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26-A USING A FLOW METER WITH HUMIDIFIER

It is important to measure the flow rate of gas given to an infant with a FLOW METER. It is also important to use a HUMIDIFIER so that water vapour can be added to the gas. If a humidifier is not used the infant will breathe very dry gas which may damage the airways.

The flow meter is usually plugged into an oxygen/air blender. However, the flow meter can also be plugged directly into an oxygen wall plug.

The flow of gas is measured in litres per minute and can be adjusted by turning an adjusting wheel. A flow rate of 5 litres per minute is usually used into a head box. A high flow rate wastes gas and cools the infant while a low flow rate may allow carbon dioxide to accumulate in the head box.

A simple humidifier is usually used to add water vapour to the dry gas. Sterile or boiled water (which has been allowed to cool) is added to the humidifier so that the water level reaches the full mark. When the water level approaches the empty mark more water must be added. The water must be changed and the humidifier must be cleaned every day or when the humidifier is to be used for another infant. Dangerous bacteria such as Pseudomonas can grow well in water and, therefore, the humidifier should only be filled with water when it is being used. The humidifier should be cleaned with detergent or soap and water, and be allowed to drip dry. The switch on the humidifier must be kept on "bubbles" and not "jet". The humidifier must be dry during storage.

Some humidifiers also warm the air. When infants are ventilated via an endotracheal tube (except during resuscitation) warmed, humidified gas should be used.

USING AN AIR-OXYGEN BLENDER

Except during an emergency resuscitation, 100% oxygen from a cylinder or piped source should not be used as pure oxygen is toxic to many tissues especially the retina of the eye. Therefore, oxygen should always be mixed (blended) with medical air using a BLENDER or a VENTURI.

26-B THE COMPONENTS OF AN OXYGEN/AIR BLENDER:

1. The plastic GAS PIPES: The pipe for oxygen is usually white while the pipe for medical air is usually black. Each pipe ends in a steel connector that must be plugged into a wall gas fitting or a reduction valve on a cylinder. The shape of the 2 connectors differs to prevent the pipe being connected to the incorrect source. The oxygen connector is 6 sided while the medical air connector has 2 flat sides and 2 curved sides. The wall fitting for oxygen is white and the wall fitting for medical air is grey.
2. The BLENDER UNIT: This, with the gas pipes, is usually attached to a supporting rail on the wall. The blender also has emergency escape valves which operate if the gas pressure gets too high. An alarm will sound if one of the pipes is not plugged in properly, or the pressure of oxygen or air is too low. The dial which controls the mixture of oxygen and air can be set at any combination from 21% oxygen (i.e. pure medical air) to 100% oxygen (pure oxygen).
3. The FLOW METER WITH HUMIDIFIER has been discussed above.

26-C USING A VENTURI

If a blender is not available, a venturi can be used. A venturi is cheaper than a blender but not as accurate. The venturi is a short plastic tube to which a pipe supplying oxygen is attached. The oxygen passing through the venturi sucks in room air and, thereby, mixes the 2 gasses. The venturi is usually attached to an oxygen hood. Some venturis provide a fixed concentration of oxygen while others can be used to give the concentration required. The latter are preferred. When using a venturi attached to a head box, an oxygen flow rate of 5 litres must be used. If possible the percentage of oxygen in the head box should still be accurately measured with an oxygen monitor.

USING AN OXYGEN MONITOR

Whenever an infant is given oxygen into a head box the FiO_2 (fraction of inspired oxygen) must be measured with an oxygen monitor as too high or too low a concentration of oxygen may be dangerous for that infant if it results in too much or too little oxygen in the blood. The FiO_2 CANNOT be controlled accurately with a flow meter alone. If an oxygen monitor is not available then a blender or venturi should be used to determine the approximate FiO_2 , provided a flow of 5 litres or more is used.

26-D THE COMPONENTS OF AN OXYGEN MONITOR.

