JUDICIOUS OXYGEN THERAPY IN NEWBORN

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Definition

- Administration of oxygen at a concentration equal to or greater than that of atmosphere .

- Purpose -to achieve adequate tissue oxygenation using lowest possible FiO_2.

Indications:

- Birth asphyxia ?
- Hypoxemia(spo_2 < 90% or pao_2 < 50%)
- Cyanosis (excluding congenital cyanotic heart disease without cardiac heart failure and methemoglobinemia)
- Respiratory distress(tachypnea ,retraction , grunting)
- Hypothermia , shock , seizure, severe anemia ,increased WOB
- Recurrent apnea
- Resuscitation in newborn

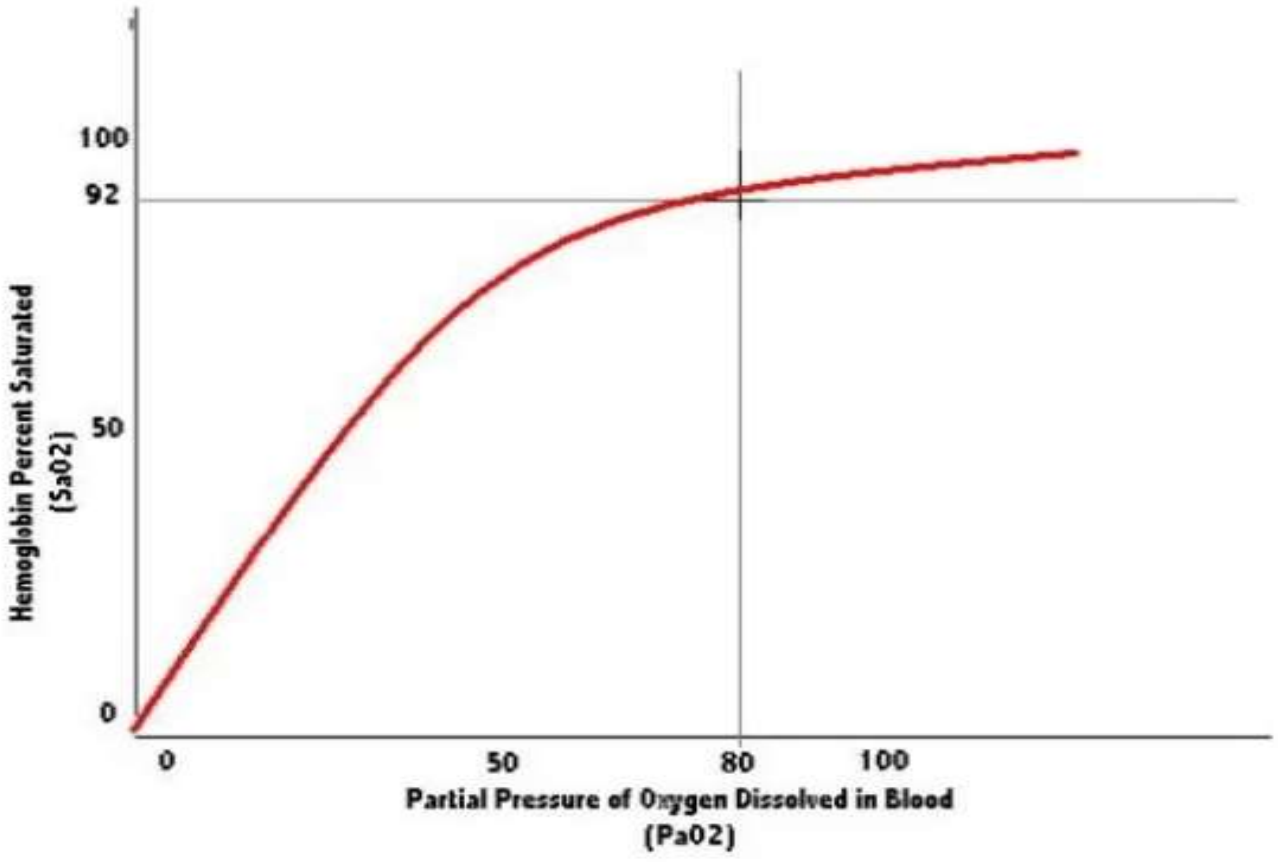
Basic definition

- **Oxygen saturation –** Expressed as percent & represents the amount of oxygen associated with a given amount of Hb compared to the amount that would be present if Hb were fully saturated. Normal value is 97-98 per cent.
