Ischaki E, Pantazopoulos I, Zakynthinos S.
Eur Respir Rev. 2017; Aug 9;26(145). Sep 30.[Epub ahead of print].

Nasal high flow therapy: a novel treatment rather than a more expensive oxygen device

AIM:

To present available data on the physiological effects and clinical efficacy of nasal high flow (NHF) therapy across a range of clinical indications and propose an algorithm for the rational clinical application of NHF therapy in patients with acute hypoxemic respiratory failure (AHRF) of almost any cause.

METHOD:

Search criteria

- Trials and reviews of NHF therapy in adult patients in PubMed and the Cochrane Database
- Search limited to English language publications using the terms “high flow” OR “heated” OR “humidified” AND “oxygen” OR “nasal oxygen” OR “nasal cannulae” in the text or title
- Last search conducted on April 1, 2017 (99 references are included)

RESULTS:

Mechanism of action overview

- NHF therapy results in improved gas exchange, lower respiratory rate (RR) and effort, improved lung volume, dynamic compliance, transpulmonary pressures and homogeneity of ventilation
    - Consequently, patients breathe more comfortably with less subjective dyspnea from the reduced work of breathing

Clinical implications overview

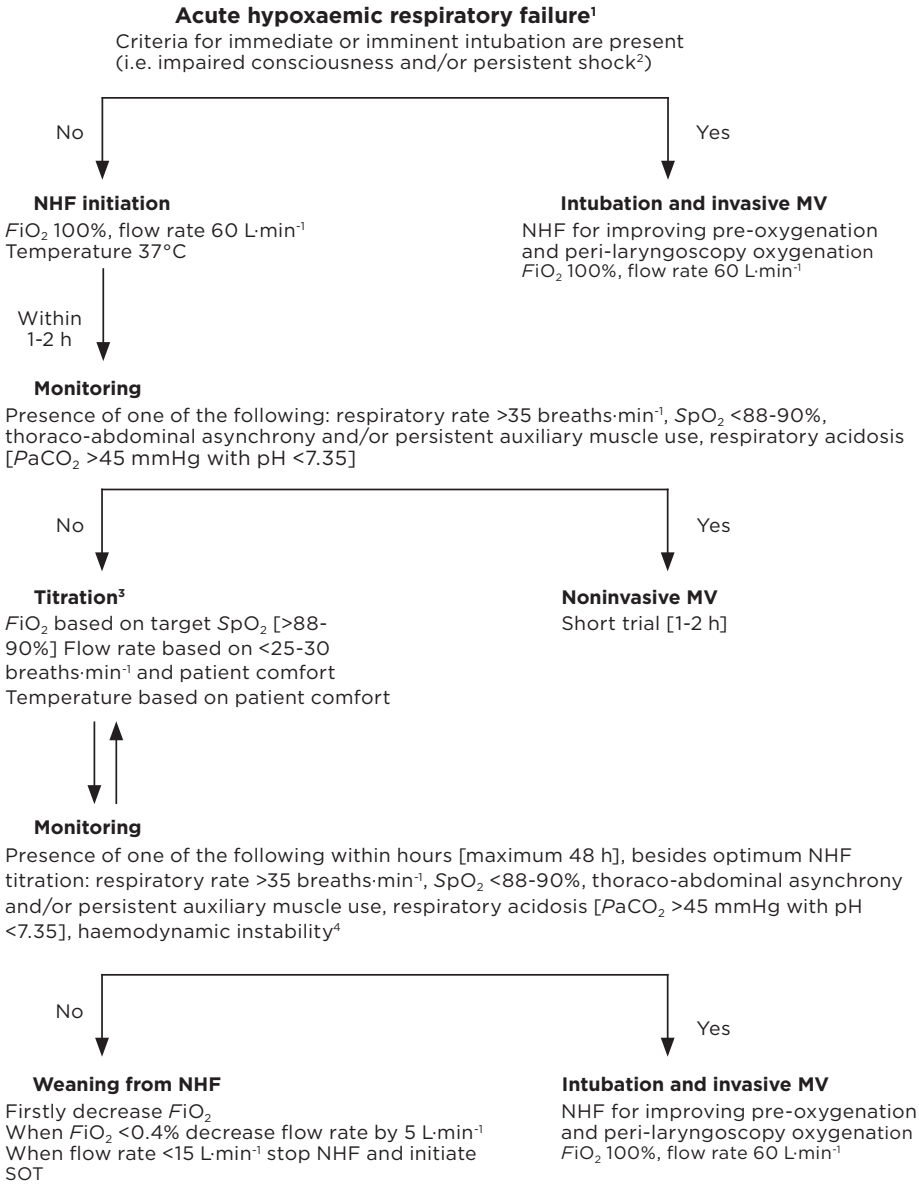
- The authors presented clinical data from studies across a range of indications in which NHF therapy has shown clinical benefit, including:
    - Acute hypoxic respiratory failure
    - Post-extubation in the ICU
    - Post-extubation following surgery
    - Pre- and peri-oxygenation during intubation
    - Acute hypoxemic respiratory failure in immunocompromised patients
- Studies in which NHF therapy had shown no clinical benefit were also presented for each of these indications
- Other potential indications for NHF therapy (with very limited data) were also presented, including: during bronchoscopy; stable chronic obstructive pulmonary disease (COPD) with chronic respiratory failure; decompensated heart failure; and in patients who have the status “do not intubate”

