In The Name Of God

Respiratory Support And Management Of RDS In NICU

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Non-Invasive Respiratory Support

- nCPAP
- Bi-level CPAP, Duo-PAP, or BIPAP
- NIPPV
- Nasal HFOV (nHFOV)
- HFNC

Continuous Positive Airway Pressure

- **CPAP** is recommended as the **first choice** for primary and secondary respiratory support.
- **CPAP** involves
  - delivering gas, ideally **heated** and **humidified**
  - with a **measurable** and **controllable pressure** through an interface (short soft nasal prongs or mask), connected tightly to the baby's face creating a seal.

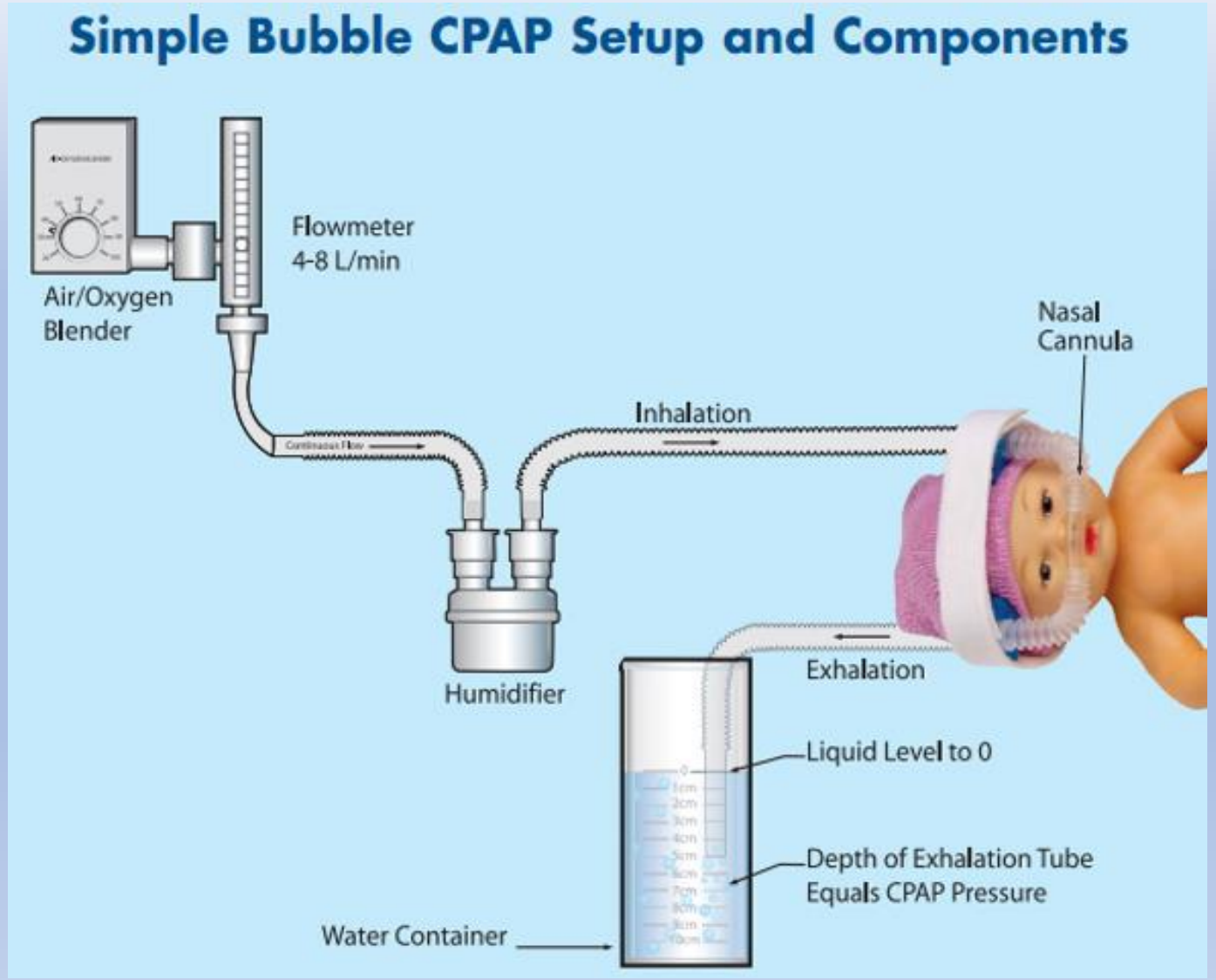
Benefits OF CPAP

- Splinting the upper airway
- Maintaining lung expansion
- Preventing end-expiratory alveolar collapse
- Reduced apnea rates
- Improved tidal volumes
- Higher functional residual capacity
- Reduced work of breathing
- Higher pressures improve oxygenation but potentially increase risk of air leaks.

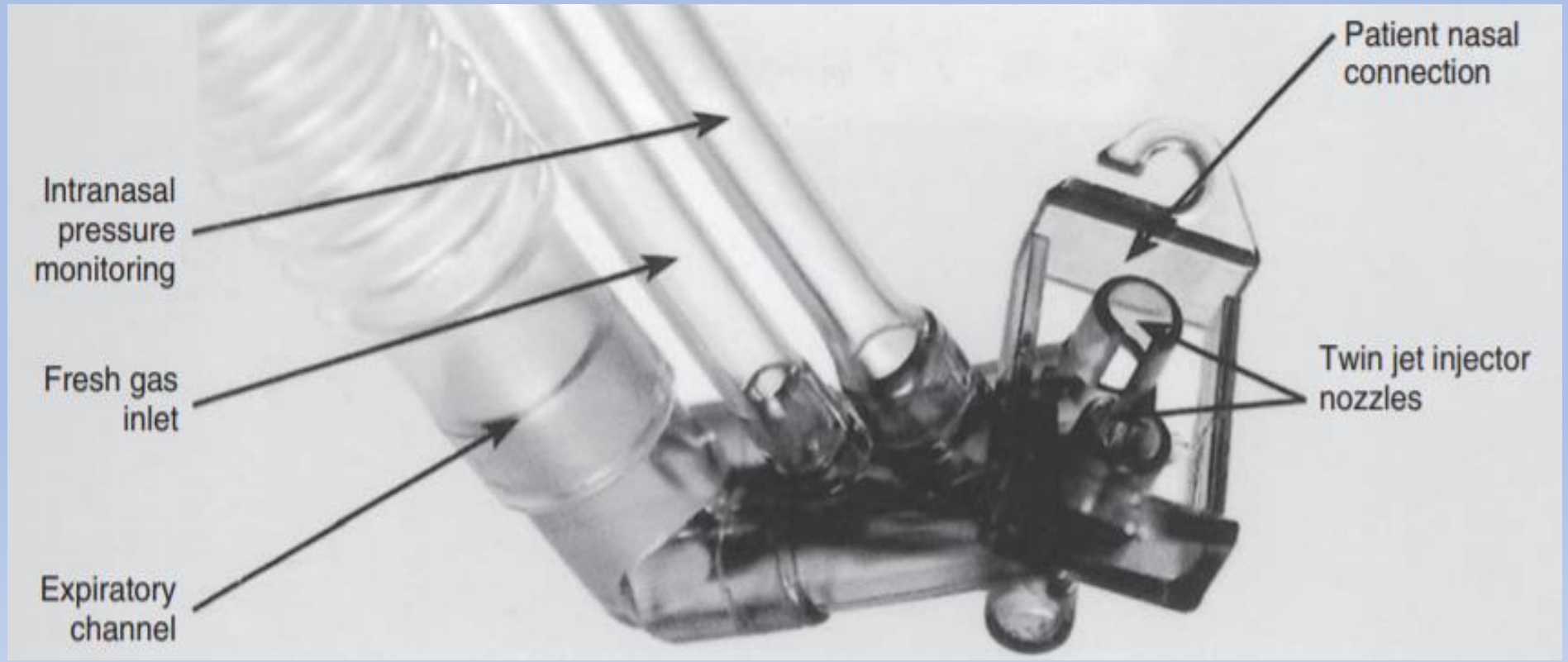
Different Types Of CPAP

- **CONSTANT FLOW CPAP**:
  - **Ventilator-derived**
  - **Bubble CPAP**
- **Variable flow CPAP**:
  - **Flow Driver CPAP**
    - **theoritical advantage: offloading expiratory work of breathing**