- **Oxygen tension-** Expressed as mm hg , it is driving force that determines the degree to which oxygen will move from one compartment to another . Normal value in full term neonates is 50-70 mm of Hg.

Oxygen dissociation curve

- A relationship between the amount of oxygen dissolved in blood and the amount attached to the hemoglobin. This is called normal oxyhemoglobin dissociation curve.
- The quantity of oxygen bound to Hb is dependent on the partial pressure of oxygen and is reflected on o_2 - dissociation curve.

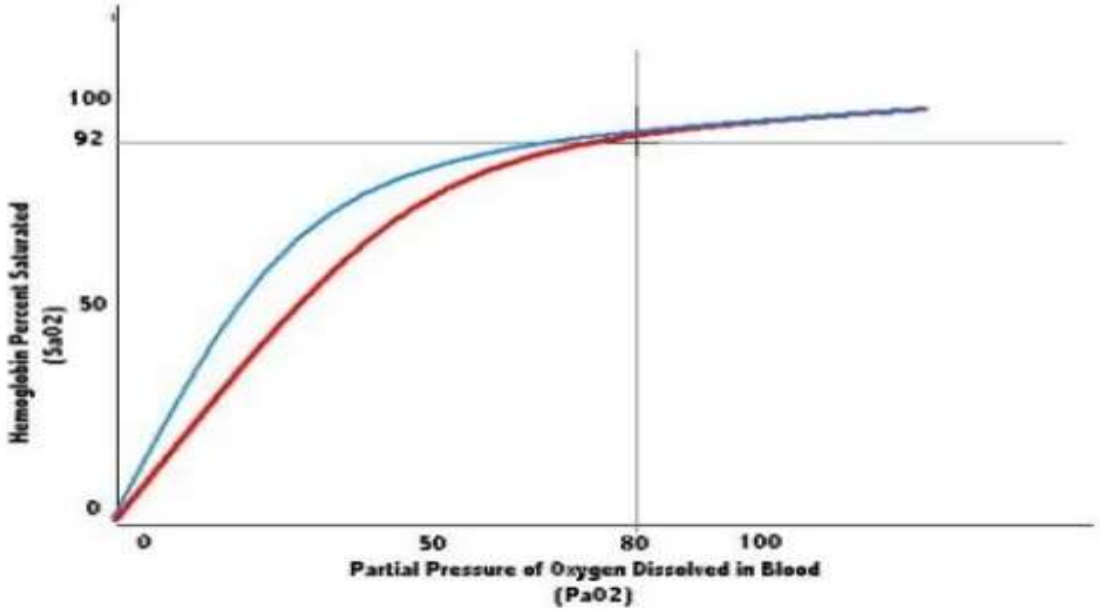
Normal Oxyhemoglobin Dissociation Curve



Predicted Relationship PaO_2 & SaO_2 Normal Oxyhemoglobin Dissociation Curve

PaO_2(mmHg)	SaO_2 (%)
100	98
90	97
80	95
70	93
60	89
50	84
40	75
30	57

97% saturation = 97 PaO2 (normal)
90% saturation = 60 PaO2 (danger)
80% saturation = 45 PaO2 (severe hypoxia)

