Nuts and Bolts of Oxygen Therapy

Ed Corazalla MS, RPFT
Scientist/Pulmonary Lab Manager
Why we Breathe

O₂ + Fuel(food) → CO₂ + H₂O + Energy

- O₂ is used and CO₂ is produced in every cell in the body.
- The lungs extract O₂ from the air and exhale CO₂ produced by the body.
- The balance of O₂ consumed and CO₂ produced is what drives our breathing.
- If the lungs are not working well this balance is disrupted.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>N₂</strong> (Nitrogen)</td>
<td>79%</td>
</tr>
<tr>
<td><strong>O₂</strong> (Oxygen)</td>
<td>20.9%</td>
</tr>
<tr>
<td><strong>CO₂</strong> (Carbon Dioxide)</td>
<td>0.03%</td>
</tr>
<tr>
<td><strong>All the Other Things</strong></td>
<td>0.07%</td>
</tr>
<tr>
<td><strong>=</strong></td>
<td><strong>100%</strong></td>
</tr>
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</table>
O$_2$ Safety

- It’s not good--to blow things up!
O₂ Safety

- Oxygen is **NOT** an explosive gas
- High O₂ levels make things more flammable. Oxygen is heavier than air and will pool in fabric making the material more flammable. Therefore, never leave the nasal prongs or mask under or on bed coverings or cushions whilst the oxygen is being supplied.
- Store oxygen equipment in well ventilated areas, not near heat sources or open flames. (hot water heaters, furnace, stoves….)
- Oxygen cylinders should be secured safely to avoid injury.
No smoking within 10 feet of Oxygen.

Never use oil/grease/alcohol based products on O₂ equipment.

No petroleum based products on your face when using O₂ (Vaseline, Vicks, A&D ointment, Chap Stick) Use water based products such as Neutrogena Oil Free, Celeteque Water-Based Moisturizer, Avene Cold Cream.

Do not use aerosol sprays while using oxygen.
Benefits of using Oxygen.

- Longer life
- Improved quality of life
- Increased Stamina and Exercise Tolerance
- Improved Memory
- Clearer Thinking
- More Restful Sleep
- Anxiety and depressions levels improve
- Studies have shown – failure to use oxygen as prescribed – will result in stress to the heart and shorter life expectancy.
Benefits of using Oxygen with Baseline Hypoxia
Other Benefits to Using Oxygen?
Terminology/Symbols

- Hypoxemia, Hypoxia
- Dyspnea, SOB, DOE
- $O_2 = \text{Oxygen}$  $C0_2 = \text{Carbon Dioxide}$
- Oxygen Saturation/Desaturation
- ABG’s = Arterial Blood Gas
Sign and Symptoms

Shortness Of Breath (SOB)

Dyspnea On Exertion (DOE)

Breathing hard and fast.

Racing or pounding heart

Speaking in broken or choppy sentences

Cyanosis – Purplish/blue color changes in lips and finger nails.

Some people have no symptoms at all!
Reasons People Need Oxygen Therapy

COPD -- Chronic Obstructive Pulmonary Disease. Which includes emphysema, chronic bronchitis and Alpha-1-Antitrypsin (A1AD).

Restrictive Lung Disease (Pulmonary Fibrosis, Interstitial Lung disease)

OSA -- Obstructive Sleep Apnea

CHF -- Congestive Heart Failure (heart disease)

Neuromuscular disease
Why Oxygen is Needed in Pulmonary Fibrosis/Interstitial Lung Disease?

Fibrosis of the lung can cause:

- **Reduced Vital Capacity (Spirometry)**
  - Smaller lungs = less surface area for $O_2$ exchange.

- **Reduced Diffusion Capacity (DLCO)**
  - Lungs are less efficient
  - Less $O_2$ is exchanged per breath

- **Reduced exercise tolerance**
  - Desat during 6 minute walk tests
After PFT’s, X-ray, CT’s and other Imagining, Mary and her husband came to me very concerned.

One Doc told her she had: *Interstitial Lung Disease (ILD)*

Another Doc told her: *Pulmonary Fibrosis?*

The Doctors note read: *Restrictive Lung Disease?*

After more testing, the lung doc told her she has: *Idiopathic Pulmonary Fibrosis (IPF)*

