MEDICAL GASES

Syllabus:
Different gases, color coding of cylinders, care of cylinders, pressure regulator and accessories.

CARBON DIOXIDE (CO_2)

Uses:

1. Normal concentration of carbon dioxide in air is 0.04%. If this concentration is raised from normal value then the depth of respiration is increased. At 3% the dept is doubled and at 5% the depth becomes thrice the normal depth. It is used in emergency to induce and improve the respiration rate in newborn babies, drowning persons, and cases of poisoning by carbon monoxide, morphine, hypnotics and other depressants.
2. Mixtures of oxygen and carbon dioxide may be administered to hasten exhalation of anaesthetic gases after surgical operations and thus reduce the post-operative vomiting and bronchitis.
3. Liquid carbon dioxide gas (at a pressure of 50 bars) when escapes suddenly through a pipe the gas freezes and *dry ice* (-80^0C) is formed which is used to remove warts.

CYCLOPROPANE (C_3H_6)

Uses:

This is a powerful anaesthetic gas. It is non-irritating and induction and recovery is rapid.

Mixtures of 4% cyclopropane with oxygen produces *analgesia*
Mixtures of 8% cyclopropane with oxygen produces *light anaesthesia*.
Mixtures of 20 – 25% cyclopropane with oxygen produces *surgical anaesthesia*.

Cyclopropane and oxygen mixture forms an explosive combination at certain concentration hence this gases are used in closed circuit.

NITROUS OXIDE (N_2O, Laughing gas)

Uses:

This is the oldest and safest gaseous anaesthetic. Induction is quick and pleasant, recovery is rapid, hence it is most popular gas for producing light anesthesia or analgesia in dentistry and obstetrics.

Disadvantages:

It has low anaesthetic potency. Large dose of this gas is required to produce anesthesia, this may cause lack of oxygen.

OXYGEN (O_2)

Oxygen is used for variety of purposes:

(A) During anesthesia, because a person's need for oxygen continues when he/she is anaesthetized.
(B) To relieve anoxia (lack of oxygen in the tissues) that may be caused by :–
    1. *Inadequate oxygenation of the blood by the lungs*. This may occur in pneumonia, chronic bronchitis, emphysema, pulmonary edema, post-operative pulmonary complications, asphyxia in newborns and barbiturate poisoning.
    2. *Reduction of the circulating blood volume*. This may result from coronary failure, collapse of the peripheral circulation and shock.
    3. *Reduction of the oxygen-carrying capacity of the blood.* This may be caused by severe anemia, hemorrhage and carbon monoxide poisoning.
(C) To increase radiation efficiency in tumor therapy
    Oxygenation of tumors sensitizes them to radiations. The oxygen must be used under high pressure with the patient enclosed in a special chamber.

HELIUM (He)

Because of its low molecular weight helium is easier to breathe than air or oxygen. A mixture of 79% helium and 21% oxygen is used for prolonged asthma or in severe obstruction or inflammation in the respiratory tract.

NITROGEN (N_2)

Nitrogen is used as an inert gas to replace the air in containers of drug or medicaments sensitive to oxygen or carbon dioxide.

COLOR CODING OF CYLINDERS

Medical gases are stored in heavy steel cylinders made to withstand pressure of about 200bars. No gas is stored at a pressure of 130 bars.

The cylinders are similar in appearance. To reduce confusion each type of gas is given a color-coding that readily identifies the gas. The symbol or name of the gas is stenciled on the cylinder shoulder.

Gas	Color code	Liquid or gas in cylinder
Carbon dioxide	Grey	Liquid
Cyclopropane	Orange	Liquid
Helium	Brown	Gas
Nitrogen	Grey body Black top	Gas
Nitrous oxide	Blue	Liquid
Oxygen	Black body White top	Gas
Oxygen and carbon dioxide mixture	Black body Grey & White top	Gas
Helium and Oxygen mixture 79 : 21	Black body Brown and white top	Gas

CARE OF CYLINDERS

1. Cylinders should be stored in a cool, well-ventilated room free from inflammable materials.
2. The room should be large enough for proper grouping according to the cylinder-contents, hence avoiding confusion.
3. A special storage rack is designed to ensure the use of old stock first and is lined to prevent defacement (damage) of identifying labels and colors.
4. The color chart is put up on a visible place in the storage room.

PRESSURE REGULATORS AND ACCESSORIES

Pressure regulators

- Before the gas in a cylinder can be used its pressure must be reduced to much lower level required for administration. This can be achieved by passing the gas through an automatic pressure regulator that provides a fixed outlet pressure. For oxygen is usually within the pressure range of 1.5 to 4.5 bars and the flow rate 2 to 4 liters per minute.
- Once the control has been set the regulator automatically maintains a constant rate until the cylinder is exhausted.
- If the distal end of the tube is blocked the regulator prevents excessive pressure build-up in the apparatus and in the tubing.
- A cylinder contents gauge is fitted to the high-pressure side of the instrument.

