OXYLOG 1000

LEARNING PACKAGE

1. INTRODUCTION

This package is aimed at increasing your knowledge in the use of mechanical ventilation as given by the oxylog 1000.
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:

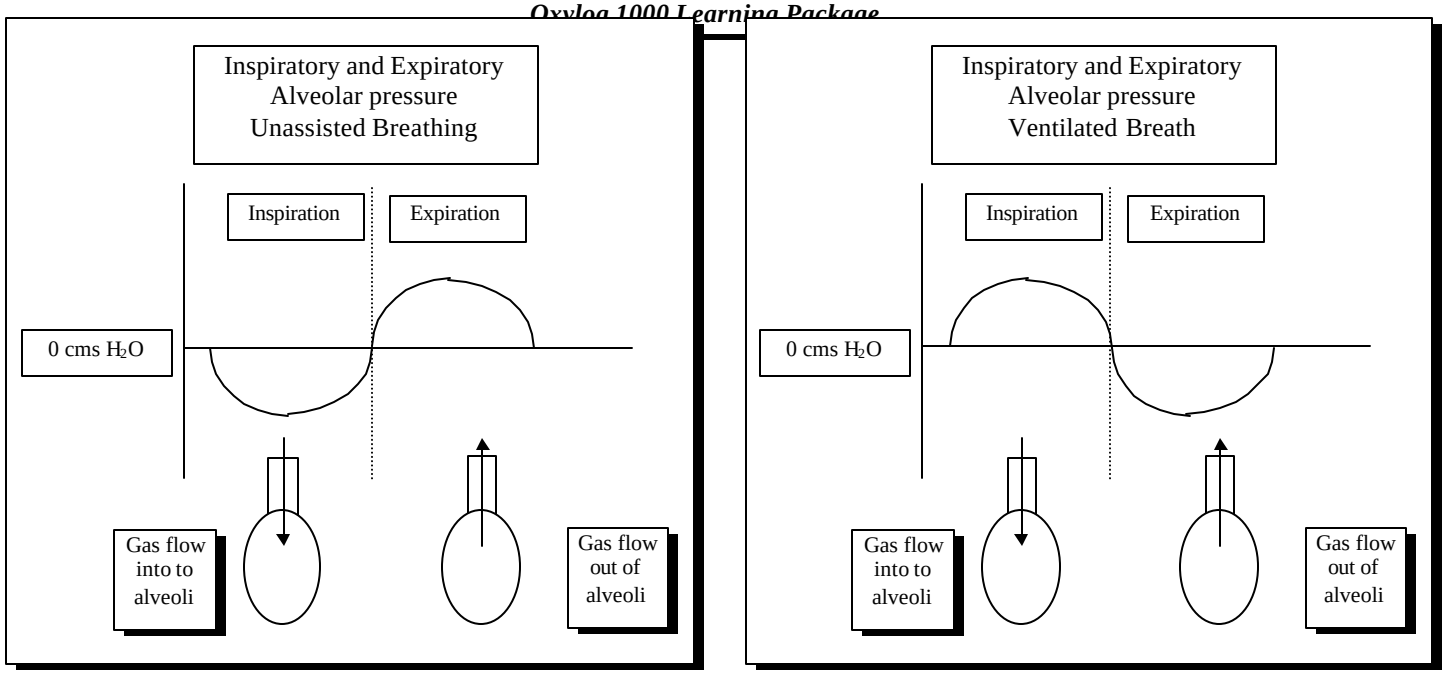
- the components of each individual breath, specifically pressure, flow, volume and time
- the method of triggering the mechanical ventilator breath/gas flow,
- potential complications of mechanical ventilation and methods to reduce ventilator induced lung injury
- the nursing observations required to 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.

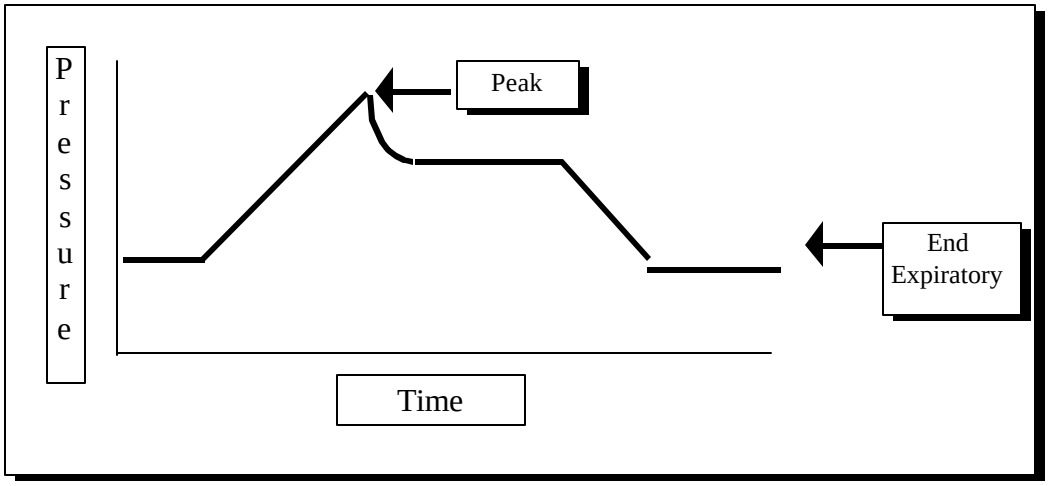
2.1 Airway Pressures (Paw)

