جامعة ساوة الاهلية
كلية التقنيات الصحية والطبية
قسم التخدير - اللجنة العلمية

اسس العناية المركزة

MECHANICAL VENTILATION INDICATIONS AND MODES L9

جامعـــــة ســـــاوة الاهلية

كليـــة التقنيـــات الصحيـة والطبيـة

قسم تقنيـــات التخديـــــر

.....المرحلـــــــــة 3

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..... Stage…3

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الجانب العملي

....محاضرة رقم ...9

Lecture No. 9

Mechanical Ventilation

Introduction

- Mechanical ventilation is the process by which the FIO2 (21% [room air] or more) is moved in and out of the lungs by a mechanical ventilator. Mechanical ventilation is not curative.
- It is a means of supporting patients until they recover the ability to breathe independently.

Indications for mechanical ventilation include

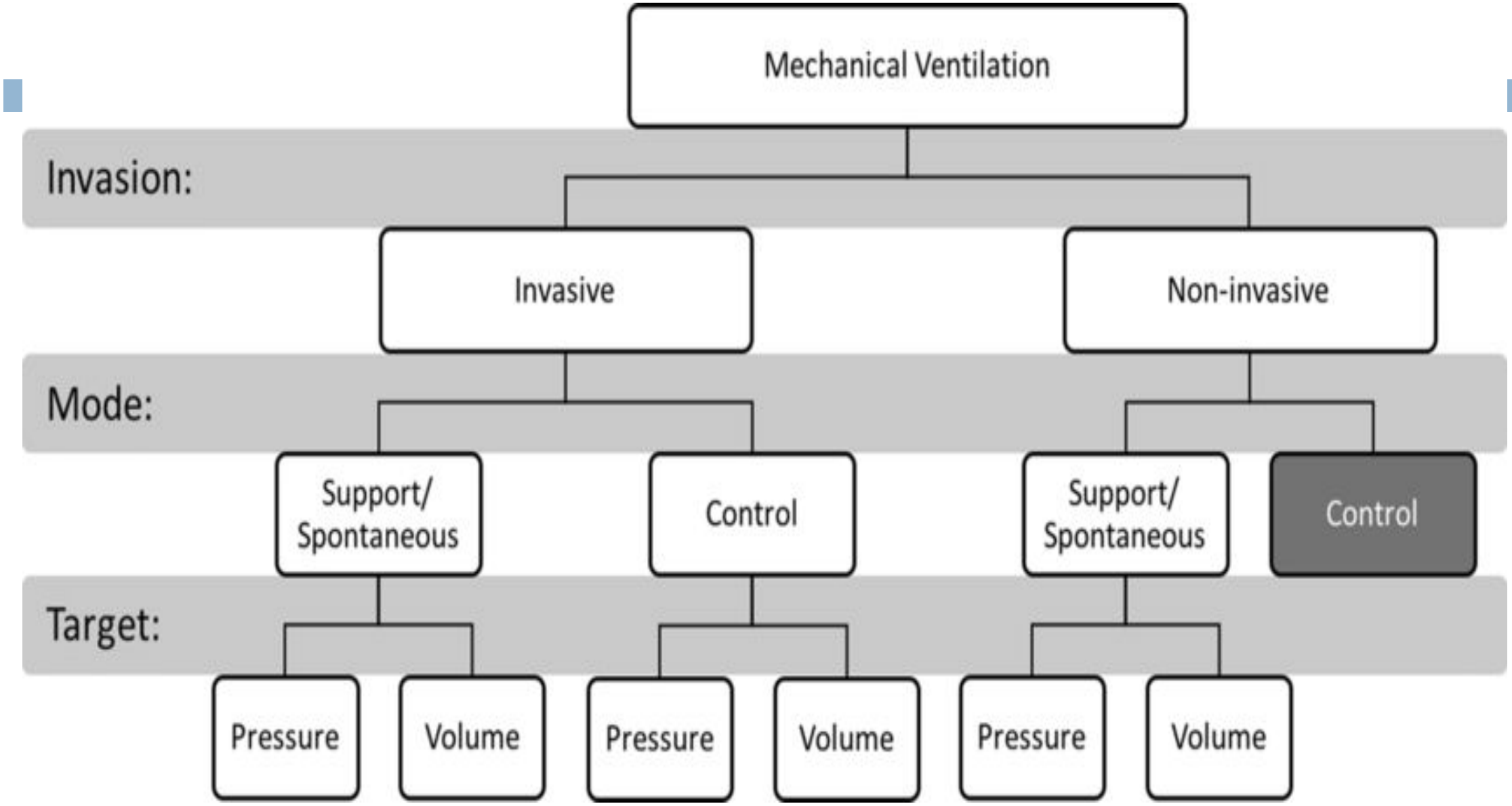
1. **Airway compromise due to disease**

- Obtunded such as those from trauma or oropharyngeal infection.
- Airway obstruction can experience either proximal (such as angioedema) or distal issues (such as asthmatic bronchospasm or acute exacerbation of chronic obstructive pulmonary disease or COPD).
- **2.Hypoventilation** :
- Impaired central drive (such as drug overdose)
- Respiratory muscle weakness (such as muscular dystrophy and myositis)
- Peripheral nervous system defects (such as Guillain-Barré syndrome or myasthenic crisis)
- Restrictive ventilatory defects (such as chest wall trauma or disease or massive pneumothorax or effusion)

Continued..

- **3. Hypoxemic respiratory failure:**
- may arise from the inability to effectively exchange oxygen or deliver it to peripheral tissues due to the following reasons:
- **Alveolar filling defects** (such as pneumonia, acute respiratory distress syndrome (ARDS), or pulmonary edema)
- **Pulmonary vascular defects** leading to ventilation-perfusion mismatch (such as massive pulmonary embolism or air emboli)
- **Diffusion defects** (such as advanced pulmonary fibrosis)

Types of ventilation



Non invasive ventilation

- At times, patients may need ventilator support,

