Welcome

Michael Rodda - Application Specialist Dräger
Dräger Academy – Basics of Respiration and Ventilation eLearning Module of Respiratory Physiology and Ventilation

British Thoracic Society paper on Oxygen Therapy Guidelines

Resources

Oxylog 3000 Plus Trainer


Dräger
Resources

Oh’s Intensive Care Manual 7th Edition

Editors: Andrew D Bersten, and Neil Soni,

Pages: 1264,

Imprint: Butterworth-Heinemann

ISBN: 9780702047626

Publication Date: 03-12-2013
Resources

**Principals and Practice of Mechanical Ventilation, Third Edition**

**Editors:** Martin J Tobin,

**Publisher:** McGraw-Hill

**ISBN:**
- eBook: 978-0-07-176678-4
- Book: 978-0-07-173626-8

**Publication Date:** 03-12-2013
Regulation of Breathing, second edition

Editors: Jerome A. Dempsey and Allan I. Pack

Publisher: Mercel Dekker, New York

ISBN: 0-8247-9227-0

Date: 1995
Clinical evidence on high flow oxygen therapy and active humidification in Adults

Gotera, C., Lobato, S. D., Pinto, T., Winck, J. C.

Oxygen delivery through high-flow nasal cannulae increases end-expiratory lung volume and reduces respiratory rate is post-cardiac surgical patients

Corley, A., Caruana, L. R., Barnett, A. G., Fraser, J. F.

British Journal of Anaesthesia, 9th September 2011
Effect of Very–High Flow Nasal Therapy on Airway Pressure and End Expiratory Lung Volume in Healthy Volunteers

Parke, R. L., Bloch, A., McGuinnes, S. P.

Respiratory Care, September 2015

Effect of Very-High-Flow Nasal Therapy on Airway Pressure and End-Expiratory Lung Impedance in Healthy Volunteers

Rachael L Parke RN PhD, Andreas Bloch MD, and Shay P McGuinness MB ChB

BACKGROUND: Previous research has demonstrated a positive linear correlation between flow delivered and airway pressure generated by high-flow nasal therapy. Current practice is to use flows over a range of 30–60 L/min; however, it is technically possible to apply higher flows. In this study, airway pressure measurements and electrical impedance tomography were used to assess the relationship between flows of up to 100 L/min and changes in lung physiology. METHODS: Fifteen healthy volunteers were enrolled into this study. A high-flow nasal system capable of delivering a flow of 100 L/min was purpose-built using 2 Optiflow systems. Airway pressure was measured via the nasopharynx, and cumulative changes in end-expiratory lung impedance were recorded using the PulmoVista 500 system at gas flows of 30–100 L/min in increments of 10 L/min. RESULTS: The mean age of study participants was 31 (range 22–44), the mean ± SD height was 171.8 ± 7.5 cm, the mean ± SD weight was 69.7 ± 10 kg, and 47% were males. Flows ranged from 30 to 100 L/min with resulting mean ± SD airway pressures of 2.7 ± 0.7 to 11.9 ± 2.7 cm H2O. A cumulative and linear increase in end-expiratory lung impedance was observed with increasing flows, as well as a decrease in breathing frequency. CONCLUSIONS: Measured airway pressure and lung impedance increased linearly with increased gas flow. Observed airway pressures were in the range used clinically with face-mask noninvasive ventilation. Developments in delivery systems may result in this therapy being an acceptable alternative to face-mask noninvasive ventilation. Key words: oxygen therapy; high-flow nasal therapy; humidification; airway pressure; lung volume. [Respir Care 0:000:1–•.] © 0 Daedalus Enterprises]
Noninvasive Positive Pressure Ventilation: The Little Things Do Make the Difference!

Kacmarek, R. M.

*Respiratory Care, 2003, 48(10), pp. 919 - 921.*
Noninvasive Ventilation — Don’t Push Too Hard.

Truwt, J. D. & Bernard, G. R.


