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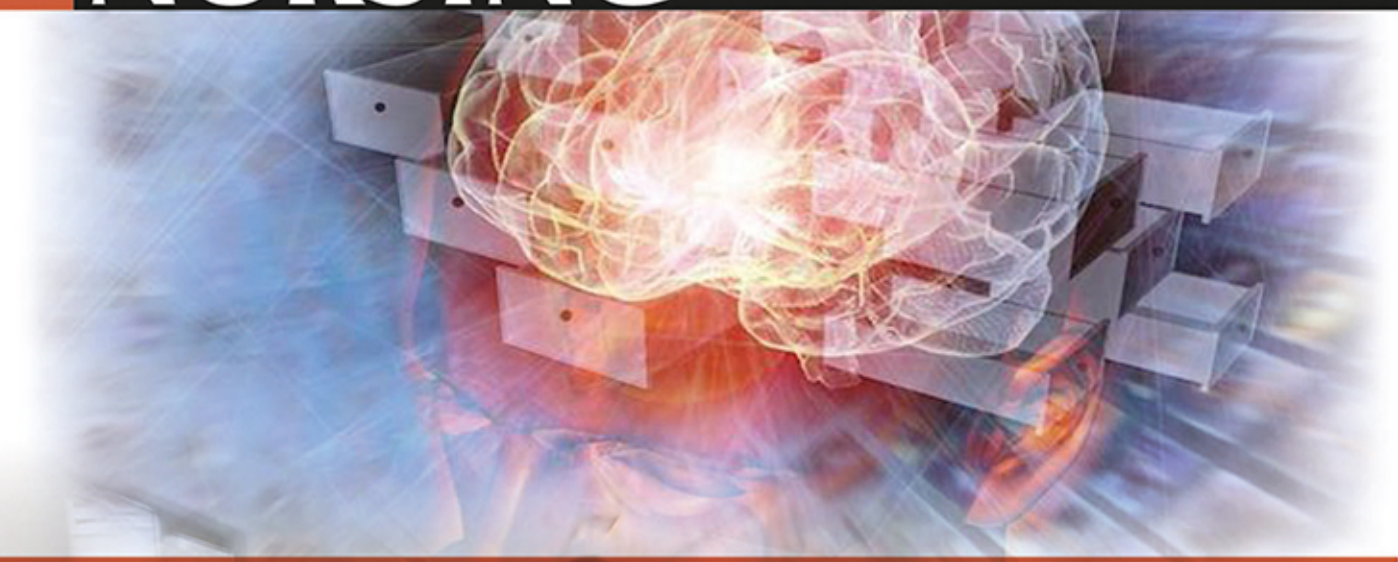
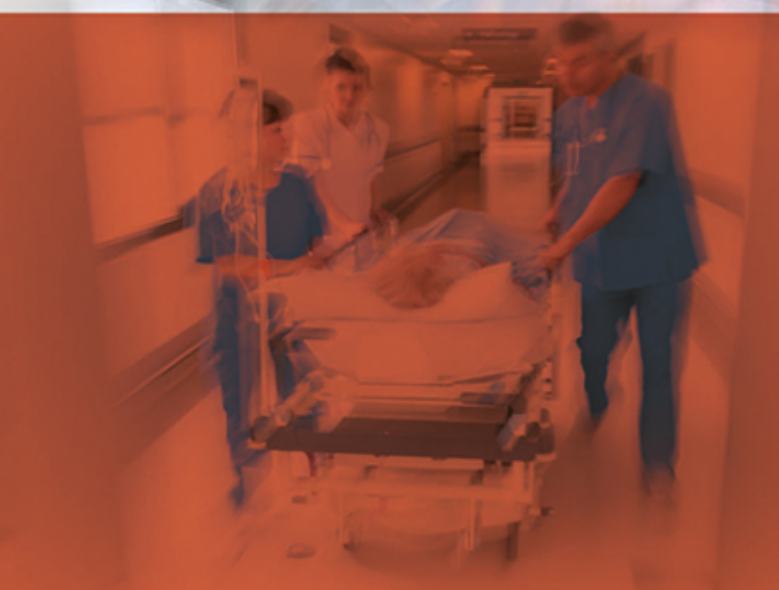
CLINICAL NEUROSCIENCES & CRITICAL CARE NURSING





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3

Setting up of Ventilator, Cardiac Monitor and Infusion Pump

Ms Nadiya Krishnan

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LEARNING OBJECTIVES

At the end of the chapter, the learner will be able to:

- Discuss the indications, different features, special nursing care and potential complications of the use of these equipments
- Demonstrate skill in setting up of ventilator, cardiac monitor and infusion pump.

This chapter has been discussed in three main sections, i.e. Setting up of Ventilator; Setting up of Cardiac Monitor; and Setting up of Infusion pump.

A. SETTING UP OF VENTILATOR

Mechanical ventilation is defined as the use of a mechanical device to assist the respiratory muscles in the work of breathing and to improve gas exchange. Mechanical ventilation is the process by which the fraction of inspired oxygen (FiO_2) at 21% (room air) or greater is moved into and out of lungs by a mechanical ventilator. It is not curative. It is used as a means of supporting patients until they recover the ability to breathe independently.