without the placement of an ET tube.

- Noninvasive ventilation (NIV) uses a mask, instead of an ET tube, to oxygenate and ventilate a patient.
- These masks can be full face or a nasal piece.
- There are 2 common modes used for NIV.

Indications of NIV

- BiPAP for acute or **acute-on-chronic respiratory acidosis** secondary to COPD exacerbation where pH </= 7.35
- BiPAP is the prevention of endotracheal intubation and mechanical ventilation in a patient that is not immediately deteriorating
- BiPAP or continuous positive airway pressure (CPAP) for cardiogenic pulmonary edema
- Early NIV for immunocompromised patients with acute respiratory failure and post operative acute resp. failure
- As palliation to dyspneic patients in the setting of terminal cancer or other terminal conditions
- Chest trauma patients with ARF
- Prevention of post-extubation respiratory failure in high-risk patients

Contraindications

Absolute

- Respiratory arrest / need for immediate intubation
- Facial trauma / burns / surgery / abnormalities
- Fixed upper airway obstruction
- Severe vomiting
- Acute severe asthma
- Pneumothorax (unless chest drain inserted)
- Confirmed wish by the patient not to receive NIV in the event of a deterioration.

Relative contraindications:

- Inability to protect airway
- Life-threatening hypoxaemia
- Haemodynamic instability
- Impaired consciousness
- Confusion / agitation
- Bowel obstruction
- Recent facial / upper airway or upper GI tract surgery
- Copious respiratory secretions
- Pneumonia

Continuous positive airway pressure (CPAP)

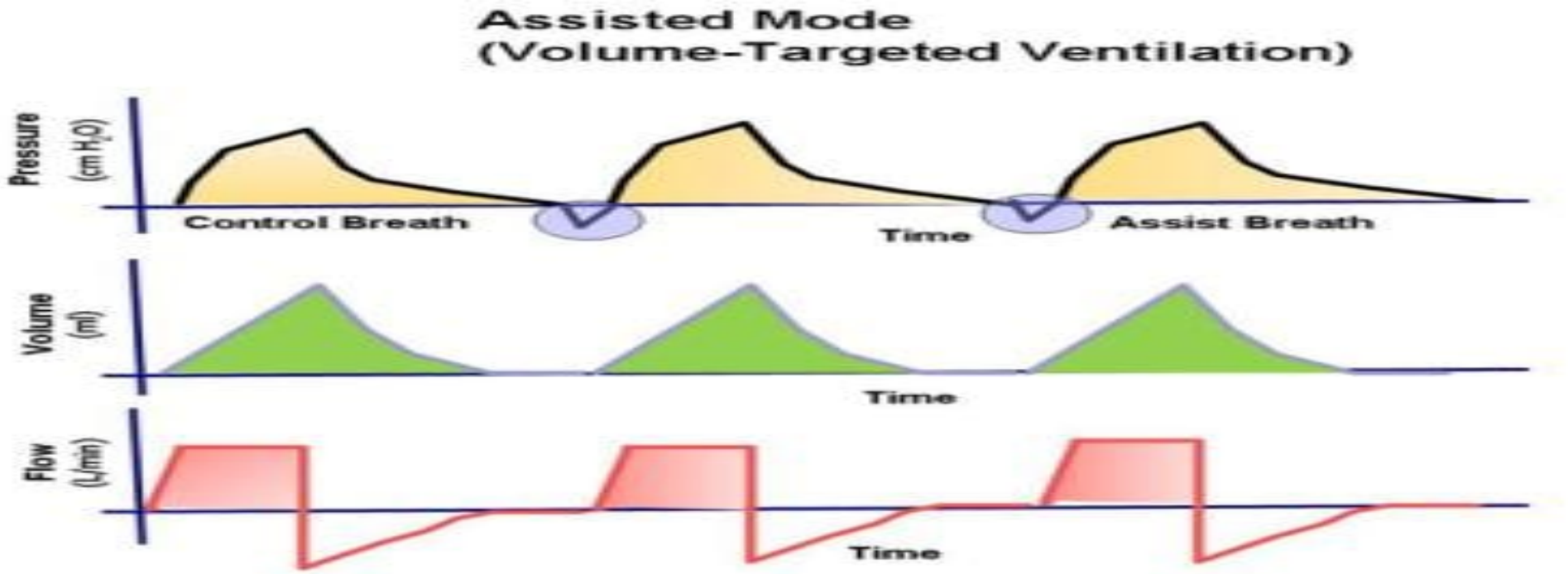
- Restores functional residual capacity (FRC) and is similar to positive end-expiratory pressure (PEEP).
- CPAP is often used to treat obstructive sleep apnea. It is a noninvasive modality, delivered through a tight fitting face mask, nasal mask, or nasal pillows.
- CPAP increases work of breathing (WOB) because the patient must forcibly exhale against the CPAP.
- Therefore it must be used with caution in patients with myocardial compromise.

