Acta Scientific Nutritional Health

Volume 2 Issue 4 April 2018

Mini Review

The Role of Nutrition in Patients with Chronic Obstructive Pulmonary Disease

Leonidas Grigorakos[1,2]*

[1]*Faculty of Nursing, National and Kapodistrian University of Athens, Greece*

[2]*Intensive Care, "KAT" Trauma Hospital of Athens, Kifissia, Greece*

***Corresponding Author:** Leonidas Grigorakos, Associate Professor, Faculty of Nursing, National and Kapodistrian University of Athens, Greece.

Received: February 19, 2018; **Published**: March 21, 2018

Abstract

A considerable proportion of patients with chronic obstructive pulmonary disease (COPD) are malnourished. Due to macronutrient and micronutrient deficiency, alterations that further increase the severity of COPD may be generated. Thus, achieving an optimal nutritional status arises as an important medical objective which can delay disease's progression. This brief review provides an overview of the consequences of malnutrition and highlights the role of nutrition in the effective management of patients with COPD. It concludes that nutritional support should be initiated early in the illness and that further studies are required to investigate the optimal nutritional supplements for patients with COPD, according to their disease severity.

Keywords: Respiratory Disease; COPD; Nutritional Support

Abbreviations

COPD: Chronic Obstructive Pulmonary Disease; BMI: Body Mass Index; ATP: Adenosine Triphosphate; 2,3-DPG: 2,3-Diphosphoglycerate

Introduction

Nutrition is an important aspect of healthcare in any patient with a respiratory disease since its relationship with respiration is correlative. Many patients with lung disease suffer of malnutrition, which weakens respiratory muscle contractility and affects both muscle strength and respiratory mechanism [1]. In the case of patients with chronic obstructive pulmonary disease (COPD), malnutrition occurs in high proportion of cases, varying from 10 to 45% [2]. Low fat and low body index as well as obesity have a negative impact on patients with COPD, exposing them to higher risk of acute exacerbations [3-5]. They are also affected by undernutrition due to energy insufficiency, as a result of decreased dietary consumption, caused by loss of appetite or dyspnea while eating but also because of augmented work of breathing, which occurs as a result of increased energy expenditure [5,6]. More so, humoral factors (i.e. inflammatory cytokines and hormones) have been identified as important factors of undernutrition in patients with COPD [7].

Achieving an optimal nutritional status arises as an important medical objective which can delay the progression of this disease and may also reduce the risks of morbidity and early mortality [8]. Thus, a growing number of studies looking at nutritional supplementation in COPD patients have been performed and wished to improve current clinical practice [9,29]. This brief review aims to provide an overview of the consequences of malnutrition and to highlight the role of nutrition in the effective management of patients with COPD.

Consequences of malnutrition

Reduction of lung elasticity and pulmonary function, loss of respiratory muscle mass, force and resistance as well as alteration of pulmonary immune mechanisms and breath control are the most important consequences of malnutrition on the respiratory system [10] (Table 1).

Decreased respiratory muscle strength		
Altered ventilatory drive		
Impaired immunological function		
↓	↓	↓
Hypercapnia	Pulmonary edema	Pulmonary infections

Table 1: Consequences of malnutrition on respiratory function in patients with COPD.

Even though primary lung diseases do not seem to be statistically significant for malnutrition, they can increase exacerbations in patients with acute respiratory failure. In the case of patients with COPD affected by malnutrition, the lack of essential vitamins and minerals as well as deficiency of carbohydrates, proteins and fats lead to changes that augment the severity of disease. More precise, protein and iron deficiency lead to low hemoglobin levels and subsequently to decreased oxygen transport capacity. Lack of vitamin C negatively influences collagen synthesis, which is fundamental in normal lung structure and function. Dyspnea may worsen in the spontaneously breathing COPD patients, while most of them also develop hypercapnia [11]. Furthermore, malnourished patients with COPD, as compared to normally nourished patient with COPD, manifest more often hypercapnic respiratory failure and/or difficulty in weaning from mechanical ventilation.

Reduced levels of calcium, magnesium, phosphorus, and potassium also lead to deficient muscle function at the cellular level. Alveolar collapse and increased respiratory effort occur due to compromised function of the surfactant as a consequence of low rates of proteins and phospholipids [12]. Pulmonary edema may arise as a consequence of hypoproteinemia, due to the decreased plasma colloid osmotic pressure with hypoalbuminemia [10].

Pulmonary infections are also a possible consequence of malnutrition in patients with COPD. Precisely, atrophy of the lymphoid tissue, principally affects cell-mediated immunity while there is a reduction in the number of T-helper lymphocytes and of the T4/

T8 ratio in the bronchoalveolar lavage fluid, along with decreased production of lymphokines and monokines [13]. Malnutrition leads to anorexia and loss of muscular mass while it alters the immune system that complements the ability of antibodies and phagocytic cells to clear microbes, thus promoting inflammation and damage of the pathogen's cell membrane [14].

