RESPIRATORY FAILURE

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Outline

- Case history
- Definition & Classification
- Physiology of respiration & gas exchange
- Aetiology of respiratory failure
- Principles of management

Case Histories

A) 25 year old male rugby player presents after an injury to the neck sustained on the playing field. He cannot move his limbs and finds it difficult to breathe, cough or talk.

B) 25 year old female presents with high fever, dypnoea, cyanosis and confusion 2 days after a septic abortion.

Definition & Classification

Arterial PO_2 less than 60mmHg(Hypoxemia),
breathing air at rest, at sea level,
in the absence of an intracardiac shunt

Type I failure:
Hypoxemia with low/ normal $PaCO_2$

Type II failure (ventilatory failure):
Hypoxemia with arterial PCO_2 more than 49mmHg

Physiology of Respiration & Gas Exchange - I

- Regulation of respiration
  - Respiratory center
    - Pons & medulla
    - Chemical control – $PaCO_2$ & [H+]

- Peripheral chemoreceptors
  - Hypoxemia PaO_2 < 60mmHg Fig

Physiology of Respiration & Gas Exchange - II

- Activation of the muscles of respiration

  Intercostal / lumbar nerves

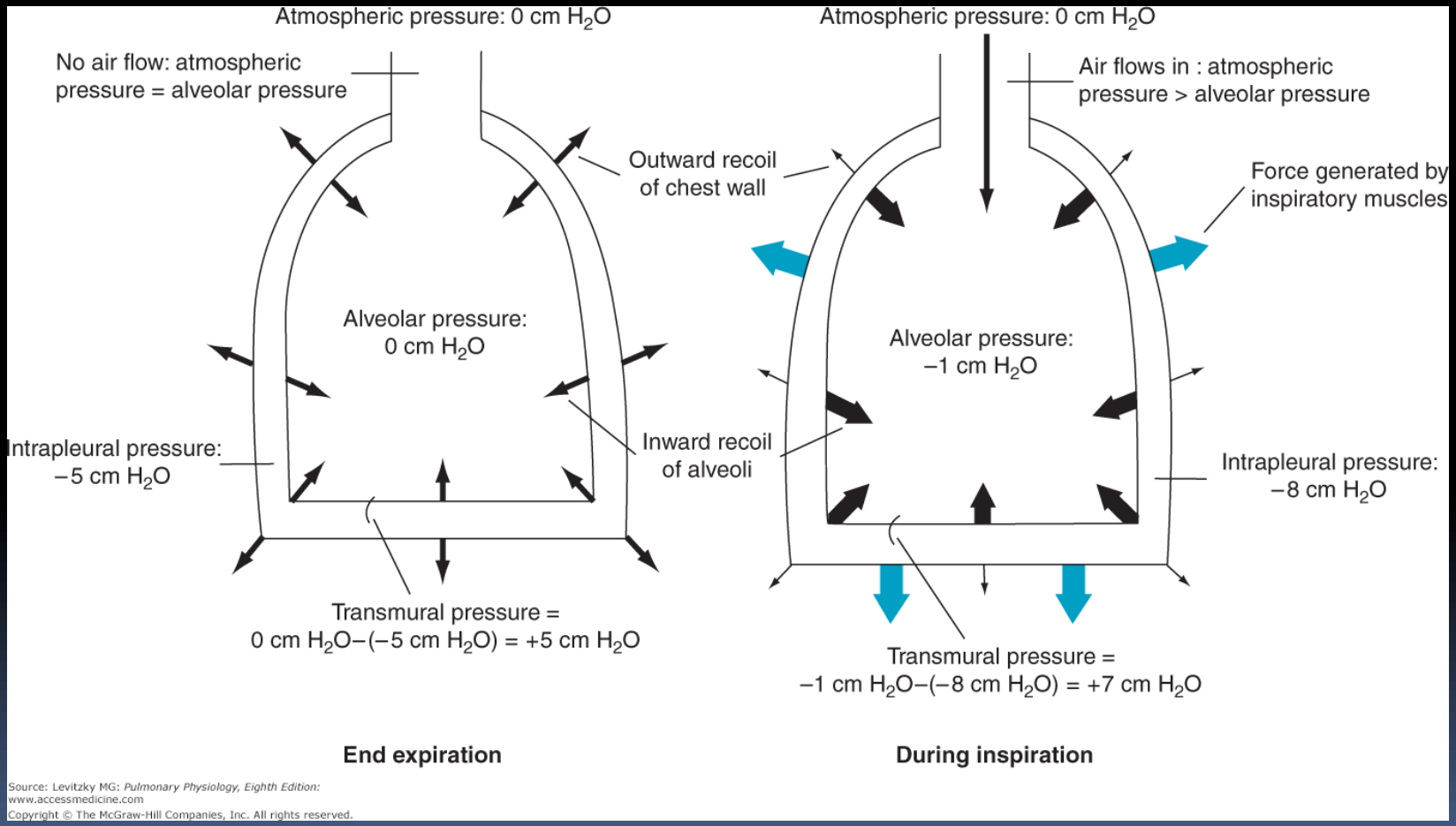
  Phrenic nerve

Physiology of Respiration & Gas Exchange - III

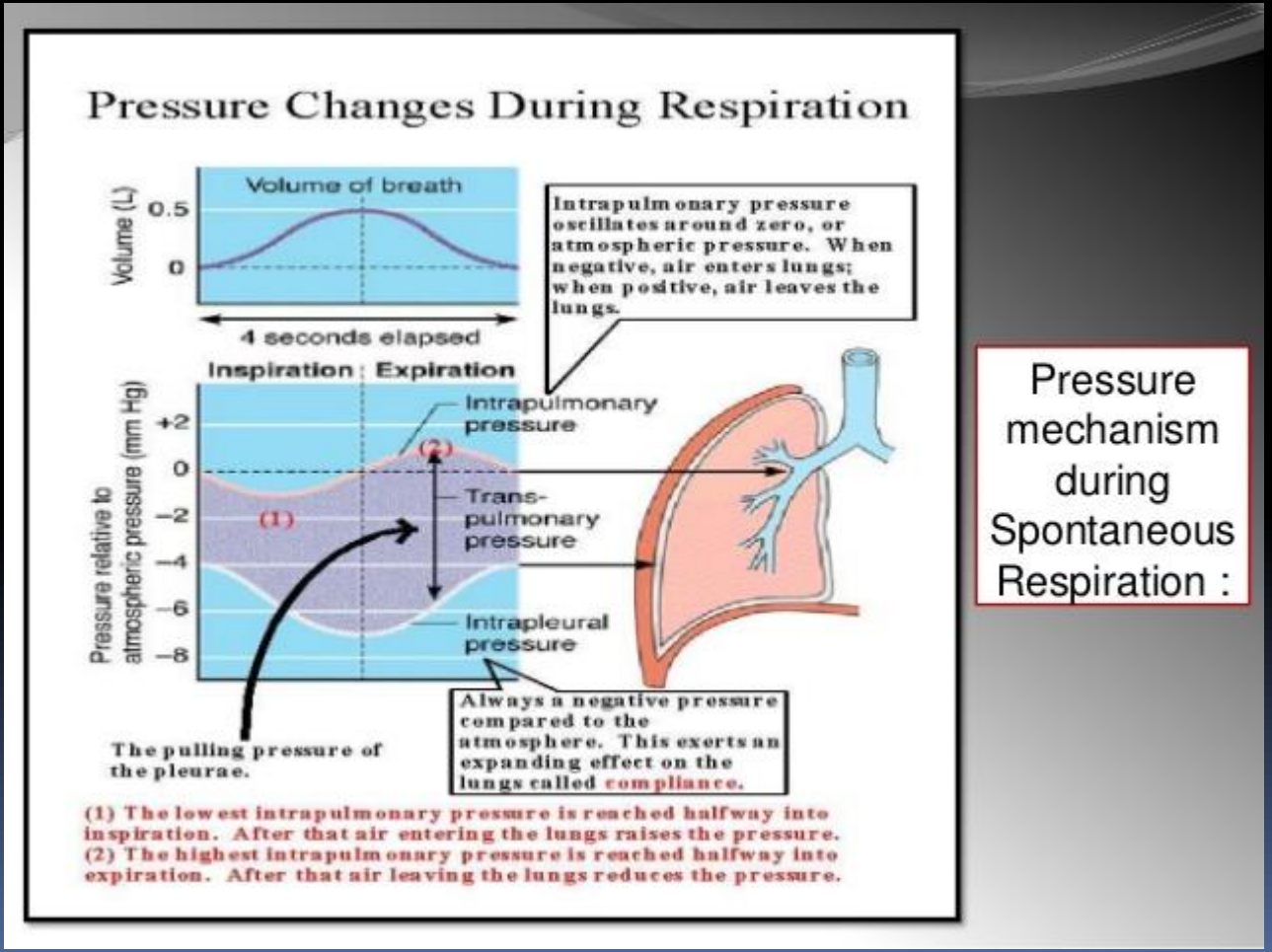
Movement of air in & out of lungs

- Expansion of chest generates negative pleural P
- Negative pleural pressures expand the lung
- Intrapulmonary pressure follows pleural P
- Compliance of the lungs - how much the lung expands

Mechanics of Respiration



Physiology of Respiration & Gas Exchange -IV



Pressure mechanism during Spontaneous Respiration :

