INDICATIONS FOR RESPIRATORY ASSISTANCE

ACUTE MEDICINE UNIT
P-YEAR MBBS4

RESPIRATORY FAILURE

- Acute respiratory failure is defined by hypoxemia with or without hypercapnia. It is one of the most common problems afflicting the severely ill patient and often necessitates intensive care unit admission.
- Critical illness may be manifest solely as respiratory insufficiency, especially in patients with covert infection. Acute respiratory failure frequently coexists with other organ system failures in the critically ill.
- The signs of critical illness tend to be similar whatever the precipitating cause and are manifest in failure of the respiratory, cardiovascular, and neurological systems.
- Full and repeated physical examination may be required to elucidate the cause of acute respiratory failure. Pulse oximetry allows the continuous noninvasive monitoring of arterial oxygen saturation and is useful in all clinical settings. Arterial blood gas (ABG) analysis confirms the type and severity of acute respiratory failure . A full range of imaging modalities, particularly computed tomography and echocardiography, may be required for diagnosis.

TYPE I RESPIRATORY FAILURE

- Acute, hypoxemic respiratory failure.
- Impairment of oxygen transfer in the lungs.
- Patients usually have impaired gas exchange with a low PaO_2, a low functional residual capacity and reduced pulmonary compliance.
- Minute ventilation increases in response to lung juxta-capillary receptor stimulation, metabolic acidosis and severe hypoxaemia, reducing the $PaCO_2$.
- There is a mechanical advantage to breathing rapidly, with small tidal volumes when the lungs have are stiff and the FRC is reduced.
- Patients with type I respiratory failure are therefore hypoxic, hypocarbic and tachypnoeic, and take small breaths.

TYPE I RESPIRATORY FAILURE

Causes-

- ↓ inspired O_2 fraction- ↑dead space and rebreathing of exhaled gases, disconnection of mechanical ventilation circuit.
- ↓ barometric pressure- high altitude.
- Alveolar hypoventilation.
- Diffusion impairment- pul edema, pul fibrosis, ARDS.
- **V/Q mismatch**- atalectasis, pul embolus, endobronchial intubation, bronchospasm, pneumonia, ARDS.
- RLS- pulmonary venous blood bypasses ventilated alveoli and is not oxygenated. Sepsis, liver failure, pul embolus, cardiac RLS.

TYPE II RESPIRATORY FAILURE

- Chronic, Ventilatory, hypercapnic respiratory failure.
- Inadequate ventilation, CO_2 retention, hypercarbia and hypoxemia.
- Patients are hypercarbic and hypoxic, with a low respiratory rate.
- Patients with neuromuscular disease or chest wall injury may be tachypneic with small tidal volumes. They may experience extreme dyspnea before their blood gases deteriorate.

TYPE II RESPIRATORY FAILURE

Causes-

- Central respiratory drive abnormalities- sedative drugs, head injury, CNS infection.
- Spinal cord abnormalities- innervation of diaphragm and intercostal muscles.
- Motor nerves abnormalities- Guillain–Barré syn.
- Muscles abnormalities- congenital myopathies, myasthenia gravis, Botulinum toxin, organophosphates, NMB agents.
- Chest wall abnormalities- kyphoscoliosis, rib fx.
- Airways and lungs abnormalities- parenchymal diseases, COPD, pul embolus.
- Increased CO_2 production- fever, ↑carbohydrate intake

ASSESSMENT OF NEED FOR RESPIRATORY SUPPORT

- History (eg, cough, sputum, chest pain, breathlessness, underlying disease, increased metabolic demands)
- **Clinical examination** (including LoC, psychomotor behavior, skin color and temperature, use of accessory muscles, RR, breath pattern and depth, chest expansion, breath sounds, tracheal deviation, percussion, vocal fremitus).
- Vital signs + Pulse oximetry.
- Blood gas analysis- Repeated PaO2, PaCO2, pH, lactate, Hb, electrolytes.
- Lung function tests, Chest X-ray, US, CT, ECG, Echo.