Mary Asks “ED! What the Hell have I got?”
Figure 2-30  Electron photomicrograph of a transverse section through capillaries in the interalveolar septum. The surface of the septum facing the alveolar spaces (AS) is lined by continuous epithelium (EP). The capillary containing red blood cells (RBC) is lined by endothelium (E). Both layers rest on basement membranes (BM) that appear fused over the "thin" portion of the membrane and that are separated by an interstitial space (IS) over the "thick" portion of the membrane. Horizontal bar=1 μm. (×11,500. Courtesy of Dr. Ewald R. Weibel.)
Figure 6-1  Electron photomicrograph showing the pathway for O₂ diffusion across the air-blood barrier in a human lung. An O₂ molecule must cross the epithelium (EP), basement membrane (BM), endothelium (EN), plasma layer (P), and red blood cell (RBC) membrane; resistance to movement through these barriers comprises the membrane component (Dₘ) of the total resistance to diffusion. After entering the red blood cell, O₂ must combine chemically with hemoglobin (Hgb); this reaction comprises the resistance imposed by the capillary blood volume (Vc) and rate of chemical combination (Θ). For discussion, see text. Horizontal bar = 1 μm. (× 41,500. Courtesy of Dr. Ewald R. Weibel.)
Interstitial Lung Disease

Can

Pulmonary Fibrosis

Might

Restrictive Lung Disease

If the Fibrosis is of unknown cause we call it Idiopathic Pulmonary Fibrosis (IPF)
How do we Know you need Oxygen?

- **ABG Arterial Blood Gas**
  - Measure gases in blood $O_2$, $CO_2$, pH
- **Oximetry**
  - Measures oxygen levels in your blood—saturation
- **6 minute walk test**
- **Exercise Tests**
- **De-saturation studies**
When is oxygen needed?

- **Oxygen**: is prescribed when your oxygen level drops below a certain point (usually $\text{SaO}_2 < 88\%$ on pulse oximetry - clip on your finger)
- Or a $\text{PaO}_2 < 55$ on an arterial blood gas - sample of blood from an artery.
Goals of Oxygen Therapy

- To maintain adequate tissue oxygenation while minimizing cardiopulmonary work (lungs and heart work harder if your low on $O_2$)
- Improved quality of life
- Longer life
Ways to Store/Process $O_2$

- $O_2$ Cylinders
- Concentrators
- Liquid $O_2$
O₂ Cylinders (Compressed gas tanks)

- Compressed gas systems
  - Pre-filled cylinders of various sizes
  - Can use regulators with continuous or conserver settings
  - Multiple tanks can be used with one regulator device
  - Limited by cylinder duration as well as cumbersomeness
  - Mobility may be limited by # of cylinders allotted to patient
Let's make things really confusing

Sample Oxygen Cylinder Specifications*

<table>
<thead>
<tr>
<th>Older Name</th>
<th>Newer Name</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>JD</th>
<th>E</th>
<th>M-60</th>
<th>M/MMM/22</th>
<th>M250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (in.)</td>
<td>2.5</td>
<td>3.2</td>
<td>4.3</td>
<td>3.2</td>
<td>4.3</td>
<td>4.3</td>
<td>5.3</td>
<td>4.3</td>
<td>7.3</td>
<td>8</td>
</tr>
<tr>
<td>Height (in.)</td>
<td>6.5</td>
<td>7.6</td>
<td>11.5</td>
<td>9.1</td>
<td>11</td>
<td>16.5</td>
<td>16.5</td>
<td>25.5</td>
<td>23</td>
<td>36</td>
</tr>
<tr>
<td>Empty Weight (lb)</td>
<td>0.7</td>
<td>1.2</td>
<td>2.1</td>
<td>2.2</td>
<td>3.3</td>
<td>3.7</td>
<td>5.3</td>
<td>8</td>
<td>7.9</td>
<td>22.3</td>
</tr>
<tr>
<td>Capacity (L) at 2,000 psi</td>
<td>42</td>
<td>113</td>
<td>165</td>
<td>164</td>
<td>198</td>
<td>255</td>
<td>425</td>
<td>640</td>
<td>680</td>
<td>1738</td>
</tr>
<tr>
<td>Transport Method</td>
<td>Carrier Bag</td>
<td>Carrier Bag</td>
<td>Carrier Bag</td>
<td>Carrier Bag</td>
<td>Carrier Bag</td>
<td>Carrier Bag</td>
<td>Carrier Bag</td>
<td>Wheelchair Bag or Cart</td>
<td>Not Portable</td>
<td>Not Portable</td>
</tr>
<tr>
<td>Regulator Type</td>
<td>CGA 870</td>
<td>CGA 870</td>
<td>CGA 870</td>
<td>CGA 870</td>
<td>CGA 870</td>
<td>CGA 870</td>
<td>CGA 870</td>
<td>CGA 870</td>
<td>CGA 540</td>
<td>CGA 540</td>
</tr>
</tbody>
</table>

*This information is intended to be used as a guide. Dimensions and names may vary by manufacturer.
O₂ Cylinders
(Compressed gas tanks)

- Gas under high pressure (full 2,200psi)
- Green tanks (sizes M2, A,B,C, D,E,H)
- Reliable, no maintenance
- High oxygen purity
- High cost