The literature indicates that in both settings, outcomes in patients with chronic obstructive pulmonary disease (COPD) or cardiogenic pulmonary edema are successful. Randomized, controlled trials also provide outcome data supporting the use of noninvasive ventilation to obviate the need for en-
<table>
<thead>
<tr>
<th>1</th>
<th>Implicit Memory and Re Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Respiratory Failure and Thoracic Physiology</td>
</tr>
<tr>
<td>3</td>
<td>High Flow Oxygen Therapy</td>
</tr>
<tr>
<td>4</td>
<td>Optimising CPAP</td>
</tr>
<tr>
<td>5</td>
<td>Optimising CPAP and Pressure support</td>
</tr>
<tr>
<td>6</td>
<td>Alternative mode options for Non Invasive Ventilation</td>
</tr>
</tbody>
</table>
Content

1 Implicit Memory and Re Learning
2 Respiratory Failure and Thoracic Physiology
3 High Flow Oxygen Therapy
4 Optimising CPAP
5 Optimising CPAP and Pressure support
6 Alternative mode options for Non Invasive Ventilation
Implicit memory is sometimes referred to as unconscious memory or automatic memory. Implicit memory uses past experiences to remember things without thinking about them. The performance of implicit memory is enabled by previous experiences, no matter how long ago those experiences occurred.

http://www.livescience.com/43353-implicit-memory.html
Implicit Memory and Re Learning

Explicit memory, also called declarative memory, which involves a conscious attempt to retrieve memories of past events.

http://www.livescience.com/43353-implicit-memory.html
In a 1977 experiment, participants were asked to read 60 believable statements every two weeks and to rate them based on their validity. This was a test of the illusion-of-truth effect — that a person is more likely to believe a familiar statement than an unfamiliar one. Participants were more likely to rate as true statements the ones they had previously heard — even if they didn't recall having heard them — regardless of the truth of the statement.

http://www.livescience.com/43353-implicit-memory.html

Implicit memory also leads to the illusion-of-truth effect,

Implicit Memory and Re Learning

Re Learning

It is said that whatever resides in Implicit memory is there forever.

People can override implicit memory with cognitive thought.

To do this you must cognitively believe that the new belief/behaviour is fundamentally an improvement on your implicit belief/behaviour.
## Content

<table>
<thead>
<tr>
<th></th>
<th>1  Implicit Memory and Re Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Respiratory Failure and Thoracic Physiology</strong></td>
</tr>
<tr>
<td>3</td>
<td>High Flow Oxygen Therapy</td>
</tr>
<tr>
<td>4</td>
<td>Optimising CPAP</td>
</tr>
<tr>
<td>5</td>
<td>Optimising CPAP and Pressure support</td>
</tr>
<tr>
<td>6</td>
<td>Alternative mode options for Non Invasive Ventilation</td>
</tr>
</tbody>
</table>
Type I Respiratory Failure

Hypoxaemia without Hypercapnia
Respiratory Failure and Thoracic Physiology

Type I respiratory failure causes

- Altered Respiratory Membrane Structure
- Reduced Thoracic Volume
- Disturbance of Pulmonary Blood Flow
Respiratory Failure and Thoracic Physiology

Focus

Loss of Surface Area for Gas Exchange
Oxygenation

- Room air 21% oxygen, 79% Nitrogen
- Alveoli provide a surface area for gas exchange
- Oxygen exchange occurs during inspiration and expiration
- Chest wall position maintains Functional Residual Capacity, keeps alveoli open to exchange gas at the end of expiration
Functional Residual Capacity (FRC) is the volume of gas in the lungs at the end of normal expiration.
Respiratory Failure and Thoracic Physiology
At FRC all 300 Million Alveoli are open
Respiratory Failure and Thoracic Physiology

Critical Opening Point
Respiratory Failure and Thoracic Physiology

FRC and the work of breathing

![Diagram showing the relationship between FRC, transpulmonary pressure, and volume. Normal FRC, high FRC (overexpansion), and low FRC (atelectasis) are illustrated.](image)
Respiratory Failure and Thoracic Physiology

- **Lung Interdependence**
- **Nitrogen**
- **Surfactant**
Lung Interdependence
Respiratory Failure and Thoracic Physiology

Nitrogen

Relative composition of air

- 78% Nitrogen
- 21% Oxygen
- 1% Other
What is “absorption atelectasis”?

