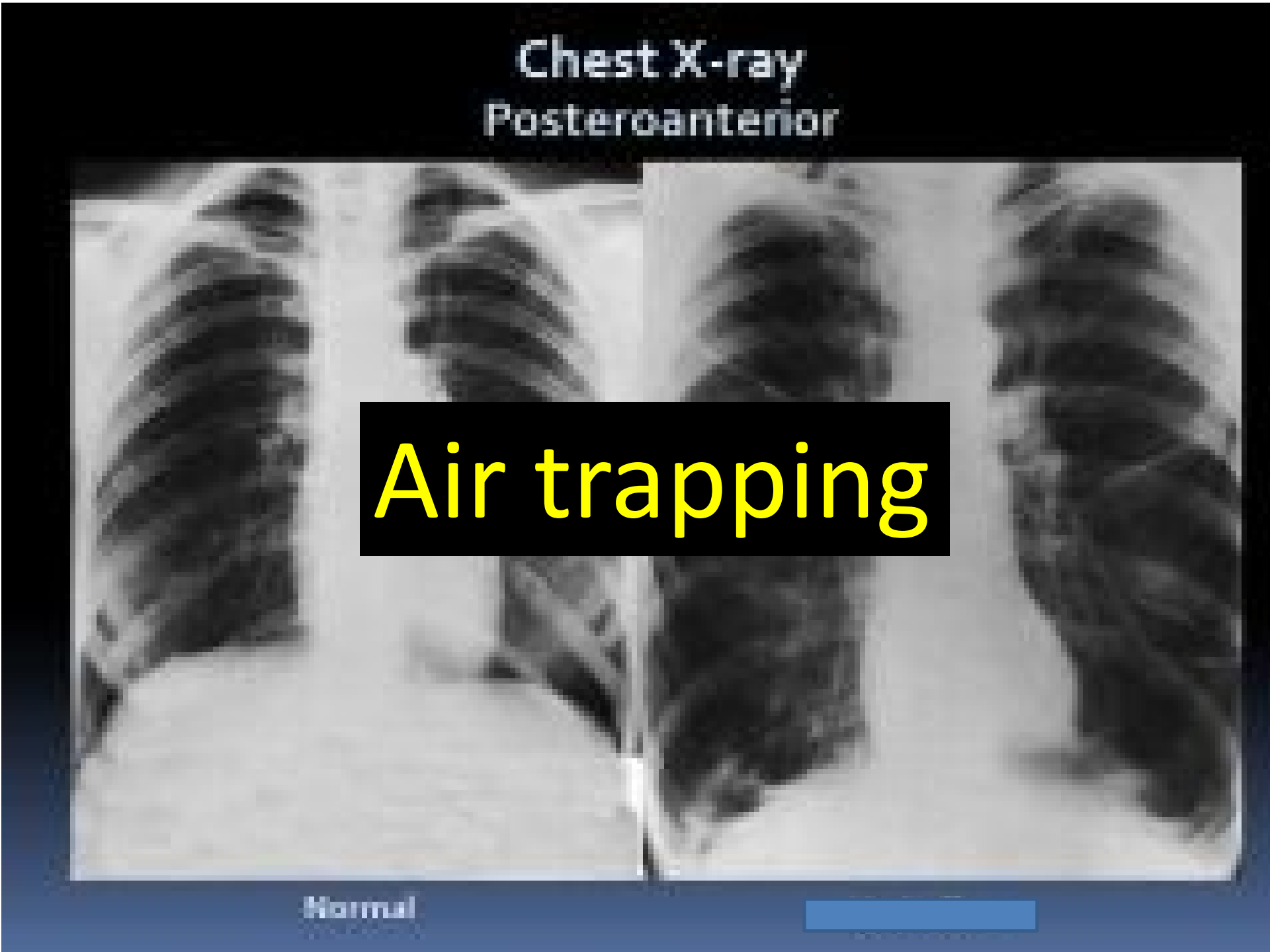
Obstructive Spirogram


Restrictive
Airflow (L/s)
15
12
9
6
3
0
9
8
7
6
5
4
3
2
1
0
TLC
TLC
RV
TLC
RV
RV
Lung volume (L)
Obstructive

Flow-Volume Loops



Normal


Chest X-ray
Posteroanterior
Air trapping
Normal

CHAPTER 13

ANAESTHETIC APPROACH TO THE RESPIRATORY SYSTEM

This Chapter must be read with Chapter 14 (Perioperative Hypoxia)

"A heavy step was heard ascending the stair, with a great wheezing and rattling as from a man who was sorely put to it for breath. Once or twice he stopped, as though the climb were too much for him, but at last he made his way to our door and entered. His appearance corresponded to the sounds which we had heard. He was an aged man, clad in seafaring garb, with an old pea-jacket buttoned up to his throat. His back was bowed, his knees were shaky, and his breathing was painfully asthmatic. As he leaned upon a thick oaken cudgel his shoulders heaved in the effort to draw the air into his lungs."

Dr Watson in *The Sign of Four*
Sherlock Holmes 1890

Key points

1. Perioperative approach to respiratory system
First principle: Functional approach
Second principle: systematic approach
Third principle: complications
Forth principle: monitoring
Fifth principle: perioperative approach
- Ventilation
- Pulmonary perfusion
- Relationship between pulmonary ventilation and perfusion
- Control of breathing
- Work of breathing
- Airway protection

2. Postoperative pulmonary complications (PPC)
- Intra-operative effects of anaesthesia and surgery
- Postoperative respiratory function
- Prevention of postoperative pulmonary complications
- The anaesthetic and surgical techniques, respiratory disease and PPC
- Postoperative management and the prevention of PPC

3. Respiratory failure

Central to the learning of anaesthesia and critical care is an appreciation of *the principles underlying uptake of O_2 from the alveoli, delivery of O_2 to body tissues, and removal of CO_2 by the lungs.* You must always have the following principles in mind when treating patients with diseases or interventions that involve ventilation.