Disadvantages

- Heavy
- High pressure hazard
- Frequent deliveries
- Clumsy/Unsightly
**O₂ Concentrators**

- O₂ is concentrated out of the air
- Low cost, safe, no delivery problems
- 87-95% O₂ Depending on flow rate. (Higher the flow rate O₂ is less pure)
- Some can fill O₂ Cylinders (takes 22hr to fill an E)
- New light weight battery powered portables but are expensive $3,000-$8,000

**Disadvantages**

- Electricity or plenty of batteries needed
- Unreliable at higher flows
- Risk of mechanical failure
- In the past --- Heavy, loud and not portable
O₂ Concentrators

- A miniaturized air compressor inside the machine will pressurize this air through a system of chemical filters known as a molecular sieve. This filter is made up of silicate granules called Zeolite (Volcanic rock) which sieves the nitrogen out of the air, concentrating the oxygen.
Concentrators that fill O$_2$ Cylinders
Non-Delivery Systems

- No delivery costs or scheduling
- Issues
  - Fill times
  - Use times
  - Oxygen purity
  - OCD/ dose capability
  - Electricity
Portable Concentrators

- Improved operational range with access to AC or battery
- Issues
  - Max. oxygen generation
  - Max. oxygen dose
  - Oxygen purity
  - Sleeping
  - 24 hour use
Liquid $O_2$

- -300F $O_2$ gas becomes a liquid
- Volume of $O_2$ decreases 800 to 1
- Very portable
- Storage can be smaller & lighter
- High oxygen purity
- *Soon we will be able to make liquid $O_2$ at home*

Disadvantages

- High cost
- Evaporation (use it or lose it)
- Frequent deliveries needed
- If they tip or during filling –they can freeze up
- Frost bite hazard
- Incompatibility with different systems
Portable liquid oxygen systems

- Oxygen is transferred from a large bulk oxygen vessel into the smaller portable unit
- Models can include continuous flow, conserver or both
- Limited by how far you can travel away from the stationary vessel
- Light-weight long-lasting portables
- High flow/dose capability

Issues
- Use it or loose it
- Delivery cost
  - Equipment
  - Frequency of fill
Delivery of $O_2$

- **Continuous Flow**
  - Flow is constant at a set rate (Liters/minute)
  - Single cannulas
  - More can be delivered/minute.
  - Your $O_2$ Supply runs out faster.
  - Wastes more $O_2$ because it delivers $O_2$ even when you are breathing out
  - Better for high demand times (exercise) or for people who have advanced disease.
# Nasal Cannula

**Continuous flow**

<table>
<thead>
<tr>
<th>Liter Flow of Oxygen Thru nasal cannula</th>
<th>Estimated Concentration of $O_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20.9%</td>
</tr>
<tr>
<td>1</td>
<td>24%</td>
</tr>
<tr>
<td>2</td>
<td>28%</td>
</tr>
<tr>
<td>3</td>
<td>32%</td>
</tr>
<tr>
<td>4</td>
<td>36%</td>
</tr>
<tr>
<td>5</td>
<td>40%</td>
</tr>
<tr>
<td>6</td>
<td>44%</td>
</tr>
</tbody>
</table>
Oxygen Conserving Devices (OCD)

- Pulse and Demand devices
  - $O_2$ is delivered on the inspiration only
  - Conserves (uses less $O_2$/minute) 2-4 times
  - Duel cannulas/Single cannulas
  - Storage containers can be smaller/lighter/more portable and last longer

- Issues:
  - May not supply enough $O_2$ for exercise or advanced disease.
  - Each device needs to be tested (titrated) to be sure it works for that patient
Pulse vs Demand (OCD)

- OCD that deliver a fixed volume per breath are classified as pulsing devices.

- OCD that deliver a variable volume (commensurate with the length of inspiration) are called demand devices.
When 2 doesn’t = 2?

Studies have shown that:

- $O_2$ gauges are not very accurate
- A setting of “2” on conserving device does not deliver 2L/min
- A wide range of oxygen is actually delivered with conserving devices
  - Depending on:
    - How the $O_2$ device works
    - Tidal volumes (how deep people breathe)
    - Different sized people
    - Breathing rates
Nasal Cannula is the most commonly used device to deliver Oxygen ---yet

- You have to be able to breathe through your nose!
- We rotate which nostrils (nares) is dominate every few hours.
- Allergies, sinusitis, nasal septum problems.
- On exertion (when you need oxygen the most) most people start breathing through their mouth.
  - Practice Yoga breathing: In through the nose – out through the mouth.
Cylinder Duration

Cylinder Pressure (PSI) x Conversion Factor = Minutes The Tank Will Last
Flow Setting (L/Min)

