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Procalcitonin as a biomarker of good prognosis for patients with exacerbation of chronic obstructive pulmonary disease.

Procalcitonin as a biomarker of good prognosis for patients in exacerbation of chronic ob-structive pulmonary disease.

Gabriela Theodoro Tórtola - Undergraduate student. Medicine course – University of Ribeirão Preto (UNAERP).

Eloisa Maria Gatti Regueiro - Professor. Department of Medicine – University of Ribeirão Preto (UNAERP).
Department of Physiotherapy – Barão de Mauá University Center.
(CBM).
ORCID: https://orcid.org/0000-0002-1953-4307 tes.cnpq.br/ / Lattes: http://lat-2901466840054711

Summary

Chronic Obstructive Pulmonary Disease (COPD) is a lung condition characterized by persistent airflow limitation, usually associated with smoking, resulting from an abnormal inflammatory response of the airways to the inhalation of harmful particles. COPD exacerbations consist of episodes of acute worsening of respiratory symptoms and are associated with increased hospitalizations, impaired functional capacity, increased mortality, and...

reduced quality of life for patients. In this context, procalcitonin (PCT), a biomarker derived from calcitonin, has been investigated as an auxiliary tool in differentiating between infectious and non-infectious exacerbations, in addition to its potential prognostic value.
A narrative literature review was conducted in the PubMed, SciELO, and Cochrane databases, encompassing publications from 2020 to 2025, using the descriptors "Pulmonary Disease," "Antibiotic Resistance," "Procalcitonin," and "Medicine." The analyzed studies showed that antibiotic therapy guided by serum PCT levels is associated with reduced antibiotic use and duration, without compromising clinical outcomes, as well as a lower occurrence of adverse effects and a contribution to combating bacterial resistance. Furthermore, elevated PCT levels were associated with greater severity of exacerbations, longer hospital stays, and a worse clinical prognosis. Therefore, it is suggested that PCT represents a relevant biomarker in the management of COPD exacerbations, assisting in both therapeutic decision-making and prognostic assessment, promoting safer and more individualized care.

Keywords: Lung disease; Procalcitonin; Antibiotic resistance; Medicine.

Abstract

Chronic Obstructive Pulmonary Disease (COPD) is a pulmonary condition characterized by persistent airflow limitation, usually associated with smoking, resulting from an abnormal in-flammatory response of the airways to the inhalation of harmful particles. COPD exacerbations consist of episodes of acute respiratory symptoms and are associated with increased hospitalizations, deterioration of functional capacity, increased mortality, and reduced quality of life. In this context, procalcitonin (PCT), a biomarker derived from calcitonin, has been investigated as an auxiliary tool to differentiate between infectious and non-infectious exacerbations, in addition to its potential prognostic value. A bibliographic review was conducted using the Pub-Med, SciELO, and Cochrane databases, including publications from 2020 to 2025, and using the descriptors “pulmonary disease,” “Antibiotic Resistance,” “Procalcitonin,” and “Medicine.”

The analyzed studies demonstrated that antibiotic therapy guided by serum PCT levels is associated with a reduction in both antibiotic use and duration, without compromising clinical out-comes, in addition to a lower incidence of adverse effects and a contribution to combating bacterial resistance. Furthermore, elevated PCT levels were associated with greater exacerbation severity, longer hospital stays, and worse clinical prognosis. Therefore, it is suggested that PCT
represents a relevant biomarker in the management of COPD exacerbations, assisting both ther-apeutic decision-making and prognostic assessment, and promoting safer and more individual-ized patient care.

Keywords: Pulmonary disease; Procalcitonin; Antibiotic resistance; Medicine.

Introduction

Chronic obstructive pulmonary disease (COPD) is a debilitating condition characterized by...
characterized by inflammation that prevents the free flow of air through the lungs, its main symptom being-
The main etiology is smoking. This condition is chronic and frequently aggravated by exacerbations.
tions, which present as acute episodes of sudden worsening that lead to aggravation of
Respiratory symptoms, such as worsening dyspnea, increased sputum, and changes in its consistency.
intensity and coloration (GOLD, 2025). These exacerbations can be caused by viral infections.
bacterial, bacterial, or environmental causes are associated with worse clinical outcomes, causing
causing an increase in hospitalizations and raising the risk of mortality, often requiring...
saria a optimum do tratamento, mudar a terapia habitual usado pelo paciente (Guo-Parke
et al., 2020).