Absorption atelectasis refers to the tendency for airways to collapse if proximally obstructed. Alveolar gases are reabsorbed; this process is accelerated by nitrogen washout techniques.

Oxygen shares alveolar space with other gases, principally Nitrogen. Nitrogen is poorly soluble in plasma, and thus remains in high concentration in alveolar gas. If the proximal airways are obstructed, for example by mucus plugs, the gases in the alveoli gradually empty into the blood along the concentration gradient, and are not replenished: the alveoli collapse, a process known as atelectasis. This is limited by the sluggish diffusion of Nitrogen. If nitrogen is replaced by another gas, that is if it is actively “washed out” of the lung by either breathing high concentrations of oxygen, or combining oxygen with more soluble nitrous oxide in anesthesia, the process of absorption atelectasis is accelerated. It is important to realize that alveoli in dependent regions, with low V/Q ratios, are particularly vulnerable to collapse.

http://www.ccmtutorials.com/rs/oxygen/page08.htm
Surfactant Function

To increase pulmonary compliance.

To prevent atelectasis (collapse of the lung) at the end of expiration.

To facilitate recruitment of collapsed airways

http://en.wikipedia.org/wiki/Pulmonary_surfactant
Type II Pneumocytes

Surfactant pump???????????
Type II Respiratory Failure

Hypoxaemia with Hypercapnia
Respiratory Failure and Thoracic Physiology

Cause

Loss of surface area of gas exchange

+ 

Failure of the thoracic pump
Control of Breathing

• Autonomic

• Cognitive
Autonomic Control of Breathing

- Chemical Receptors
  - Oxygen
  - pH
  - other self releases substances

- Mechano Receptors
  - situated throughout the lung and chest wall
  - Stretch, Pressure, Position
Mechano Receptors

“The timing of inspiratory termination is strongly influenced by sensory inputs, especially those arising from slowly adapting pulmonary stretch receptors.”

“Pulmonary stretch receptor activation elicits the Breuer – Hering expiratory prolonging reflex (the prolongation of expiratory duration when lung inflation is maintained during the expiratory period).”

<table>
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<tr>
<th></th>
<th>Content</th>
</tr>
</thead>
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<tr>
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<td>Optimising CPAP and Pressure support</td>
</tr>
<tr>
<td>6</td>
<td>Alternative mode options for Non Invasive Ventilation</td>
</tr>
</tbody>
</table>
High Flow Oxygen Therapy

What is high flow oxygen?
Why High Flow Oxygen?
How can we administer it?
What can it do?
<table>
<thead>
<tr>
<th>Table 1</th>
<th>Physiological effects of HFNC.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Pharyngeal dead space washout</td>
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<td>- Reduction of nasopharyngeal resistance</td>
</tr>
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<td></td>
<td>- Positive expiratory pressure (PEEP effect)</td>
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<td></td>
<td>- Alveolar recruitment</td>
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<td></td>
<td>- Humidification, great comfort and better tolerance</td>
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<td></td>
<td>- Better control of FiO₂ and better mucociliary clearance</td>
</tr>
</tbody>
</table>
Non Invasive Positive Pressure Ventilation
Terminology

Non Invasive Vs. Invasive Ventilation?

Non Invasive Ventilation - NIV
   – Negative pressure - NPV
   – Positive Pressure - NIPPV

Non Invasive Positive Pressure Ventilation
   – NIPPV
   – NPPV
Non Invasive Positive Pressure Ventilation

Terminology

- **Continuous Positive Airways Pressure**
  - CPAP (EPAP)
- **Positive End Expiratory Pressure**
  - PEEP (EPAP)
- **Inspiratory Support**
  - Volume Support (VC)
  - Pressure Controlled Ventilation (PCV, BIPAP)
  - Pressure Support Ventilation (PS) (IPAP)
<table>
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<tr>
<th></th>
<th>Content</th>
</tr>
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</tr>
<tr>
<td>6</td>
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</tr>
</tbody>
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Attitude and Behaviour in NIV

The reason for this lack of success is not the technique itself but all of the little things that go into a successful NPPV program. The most important issues in a successful NPPV program are the education of the staff providing NPPV (therapists, physicians, and nurses) and the approach used during the initial application of NPPV.