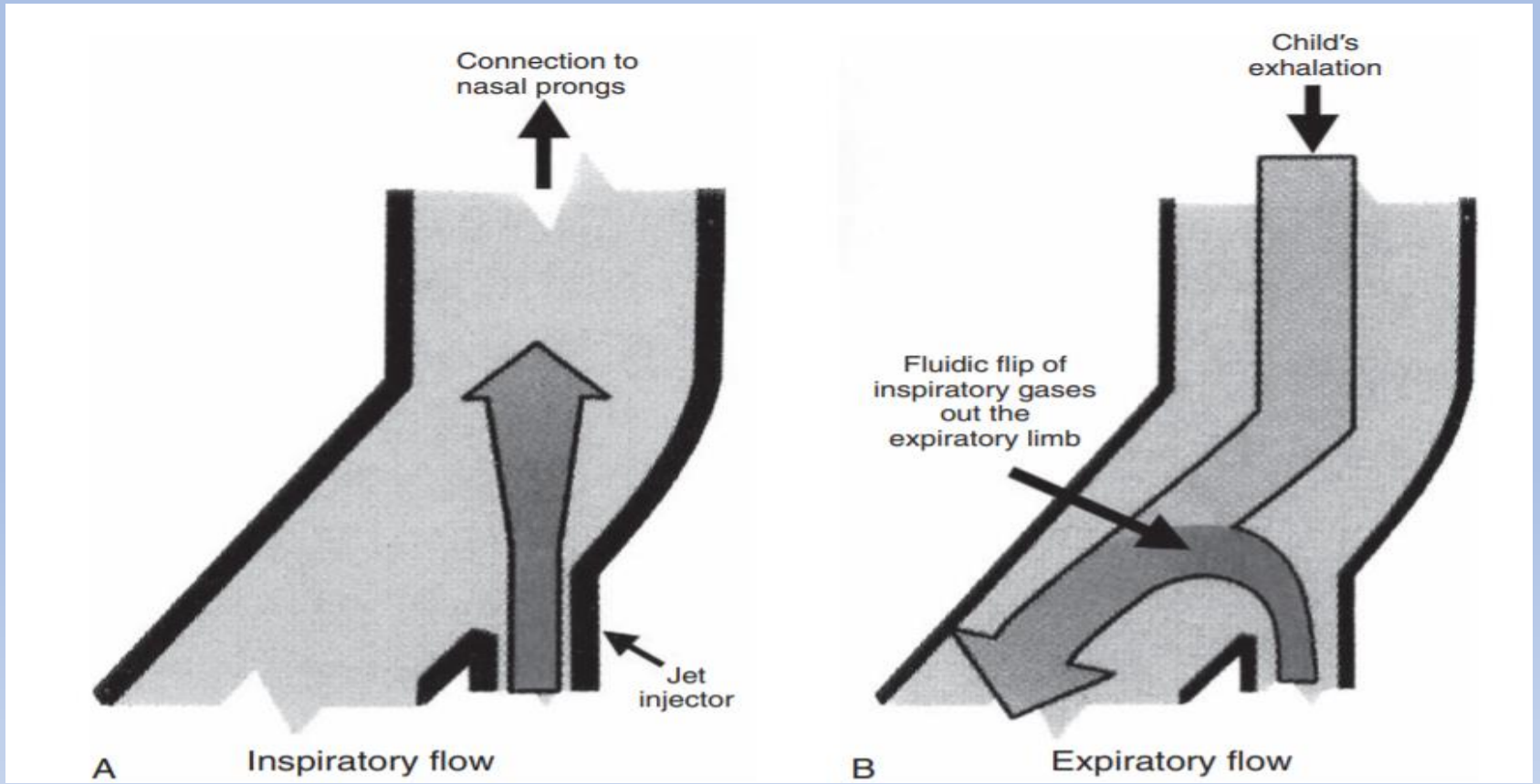
Simple Bubble CPAP Setup and Components



The Infant Flow Driver



The "fluid flip" of the variable-flow CPAP device



Recommendations Of AAP

- The American Academy Of Pediatrics (AAP) now recommends using nCPAP immediately after birth, with selective surfactant as needed.
- **Early nCPAP** may lead to a reduction in the duration of **mechanical ventilation** and use of **postnatal steroids**.
- The randomized trials and cochrane meta-analyses showing lower rates of CLD/death compared to prophylactic or early surfactant

