Oxygen Therapy in Lung Disease

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NO DISCLOSURES

OBJECTIVES

Understand the data backing oxygen therapy in chronic lung disease.

Understand the basics of home oxygen therapy.

Understand the uses for portable versus stationary oxygen concentrators.

WHO SHOULD BE CONSIDERED?

ACUTELY

Anyone w/resting hypoxemia post-hospitalization

- Temporary for most patients
- PaO2 usually defined <=55 mm Hg

WHO SHOULD BE CONSIDERED?

CHRONICALLY

COPD

ILD

Other dx w/ chronic hypoxemia

Heart disease

DATA FOR CHRONIC OXYGEN

COPD-most established data

ILD-less data

Other pulmonary dx-poor data

COPD

LANDMARK TRIALS THAT ESTABLISHED EFFICACY OF OXYGEN THERAPY IN SELECTED PATIENTS W/COPD

Continuous or nocturnal oxygen therapy in hypoxemic chronic obstructive lung disease: a clinical trial. (1980)

Long term domiciliary oxygen therapy in chronic hypoxic cor pulmonale complicating chronic bronchitis and emphysema. (1981)

POINTS TO REMEMBER FOR THESE TRIALS

Trials targeted patients w/COPD & severe chronic daytime hypoxemia (by ABG)

Long-term oxygen used >=15-18 hrs/day improved survival in patients w/COPD

COPD

EFFICACY OF NOCTURNAL OXYGEN IN PATIENTS WHO DON'T QUALIFY FOR DAYTIME OXYGEN:

Fletcher et al (1992) & Chaouat A, et al (1999)

- First 2 trials that examined the effect of nocturnal oxygen on survival & progression to long-term oxygen therapy at 3 years of follow-up
- Negative results, but were underpowered (38 patients randomized in one & 76 in the other trial)

COPD

EFFICACY OF NOCTURNAL OXYGEN IN PATIENTS WHO DON'T QUALIFY FOR DAYTIME OXYGEN:

Lacasse Y, et al (2020):Nocturnal oxygen versus placebo

Results

- Recruitment stopped prematurely because of recruitment & retention difficulties after 243 patients (projected 600) randomized at 28 centers
- 3 years F/U: 39% of the patients assigned to nocturnal oxygen (48/123) & 42% of those assigned to placebo (50/119) met NOTT-defined criteria for long-term oxygen therapy or had died (p not significant)

Conclusions

- Underpowered trial
- No indication that nocturnal oxygen had a positive effect on survival or progression to long-term oxygen therapy in patients w/COPD

COPD

EFFICACY OF OXYGEN IN PATIENTS WHO HAVE MODERATE DESATURATIONS:

Long-Term Oxygen Treatment Trial Research Group et al (2016): Supplemental oxygen vs. none in stable COPD w/moderate resting desaturation (Spo_2 89 to 93%)

Results

- 738 patients at 42 centers followed for 1-6 years
- No significant difference between supplemental-oxygen group & no oxygen group for:
  - Time to death or first hospitalization (P=0.52)
  - Rates of all hospitalizations (rate ratio, 1.01; 95% CI, 0.91 to 1.13)
  - COPD exacerbations (rate ratio, 1.08; 95% CI, 0.98 to 1.19)
  - COPD-related hospitalizations (rate ratio, 0.99; 95% CI, 0.83 to 1.17).
  - Between-group differences for measures of QOL, lung function, & 6 MWD

COPD

BREATHLESSNESS IN THOSE WHO DO NOT QUALIFY:

Ekström M, et al (2016): Cochrane Meta-Analysis w/33 studies (N=901)

Results

- Oxygen can relieve breathlessness during exercise in mildly hypoxemic & non-hypoxemic COPD patients who don't qualify for oxygen therapy
- Evidence pertains to acute effects during exercise
- Oxygen doesn't decrease breathlessness in daily life setting
- Oxygen doesn't affect health-related QOL

ILD

Bell et al (2017): Systematic review; 8 studies (N=1509)

Results

- No effects of oxygen therapy on dyspnea during exercise in ILD
- Exercise capacity increased

ILD

Khor et al (2020): Assess if oxygen improved QOL, exercise capacity in ILD

Results

- Oxygen vs no oxygen
- No significant difference in 6 MWD (P = .34)
- Secondary outcomes at week 12 in Oxygen Group
  - Significantly better cough-related quality of life (P = .01)
  - Improved moderate-to-vigorous activities (P = .04)

Conclusion

Randomized controlled trial w/longer intervention duration is warranted to clarify oxygen impacts in patients w/ILD

