Q&A

Is CO_2 retention a common problem for COPD patients on LTOT in the home care setting?

Clinicians are occasionally hesitant and even fearful when prescribing oxygen for the CO_2-retaining COPD patient because of concerns over increasing hypercapnia. Many mechanisms have been proposed to explain this; original thoughts include that patients with COPD rely on a hypoxic ventilatory drive due to a blunted sensitivity to CO_2 (i.e., pH), and the hypercapnia resulted from "removal" of hypoxic drive which in turn led to reduction in alveolar ventilation. Empiric data, however, has not been able to support this theory. Additionally, the hypercapnia following supplemental oxygen is reputed to occur with high FIO_2 levels which typically are not found in the home care setting.

According to Petty, COPD patients with chronic ventilatory failure metabolically can clinically adapt to chronic hypercapnia. The ability of patients to tolerate CO_2 retention is believed to be an "adjustment" mechanism that reduces the work of breathing. Considering the "adjustment," and the benefits of long term oxygen therapy (decreased dyspnea, increased PaO_2, thereby resting the exhausted respiratory pump) could, in part, explain an improved prognosis found with many of these patients on LTOT. In all cases, correction of hypoxemia should take priority over fears of CO_2 retention.

REFERENCES:

Gomersall, et al. Oxygen therapy for hypercapnic patients with chronic obstructive pulmonary disease and acute respiratory failure: A randomized, controlled pilot study. *Critical Care Medicine* 2002; 30:113-116

Petty, TL. CO_2 Can Be Good for You! *Chest* 2006; 129:494-495

Plant P, Owen J, Elliott M. One year period prevalence study of respiratory acidosis in acute exacerbations of COPD: implications for the provision of non-invasive ventilation and oxygen administration. *Thorax* 2000; *55*:550-554

Simpson SQ. Oxygen-induced acute hypercapnia in chronic obstructive pulmonary disease What's the problem? Critical Care Medicine 2002; 30 (Editorial)

Stradling JR. Hypercapnia during oxygen therapy in airways obstruction: A reappraisal. *Thorax* 1986; 41: 897–902

Inspired technologies

Q&A

What are the key indicators for COPD patients for repeat hospitalizations after exacerbation? What makes them high risk?

Data on exacerbations, predictive factors and prevalence, and re-hospitalizations for the COPD patient are limited. Many studies predominately document factors of changing pulmonary function values and lack of pharmacologic compliance, and also note that an average 86% of participating patients do not attend rehabilitation programs or participate in ambulation conditioning; 28% of patients are not using or incorrectly using LTOT; and 43% fail essential inhaler maneuvers.

Several studies observe a moderate to high prevalence of potentially modifiable risks (e.g., pulmonary rehabilitation program, exercise, correct use of prescribed oxygen, earlier intervention) for a chronic obstructive pulmonary disease exacerbation, suggesting unsatisfactory features in their management. Ringbaek et al. found in their study with chronic obstructive pulmonary disease patients, long-term oxygen therapy is associated with a reduction in hospitalization. These same studies suggest use of an integrated care intervention, supported by new technologies and education that effectively support the needs of the COPD patients.

REFERENCES:

Casas A, Troosters T, Garcia-Aymerich J, Roca J, Hernandez C, Alonso A, del Pozo F, de Toledo P, Anto J, Rodriguez-Roisin R, et al. Integrated care prevents hospitalizations for exacerbations in COPD patients. *Eur Respir J* 2006; 28(1): 123-130

Garcia-Aymerich J, Barreiro E, Farrero E, Marrades RM, Morera J, and Anto JM. Patients hospitalized for COPD have a high prevalence of modifiable risk factors for exacerbation (EFRAM study) *Eur Respir J* Dec 2000; 16: 1037-1042.