BiPAP

- In addition to O2, bilevel positive airway pressure (BiPAP) provides 2 levels of positive pressure support: higher inspiratory positive airway pressure and lower expiratory positive airway pressure.
- Like CPAP, the patient must be able to spontaneously breathe and cooperate with this treatment
- BiPAP is used for COPD patients with HF and acute respiratory failure and for patients with sleep apnea.
- Its use after extubation can help prevent reintubation.

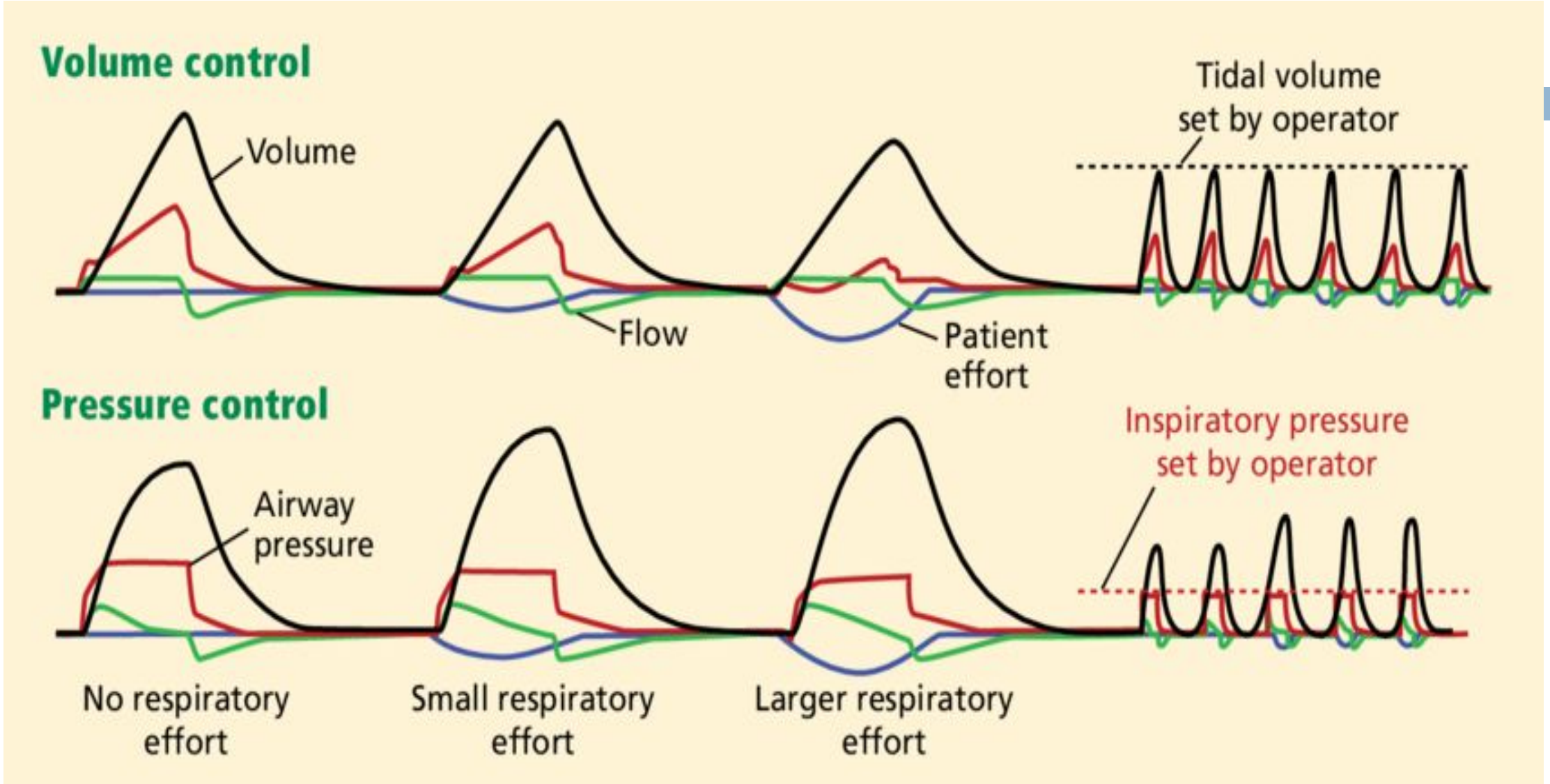
Volume Ventilation

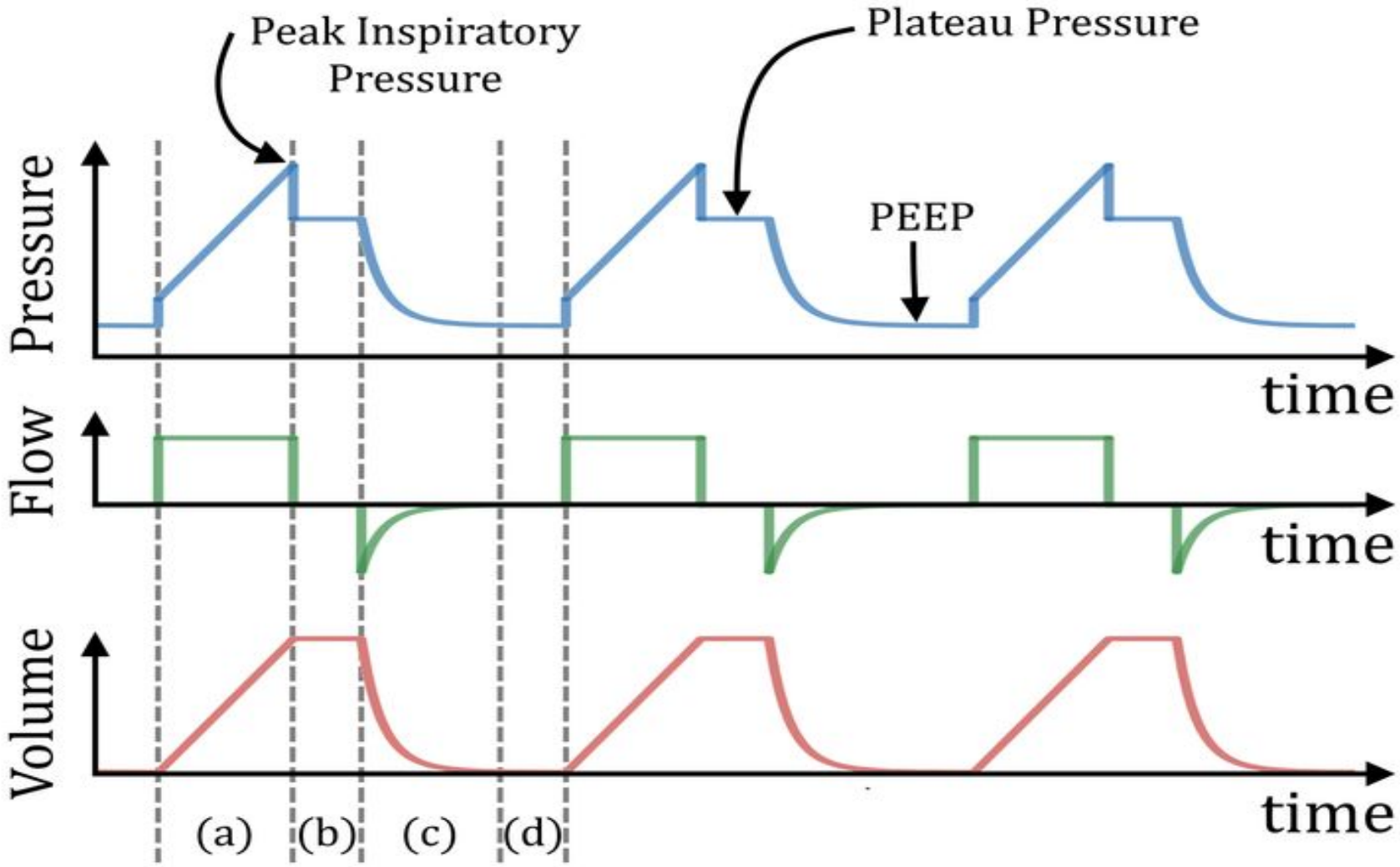
- With volume ventilation, a predetermined VT is delivered with each inspiration.
- The amount of pressure needed to deliver the breath varies based on compliance and resistance factors of the patient ventilator system.
- So, the VT is consistent from breath to breath, but airway pressures vary.