CHRONIC LUNG DISEASE

Ergan et al (2017): Summary of all literature for oxygen usage

- Good evidence for the benefits of LTOT in hypoxemic COPD patients for improving survival
- No evidence for the benefits of LTOT COPD patients w/
  - Moderate or intermittent hypoxemia
  - Nocturnal hypoxemia
  - Exercise-induced hypoxemia
  - Breathlessness

MEDICARE NCD 240.2

Group 1: Three Categories

- Resting: Arterial PO2 <=55 mm Hg, or arterial oxygen saturation <=88%, taken at rest, breathing room air
- Sleep: Arterial PO2 <= 55 mm Hg, or arterial oxygen saturation <= 88%. Provided only for during sleep, and only one type of unit covered. Portable oxygen not covered
- Exercise: Arterial PO2 <=55 mm Hg or arterial oxygen saturation <=88%, taken during exercise [defined as either the functional performance of the patient or a formal exercise test]. Supplemental oxygen provided during exercise if the use of oxygen improves the hypoxemia as demonstrated during exercise when the patient was breathing room air.

MEDICARE NCD 240.2

Group II: Coverage for patients whose arterial PO2 is 56-59 mm Hg or whose arterial blood oxygen saturation is 89%, if there is

- Dependent edema suggesting CHF
- Pulmonary hypertension or cor pulmonale, determined by measurement of pulmonary artery pressure, gated blood pool scan, echocardiogram, or "P" pulmonale on EKG (P wave >3 mm in standard leads II, III, or AVFL)
- Erythrocythemia with a hematocrit greater than 56%.

ATS GUIDELINES (2020)

COPD Recommendations

- COPD w/chronic resting room air hypoxemia, recommend prescribing Long Term Oxygen Therapy (LTOT) >=15 hrs/day (strong recommendation, moderate quality evidence).
- COPD w/moderate chronic resting room air hypoxemia, suggest not prescribing LTOT (conditional recommendation, low quality evidence).
- COPD w/severe exertional room air hypoxemia, suggest prescribing ambulatory oxygen (conditional recommendation, moderate quality evidence).

ATS GUIDELINES (2020)

ILD Recommendations

- ILD w/severe chronic resting room air hypoxemia, recommend prescribing LTOT >=15 hrs/day (strong recommendation, very low quality evidence).
- ILD w/severe exertional room air hypoxemia, suggest prescribing ambulatory oxygen (conditional recommendation, low quality evidence).