Initial Setting

- Starting pressure level: **5 to 6 cm H2O**
- Increase to **8 to 10 cm H2O** to improve oxygenation
- Flow: **2-8 L/min**
- Perform blood gas analysis within **30 to 60 minutes** after any changes in pressure
- If oxygenation worsens or CO2 levels increase after increases in the pressure, the lungs may be overdistended.

What Is The Goal Of Treatment?

- The goal is to keep **o2 saturation** **90-95%** and **Fio2** **below 0.30** by increasing the nCPAP level stepwise up to **8 cm H2O**, if necessary.
- **VBG**: **PH >7.25** **Pco2 <60** **Po2: 50-80**

Weaning From CPAP

- **Low level pressure** (~5 cm H2O)
- Oxygen (**Fio2**) to **below 25%**
- **Without increased WOB** and **no** evidence of **apnea**, **bradycardia**, or **oxygen desaturation**

When weaning babies from CPAP a gradual reduction in pressure rather than sudden cessation of CPAP results in greater likelihood of success.

Contraindications To Nasal CPAP

- **Progressive respiratory failure**:
  - **Paco2 ≥ 60** mm hg and/or **PH ≤ 7.25**
- Congenital malformations:
  - **Congenital diaphragmatic hernia**
  - **Tracheoesophageal fistula**
  - **Choanal atresia**
  - **Cleft palate**
  - **Gastroschisis**

Contraindications To Nasal CPAP

- Severe cardiovascular instability : **hypotension**, **poor ventricular function**
- Poor or unstable respiratory drive:
  - Frequent **apnea**, **bradycardia**, and/or **oxygenation desaturation** that is not improved by nCPAP

Bi-level CPAP, Duo-PAP, or BIPAP

- Variants between CPAP and IPPV
- Use low pressure differences between inspiratory and expiratory phases at PIPs of 9–11 cm H2O at rates of around 20–40 per minute with long inspiratory times of up to 1.0 s.
- There is no evidence that BIPAP confers any advantage over CPAP

NIPPV

- **NIPPV** means providing **nasal intermittent positive pressure ventilation**, through modern ventilators , using pressures similar to those used for invasive MV.
- What are the Challenges of NIPPV?
  - pressure delivery through a **non-sealed system**, which is limited by **leak at the nasal interface** and the infant's tolerance to gas inflation of the stomach
- Recent systematic reviews concluded that **synchronised NIPPV** was the **most effective** primary respiratory support or post-extubation support, **decreasing the need for MV**, or **re-ventilation**, **and air leaks but without any reduction in BPD** in preterm infants.

Nasal HFOV (nHFOV)

- **Nasal HFOV (nHFOV)** is used in some centres in Europe and is the subject of ongoing research.
- A systematic review suggests that nHFOV **decreases intubation rates** when compared to CPAP.
- However, there is **lack of clarity in the methodology** of some of the studies, making it difficult for studies to be **replicated** and for **firm recommendations** to be made.

HFNC

- **Heated/Humidified gas** is delivered to the nostrils with **nasal catheters** that are specifically designed **not to occlude the nostrils**, typically at **flows of between 2 and 8 L/min**, with weaning of flow rate determined clinically by FiO2 remaining low and judgement of work of breathing
- In clinical trials, HFNC is broadly observed as **equivalent to CPAP** for **babies >28 weeks** **coming off MV**, with greater ease of use and less nasal trauma, although there is less evidence for smaller babies.