Indications for mechanical ventilation[1, 2]

Common indications for mechanical ventilation include the following:

- **Respiratory conditions**
  - Bradypnea or apnea with respiratory arrest.
  - Acute lung injury and the acute respiratory distress syndrome.
  - Tachypnea (respiratory rate >30 breaths per minute).
  - Vital capacity less than 15 ml/kg.
  - Minute ventilation greater than 10 L/min
  - Arterial partial pressure of oxygen (PaO_2) with a supplemental fraction of inspired oxygen (FIO_2) of less than 55 mm Hg.

- Acute partial pressure of carbon dioxide ($PaCO_2$) greater than 50 mm Hg with an arterial pH less than 7.25. The trend of these values should influence clinical judgment. Increasing severity of illness should prompt the clinician to consider starting mechanical ventilation.
- Respiratory muscle fatigue/paralysis.

➢ **Cardiac dysfunction**
- In cardiac insufficiency post MI or heart failure to reduce the work of breathing and to reduce oxygen consumption.

➢ **Neuromuscular disease**
- Central hypoventilation/frequent apnea.
- Comatose patient, GCS < 8 (coma), obtundation.

➢ **Others**
- Hypotension
- Clinical deterioration
- Patients are often intubated before they reach the point of respiratory failure. Respiratory distress can be due to inadequate ventilation, oxygenation or a combination thereof. The process can be either intrinsic to the lungs (e.g. pneumonia) or to the chest wall ("pump failure", as in muscular dystrophies).

Nomenclature

Below Table 3.1 are listed some of the most common abbreviations used in ventilators and their definitions[3]

Table 3.1: Common abbreviations used in mechanical ventilation

Abbreviation	Term	Definition
PIP	Peak Inspiratory Pressure	Point of maximal airway pressure
PEEP	Positive End Expiratory Pressure	Pressure maintained in airways at end of exhalation
ΔP	Delta Pressure	Difference between PIP – PEEP*
Vt	Tidal Volume	Volume of gas entering patient's lung during inspiration
It	Inspiratory time	Duration of time in inspiration
Et	Expiratory time	Duration of time in expiration
MAP	Mean Airway Pressure	An average of the airway pressure throughout the respiratory cycle
R	Rate	Respiratory rate as set on the Ventilator

PIP:* *Peak Inspiratory Pressure,* ***PEEP:* *Positive End Expiratory Pressure*

Physiology of normal breath

Figures 3.1 (A and B) and 3.2 describes the normal physiology and phases of respiration

Modes of ventilation[4, 5]

Ventilator mode refers to a combination of control and phase variables, breath patterns and breath types.

1. **Control variables:**
   The control variable in a ventilator is the single independent variable that is fixed during the delivery of the breath. Volume, pressure, flow and time can be control variables depending on the ventilator type. In

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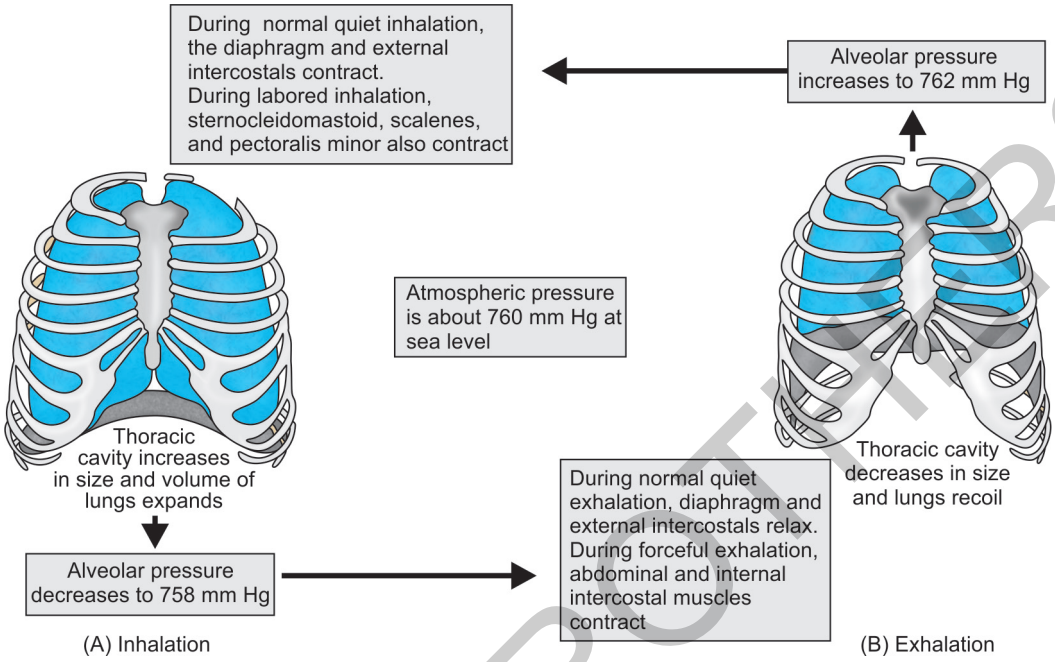

Figs 3.1 (A and B): Mechanism of a normal breath[6]
(Adopted from Tortora GJ, Grabowski Sr. Principles of Anatomy and Physiology 10th ed.)

