

High Flow Nasal Oxygen: Is it the bees knees of O₂ therapies?

Nepean WTET summary 28/4/20

Rationale and Background

- The administration of warmed humidified oxygen at flow rates that may match or even exceed peak inspiratory flow rates (in the well patient at rest this is 30L/min) has a number of potential benefits over conventional methods of delivering oxygen therapy:
 - Improved oxygenation; PEEP (increased end expiratory lung volume) up to 7cmH₂O, more reliable FiO₂ delivery (by matching of inspiratory flow rates – less entrained air, potential reservoir effect)
 - Increased CO₂ clearance; washout of pharyngeal dead space and improved respiratory efficiency, positive pressure effect may assist with mild obstruction (OSA)
 - Improved secretion clearance; better mucociliary function (humidification), interface itself promotes comfort and self-expectoration
- It is however not without its own caveats and complications and thus warrants a balanced approach
 - May lead to inappropriate delays in initiation of invasive ventilation (can deliver high FiO₂, patients look 'less sick' with nasal oxygen)
 - Much of the potential PEEP benefit lost if mouth open (2cmH₂O)
 - Barotrauma and pneumothoraces are particularly seen in the paediatric/neonatal population if high flows (relative to weight/age) used
 - Aspiration (gastric contents or circuit rainout) although less so than with NIV
 - Epistaxis due to damage of nasal mucosa (particularly if coagulopathic)

Indications and Contraindications

- Indications;
 - Intubation not appropriate (frail, multiple comorbidities, possible reversible respiratory failure)
 - Intubation not desired first line therapy e.g. immunocompromised with hypoxic respiratory failure
 - Non-invasive ventilation not appropriate e.g. upper GI surgery (ivor-lewis), intolerance (reduce anxiolytics use)
 - Pre-intubation apnoeic oxygenation (?in particular difficult airway or obese)
 - Revolutionised paediatric practice (won't discuss this literature here) e.g. bronchiolitis and cardiac
- Contraindications;
 - Need for predictable level of PEEP
 - Unprotected airway (as per any other modality of non-invasive supplemental O₂) or other indication for invasive ventilation → do not delay invasive ventilation where indicated
 - Base of skull fractures, severe facial/nasal trauma, post transsphenoidal pituitary resection
 - Usually avoid in pneumothorax, epistaxis (most UGI surgeons happy for use post-op but individual)

Evidence

- Acute respiratory failure;
 - Parke et al 2011 Respiratory Care
 - Cardiothoracic/vascular ICU mild-moderate HRF; high-flow nasal versus high flow facemask oxygen, randomised n=60
 - Less treatment failure (desaturations and/or 'rescue NIV') in HFNO group
 - FLORALI 2015 NEJM
 - Hypoxaemic respiratory failure (HRF) P/F<300 (without hypercapnoea)
 - HFNO vs O₂ via facemask vs NIV; randomised multicenter, n=310
 - Non-statistically significant reduction in intubation at 28d with HFNO (38%, 47%, 50%), but improvement in ventilation days and 90d mortality in HFNO group
 - Meta-analysis (all-comers) 2017 Critical Care
 - 9 trials, n=2507 with or AT RISK of acute respiratory failure

- No statistical difference in mortality or intubation rates but more evidence required
 - Qualitative analysis of 13 trials → reduced dyspnea score, increased patient comfort with HFNO
 - HIGH RCT JAMA 2018
 - HFNO vs standard O2 therapy in immunocompromised with HRF, n=778
 - No difference in 28d mortality, intubation rates or ICU length of stay (LOS)
 - Meta-analysis (immunocompromised) 2019-2020 ATS/Respiratory Care/Critical Care
 - Differing meta-analyses with differing conclusions → those looking at early mortality seem to suggest a benefit (28d), those looking at in hospital and 90d mortality did not show a benefit
 - Generally agree however reduced invasive mechanical ventilation
- Pre-intubation;
 - Thrive 2014 Anaesthesia
 - 25 patients undergoing airway surgery oxygenated with HFNO (70L/min!) and jaw thrust
 - Median apnoea time 14mins (range 5-65mins!!) no desaturation <90% → conclude better than classic apnoeic oxygenation conditions
 - Preoxyflow 2015 ICM
 - HRF with P/F<300, FiO2>0.5 and respiratory rate >30/min; continuous HFNO versus face mask removed at the end of induction. MC RCT n=119 included in intention to treat analysis
 - Lowest SpO2 91.5% vs 89.5% (p=0.44) and no difference in intubation grade → no benefit
- Post-extubation;
 - Maggiore et al. 2014 Am J Resp Crit Care
 - P/F<300 immediately before extubation randomised to HFNP versus venturi for 48h, n=105
 - HFNO better oxygenation (P/F 287 vs 247 P=0.03) and fewer reintubations (4% vs 21% P=0.01)
 - BIPOP 2015 JAMA
 - Post-operative cardiothoracic surgical patients with or at high risk of HRF randomised to continuous HFNO versus minimum 4h/d of BIPAP, n=830, NONINFERIORITY study
 - No difference in treatment failure (reintubation) or mortality → non-inferior
 - *Many other trials looking at various subgroups and comparing different strategies (incl. Hernandez)*
 - Meta-analysis 2019 Crit Care
 - 10 studies, n=856. HFNO compared to conventional oxygen therapy after planned extubation
 - Less respiratory failure and tachypnoea in HFNO, but no difference in reintubation or LOS
- *Low level but promising work in other patient groups eg asthma*

Summary (my practice)

- If already in situ I may consider using HFNO peri-intubation but it does not form part of my usual practice. Firstly for apneic oxygenation to occur by mass shift principles there MUST be a patent airway (in which case the option of BMV remains, if required), furthermore their bulky presence often impedes BMV seal for both preoxygenation and if manual ventilation becomes indicated. Gastric insufflation may also be worsened (compared to no BMV). I therefore consider them (if in situ) for a patient at risk of rapid desaturation (primary lung pathology) during even the shortest periods of airway manipulation, alongside a solid airway plan and a skilled practitioner. I believe there is no role in general for the anticipated difficult airway in ICU (will not help in can't intubate can't ventilate, may impede attempts at good BMV). I appreciate opinions and practices vary. Elective anaesthesia studies (more exist) need to be translated with caution into the ICU population however.
- The benefits of warmed and humidified gases in patients with a productive cough or those at risk of critical illness weakness (where reduce tenacity of secretions and therefore work of expectoration is beneficial) mean that I use HFNO where more than 4L/min (low flow nasal prong oxygen) is required (unless contraindications exist) in patients with expectorative lung pathologies, hypoxic respiratory failure not requiring invasive ventilation or diseases with associated neuromuscular weakness (to include critical illness weakness)
- HFNO does not form part of my standard extubation plan in all-comers, in particular in those without ongoing respiratory failure, or who have had a short period of invasive ventilation (e.g. overdose). It does form my usual practice in most cardiothoracic post-operative patients and in those whom have ongoing risk of respiratory failure whether acute (resolving pneumonia) or pre-existing (impaired LV function, OSA/OHS etc) as a staged weaning strategy from invasive ventilation. I use it selectively in obstructive lung pathologies (asthma/COPD)
- I do not use HFNO in the populations that are contraindicated (e.g. trans-sphenoidal surgery, base of skull fracture), but in my institution may frequently use it following ivor lewis oesophagectomies or post thoracic surgery -in discussion with the treating clinician- when individual benefits outweigh associated risks.