<table>
<thead>
<tr>
<th>Cylinder Size</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-6/B</td>
<td>0.08</td>
</tr>
<tr>
<td>D</td>
<td>0.16</td>
</tr>
<tr>
<td>E</td>
<td>0.28</td>
</tr>
<tr>
<td>H/K</td>
<td>3.14</td>
</tr>
</tbody>
</table>

Example: New (Full 2200psi) E cylinder at Flow Rate 2 L/min.
2200 x 0.28/2 Liters per min = 308 Minutes or 308/60 = 5.13 hours
Flying with $O_2$

- $O_2$ level in flight is decreased to about 15% $O_2$
- FAA ruling (May 13, 2009) allows-- $O_2$ concentrators on board airlines!
  - They can be rented ($200-400/week)
- You will need a copy of your $O_2$ prescription and/or Physicians Statement
- Tell the airline you will be using the device when you book your flight.
  - Customers wanting to use a POC on board must provide a minimum 48-hour advance notification
Currently, POCs approved by the FAA are:

- The AirSep "Focus," manufactured by the AirSep Corporation
- The AirSep "Freestyle," manufactured by the AirSep Corporation
- The AirSep "Freestyle 5," manufactured by the AirSep Corporation
- The AirSep "Lifestyle," manufactured by the AirSep Corporation
- Delphi Central Air, manufactured by Delphi Medical Systems
- DeVilbiss "iGo," manufactured by DeVilbiss
- Inogen One, manufactured by the Inogen Corporation
- Inogen One G2, manufactured by the Inogen Corporation
- Inogen One G3, manufactured by the Inogen Corporation
- Inova Labs "LifeChoice Activox," manufactured by Inova Labs
- International Biophysics "LifeChoice," manufactured by Inova Labs
- Invacare SOLO2, manufactured by Invacare Corporation
- Invacare XPO2, manufactured by Invacare Corporation
- OxLife "Independence," manufactured by OxLife Incorporated
- Precision Medical EasyPulse, manufactured by Precision Medical
- Respironics EverGo, manufactured by Respironics Inc.
- Respironics SimplyGo, manufactured by Respironics Inc.
- eQuinox (model 4000), manufactured by SeQual Technologies Inc.
- Oxywell (model 4000), manufactured by SeQual Technologies Inc.
- SeQual Eclipse, manufactured by SeQual Technologies Inc.
- SeQual SAROS, manufactured by SeQual Technologies Inc.
- Trooper, manufactured by VBOX Inc.
SeaPuffers, Cruises escorted by Respiratory Therapists

Frequently Asked Questions
Download Reservation Forms
Read a Cruise Review!

We are currently booking the following cruises:

**Panama Canal**
March 15, 2006 for 10 days
Departs/returns Fort Lauderdale, FL on Holland America's MS Zaandam. Destinations include Costa Rica, Aruba, and the Panama Canal

**Mediterranean Enchantment**
May 1, 2006 for 10 days
Departs/returns Rome, Italy on Holland America's new ms Noordam. We will visit the ports of Rome, Monte Carlo, Livorno, Barcelona, Palma de Mallorca, La Goulette Tunisia, Palermo Sicily, and Naples. Also optional pre-cruise tour.

**Alaskan Explorer**
July 14, 2006 for 7 days
Departs/returns Seattle, WA on Holland America's ms Zaandam. Explore Glacier Bay National Park, Sitka, and Victoria, BC. Make your reservations early!
Web sites to check out

- www.oxygen4travel.com/tips
- www.homeoxygen.org
- http://www.discoverycampus.com/pub002/pub002.swf
- www.usalung.org
- www.seapuffers.com
- www.pulmonarypaper.org
- www.oxygentogo.com
Pulmonary Support Groups

ALAMN Groups
- Better Breather's Club - Duluth
- Respiratory Health Club - Minneapolis
- Huffers & Puffers - St Paul

Other Support Groups
- Breath of Mercy - Coon Rapids, MN
- Breathcatchers - Edina, MN
- Integrated Medical Rehabilitation (IMR) - Edina, MN
- Pulmonary Inspirations - Fargo, ND
- Windjammers - Mankato, MN
- Huff & Puff Group - Rochester, MN
- Twin Cities Pulmonary Hypertension Support Group - Roseville, MN
- Breath Savers Support Group - St Cloud, MN
- Mercy's COPD Support Group - Moose Lake, MN
- Fairview Lakes COPD Support Group - Wyoming, MN
- Alpha Loans - Wyoming, MN
- Methodist Hospital Pulmonary Rehabilitation Support Group - St. Louis Park, MN

Click here to enter a new pulmonary support group
Questions?

Can I get addicted to Oxygen?

Will wearing Oxygen make my lungs weaker?

Can too much $O_2$ be bad?