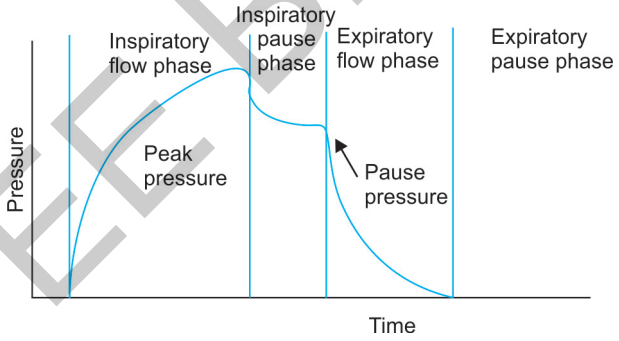

Fig. 3.2: Phases of the respiratory cycle[4]

pressure-controlled ventilation, the lungs are inflated to a preset pressure. The tidal volume (TV) delivered depends on the mechanical properties of the lungs and chest wall; therefore, the pressure will be constant from breath to breath, but the resulting TVs may vary. In volume control, each breath has a preset TV (i.e. volume is the control variable), and inspiratory pressure becomes the dependent variable.

Controlled modes: These deliver pre-set volumes at a pre-set rate and a pre-set flow rate. The patient cannot generate spontaneous breaths, volumes, or flow rates in this mode.

Control modes are used when complete control over the patient's ventilation and/or oxygenation is desired. This is usually because the patient's lung disease is significant enough that maximal support has to be given. A condition in which precise control the $PaCO_2$ is desired, as in hyperventilation for increased intracranial pressure. Patients placed on control modes are often deeply sedated and may be given neuromuscular blockers.

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Assist controlled modes: In most circumstances, the initial mode of ventilation should be the assist-control mode, in which a tidal volume and rate are preset and guaranteed (Fig. 3.3). The patient can affect the frequency and timing of the breaths. If the patient makes an inspiratory effort, the ventilator senses a decrease in the circuit pressure and delivers the preset tidal volume. In this way, the patient can dictate a comfortable respiratory pattern and may trigger additional machine-assisted breaths above the set rate. If the patient does not initiate inspiration, the ventilator automatically delivers the preset rate and tidal volume, ensuring minimum minute ventilation. In the assist-control mode, the work of breathing is reduced to the amount of inspiration needed to trigger the inspiratory cycle of the machine. This trigger is adjusted by setting the sensitivity of the machine to the degree of pressure decrease desired in the circuit.

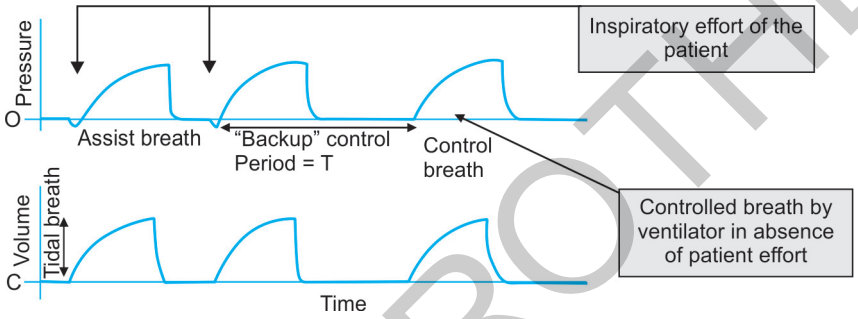

Fig. 3.3: Assist controlled ventilation – volume controlled

In assist control modes (pressure control, volume control), the machine will deliver a full breath whether it is triggered by patient effort (note the negative deflection in the uppermost graph indicating patient effort (Fig. 3.4) or triggered by the machine (the machine will act if a set amount of time (T) elapses without discernible patient effort).

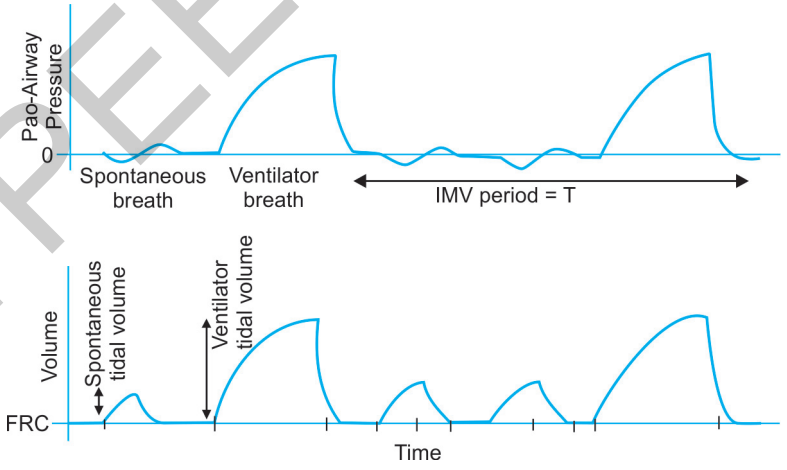

Fig. 3.4: ACV, volume limited. The spontaneous breath of the patient varies in volume (note first, third and fourth breath) but all the ventilator breaths are of the same volume (second and fifth breath)

(ACV: Assist Control Ventilation; IMV: Intermittent Mandatory Ventilation; FRC: Functional Residual Capacity)

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Assist-control differs from controlled ventilation because the patient can trigger the ventilator to deliver a breath and, thereby, adjust their minute ventilation. In controlled ventilation, the patient receives only breaths initiated by the ventilator at the preset rate.