First principle: Functional approach

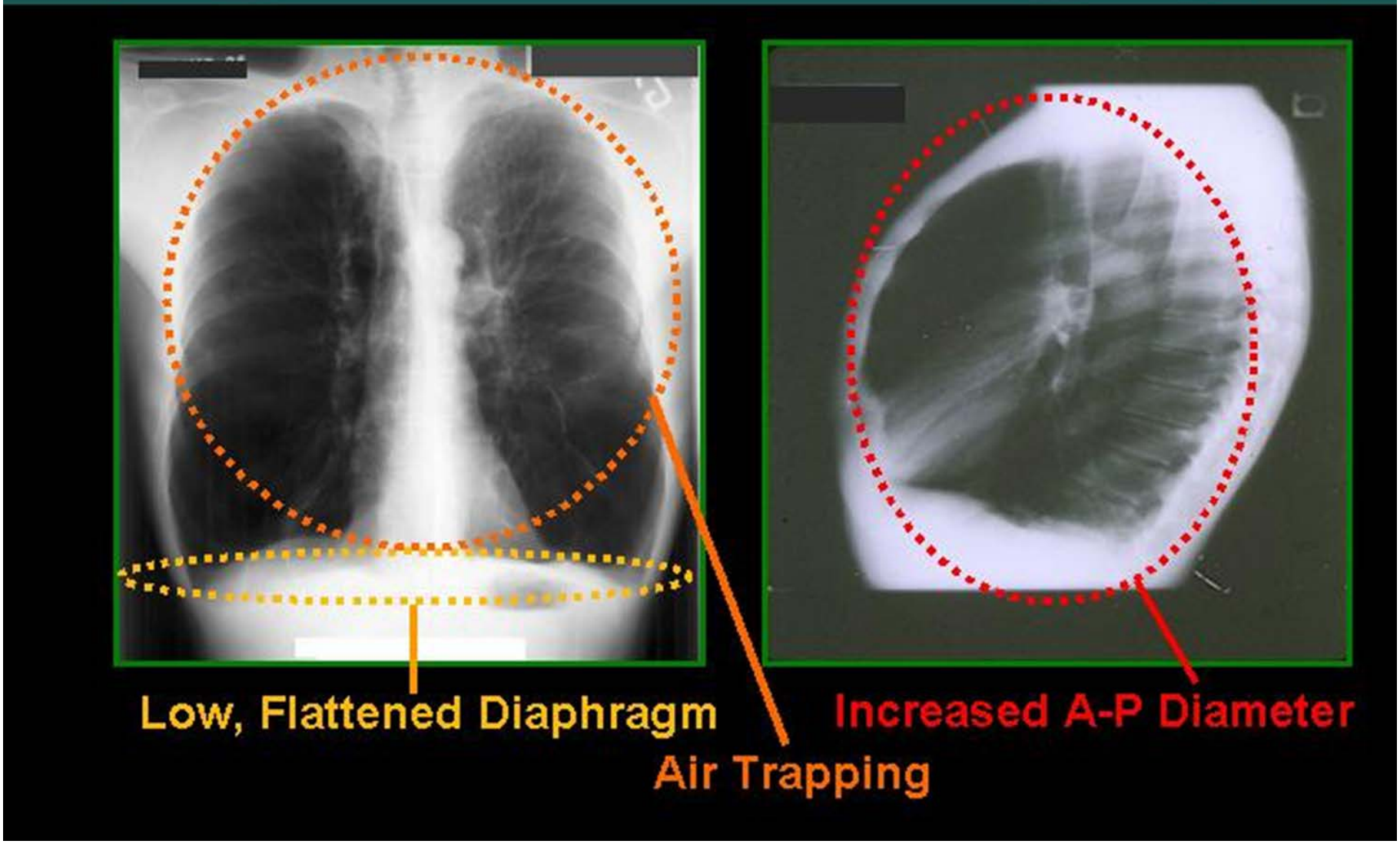
The components of the respiratory system do not operate independently, but always interact; change in the one, always have an impact on the others:

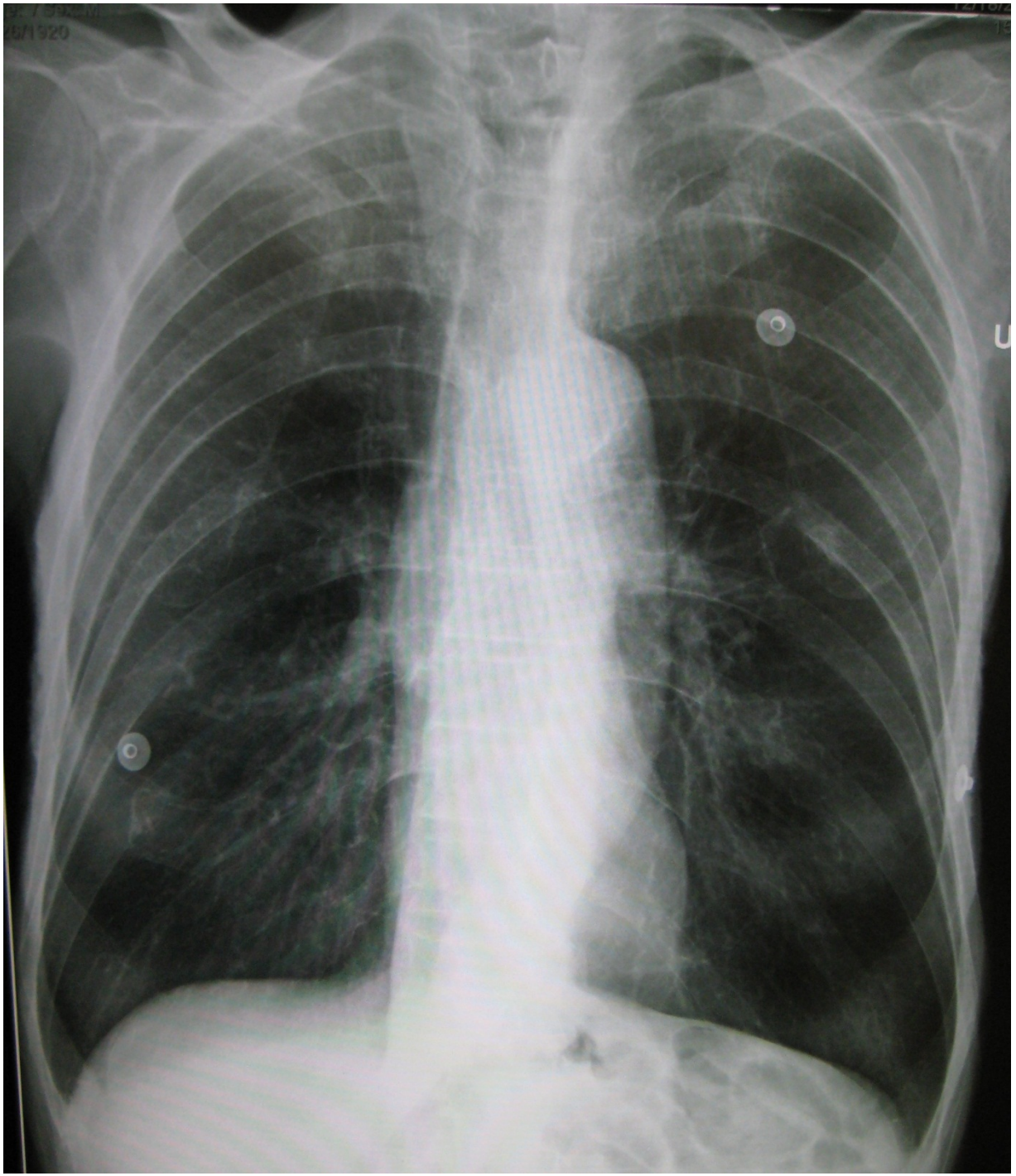
- Ventilation of the alveoli
- Perfusion of the alveoli
- The relationship between alveolar ventilation and alveolar perfusion
- Diffusion of gas between the alveoli and the alveolar capillaries
- The work of breathing or ventilation
- Control of ventilation
- Airway protection

