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Serum Procalcitonin in Chronic Obstructive Pulmonary Disease

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ABSTRACT

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide. One of the most important events in the course of COPD is acute exacerbation. Acute exacerbation of COPD (AECOPD) is characterized by the aggravation of dyspnea, cough, and sputum. Chronic obstructive pulmonary disease exacerbation leads to respiratory failure, hospitalization, morbidity, and mortality. During and after the COPD attack, lung function dramatically decreased. Bacterial pneumonia is an important and serious risk factor for AECOPD. However, there are other inflammatory and non-inflammatory causes of AECOPD. Antibiotic treatment is usually challenging in AECOPD. Procalcitonin is a non-hormone active protein and precursor to calcitonin that consists of 116 amino acids, and 13 kDa weight is produced by the neuroendocrine cells of the thyroid gland. However, procalcitonin is secreted in septic shock, metastatic cancers, bacterial and fungal infections; therefore, serum procalcitonin is increased in bacterial pneumonia of AECOPD. Some studies recommended procalcitonin serum measurement as a guide for antibiotic initiation in AECOPD.

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Introduction

Chronic obstructive pulmonary disease (COPD), as a debilitating and common disease, is characterized by irreversible airflow limitation. Acute exacerbation of COPD (AECOPD) is considered an important event in the course of the disease.This event in COPD is associated with significant morbidity, mortality, and economic burden and cost (1,2).

Bacterial and viral infections and non-infectious airway disorders lead to an exacerbation. The application of antibiotics has been suggested in most cases of severe attack leading to hospitalization (3).

Nevertheless, antibiotic prescription remains a challenge for clinicians focused on decreasing duration, excessive use, multidrug resistance, and reducing antibiotic use is a global health priority (3,4).

Procalcitonin serum level dramatically increases in bacterial infections; however, such an increase is not observed in viral or non-infectious diseases. Therefore, procalcitonin (PCT), as a peptide component, is useful in determining bacterial infections (5). Based on the results of previous studies, this current narrative review aims to update clinicians on PCT measurement in COPD patients.

Literature review

A narrative review was conducted through a literature search in the PubMed and Google Scholar databases regarding PCT in COPD, and

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130 articles were found for full-text review.

Acute Exacerbation of Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease leads to disability situations, high mortality, and economic burden on the community healthcare system. One of the reasons for frequent medical visits and hospitalizations is AECOPD (6).

The exacerbation is usually seen in the natural course of the disease, characterized by the aggravation of respiratory complaints. The definitive diagnosis of AECOPD is based on the clinical presentation, and the severity of the exacerbation can be different in the disease process.

Medical history and physical examination may be useful; moreover, chest X-ray, other imaging, blood tests for inflammatory markers, and arterial blood gases are needed to diagnose the disease (7). Nevertheless, the first diagnoses of acute exacerbation date back to the 1980s, which were often subjective in affected patients due to clinical parameters. The intensity of shortness of breath, cough, sputum, which have changed day by day, and require changes in drug doses, indicate an exacerbation of COPD status in patients (7, 8).

Despite the efforts of global healthcare systems, the mortality and morbidity rates of AECOPD have annually increased (7).

It can be mentioned that community acquired pneumonia is common in COPD patients. Although bacterial infections are one of the main causes of the exacerbation, viral infections and other non-infectious inflammatory causes need to be considered (6).

Since one of the goals of dealing with a patient with COPD is to cure and manage exacerbation, AECOPD patients are often prescribed antibiotics. Overuse or non-use of antibiotic therapy is challenging and detrimental to the healthcare and economic system of communities (9).

Shahin et al. reported that neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, red cell distribution width, and c-reactive protein (CRP) could be measured as serum biomarkers and inflammatory agents for the assessment of exacerbation COPD and for predicting hospitalization and respiratory failure in patients with COPD (10).

Elevated procalcitonin in serum patients with an acute attack of COPD increases re-exacerbations and hospitalization (11).

Procalcitonin

Procalcitonin was first defined in 1992 as a non-hormone active protein and precursor of the calcitonin, which is consisted of 116 amino acids, and 13 kDa weight is produced in the neuroendocrine cells of the thyroid gland; nevertheless, PTC is secreted in such conditions as septic shock, metastatic cancers, bacterial and fungal infections, neuroendocrine cells, liver cells, and leukocytes (12).

Procalcitonin rises during inflammation within 2-4 h and reaches its maximum within 24-48 h. As inflammation improves, the amount of procalcitonin decreases rapidly. If the inflammation continues, its level will reach a certain level and remain constant (13).

Furthermore, PCT may increase in bacterial infections with the serum levels being associated with the severity of the infection. The serial setup of PCT is better than a single measurement. Procalcitonin has 70% accuracy in differentiation between viral and bacterial pneumonia (14).

High levels of PCT are also associated with a poor prognosis for pneumonia. Early initiation of antibiotic treatment in patients with serious bacterial infections leads to a reduction in mortality and improvement of the outcome of critical patients (15).

Procalcitonin in acute exacerbation of chronic obstructive pulmonary disease

Differentiation between bacterial pneumonia and viral and other noninfectious inflammatory triggers is the first step of AECOPD management (16). On the other hand, elderly patients with COPD may not have the typical symptoms of bacterial pneumonia due to taking medications, such as corticosteroids, or having comorbidities of diabetes or heart disease (17).

Consequently, early initiation of antibiotics is critical in these patients; however, overuse of antibiotics leads to drug resistance (18). In a study conducted by Ergan et al. PCT was examined as a determinant of hospitalization time and mortality in critical patients (17).

Researchers in this study concluded that serum PTC levels could be used as a contributing factor in predicting and estimating hospital mortality rates (17).

Gong et al. found that the mortality rate of hospitalization and readmission due to AECOPD events were higher in the PCT positive group than in the PCT negative group (18).

Yanyan et al. showed that an acute increase in serum procalcitonin levels reduced the clinical improvement in COPD patients (16). The results of a study carried out by Stolz et al. indicated that serum procalcitonin levels were associated with COPD patients' survival (19).

Delghandi et al. reported that serum procalcitonin levels were associated with re-acute COPD attacks. The results of statistical tests in the mentioned study showed that there was a significant difference between serum procalcitonin level and invasive and non-invasive ventilation in insertion (20).

The procalcitonin-guided algorithm can reduce unnecessary administration of antibiotics without increasing reversed outcomes. Although in previous studies PCT has been suggested as an antibiotic guideline in patients with episodes of COPD, it may have a poor diagnostic value for patients hospitalized in the intensive care unit, and the PCT-guided algorithm may not effectively and safely reduce the antibiotic exposure (21).

It was revealed that antibiotic therapy was not an effective treatment for patients with mild to moderate exacerbation COPD and low serum PCT (22). Nevertheless, Lindenauer et al. showed that there was no significant difference between hospitalized patients with and without proved PCT guidance regarding antibiotic prescription rates and duration of treatment (23).

Giorgi et al. indicated that serum PCT in AECOPD levels alone might not be a definitive predictor for mechanical ventilation (24). According to the results of a study performed by Gong et al., PCT levels had a direct relationship with CRP, leukocyte count, neutrophil percent, and hospitalization (18). The initiation and/or discontinuation of antibiotic therapy with PCT monitoring led to better treatment and shorter antibiotic administration (25).

Conclusion

Although there are reports in agreement and disagreement of measuring PCT in the acute onset of obstructive pulmonary disease attacks and the positive role of PCT in bacterial infections, measuring PCT in AECOPD seems to be a valuable method with considering the results of previous studies.

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Conflict of interest

All authors declare that they have no conflicts of interest.

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