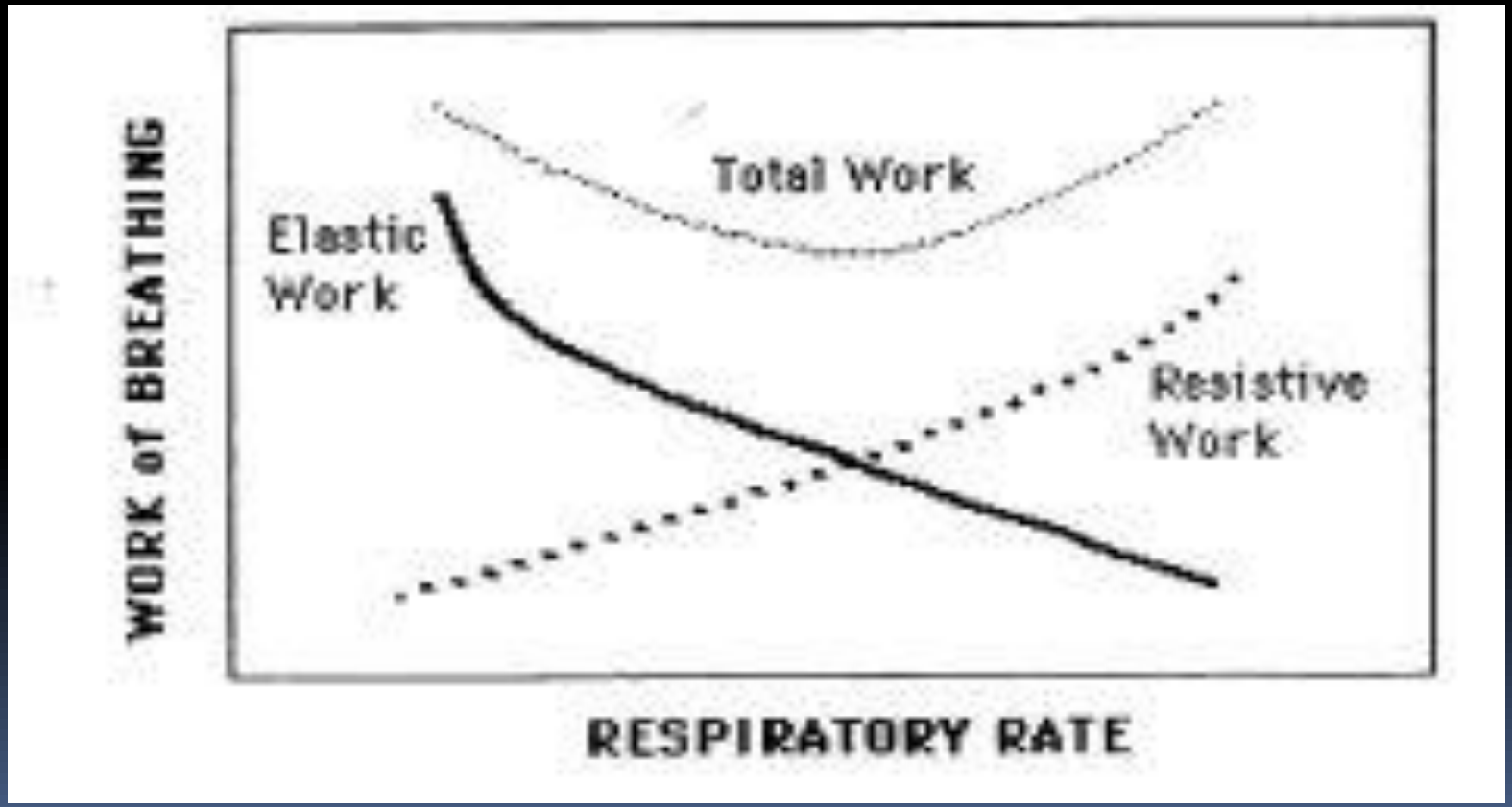
Physiology of Respiration & Gas Exchange - V

'Work of breathing'