Therefore, it is important to differentiate the etiology of the exacerbation in order to control the condition.
with appropriate therapy, especially to assess the need for antibiotic use-
therapy, contributing to the avoidance of hasty prescriptions, given that the majority-
The theory behind exacerbations has no bacterial etiology, and yet antibiotics are widely used.
This method is commonly used in the treatment of these cases, culminating in the risk of bacterial resistance.
stemming from the excessive and unnecessary use of antibiotics. Considering this problem, the
Procalcitonin (PCT), a biomarker derived from the precursor hormone calcitonin, is released-
It is found in bacterial infections, and shows low values in cases of viral infections or
Non-infectious conditions. This biomarker has shown promising effects in therapeutic selection.
A therapeutic approach in cases of exacerbation, avoiding the hasty prescription of antibiotics for these.
patients (Schuetz, 2023).

Therefore, it is necessary to explore the role of PCT as a biomarker in orientation.
therapeutic management of COPD exacerbations, highlighting its importance in etiological differentiation.
logical, its impact on the choice of antibiotic therapy and its prognostic implications. Being
Thus, observing the clinical applicability of this biomarker represents a significant development.
in improving treatment, seeking to reconcile treatment effectiveness and preservation of the
antimicrobial efficacy over a prolonged period. In this context, the question arises as to how the use of-
Identifying a biomarker can help improve the prognosis of exacerbations in these patients.

Theoretical framework

Chronic obstructive pulmonary disease

COPD is a heterogeneous disease whose symptoms include cough,
Dyspnea and expectoration. This condition occurs due to compromise of the upper respiratory tract.
upper and lower lungs, which may clinically manifest as bronchiolitis or pulmonary emphysema.
Monar, which cause obstruction of the airways, resulting in the trapping of airflow.
(GOLD, 2025). The disease results from the interaction of several factors, such as genetic and environmental factors.
Mental health problems, which can occur throughout life, damage the lungs until old age.
Environmental exposures, as well as intense exposure to tobacco smoke and inhalation of particles.
and toxic pollutants, common in individuals who work in exposure to smoke (GOLD,
2025). Smoking is highlighted as the main agent involved in the development of this condition.
disease, being a significant problem in maintaining the prevalence of the disease in
world.

Regarding genetic factors, mutations in the SERPINA1 gene are observed, which leads to...
Alpha1-antitrypsin (AAT) deficiency, a protein produced in the liver, whose main function is to
The main function is to protect the lungs from the destructive action of proteolytic enzymes, such as elastase.
neutrophils. In the absence or deficiency of AAT, an imbalance occurs between proteases and anti-
proteases in the lungs, resulting in progressive degradation of lung tissue and development.
emphysema progression (Janssen *et* al., 2019).

COPD exacerbation

Patients with COPD have a high risk of their condition worsening.
respiratory condition, configuring an exacerbation that is accompanied by clinical worsening, with a picture

sudden respiratory distress, characterized by an increase in sputum with a change in its color, Pnea and worsening cough. These exacerbations are frequently precipitated by infections of the airways (viral or bacterial) or through exposure to environmental pollutants (Guo-Parke *et* al., 2020).

Since COPD is responsible for chronic inflammation of the airways, the patient, When presenting with a viral or bacterial infection, there will be additional inflammation of the respiratory tract. piracy, since both viruses and bacteria release inflammatory cytokines that They stimulate the recruitment of neutrophils that migrate to the lungs, releasing pro-enzymes. teolytic, intensifying lung tissue damage (Vogelmeier *et al.,* 2020); in addition, there are Stimulation of goblet cells by these microorganisms, which contributes to the increase from mucus production, which causes greater airway obstruction (GOLD, 2025), inten- signifying the negative impact on disease progression, contributing to a poor prognosis, increasing hospitalization time and contributing to higher mortality rates. (Guo-Parke *et* al., 2020).

