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Review

The Debate on Continuous Home Oxygen Therapy☆

Salvador Díaz Lobato,* José Luis García González, Sagrario Mayoralas Alises

Servicio de Neumología, Hospital Ramón y Cajal, Madrid, Spain

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ABSTRACT

Two studies published in the early 80s, namely the Nocturnal Oxygen Therapy Trial (NOTT) and the Medical Research Council Trial (MRC), laid the foundations for modern home oxygen therapy. Since then, little progress has been made in terms of therapeutic indications, and several prescription-associated problems have come to light. Advances in technology have gone hand in hand with growing disregard for the recommendations in clinical guidelines on oxygen therapy. The introduction of liquid oxygen brought with it a number of technical problems, clinical problems related to selecting candidate patients for portable delivery devices, and economic problems associated with the rising cost of the therapy. Continuous home oxygen therapy has been further complicated by the recent introduction of portable oxygen concentrators and the development in quick succession of a range of delivery devices with different levels of efficiency and performance. Modern oxygen therapy demands that clinicians evaluate the level of mobility of their patients and the mobility permitted by available oxygen sources, correctly match patients with the most appropriate oxygen source and adjust the therapy accordingly. The future of continuous home oxygen therapy lies in developing the ideal delivery device, improving the regulations systems and information channels, raise patient awareness and drive research.

Controversias en oxigenoterapia continua domiciliaria

Palabras clave:
Oxígeno líquido
Oxigenoterapia continua domiciliaria
Concentrador portátil
Controversias

RESUMEN

Dos estudios publicados a comienzo de los 80, el Nocturnal Oxygen Therapy Trial (NOTT) y el Medical Research Council Trial (MRC), sentaron las bases de la oxigenoterapia domiciliaria moderna. Desde entonces, se ha avanzado muy poco en el campo de las indicaciones mientras que se han puesto en evidencia múltiples problemas relacionados con su prescripción. La falta de adherencia a las recomendaciones establecidas por las guías clínicas en oxigenoterapia es un fenómeno que ha ido aumentando en paralelo al desarrollo tecnológico. La incorporación del oxígeno líquido trajo de la mano problemas técnicos, problemas clínicos relacionados con la selección de pacientes candidatos a beneficiarse de equipos portátiles y problemas económicos, al aumentar el coste de la terapia. La incorporación reciente de los concentradores portátiles ha complicado aún más la oxigenoterapia continua domiciliaria poniendo a nuestra disposición equipos de oxígeno con rendimientos y prestaciones muy variables a la velocidad de la innovación tecnológica. La oxigenoterapia moderna exige tener que valorar el perfil de movilidad de los pacientes, la movilidad permitida por las fuentes de oxígeno disponibles, la adecuada selección de paciente y fuente de oxígeno y la necesidad de titular la oxigenoterapia. La búsqueda del equipo de oxígeno ideal, mejorar los sistemas de regulación e información de las terapias, avanzar en la educación de los pacientes y potenciar la investigación, son líneas de trabajo que nos marcan el futuro de la oxigenoterapia continua domiciliaria.

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* Corresponding author.
E-mail address: sdiazlobato@gmail.com (S. Díaz Lobato).

Oxygen has been used for medicinal purposes almost since its discovery by Joseph Priestley in 1772.[1,2] After a period in which it was used for virtually everything (with varying results), Alvin Barach was the first to use it rationally, demonstrating its effectiveness in cor pulmonale and acute and chronic respiratory failure. Considered the father of modern oxygen therapy,[3] he led the way in ambulatory oxygen therapy, with the development of the first portable devices and oxygen-conserving systems.

In the early 80s, 2 studies were conducted which, despite their limitations, laid the foundations for long-term home oxygen therapy (LTOT) as we know it today: the Nocturnal Oxygen Therapy Trial (NOTT) and the Medical Research Council Trial (MRC)[4,5] (Table 1). The legacy of these studies was the recommendation that LTOT should be prescribed to patients with chronic obstructive pulmonary disease (COPD) who had stopped smoking, were receiving optimal medical treatment and who, when clinically stable, had sea level PaO_2 values of less than 55 mmHg or between 55 and 60 mmHg if there was evidence of damage due to hypoxia (arrhythmias, cor pulmonale, right heart failure, polycythemia or impaired intellectual function). These criteria for prescribing long-term oxygen therapy have been included since then in all LTOT guidelines, and have also appeared in the recently published SEPAR guidelines on "Continuous Home Oxygen Therapy"[6] and in the recommendations for prescribing home respiratory therapies[7] (Table 2). In these patients, the use of oxygen for at least 15 h a day improves survival and quality of life. Long-term oxygen therapy also reduces right heart failure caused by cor pulmonale, improves neuropsychological function, and increases exercise tolerance and the ability to perform activities of daily living.[6]