3-5% of total energy expenditure at rest

- Compliance work
- Airway resistance work
- Tissue resistance work

Work of Breathing



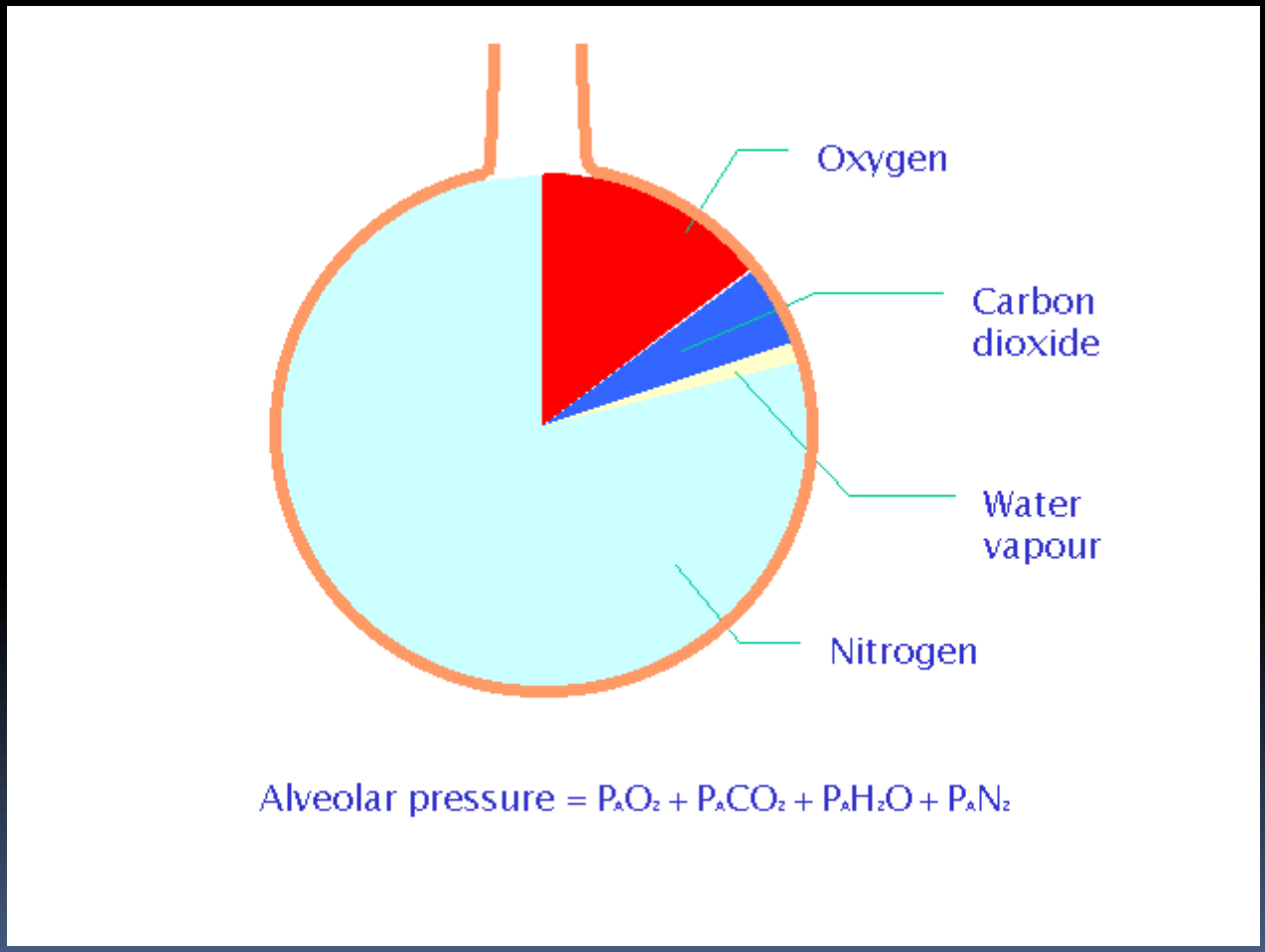
Physiology of Respiration & Gas Exchange - VI

O_2 concentration & partial pressure in alveoli

Depends on

- Concentration of inspired O_2
- Rate of uptake of O_2 into blood
- Rate of entry of new O_2 into alveoli
- Pressure of other gases eg. CO_2

