High Flow NC Oxygenation, and Ventilation at Your ASC and NORA

Basem Abdelmalak, MD, FASA

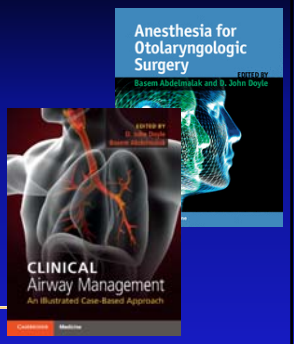
Professor of Anesthesiology
Director, Anesthesia for Bronchoscopic Surgery
Director, Center for Procedural Sedation
Anesthesiology Institute, Cleveland Clinic

President, Society For Head and Neck Anesthesia
President-elect, Society for Ambulatory Anesthesia

@basemcc

Conflict of Interest Disclosure

- No active industry grants
- Co-editor, text books on "Anesthesia for Otolaryngology" and "Clinical Airway Management: an Illustrated Case Based Approach"
- No relevant financial COI to disclose.



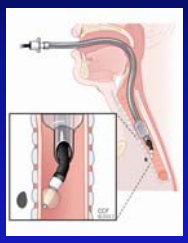
Objectives

At the end of this presentation the participant will be able to discuss:

- Traditional airway management options for advanced bronchoscopy and ambulatory VC surgery
- Novel ventilation option for advanced bronchoscopy and ambulatory VC surgery
- Available equipment for HFNO
- Clinical Pearls in apneic oxygenation and ventilation

Choice Of The Airway for Bronchoscopy: ETT

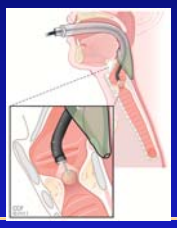
- Lower tracheal and bronchial lesions and /or defects:
  - Use as large of a tube as possible to allow room for the bronchoscope and ventilation

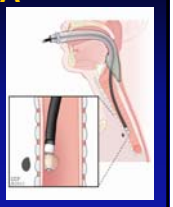


Abdelmalak B, Gildea T, Doyle J. Anesthesia For Bronchoscopy. Current Pharmaceutical Design, 2012, 18, 6314-6324

Choice Of The Airway for Bronchoscopy: SGA

- Sub-glottic and upper tracheal lesions: SGA





Abdelmalak B, Gildea T, Doyle J. Anesthesia For Bronchoscopy. Current Pharmaceutical Design, 2012, 18, 6314-6324

Non-intubation Technique for VC Surgery

- **No endotracheal tube**
  - Advantage:
    - Decreased risk of fire
    - Surgical access
  - Disadvantage:
    - Unsecured airway
    - Aspiration risk
- **Spontaneous Breathing Techniques**
- **Intermittent Apnea Techniques**
- **Jet Ventilation Technique**

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Jet Ventilation

Jet Ventilation Equipment

7

Proximal Supraglottic JV

Distal Supraglottic JV

Subglottic Jetting




Transcutaneous CO_2 Monitoring


Total Intravenous Anesthesia (TIVA)

- Avoid polluting the room with inhaled anesthetic agents
- Ensures continuous delivery of anesthesia despite possible ventilation leaks
- Allows for utilization of intermittent apnea or jet ventilation techniques

Doyle, J., **Abdelmalak, B,** Machuzak , M; Gildea,T. Anesthesia and Airway Management for Removing Pulmonary Self-expanding Metallic Stents J Clin Anesth. 2009 Nov;21(7):529-32.

High Flow Nasal Oxygen (HFNO)

- It provides oxygenation and ventilation for spontaneously breathing and paralyzed patients
- No VC, or airway protection

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Renda T, Corrado A, Iskandar G, et al **Br J Anaesth**. 2018 Jan;120(1):18-27
Douglas N, Ng I, Nazeem F, et al Anaesthesia 2018 Feb;73(2):169-176.

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Equipment

OptiFlow ™

Bird™ Sentry 2 Blender

https://www.vyaire.com/us/our-products/respiratory-care/mechanical-ventilation/adult-pediatric-ventilation-solutions/bird-blenders/bird-sentry-2-blender

Precision Flow

https://vapotherm.com/hi-vni-technology/

How Does it Work?

