

Lung Physiology

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| Ventilation | <ul style="list-style-type: none"> To lower PaCO₂, one must either increase RR or increase tidal volume. Minute ventilation = $RR \times VT^{**}$. |
| Oxygenation | <ul style="list-style-type: none"> Monitored by O₂ saturation and PaO₂. To increase PaO₂ in the ventilated patient, one must either increase FiO₂ or PEEP. Can also extend inspiratory time fraction. Can improve oxygen delivery by increasing CO or hemoglobin. Can decrease oxygen requirements by decreasing work of breathing, agitation or fever. Remove pulmonary vasodilators like nitroprusside. |

Key Terms

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| Minute Ventilation | <ul style="list-style-type: none"> RRxVT. Should be adjusted to achieve baseline PaCO₂. Initial VT of 8-10mL/kg is appropriate in most cases (lower in ARDS and COPD). A rate of 10-12 breaths/min is appropriate. |
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Key Terms (cont)

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| FiO ₂ | <ul style="list-style-type: none"> Initially should be 100%. Quickly titrate down and use the lowest possible level to maintain a PaO₂ of 50-60 or higher. Avoid oxygen toxicity with FiO₂<60% if possible. If FiO₂ of 0.5 does not result in adequate PaO₂, add PEEP or CPAP (allow reduction in FiO₂). |
| Inspiratory/-expiratory ratio | <ul style="list-style-type: none"> Duration of time allotted to inspiration compared to expiration in one delivered breath. Duarte of each breath is determined by set RR. Increased time in inspiration will proportionally decrease tie-in expiration. 1:2 is usually used. |

Key Terms (cont)

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| PEEP | <ul style="list-style-type: none"> Positive pressure maintained at the end of passive exhalation to keep alveoli open. 2.5-10cm H₂O is the initial setting. Can be added to any mode of ventilation and used mostly in hypoxic respiratory failure. Increases lung compliance and oxygenation (improves gas exchange). Prevents alveolar collapse and atelectasis. Can cause barotrauma or low CO (due to decreased venous return and increased PVR, esp. with hypovolemia). |
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Mechanical Ventilation

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| Indications | <ul style="list-style-type: none"> Significant respiratory distress or respiratory arrest. Impaired or reduced level of consciousness with inability to protect the airway (absent gag or cough reflex). Metabolic acidosis without adequate compensation. Respiratory muscle fatigue. Significant hypoxemia (PaO₂<-70mmHg) or hypercapnia (PaCO₂>50mmHg). Respiratory acidosis (pH<7.2) with hypercapnia. |
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Complications

Complications	<ul style="list-style-type: none"> • Anxiety and discomfort treated with sedation. • Tracheal secretions need regular suction. • Nosocomial pneumonia (if >72 hours), accidental extubation, • Barotrauma (high P) • Oxygen toxicity (if FiO₂>60% for >2 days). • Hypotension (high intrathoracic pressure decreases VR). • Tracheomalacia (softening of cartilage) due to prolonged ETT. Prevent with tracheostomy if >2weeks. • Laryngeal damage, GI effects (stress ulcers, cholestasis).
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Page 1 of 3.

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- **Barotrauma (high P)**
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- Tracheomalacia (softening of cartilage) due to prolonged ETT. Prevent with tracheostomy if >2weeks.
- Laryngeal damage, GI effects (stress ulcers, cholestasis).

Modes

- Assisted Controlled Ventilation
 - Initial mode used in respiratory failure.
 - Guarantees a **"backup" minute ventilation**.
 - The ventilator delivers a breath of **predetermined tidal volume** when the patient initiates a breath.
 - If the patient does not initiate a breath, the ventilator takes control and **delivers a breath at a predetermined rate**.
 - **All breaths are delivered by the ventilator**.
 - The patient can go over the determined rate but not under, and **every breath is a determined TV**.

Modes (cont)

- Synchronous Intermittent Mandatory Ventilation
 - Patients can breathe above the mandatory rate without help from the ventilator.
 - The tidal volume of extra breaths is not determined by the ventilator.
 - When the patient breathes spontaneously, there is no preset volume, but the **patient has a guaranteed predetermined rate**.
 - Delivers the mandatory breath in synchrony with patient's initiated spontaneous breath (so they do not overlap).
 - Good for support of ventilation and weaning.

Continuous Positive Airway Pressure (CPAP)

- **Positive pressure (0-20cm H₂O) is delivered** continuously during expiration and inspiration, but no volume breaths are delivered.
- The patient breathes on their own.
- The only **parameters to set are PEEP and pressure support**.
- If the patient is being weaned, CPAP can be used to assess whether they can be extubated.

Modes (cont)

- Pressure Support Ventilation
 - Mostly during weaning trials.
 - Pressure is delivered with an initiated breath to assist breathing.
 - Pressure is not continuous and only responds to initiated breaths.
 - It **enhances respiratory efforts made by the patient**.
 - PEEP may be added.



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