O2 concentration & partial pressure in alveoli

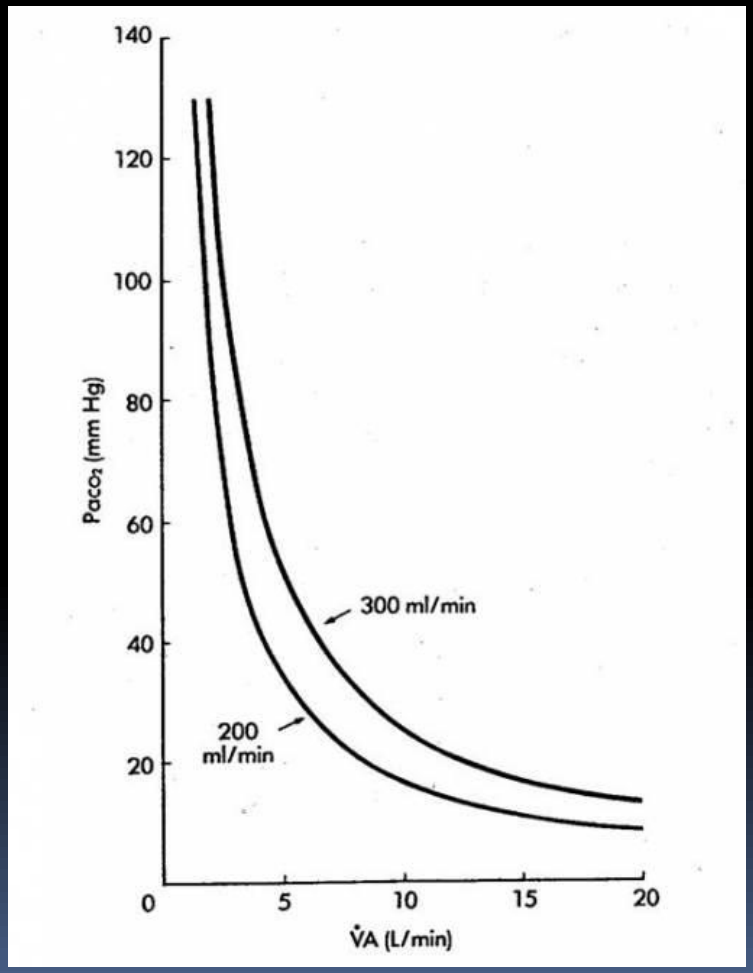


Physiology of Respiration & Gas Exchange -VII

Alveolar CO_2 concentration depends on

- Rate of CO_2 production by the body
- Rate of CO_2 elimination/ ventilation

Effect of Alveolar Ventilation on alveolar CO2

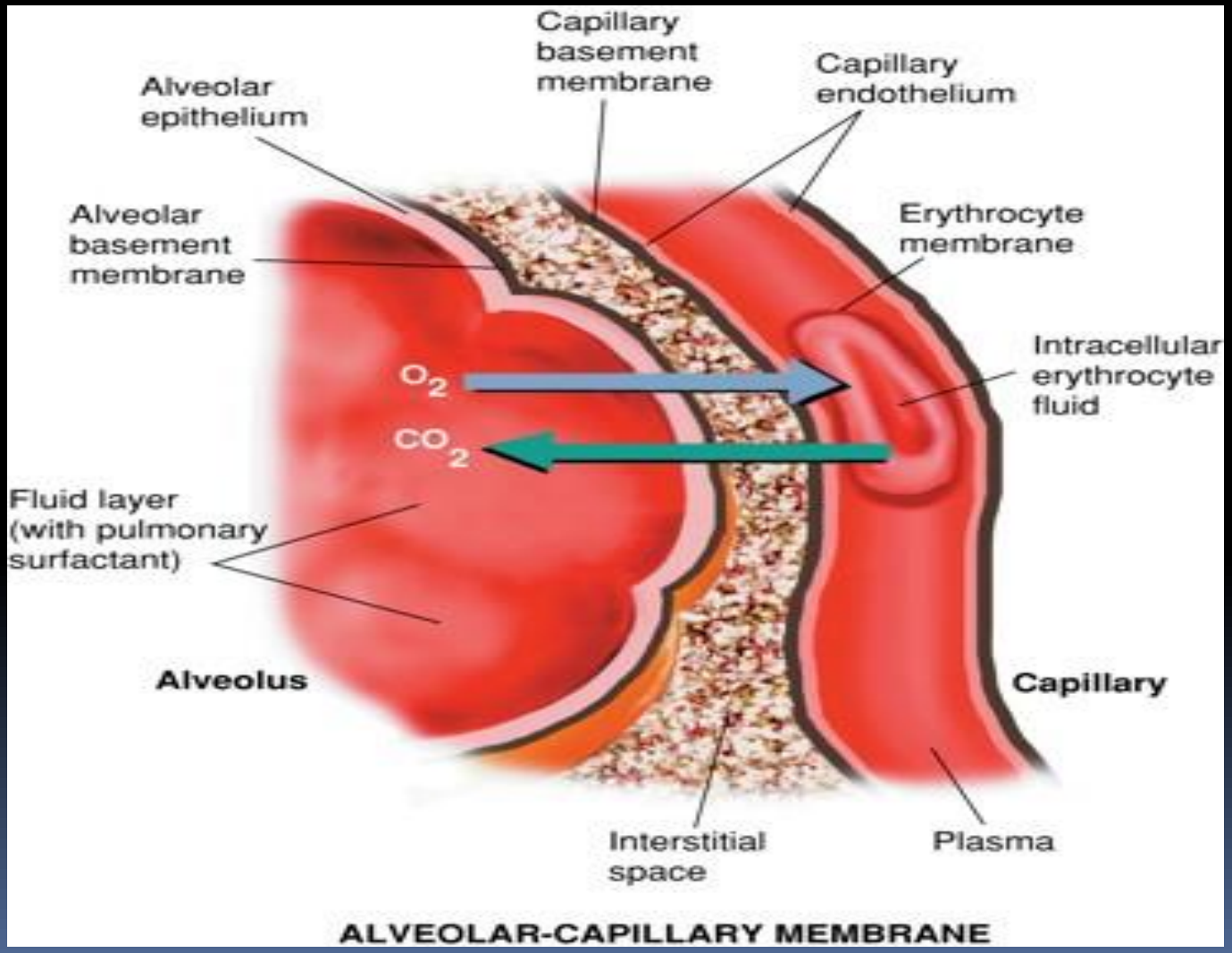


Physiology of Respiration & Gas Exchange

Transfer of gases across the alveolar capillary membrane depends on

- Thickness of membrane
- Surface area of membrane
- Diffusion coefficient of gas
- Partial pressure difference across membrane
- Ventilation (V) / Perfusion (Q) matching