The added value of nutrition

For the treatment of patients with COPD suitable nutrition in both quantitative and qualitative terms is of fundamental importance for the treatment of patients with COPD [15]. Precisely, it should focus on applying proper measures that can reduce the level of complications and prevent premature death while ensuring a better quality of life [16,17].

When chronic respiratory insufficiency leads to hypercapnia, the target of treatment should be directed toward reducing CO_2. In theory this could be achieved by reducing CO_2 production while increasing its elimination. Although healthy individuals may increase CO_2 elimination by increasing ventilation, patients with respiratory failure cannot achieve this because they have limited potential for increased alveolar ventilation. Consequently, the objective of nutritional support should only be directed to producing reduced amounts of PCO_2. Therefore, since the respiratory rate of fats (0.7) is less than that of the other major energy sources (carbohydrates 1, protein 0.8), high fat and low-carb diet should be one of the main goals [18] (Table 2). However, it should be stressed that severely underweight patients receiving combined nutritional support (enteral - parenteral) are unable to use fat. Instead, they use carbohydrates, adding another problem to their already severe health condition [18]. In this case, controlling hyperglycemia is considered to be essential [19].

Relationship between nutrition and respiratory function in patients with respiratory failure

Efffect of high carbohydrate and fat content

↓

Pulmonary Deficiency

↓

Reduction of calories consumed

Increase of caloric requirements

↓

Malnutrition

Tisue damage, which involves:

1. Deterioration of respiratory muscle function
2. Decreased response to hypoxia
3. Reduction of resistance to infections
4. Deterioration of pulmonary function

Administration of high carbohydrate diet

Increase of CO_2 production

Increase of respiratory rate

↓

Inability to release CO_2

CO_2 retention

↓

Respiratory Deficiency

High fat content diet

↓

Improvement of nutritional status without retention

Low carbohydrate content diet

↓

Increase CO_2 production and retention

Table 2: Role of nutrition in patients with COPD.

In order to maintain and/or to improve muscle mass in patients with COPD with malnutrition but also to hinder disease's evolution, nutritional supplement has proved to be of high importance [20-22]. For healthy individuals, supplying high protein diet has been found to increase breathing stimuli and air ventilation per minute. However, in patients with respiratory problems, as it is the case of patients with COPD, who have decreased alveolar reserves, the increase in the stimulus entails an increase in the work of breathing and an increase in the feeling of dyspnea. As the energy cost of breathing in patients with COPD is 439 - 720 cal/day, meaning ten times higher than in healthy people, specific individualized dietary measures with high calorie density should be applied [18,23] (Table 3). Phosphorus administration proves to be beneficial as it increases the reduced 2,3 DPG levels of erythrocytes and ATP, thus helping to a better release of oxygen from the hemoglobin [24]. Fruits and vegetable reach in antioxidants, minerals, vitamins and fiber as well as Omega-3 polyunsaturated fatty acids, vitamin C, D and E supplementation have been found beneficial in chronic and acute respiratory conditions [25-27]. Last, but not least, small frequent meals that are dense in nutrient content with sufficient calories that meet basal energy expenditure and induce weight gain as well as resting before meals are highly recommended [28].

Determination of daily energy requirements (total calories)
Substrate mix
Carbohydrates: 28%
Fats: 55%
Protein:17% of total calories
Phosphorus, vitamin C, D, E administration
Fruits, vegetables, Omega-3 polyunsaturated fatty acids

Table 3: Nutritional recommendations for patients with COPD.

Conclusion

During the last decades, COPD's occurrence has increased while its consequences due to malnutrition and/or undernutrition are significant both in economic and social terms. Thus, evaluating and applying effective individualized nutrition therapy proves to be of crucial importance for the improvement of alterations both in the respiratory muscle function and in the complement system of patients suffering from malnutrition due to COPD. More precise, they should estimate or calculate total energy needs in order to prevent either underfeeding or overfeeding. When spontaneous oral nutrition is scarce, its supplementation with enteral nutritional formula or complete nutritional support with parenteral feeding should be considered.

In summary, protein-calorie malnutrition should be suspected in any patient with COPD and acute respiratory failure. In order to avoid preexisting nutritional deficits, aggressive nutritional support should be initiated early in the illness. Nutritional therapy should be directed toward replacing deficits in addition to conserving body protein stores. A high-fat diet, the administration of necessary proteins and phosphorus, maintaining reduced levels of glucose, paying attention to fluid and electrolyte balance as well as ensuring small but dense meals that lead to less oxygen consumption and a better descent of the diaphragm represent the ideal solution for patients with respiratory problems, as it is the case of patients with COPD. Whether such therapy can improve morbidity and reduce mortality should be the subject of future studies.

Conflict of Interest

No conflicts of interest to disclose.

Bibliography

1. Nishimura Y., *et al*. "Relationship between respiratory muscle strength and lean body mass in men with COPD". *Chest* 107.5 (1995): 1232-1236.

2. Schols AM. "Nutrition as a metabolic modulator in COPD". *Chest* 144.4 (2013): 1340-1345.

3. Schols AM., *et al*. "Weight loss is a reversible factor in the prognosis of chronic obstructive pulmonary disease". *American Journal of Respiratory and Critical Care Medicine* 157 (1998): 1791-1797.