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.**



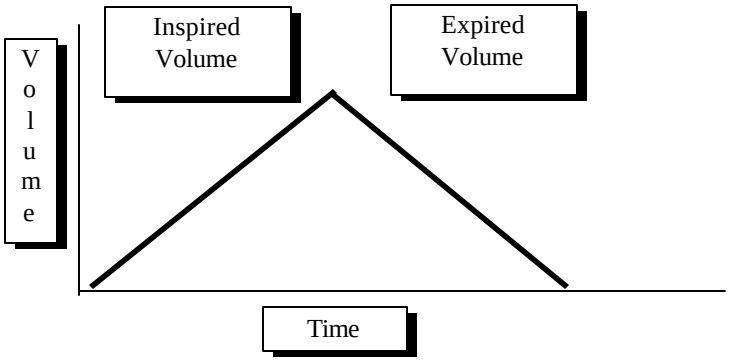
2.1.1 Definitions

- **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 Minute Volume

Minute volume is the patient's Tidal Volume multiplied by their breath rate. The Oxylog 1000 requires the operator to set the minute volume rather than the tidal volume. To do this a quick calculation of the required TV multiplied by the set breath rate is required.

EG: 70 kg individual will require a TV of approx 700mls or 0.7 litres, to set this on the oxylog 1000 for an individual ordered 10 breaths a minute you would multiply 0.7 litres by 10 = 7 lpm minute volume.

Question: your patient weights 85kg what would be your set MV for this patient if they where ordered a breath rate of 14 bpm

2.4 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.

2.5 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]. The IE ratio on oxylog 1000 is set at a constant 1:1.5 ratio and is unable to be changed

2.6 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.

Peak. **pressure** (high pressure alarm)
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. On the Oxylog 1000 the peak pressure alarm should always be set at 40 mbar as a starting point. If this pressure is exceeded the ventilator stops delivering the breath and thus limits the pressure to what ever is set ie 40 mbar

End Expiratory Pressure. (Low pressure alarm)
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 1000 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 dictated by unit practice (eg 10 mls / kg) but is usually set to ensure adequate elimination of carbon dioxide without producing excessive inspiratory pressure.

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 1000 ventilators the flow is set by the machine and cannot be adjusted.

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**.

Besides CPAP this is the only mode of ventilation available on the oxylog 1000

2.7.1 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.

2.7.2 Advantages and Disadvantages of Volume Cycled Ventilation

Advantages:

Ease of Use.

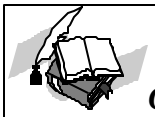
- Due to the widespread implementation of volume cycled ventilation it is a type of ventilation that is familiar to many clinicians.

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.
- There is no patient ventilator synchrony, hence if the patient makes a respiratory effort the ventilator cannot register or act on it. This can lead to increased work of breathing for the patient and high airway pressures as the patient "fights" the ventilator. To overcome this the patient should be paralysed and sedated



Question). 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.

3. MECHANICAL VENTILATORS USED IN HUNTER HEALTH RURAL DIVISION

3.1 OXYLOG 1000 Adult Operating Modes

Pressure high/ low pressure alarm indicators

Insufficient supply gas alarm

Alarm silence/reset Button

Air mix switch
- No air mix gives 100 % O_2,
- Air Mix gives approx 60 % O_2

Pressure dial shows pressures on inhalation and expiration

On Off switch
- I = ON
- O = OFF

P max setting adults P max should always be less than 40 mbar

Freq: Breath rate start at 10 bpm for adults
- brown zone adults
- Blue children
- green paediatrics

MV Minute volume in litres set adjust to give approx 10ml/kg TV
MV = TV x Freq
EG pts weights 70kg freq set at 10
MV+10x 700ml= 7L/MIN
- brown zone adults
- Blue children
- green paediatrics

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.