A conservation device for oxygen therapy in COPD

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ABSTRACT: Patients with hypoxaemia secondary to chronic obstructive pulmonary disease (COPD) are frequently prescribed oxygen therapy for short- and long-term domiciliary use. Oxygen administered via nasal cannulae incorporating a small collapsible reservoir ("Oxymer", Chad Therapeutics Inc., USA) improves transcutaneous oxygen tensions in the short-term when compared to standard nasal cannulae. The effects of this device on arterial oxygen (Pao2) and carbon dioxide (Paco2) tensions was assessed over 60 min in twelve patients with severe hypoxaemia (6.2±0.9 kPa, mean±SD) and hypercapnia (7.5±1.2 kPa). Following baseline measurements, oxygen was administered using standard nasal cannulae, and further measurements were made at 15 min intervals for at least 45 min. Patients were then changed to the "Oxymer" and measurements continued at 15 min intervals for a further 60 min. Mean Pao2 increased by 1.12±0.78 kPa (p<0.001), using the "Oxymer", but Paco2 was significantly greater after 15 min on the device than after 60 min (p<0.05). There was no change in Paco2 (p>0.05). The "Oxymer" increases Pao2 compared with standard cannulae, but the effect may not be sustained.

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Patients with hypoxaemia secondary to chronic obstructive pulmonary disease (COPD) frequently require oxygen for domiciliary use [1, 2]. Short bursts of oxygen therapy administered from cylinders may be prescribed for the relief of exercise-induced breathlessness [3]. Long-term, low-flow oxygen administered from cylinders, liquid gas systems, or oxygen concentrators for at least 15 h per day is the only therapy known to reduce mortality in patients with hypoxic cor pulmonale secondary to COPD [4, 5]. In either case, oxygen is conventionally administered using nasal speculae (fig. 1A).

The use of nasal cannulae incorporating a small collapsible reservoir ("Oxymer", Chad Therapeutics Inc., CA, USA; fig. 1B), has been shown to increase transcutaneous oxygen tension or saturation during short study periods, suggesting that considerable savings in oxygen consumption may be made [6, 7]. No comparison of these devices has been made over longer study periods assessing the effects on both arterial oxygen (Pao2) and carbon dioxide (Paco2) tensions. We therefore compared the effects of the "Oxymer" with standard cannulae on arterial gas tensions over a 60 min period in twelve patients with severe COPD.

Methods

In order that the device could be assessed in patients fully accustomed to the long-term use of nasal cannulae, subjects were taken from our domiciliary oxygen programme in which they had been involved for a minimum of twelve months. Entry criteria therefore included clinical and physiological evidence of severe, irreversible COPD and either chronic hypoxaemia (Pao2 less than 7 kPa on repeated measurements) requiring the provision of domiciliary oxygen therapy for at least 15 h per day [4]; or the use of short bursts of oxygen for at least 1 h per day for the relief of breathlessness [3]. Consequently, twelve patients (eight males, four females; mean age 64 yrs, range 55-74 yrs) with COPD, forced expiratory volume in one second (FEV1) 64±0.9 l, mean±SD; forced vital capacity (FVC) 1.50±0.45 l, entered the trial. All had severe hypoxaemia (Pao2 on air 6.1±0.9 kPa, mean±SD) and variable hypercapnia (7.5±1.2 kPa). Ten were taking domiciliary oxygen therapy via standard nasal cannulae for at least 15 h per day and two short burst therapy.

On the day of the trial spirometry was checked (Micro Medical Instruments, UK). A radial artery cannula was inserted under local anaesthetic. All blood samples were drawn into heparinized glass syringes and analysed immediately (Corning 170 instrument, Corning Medical and Scientific Inc., Mass., USA). Following baseline measurements, oxygen (1 l/min) was administered using standard cannulae for at least 45 min. No instructions were given to subjects regarding ventilation in order that they should adopt their customary breathing pattern. Furthermore, the investigation was always carried out in the morning, and reading or the watching of television was encouraged to avoid somnolence. Further measurements
of arterial gas tensions were made every 15 min until two successive results for PaO₂ and PaCO₂ were obtained within limits of 0.5 kPa. Patients were then changed to the conservation device at identical oxygen flow and arterial gas analysis was carried out every 15 min for at least a further 60 min (until successive gas tensions were within 0.5 kPa).

Using Wilcoxon's signed rank procedure, statistical comparisons were made between mean results for PaO₂ and PaCO₂ at oxygen flow rates of 1 l·min⁻¹ using standard cannulae, 1 l·min⁻¹ using the conservation device for 15 min, and the final measurement using the conservation device. Values of p less than 0.05 were considered significant.

Results

Arterial gas tensions for each patient on oxygen using standard cannulae (mean of four measurements for each patient) and using the "Oxymizer" (all values) are shown.


**Un appareil de conservation pour oxygénothérapie aux BPCO**. T.W. Evans, I.C. Waterhouse, A.J. Suggett, P. Howard. RÉSUMÉ: Une oxygénothérapie est fréquemment prescrite pour des patients dont l'hypoxémie est secondaire aux BPCO, ce qui doit être prescrit pour pendant une période de 60 minutes chez 12 patients atteints d'hypoxémie sévère (6,2±0,9 kPa). Après les mesures initiales de la Pao2 et de la Paco2, l'oxygène a été administré par une canule nasale standard, et des mesures ultérieures ont été réalisées à des intervalles de 15 minutes pendant au moins 45 minutes. Les patients ont été placés ensuite sous "Oxygnizer", et les mesures ont été poursuivies pendant 60 minutes de plus à des intervalles de 15 minutes. La Pao2 moyenne a augmenté sous l'effet de l'"Oxygnizer" de 1,1±0,78 kPa (p<0,05); mais la Paco2 a augmenté de 15 minutes s'averait significativement plus élevée que celle mesurée après 60 minutes (p<0,05). On n'a pas noté de modification de la Pao2 (p>0,05). L'"Oxygnizer" augmente donc la Pao2 par comparaison avec les canules standards chez les patients nécessitant de l'oxygène pour la correction d'une hypoxémie sévère, mais son effet peut être plus persistant.