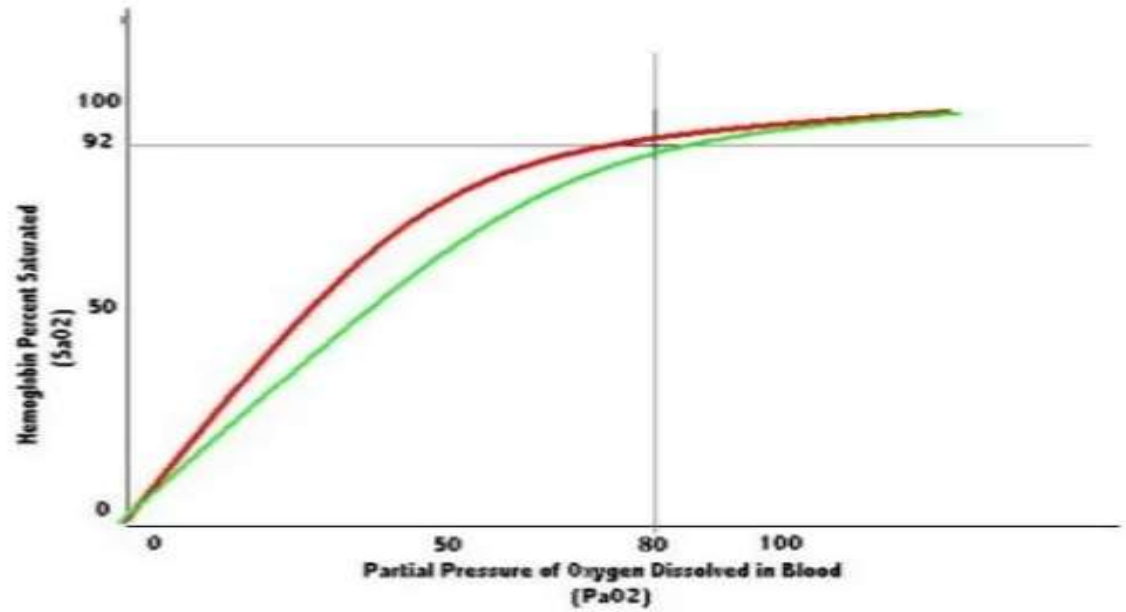


SHIFT TO LEFT

- Increase in pH
- Decrease in CO2
- Decrease in 2.3-DPG
- Decrease in temperature

SHIFT TO RIGHT

- Decrease in pH
- Increase in CO2
- Increase in 2,3-DPG
- Increase in temperature



Source of oxygen

- Central piped gases – ideal but expensive
- Cylinder – low cost , easy availability , smaller set ups , good as a back up
- Oxygen concentrators – it is an electric device with a molecular sieve to extract oxygen from the air by filtering out nitrogen , water vapours and other trace gases
- Polymeric membrane concentrators can deliver 50-90% oxygen at a flow rate up to 10 L / min