1. The MONITORING UNIT: This is usually attached to a rail or stands on a shelf. On the front of the unit is an on/off switch, a display of the FiO_2 , high and low settings, a calibration knob and an alarm light. The monitor is powered by batteries that have to be replaced at intervals. Most models have a "low battery" display to warn that the battery is getting flat.
2. The OXYGEN SENSOR: This is attached to the monitoring unit by a thin cable. The sensor is placed in the head box (oxygen hood) next to the infant's head.

26-E CALIBRATING THE OXYGEN MONITOR.

Place the sensor in room air and switch on the monitor. The display should read 21%. If not, adjust the calibration knob until the display reads 21%. The monitor should always be calibrated before it is used. It should also be calibrated at least daily while in use.

26-F USING THE OXYGEN MONITOR.

Calibrate the monitor with room air as described above. Then place the sensor into the head box. The display should now give the FiO_2 . Set the high and the low alarm limits to 5% above and 5% below the required FiO_2 . If the display falls outside these limits, the red alarm light will come on and the alarm buzzer will sound. Silence the alarm by correcting the air/oxygen mixture. The display should be read and recorded on the observation chart at regular intervals while the infant is receiving extra oxygen. Remember that the monitor measures the FiO_2 but does not control the FiO_2 . The FiO_2 cannot be changed by simply adjusting the oxygen monitor!

USING A SATURATION MONITOR (PULSE OXIMETER)

A saturation monitor (also called a pulse oximeter) measures the saturation (amount) of oxygen in the red cells of small arteries under the skin. The result is expressed as a percentage and the normal saturation of oxygen (SaO_2) in a newborn infant is 85 - 90%. A saturation below or above this range is dangerous to the infant. The measurement is made by shining a bright light through the skin and then determining the colour of the transmitted light on the other side with a sensor. If the blood is red (well saturated) the SaO_2 reading will be normal or high. A low reading will be obtained if the blood is cyanosed. The monitor also measures the pulse rate by detecting the arterial pulsations in the small vessels in the skin.

26-G COMPONENTS OF A SATURATION MONITOR.

The monitor is attached to a skin sensor by a thin cable. The monitor is powered by electricity (via a power cable which plugs into a wall fitting) or battery and displays a pattern of the pulse wave together with the percentage saturation and pulse rate. A number of different sensors are available. One type looks like a clothes peg and can be clipped onto the infant's hand, foot or ear lobe. Another type can be strapped onto a hand or foot with tape, while an adult finger sensor can, with difficulty, be slipped over the infant's foot. A regular pulse wave indicates that the skin sensor is correctly positioned.

26-H USING A SATURATION MONITOR.

1. Attach the sensor to the infant's hand, foot or ear and then switch on the monitor. It may take a short while before it displays the pulse wave on the screen.
2. A good, regular pulse wave should be displayed. If not, adjust the position of the sensor slightly or move the sensor to another part of the body.

3. Set the upper and lower limits for the SaO₂ and pulse rate. This is usually done by simply pressing the limit buttons. The SaO₂ limits are usually set at 85% and 92% and while the pulse rate limits are usually set to 120-160 beats per minute.
4. You should now be able to read both the SaO₂ and the pulse rate on the display panel. If the pulse wave is poor or the SaO₂ or pulse rate is abnormal the alarm will sound. Press the alarm button to switch off the alarm and take the necessary action.

26-I PROBLEMS WITH A SATURATION MONITOR.

1. If the infant moves a lot it may not be possible to obtain a good pulse wave reading and the monitor will alarm repeatedly.
2. If the infant's perfusion is poor it is best to attach the sensor to the hand or ear rather than the foot.
3. If the infant is receiving phototherapy or is under a bright light, it is preferable to cover the sensor with a nappy or piece of cloth as the light may interfere with the function of the sensor.

The saturation monitor should be used when the measurement of SaO₂ is needed on a sick infant. The sensor can be left attached for continuous monitoring or the sensor can be attached at regular intervals for a single reading. The monitor should not be used simply to obtain the pulse rate. If the pulse rate recorded by the monitor differs from the correct heart rate, then the monitor is not functioning properly and, as a result, the SaO₂ displayed may be incorrect. When moving the sensor from one infant to another, the sensor should first be wiped with an alcohol swab to prevent the spread of infection.