An algorithm for clinical use

- Based on the existing literature on NHF therapy in patients with AHRF, the authors proposed an algorithm for use when NHF therapy is available and has been chosen as the initial oxygen delivery device (shown below)

In summary:

- If a patient is admitted with clinical signs of acute respiratory distress and blood gas analysis demonstrates hypoxemia (PaO_2/FiO_2 < 300) of almost any cause without hypercapnia ($PaCO_2$ > 45mmHg with pH < 7.35), check primarily whether or not the criteria for imminent intubation and invasive mechanical ventilation are met (see algorithm)
    - If the criteria are met, intubation should be performed (NHF may be used for pre-oxygenation and apneic oxygenation during laryngoscopy)
    - If the criteria are not met, NHF should be initiated as soon as possible
- Monitoring for respiratory parameters with negative prognostic significance should be performed within 1-2 hours of NHF initiation
    - This allows for early identification of patients not responding to NHF therapy. (They could be considered for a short course of noninvasive ventilation [NIV] prior to intubating)
    - NHF settings should be checked and adjusted accordingly during the monitoring of the patient
    - Flow rate could be adjusted downwards by 5-10 L/min every 1-2 hours if no negative prognostic factors are present
    - If targets of SpO_2 and RR are not achieved while the flow rate is < 60 L/min, the flow rate can be increased by 5-10 L/min rather than raising the FiO_2. (Higher flow rates reduce entrainment of room air during inspiration and increase the airway pressure linearly, thus recruiting more alveolar units)
    - If SpO_2 remains low, then an increase in FiO_2 is required
- Patients under NHF therapy should be monitored closely to avoid undesired respiratory and cardiac complications with a maximum timeframe of 48 hours
    - Parameters that require regular monitoring include respiratory parameters and parameters indicating hemodynamic instability
- If no improvement in seen within 48 hours, NHF therapy should be considered to have failed and intubation and mechanical ventilation should be initiated as soon as possible. (Maintaining a failed NHF therapy could disguise further respiratory deterioration and increase mortality)
- If clinical and gasometric parameters gradually improve, then weaning from NHF can be commenced
    - FiO_2 should first be lowered to 40-50%, proceeding with a stepped decrease in flow rate of 5-10 L/min. (The intervals of these decrements can be longer or shorter depending on the patient's clinical and physiological parameters)
    - When the patient is stable for 1-2 hours with FiO_2 at 40% and flow rate < 15 L/min, NHF should be stopped and a Venturi mask or nasal oxygen can be commenced



[1] Recommended algorithm for nasal high flow use in acute hypoxaemic respiratory failure in immunocompetent or immunocompromised patients, those with PaO_2/FiO_2 < 300. Those with $PaCO_2$ > 45mmHg and pH < 7.35 are excluded.

[2] Systolic arterial blood pressure < 90 mmHg despite adequate fluid administration.

[3] The rationale for change in NHF settings:

a) Flow rate could be reduced by 5-10 L.min^{-1} per 1-2h if none of the negative prognostic factors are present. However, if targets of arterial oxygen saturation measured by pulse oximetry (SpO_2) and respiratory rate are not achieved, while the flow rate is still < 60 L.min^{-1}, increase of flow rate by 5-10 L.min^{-1} is preferred to raising FiO_2.

b) Increase in FiO_2 causes increase in PaO_2 and SpO_2.

c) Temperature can be set at 37°C or lower (31-34°C), based on the patient's comfort.

[4] Haemodynamic instability is defined by heart rate > 140 beats.min-1 or change > 20% from baseline and/or systolic arterial blood pressure > 180 mmHg, < 90 mmHg or decrease > 40 mmHg from baseline.

MV = mechanical ventilation; SOT = standard oxygen treatment

CONCLUSIONS:

Mechanism of action overview

- More stable FiO_2, CO_2 wash-out effect, PAP generation, and effective hydration of the administered gas are the main mechanisms behind the greater perceived comfort and tolerance of NHF therapy by the patient, as well as more effective oxygenation and improved breathing with less dyspnea
- Further controlled studies are needed in specific diseases and types of respiratory failure to determine which types of patients will benefit most from NHF therapy
    - Special attention should be given to the settings of FiO_2 and flow rate per disease and the maximum safe duration of NHF application before the initiation of NIV or invasive mechanical ventilation
    - Currently, the choice of supplemental oxygen should be personalized and based on a patient's clinical status, underlying disease, severity of hypoxemia, coexistence of hypercapnia, and patient tolerance and comfort

KEY POINTS:

- The beneficial effects of NHF therapy over standard oxygen therapy are reported in most of the studies identified in this review
- An algorithm is proposed for cases of NHF application in patients with AHRF of almost any cause
- The choice of supplemental oxygen therapy should be personalized, and based on clinical status, underlying disease, severity of hypoxemia, coexistence of hypercapnia, and patient tolerance and comfort