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Better lung health for all

The role of ambulatory oxygen therapy during exercise

RACHEL GARROD Ph.D
Respiratory Physiotherapist
University of Galway

Objectives

To understand the role of Ambulatory Oxygen therapy in patients with chronic respiratory disease

To appreciate the role of AOT as an adjunct in PR

To be aware of adverse events and considerations when prescribing oxygen

Introduction

- Prevalence of EID will differ according to which exercise test used
  - Sixteen patients (32%) and 13 patients (26%) met the criteria for ambulatory oxygen with the ISWT and the 6MWT, respectively (P = 0.32) (Lewko et al, Physiotherapy 2007)
- Exercise induced desaturation (EID) is common
  - Up to 47% of patients with COPD desaturate below 90% during a field walk test (Ringbaek et al, 2013)
  - Desaturation to <80% occurred in 58% of patients with ILD during the 6MWT (Park et al, 2011)
- EID complicates the disease trajectory
  - Associated with mortality and decreased physical activity (Casanova et al 2008)
- There is concern that EID limits the effectiveness of exercise interventions such as PR
  - Do patients with EID tolerate high intensity exercise?
  - Staff may decrease intensity of training to manage desaturation

Ambulatory oxygen therapy (AOT)

- The provision of oxygen during exercise or during physical activity

- AOT modalities
  - portable cylinders
  - liquid oxygen
  - portable oxygen concentrator

- May be used to support a long-term oxygen (LTOT) prescription, or by non-LTOT users who have EID who have met criteria for AOT

Short term ambulatory oxygen for chronic obstructive pulmonary disease

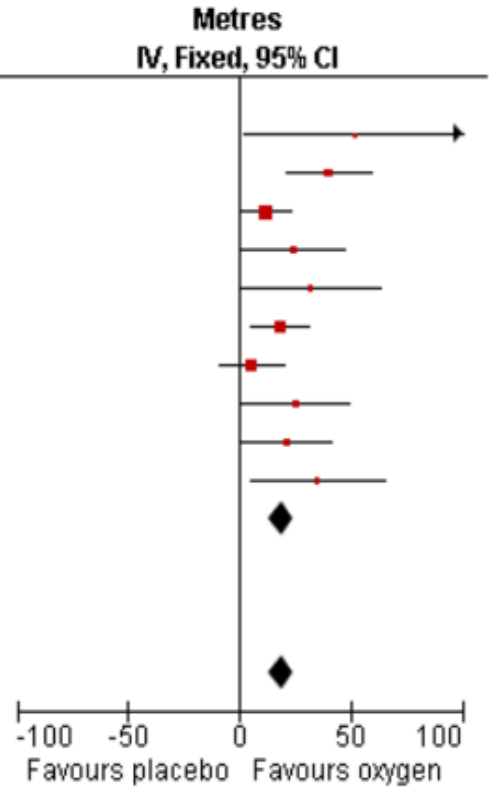
Bradley & O'Neill (2005)

- Meta analysis of 31 RCTs comparing AOT v. placebo air during an exercise test in patients with COPD

- Oxygen **improved** all pooled outcomes relating to endurance exercise capacity (distance, time, number of steps) and maximal exercise capacity (exercise time and work rate).

Figure 1. Forest plot of comparison: 1 Oxygen versus placebo (crossover studies), outcome: 1.1 Endurance test - exercise distance (Davidson 1988 6MWT).

