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Review Article

THE ROLE OF GENERAL PRACTITIONERS IN HOME OXYGEN THERAPY

SB Khoo *FRACGP*
Penang Medical College.

Address for correspondence: Dr Khoo Siew Beng, Department of Clinical Skills, Penang Medical College, No 4, Sepoy Lines Road, Penang 10450, Malaysia. Tel: 604-2263451, Fax: 604-2284285, E-mail: sbkhoo@pmc.edu.my

Conflict of interest: none

Abstract

Recommendation of oxygen therapy must include clear indication and benefits of its use, appropriate prescription, vigilant monitoring and appropriate methods of delivery. Home oxygen therapy is expensive, inconvenient and cumbersome; it should be recommended only if benefits outweigh the disadvantages and adverse effects of oxygen. GPs play an important supportive and supervisory role in the use of long-term oxygen therapy (LTOT) to improve mortality of patients with chronic hypoxaemia. Prescription of short burst oxygen therapy (SBOT) for palliation of breathlessness is without clear evidence of its efficacy. GPs can prescribe SBOT when other secondary causes of breathlessness are excluded or treated, when breathlessness is not relieved by other treatments and if an improvement can be documented in patients.

Keywords: Long term oxygen therapy, short burst oxygen therapy, chronic hypoxaemia, breathlessness, palliation
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INTRODUCTION

Oxygen is a powerful symbol of medical care that is probably more important than its actual therapeutic value in the relief of breathlessness.[1] It is widely available and commonly prescribed by medical and paramedical staff but is often given without careful evaluation of its potential benefits and side effects. Like any drug therapy there must be clear indications for treatment with oxygen, appropriate prescription, vigilant monitoring and appropriate methods of delivery.[2]

Home oxygen therapy is an effective but potentially expensive and inconvenient intervention. It should be prescribed only for patients in whom there is evidence of benefit, such as those whose disability relates to a chronic reduced arterial oxygen concentration (chronic hypoxaemia).[3] In the absence of hypoxaemia, oxygen therapy is less likely to be useful except for cluster headache.[3] Reasons for inadequate or inappropriate use of home oxygen therapy may be partly due to professional knowledge and behaviour.[4]

It is important to understand the terminology used in home oxygen therapy (Table 1 and Figure 1).

Table 1. Terminology of home oxygen therapy

Terms	Definitions
Hypoxaemia	The following laboratory values, obtained while breathing ambient air: Arterial partial pressure of oxygen (PaO_2) ≤55mm Hg Arterial oxygen saturation (SaO_2) ≤88% In the presence of secondary polycythaemia and pulmonary hypertension: PaO_2 between 55-60 mmHg.
Long Term Oxygen Therapy (LTOT)	Provision of oxygen therapy for continuous use at home for patients with chronic hypoxaemia. The flow rate must be sufficient to raise the waking oxygen tension in adults to above 60mm Hg. It is usually given for at least 15 hours daily, to include nighttime.
Short Term Oxygen Therapy	Similar use as in LTOT but only for a brief period of 1-3 months during unstable clinical condition such as those following acute episodes of pneumonia or attacks of COPD.
Short Burst Oxygen Therapy (SBOT)	Intermittent use of supplemental oxygen at home usually for periods of about 10-20 minutes at a time to relieve breathlessness.
Ambulatory Oxygen Therapy	Provision of oxygen therapy during exercise and activities of daily living.

Note: In the literature Long Term Oxygen Therapy (LTOT) is often used as a synonymous of Continuous Oxygen Therapy (COT) and Home Oxygen Therapy (HOT)

