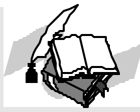
OXYLOG 2000

LEARNING PACKAGE

1. INTRODUCTION

This package is aimed at increasing your knowledge in the use of the oxylog 2000 mechanical ventilator.
It is essential that you have completed the respiratory physiology learning package or have a good understanding of it before you start this package.


Activity: Before you start reading, write your own definitions for:

- Work of breathing
- Respiratory resistance
- Respiratory compliance
- Functional residual capacity

2. INTRODUCTION TO MECHANICAL VENTILATION:

Despite the method by which mechanical ventilation is applied the primary factors to consider when applying mechanical ventilation are:

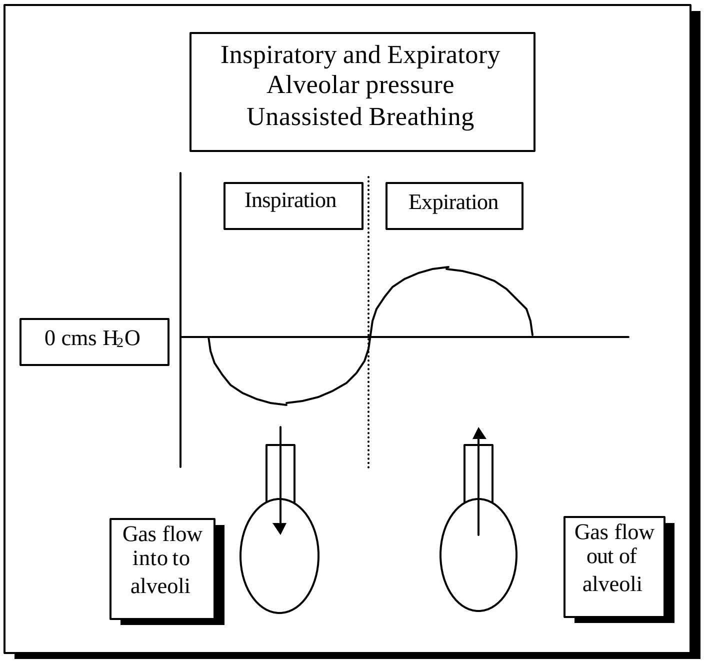
- the components of each individual breath, specifically whether pressure, flow, volume and time are set by the operator, variable or dependent on other parameters
- the method of triggering the mechanical ventilator breath/gas flow,
- potential complications of mechanical ventilation and methods to reduce ventilator induced lung injury
- methods to improve patient ventilator synchrony; and
- the nursing observations required to provide a safe and effective level of care for the patient receiving mechanical ventilation

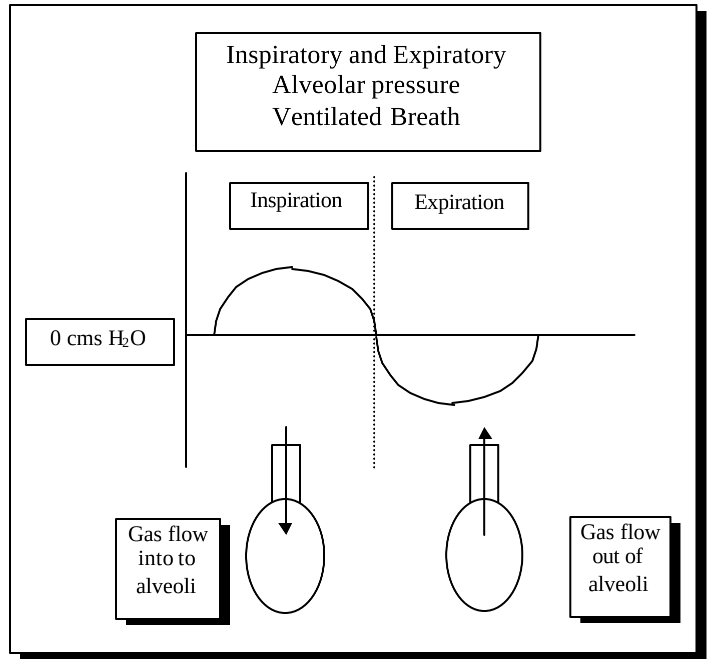
The following sections will provide an overview of each of the above considerations. This section - an introduction to mechanical ventilation will provide a rather detailed overview of four key parameters that are necessary to consider when evaluating and classifying ventilator delivered breaths. These parameters are

- pressure,
- volume,
- flow and
- time.