Study or Subgroup	Metres	SE	Weight	Metres IV, Fixed, 95% CI
1.1.1 Low dose				
Davidson 1988	52	25.53	1.3%	52.00 [1.96, 102.04]
Eaton 2002	40	9.77	9.0%	40.00 [20.85, 59.15]
Fujimoto 2002a	12	5.64	27.0%	12.00 [0.95, 23.05]
Fujimoto 2002b	24	11.64	6.3%	24.00 [1.19, 46.81]
Fujimoto 2002c	32	16.03	3.3%	32.00 [0.58, 63.42]
Ishimine 1995	18	6.67	19.3%	18.00 [4.93, 31.07]
Knebel 2000	5.49	7.253	16.3%	5.49 [-8.73, 19.71]
Kurihara 1989	25	12.16	5.8%	25.00 [1.17, 48.83]
McDonald 1995	21	10.45	7.9%	21.00 [0.52, 41.48]
Woodcock 1981	35	15.54	3.6%	35.00 [4.54, 65.46]
Subtotal (95% CI)			**100.0%**	**18.86 [13.11, 24.61]**
Heterogeneity: Chi² = 13.50, df = 9 (P = 0.14); I² = 33%				
Test for overall effect: Z = 6.43 (P < 0.00001)				
Total (95% CI)			**100.0%**	**18.86 [13.11, 24.61]**
Heterogeneity: Chi² = 13.50, df = 9 (P = 0.14); I² = 33%				
Test for overall effect: Z = 6.43 (P < 0.00001)				
Test for subgroup differences: Not applicable				



Ambulatory oxygen for people with chronic obstructive pulmonary disease who are not hypoxaemic at rest

Cochrane Library
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Ameer et al (2015)

Does AOT improve longer term outcomes of exercise capacity or health related quality of life?

- 4 RCTs (n=331) comparing AOT (various modalities) v placebo air cylinders or usual care in participants with COPD
  - No evidence of any effect was reported for survival
  - Limited benefits observed for exercise capacity
  - 2 studies (McDonald, 1995; Nonoyama, 2007) found a statistical and clinical improvement in dyspnoea post exercise favoring the oxygen group
  - Dyspnoea and fatigue domains of the CRQ improved in all 4 studies in favour of the oxygen group (Eaton, 2002; McDonald 1995; Moore 2011; Nonoyama 2007)
    - Mean change in dyspnoea domain 0.28 95%CI (0.10 to 0.45)
    - Mean change in fatigue domain 0.17 95% CI (0.04 to 0.31)
  - Lack of evidence to determine treatment effect on exercise capacity, mortality or quality of life

Long term impact of AOT

- None of the studies reported oxygen related adverse events – CO_2 retention, fires or burns

In the study by Moore (2011)

- Patients used their cylinders (oxygen or compressed air) for only an average of 40 minutes each day
- At the end of the study 46% of patients requested to cease using the cylinders

What challenges do you come across with patients who use AOT at home?

Stigma

Compliance

Patient perception

Safety

Smoking

GOLD 2023 – treatment of hypoxaemia

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- In patients with severe resting hypoxaemia LTOT is indicated.
- In patients with stable COPD and resting hypoxaemia or moderate EI desaturation, LTOT should not routinely be prescribed; however, individual patient factors may be considered when examining need for supplemental Oxygen
- Resting oxygenation at sea level does not exclude the development of severe hypoxaemia when travelling by air.

GLOBAL INITIATIVE FOR CHRONIC OBSTRUCTIVE LUNG DISEASE

AOT – within context of exercise

- Relieves breathlessness
- Increases exercise tolerance
- Prevents raised pulmonary artery pressure
- Can correct arterial desaturation
- Reduces ventilation
- Reduces hyperinflation
- Inhibits chemoreceptor activity
- Slows rise in RR and TV with exercise
  - Somfay et al, Chest: 121 : 2002

Ambulatory oxygen therapy and pulmonary rehabilitation

Does AOT allow patients to tolerate higher intensity training during PR, thus improving outcomes?

- Patients will be able to do more
- Patients will be able to exercise at a greater intensity
- Patients will be less breathless during exercise
- Muscle kinetics will be faster

- Do they do more ?
- Does supplemental oxygen enhance delivery at the muscle level?
- Could this minimise desensitisation to dyspnoea?
- Could anaerobic metabolism be a stimulus to training effects?