Flowmeters

The rate of flow of gas to the patient can be measured by different ways:

1. By observing the movement of rebreathing bag connected to the patient's mask.
2. By gauge flow-meters the gas flows through a fixed orifice and the pressure is measured on a dial reading pressure gauge behind the orifice.
3. Float flow-meters consists of a graduated vertical tube housed in a clear plastic container. The gas is led into the lower end and its pressure causes a small lightweight colored float to rise in the tube to a point where equilibrium is established between the pressure of the gas and the weight of the float. The flow rate, usually in liter / min is indicated by the height of the float relative to the graduated scale.
4. In domiciliary oxygen therapy a separate flow meter is not required. The cap of the regulator consists of a flow selector where three positions are marked:
   (a) OFF (b) MED (flow rate 2lit/min) and (c) HIGH (flow rate 4lit/min)

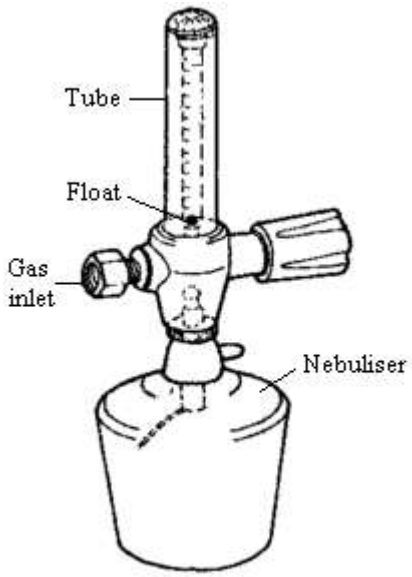

Fig. Float flowmeter and nebulizer

Nebulizers

During oxygen therapy a stream of dry oxygen on a small area of mucous membrane may cause considerable pain. To reduce this pain the oxygen is humidified by passing the oxygen through water kept inside the nebulizer at room temperature.

MASKS

An oxygen mask is necessary to provide appropriate oxygen therapy to the patient.

Low concentration masks

Use: These are used for long standing respiratory conditions like chronic bronchitis, emphysema, and bronchial asthma.

- With these masks a 23 to 30% oxygen concentration can be at a flow rate of 2 lit/min.

Examples:

1. Mask with venturi device: Its upper part is transparent, flexible, loose fitting plastic network with a foam-lined edge for comfort. It is sealed to a clear, rigid, plastic funnel incorporating a venturi device that ensures a 28% oxygen at a rate of 2 lit/min.
2. Mask with many holed centered (MC Mask): This is a transparent, rigid, foam-edged, plastic mask with 14cventillation holes around a central, angled, inflow pipe that opens near to the mouth.
3. Mask with open center (Edinburg Mask): It has a translucent, loose-fitting, plastic face piece with a foam-covered, flexible strip at the edge and a thick-rimmed, cylindrical opening, 5cm in diameter, at the front. The inflow tube passes through the rim, close to the mouth and at right angles to the movement of the respiratory air.

High concentration mask

These are used for acute conditions in which there is little risk of carbon-dioxide narcosis, e.g. acute lobar pneumonia, severe anaemia, coronary thrombosis and severe shock.

1. Kidde Mask: This plastic mask provides 40 to 60% oxygen concentration at a rate of 4lit/min. It is avilable in two versions:
   (a) *Re-breathing type*: This consists of a semi-transparent, moulded, plastic face piece containing a ventilating orifice and attached to a plastic re-breathing bag. The bag deflates and expands as the patient inhales and exhales respectively. At the beginning of the exhalation the breath is richest in oxygen and is returned to the bag along with fresh oxygen from the cylinder. It restricts escape of exhaled air until the bag is full. The rest of the air full of carbon dioxide is expelled.
   (b) *Non-rebreatnig type*: In this case a non-return valve prevents the exhaled air from entering the bag. Here the bag acts as oxygen reservoir. This mask is used when it is necessary to prevent rebreathing of exhaled carbon dioxide.
2. MC Mask: This mask is used for high concentration oxygen therapy. It delivers 60% oxygen concentration at a flow rate of 6 lit/min.

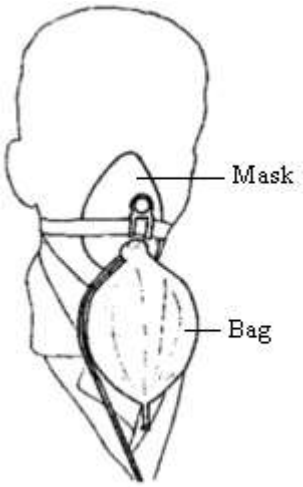

Fig. Kidde Mask

OXYGEN EQUIPMENTS

1. Flat bottomed cylinder of oxygen of 48ft^3 (1300 litters) capacity and fitted with bull-nose valves.
2. Ancillary equipment comprising–
   (a) a control head containing (i) a pressure-reducing valve, (ii) a contents gauge, calibrated in units of pressure and with ¼ , ½ and FULL markings, (iii) a cap comprising a two-flow (MED and HIGH) selector, (iv) an outlet carrying the male side of the bayonet connection, (v) a bull-nosed cylinder adapter for finger tightening.
3. 1.37 m of polythene connecting tube with a bayonet fitting at one need to link with (iv) above. Light weight plastic tube is preferred.
4. A key spanner, for opening the cylinder.
5. A disposable mask.
6. A cylinder stand.

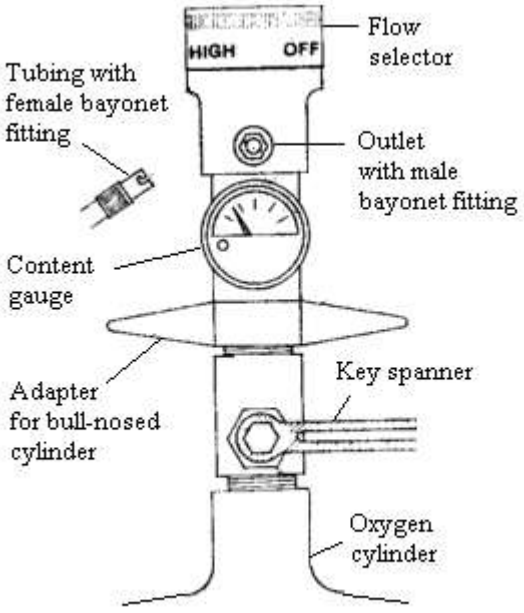

Fig. Control head of an oxygen cylinder