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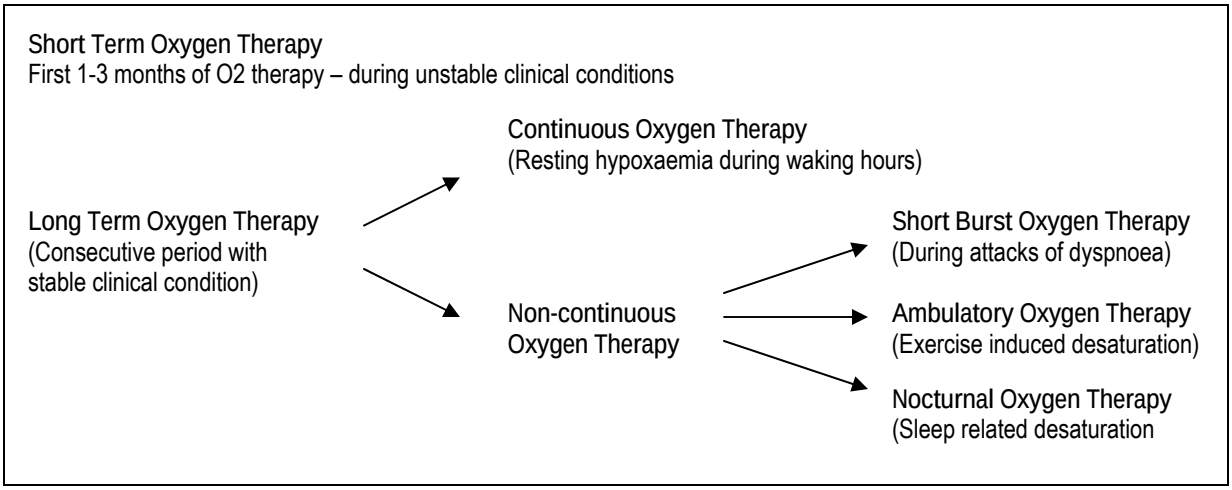
Figure 1. Terminology of home oxygen therapy[5,6]



INDICATIONS FOR HOME OXYGEN THERAPY

There are many medical conditions which may benefit from home oxygen therapy. The British Thoracic Society has published a guideline for the use of home oxygen therapy[5] (Box 1). Some of these conditions seen in primary care may be possible in the primary care setting.

HOME OXYGEN THERAPY FOR CHRONIC HYPOXAEMIA AND BREATHLESSNESS

The signs and symptoms of hypoxaemia are not specific; often they are present only when the condition is severe. Hypoxaemia adversely affects function and increases risk of death.[7] Correction of this condition is the only treatment documented to improve survival in patients with COPD.[8]

Breathlessness is a complex experience of the body and the mind. It is a multi-systemic disorder with many accompanying subtle neuro-hormonal abnormalities and alterations in skeletal and respiratory muscle structure and function. The experience of breathlessness is likely to be modified both by previous experience of the sensation and by pathways from different areas in the central nervous system. Patients with similar disease can have breathlessness of widely different severity.[9]

Hypoxaemia itself does not cause breathlessness. Not all breathlessness can be relieved with oxygen therapy. Therefore breathlessness alone is not an indication for oxygen supplementation. However oxygen therapy may reduce breathlessness in hypoxaemic patients during exercise by decreasing ventilatory requirements and thereby reducing the work of breathing.[7]

Box 1. Indications for home oxygen therapy[5]

Long Term Oxygen Therapy

Chronic hypoxaemia in:
Chronic obstructive pulmonary disease
Severe chronic asthma
Diffuse interstitial lung disease
Cystic fibrosis
Bronchiectasis
Widespread pulmonary neoplasm
Pediatric bronchopulmonary dysplasia (BPD)
Pulmonary hypertension
Recurring congestive heart failure due to chronic cor pulmonale

Nocturnal hypoventilation (With continuous positive airway pressure, CPAP)
Obesity
Neuromuscular / spinal / chest wall disease
Obstructive sleep apnoea

Palliative use
Pulmonary malignancy

Short Burst Oxygen Therapy (SBOT)

SBOT has traditionally been used for:
Pre-oxygenation before exercise
Breathlessness during recovery from exercise
Control of breathlessness at rest
Used in palliative care
Used after an exacerbation of COPD to bridge the time to full LTOT assessment

Ambulatory oxygen therapy

Chronic hypoxaemia who are on LTOT and who need to leave the home on regular basis. Without chronic hypoxaemia, evidence of exercise oxygen de-saturation, improvement in exercise capacity and / or less breathlessness with ambulatory oxygen therapy.