Overview of O2 and exercise trials

Rooyackers 1997	4 lts O2 vs room air (gen exercise)	24 hypoxic COPD	No sig diff btwn groups
Garrod 2000	Cylinder air vs 4l O2 (gen exc)	26 hypoxic COPD	No sig diff btwn groups
Wadell 2001	Room air vs 4 lt O2 (treadmill)	20 hypoxic COPD	No sig diff btwn groups
Emtner 2003	3lts Oxygen vs compressed air (cycle)	29 NON Hypoxic COPD	Additional 4 mins endurance cycle in O2 trained and reduced SOB at isotime training
Dyer 2012 *	4lts O2 backpack vs room air (gen exc)	51 hypoxic- all showed benefit initially	5 mins improvement in ESWT in O2 trained (nb test performed on O2 in O2 gp only)

Problems

- Small sample sizes ***
- Sometimes vague exercise prescription
- Insufficient oxygen flow rates?
- No measures of muscle metabolism and enzymes
- Ensured patients stopped because of fatigue/ breathlessness ?
- Measures pre and post not during training period

Ambulatory oxygen improves effectiveness of PR in selected patients with COPD

Dyer et al (2012)

- Single blind RCT comparing AOT v usual care
- n=51

Table 2. Change in endurance shuttle walking test with PR

	RA group	O_2 group	Difference	95% CI	*p* value
Mean change, seconds[a] (SD)	378 (364)	679 (317)	301	101–501	0.004
Mean change, m[b] (SD)	393 (395)	883 (484)	489	228–750	0.0005
Mean change, %[c] (SD)	77 (59)	204 (468)	127	31–223	0.01

- Patients were unblinded – impact of bias?

AOT as an adjunct for PR

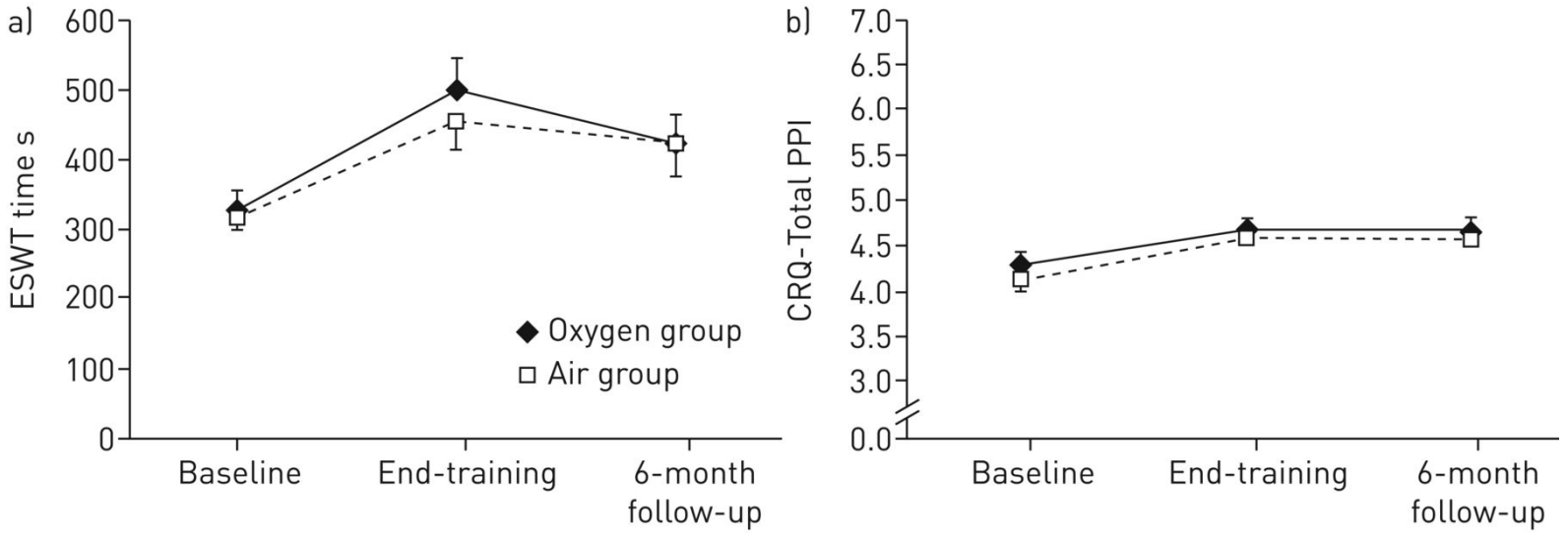
- Alison et al (2019) completed a double-blind RCT that compared AOT with medical air during an 8-week exercise intervention