2.1 Airway Pressures (Paw)

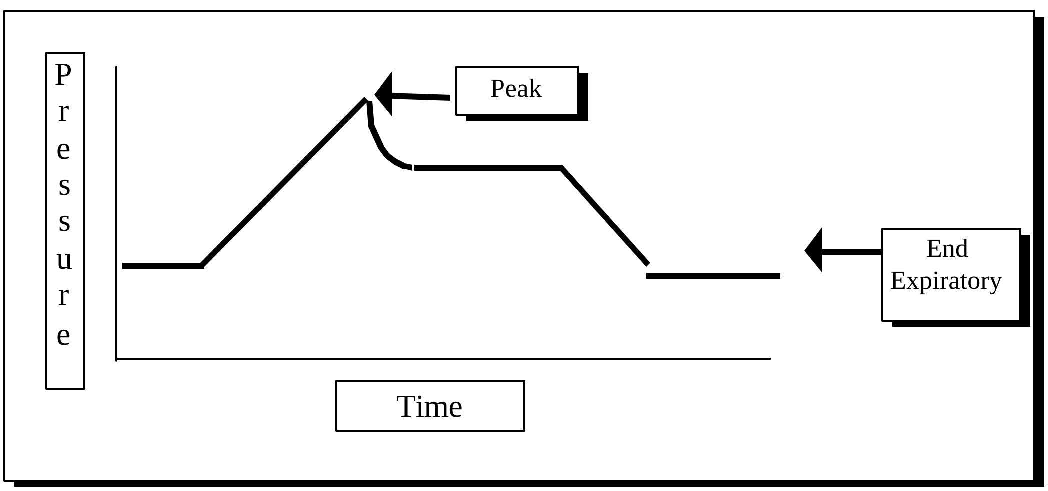
For gas to flow to occur there must be a positive pressure gradient. In spontaneous respiration gas flow occurs due to the generation of a negative pressure in the alveoli relative to atmospheric or circuit pressure (as in CPAP) (refer to following diagram).





Mechanical ventilation delivers flow and volume to the patient's as a result of the development of a positive pressure gradient between the ventilator circuit and the patient's alveoli as illustrated in the diagram above. **There are two pressures to be aware of in regards to mechanical ventilation. These are the:**

1. **Peak**
2. **End expiratory pressures.**

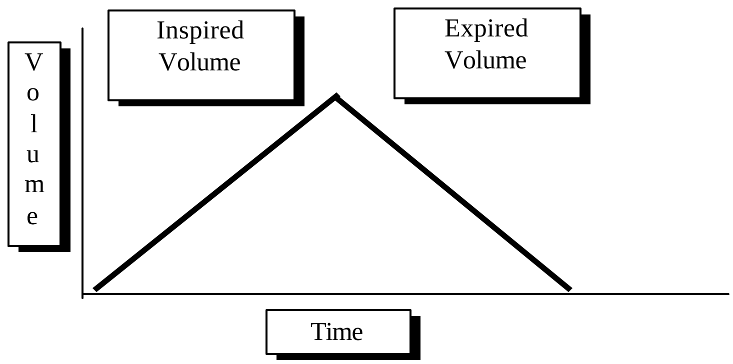


2.1.1 Definitions

- **Peak Inspiratory Pressure (PIP).** The peak pressure is the maximum pressure obtainable during active gas delivery.
- **End Expiratory Pressure.** End expiratory pressure is the airway pressure at the termination of the expiratory phase and is normally equal to atmospheric or the applied PEEP level. [1,2,3]

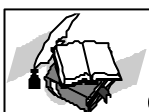
2.2 Volume (VT)

Tidal volume refers to the size of the breath that is delivered to the patient. Normal physiological tidal volumes are approximately 5-7 mls / kg whereas the traditional aim for mechanical ventilator tidal volumes has been approximately 10 mls / kg. The rationale for increasing the size of the tidal volume in ventilated patients has been to prevent atelectasis and overcome the deadspace of the ventilator circuitry and endotracheal tube. Inspired and expired tidal volumes are plotted on the y axis against time as depicted in the following diagram.