Advantages of ACV: In ACV, the work of breathing is not eliminated but, this mode gives the respiratory muscles the greatest amount of rest because the patient needs only to create enough negative pressure to trigger the machine. An added advantage is that the patient can achieve the required minute ventilation by triggering additional breaths above the set back-up rate.

A second possible advantage of this mode of mechanical ventilation is that cycling the ventilator into the inspiratory phase maintains normal ventilatory activity and, therefore, prevents atrophy of the respiratory muscles.

Disadvantages of ACV: A potential disadvantage of the assist-control mode is respiratory alkalosis. This is a possibility in patients whose respiratory drive supersedes the regulation by chemoreceptors and mechanical receptors. Patients with a potential for alveolar hyperventilation and hypocapnia in the assist-control mode include those with end-stage liver disease, those in the hyperventilatory stage of sepsis, and those with head trauma.

Another possible disadvantage is the potential for serial preset positive-pressure breathes to retard venous return to the right side of heart and to affect global cardiac output.

2. Phase variables

The various phases of the respiratory cycle can be controlled by the machine.

The trigger variable: It initiates inspiration. Ventilators can be triggered by changes in pressure, flow, or volume, which can be preset by the operator. When a patient is not triggering breaths, the ventilator initiates inspiration based on a time period dictated by the preset respiratory rate. The trigger variable allows the ventilator to respond to a patient's ventilator effort and is also known as *ventilator sensitivity*. If the trigger variable is too sensitive, breaths may be inadvertently triggered by non-respiratory movements such as patient handling or trembling, thereby creating patient distress and increasing patient–ventilator asynchrony.

An insensitive setting of the trigger variable prevents the ventilator from recognizing a patient's attempt to breathe. An increase in the respiratory rate is one of the ways that a patient on Positive Pressure Ventilation (PPV) is able to respond to life-threatening abnormalities such as hypoxemia or hypercapnia. Therefore, the trigger variable should always be set so that the ventilator can recognize genuine patient ventilator effort.

The cycle variable: It is the value that is set to terminate inspiration. Breaths can be time, flow, pressure, or volume cycled. Once the selected preset value is reached, the breath is terminated. A breath can have only a single cycle variable. This variable is set by the operator or predetermined by the machine, depending on the type of ventilator used.

3. **Breath type:** A ventilator breath can be either mandatory or spontaneous. A **mandatory** breath is initiated and or terminated by the machine. Mandatory breath initiated by the patient can be further classified as **assisted ventilation**. A **spontaneous breath** must be both initiated and terminated by the patient. Spontaneous breaths in which the inspiration is augmented by the ventilator are considered **supported ventilation**. Assist controlled ventilation (ACV) refers to ventilator settings that allows patients to initiate their own breath (assisted), but the breath is still generated and terminated by the machine (mandatory breaths).

4. **Breath patterns:**

Ventilators can deliver three primary breath patterns

a. **Continuous mandatory ventilation:** all breaths are mandatory

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b. **Intermittent mandatory ventilation (IMV):** It combines mandatory breaths with spontaneous breathing. Synchronized Intermittent Mandatory Ventilation (SIMV) (Fig. 3.5) is a variation of IMV in which the ventilator attempts to coordinate mandatory breaths with patient efforts. This mode can be beneficial in weaning patients off the ventilator because the number of mandatory breaths can be gradually reduced, allowing patients to slowly take over the work of breathing.

Synchronized Intermittent Mandatory Ventilation (SIMV): SIMV modes are chosen when one want the patient to do as much work as they can tolerate and try to minimize the support from the ventilator. SIMV modes are used to wean patients; as the set rate is decreased, the patient will need to do more on their own to maintain normal blood gases.

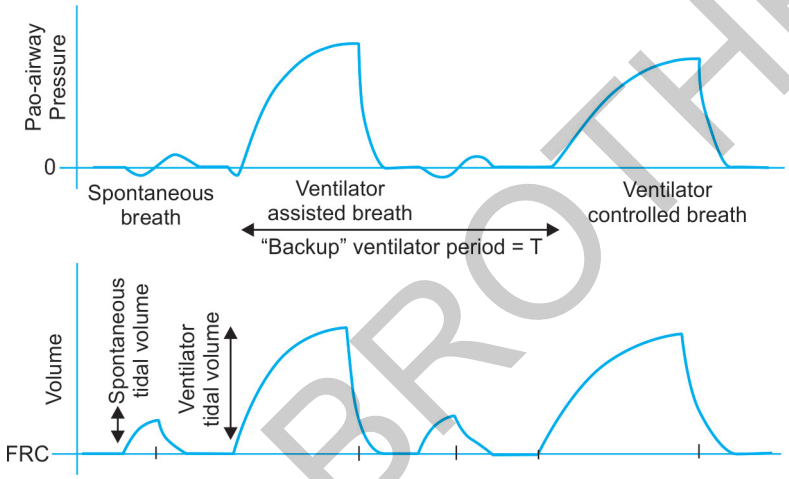

Fig. 3.5: Synchronized intermittent mandatory ventilation

c. **Continuous spontaneous ventilation:** All breaths are spontaneous. This mode is used in patients with a normal ventilatory drive.