  - Prospective, multi-centre, double blinded RCT
  - Recruited people with COPD who were normoxaemic at rest and desaturated during exercise
  - Exercise intervention
  - Exercise only stopped f desaturation fell < 80%
    - 20 minutes treadmill at 80% average 6MWT speed & 10 minutes cycle at 60% peak WR
    - Supervised 3 times per week for 8 weeks
    - Duration increased to 40 minutes by week 3, intensity increased according to dyspnoea
  - Participants randomised to receive 5LPM oxygen or medical air during exercise

AOT as an adjunct for PR

- 111 participants were recruited
  - <u>All outcomes increased significantly with training in both groups</u>
  - No between group difference in ESWT time or CRQ-T at end-training or at 6 months follow up
  - No between group difference in ISW distance at end-training, or any of the CRQ domain scores

Change in a) endurance shuttle walk test (ESWT) time and b) Chronic Respiratory Disease Questionnaire (CRQ)-Total in the Oxygen and Air groups.



No significant difference between groups for any outcome,
Within group changes positive as expected

But did demonstrate acute benefit of AO at start_

Current AOT guidelines

BTS (2015) Home Oxygen for use in Adults

- AOT should not be routinely offered to patients who are not eligible for LTOT. (Grade B)
- AOT should not be routinely offered to patients already on LTOT. (Grade D)
- AOT assessment should only be offered to patients already on LTOT if they are mobile outdoors. (Grade A)
- AOT should be offered to patients for use during exercise in a pulmonary rehabilitation programme or during an exercise programme following a formal assessment demonstrating improvement in exercise endurance. (Grade B)

