HIGH FLOW NASAL CANNULA IN THE EMERGENCY DEPARTMENT

Sharmistha Dev, MD MPH
University of Michigan

NO FINANCIAL DISCLOSURES
Table of Contents

- Comparing modalities of oxygenation
- What is HFNC?
- Physiology of HFNC
- Benefits of HFNC
- Uses
- Pitfalls

Case #1:

- 75F hx of dementia, HTN, HL, dysphagia, nursing home patient presents after being found by nurse to be lethargic with a low O2 saturation.
- Vitals: T 38.8 100/78 105 28 94% on nonrebreather (82% on room air)
- Confused, rales at bilateral bases
- ABG on RA (pH 7.45 PCO2 28 PO2 65 HC03 25)

https://www.researchgate.net/profile/John_Greene7/publication/296686902/figure/fig1/AS:337003515269121@1457359307429/X-ray-of-the-chest-revealed-a-right-basilar-opacity-which-represented-consolidation-or.png
Case #2

- 60M hx of COPD presents w/ 2 days of worsening SOB after recent URI symptoms.
- Vitals: T 37.8 150/95 112 32 90% on RA
- Speaking in short sentences, use of accessory muscle for breathing, wheezing bilaterally diffusely,
- ABG on RA pH 7.20, PCO2 70, PO2 62, HC03 25

Modalities of Oxygenation

<table>
<thead>
<tr>
<th>TYPE</th>
<th>FLOW RATE</th>
<th>FIO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal Cannula</td>
<td>1-6 LPM</td>
<td>25-45%</td>
</tr>
<tr>
<td>Venturi-Mask</td>
<td>4-15 LPM</td>
<td>25-50%</td>
</tr>
<tr>
<td>Non-Rebreather</td>
<td>10-15 LPM</td>
<td>~ 100%</td>
</tr>
<tr>
<td>NIPPV</td>
<td>IPAP/EPAP</td>
<td>Any FiO2</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>Any flow rate</td>
<td>Any FiO2</td>
</tr>
</tbody>
</table>
### Nasal Cannula

<table>
<thead>
<tr>
<th><strong>PROS</strong></th>
<th><strong>CONS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Readily available</td>
<td>Can dry out mucous membranes</td>
</tr>
<tr>
<td>Usually well tolerated</td>
<td>Less control of FiO2</td>
</tr>
<tr>
<td></td>
<td>Uncomfortable at high flow rates</td>
</tr>
</tbody>
</table>

![Nasal Cannula](https://upload.wikimedia.org/wikipedia/commons/0/0a/Nasal_Cannula_Adult.png)

### Venturi-Mask

<table>
<thead>
<tr>
<th><strong>PROS</strong></th>
<th><strong>CONS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Can set precise FiO2</td>
<td>Dependent on mask-fitting</td>
</tr>
<tr>
<td>Usually well tolerated</td>
<td>Interferes w/ eating, talking, coughing</td>
</tr>
</tbody>
</table>

![Venturi-Mask](https://img2.tfd.com/mk/V/X2604-V-09.png)
### Non-Rebreather

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closer to 100% FiO2</td>
<td>Same problems as other masks</td>
</tr>
<tr>
<td>Usually well tolerated</td>
<td>Intended for temporary use</td>
</tr>
</tbody>
</table>

![Non-Rebreather Mask](http://media.attesting.com/rm/media01/nonrebreather_mask/images/media1_2.jpg)

### NIPPV

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivers set FiO2 and PEEP</td>
<td>Can be uncomfortable</td>
</tr>
<tr>
<td>Provides ventilatory support</td>
<td>Relative contraindication in AMS patients</td>
</tr>
<tr>
<td></td>
<td>Mask fit important</td>
</tr>
</tbody>
</table>

![NIPPV Mask](http://media.attesting.com/rm/media01/nonrebreather_mask/images/media1_2.jpg)
What is HFNC?

- Method of delivering high-flow oxygen via wide bore nasal cannula or trach adapter
- Provided humidified oxygen therapy
- Can set to flow rate up to 60L/min
- FiO2 can be adjusted
- High flow rates can generate low levels of PEEP

![Image](https://media.springernature.com/lw785/springer-static/image/art%3A10.1186%2Fs40560-015-0084-5/MediaObjects/40560_2015_84_Fig1_HTML.gif)

Physiology

- Humidified air helps decrease airway resistance
- Improves nasal mucociliary clearance
- Helps decrease physiological dead space
- Increases alveolar recruitment

![Image](https://www.researchgate.net/profile/R_Coudroy/publication/318677553/figure/fig1/AS:52066825718888881501148394356/Physiological-effects-of-HFNC-oxygen-therapy-HFNC-high-flow-nasal-cannula.png)
Benefits