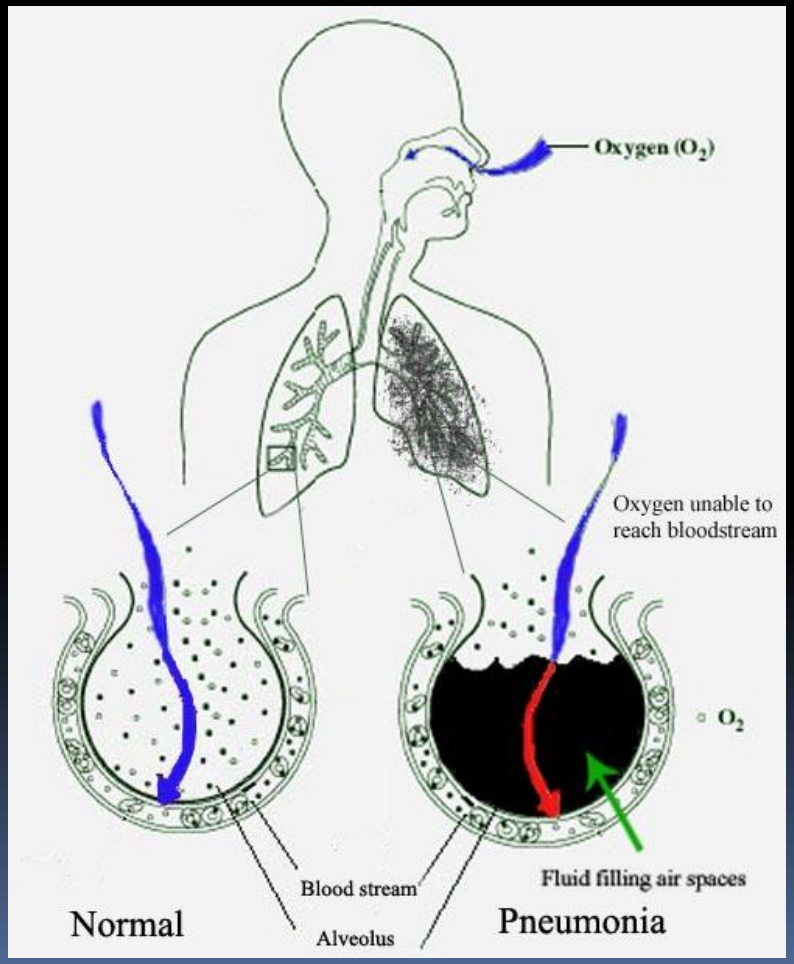
Gas Diffusion in Alveoli



Aetiology of Respiratory Failure - Type I failure

b) V/Q mismatch

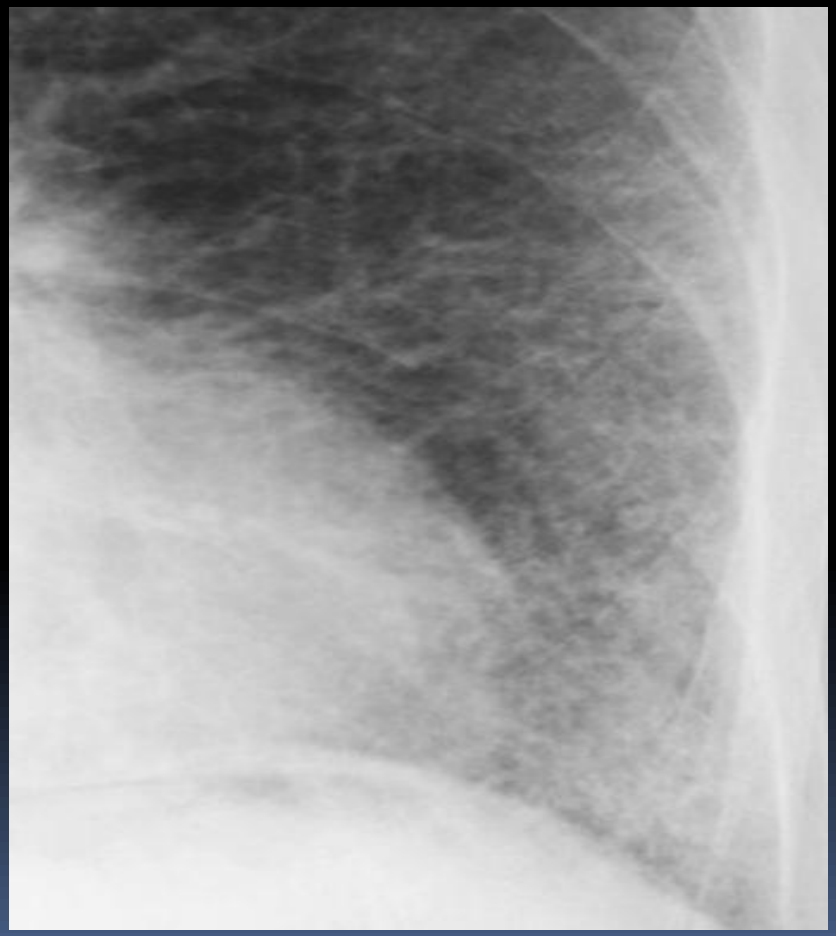
Eg.Consolidation (Pneumonia)



Aetiology of Respiratory Failure -Type I failure

a) Impaired transfer of O_2 across A-C membrane

eg. Fibrosing alveolitis



