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Oxygen Therapy: Resuscitation in Obstetrics and Gynaecology

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Abstract

Purpose of oxygen therapy is to increase oxygen saturation in tissues where the saturation levels are too low due to injury or illness. There are a number of devices to deliver oxygen Like Variable Performance Low flow system and Fixed performance High flow system / HAFOE device (High Air flow Oxygen Enrichment device). Variable Performance Low flow system includes Nasal Canula, Face Mask, Simple Oxygen mask, Partial rebreather mask and Non- rebreather mask. High flow system includes Venturi Mask, Trachea Collar and T. Piece. In this article we review in detail about these devices.

Keywords: Oxygen Therapy, Obstetrics, Hypoxia.

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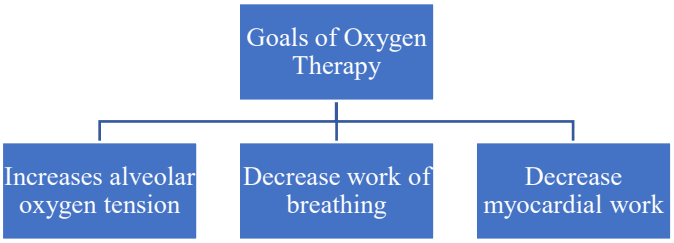
1. Introduction

Oxygen is also like a drug. It must be used meticulously & diligently at a definite rate to achieve the target goal. If abused it may cause complications.

1.1 Where oxygen therapy is needed:

Purpose of oxygen therapy is to increase oxygen saturation in tissues where the saturation levels are too low due to injury or illness. Types of Hypoxia which are encountered in clinical practice and their response to oxygen therapy is as follows:

Sr. No.	Type of Hypoxia	Pathology	Response to oxygen therapy
1.	Hypoxic hypoxia	Decreased O_2 saturation due to alveolar hypoventilation & low FiO_2	**O_2 therapy is most fruitful**
2.	Stagnant hypoxia	Due to low cardiac output states & vascular occlusion	O_2 therapy helps to a lesser extent
3.	Anemic hypoxia	O_2 carrying capacity is reduced like anaemia, hemodilution, CO poisoning	O_2 therapy useful to some extent
4.	Histotoxic hypoxia	Due to cyanide poisoning. Cells cannot utilise O_2.	O_2 therapy least likely to be useful



1.2 Common Indications for O_2 Therapy

a) ***Hypoxia***– When PaO_2 comes down to 60mmHg or SPO_2 come down below 90%.

b) ***Normoxic hypoxia –*** like low cardiac output states such as M.I., anaemia, haemodilution, CO poisoning, acute hypermetabolic states

c) ***Trapped gases*** – like obstruction

d) ***Special situations*** – like anaesthesia

1.3 Prerequisites of Oxygen Therapy

- Physician's orders, except in cases of emergency
- Continuous clinical observation
- Arterial blood gas measurements
- Pulse oximetry

1.4 Components of Physician's Prescription

- Documentation of oxygen therapy
- Date and time oxygen started
- Method of delivery
- Oxygen concentration and flow rate
- Patient's observation
- Oronasal care to be added nursing care

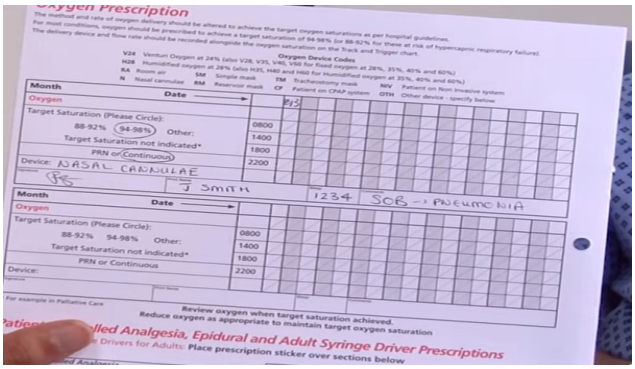


Figure: Sample Prescription

2. Devices to deliver Oxygen [2]

I. Variable Performance Low flow system

II. Fixed performance High flow system/HAFOE systems (High air flow oxygen enrichment device)

2.1 Variable Performance Low flow system

These devices contribute partially to the oxygen patients breathe in. These are:

1. Nasal Canula
2. Face Mask
   a) Simple Oxygen mask
   b) Partial rebreather mask
   c) Non- rebreather mask

Low-flow system	Oxygen flow rates (L)	FiO_2
Nasal Cannula	1	0.24
	2	0.28
	3	0.32
	4	0.36
	5	0.40
	6	0.44
Simple face mask	5-6	0.40
	6-7	0.50
	7-8	0.60
Partial rebreathing mask	6	0.60
	7	0.70
	8	0.80
	9	0.80+
	10	0.80+
Non rebreathing mask	10	0.80+
	15	0.90+

Flow rates and FiO_2 with low-flow oxygen-delivery devices.
Predicted FiO_2 values for low-flow systems assume a normal and stable pattern of ventilation.

1) Nasal Canula:

It is a disposable plastic devise with two protruding prongs for insertion into the nostrils, connected to an oxygen source. It is used for low-medium concentrations of Oxygen (24-44%).

Advantage: Patient is able to talk and eat with oxygen in place. It can be used in home setting also.

Disadvantage: It may cause irritation to the nasal and pharyngeal mucosa and is useless in mouth breather.

2) Face mask

They are of four types:

a) The Simple oxygen mask
b) The Partial rebreather mask
c) The Non rebreather mask
d) Venturi Mask

a) Simple oxygen Mask

Simple mask is made of clear, flexible, plastic or rubber that can be moulded to fit the face. It is used for 35% to 60% oxygen concentrations. It should be used at a flow rate of 6 to 10 litres per minute. Often it is used when an increased delivery of oxygen is needed for short period (i.e., less than 12 hours).

Advantage: It provides increased delivery of oxygen for short period of time.

Disadvantage:

- Tight seal is required.
- It is difficult to keep mask in position.
- Facial skin rashes due to pressure and moisture.
- Wasting
- To be removed during eating, drinking and vomiting.

b) The Partial rebreather mask

This mask is has a reservoir bag that must remain inflated during both inspiration & expiration. It collects the first parts of the patients' exhaled air. It is used to deliver oxygen concentrations up to 80%.

The oxygen flow rate must be maintained at a minimum of 6 L/min to ensure that the patient does not rebreathe large amounts of exhaled air. The remaining exhaled air exits through vents. Oxygen is directed into the reservoir. During inspiration patient draws gas from bag or room air. During expiration first 1/3 of expired air goes into the bag and forms the dead space. In the dead space gases mixes with oxygen and patient inhales that air.

Advantage: Patient can inhale room air if oxygen supply is interrupted.

Disadvantage:

- Eating and drinking is difficult and uncomfortable with this mask.
- Drying of mucus membranes.

c) The Non Rebreather mask

This mask provides the highest concentration of oxygen (95-100%) at a flow rate 6-15 L/min if bag does not completely collapses during inhalation. It has oxygen reservoir with one way valves. It is similar to the partial rebreather mask except two one-way valves prevent conservation of exhaled air. Valve over exhalation ports prevents air entrainment. The bag is an oxygen reservoir.

Precautions while using Non rebreather mask

- Maintain flow rate so that reservoir bag collapses only slightly during inspiration.
- Check that valves and rubber flaps are functioning properly and open during expiration.
- Monitor SaO_2 with pulse oximeter.
- Never allow anybody to squeeze the bag empty.

Advantage:

- Delivers the highest possible oxygen concentration
- Suitable for patient breathing spontaneous with severe hypoxemia.

Disadvantage

- Impractical for long term Therapy - Malfunction can cause CO_2 build up – suffocation
- Expensive
- Feeling of suffocation
- Uncomfortable

2.2 Fixed performance High flow system/HAFOE device (High Air flow Oxygen Enrichment device)

These devices deliver a specific and constant percent of oxygen independent of patient's breathing. These are:

1. Venturi Mask
2. Trachea Collar
3. T. Piece

1. Venturi mask:

- It is high flow concentration of oxygen.
- It works on Bernaulli principle.
- Oxygen delivery from 40 - 50% concentration at flow rate of 4 to 15 L/min.