The inspired and expired tidal volumes should generally correlate although certain circumstances may cause a difference between inspired and expired tidal volumes. Expired tidal volumes may be less than inspired tidal volumes if:

- there is a leak in the ventilator circuit - causing some of the gas delivered to the patient to leak into the atmosphere
- there is a leak around the endotracheal / tracheostomy tube - due to tube position, inadequate seal or cuff leak - causing some of the gas delivered to the patient to leak into the atmosphere
- there is a leak from the patient, such as a bronchopleural fistula - causing some of the gas delivered to the patient to leak into the atmosphere



Question: your patient weights 85kg what would be your set TV for this patient

2.3 Flow (V)

Flow rate refers to the speed at which a volume of gas is delivered, or exhaled, per unit of time. Flow is described in litres per minute (lpm). [1] The peak (inspiratory) flow rate is therefore the maximum flow delivered to a patient per ventilator breath.

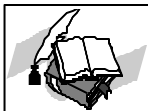
2.4 Time (Ti)

Time in mechanical ventilation is divided between inspiratory and expiratory time.

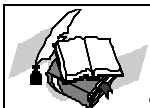
Normal inspiratory time on the spontaneously breathing healthy adult is approximately 0.8 - 1.2 seconds, with an inspiratory expiratory (I:E) ratio of 1:1.5 to 1:2 [2]. At times it may be advantageous to extend the inspiratory time in order to:

- improve oxygenation - through the addition of an inspiratory pause; or to
- increase tidal volume - in pressure controlled ventilation

Adverse effects of excessively long inspiratory times are haemodynamic compromise, patient ventilator dysynchrony, and the development of auto PEEP.
The Oxylog 2000 has a range of I:E times from 1:3 to 2:1, however if the ventilator is in SIMV mode the inspiratory time is set at 1.3 sec thus the I:E ratio is fixed.



Question . What are the factors to consider when prolonging inspiratory time beyond normal parameters?



Question . On the oxylog 2000 what is the inspiratory time set at if the patient is in has a freq of 10 on SIMV mode.

2.5 Guidelines for Setting and Monitoring Ventilation Settings

The previous sections have provided an overview of pressure, flow, volume and time. While there are many methods by which mechanical ventilation could be applied the following guidelines should assist you in providing a safe and effective level of care for your assigned patients, regardless of what type of ventilation is implemented.

Pressure:

Peak. While recognising that the causes of ventilator induced lung injury are multifactorial increased intrathoracic pressures have been identified as a potential mechanism of inducing lung injury. It is generally accepted that the peak pressure should not exceed 40 mbar.

End Expiratory Pressure. PEEP and CPAP improve oxygenation through their ability to increase functional residual capacity. PEEP and CPAP may not only be of benefit in increasing the level of oxygenation but may also be useful in the recruitment of alveoli, reduction of work of breathing and the prevention of acute lung injury. Both PEEP and CPAP however may cause a decrease in cardiac output, fluid retention, and increase the risk of the development of extra pulmonary air (eg pneumothorax).

The oxylog 2000 is fitted with a low pressure alarm to assist with the identification of system faults or circuit leakages. If the pressure in the circuits fails to reach at least 10 mbar during inspiration the ventilator will alarm

Volume. The size of the tidal volume to be delivered is generally set at 10 mls/kg

Flow. The peak inspiratory flow rate should be set to match the patient's inspiratory flow requirements. Where flow does not meet this requirement the patients work of breathing may be unnecessarily increased. On the oxylog ventilators the flow is set by the machine and cannot be adjusted.