Pressure support: Augmentation of spontaneous breaths with increased airway pressure during inspiration. Pressure support can be helpful in offsetting resistance associated with the ventilator tubing, humidifier, and machine valves in spontaneously breathing patients. It is recommended to set this value at 6 to 8 cm H_2O to overcome this increase in resistance.

Continuos Positive Airway Pressure (CPAP): Another approach to aid patients on continuous spontaneous ventilation is to provide an elevated baseline airway pressure throughout inspiration and exhalation. This baseline pressure is known as *continuous positive airway pressure* (CPAP) and helps prevent atelectasis, thereby promoting better gas exchange. CPAP is also a helpful breath pattern to use when weaning patients from mechanical ventilation. It is often used as an intermediate step between SIMV and complete removal of ventilator support.

Classifications of Positive-Pressure Ventilators

Ventilators can be classified by their method of cycling from the inspiratory phase to the expiratory phase into volume cycled ventilator, pressure cycled ventilator or a time cycled ventilator. That is, they are named after the parameter that signals the termination of the positive-pressure inspiration cycle of the machine. The signal

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to terminate the inspiratory activity of the machine is either a preset volume (for a volume-cycled ventilator), a preset pressure limit (for a pressure-cycled ventilator), or a preset time factor (for a time-cycled ventilator).

Ventilators deliver gas to the lungs using positive pressure at a certain *rate*. The amount of gas delivered can be *limited* by time, pressure or volume. The duration can be *cycled* by time, pressure or flow. If volume is set, pressure varies…..if pressure is set, volume varies….. ….according to the compliance…...(Fig. 3.6)

COMPLIANCE = ∆ VOLUME/∆ PRESSURE

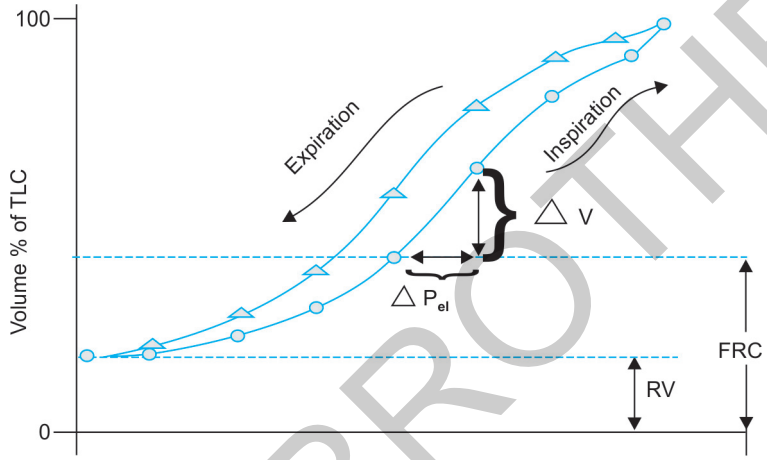

Fig. 3.6: Compliance[7]

TLC: Total lung capacity

RV: Reserved volume

∆V = Change in volume

∆P = Change in pressure FRC: Functional residual capacity

Volume-cycled ventilation is the most common form of ventilator cycling used in adult medicine because it provides a consistent breath-to-breath tidal volume. Termination of the delivered breath is signalled when a set volume leaves the ventilator.

Initial Ventilator Settings[8-10]

Tidal volume and rate

For a patient without preexisting lung disease, the tidal volume and rate are traditionally selected by using the 12-12 rule. A tidal volume of 12 mL for each kilogram of lean body weight is programmed to be delivered 12 times a minute in the assist-control mode.

For patients with chronic obstructive pulmonary disease (COPD), the tidal volume and rate are slightly reduced to the 10-10 rule to prevent overinflation and hyperventilation. A tidal volume of 10 mL/kg lean body weight is delivered 10 times a minute in the assist-control mode.

In acute respiratory distress syndrome (ARDS), the lungs may function best and volutrauma is minimized with low tidal volumes of 6-8 mL/kg. Tidal volumes are preset at 6-8 mL/kg of lean body weight in the assist-

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control mode. This ventilatory strategy is called **lung-protective ventilation**. These lowered volumes may lead to slight hypercardia. An elevated PCO_2 is typically recognized and accepted without correction, leading to the term **permissive hypercapnia**. However, the degree of respiratory acidosis allowable is a pH not less than 7.25. The respiratory rate of the ventilator may need to be adjusted upward to increase the minute ventilation lost by using smaller tidal volumes.

Double-checking the selected tidal volume

After a tidal volume is selected, the peak airway pressure necessary to deliver a single breath should be determined. As the tidal volume increases, so does the pressure required to force that volume into the lung. Persistent breath-to-breath peak pressures greater than 45 cm water are a risk factor for barotrauma (see Complications of Mechanical Ventilation). The tidal volume suggested by the above rules may need to be decreased in some patients to keep the peak airway pressure less than 45 cm water.