Foreman M, DeMeo D, Hersh C, Reilly J, Silverman EK. Clinical Determinants of Exacerbations in Severe, Early-onset COPD. *Eur Respir J* published online before print August 22, 2007 as doi: doi:10.1183/09031936.00009307

Miravitlles M, Guerrero T, Mayordomo C, et al. Factors associated with increased risk of exacerbation and hospital admission in a cohort of ambulatory COPD patients: a multiple logistic regression analysis. *Respiration* 2000; 67:495-501

Mohan A, Bhatt SP, Guleria R. Risk Indexes for Exacerbations Due to COPD - Need To Validate Using Broader Criteria. *Chest* 2007; 132:735-736

Niewoehner D, Lokhnygina Y, Rice K, Kuschner W, Sharafkhaneh A, Sarosi G, Krumpe P, Pieper K, Kesten S. Risk Indexes for Exacerbations and Hospitalizations Due to COPD. *Chest* 2007; 131:20-28

Ringbaek TJ, Viskum K, Lange P. Does long-term oxygen therapy reduce hospitalization in hypoxaemic chronic obstructive pulmonary disease? *Eur Respir J* 2002; 20:38-42

Inspired technologies

Q&A

Is survival of the COPD patient affected by ambulatory oxygen use?

The impact of oxygen use on mortality has been debated for several decades. Many investigators have confirmed that a low PaO_2 is associated with decreased survival in COPD. And significantly, oxygen therapy in hypoxemic patients has demonstrated improved survival in large, multicenter controlled trials.

Interestingly, the overall impairment in functional status is associated with impaired survival in COPD. Several investigators have noted the correlation between decreased exercise capacity and declining survival rates in COPD patients. However, the correlation is not noted in patients in the late stages of COPD; while oxygen therapy improves their oxygenation and increases their quality of life, it has not been demonstrated as affecting survival in late stage COPD.

The notable Nocturnal Oxygen Therapy Trial (NOTT) showed improved quality of life with ambulatory oxygen and noted statistically significant improvement in survival, compared with stationary oxygen. It is felt the differences could either be due to the duration of oxygen therapy or the method.

REFERENCES:

Hodgkin JE. Prognosis in chronic obstructive pulmonary disease. *Clin Chest Med* 1990; 11:555-569

Chailleux E, Fauroux B, Binet G, et al. Predictors of survival in patients receiving domiciliary oxygen therapy or mechanical ventilatory: a 10-year analysis of ANTADIR observatory. *Chest* 1996; 109:741-749

Fujimoto K, et al. Benefits of Oxygen on Exercise Performance and Pulmonary Hemodynamics in Patients With COPD With Mild Hypoxemia. *Chest* 2002; 122:457-463

Martinez F, et al. Prognostication in Chronic Obstructive Pulmonary Disease: Implications for Lung Transplantation. *Semin Respir Crit Care Med* 22(5):489-498, 2001

Ries A, et al. Pulmonary Rehabilitation - Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines. *Chest* 2007; 131:4S–42

Inspired technologies

What is the mechanism by which the pulmonary rehab graduates have the ability to control their respiratory rate during exercise?

The most common symptom that limits exercise and quality of life in COPD patients is breathlessness. Studies have demonstrated that exercise training can improve both exercise tolerance and health status in these patients, with the intensity of the exercises being of key importance.

Pulmonary rehabilitation permits the patient to take control of their condition. Studies demonstrate it to be effective in improving everyday quality of life by using the lungs and muscles—ultimately oxygen—more efficiently. It helps the COPD patient from slipping into a downward spiral. Cotes, et al. note "breathlessness on exertion during daily living and the associated quality of life are related more closely to an increase in the ventilatory cost of exercise than to impaired lung function." While Casaburi et al. states "increased central motor drive (and effort) is required to increase ventilation during activity because the inspiratory muscles become acutely overloaded and functionally weakened."