2.6 Triggering

Triggering refers to the mechanism through which the ventilator senses inspiratory effort and delivers gas flow or a machine breath in concert with the patient's inspiratory effort. The Oxylog 200 is a in flow triggered ventilator. This means that the ventilator senses a drop in flow through the circuit as a result of a patient respiratory effort as being the trigger for delivering a breath. In SIMV mode if the ventilators demand valve senses a drop of flow > 4L/min or –1m mbar it is taken to be indicative of respiratory effort and a breath is delivered.

2.7 Volume Cycled Ventilation

Volume cycled ventilation delivers a:

- set **volume;**
- with a variable **Pressure** - determined by resistance, compliance, inspiratory effort;
- **flow;** determined by set volume and inspiratory time and and
- **set inspiratory time**.

2.8 Inspiratory Pressures

Because pressure is the variable parameter in volume cycled ventilation it is critical to observe the patients inspiratory pressures and act appropriately in response to increased inspiratory pressures.
In volume cycled ventilation the inspiratory pressures vary in response

- to the size of the breath delivered to the patient;
- the resistance of the endotracheal / tracheostomy tube;
- the resistance of the upper airways;
- the patients compliance; and
- inspiratory effort.

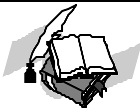
2.9 Advantages and Disadvantages of Volume Cycled Ventilation

Advantages:

Ease of Use. Due to the widespread implementation of volume cycled ventilation it is a type of ventilation that is familiar to many clinicians.

Set Volumes: One of the major advantages of volume cycled ventilation is the ability to set a tidal volume.

Disadvantages
The major disadvantage of volume cycled ventilation is the variable pressure. It is therefore a necessary part of nursing practice to closely monitor the patient's inspiratory pressure.



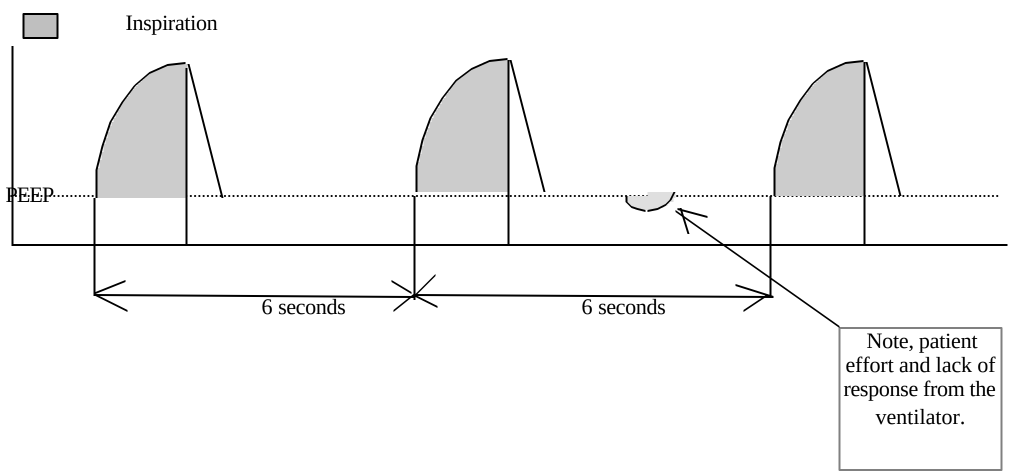
Question6). What are the factors could cause the:

- high inspiratory pressure alarm;
- low inspiratory pressure alarm;

to be activated in volume cycled ventilation. Describe appropriate action to be taken in order to rectify the problem.

2.10 Controlled Mandatory Ventilation (CMV,IPPV)

In this mode of ventilation the operator sets a rate to a predetermined pressure, volume or time limit and the patient receives this breath in a in a set time interval. For example if the patient is on a rate of 10, then they will receive a breath every 6 seconds, regardless of there inspiratory effort (see following diagram). In this mode there are no spontaneous or assisted breaths.