HFNC

- In a large-scale non-inferiority RCT, HFNC more often resulted in **treatment failure** compared to CPAP, but **the need for MV was similar.**
- **Positive attributes of HFNC**: less nasal trauma, reduced pneumothorax, greater patient satisfaction, and parent and nursing staff preference
- A more recent meta-analysis of HFNC trials recommends HFNC use as a **first-line option** for respiratory support in centres capable of offering CPAP and/or NIPPV as a backup

Recommendations

- **CPAP** or **(s)NIPPV** should be started from birth in all babies at risk of RDS, such as those **<30 weeks** of gestation who do not need intubation for stabilisation (A1).
- **NIV** with **early rescue surfactant** by **LISA** technique is considered **optimal management** for babies with RDS (A1).
- **The system delivering CPAP is of little importance**; however, the **interface** should be **short binasal prongs** or **mask** with a starting pressure of about **6–8 cm H2O** (A2). Ability to escalate to NIPPV will reduce the need for invasive MV in some infants (A1).

Recommendations

- **Synchronised NIPPV**, if delivered through a ventilator, can **reduce** need for **ventilation** or need for **re-ventilation** following extubation and may reduce **BPD** (A2).
- **HFNC** can be used as **an alternative** to CPAP for some babies, with the advantage of less nasal trauma, provided centres have access to CPAP or NIPPV for those failing this mode (B2)

Recommendations

- **MV** should be used in babies with RDS when other methods of respiratory support have **failed** (A1). Duration of MV should be minimised (B2).
- When assisted mechanical ventilation is required?
  - respiratory failure or persistent apnea
- Reasonable measures of **respiratory failure** are
  - (1) arterial blood pH<7.20
  - (2) $PaCO_2$ ≥60 mm Hg
  - (3) SaO_2 <90% at O_2 concentration of 40–70% and nCPAP of 5-10 cm H_2O
  - (4) persistent or severe apnea.

- Lung-protective modes such as **VTV** or **high-frequency oscillation ventilation** should be the **first choice** for babies with RDS who require MV (A1).
- **Volume-targeted ventilation** (VTV) allows real-time **weaning of pressure** as lung compliance improves and results in **less time on ventilation, fewer air leaks**, and **less BPD.**
- **Volume targeting** can **reduce hypocarbia** in even the smallest infants.

Recommendations

- **Ventilation modes supporting every spontaneous breath** rather than **synchronised IMV** **makes sense**,
  - although **if volume targeting is not possible**, it may be **safer to use synchronised IMV** where the ventilation rate is clinician controlled.
- Supporting the infants' own respiratory efforts with **modes** where both **inspiration** and **expiration** are **synchronised**, such as **PSV** or NAVA, can **improve patient comfort** and **facilitate weaning**.
- Acceptable ranges of ABG values:
  - **PaO2 50-70 mm Hg**
  - **PaCO2 45-65 mm Hg (and higher after the 1st few days when risk of IVH is less)**
  - **and pH 7.20-7.35.**

Recommendations

- When **weaning** from MV, it is reasonable to tolerate a **modest degree of hypercarbia**, provided the **pH** remains above **7.22** (B2). **Avoid pCO2 < 35 mm Hg** when on MV to **reduce brain injury** (C1).
- **INO** in **preterm** babies should be limited to a **therapeutic trial** for those in whom there is documented **pulmonary hypertension** with **severe respiratory distress** and stopped if there is no response (D2).
- **Caffeine** (20 mg/kg loading, 5–10 mg/kg maintenance) should be used to **facilitate weaning** from MV (A1). Early caffeine can be considered for babies at **high risk** of needing MV such as **preterm babies on NIV** (C1)

Recommendations

- A short tapering course of **low-dose dexamethasone** should be considered to **facilitate extubation** in babies who remain on MV **after 1–2 weeks** (A2)
- **DART trial protocol**: 0.075 mg/kg/dose every 12 hours for 3 days, 0.05 mg/kg/dose every 12 hours for 3 days, 0.025 mg/kg/dose every 12 hours for 2 days, and 0.01 mg/kg/dose every 12 hours for 2 days
- **Opioids** should be used selectively when indicated by clinical judgement and evaluation of pain indicators (D1). The routine use of morphine or midazolam infusions in ventilated preterm infants is not recommended (A1).


THANK
YOU!