REVIEW ARTICLES

High-flow nasal oxygen therapy in intensive care and anaesthesia

T. Renda[1,*], A. Corrado[2], G. Iskandar[3], G. Pelaia[4], K. Abdalla[5] and P. Navalesi[5]

- Mechanism is poorly understood
- Alleged Potential Physiologic Effects:
  - Pharyngeal dead space washout
  - Reduction of work of breathing (decreased resistance metabolic work)
  - PEEP effect
  - Improved mucociliary clearance and patient comfort

British Journal of Anaesthesia, 120(1): 18–27 (2018)

Anaesthesia 2019 doi:10.1111/anae.14541

Original Article

A physiological study to determine the mechanism of carbon dioxide clearance during apnoea when using transnasal humidified rapid insufflation ventilatory exchange (THRIVE)*

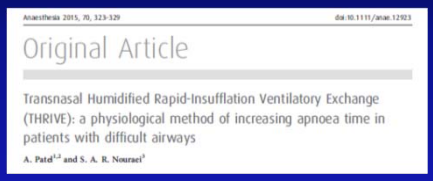
L. A. Hermez,[1] C. J. Spence,[1] M. J. Payton,[2] S. A. R. Nouraei,[4] A. Patel[5] and T. H. Barnes[3,6,7]

ventilatory exchange flow rate was increased from 20 l.min^{-1} to 70 l.min^{-1} ($p = 0.0014$). These findings suggest that enhanced carbon dioxide clearance observed under apnoeic conditions with transnasal humidified rapid-insufflation ventilatory exchange, as compared with classical apnoeic oxygenation, may be explained by an interaction between entrained and highly turbulent supraglottic flow vortices created by high-flow nasal oxygen and cardiogenic oscillations.

Apneic Ventilation with HFNO

Uses: Pre-induction

How it Started in Anesthesia: In the Difficult Airway Management

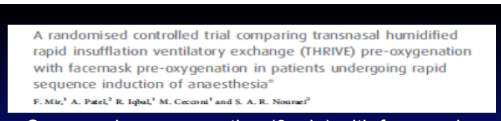


Anaesthesia 2015, 70, 323-329 doi:10.1111/anae.12923

Original Article

Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE): a physiological method of increasing apnoea time in patients with difficult airways

A. Patel[1,2] and S. A. R. Nouraei[1]



A randomised controlled trial comparing transnasal humidified rapid insufflation ventilatory exchange (THRIVE) pre-oxygenation with facemask pre-oxygenation in patients undergoing rapid sequence induction of anaesthesia*

F. Mir,[1] A. Patel,[2] R. Iqbal,[1] M. Cecconi[1] and S. A. R. Nouraei[1]

- Compared preoxygenation (3 min) with facemask (12L/min) vs. HFNO (30 then 70L/min) in 40 patients
- Longer apnea time of 248 (71) s in the HFNO group compared with 123 (55) s in the facemask group ($p < 0.001$)
- During induction Face mask was discontinued , while HFNO was not !!

Mir F, Patel A, Iqbal R, Cecconi M, Nouraei RA. **A randomised controlled trial comparing transnasal humidified rapid insufflation ventilatory exchange (THRIVE) pre-oxygenation with facemask pre-oxygenation in patients undergoing rapid sequence induction of anaesthesia.** Anaesthesia. 2017 Apr;72(4):439-443.

High-Flow Nasal Oxygen Improves Safe Apnea Time in Morbidly Obese Patients Undergoing General Anesthesia: A Randomized Controlled Trial

David T. Wong, MD,* Amelie Dallaire, MD,* Kawal Preet Singh, MD,* Poorna Madhusudan, MD,* Timothy Jackson, MD,† Mandeep Singh, MD,* Jean Wong, MD,* and Frances Chung, MBBS*

- Compared preoxygenation (3 min) with facemask (15L/min) vs. HFNO (40 L/min 100%) in 40 patients BMI>40!
- Longer apnea duration
- During induction face mask was discontinued, while HFNO was not !!

Anesthesia and Analgesia 2019 in print

Uses: Intraoperatively

HFNO with Spontaneous Ventilation in Airway Stenosis

- 26 patients with tracheal stenosis
- GA with spontaneous ventilation
- 18-100 min
- Maintained oxygenation with minimal rise in CO_2

S. Badiger, M. John, R.A. Fearnley, I. Ahmad. Optimizing oxygenation and intubation conditions during awake fibre-optic intubation using a high-flow nasal oxygen-delivery system. BJA, Volume 115, Issue 4, 2015, pp. 629-632

HFNO in Suspension Laryngoscopy Surgeries

Anaesthesia 2018, 73, 169–176 doi:10.1111/anae.14156

Original Article

A randomised controlled trial comparing high-flow nasal oxygen with standard management for conscious sedation during bronchoscopy

N. Douglas,[1] L. Ng,[2] F. Nazeem,[3] K. Lee,[2] P. Mezzavia,[2] R. Krieser,[2] D. Steinfort,[4] L. Irving[4] and R. Segal[2]

Prospective Experience of High-flow Nasal Oxygen During Bronchoscopy in 182 Patients

A Feasibility Study

Jennifer A. Service, MBChB, FRCA, FFICM, Jennifer S. Bain, MBChB, FRCA, FFICM, Clare P. Gardner, MBChB, FCARCSI, and Alistair F. McNarry, MA, FRCA