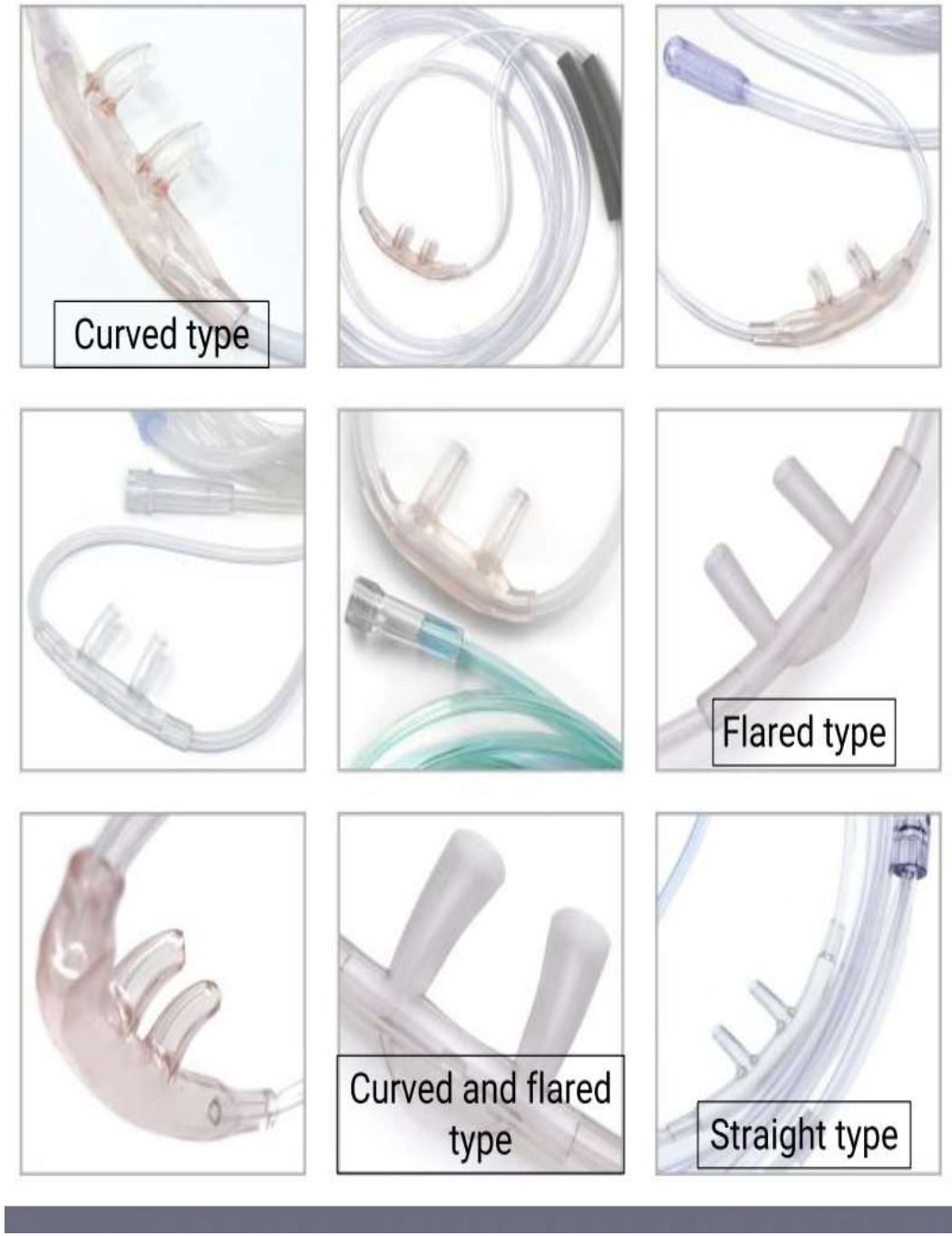
Modes of oxygen administration

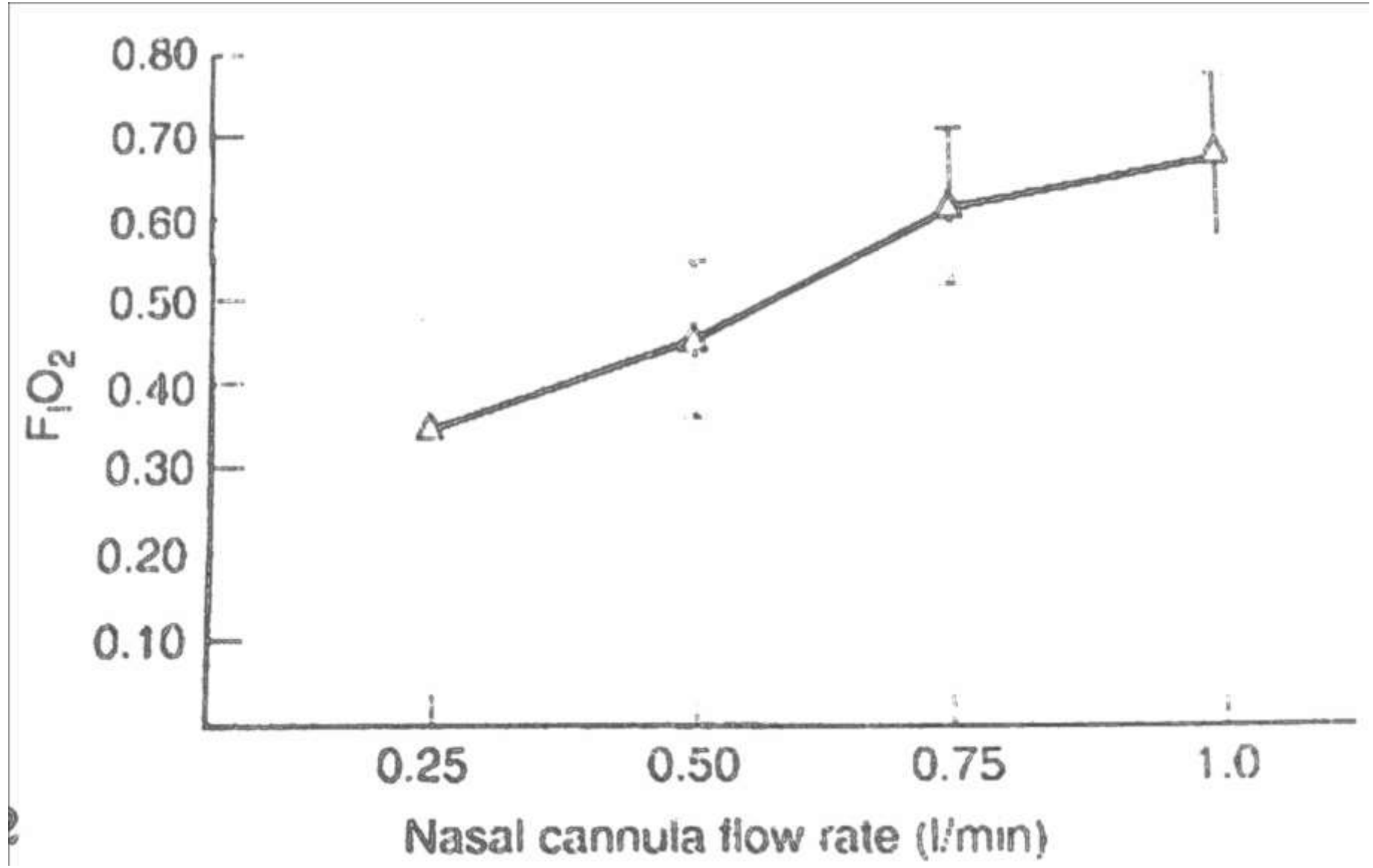
- **For breathing infants-** , Nasal prong , oxygen hood ,nasal catheter , CPAP, HHHFNC

- **For non breathing infant or tiring infant or severe respiratory distress-**
  - IPPV(AMBU)
  - Mechanical ventilation –NIPPV or IMV

Nasal canula

- Available in different sizes and shapes --- easy to administer oxygen.
- Oxygen is humidified in bubble humidifier and delivered via nasal prongs inserted in nares.
- Nasal irritation with high flow rate.




0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
F_iO_2
0.25
0.50
0.75
1.0
Nasal cannula flow rate (l/min)

Head box

- Simple , cheap , well tolerated , no gastric distension
- Oxygen concentration in the head box depends upon