It is essential to understand that oxygen administration only corrects hypoxemia during application, and has no residual effect. When the supplemental oxygen supply is discontinued, hypoxemia reappears; oxygen therapy must therefore be maintained for at least 15 h per day in order for it to be beneficial.[6] It is equally important to bear in mind that the indication for prescribing long-term oxygen therapy in patients with severe hypoxemia was established because of its effect on survival.[3,4] In all cases, LTOT should be considered after confirming respiratory failure in 2 separate blood gas measurements taken 3 weeks apart, in a clinically stable phase, after an exacerbation-free period of at least 3 months.[6] The oxygen flow prescribed should be sufficient to achieve a PaO_2 of over 60 mmHg or 90% arterial oxygen saturation measured by pulse oximetry (SpO_2), without this triggering acute hypercapnia or acidosis.[6] Finally, LTOT should be reconsidered in patients who, despite meeting the necessary requirements, continue to smoke, have a clear history of poor treatment compliance or are unable to correctly handle oxygen supply systems.[6]

After the Nocturnal Oxygen Therapy Trial and the Medical Research Council Trial, What Next?

The criteria established by the NOTT and MRC trials have remained consistent for more than 30 years, despite advances in the treatment of respiratory diseases, the introduction of home non-invasive mechanical ventilation, identification of patients with sleep apnea syndrome, and improved phenotypic differentiation of COPD patients, all of which are confounding factors in patients with chronic respiratory failure. That these recommendations have remained unchanged has mainly been due to the lack of studies in LTOT during this time.[8] Feeble attempts have been made to assess the efficacy of oxygen therapy in patients with moderate hypoxemia (PaO_2 55–65 mmHg), such as the studies by Gorecka et al.[9] and Haidl et al.,[10] neither of which were able to demonstrate improved survival. These studies were methodologically very limited and provided no information on the effect of oxygen on other clinical variables, such as dyspnea or quality of life. In this regard, a recent meta-analysis[11] selecting very heterogeneous studies found that oxygen therapy significantly improves dyspnea. Another study, likewise based on incomplete data, showed that LTOT could improve health-related quality of life, depression and cognitive function in patients, and could have a positive impact on the frequency of hospitalization.[12] These data suggest that if we focus on survival alone, we could be overlooking clinical variables on which LTOT could have a positive effect, and suggests the need for studies that more clearly define the objectives to be reached when prescribing oxygen therapy.

Other situations that have been cautiously explored by the scientific community concern the use of oxygen in patients with isolated exertional or nocturnal oxygen desaturation. Although oxygen therapy during exercise may increase exercise tolerance and reduce dyspnea, it has not been shown to have any impact on survival.[13,14] In this uncertain setting, SEPAR guidelines recommend the use of oxygen during exercise in these patients if there is evidence that it corrects hypoxemia and improves dyspnea or exercise tolerance, increasing the distance covered in the 6-min walk test by at least 25–30 m.[6,15–17] These guidelines also consider the administration of oxygen to patients with exercise-induced desaturation enrolled in rehabilitation programs, in order to increase the duration and intensity of training.[6,18]

There is also little information on the effect of oxygen therapy in patients with nocturnal hypoxemia without daytime respiratory failure. Nocturnal hypoxemia has been arbitrarily defined as an SpO_2 <90% for more than 30% of the night,[19] although some authors have used more flexible criteria.[20] Current evidence suggests that nocturnal oxygen therapy does not improve survival in COPD patients with nocturnal desaturation alone.[21] SEPAR

Table 1
NOTT and MRC Trials Inclusion Criteria and Patients.

	NOTT (1980)[4]	MRC (1981)[5]
Patients	203 patients (77% M) 101 with continuous O_2 (24 h/d)/102 with nocturnal O_2 (12 h/d)	87 patients (75% M) LTOT (15 h/d) vs no LTOT
Inclusion criteria	Clinical diagnosis of COPD Age >35 years PaO_2 <55 mmHg or PaO_2 <59 mmHg plus one of the following: – Edema – Hematocrit >55% – Cor pulmonale on ECG – FEV_1/FVC <70% – TLC >80%	Age <70 years (42–69) FEV_1 <1.2 l PaO_2 between 40 and 60 mmHg in 2 tests performed 3 weeks apart

ECG: electrocardiogram; COPD: chronic obstructive pulmonary disease; FEV_1/FVC: forced expiratory volume in the first second divided by forced vital capacity; h/d: hours/day; MRC: Medical Research Council Trial; NOTT: Nocturnal Oxygen Therapy Trial; O_2: oxygen; LTOT: long-term home oxygen therapy; PaO_2: partial oxygen pressure in arterial blood; TLC: total lung capacity; M: males.