Evidence of benefits

Review of existing literature by the Association of Palliative Medicine Scientific Committee (APMSC)[10] reveals that:

1. The British Thoracic Society (BTS) guidelines recommend the use of long-term oxygen therapy (LTOT) in specific patients with COPD to improve survival rather than palliation of breathlessness. Trials tend to use quality and quantity of life measures rather than breathlessness per se as the desired outcome.
2. Short bursts and ambulatory oxygen are widely prescribed to relieve breathlessness of COPD but there are no data to support or refute this practice.
3. In patients with advanced cancer, oxygen is commonly used in the palliation of breathlessness without clear evidence of its efficacy.
4. There is insufficient evidence for use of oxygen for breathlessness in patients with chronic heart failure.

SUPPORTIVE ROLE OF GENERAL PRACTITIONERS

General practitioners (GPs) play an important role in providing patient education and support for patients and family members. Information on how to purchase oxygen sources, its various modes of delivery, and advice on precautions to be taken while keeping oxygen at home are helpful to them. There are many modalities that are useful for treatment of breathlessness. Efforts to minimize anxiety can provide comfort. Bright, airy, spacious room and open windows help to decrease a sense of breathlessness. Recumbent position on a declining chair, relaxation technique, distraction therapy, hypnosis, massage, aromatherapy and acupuncture may make the patient feel better.

Some authors proposed that the reductions in breathlessness could be due to cool air that is directed against the cheeks to stimulate the 2nd and 3rd branch of the trigeminal nerve that in turn will have an inhibitory effect on the cerebral cortex.[11] Movement of gases (either air or oxygen) across nasal receptors may also have the same effect.[12] A simple fan blowing cool air on the face is more effective for relief of breathlessness than a 100% non-rebreather mask[11] Patient's report of breathlessness offers opportunity to explore fears related to the illness or other aspects of patient's life.[1]

Therapeutic management of underlying causes should be given priority. Dexamethasone and radiotherapy are useful for shrinking the tumor mass that is obstructing the airway and for relieving superior vena obstruction and lymphangitis carcinomatosis. Antibiotics are used to treat lung infections; bronchodilator and steroid inhalation are indicated for obstructive airways disease; diuretics with or without angiotensin converting enzyme inhibitors are useful for congestive cardiac failure. Blood transfusion can provide transient relief of breathlessness due to anaemia; benzodiazepines may reduce panic attacks that invariably accompany the patient's fear of being choked to death. Pleural and peritoneal tapping can be performed for massive pleural effusion and ascites that are compressing on the diaphragm and lung parenchyma. For symptomatic relief of breathlessness itself, opioids are indicated as first line treatment not only for those with terminal cancer but also of other causes. Anxiolytics and neuroleptics can also be useful.[1]

Supervisory role in LTOT and ambulatory oxygen therapy in chronic hypoxaemia

Patients with COPD, interstitial lung disease, bronchiectasis, and severe asthma have slow descent into breathlessness, are older by the time they have severe disease. Over the years they become familiar with doctors, nurses, hospitals and oxygen equipment; hence it may not be too difficult for them to cope with the complex task of delivery of LTOT.[9]

Long-term oxygen therapy is the only intervention known to increase life expectancy in patients with COPD.[13] When used in conjunction with pulmonary rehabilitation, it also improves quality of life. Specific benefits include amelioration of cor pulmonale, polycythaemia and pulmonary hypertension, improved neuropsychiatric function, exercise performance and skeletal-muscle metabolism, enhanced cardiac function, increased body weight, and reduced need for hospitalization and possible reversal of sexual impotence.[14]

GPs are required to refer patients to a respiratory physician for LTOT and ambulatory oxygen prescription. Appropriate assessment for LTOT requires consideration of 3 factors[5]:

1. Clinical diagnosis of the disorder associated with chronic hypoxaemia
2. Optimum medical management of the particular condition and clinical stability for at least 5 weeks prior to assessment
3. Arterial blood gas tensions must be measured

For ambulatory oxygen therapy, assessments are performed after pulmonary rehabilitation and are currently designed around the short-term response to supplemental oxygen therapy, when the patient is performing an exercise test such as a 6-minute walking test or a shuttle test.[5] Oximeters are used to record SaO2 during exercise. Supplemental oxygen flow rate that is required to maintain the SaO_2 above 90% is noted. Walking distance and measurement of resting / end exercise breathlessness are made using Borg score or Visual Analogue Score.