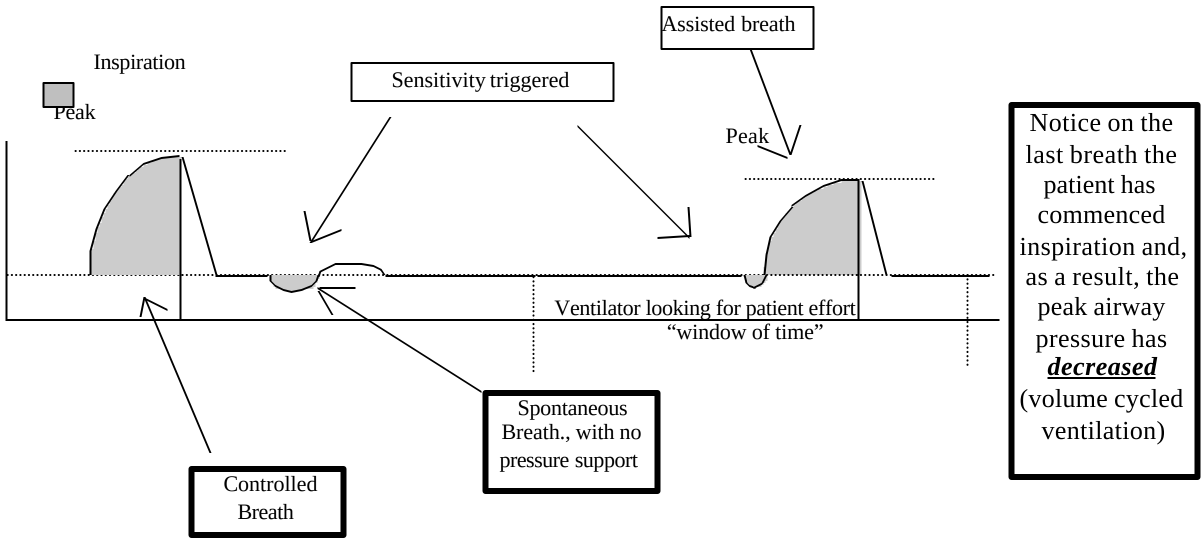


2.11 Intermittent Mandatory Ventilation (IMV/ Synchronised Intermittent Mandatory Ventilation (SIMV).

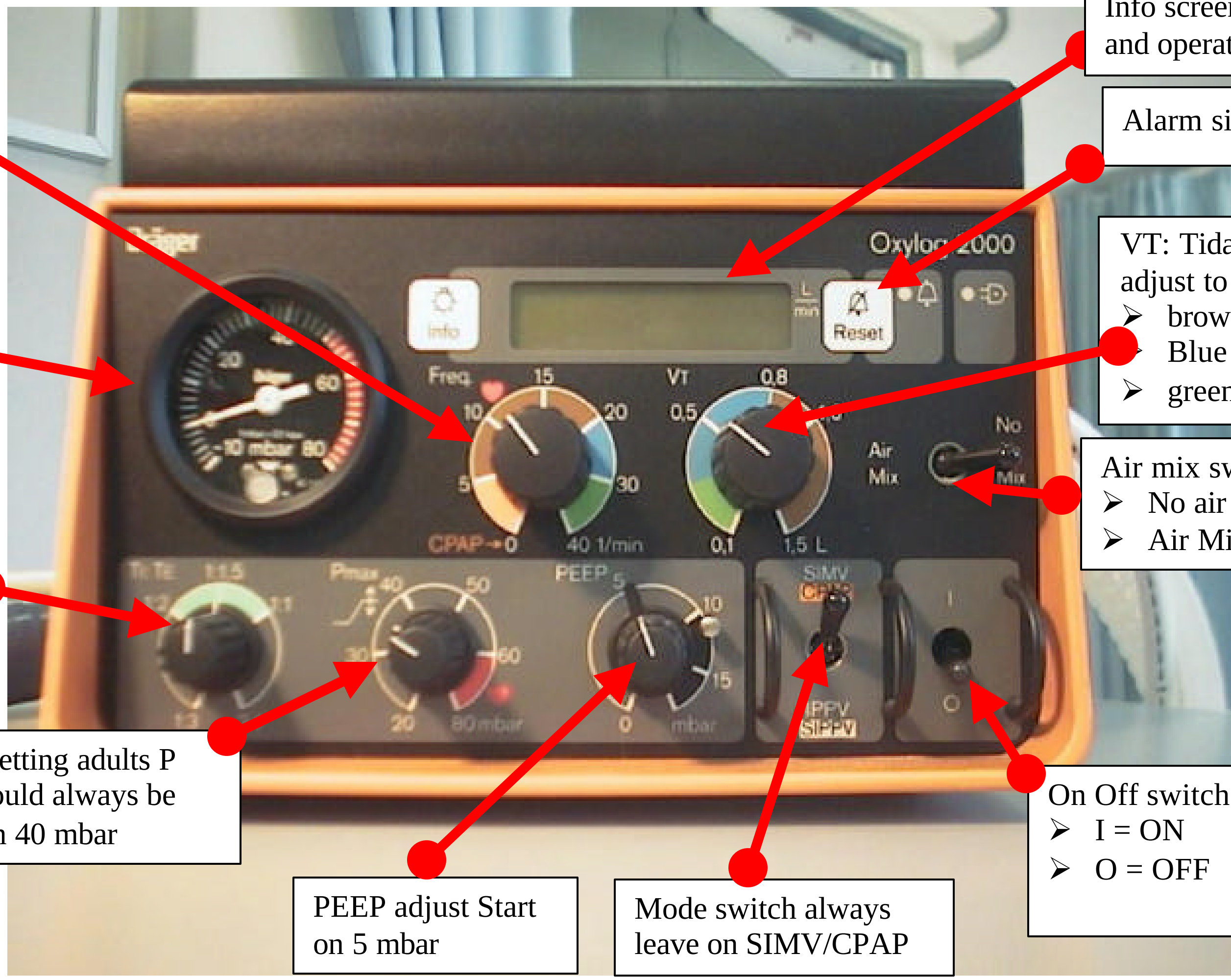
Intermittent mandatory ventilation (IMV) was an earlier version of the more advanced SIMV. In this mode of ventilation a preset respiratory rate is delivered at a specified time interval. For a patient receiving 10 breaths per minute, a breath is delivered every six seconds regardless of the patients efforts. The theoretical disadvantage of this form of ventilation is that the patient may take a spontaneous breath and could receive a machine delivered breath at the same time or during expiration, causing hyperinflation and high peak airway pressures. SIMV is said to avoid this problem by monitoring the patients respiratory efforts and delivering breaths in response to the patients inspiratory efforts

SIMV is similar to IMV in that it will still deliver a minimum number of breaths, despite the potential lack of inspiratory effort from the patient If the ventilator is set to deliver 10 bpm the patient will receive these breaths if they are breathing or not. SIMV utilises a window of time in which a breath is due and will look to deliver this breath within a specified time frame. If the patient makes a sufficient inspiratory effort (governed by sensitivity) the machine will sense this effort and give the patient the breath during this time, synchronised to their own effort.

SIMV



3. OXYLOG 2000 BASIC OPERATING MODES



4. References and Resources

1. Banner, M. & Lampotang, S, 1992, "Mechanical ventilation - fundamentals" in Handbook of Mechanical Ventilatory Support, A. Perel and Stock, M. eds, Williams & Williams, Baltimore.
2. Slutsky, A. 1993, "Mechanical ventilation", Chest, Vol 104, no 6, pp 1833 - 1859
3. Cress, M. & Cronover, S. "A clinical guide to cardiopulmonary medicine", Puritan Bennett.
4. Kacmarek, R. & Hess, D. 1994, "Basic Principles of Ventilator Machinery", in Principles and Practice of Mechanical Ventilation, M. Tobin, ed, McGraw Hill, New Work.