Current PR guidelines

- BTS (2013) Pulmonary Rehabilitation in Adults

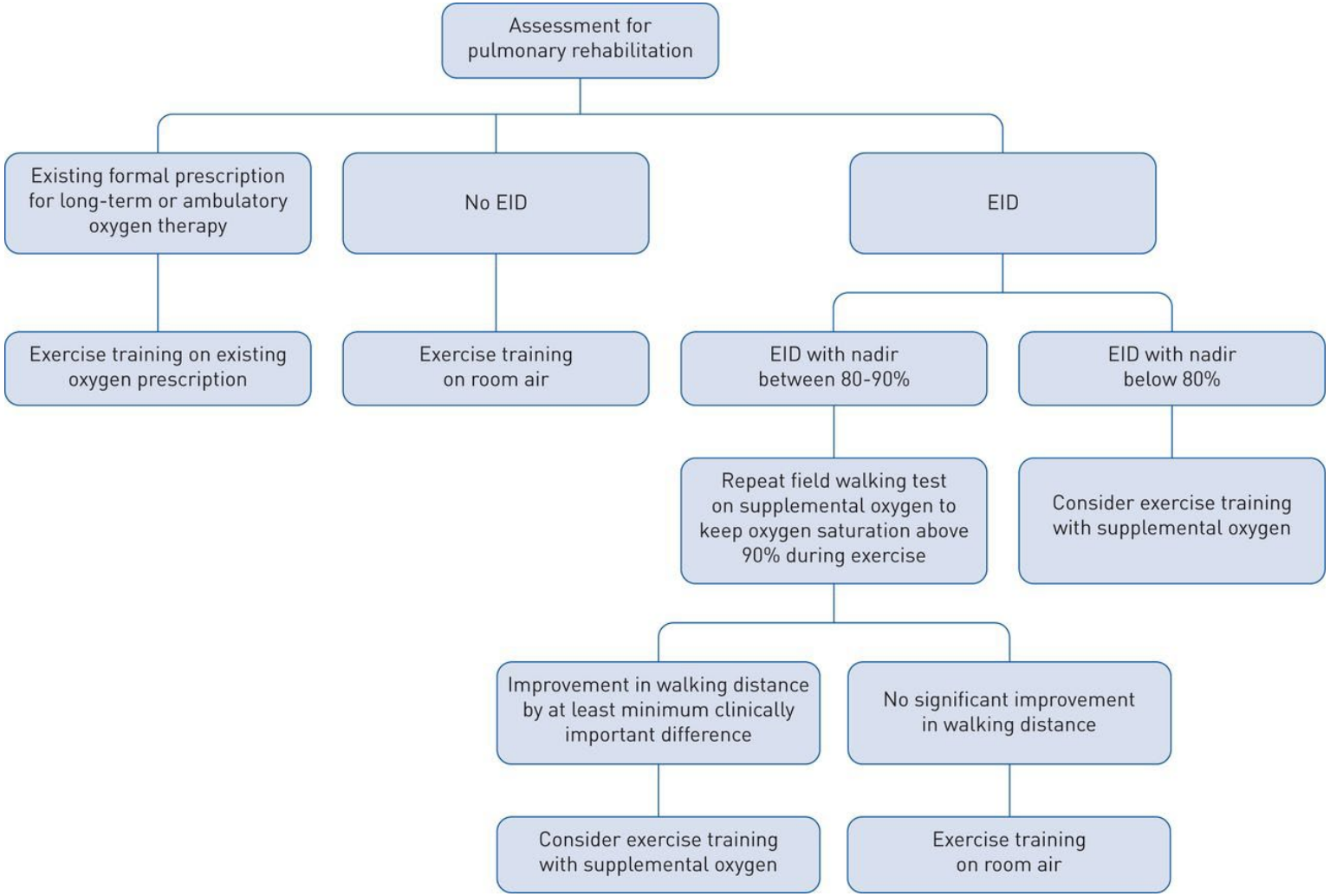
Supplemental oxygen in patients undergoing rehabilitation

- Supplemental oxygen should not be routinely used for all patients undergoing pulmonary rehabilitation. (Grade B)
- Supplemental oxygen during pulmonary rehabilitation should be offered to those who fulfil the assessment criteria for long-term or ambulatory oxygen unless there are compelling clinical reasons to use alternative criteria. (Grade D)
- Individuals who are prescribed oxygen but decline to use it during exercise should have this clearly documented in their notes. (√)
- Pulmonary rehabilitation provides an opportunity to assess the adequacy of the prescribed flow rate for patients already in receipt of long-term oxygen therapy (LTOT) or ambulatory oxygen. (√)

Adverse events due to hypoxaemia
Possible treatment effects

- Adverse events have not been directly studied in association with the ISW
- No literature describing complications of conducting ISW
- Desaturation <80% was noted as an adverse event and cause for test termination during the 6MWT by Jenkins et al (2011)
- Consensus suggests the ISW and 6MWT should be discontinued if Sp02 <80% (Holland et al, 2014)
- There is increased interest in the therapeutic use of hypoxic conditions in brain and nerve injury (spinal cord injuries - neuroplasticity)
- Training at hypoxia increases erythropoietin EpO leading to increased red cell mass, V02max.

An algorithm to assess exercise induced oxygen desaturation (EID) (defined as nadir oxygen saturation below 90% during a field walking test performed on room air) in patients with chronic obstructive pulmonary disease referred for pulmonary rehabilitation.



Jessica A. Walsh et al. Eur Respir J 2019;53:1900837

Considerations when prescribing oxygen

Consent?

Safety

Pulsed/continuous flow

Education

Flow rate?

Patient preference

Economy of resources

Practicality

Smoking?

Take home messages

- EID is a common in people with chronic lung disease
- Good evidence to support supplemental oxygen during individual exercise tests, less clear evidence regarding benefits of AOT in the longer term
- Individual assessment is important
- Little evidence that it adds much to PR
- If they already have it encourage them to bring to rehab

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