- 182 patients , simple bronch and EBUS
- Deep sedation with propofol and remi, no muscle relaxation
- Flows between 10-70 L/min

J Bronchol Intervent Pulmonol 2019;26:66–70

Uses: Post-operatively/ Post Extubation

HFNC Postoperatively in morbidly obese patients

- 32 patients post gastric bypass in each group
- Randomized to NC Vs. HFNC
- Less desaturations 29 Vs. 80%
- Less atelectasis 31 Vs. 77%

Ferrando C[1] et al.**High-flow nasal cannula oxygenation reduces postoperative hypoxemia in morbidly obese patients: a randomized controlled trial.** Minerva Anestesiol. 2019 Apr 16.. [Epub ahead of print]

HFNO in PACU Post Extubation in High Risk Patients

Relative Contraindications

- Partial nasal obstruction
- Disrupted airway, e.g., laryngeal fracture, mucosal tear, or tracheal rupture
- Need for laser or diathermy (electrocautery)
- Contagious pulmonary infections, such as tuberculosis
- Nasal infection resulting in pulmonary seeding with HFNO use (theoretical)

Cooper et al, APSF newsletter Oct. 2018https://www.apsf.org/article/safe-use-of-high-flow-nasal-oxygen-hfno-with-special-reference-to-difficult-airway-management-and-fire-risk/

Relative Contraindications

- Contraindications to high concentrations of oxygen (e.g., prior bleomycin chemotherapy)
- Inability to tolerate hypercarbia if HFNO is used with prolonged apnea (e.g., patients with sickle cell anemia, pulmonary hypertension, ICP)
- Children under the age of 16. Cases of air-leak syndrome (i.e., pneumothorax) have been reported with HFNO use in children below the age of 16

Cooper et al, APSF newsletter Oct. 2018https://www.apsf.org/article/safe-use-of-high-flow-nasal-oxygen-hfno-with-special-reference-to-difficult-airway-management-and-fire-risk/
Hegde S, Prodhan P. Serious air leak syndrome complicating high-flow nasal cannula therapy: a report of 3 cases. Pediatrics 2013;131:e939–44.

Intra-oral ignition of monopolar diathermy during transnasal humidified rapid-insufflation ventilatory exchange (THRIVE)

D. Onwochei,[1] K. El-Boghdadly,[1] R. Oakley[2] and I. Ahmad[3]

- Palate Surgery in a 65 Y/O using
- Noticed an Arc arising from the diathermy tip
- The Fire Triad:
  - Oxidizer
  - Fuel
  - Energy source

Anaesthesia 2017, 72, 781-783

Absolute Contraindications

- Use of alcohol-based skin preparation solutions in combination with HFNO, which increases the fire risk
- Known or suspected skull base fractures, CSF leaks
- Significant pneumothorax which has not been treated with a chest tube.
- Complete nasal obstruction
- Active epistaxis or recent functional endoscopic sinus surgery (FESS).

Cooper et al, APSF newsletter Oct. 2018https://www.apsf.org/article/safe-use-of-high-flow-nasal-oxygen-hfno-with-special-reference-to-difficult-airway-management-and-fire-risk

Use in Colonoscopy

- Case series (3), all did well!!
- They were able to measure CO2, never more than 50
- Randomized trial in morbidly obese patients compared HF (60L/min and 35%) to NC (4L/min) showed no difference
- ? Inspiratory flow rate vs.FiO2

Lee et al. Use of high-flow nasal cannula in obese patients receiving colonoscopy under intravenous propofol sedation: A case series Respiratory Medicine Case Reports, 2018-01-01, Volume 23, Pages 118-121
Fox et al. High-flow versus standard nasal cannula in morbidly obese patients during colonoscopy: A prospective, randomized clinical trial. JCA 54(2019) 19-24

A Nasal High-Flow System Prevents Hypoxia in Dental Patients Under Intravenous Sedation

Teppei Sago, DDS, PhD,[a] Nozomu Harano, DDS, PhD,[†] Yuki Chogyoji, DDS,[‡] Masahito Numomaki, DDS, PhD,[§] Shunji Shiba, DDS, PhD,[‖] and Seiji Watanabe, MD, PhD[¶]

- 30 patients , 3 groups; 5L NC, 30L HFNO, 60 L HFNC
- The higher the flow the lower the desatration

J Oral Maxillofac Surg 73:1058-1064, 2015

Summary

- HFNO is an effective way for oxygenation and ventilation
- Can be used for Bronchoscopy, VC surgery, as well as a variety of MAC Sedation cases at the ASC and NORA
- The optimal flow, FiO2, and duration as well as the best patient candidate to benefit from it continue to evolve

Society for Head and Neck Anesthesia
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Thank you for your attention

Basem Abdelmalak, MD, FASA
abdelmb@ccf.org