Second principle: systematic approach

Lung function (the above seven aspects) is not something that exists in isolation. It is always affected by the anatomy, physiology, and treatment of lung disease. Again, these influences do not act independently, but interact with each other:

- Anatomy of the respiratory system (patho-anatomy)
  - Upper airway: outside the wall, in the wall, in the lumen
  - Glottis
  - Lower airways
  - Alveoli
  - Blood supply
  - Lung interstitium
  - Pleurae and interpleural space
  - Thoracic wall: skeletal (anterior, posterior, lateral) and muscular (diaphragm and intercostal muscles)
  - The mediastinum: trachea and main bronchi, oesophagus, heart, great vessels, lymphatic ducts, lymph nodes, thymus


Low, Flattened Diaphragm
Air Trapping
Increased A-P Diameter




SUPINE IN ROOM 4
L

Obstructive lung disease - ventilation strategy

- Reversible
  - Asthma
- Irreversible
  - Emphysema

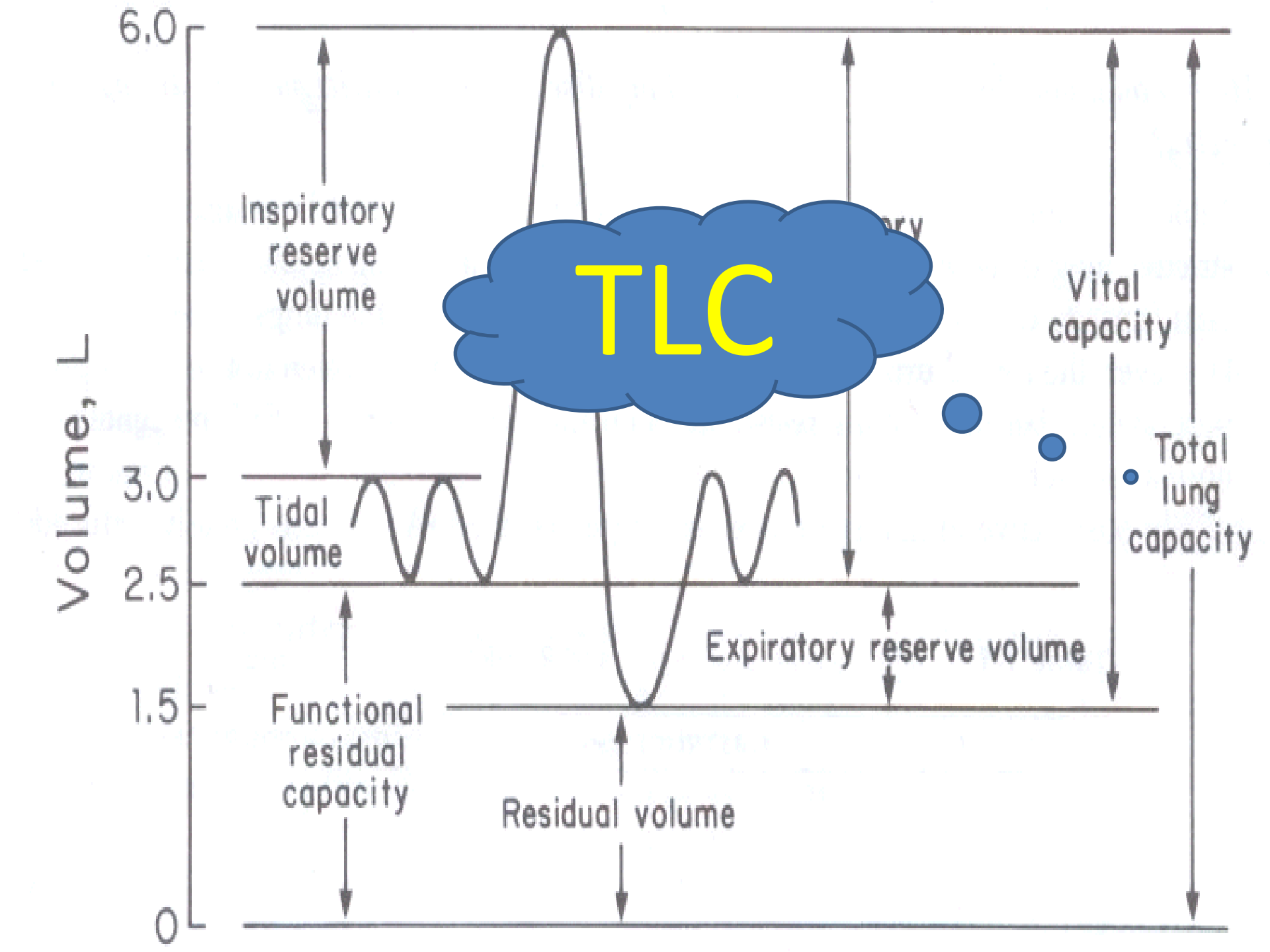
Avoid airway manipulation

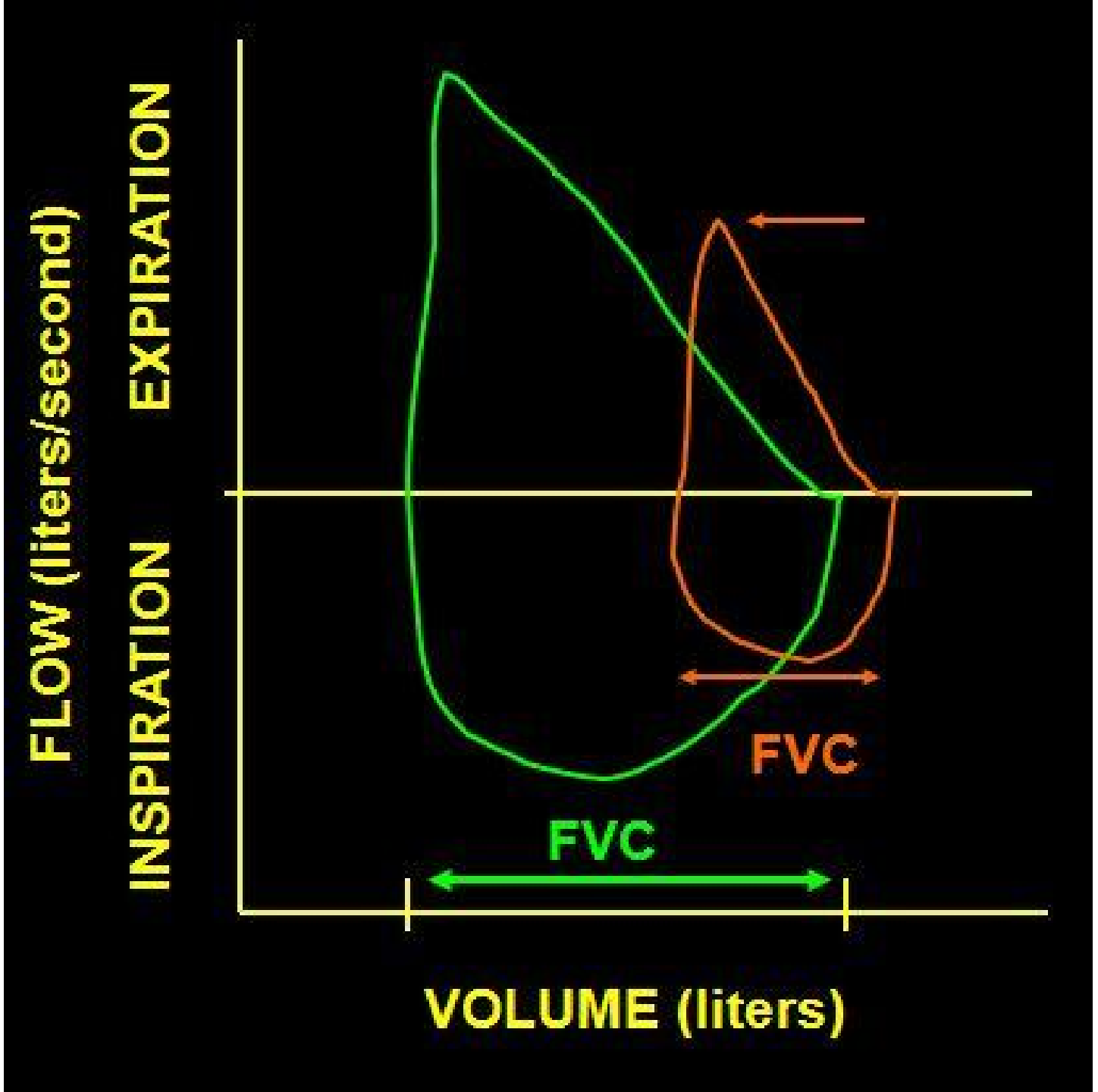
- **Intubation**
- **Guedel airway**

Obstructive lung disease - ventilation strategy

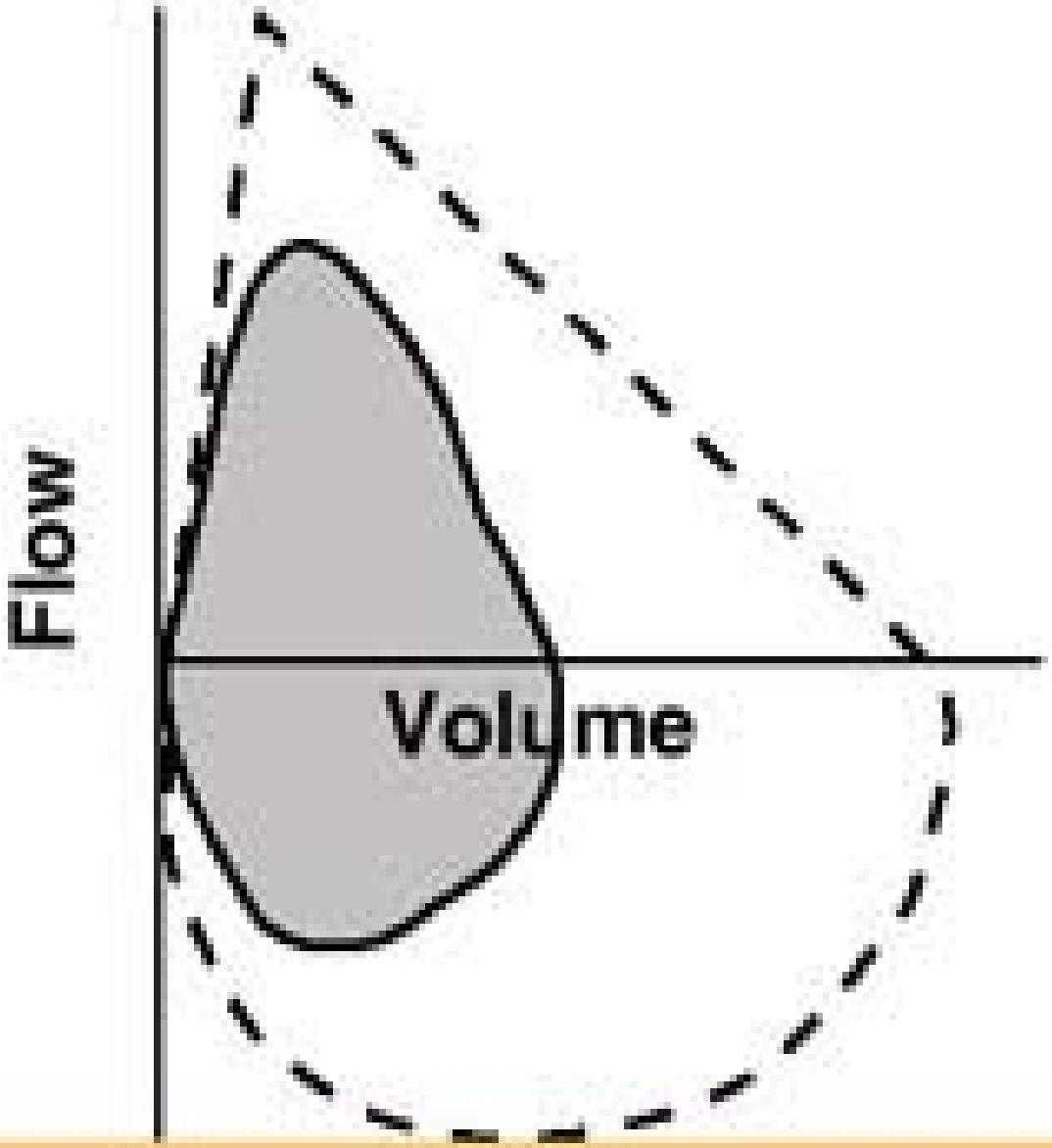
- Ventilation rate 8-12 bpm
- I:E ratio 1:3
- Airway pressure
  - Peak; low as possible (< 30 cm H_2O)
  - Plato; low as possible (< 25 cm H_2O)
- $HbSaO_2$ % > 88-90 %
- P_aCO_2 > 39 mm Hg