Pressure Ventilation

- With pressure ventilation, the peak inspiratory pressure is predetermined.
- The VT delivered to the patient varies based on the selected pressure and compliance and resistance factors of the patient ventilator system.
- Careful attention must be given to the VT to prevent unplanned hyperventilation or hypoventilation.


Volume control
Volume
Flow
Patient effort
Tidal volume set by operator
Pressure control
Airway pressure
Inspiratory pressure set by operator
No respiratory effort
Small respiratory effort
Larger respiratory effort


Peak Inspiratory Pressure
Plateau Pressure
PEEP
Pressure
time
Flow
time
Volume
time
(a)
(b)
(c)
(d)

Settings in ventilator

Mode Variables

Variable	Common Options	Typical Settings
Trigger	Time Triggered	To provide RR of 14-20
	Flow Triggered	2-3 L/min
	Pressure Triggered	0.5 – 2 cm H_2O
Control	Flow Controlled	Indirectly set by selecting V_T (6-10 mL/kg), RR, and I:E ratio.
	Pressure Controlled	To provide V_T of 6-8mL/kg
Cycling	Flow Cycled	< 25 % peak flow
	Volume Cycled	To provide V_T of 6-10mL/kg
	Time Cycled	To provide RR of 14-20

Settings

- **Tidal volume (V_T):** The tidal volume is usually determined based on ideal or predicted body weight (PBW) rather than actual weight.
- **Respiratory rate (RR):** The respiratory rate is typically between 12 and 16 breaths per minute.
- **Inspiratory flow rate (IFR):** The inspiratory flow rate is usually set between 40 and 60 L/min to achieve an inspiratory and expiratory ratio of 1:2 or 1:3.

Setting

- **Fraction of inspired oxygen (FiO_2):** FiO_2 should be adjusted to the minimum level necessary to maintain a pulse oximetry (SpO_2) reading of 90% to 96%.
- **Positive end-expiratory pressure (PEEP):** PEEP increases the functional residual capacity and prevents the collapse of alveoli
- Initially, the PEEP level is typically set at 5 cm H_2O and adjusted based on the patient's underlying condition and oxygenation requirements.

- **Trigger sensitivity:** Triggers can be categorized into 2 types—flow trigger and pressure trigger.
- Pressure triggers are typically set at -2 cm H_2O but should be avoided if auto-PEEP is suspected.
- In such cases, flow triggers should be used and set at a threshold of 2 L/min

- **SIMV/PSV mode:** When SIMV/PSV mode is selected, the initial settings include the following:

- Pressure support (PS): The pressure support typically ranges from 5 to 15 cm H_2O for spontaneous breaths initiated by the patient above the set rate.

Table 25-2 • Troubleshooting Ventilator Problems

PROBLEM	CAUSE
Ventilator	
Increase in peak airway pressure	Coughing or plugged airway tube
	Patient "bucking" ventilator
	Decreasing lung compliance
	Tubing kinked
	Pneumothorax
	Atelectasis or bronchospasm
Decrease in pressure or loss of volume	Increase in compliance
	Leak in ventilator or tubing; cuff on tube/humidifier not tight
Patient	
Cardiovascular compromise	Decrease in venous return due to application of positive pressure to lungs
Barotrauma/pneumothorax	Application of positive pressure to lungs; high mean airway pressures lead to alveolar rupture
Pulmonary infection	Bypass of normal defense mechanisms; frequent breaks in ventilator circuit; decreased mobility; impaired cough reflex

Troubleshoot

D	**Displacement** of the endotracheal tube
O	**Obstruction** in the airway or tube
P	Pneumothorax
E	Equipment Failure

Thank you