GPs, in close proximity to patients in the community are in the best position to advise and supervise on the delivery of home oxygen therapy once prescription is given by the respiratory physician. Various stationary and ambulant sources of oxygen and different modes of oxygen delivery are tabulated in Table 3. Selection of the appropriate source and mode of delivery depends on the objective of therapy whether for symptom relief or survival improvement, total daily requirement, flow rate of oxygen, indoor and out-door activities of patients and their personal preference. Patients and carers must be educated on the precautions to be observed while maintaining home oxygen therapy (Table 3, Box 2, Box 3).[15]

Table 3. Oxygen delivery system[13]

Oxygen Supply	
Sources	Features
A. Stationary	
1. Oxygen concentrators	Electrically powered Uses molecular sieve beds to filter and concentrate oxygen molecules from ambient air, generating oxygen concentrations of 90% to 98% Maximum flow of 3-5 L/min Backup oxygen supply with a cylinder is necessary
2. Compressed gas cylinders H-sized	Large and heavy (about 150lbs) Provides oxygen for about 57 hours at flow of 2 L/min Up to 15 L/min can be attained
E-sized	Readily available and inexpensive for patients who require 2 L/min or less Weighs 13-17 lbs, requires a cart to move Lasts about 5½ hours at 2 L/min
3. Liquid oxygen reservoirs	Can be used to refill portable units Last 5-7 days at 2 L/min Relatively high cost / occasional "freezing" of the valve at flow of about 8 L/min / evaporation of the liquid oxygen when not in use.
B. Ambulant	Ambulatory oxygen sources are small and light weight and a necessity for active patients who leave their homes.
Aluminium B tank	Last only 1 hour at 2 L/min
Aluminium D tanks	Last 3½ hours at 2 L/min
Portable liquid oxygen tank	Weigh 6-10 lbs Last 6-10 hours at 2 L/min Can be refilled from stationary liquid oxygen reservoir
Oxygen Delivery Devices	
Devices	Features
1. Nasal cannulas	Simple and inexpensive but inefficient delivery method Maximum delivered at 6 L/min
2. Demand flow devices	Senses the start of ventilation and delivers a pulse of oxygen during inspiration when it is more likely to be useful in gas exchange Eliminates oxygen flow during expiration that would otherwise be wasted Oxygen savings of 50-85% Different models differ in duration, frequency and pulse volume Noise produced is a disadvantage
3. Reservoir cannulas	Traps initial portion of expired gas that comes from the conducting airways and contains almost pure oxygen Two types available: Oxygen conserving nasal cannula with a reservoir situated below the nose and an oxygen-conserving pendant with a reservoir situated on the patient's chest. Reduce oxygen use by 50-75% Patients may find their appearance objectionable
4. Transtracheal oxygen catheters	Devices deliver oxygen directly through a catheter inserted into the cervical trachea Improves patient adherence to therapy Continuous oxygen use for 24 hours a day is attainable Successful in patients who have refractory hypoxaemia to oxygen delivered by nasal cannula

Box 2. Adverse effects of oxygen therapy[2]

Restriction of mobility and activities
Cumbersome oxygen apparatus
Expensive, inconvenient
Impaired communication between patient and family
Induces anxiety, alters self image of patient
Psychological dependence
Prolonged hospitalization
Fire hazard
Reduce hypoxic respiratory drive
Difficult to withdraw oxygen therapy even if it is used appropriately
Humidifier noisy, bulky and often ineffective
Pulmonary oxygen toxicity

Box 3. Precautions[15]