Restrictive lung disease

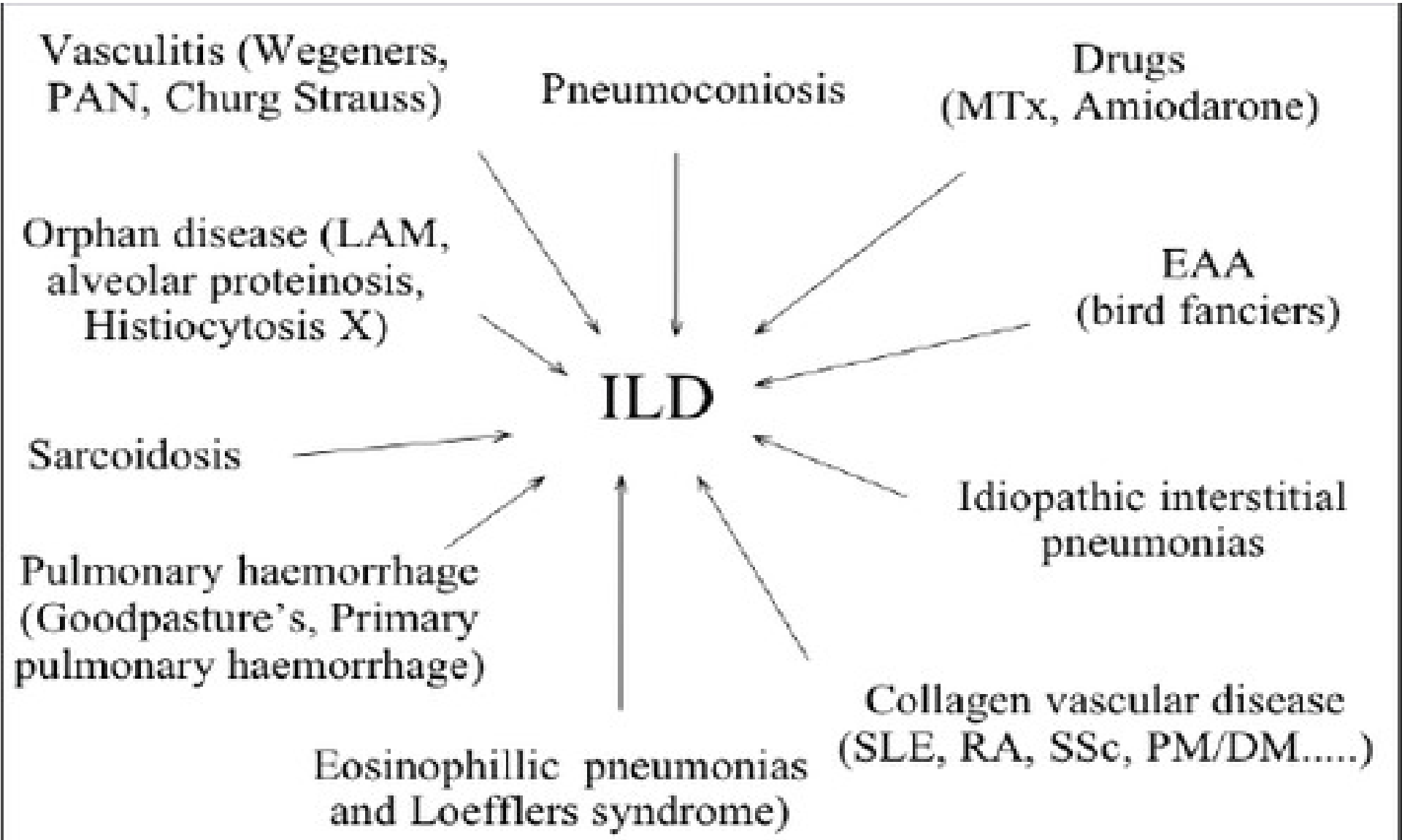

6.0
3.0
2.5
1.5
0
Volume, L
Inspiratory reserve volume
Tidal volume
Functional residual capacity
Residual volume
Expiratory reserve volume
Vital capacity
Total lung capacity
TLC


FLOW (liters/second)
EXPIRATION
INSPIRATION
FVC
FVC
VOLUME (liters)