Of importance to resolving increasing respiratory rates and breathlessness is oxygen supplementation during exercise. Improvement in endurance and symptom perception in hypoxemic COPD patients—let alone non-hypoxemic COPD patients—has been demonstrated in several studies. The hypothesis behind these findings is the relationship related to slower breathing patterns and decreased hyperinflation. The evidence supports the theory that with increases in RR during exercise, supplemental oxygen meets the patients' immediate needs and will promote endurance, and ultimately symptom relief of breathlessness—thus decreasing respiratory rates or promoting control of the respiratory rate.

REFERENCES:

Ambrosino N, Strambi S. New strategies to improve exercise tolerance in chronic obstructive pulmonary disease. *Eur Respir J* 2004; 24: 313-322

Cotes JE, Reed JW. Recommendations on the use of exercise testing in clinical practice. *Eur Respir J* 2007; 29(5): 1064 - 1066

Cotes JE, Zejda J, King B. Lung function impairment as a guide to exercise limitation in work-related lung disorders. *Am J Respir Crit Care Med* 1988;137:1089–1093.

O'Donnell DE, Banzett B, Carrieri-Kohlman V, Casaburi R, Davenport PW, Gandevia SC, A. F. Gelb AF, Mahler DA, Webb KA. Pathophysiology of Dyspnea in Chronic Obstructive *Pulmonary Disease: A Roundtable Proceedings of the ATS,* 2007; 4(2):145-168

Palange P, Ward SA, Carlsen KH, Casaburi R, et al. Recommendations on the use of exercise testing in clinical practice. *Eur Respir J* 2007; 29:185-209

Ries A, et al. Pulmonary Rehabilitation - Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines. *Chest* 2007; 131:4S–42S

Somfay A., Porszasz J, Lee SM, Casaburi R. Dose-response effect of oxygen on hyperinflation and exercise endurance in nonhypoxaemic COPD patients. *Eur Respir J* 2001; 18:77-84

Inspired technologies

Why is continuous flow oxygen considered the gold standard?

Historically, continuous flow oxygen was used with a 2LPM flow setting for everyone and every situation. Manufacturers of pulse devices looked to continuous flow and tried to establish an "equivalency" to it. But now we know that respiratory rate makes an "equivalency" nonsensical; oxygen should be titrated to a correct flow per patient ventilatory pattern, regardless of the setting. While continuous oxygen is still used on a regular basis, the prevalence of oxygen conserving devices has raised issues about FIO_2 and titration/ saturation needs, particularly at exercise. Therefore, the use of continuous flow oxygen needs analysis both at rest and at exercise.

At rest, with sufficient inspiratory and expiratory time a continuous flow device will typically maintain sufficient oxygen volume to meet the patient's ventilatory pattern. FIO_2 remains reasonably stable and if the amount prescribed is correct, the saturation will be at a therapeutic level.

The situation changes when a patient is ambulatory or exercising. Continuous flow does not mean "any amount"—it only means a continuous flow, so when the patient's respiratory rate increases and I:E changes, continuous flow is no longer able to meet the patient's needs. Additionally, most oxygen conserving devices are not able to meet the patient's needs at increases respiratory rates. Oxygen dose varies by device, and there is no equivalency in FIO_2 actually delivered to the patient in rest—let alone changing respiratory rates. Rather than rely on what was a gold standard, therapists need to recognize device capabilities and limitations, and determine which delivery method best addresses the patient's oxygen needs.

REFERENCES:

Bliss PL, McCoy RW, Adams AB. Characteristics of demand oxygen delivery systems: maximum output and setting recommendations. *Respir Care* 2004; 49(2):160–165.

McCoy R. Oxygen-Conserving Techniques and Devices. *Respir Care* 2000; 45(1):95–103.

McCoy R. 2007 Guide to Understanding Oxygen Conserving Devices, Valley Inspired Products, bmccoy@inspiredrc.com

Petty TL, Long-term oxygen therapy. *Eur Respir J* 2005; 26:746-747

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