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Chronic Obstructive Pulmonary Disease and Protein Consumption: What is the Connection?

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Abstract

Chronic obstructive pulmonary disease is characterized by obstruction to pulmonary airflow and dyspnoea. These characteristics are a consequence of exposure to harmful gases and particles that lead to oxidative stress in the lungs along with an exaggerated inflammatory response. In addition to respiratory impairment, chronic obstructive pulmonary disease presents systemic manifestations, nutritional alterations and exercise limitation. Whey protein supplementation, concomitant with physical activity for patients with chronic obstructive pulmonary disease, is intended to stimulate protein synthesis and decrease muscle catabolism that may be caused by exercise.

Keywords: Pulmonary disease; Exercise; Sarcopenia; Whey protein

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is characterized physiologically by obstruction to pulmonary airflow and clinically by dyspnea [1]. The disease arises from exposure to harmful gases and particles that lead to oxidative stress in the lungs along with an exaggerated inflammatory response, which results in destruction of the elastin present in the pulmonary alveoli [2,3]. Smoking is a major cause of COPD [4], but other risk factors are also associated, such as exposure to dust, chemicals, wood smoke, severe respiratory infections in childhood, old age, socioeconomic status and individual factors [5,6].

COPD is increasingly present in the adult population, in both sexes, especially after 40 years [7]. Data from two large multicenter studies, PLATINO [8] and BOLD [5], show that the prevalence is close to 10%, reaching almost 20% in some regions. In addition to being prevalent, it is an important cause of morbidity and mortality worldwide, estimated by the WHO as the fifth cause of death in 2002 and possibly characterized as the third cause in 2030 [9].

Cough and dyspnoea are the most common symptoms, which can occur daily or intermittently [10]. Exacerbations, also present in these patients, are characterized by a greater amplification of the inflammatory response in the respiratory tract, being able to be triggered by bacterial or viral infections, or by environmental pollutants. During this process, there is an increase in pulmonary hyperinflation and airway obstruction, with reduced expiratory flow, representing a significant increase in shortness of breath [11]. The chronicity of the disease generates limitations due to the symptomatology and worsening of the quality of life of the affected individuals, besides many expenses to the health system due to hospitalizations, medications and exams [12].

The gold standard in the diagnosis of COPD is spirometry. The post bronchodilator fixed ratio between forced expiratory volume in the first second and forced vital capacity of 0.7 is used to define the presence of airflow limitation [13]. The main goals in relation to the disease and treatment are to determine the severity, impact on the patient's daily life and risk of new events (exacerbations, hospitalizations, death). For this, it is necessary to know separately each of the following aspects: level of current symptoms, results of spirometry, risk of exacerbation and presence of comorbidities [11].

In addition to respiratory compromise, COPD has systemic manifestations, such as increased oxidative stress, inflammatory cell activation, nutritional and body composition alterations, osteoarticular, cardiovascular and nervous system involvement [14]. Likewise, exercise limitation is not only conditioned by respiratory changes, but also by skeletal muscle dysfunction, often involving sarcopenia [15-17]. Worsening of the prognosis of these patients is related to sedentarism, tissue hypoxia, chronic use of corticosteroids, nutritional depletion and, mainly, systemic inflammation [18,19]. Many of these symptoms, such as increased muscle catabolism, low physical activity and insufficient protein intake may be further aggravated, since the population suffering from COPD is mainly composed of elderly individuals. In this population, there is a physiological tendency for this to occur even without the disease [20-22].

Nutritional depletion characterized by weight loss and/ or muscle mass in patients with COPD may be the result of imbalance caused by insufficient dietary intake and an increased energy and protein requirement [23]. Decreased protein intake, especially during the first few days of acute exacerbation, decreases protein synthesis and increases protein turnover [23]. In addition, the exaggerated systemic inflammatory response characteristic of this disease has been described as a possible cause of this protein imbalance due to the marked catabolism that is inherent to this process [24]. Adding to this is the tendency to reduce the level of physical activity due to an intolerance to exercise, which is associated with sedentary lifestyle, depletion or peripheral muscular dysfunction, and respiratory restrictions such as exertional dyspnea [25]. Physical inactivity results in greater deconditioning and impairment of skeletal muscle function, leading to sarcopenia [26], and the loss of lean body mass in patients with COPD can occur in those with normal weight, overweight and obesity, it is not restricted to patients with low weight [27,28].

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In general, the rate of absorption and availability of amino acids in plasma (protein kinetics) depends on several factors, such as: mode of administration, quality and quantity of protein ingested, which in turn will directly influence muscle protein synthesis [29,30]. Several studies have shown that elderly people have a higher leucine threshold, the amino acid with greater potential for protein synthesis [31] and therefore may require higher levels of protein, both at rest and at concomitant physical exercise, than young people [31-34]. Another consideration in the recommendations of protein consumption is its quality, since the elderly population may present low energy and protein consumption, together with reduced appetite and levels of physical activity [34-36]. Higher quality proteins may be advantageous since they do not require an intake as high as low biological value protein to reach the leucine thresholds [37-39].

Whey Protein (WP), are currently considered the best type of protein to be ingested because of its high biological value, related to the profile of essential amino acids it possesses, especially leucine, in addition to fast and easy digestion and absorption [40,41]. Thus, WP is essentially used because of the role it plays in the synthesis of muscle protein [42]. Numerous studies have demonstrated the effects of WP on protein synthesis and hypertrophy in different situations involving diseases such as cancer, rheumatoid arthritis, neurodegenerative diseases and in patients with human immunodeficiency virus [43-45]. However, its use in COPD patients still has controversial results in the literature [40,46-49].

According to nutrient recommendations from the Dietary Reference Intakes [50] based on analyzes of nitrogen balance studies in humans, the recommended dietary intake of high biological value protein for healthy subjects of both sexes is 0.8g/kg body weight per day. However, a recent review in 2016 established recommendations for the elderly population of 0.4g /kg body weight per main meal: breakfast, lunch and dinner, in order to provide the amount of protein required for optimum synthesis of muscle protein and at the same time limit and treat age-related declines in muscle mass, strength and function [51], suggesting that this amount of protein is more important than 0.8g/kg/day.

Conclusion

The population with COPD is mostly composed of elderly individuals, who often present with nutritional depletion, loss of lean mass and exercise intolerance. Highlight that the normalization of protein intake in order to reach the goal of 0.4g/kg body weight per main meal could minimize synergistic sarcopenic effects of age and disease.

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