OXYGEN THERAPY

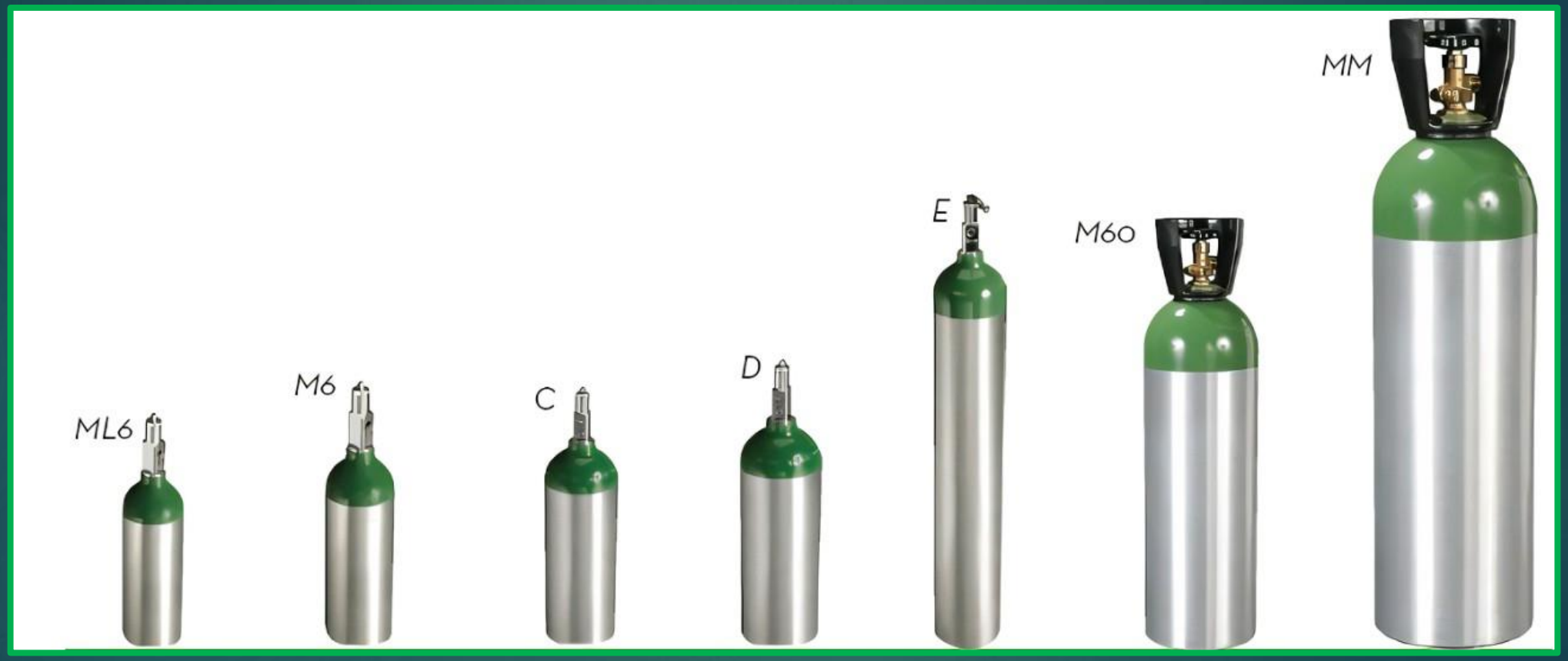
Tanks

- Several sizes & weights

Concentrators

- Stationary
- Portable
  - Different sizes handle different liter flow
  - Range in size from very small to airplane carryon size

OXYGEN THERAPY



OXYGEN THERAPY

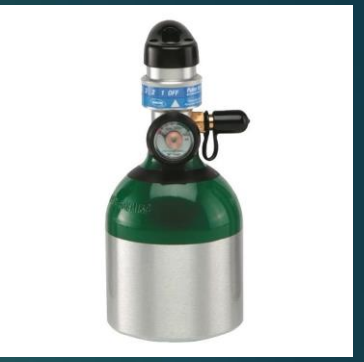
Types of Delivery

- Continuous
- Pulsed Flow

Common Oxygen Cylinder / Tank Delivery Chart:

Cylinder Duration Times (Shown In Hours)								
Flow Rate in LPM:	1	1.5	2	2.5	3	4	5	6
M4 (A) = 113 Liters								
Pulse Dose *	10.7	6.8	4.9	4.3	2.9	2.4	2.1	1.9
Continuous Flow	1.9	1.3	.9	.7	.6	.5	.4	.3
M6 (B) = 165 Liters								
Pulse Dose	16.3	10.5	8.1	6.3	4.8	4.1	2.7	2.4
Continuous Flow	2.7	1.8	1.4	1.1	.9	.7	.6	.4
ML6 = 165 Liters								
Pulse Dose *	8.6	5.7	4.3	3.4	2.9	2.1	1.7	1.4
Continuous Flow	2.8	1.9	1.4	1.1	.9	.7	.6	.4
M9 (C) = 255 Liters								
Pulse Dose *	24.1	16.1	12.1	8.9	8.0	6.0	4.4	4.0
Continuous Flow	4.0	2.7	2.0	1.6	1.3	1.0	.8	.7
D = 425 Liters								
Pulse Dose *	41.0	26.0	20.5	14.4	13.0	10.2	8.2	6.5
Continuous Flow	6.9	4.6	3.5	2.8	2.3	1.7	1.4	1.2

PULSED DOSING



- Flows up to 6 L/min
- Requires use of Conservor
  - Increases length of time 5 fold
  - Oxygen triggered for delivery when patient takes a breath
  - Can’t be used if patient breath is not large enough to trigger a breath from Conservor
    - Test for this with 6 MW w/saturations

TANKS

D Cylinder

- Most commonly used small size cylinder
- 6 pounds empty, 2 pounds gas added
  - Shoulder bag to carry
- Tank time ~2.5 hours
  - Pulsed dosing >3 L/min
  - Open flow <=3 L/min
  - Tank time determined by L flow, pulsed vs open flow

TANKS

B & C Cylinders

- 2, 4 pounds respectively empty; ~ 1 pound gas added
  - Shoulder bag to carry
- Most useful with flows <=3 L/min
- Less tank-time than D cylinder
  - Pulsed dosing extends tank time

TANKS

Monthly delivery of tanks is usual

Can fill tanks from Concentrator

- Requires I-Fill unit
- Requires hand mechanics to turn valves
- Limited number of tanks delivered

CONCENTRATORS

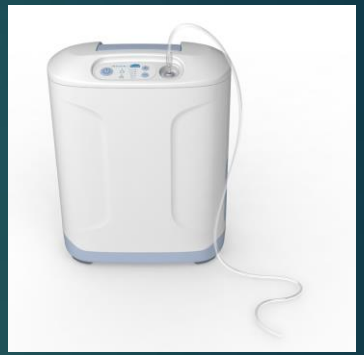
How do they work?