1. Stay at least 6 feet away from open flame or heat source.
2. Do not store oxygen system near heat sources or open flame. Store in cool, well-ventilated area.
3. Do not smoke. Post "No smoking" signs.
4. Use correct regulator and pressure gauge. Do not change flow rate on your own.
5. Oxygen is a drug and must be used as your doctor prescribed it.
6. Before connecting regulator, open cylinder momentarily with valve pointing away, to remove any dust that may be in the outlet.
7. Never use more than 50 feet of oxygen tubing – will dilute concentration of oxygen received.
8. Be sure to have a functioning smoke detector and fire extinguisher in your home.
9. Keep oxygen away from aerosol cans and sprays.
10. Do not use cleaning products or other products containing grease or oils, petroleum jelly, alcohol or flammable liquids on or near oxygen system.
11. Do not carry liquid oxygen in a backpack or enclosed space.
12. Notify electrical company if you are using oxygen concentrator system so they can make your house priority during a power outage.
13. Avoid skin contact when filling your portable liquid oxygen tank as frost build-up can cause injury.
14. Always have backup tanks available and know how to use them.
15. When cylinder is almost empty, close the valve and mark the cylinder as empty. Do not store full and empty cylinders together.

Prescription of SBOT for palliation of breathlessness

Oxygen therapy may be part of palliative care for patients with cancer, COPD and CHF but never a complete treatment in itself. In view of lack of evidence to support its use for episodic relief of breathlessness and the many adverse effects of oxygen therapy it should be used appropriately rather than universally.[10] SBOT should only be prescribed when other causes of breathlessness are excluded, when breathlessness is not relieved by other treatments and if an improvement can be documented in patients.[5] Considering the goal is to relieve the symptom of breathlessness regardless of hypoxaemia, a trial of oxygen therapy can be carried out when all other treatments fail.[1]

SBOT can be prescribed by GPs after a period of casual observation at home. Formal exercise testing may not be appropriate for assessment. Clinical judgment and consultation with the patient are the foundations of palliative care as relief of symptoms and improved quality of life are the central aim.[10] Before oxygen therapy is prescribed simple test like visual analogue scale must show clear evidence of benefit.[9] Frequent reassessment of treatment strategy is necessary as the symptoms may change quite rapidly in advanced cancer. Patients with cancer may experience rapid onset of breathlessness from previous good health, at a younger age. Some have double fear that death is imminent and that they will die gasping for breath.[9]

Breathlessness is not related to oxygen saturation or other respiratory measurements. Hence monitoring of oxygen saturation or arterial blood gases is not useful in assessing whether oxygen works.[1] Patient's report of symptom severity using visual analogue scale is the best measure.[9] Oxygen is not indicated unless patients say it makes them feel better. It should not be continued unless there is clear benefit. While oxygen is easy to use, it is expensive and may be cumbersome and burdensome at home for some. Adverse effects of oxygen are tabulated in Table 4.[2]

CONCLUSION

GPs play a supportive role in the use of long-term and ambulatory oxygen therapy for chronic hypoxaemic conditions where LTOT has been proven to improve mortality and morbidity. Prescription of SBOT by GPs for symptomatic relief of breathlessness needs to be considered only after the exclusion and management of secondary causes of breathlessness, failure of optimal non-therapeutic and therapeutic interventions. Criteria for using SBOT is clear indication that the benefits of relieving breathlessness as expressed subjectively by the individual patient, outweighs the inconvenience and adverse effects of oxygen therapy.

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Memorable quotes

Eat Food.
Not too much.
Mostly plants.

Michael Pollan, *New York Times*, January 28, 2007. [Full text]

Grumbach's interpretation of Pollan's dietary prescription:
Eat food: meaning eat whole food that came from the soil or a branch, an apple instead of an apple-flavored pop tart;
Not too much: cut back on portions—resist the American zeal for super sizing;
Mostly plants: reduce the amount of meat and dairy in one's diet.

Grumbach's health prescription for the American:

Get medical care.
Not too much.
Mostly primary care.

2007 Blanchard Memorial Lecture: Family Doctors, Family Farming, and ATMs
Kevin Grumbach, MD, University of California, San Francisco
40th Annual Spring Conference. Society of Teachers of Family Medicine. Chicago, USA. [Full text]