Sighs

Because a spontaneously breathing individual typically sighs 6-8 times each hour to prevent microatelectasis, some investigators once recommended that periodic machine breaths that were 1.5-2 times the preset tidal volume be given 6-8 times per hour. However, the peak pressure often needed to deliver such a volume was high enough to predispose the patient to barotrauma. At present, accounting for sighs is not recommended if the patient is receiving tidal volumes of 10-12 mL/kg or if the patient requires positive end-expiratory pressure (PEEP). When a low tidal volume is used, sighs are preset at 1.5-2 times the tidal volume and delivered 6-8 times an hour if the peak and plateau pressures are within acceptable limits.

Initial FIO_2

The highest priority at the start of mechanical ventilation is providing effective oxygenation. For the patient's safety after intubation, the FIO_2 should always be set at 100% until adequate arterial oxygenation is documented. A short period with an FIO_2 of 100% is not dangerous to the patient receiving mechanical ventilation and offers several advantages. First, an FIO_2 of 100% protects the patient against hypoxemia if unrecognized problems occur as a result of the intubation procedure. Second, using the PaO_2 measured with an FIO_2 of 100%, the clinician can easily calculate the next desired FIO_2 and quickly estimate the shunt fraction.

The degree of shunt with 100% FIO_2 can be estimated by applying this general rule: The measured PaO_2 is subtracted from 700 mm Hg. For each difference of 100 mm Hg, the shunt is 5%. A shunt of 25% should prompt the clinician to consider the use of PEEP.

Inadequate oxygenation despite the administration of 100% oxygen should lead to a search for complications of endotracheal intubation (e.g. mainstem intubation) or positive-pressure breathing (pneumothorax). If such complications are not present, PEEP is needed to treat the intrapulmonary shunt pathology. Because only a few disease processes can create an intrapulmonary shunt, a clinically significant estimated shunt should narrow the potential source of hypoxemia to the following conditions:

- Alveolar collapse – Major atelectasis
- Alveolar filling with something other than gas – Lobar pneumonia
- Water and protein – ARDS
- Water – Congestive heart failure
- Blood – Hemorrhage

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Pressure settings

Peak inspiratory pressure (PIP): It is the highest proximal airway pressure achieved during inspiration

Positive End Expiratory Pressure (PEEP)[9-11]

PEEP (Fig. 3.7) is a mode of therapy used in conjunction with mechanical ventilation. At the end of mechanical or spontaneous exhalation, PEEP maintains the patient's airway pressure above the atmospheric level by exerting pressure that opposes passive emptying of the lung. This pressure is typically achieved by maintaining a positive pressure flow at the end of exhalation. This pressure is measured in centimeters of water. This pressure prevents the exhalation of the entire TV, helping to prevent atelectasis and keeping more alveoli open for effective gas exchange.

Applying PEEP increases alveolar pressure and alveolar volume. The increased lung volume increases the surface area by reopening and stabilizing collapsed or unstable alveoli. This splinting, or propping open, of the alveoli with positive pressure improves the ventilation-perfusion match, reducing the shunt effect.

After a true shunt is modified to a ventilation-perfusion mismatch with PEEP, lowered concentrations of oxygen can be used to maintain an adequate PaO_2. PEEP therapy may also be effective in improving lung compliance. When used to treat patients with a diffuse lung disease, PEEP should improve compliance, decrease dead space, and decrease the intrapulmonary shunt effect. The most important benefit of the use of PEEP is that it enables the patient to maintain an adequate PaO_2 at a low and safe concentration of oxygen (< 60%), reducing the risk of oxygen toxicity.

The use of PEEP is with its share of hemodynamic (e.g. ↓ cardiac output) complications. Therefore there should be proper indication for its use. The addition of external PEEP is typically justified when a PaO_2 of 60 mm Hg cannot be achieved with an FIO_2 of 60%.