Aetiology of Respiratory Failure - Type II failure

a) Failure of central control

eg. Brainstem death

b) Spinal cord injury

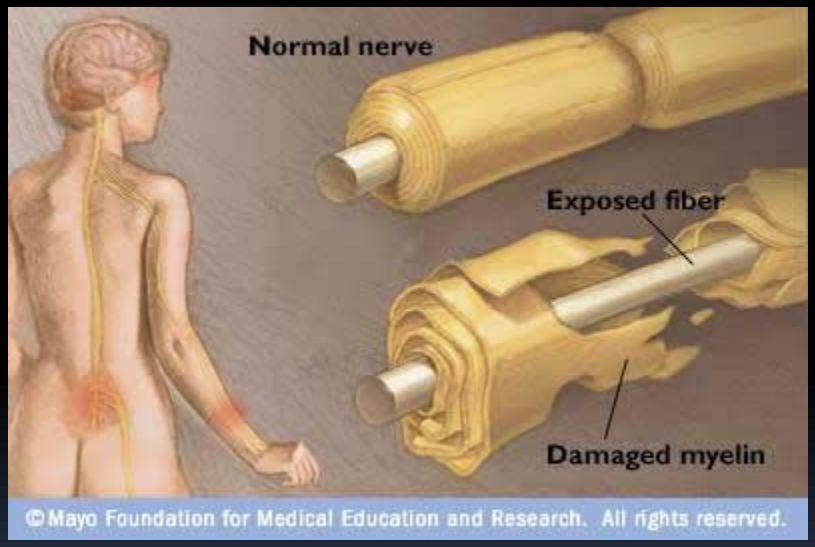
c) Impaired motor nerve function

eg. Guillain-Barrre syndrome

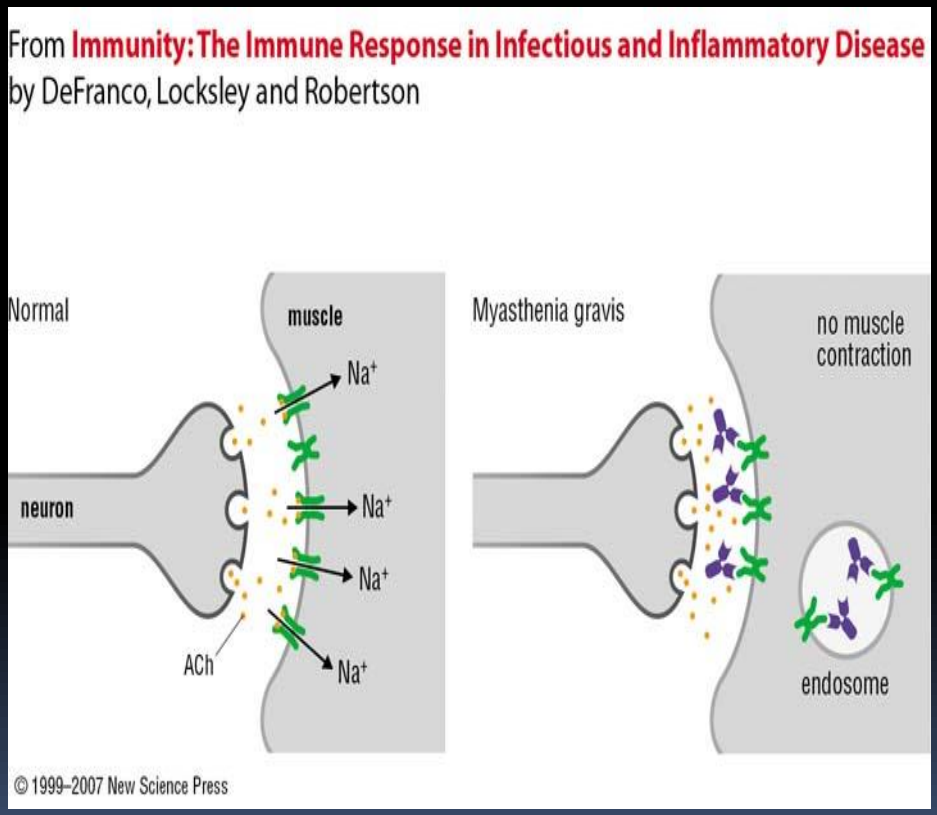
d) Abnormal conduction at neuromuscular junction