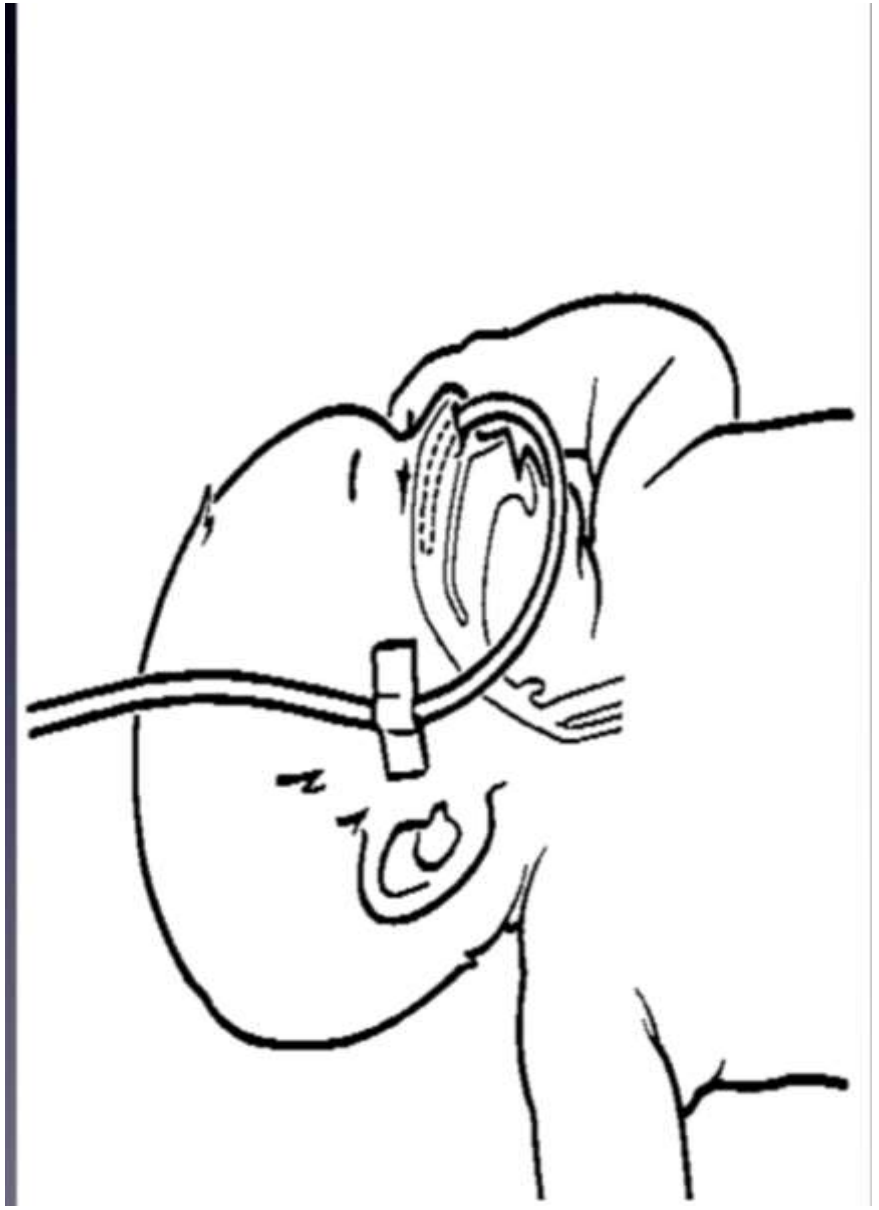
1.Flow rate

2. Size of the head box

3. Position of lid

Nasal catheter

- Thin , flexible tube (6F) which is passed through nose and ends with its tips in the nasal cavity.
- A catheter passed for a distance that is equal to the distance from the side of the nostrils to the inner margin of the eyebrow usually reaches to the posterior part of the nasal cavity.
- Humidification of the oxygen is not necessary because the tip lies in nasal cavity.



CPAP(Continuous Positive Airway pressure)

Improves oxygenation by

1.Increasing FRC

2.Decrease intrapulmonary shunting

3.Improves ventilation perfusion

Indications –

1.mild to moderate RDS ,

2. AOP ,

3. During weaning from mechanical ventilation

HHHFNC(heated Humified High Flow Nasal Canula)

- Alternative to CPAP
- **<u>Mechanism of action</u>**
- Support the pharynx and splinting of the upper airways.
- Delivery of positive distending pressure to the airway , recruits alveoli and stabilizes both large and small airways and the alveoli at the end of expiration thus maintaining FRC .
- Heated humidified gas reverses the dryness and mucosal injury.