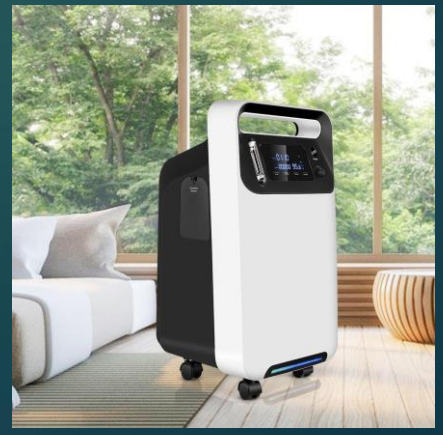
- Draw in room air through filters to remove dust, bacteria
- Remove nitrogen through semi permeable membranes
- Oxygen is concentrated during membrane process
- Most stationary function w/0.5 to 10-15L flow rates

CONCENTRATORS

Stationary

- In-home; plugs into main electricity supply
- Somewhat portable & may have wheels
  - ~35 pound weight
- Patient fills tanks to get more portability
- Long oxygen lines
  - Patient can get tangled





CONCENTRATORS

Portable Concentrators

- Used mainly for people who are working &:
  - Can’t have oxygen in work area
  - Can’t drag a tank w/them (e.g. house inspector under a house)
  - Need frequent tank changes at inconvenient times

CONCENTRATORS

Two main types

- Larger
- Smaller-like those advertised on TV

Battery Time

- Lithium Ion Batteries
- Determined by L flow, pulsed vs. open flow
  - Limiting factor in how long patient can be outside of home
- Second battery can be added but adds weight

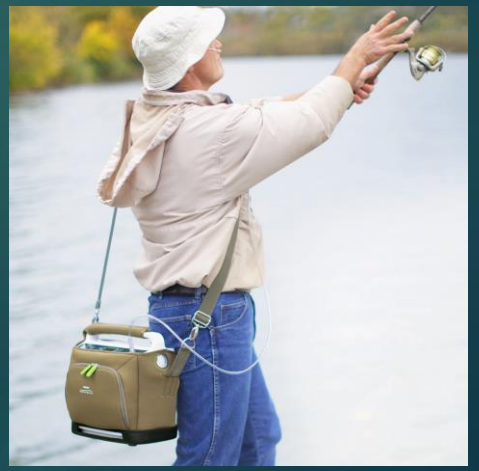
CONCENTRATORS

Larger

- ~19 pounds; like carryon suitcase
- Open & pulse flow available
- Flows up to 6L/min using pulsed flow
- Battery time ~2.5 hours

Smaller

- ~6 pounds
- Open & pulse flow available
- Flows <3L/min; preferably <=2L/min
- Battery time ~2.5 hours



WHICH IS BETTER?

Khor YH er al (2017): Portable concentrator vs oxygen cylinder during walking in ILD

Results

- Randomized; (N=20)
- Crossover design
- No significant difference in 6 MWD

WHICH IS BETTER?

LeBlanc et al (2013): Trialed 3 portable systems

Results

- Eclipse 3, EverGo, Igo in COPD patients
- Patients favored Eclipse 3
- 6MWD significantly different w/Eclipse 3
- Eclipse 3 delivered bigger oxygen bolus

WHICH IS BETTER?

Strickland et al (2008): Trial 4 portable oxygen systems

Results

- Helios, HomeFill, FreeStyle, & oxygen cylinder system
- VA COPD patients; N=39; Randomized
- No significant differences in
  - SpO2
  - 6 MWD
  - No evidence of inadequate oxygenation w/the 2 systems that provided a lower oxygen concentration

LIQUID OXYGEN

Not utilized much

- Safety concerns
  - 140# tank of liquid oxygen stored in the home (much higher flammable risk than non-liquid oxygen)
- Patient fills tanks-must be able to twist and close valves
- Usually a higher cost than traditional oxygen

Benefit

- Lasts longer than traditional tanks (~double the time of comparable sized cylinder)

LIQUID OXYGEN

ATS Liquid Oxygen Recommendation (2020)

In patients with chronic lung disease who are mobile outside of the home & require continuous oxygen flow rates of >3L/minute during exertion, we suggest prescribing portable liquid oxygen

WHICH IS BETTER?

Nasilowski et al (2008): portable oxygen vs. portable liquid oxygen in COPD

Results

- N=13; all on chronic Oxygen
- No significant difference in 6 MWD

CONCLUSIONS

- Definite Role for oxygen therapy in Selected Candidates
- Tank versus Concentrator depends on Patient
- Small Concentrators serve few
- Liquid oxygen not frequently indicated

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