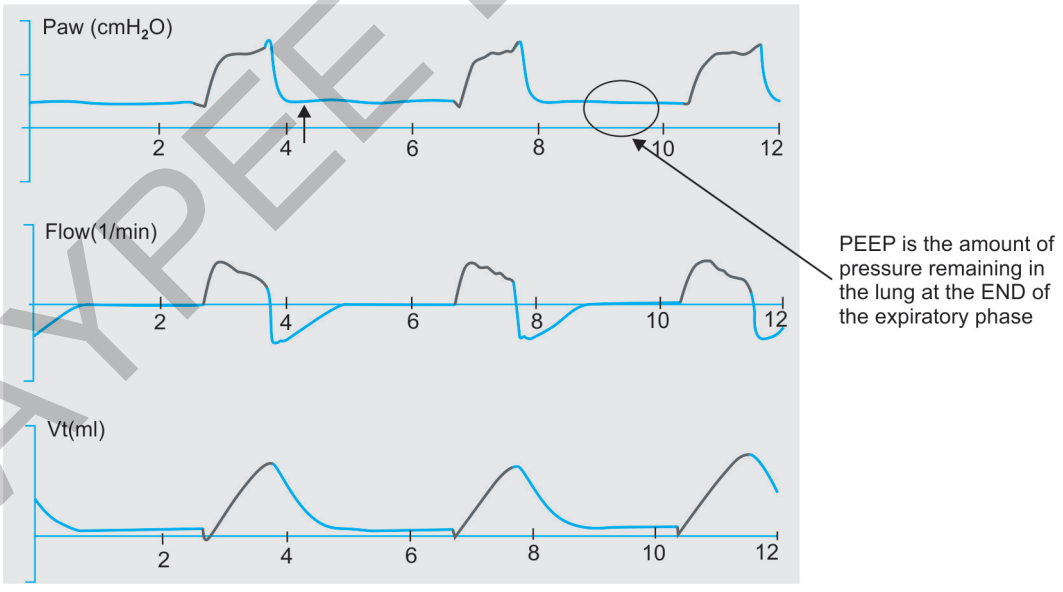

Fig. 3.7: Positive end expiratory pressure

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Intrinsic or auto PEEP is a phenomenon resulting from ventilator modes that do not allow the patient to complete an exhalation before the next inspiration begins. This creates an elevated expiratory airway pressure similar to PEEP. Intrinsic PEEP is dangerously as it develops insidiously and cannot be controlled directly.

Summary of initial ventilator setup[10]

Initial settings for ventilation may be summarized as follows:

- Assist-control mode
- Tidal volume set depending on lung status - Normal = 12 mL/kg ideal body weight; COPD = 10 mL/kg ideal body weight; ARDS = 6-8 mL/kg ideal body weight
- Rate of 10-12 breaths per minute
- FiO_2 of 100%
- Sighs rarely needed
- PEEP only as indicated after first arterial blood gas determination, i.e. shunt greater than 25%
- Inability to oxygenate with an FiO_2 less than 60%

Weaning from ventilator[4, 12]

Numerous weaning parameters can be used to help predict successful extubation. However, no weaning protocol is 100% accurate in predicting successful weaning and extubation. These weaning parameters must be tailored for each clinical scenario.

The following questions are usually asked before weaning is initiated.

Before the initiation of weaning the patient must demonstrate an ability to maintain adequate respiratory function without high levels of PEEP or PIP. Patients with neuromuscular disease must have a strong respiratory drive and thoracic wall function sufficient to generate an acceptable TV.

- Is the process responsible for the patient's respiratory failure resolving or improving?
- Is the patient hemodynamically stable? Is the patient free of active cardiac ischemia or unstable arrhythmias, and vasopressor support absent or minimal?
- Is oxygenation adequate with a PaO_2 of greater than 60 mm Hg with FiO_2 of less than 60% and a PEEP of less than 5 cm water? Efforts are made to further reduce the FiO_2 but it is not essential as patients can be maintained on supplemental O_2 without PPV.
- Are mental and neuromuscular statuses appropriate with the patient on minimal or no sedation? Does the patient have adequate strength of the respiratory muscles?
- Are the acid-base status and electrolyte status optimized?
- Is the patient afebrile?
- Are the patient's adrenal and thyroid functions adequate to allow for weaning?

Complications associated with mechanical ventilation[1, 4, 8]

Complications of intubation

Complications that can occur during placement of an endotracheal tube include upper airway and nasal trauma, tooth avulsion, oral-pharyngeal laceration, laceration or hematoma of the vocal cords, tracheal laceration, perforation, hypoxemia, and intubation of the esophagus. Inadvertent intubation of the right main stem bronchus is reported in 3-9% of all intubations in adults. Aspiration rates are 8-19% in intubations performed in adults without anesthesia. Sinusitis, tracheal necrosis or stenosis, glottic edema, and ventilator-associated pneumonia may occur with prolonged use of endotracheal tubes.

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Ventilator-induced lung injury

With ventilator-induced lung injury, the alveolar epithelium is at risk for both barotrauma and volutrauma.

Barotrauma

Barotrauma refers to rupture of the alveolus with subsequent entry of air into the pleural space (pneumothorax) and/or the tracking or air along the vascular bundle to the mediastinum (pneumomediastinum). The true prevalence of barotrauma is difficult to establish, but reports suggest a rate of 6-25%. Large tidal volumes and elevated peak inspiratory and plateau pressures are risk factors even so, peak inspiratory pressures of less than 45 mm Hg and plateau pressures of less than 30-35 mm Hg are recommended.

Attention to the inspiratory-to-expiratory ratio is important to prevent barotrauma in patients with obstructive airway disease (e.g. asthma and chronic obstructive pulmonary disease).

Volutrauma

Volutrauma refers to the local overdistention of normal alveoli. Volutrauma has gained recognition over the last 2 decades and is the impetus for the lung protection ventilation with lower tidal volumes of 6–8 mL/kg. Computed tomography scans have demonstrated that ARDS has a heterogeneous pattern of lung involvement. Abnormal consolidated lung is dispersed within normal lung tissue. When a mechanical ventilation breath is forced into the patient, the positive pressure tends to follow the path of least resistance to the normal or relatively normal alveoli, potentially causing overdistention. This overdistention sets off an inflammatory cascade that augments or perpetuates the initial lung injury, causing additional damage to previously unaffected alveoli. The increased local inflammation lowers the patient's potential to recover from ARDS. The inflammatory cascade occurs locally and may augment the systemic inflammatory response as well.

Since volutrauma was recognized, lung-protective ventilation strategy is recommended in all patients with ARDS or acute lung injury.