RESPIRATORY SUPPORT

- Oxygen supplementation
  - Nasal cannula
  - Venturi mask
  - Partial rebreathing mask
  - Nonrebreathing mask (reservoir bag)
  - Face mask
- Continuous Positive Airway Pressure
- Bag ventilation
- Laryngeal mask
- ET intubation
- Mechanical ventilation

INDICATIONS FOR OXYGEN SUPPLEMENTATION- I

- Delayed and inadequate treatment of hypoxia leads to **cerebral damage** and **organ dysfunction**.
- In acute respiratory failure, a PaO_2 <8 kPa (60 $_{mmHg}$) or an SaO2 <90%, is an indication for oxygen therapy. Aim to maintain an SaO_2 of >92%.
- If the SaO_2 is <90% or the PaO_2 is <7 kPa (53 $_{mmHg}$), O_2 concentration should be increased.
- In the small proportion of patients with chronic type II respiratory failure who have lost their hypercapnic drive, the inspired O_2 concentration should be limited to 24–28%. Aim to maintain PaO_2 at 8–10 kPa (60–75 $_{mmHg}$).
- If the hypoxemia does not improve with oxygen therapy, or the patient becomes exhausted with a rising $PaCO_2$, then transfer to an ICU and mechanical ventilation should be considered.

INDICATIONS FOR OXYGEN SUPPLEMENTATION - II

Tolerance to Arterial Hypoxemia

- The standard indications for supplemental oxygen are an arterial PaO_2<60 $_{mm\ Hg}$ or an arterial SaO_2<90% .
- However, clinical observations show that severe degrees of hypoxemia are tolerated without evidence of inadequate tissue.
- Blood lactate levels don't show evidence of a switch to anaerobic metabolism in patients with severe hypoxemia, even at arterial PO_2 as low as 22 $_{mm\ Hg}$.
- Remember this when considering the use of supplemental oxygen based on measures of arterial oxygenation.

INDICATIONS FOR RESPIRATORY ASSISTANCE- I

The decision **to intubate and initiate mechanical ventilation** has always seemed more complicated than it should be. The following simple rules should suffice:

I. **The indication for intubation and mechanical ventilation is thinking of it.** There is a tendency to delay intubation and mechanical ventilation as long as possible in the hopes that it will be unnecessary. However, elective intubation carries far fewer dangers than emergency intubation. If the patient's condition is severe enough for intubation and mechanical ventilation to be considered, then proceed without delay.

II. **Intubation is not an act of personal weakness.** House staff tend to apologize on morning rounds when they have intubated a patient during the evening, almost as though the intubation was an act of weakness on their part. Quite the contrary, intubation carries the strength of conviction, and no one will be faulted for gaining control of the airways in an unstable patient.

III. **Initiating mechanical ventilation is not the "kiss of death."** The perception that "once on a ventilator, always on a ventilator" is a fallacy that should never influence the decision to initiate mechanical ventilation. Being on a ventilator does not create ventilator dependence; having a severe cardiopulmonary or neuromuscular diseases does.

INDICATIONS FOR RESPIRATORY ASSISTANCE- II

Indications for tracheal intubation-

- Cardiopulmonary arrest.
- Facilitation of mechanical ventilation.
- Protection from aspiration- bulbar dysfunction, ↓LoC.
- Facilitation of tracheobronchial suction- pain, weakness, ineffective cough, excessive secretions.
- Relief of upper airways obstruction- ↓LoC, edema, trauma, foreign body.

INDICATIONS FOR RESPIRATORY ASSISTANCE- III

Indications for mechanical ventilation-

- **Support in respiratory failure**- should be considered if $PaCO_2$>7 kPa (53 $_{mmHg}$) in a patient who usually has a normal $PaCO_2$, or if $PaCO_2$ increases by more than 2 kPa (15 $_{mmHg}$), especially if accompanied by acidosis. Suggestive clinical features are dyspnea, difficulty in talking, sweating, pursed lips, use of accessory respiratory muscles, tachycardia, agitation, ↓LoC, orthopnea, intercostal recession, abdominal paradox, cyanosis, pallor. RR>30/min, TV<3–4 ml/kg, and VC<15 ml/kg, often accompanied by disorientation or a deterioration in the LoC, suggest impending exhaustion. Signs of acute respiratory distress are sometimes better indicators than blood gas results.
- Control of ICP- $PaCO_2$ should be maintained at the lower end of the normal range (4.5–5.0 kPa, 33–38 mmHg) in head injuries to reduce cerebral blood flow.
- Reduction of metabolic demands (of diaphragmatic and accessory respiratory muscle contraction).
- Postoperative ventilation- should be considered in patients at risk of postoperative respiratory failure. A period of ventilation after the operation allows anaesthia to wear off and the patient to warm up. Patients can then be weaned from the ventilator when they are stable and their pain has been controlled.
- Inter- or intra-hospital transfer of the critically ill patient.

ADJUVANTS TO RESPIRATORY SUPPORT

- TV, RR, PEEP, I:E ratio, FiO_2.
- Humidification- protect ciliated epithelium lining upper AW.
- Physiotherapy- secretion clearance.
- Position- mobilize and clear secretions.
- Pharmacological- Inh NO, Sedation, analgesia, NMB agents.

REFERENCES

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