eg. Myasthenia Gravis

Guillain Barre Syndrome



Myasthenia Gravis



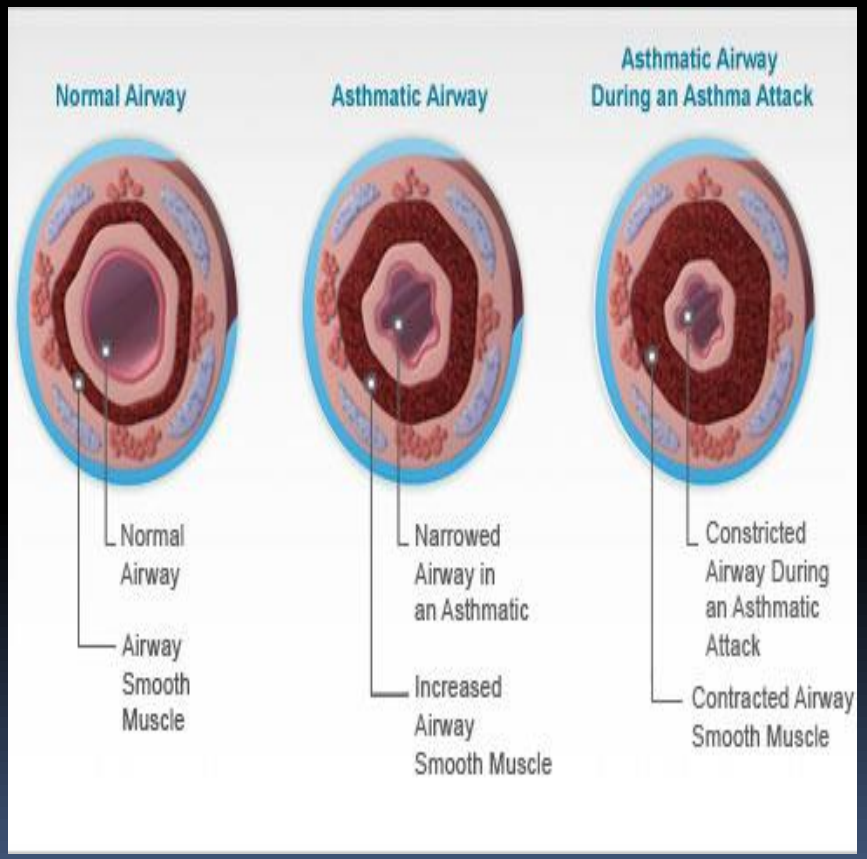
Aetiology of Respiratory Failure - Type II failure

- e) Muscle weakness

  eg. Muscle dystrophy

  f) Airway obstruction

  eg. Severe bronchial asthma



Principles of Treatment

- Quick initial assessment of airway, breathing & circulation

  Speech, air entry & added sounds, SpO_2 & ABG
- High flow O_2
- If respiratory muscle function/ mechanism is impaired – assist respiration with ambu bag & mask

Supporting Respiration: O_2 Via Ambu bag & mask

Principles of Treatment - II

- Call for help
- Positive pressure ventilation – NIV, Invasive ventilation
- Treat the cause eg. Antibiotics for pneumonia

Case histories

1) Type of respiratory failure?

2) Type of respiratory failure?

   What is your immediate management?

Impending Respiratory Failure

- Tachypnea
- Accessory muscle use/ nasal flaring
- Confusion/ restless
- Sweaty
- Tachycardic/ arrhythmia
- Hypertensive
- Progressing to apnoea, cardiac arrest

How do you identify the patient at risk of respiratory failure?

Look for danger signs!!!
Confusion
Tachypnoea followed by reduced rate & effort
Tachycardia
Sweating, agiatation