PHTY5197 NEUROLOGICAL AND CARIOPULMONARY PHYSIOTHERAPY

WEEK 1 RESPIRATORY FAILURE AND INTUBATION (Tubes + Ventilation + Life Support)

- When the patient loses the ability to ventilate (move enough gas in and out of the lungs) adequately or to provide sufficient oxygen to the blood and system organs.
- Arterial Blood Gas (AGB) determines if patients are in failure or not.

TYPES OF RESPIRATORY FAILURE

HYPOXAEMIC

- Type 1, lung, O_2 gas movement, regional ventilation
- P_aO_2 <60mmHg
- P_aCO_2<42mmHg
- Ling disease is severe enough to interfere with O_2 exchange
- (SA problems) (CO_2 can be normal or less than normal).

HYPERCAPNIC

- Type 2, pump, CO_2 gas movement, ineffective minute ventilation, ↓ overall ventilation. (pump problem).
- P_aCO_2>50mmHg
- The respiratory system pump is inadequate and can not maintain ventilation to eliminate the CO_2 produced by metabolism.
- Not enough gas in and out to blow off CO_2, has low O_2, caused by pump not working.

RESPIRATORY FAILURE CAN BE

ACUTE

- Rapid onset, short course and pronounced symptoms.

CHRONIC

- Long duration or poor AGB values with metabolic compensation (PH will be normal)

ACUTE ON CHRONIC

- E.g. acute exacerbation of advanced COPD/ failure with an infection.

IMPORTANT TERMS

- **V_E**= minute ventilation (=RRV_T). Amount of gas in the lungs every minute.
- **Vd** = dead space (non gas exchange area) (air that doesn't move into alveoli or gas that is not exchanged)
- **V_D** = Dead space ventilation (RRxVd)
- **V_A** = alveolar ventilation (=(V_T-V_d) xRR) diffused gas

a = arterial A = alveoli

- What is the V_E, V_A & does the CO_2 ↑ or ↓
- Normal male
  - Vd = 100 ml, V_T = 500 ml, RR = 12
  - $\dot{V}_E$ = 6 l/min $\dot{V}_A$ = 4.8 l/min CO_2 = N
- Post abdominal surgery
  - Vd = 100 ml, V_T = 250 ml, RR = 24
  - $\dot{V}_E$ = 6 l/min $\dot{V}_A$ = 3.6 l/min CO_2 = ↑
- DBE with the physiotherapist
  - Vd = 100 ml, V_T = 750 ml, RR = 8
  - $\dot{V}_E$ = 6 l/min $\dot{V}_A$ = 5.2 l/min CO_2 = ↓
- PE 2 weeks post discharge
  - Vd = 200 ml, V_T = 500 ml, RR = 12
  - $\dot{V}_E$ = 6 l/min $\dot{V}_A$ = 3.6 l/min CO_2 = ↑

Normal values (ranges) for ABG analysis

pH	= 7.38 – 7.42*
$PaCO_2$	= 38 – 42 mmHg*
PaO_2	= 85 – 100 mmHg
HCO_3^-	= 22 – 26 mmol/L
BE	= ± 2

NORMAL VALUES FOR ABG ANALYSIS

- PH
  - Normal = 7.38 - 7.42
  - **Acidaemia** = below 7.38
  - **Alkalaemia** = above 7.42
- $PaCO_2$
  - **Normal** = 38 - 42mmHg
  - **Respiratory acidosis** = above 42mmHg
  - **Respiratory alkalosis** = below 38mmHg
- HCO_3
  - **Normal** = 22-26 mmol/L
  - **Metabolic acidosis** = Below 22 mmol/L
  - **Metabolic alkalosis** = Above 26 mmol/L
- BE
  - **Normal** = -2 to +2
  - **Metabolic acidosis** = Below -2
  - **Metabolic alkalosis** = Above +2

- Normal PaO_2 range: 85-100mmHg
- Hypoxaemic = PaO_2 <60mmHg
- Rule of thumb: F_iO_2 x 5 for PaO_2

MECHANISMS AND CAUSES
HYPOXEMIC RESPRIATORY FAILURE
- Reduced gas going to areas with perfusion (low lung volume)
- No gas going to areas with perfusion (acute lobar collapse)
- Diffusion impairment (pulmonary fibrosis)
- Gas going to areas with reduced perfusion (pulmonary embolism)
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HYPERCAPNIC RESPIRATORY FAILURE (CO_2 movement problem)
- Depressed drive
- Impaired neuromuscular function (cervical chord injury, myopathies, neuropathies, respiratory muscle dysfunction)
- Increased respiratory load (↑ airway resistance)
- Altered chest wall compliance (kyphoscoliosis/ # ribs)
- ↓ lung compliance (collapse)

CLINICAL MANUFESTATIONS
HYPOXAEMIA
- ↓ mental acuity (P_aO_2 < 40-50mmHg
- agitation followed by somnolence
- dyspnoea
- ↑ RR, change in pattern of breathing
- organ failure – renal failure, brain injury

HYPERCAPNIA
- depends on rate of rise of CO_2 and metabolic compensation
- dyspnoea
- ↑ RR, change in pattern of breathing (COPD)
- agitation, tremor, confusion to coma.
- ↑ ICP (in brain injury), headache (no brain injury)

IMPLICATIONS FOR PHYSIOTHERAPY
- watch for signs and symptoms of respiratory failure.
- Review medical assessment and management
- Determine type of respiratory failure (hypoxemic/ hypercapnic)
- Determine cause of respiratory failure
- Choose appropriate treatment interventions.

INTUBATION
Used for:
- maintaining patent upper airway (suffocation)
- protect lower respiratory tract (aspiration)
- enable adequate tracheobronchial toilet (suctioning)
- Allow ventilatory support (mechanical ventilation, oxygen therapy/ CPAP/ PEEP
- The cuff on the tube is used to make a seal so that air only goes through the tube and not around it.

WEEK 1 VENTILATORY SUPPORT
- Assists with respiration and moving O_2 and CO_2.
- Spontaneously breathing on mechanical ventilation.
- Intubated and non intubated patients
- Intermittent to continuous/ total support.
- Oxygen therapy increases the available O_2 for gas exchange.
- PEEP and CPAP both do the same thing (increases surface area by opening up alveoli for longer.

POSSIBLE REASONS FOR HYPOXAEMIC RESPIRATORY FAILURE
- Inadequate transfer of O_2 into blood
    - Inadequate fresh air reaching exchange area, reduced SA, diffusion problems.
- Inadequate O_2 transport (Hb, Inadequate circulation)
- Extraction/ utilisation problems.