High flow heated humidified Oxygen therapy (HFNC) – What is it’s role?

Paul Ritson MCSP
Clinical Specialist Physiotherapist in Paediatric Intensive Care
Alder Hey Children’s NHS Foundation Trust, Liverpool, UK
Objectives

• What is HFNC?

• Key benefits

• Which patients?

• Delivering HFNC

• Weaning...
What is HFNC?

- Comfortable and effective delivery of oxygen and humidification via nasal cannula
- Hypoxaemia
- Hypercapnoea
- Mild to moderate respiratory distress
Key Benefits

Optimal Humidity

High flows of oxygen delivered comfortably through nasal cannula.

- Meet Inspiratory demand. Deliver up to 100% oxygen accurately.
- Washout of anatomical deadspace.
- Positive Airway Pressure.
- Optimized mucociliary clearance.
1. Optimised mucociliary clearance

- HFNC provides humidification technology that emulates the natural balance of temperature and humidity in healthy lungs

- The air/oxygen blend delivered with HFNC is conditioned to provide optimal humidity

- $37^{\circ}C$, $44mg/L$
• Delivering optimal humidity improves mucociliary clearance

• Reduced secretion viscosity

• Improved transport of mucous from the airway

Schiffmann, 2006
2. Positive airway pressure

- Low levels of positive airway pressure may be generated

- Amount is dependent on a number of variables:
  - Flow (5-60L/min)
  - Upper airway anatomy
  - Nasal cannula size relative to nares
  - Mouth open or closed

Parke et al., 2009 and Kubicka et al., 2008)
Expiratory pharyngeal pressure - mouth closed

Pressure (cmH₂O) vs. Flow rate (L/min)

(Corley et al., 2011)
Parke et al., 2009 (Adult study)

Comparing NP pressures with HFNC and face mask oxygen therapy with mouth open and closed
3. Effective Oxygen delivery

- Flow delivered with HFNC aims to meet or exceed the patient’s inspiratory demand:
  a) Minimises room air entrainment
  b) Dilution of oxygen and humidity reduced
4. Washout of anatomical dead space

- Washout of the anatomical dead space by the continuous delivery of high flow gas
  
a) Reduces re-breathing of expired CO$_2$

b) Provides reservoir of fresh gas in the upper airway for each breath

- May assist in more efficient gas exchange

Spentzas et al., 2009
Which patients?

- HFNC is a comfortable and effective means of delivering oxygen and humidification to infants and children in respiratory distress
- It provides a bridge between low flow \( O_2 \) therapy and CPAP/non invasive ventilation
- It MAY reduce the requirement for CPAP and intubation in some clinical scenarios, if used at the right time... (Abboud et al., 2012)
Cautions/ Contra-indications

- Maxillofacial trauma
- Complete nasal obstruction
- Basal skull fracture
- All contraindications to CPAP/ BiPAP apply
<table>
<thead>
<tr>
<th>Patient group</th>
<th>Examples</th>
<th>Clinical issues</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstructive pulmonary disease</td>
<td>Bronchiolitis</td>
<td>Thick secretions</td>
<td>Mild /moderate hypoxaemia/hypercapnoea</td>
</tr>
<tr>
<td></td>
<td>Asthma</td>
<td>Blocked airways (structural or secretions)</td>
<td>↑ WOB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>↑ O₂ requirements</td>
</tr>
<tr>
<td>Restrictive pulmonary disease</td>
<td>Fibrosing alveolitis</td>
<td>↓ FRC</td>
<td>As above</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓ Gas exchange</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>Influenza</td>
<td>Airway obstruction due to secretions</td>
<td>As above</td>
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<td></td>
<td></td>
<td>Consolidation</td>
<td></td>
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<tr>
<td>Atelectasis</td>
<td>Post op patient</td>
<td>V/Q mismatch</td>
<td>As above</td>
</tr>
<tr>
<td></td>
<td>Trauma</td>
<td>Mucous plugging</td>
<td></td>
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</tbody>
</table>
When to initiate?

- High oxygen requirement
- Increased work of breathing
- Poor tolerance of mask
- Patients who may benefit from humidity/assistance clearing secretions

- Do we really need a gas?
Delivering HFNC

Optiflow™ and Vapotherm® are equally effective for weaning from NCPAP without increasing the risk of pneumothorax or bronchopulmonary dysplasia (Mahoney et al., 2011)
Airvo™ and Airvo2™

- **Advantage** – does not require high pressure air source
- Air is entrained
- $\text{O}_2$ added via standard green bubble tubing
Delivering HFNC (Optiflow)

- Heated wire humidity delivery circuit
- F&P MR850 humidifier
- Air/Oxygen blender with standard or higher flow flow meter (air and \( \text{O}_2 \) source)
- Nasal cannula interface
Delivering HFNC (Airvo)

• Heated wire humidity delivery circuit
• $O_2$ source (cylinder or flow meter)
• Nasal cannula interface
## Cannula size and recommended flow

<table>
<thead>
<tr>
<th>Description</th>
<th>Approx weight</th>
<th>Max Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature nasal cannula</td>
<td>&lt;2kg</td>
<td>6-8 L/min</td>
</tr>
<tr>
<td>Neonatal nasal cannula</td>
<td>1-8Kg</td>
<td>8 L/min</td>
</tr>
<tr>
<td>Infant nasal cannula</td>
<td>3-15kg</td>
<td>20 L/min</td>
</tr>
<tr>
<td>Paediatric nasal cannula</td>
<td>12-22Kg</td>
<td>25 L/min</td>
</tr>
</tbody>
</table>
Management of HFNC
Don’t forget the BASICS!

Baseline observations

• Respiratory rate
• Heart rate
• FiO₂
• SpO₂
• Work of breathing
• (Auscultation)

Level of support

• FiO₂
• Flow – (2litres/kg approx)
• Humidification temp
• Positioning
• Consider ↓ volume and ↑ frequency of feeds
• Regular reassessment and titration of support
Indicators of success

• Normalising respiratory and heart rates

• Improved work of breathing

• Improved SpO₂

• Reduction in FiO₂

• Timescale?

• Don’t flog!!

• Plan for deterioration
Weaning (be flexible!)
In our experience...

First reduce FiO2

- Keep SpO₂ within normal limits
- Reverse change if ↓ SpO₂ or ↑WOB
- Wean until FiO₂ 0.3 (depends on normal O₂ requirement)

Next reduce flow

- Reduce flow by 0.5 or 1.0 L at a time (more if tolerated)
- Reverse change if ↓ SpO₂ or ↑WOB
- Consider change to normal nasal cannula O₂ once flow at 2 L/min, with low FiO₂, normal SpO₂, and no ↑WOB
- Timescale varies +++
Caution!!

- At low flow rates (compared to the age/size of the patient), entrainment of room air will occur.
- Therefore, accurate FiO₂ measurement is not possible.
Where?

• Any area that has skilled clinicians capable of recognising the deteriorating (and improving) child 24 hours a day
Take home message

• Easy to set up and maintain

• Provides accurate Oxygen delivery

• Helps improve mucociliary clearance

• Can prevent intubation and mechanical ventilation if used at the right time

• If it’s going to work, it will work quickly if the right level of support is given
References


• Kubicka ZJ, Limauro J, Darnall RA: Heated, humidified high flow nasal cannula therapy: Yet another way to deliver continuous positive airway pressure? *Pediatrics* 2008; 121:82-88

• Mahoney L, et al: Optiflow™ versus Vapotherm® as extended weaning mode from nasal continuous airway pressure (NCPAP) in preterm infants ≤28 weeks gestational age (GA). *Pediatric Research* 2011; 70: 526–526