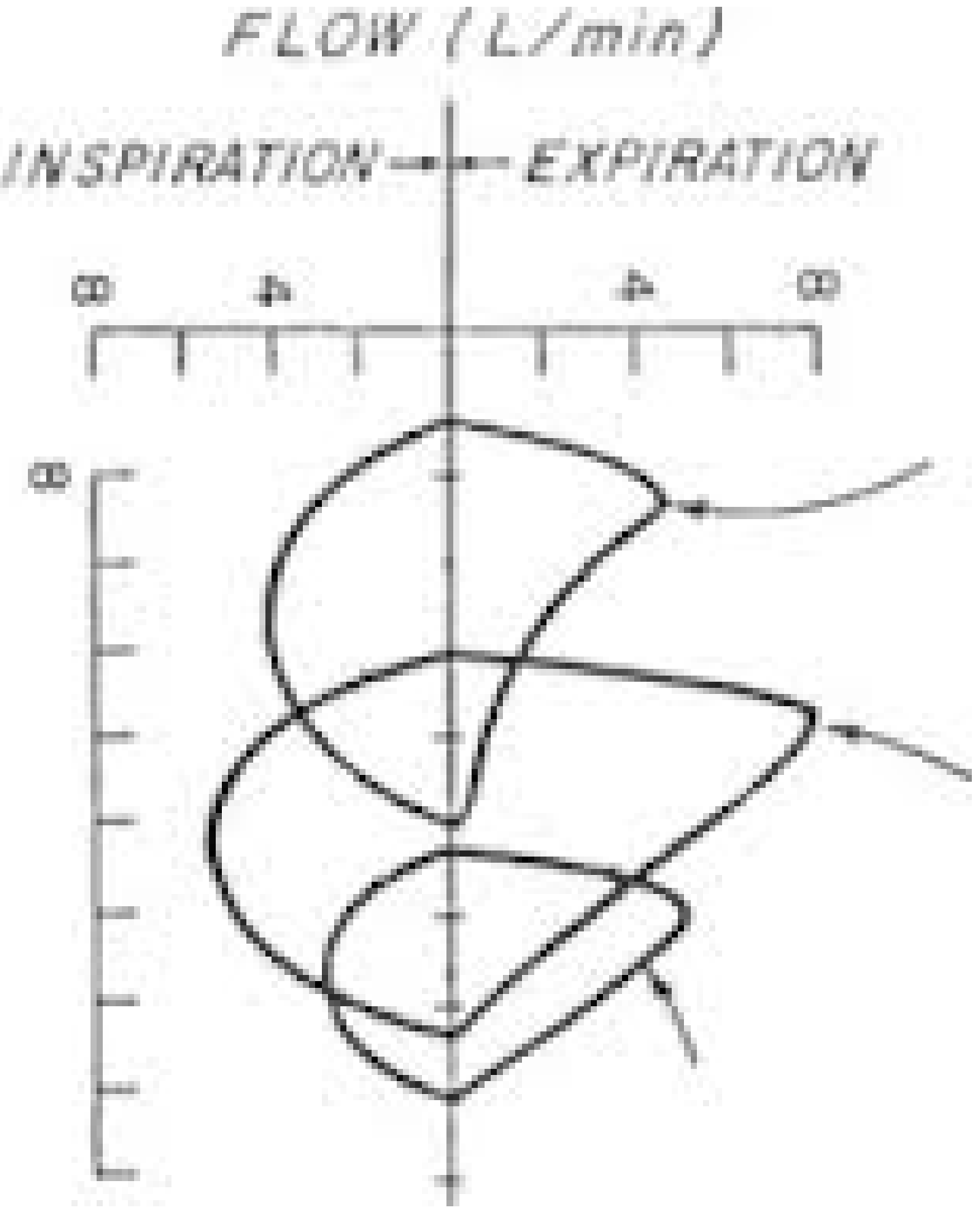
Restriction



Restrictive lung disease

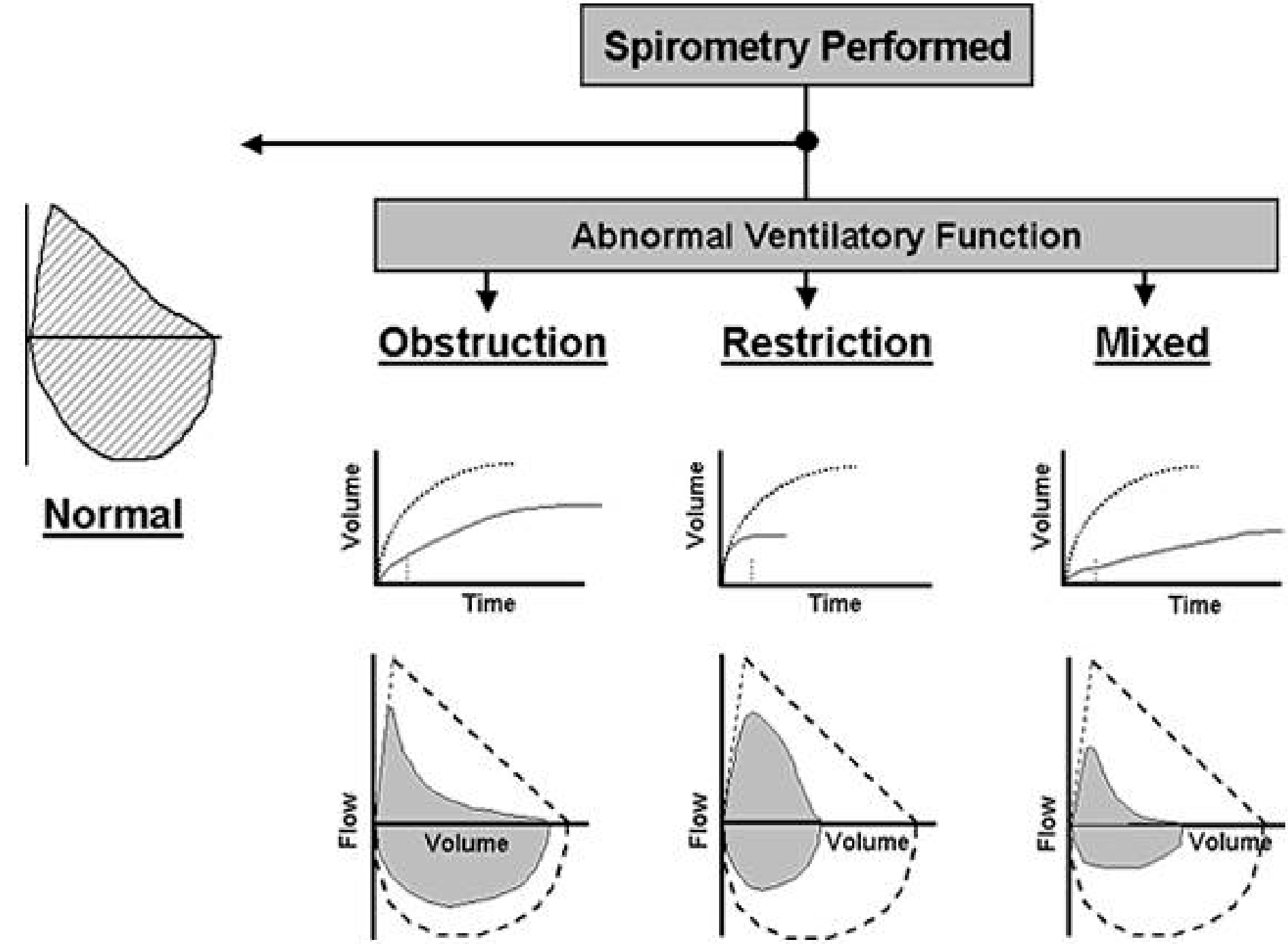


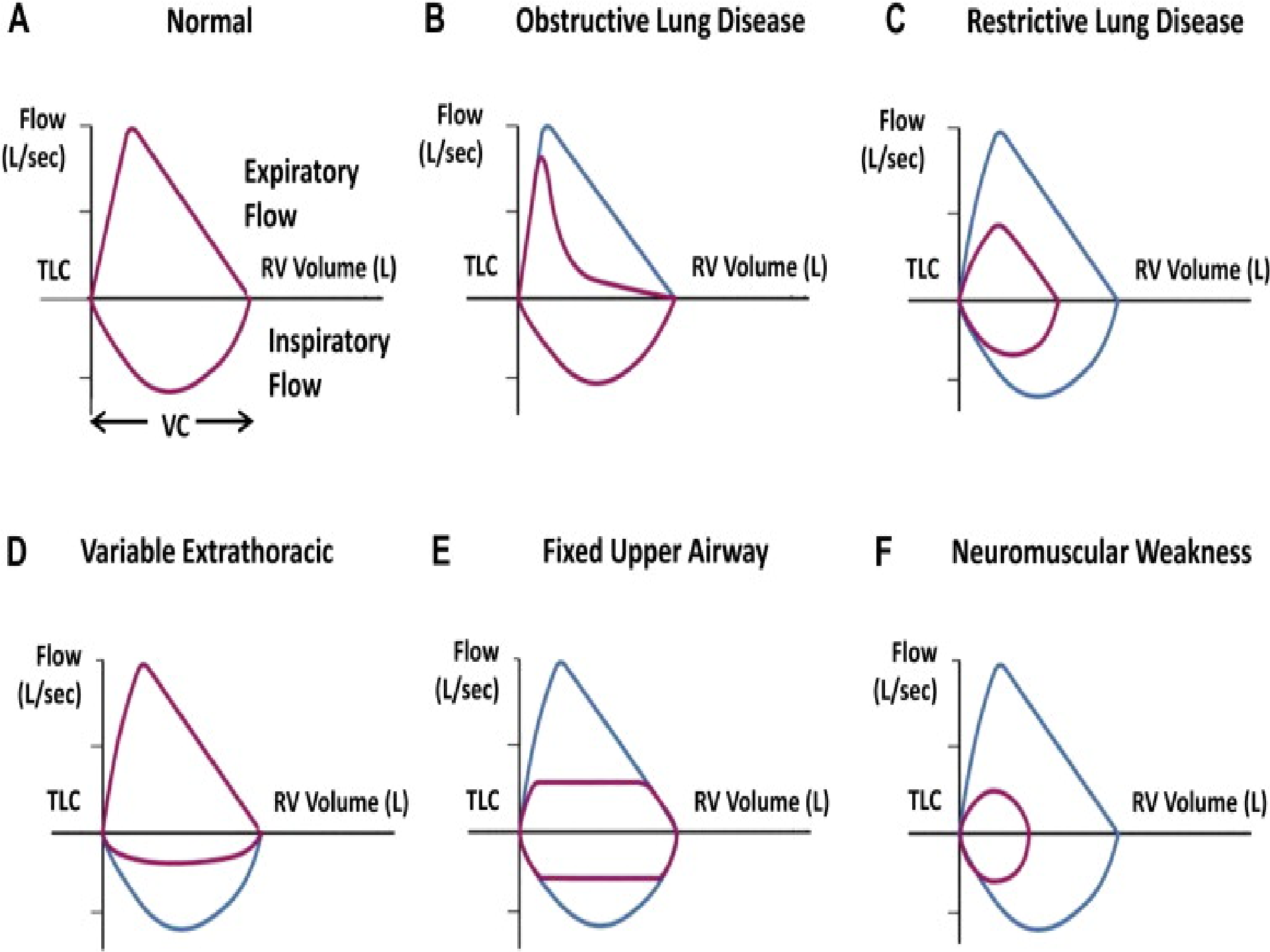

L


FLOW (L/min)
INSPIRATION
EXPIRATION

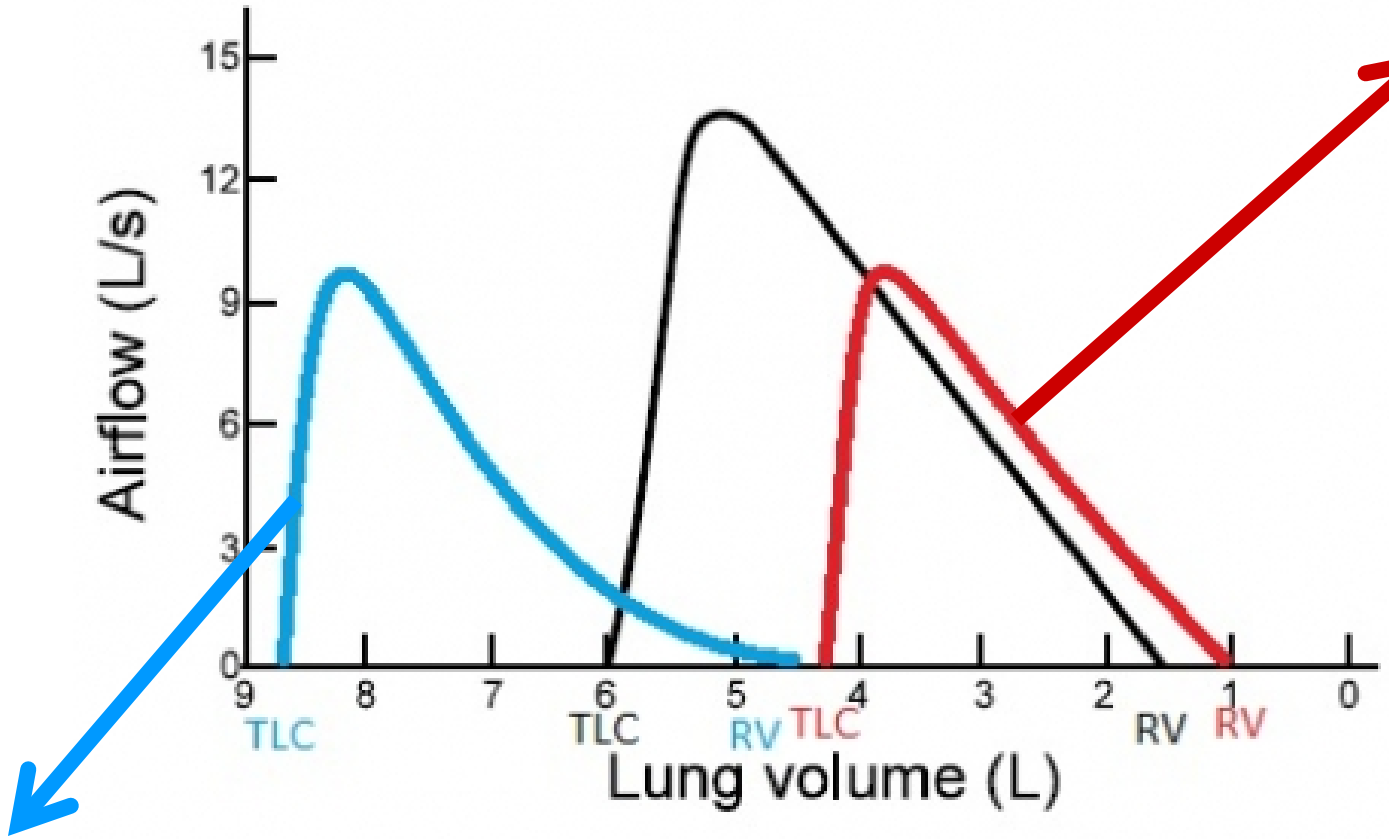
Restrictive lung disease - ventilation strategy

- Ventilation rate 12 – 16 bpm
- I:E ratio 1:2 to 1:1
- Airway pressure
  - Peak; low as possible (< 35 cm H_2O)
  - Plato; low as possible (< 30 cm H_2O)