2. Trachea Collar

To secure Trach tube in its position

3. T Piece

- Used on end of ET tube when weaning from ventilator
- Provides accurate FIO_2
- Provides good humidity

Bi-PAP [NIV] and C PAP

Non-Invasive Ventilation (NIV) and Continuous Positive Airway Pressure (CPAP) are forms of ventilatory support used in acute respiratory failure when a patient remains hypoxic despite optimisation of medical management. Both have additional indications in the chronic setting.

Bi-PAP [NIV]

NIV delivers differing air pressure depending on inspiration and expiration. The inspiratory positive airways pressure (iPAP) is higher than the expiratory positive airways pressure (ePAP). In the acute setting, NIV is used in type 2 respiratory failure (for example in a COPD exacerbation), with respiratory acidosis (pH < 7.35).

3. Role of Non- Invasive Ventilation (NIV)

- In fully conscious and alert patient
- Maintained cough reflex
- Can protect airway
- Mild –moderate respiratory failure

Caution – pregnant women at higher risk of aspiration

Advantages of NIV

- Avoids risks of invasive ventilation
- Preservation of speech and swallowing
- Maintenance of upper airway protective mechanisms- Glottic barrier maintained- no pooling of secretions- lesser nosocomial pneumonia
- Improved comfort & no sedation
- Adequate nutrition can be provided
- Humidification better

In pregnancy 4 fold increase in difficult intubation and 8 fold increase in failed intubation.

C PAP

C PAP supplies constant fixed positive pressure throughout inspiration and expiration. It, therefore, is not a form of ventilation, but splints the airways open. In the chronic setting it is used for severe obstructive sleep apnoea

(splinting the upper airway) and in the acute setting for type 1 respiratory failure, for example in acute pulmonary oedema (recruiting collapsed alveoli).

Indications of intubation

- Increased work of breathing
- Shallow respiration less than 8 /min
- Inability to maintain PaO_2 of 70 mmHg and SPO_2 of 95% with mask/NIV (mask FiO_2> 0.6)
- Alteration in mental status GCS < 8
- Hemodynamic instability
- Inability to protect airway/vomiting /gastric lavage
- Normal $PaCO_2$ – a sign of impending respiratory failure
- Severe metabolic derangements
- Cardiopulmonary arrest

Advantages

- Provides an unobstructed airway when properly placed
- Prevents aspiration of secretions (blood, mucous, stomach / bowel contents) into the lungs
- Can be easily maintained for a lengthy period of time
- Decreases anatomic dead space by approximately 50%
- Facilitates positive pressure breathing without gastric inflation
- Facilitates body positioning and movement of the patient

Disadvantages

- Need advanced training to properly perform procedure
- Bypasses the nares function of warming and filtering the air
- Increased incidence of trauma due to neck manipulation when spinal cord injury is suspected
- May increase respiratory resistance
- Improper placement
- 8 times difficult in pregnant/labouring patients than non-pregnant ones. Pharyngolaryngeal edema consequent to PET, fluid overload due to oxytocin, and prolonged strenuous bear-down effort.

Hazards of O_2 Therapy [3]

1) Drying of mucous membrane
2) Depression of ventilation in COPD
3) Reversal of compensatory hypoxic vasoconstriction
4) Atelectasis due to absorption collapse.
5) O_2 toxicity

When to taper and Stop

1) Breathing pattern regular and at normal rate
2) Tidal volume and work of breathing is normal
3) Pink colour nail beds, lips, conjunctiva of eyes
4) No confusion, disorientation, difficulty with cognition
5) Arterial oxygen concentration : PaO2,PaCO2 and acid base with in normal limits
6) Oxygen saturation within normal limits

4. Conclusion

All the doctors and nurses working in critical care units should be well versed with all types of oxygen delivering systems and oxygen therapy should be started and monitored judiciously.

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