- Increased patient tolerance and comfort
- Decreased work of breathing
- Allows for broad range of flows and oxygen concentrations

USES: Hypoxemic Respiratory Failure

- Classic use
- Benefit compared to NC: improved FiO2, and less airway resistance
- Benefit compared to NIPPV: allows for coughing and mobilizing of secretions
- Sztrymf et al: nonrebreather (15L/min) vs. HFNC (49 +/-9L/min)
  - Decreased RR
  - Decreased HR
  - Decreased retractions
  - Improved thoraco-abd synchrony
  - Improved SpO2
  - Improved patient tolerance
USES: Hypoxemic Respiratory Failure

- Frat et al: 310 CAP patients randomized to nonrebreather vs. HFNC (at least 2 days) vs. NIPPV (at least 8 hours/day)
  - No difference in intubation rates
  - Lower rates of 90-day all-cause mortality w/ HFNC, even after risk adjustment
  - Post-hoc analysis of PaO2/FiO2<200: lower intubation rates
- Ni Yue-Nan et al: Meta-analysis of 18 studies of patients w/ resp failure; standard O2 vs. HFNC vs NIPPV
  - Standard O2 vs HFNC → decreased rates of intubation
  - HFNC vs. NIPPV → no diff in rates of intubation
  - No change in ICU mortality or LOS
  - HFNC better tolerated

USES: Preintubation Oxygenation

- Allows for apneic oxygenation
- Miguel Montanes et al: HFNC vs. nonrebreather for preoxygenation
  - Higher SpO2
  - Lower rates of severe hypoxemia
- Frat et al: HFNC vs. NIPPV for preoxygenation prior to intubation
  - No diff in risk of hypoxemia during intubation
  - NIPPV better in those with severe hypoxemia (PaO2/FiO2<200)
USES: Post-extubation Oxygenation

- Hernandez et al: Extubated to standard O2 (NC/NRB) vs. HFNC
  - HFNC had lower rates of re-intubation within 72 hours
  - HFNC has lower rates of post-extubation resp distress/failure
- Hernandez et al: Extubated to NIPPV vs. HFNC
  - No significant difference in re-intubation rate
  - No significant difference in time to re-intubation
  - Decreased ICU LOS in HFNC group
  - NIPPV had higher rates of withdrawal of therapy due to patient intolerance

USES: Pulmonary Edema

- Not a lot of data
- Decreased inspiratory IVC collapse during inspiratory phase seen on echo with use of HFNC
- Makdee et al: standard O2 vs. HFNC in patients with cardiogenic pulmonary edema
  - Lower resp rate with HFNC
  - No diff in admission rate, ED and hospital LOS, NIPPV, intubation or mortality
Other Potential Uses

- DNR/DNI patients
  - Better tolerated than NIPPV
  - May allow for treatment outside of ICU
- Use during procedural sedation
- Better tolerated long term in patients with respiratory failure due to neuromuscular conditions

Pitfalls

- Has not been shown to be effective in hypercapneic respiratory failure
  - Limited studies
- Do not delay intubation
  - Kang et al: delay in intubation due to HFNC → increased mortality
- Consider using Rox index to determine success of HFNC
  - \((\text{SpO2}/\text{FiO2})/\text{RR}\)
  - Index higher than 4.88 → increased success with HFNC
- Remember to wean your FiO2
Case #1:

- 75F hx of dementia, HTN, HL, dysphagia, nursing home patient presents after being found by nurse to be lethargic with a low O2 saturation.
- Vitals: T 38.8 100/78 105 28 94% on nonrebreather (82% on room air)
- Confused, rales at bilateral bases
- ABG on RA (pH 7.45 PC02 28 PO2 65 HCO3 25)


Case #2

- 60M hx of COPD presents w/ 2 days of worsening SOB after recent URI symptoms.
- Vitals: T 37.8 150/95 112 36 86% on RA
- Speaking in short sentences, use of accessory muscle for breathing, wheezing bilaterally diffusely,
- ABG on RA pH 7.20, PC02 70, PO2 62, HCO3 25

https://prod-images.static.radiopaedia.org/images/762502b8/1be8c81730425b6761052bfa1d569_jumbo.png
SUMMARY

- HFNC can decrease work of breathing and better tolerated than NIPPV
- Proven benefit in hypoxemic respiratory failure compared to standard oxygen therapy
- May be an alternative to NIPPV in hypoxemic respiratory failure
- Consider in preintubation instead of nonrebreather for apneic oxygenation
- Post extubation, found to decrease reintubation rates compared to standard oxygenation
- No benefit in hypercapnic respiratory failure
- Reassess for benefit of HFNC
- Do not delay intubation

References

References