- $HbSaO_2$ % > 88-90 %
- P_aCO_2 > 39 mm Hg


Spirometry Performed
Abnormal Ventilatory Function
Obstruction
Restriction
Mixed
Normal
Volume
Time
Volume
Time
Volume
Time
Flow
Volume
Flow
Volume
Flow
Volume


A
Normal
Flow
(L/sec)
Expiratory
Flow
TLC
RV Volume (L)
Inspiratory
Flow
VC
B
Obstructive Lung Disease
Flow
(L/sec)
TLC
RV Volume (L)
C
Restrictive Lung Disease
Flow
(L/sec)
TLC
RV Volume (L)
D
Variable Extrathoracic
Flow
(L/sec)
TLC
RV Volume (L)
E
Fixed Upper Airway
Flow
(L/sec)
TLC
RV Volume (L)
F
Neuromuscular Weakness
Flow
(L/sec)
TLC
RV Volume (L)

Restrictive



Obstructive

Ventilation strategy

Obstructive lung disease

- Ventilation rate; 8-12 bpm
- I:E ratio; 1:3
- Airway pressure
  - Peak; low as possible (<30cmH_2O)
  - Plato; low as possible (<25cmH_2O)
- $HbSaO_2$ %; > 88-90 %
- P_aCO_2 ; > 39 mm Hg

Restrictive lung disease

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