4. Robinson M., *et al*. "The relationship among obesity, nutritional status and mortality in critically ill". *Critical Care Medicine* 43.1 (2015): 87-100.

5. Hallin R., *et al*. "Nutritional status, dietary energy intake and the risk of exacerbations in patients with chronic obstructive pulmonary disease (COPD)". *Respiratory Medicine* 100.3 (2006): 561-567.

6. Ischaki E., *et al*. "Body mass and fat-free mass indices in COPD". *Chest* 132.1 (2007): 164-169.

7. Gan WQ., *et al*. "Association between chronic obstructive pulmonary disease and systemic inflammation: a systematic review and a meta-analysis". *Thorax* 59.7 (2004): 574-580.

8. Raherison C and Girodet PO. "Epidemiology of COPD". *European Respiratory Review* 18.114 (2009): 213-221.

9. Collins PF., *et al*. "Nutritional support and functional capacity in chronic obstructive pulmonary disease: a systematic review and meta-analysis". *Respirology* 18.4 (2013): 616-629.

10. Fernandes AC and Bezerra OMPA. "Nutrition therapy for chronic obstructive pulmonary disease and related nutritional complications". *Jornal Brasileiro de Pneumologia* 32.5 (2006): 461-471.

11. Rochester DF and Braun NMT. "Determinants of maximal inspiratory pressure in chronic obstructive pulmonary disease". *American Review of Respiratory Disease* 132.1 (1985): 42-47.

12. Zuo YY., *et al*. "Current perspectives in pulmonary surfactant - Inhibition, enhancement and evaluation". *Biochimica et Biophysica Acta* 1778.10 (2008): 1947-1977.

13. Bhat T., *et al*. "Immune Dysfunction in patients with chronic obstructive pulmonary disease". *Annals of the American Thoracic Society* 12.2 (2015): S169-S175.

14. Debigare R., *et al*. "Peripheral muscle wasting in chronic obstructive pulmonary disease. Clinical relevance and mechanisms". *American Journal of Respiratory and Critical Care Medicine* 164.9 (2001): 1712-1717.

15. Sindhwani G and Rawat J. "Ventilator Dependence: Role of Nutrition and Airway Clearance Therapy". *Lung India* 23 (2006): 39-41.

16. Shepherd A. "The nutritional management of COPD: an overview". *British Journal of Nursing* 19.9 (2010): 559-562.

17. Cai B., *et al*. "Effect of supplementing a high-fat, low-carbohydrate enteral formula in COPD patients". *Nutrition* 19 (2003): 229-232.

18. Grigorakos L. "Nutrition in patients with respiratory disorders". *Medical Cooperation* 4.4 (1991): 20-23.

19. Casaer M., *et al*. "Impact of early parenteral nutrition completing enteral nutrition in adult critically ill patients (EPaNIC trial): a study protocol and statistical analysis plan for a randomized controlled trial". *Trials* 12 (2011): 21.

20. Berthon BS and Wood LG. "Nutrition and Respiratory Health-Feature Review". *Nutrients* 7 (2015): 1618-1643.

21. Ferreira IM., *et al*. "Nutritional supplementation for stable chronic obstructive pulmonary disease". *Cochrane Database of Systematic Reviews* 12 (2012): CD000998.

22. Collins PF., *et al*. "Nutritional support and functional capacity in chronic obstructive pulmonary disease: a systematic review and meta-analysis". *Respirology* 18.4 (2013): 616-629.

23. Hsieh MJ., *et al*. "Nutritional supplementation in patients with chronic obstructive pulmonary disease". *Journal of the Formosan Medical Association* 115.8 (2016): 595-601.

24. Shaheen SO., *et al*. "The relationship of dietary patterns with adult lung function and COPD". *European Respiratory Journal* 36.2 (2010): 277-284.

25. Rawal G., *et al*. "Medical nutrition therapy for the critically ill". *International Journal of Health Sciences and Research* 5 (2015): 384-393.

26. Wu TC., *et al*. "Vitamin E and vitamin C supplementation in patients with chronic obstructive pulmonary disease". *International Journal for Vitamin and Nutrition Research* 77.4 (2007): 272-279.

27. Khan DM., *et al*. "Role of Vitamin D in reducing number of acute exacerbations in Chronic Obstructive Pulmonary Disease (COPD) patients". *Pakistan Journal of Medical Sciences* 33.3 (2017): 610-614.

28. Seo SH. "Medical Nutrition Therapy based on Nutrition Intervention for a Patient with Chronic Obstructive Pulmonary Disease". *Clinical Nutrition Research* 3.2 (2014): 150-156.

29. Grigorakos L., et al. "Combined nutritional support in patients with chronic obstructive pulmonary disease (COPD) under mechanical ventilation (MV)". *Hepatogastroenterology* 56.96 (2009): 1612-1614.

Volume 2 Issue 4 April 2018