Mechanical ventilator

- It supports the patient inadequate respiratory effort until improvement in respiratory function.
- Indication : hypoxemia , RDS , To maintain patent airway.
- Modes :

  1.CMV

  2.SIMV(synchronized intermittent mandatory ventilation)

  3. Assist controlled(PACV or VACV)

  4.PSV- pressure support ventilation

Oxygen toxicity

- It produces oxygen free radicals
- These free radicals are highly reactive ,causes damage to cell membrane by lipid peroxidation, inactivation of enzymes, injury to DNA , and degradation of structural proteins.
- Number of diseases in newborn may occur as a consequences of free radicals - 1.ROP

  2. NEC

  3. BPD

  4. IVH

How do you monitor oxygen therapy

- 1. ABG
- 2. Continuous pulse oximetry monitoring
- 3. Continuous transcutaneous monitoring

Continuous Pulse oximetry

- Accuracy of pulse oximeter is -3 to + 3
- Potential source of artefacts – fetal Hb > 50% , carboxy or meth Hb , presence of high intensity light (phototherapy)

Advantages	**Disadvantages**
Heatless	Requires perfusion and pulse
Easy application	Motion artifact
Instant reading	Light interference
No calibration	Does not measure PaO_2
Fast response time	

Blood gases

- ABG must be measured at least 4-6 hourly during acute phase of the disease.
- When the neonate is more stable and FiO2 is less than 0.3 , frequency of sampling can be reduced to 8 hourly ? 12 hrly ? 24 hrly ?
- Normal PO2 : 50- 70 mmHg
- Hypoxia :< 50 mm Hg in arterial blood
- Hyperoxia : PO2 > 70 mmHg in arterial blood

Continuous transcutaneous monitoring

- Principle - PO_2 diffusing from capillaries through skin heated at 44◦C is very close to true arterial PO_2 .
- It is unreliable in babies with severe hypothermia ,shock & thick skin .
- The electrode site must be changed every 4 hourly to prevent skin damage.

ROP screening

- National guidelines suggest that all infants born < 34 week GA should undergo screening.
- Those infants whose GA is not known or unsure , a birth weight ≤ 2000gm is used as cut off.
- First screening is performed before discharge from NICU , but surely before 30 days of life.
- For infant weight < 1200gm and GA < 30 weeks , the first screening is recommended between 2 and 3 weeks of life.

Saturation guidelines

- Target SPO_2 - 91- 95%

- Alarm limit should be set no more than 1% or 2% above or below the chosen target range and should always be on.

- Question 1 : Among preterm neonates born at ≤ 34 weeks' gestational age and on any respiratory support, do "higher oxygen saturation targets (91-95%)" compared to "Lower oxygen saturation targets (85-89%)" affect mortality or severe morbidities?

- NeOProM collaboration - Neonatal Oxygen Prospective Meta-Analysis collaboration which includes 5 randomised trials (SUPPORT - USA , COT - Canada and three BOOST II trials - in UK , New Zealand , Australia) recommends :

- All preterm neonates born at ≤ 34 weeks of gestational age and requiring respiratory support should be managed using oxygen saturation target of 91-95% in preference to lower (85-89%) oxygen saturation targets.

- Justification: Strong recommendation, based on evidence of high certainty demonstrating reductions in the risk of mortality (critical outcome) and of severe NEC before discharge (important outcome) with no significant effect on the long term visual and neurodevelopmental outcomes among extremely preterm neonates (< 28 weeks' gestation).

- Note: There is a small but significant increase in the risk of ROP requiring treatment with use of higher oxygen saturations targets. For every 1000 babies treated with higher oxygen saturation targets (91-95%), there may be 42 additional cases of severe ROP requiring treatment but there may be 26 fewer deaths before discharge.

Initial oxygen concentration for resuscitation in newborn

- ≥ 35 weeks GA – 21 % oxygen
- < 35 weeks – 21-30 % oxygen

Target Oxygen Saturation Table	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%


THANK YOU
We're on Track For a Cure