NRobert M Kamarek PhD, Noninvasive Positive Pressure Ventilation: Do Little Things Make The Difference, Respiratory Care, October 2003, Vol 48, No. 10, pg 919 – 921
CPAP helps to increase FRC

How?
1. Expand up already open Alveoli
2. Open some closed airways
How much CPAP?
Extra recruitment?
Non Invasive Positive Pressure Ventilation

Surfactant pump?
Non Invasive Positive Pressure Ventilation

CPAP - Application
<table>
<thead>
<tr>
<th></th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
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</tr>
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</tr>
</tbody>
</table>
CO2 Elimination

Minute Ventilation = Tidal Volume x Rate

Our brain steam controls our respirations (Tidal volume and rate) to maintain a controlled level of CO2

This requires muscular activity to maintain
CO2 Elimination

If the muscular activity to maintain CO$_2$ balance becomes higher than the patient can sustain, respiratory workload adaption occurs to protect the muscles.

If the excessive workload is not removed, respiratory muscle failure follows.
Optimising CPAP and Pressure support

CO2 Elimination

To prevent respiratory muscle failure we can use positive pressure to assist the muscles with the workload – NIPPV

This is inspiratory support

Inspiratory support can be controlled and timed (CMV – SIMV) or supportive (Pressure Support) in nature
NIPPV - Pressure Support

- Why Pressure Support?
- How does Pressure Support work?
Optimising Pressure Support

- Synchronisation
- Initiation of the cycle (Trigger Delay, Ineffective Triggering, Auto triggering, Multiple Cycles)
- Pressurisation (Slope, Rise time)
- Termination of Pressure Support
- Pressure Support Level
Pressure Support - Demonstration
CPAP and NIPPV provide a level of respiratory support which can be provided to the patient quickly and easily with minimal equipment.

Groups that fundamentally do better are those who have reversible disease using lower levels of CPAP and ventilation which can be achieved via NIPPV.

If reversibility is delayed by severity or the level of support required is higher than NIPPV can provide then the patient will require intubation.
Non Invasive Positive Pressure Ventilation

Rationale

The relative success of NIPPV is based on the likelihood of the patient condition improving in the short term.

- Disease reversibility?
- How long will it take to reverse the disease?
- How much support will the patient require until reversibility occurs
1 Implicit Memory and Re Learning
2 Respiratory Failure and Thoracic Physiology
3 High Flow Oxygen Therapy
4 CPAP
5 CPAP and Pressure support
6 Alternative mode options for Non Invasive Ventilation
Alternative mode options for Non Invasive Ventilation

World wide use of Modes in NIPPV

Not all of the world uses PSV for NIPPV

Volume Control – 15%
Pressure Control – 18%
Pressure support – 67%
After careful consideration of the patient’s good tolerance of the noninvasive ventilation, ability to cooperate, and hemodynamic stability the decision was made to transfer her under NPPV to the catheter laboratory to rule out significant coronary stenosis. NPPV with a full-face mask was continued with a transport ventilator (Oxylog 3000, Dräger, Germany) using the bilevel positive airway pressure mode with an inspiratory pressure of 21 cmH₂O, a PEEP of 5 cmH₂O, a respiratory rate of 25 breaths/min, and fraction of inspired oxygen of 0.4. At these settings, the tidal volume averaged 500 ml. A critical care physician and a nurse accompanied the patient and performed monitoring. Throughout the transport and cardiac catheterization SaO₂ consistently remained higher than 90 %, and the patient was awake and cooperative.
Questions
Thank you for your attention.
References


References


John V. Peter; John L. Moran; Jennie Phillips-Hughes; David Warn; Noninvasive Ventilation in Acute Respiratory Failure- A Meta Analysis

References

