

NEUROLOGICAL AND CARDIOPULMONARY PHYSIOTHERAPY

L1 RESPIRATORY FAILURE AND INTUBATION

Respiratory Failure:

Definition:

- When the patient loses the ability to ventilate adequately or to provide sufficient oxygen to the blood and systemic organs

Types:

- Hypoxaemic:
 - Type 1, O₂ movement, regional ventilation
 - PaO₂ < 60mmHg
 - PaCO₂ << 42mmHg (without hypercapnia)
 - Lung disease is severe enough to interfere with oxygen exchange
- Hypercapnic:
 - Type 2 pump, CO₂ movement, ineffective ventilation, reduced overall ventilation
 - PaCO₂ > 50mmHg
 - The respiratory system pump is inadequate and cannot maintain ventilation to eliminate the CO₂ produced by metabolism
- Respiratory failure can also be acute, chronic or acute on chronic
 - Acute= rapid, short course and pronounced symptoms
 - Chronic= long duration of poor ABG values with compensation
 - Acute on chronic= worsened situation such as due to infection

Important Terms:

- \dot{V}_E = minute ventilation
= RR x V_T
- V_d = dead space (non gas exchange area)
- \dot{V}_D = dead space ventilation
= RR x V_d
- \dot{V}_A = alveolar ventilation
= ($V_T - V_d$) x RR
= $\dot{V}_E - \dot{V}_D$

- What is the V_E , V_A & does the CO₂ ↑ or ↓
- Normal male
 - V_d = 100 ml, V_T = 500 ml, RR = 12
 - \dot{V}_E = 6L/min V_A = 4.8L/min CO₂ = Normal
- Post abdominal surgery
 - V_d = 100 ml, V_T = 250 ml, RR = 24
 - \dot{V}_E = 6L/min V_A = 3.6L/min CO₂ = Increased
- DBE with the physiotherapist
 - V_d = 100 ml, V_T = 750 ml, RR = 8
 - \dot{V}_E = 6L/min V_A = 5.2L/min CO₂ = Decreased
- PE 2 weeks post discharge
 - V_d = 200 ml, V_T = 500 ml, RR = 12
 - \dot{V}_E = 6L/min V_A = 3.6L/min CO₂ = Increased

Mechanisms and Causes:

- Hypoxaemic respiratory failure
 - Reduced gas going to areas of perfusion (low lung volume)
 - No gas going to areas with perfusion (lobar collapse)
 - Diffusion impairment (pulmonary fibrosis)
 - Gas going to an area with reduced perfusion
- Hypercapnic respiratory failure:
 - Depressed drive (brainstem injury, opiate overdose)
 - Impaired neuromuscular function (cervical spinal cord injury, myopathy, neuropathy respiratory muscle dysfunction)

- Increased respiratory load (increased airway resistance, altered chest wall compliance, decreased lung compliance)

Clinical Manifestations:

- Hypoxaemia:
 - Decreased mental acuity ($\text{PaO}_2 < 40\text{-}50\text{mmHg}$)
 - Agitation followed by somnolence
 - Dyspnoea
 - Increase RR, change in pattern of breathing
 - Long term → organ failure- renal and brain damage
- Hypercapnia:
 - Depends on rate of rise of CO_2 and metabolic compensation
 - Dyspnoea
 - Increased RR, change in pattern of breathing (COPD- accessory muscle use, paradoxical breathing, rib indrawing, pursed lips breathing)
 - Agitation, tremor
 - Confusion to coma
 - Increase ICP, headache

Implications for physiotherapy:

- Watch for signs and symptoms
- Review medical assessment and management
- Determine type of respiratory failure
- Determine cause of respiratory failure

Case Studies:

1. 63yr old man following CAGSx3. Extubated onto oxygen therapy (40% venture).

ABGs= pH 7.39, paCO_2 40, PaO_2 50, HCO_3^- 26, BE+2

CXR= left lower lobe collapse

Confused, agitated, aggressive, with rapid and shallow breathing

Ausc= decreased BS left lower zone

Moist, weak, NP cough

- Oxygen movement problem
- Decreased SA
- General secretion movement impairment
- → type 1 hypoxaemic respiratory failure

2. 69yr old COPD patient Dx 10yrs ago, 1-2amdn/year with chest infections. 40yr smoking history. Presents with: 2/7h/o increased SOB, chills, fever, chest pain

Cough= p/o/s/a green sp, difficulty clearing

CXR= hyperinflation (chronic), flattened diaphragms, patchy consolidation, (R)LL

PFTS= severe COPD- $\text{FEV}_1/\text{FVC} = 0.38/1\text{L}$

Ausc= crackles (R)LZ laterally, decreased BS throughout

ABGs- on 2L/min O_2 via nasal prongs, pH= 7.35, $\text{PaCO}_2 = 65$, $\text{PaO}_2 = 58$, $\text{HCO}_3^- = 28$, BE= 3 (normally on 1L/min $\text{O}_2 = 7.39/50/80/28/3$)

- O_2 and CO_2 movement problem
- Acute on chronic failure
- Secondarily secretion movement impairment