Oxygen toxicity

Oxygen toxicity is a function of increased FiO_2 and its duration of use. Oxygen toxicity is due to the production of oxygen free radicals, such as superoxide anion, hydroxyl radical, and hydrogen peroxide. Oxygen toxicity can cause a variety of complications ranging from mild tracheobronchitis and absorptive atelectasis to diffuse alveolar damage that is indistinguishable from ARDS.

The clinician is encouraged to use the lowest FiO_2 that accomplishes satisfactory oxygenation.

Ventilator-associated pneumonia

Ventilator-associated pneumonia (VAP) is a life-threatening complication with mortality rates of 33-50%. It is reported to occur in 10-25% of patients given mechanical ventilation. The risk of VAP is highest immediately after intubation. VAP is estimated to occur at a rate of 3% per day for the first 5 days, 2% per day for next 5 days, and 1% per day thereafter. VAP occurs more frequently in trauma, neurosurgical, or burn units than in respiratory units and medical intensive care units.

VAP is defined as a new infection of the lung parenchyma that develops within 48 hours after intubation. The diagnosis can be challenging. VAP should be suspected when a new or changing pulmonary infiltrate in seen in conjunction with fever, leukocytosis, and purulent tracheobronchial secretions.

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Microorganisms implicated in VAP are *Haemophilus influenza, Streptococcus pneumonia*. Gram-negative bacilli such as *Pseudomonas aeruginosa; Escherichia coli*; and *Acinetobacter, Proteus*, and *Klebsiella* species predominate. *Staphylococcus aureus*, especially methicillin-resistant *S aureus*(MRSA), typically becomes a major infective agent after 7 days of intubation and mechanical ventilation.

Intrinsic PEEP, or auto-PEEP

Intrinsic positive end-expiratory pressure (PEEP) or auto-PEEP is a complication of mechanical ventilation that most frequently occurs in patients with COPD or asthma who require prolonged expiratory phase of respiration. These patients may have difficulty in totally exhaling the ventilator-delivered tidal volume before the next machine breath is delivered. When this problem occurs, a portion of each subsequent tidal volume may be retained in the patient's lungs, a phenomenon sometimes referred to as breath stacking. If this goes unrecognized, the patient's peak airway pressure may increase to a level that results in barotrauma, volutrauma, hypotension, patient-ventilator dyssynchrony, or death.

Cardiovascular effects

Mechanical ventilation always has some effect on the cardiovascular system. Positive-pressure ventilation can decrease preload, stroke volume, and cardiac output. Positive-pressure ventilation also affects renal blood flow and function, resulting in gradual fluid retention. The incidence of stress ulcers and sedation-related ileus is increased when patients receive mechanical ventilation. In fact, mechanical ventilation is a primary indication for GI prophylaxis. Positive pressure maintained in the chest may decrease venous return from the head, increasing intracranial pressure and worsening agitation, delirium, and sleep deprivation.

Steps of setting up ventilator[13, 14]

Here the set-up of the ventilator is explained by using bird ventilator.
Every ventilator set-up involves the following:

- Control Panel (Fig. 3.8)
- Ventilator Set-up (Fig. 3.8, Fig. 3.10)
- Setting Modes
- Ventilation Parameters
- Setting Alarms
- Wave Forms
- Special Functions

Steps for setting up ventilator

After turning the power ON:

- Connect to power source and turn on.
- Power source LED illuminates (if not plugged in will run off internal battery)
- Begins operation with last used settings.
- Press MONITOR SELECT to clear display. Vent then displays the current Apnea Interval settings.
- Pressing MS again displays current Bias Flow
- Press MONITOR SELECT again to display tests
- Five tests appear in order as the CONTROL KNOB see Fig. 3.9 (A) is rotated: alarm, lamp, switch, filter, leak, and exit.

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CLINICAL NEUROSCIENCES & CRITICAL CARE NURSING

This book is an excellent overview of the care and management of critically ill patients. The book has been written for the nursing faculty, the post graduate and undergraduate nursing students and the nurses working in the intensive care setups. Nurses working in other bedside areas will find this book to be equally useful. The contributors to the book are the eminent nursing and medical faculty from all over India. The book provides comprehensive and in-depth coverage of caring for a critically ill patient along with appropriate illustrations. Several new topics such as nursing management of brain dead organ donors, Care of the patients admitted in ICU, Standard safety measures, Role of Nurse in Acute Stroke Management, and Transfer of a critically ill patient etc. have been covered in the book. It has the material and knowledge to become the preferred reference for state of art nursing practice. Authors' own professional experience and the addition of evidences from other research studies regarding the topics under discussion make the current book different.



Sukhpal Kaur is currently working as a lecturer at the National Institute of Nursing Education, PGIMER, Chandigarh. She is member of 17 national scientific bodies. She has presented a number of papers and is the invited guest faculty at many National and International conferences. She has more than seventy publications in reputed journals and also authored many chapters in various books. She is a member of editorial board of the 'Journal of Postgraduate Medicine, Education and Research' and 'International Journal of Nursing Education' and is the regular reviewer in 'International Journal of Nursing Studies'. She is the former secretary and present vice president of Nursing Research Forum, NINE, PGIMER, Chandigarh. She has keen interest in critical care, neurosciences, elderly and palliative care. She has a large number of research projects funded from Institute research scheme, ICMR, DST, and DBT.

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