Procalcitonin: definition and physiological mechanisms

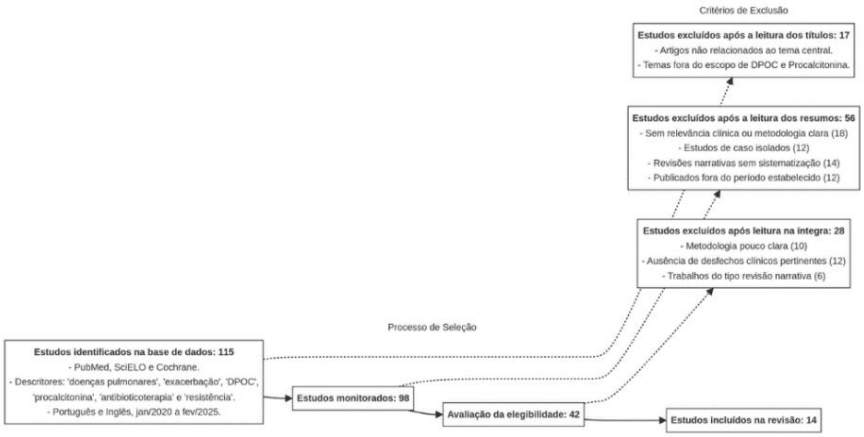
PCT is a peptide of 116 amino acids, a precursor to the hormone calcitonin, produced- physiologically produced by the C cells of the thyroid gland, presenting undetectable serum levels. stable in healthy individuals. In inflammatory processes, especially in bacterial infections- In thyroid hormones, their synthesis becomes predominantly extrathyroidal, occurring in various tissues. of the organs, such as lungs, liver, adipose tissue, spleen and intestinal neuroendocrine cells (Maruna *et* al., 2000). The increase in production is related to the action of bacterial endotoxins and pro-inflammatory cytokines, mainly TNF-ÿ, IL-1ÿ and IL-6, which induce the expression of The CALC-1 gene is responsible for PCT synthesis. In contrast, in viral infections, the response Inflammatory reactions mediated by interferon gamma (IFN-ÿ) inhibit the transcription of this gene, resulting at normal or slightly elevated PCT levels. Thus, a significant elevation of The peptide is characteristic of bacterial infections, giving it significant value as a bio- marker in the differential diagnosis of infectious and inflammatory states (Medina *et* al., 2022).

Procalcitonin as a prognostic biomarker in COPD exacerbation.

Considering how the PCT works, its importance is evident both for the etiological discovery of exacerbation, as well as for prognostic indicator in COPD exacerbation- Patients with low PCT levels (<0.05 ng/mL) tend to have less severe cases. clinical, shorter hospital stay and lower mortality rate compared to those who exhibit high levels also have a higher probability of needing Mechanical ventilation and admission to the intensive care unit (Lin *et* al., 2021). Furthermore, Prescribing antibiotics guided by PCT reduces unnecessary exposure to these medications. treatments, avoiding their side effects, such as the development of resistance to them, when bacteria develop mechanisms to neutralize the drug's action, making the ineffective treatment and increasing the risk of recurrent infections (Huemer *et* al., 2020).

Methodology

This study consists of a narrative literature review of scientific articles. cos indexed in the PubMed, SciELO, and Cochrane databases. The database search considered Articles published between January 2020 and February 2025, in Portuguese. and English, using the descriptors "pulmonary diseases", "exacerbation", "COPD", "procalci- "tonin," "antibiotic therapy," and "antibiotic resistance," as well as their corresponding terms in English language, combined by Boolean operators. The research lasted 12 months. Studies published in the last five years that presented clinical relevance were included. nica, such as randomized clinical trials, analytical observational studies, systematic reviews- Studies and meta-analyses, provided they presented a clear methodology and relevant clinical outcomes. factors such as mortality, need for antibiotic therapy, length of hospital stay, or resistance. bacterial. The selection of studies considered the selection of titles and abstracts, excluding articles unrelated to the topic were followed by reading of the eligible texts. The following were excluded: all published outside the established period, those without clinical relevance, as well as studies- isolated case studies and narrative reviews without a systematized methodology. The selection process This allowed for the inclusion of studies best suited to the research objectives.



Results and discussion ÿ

Recent studies demonstrate that serum procalcitonin (PCT) levels reveal...
plays a relevant role in the etiological differentiation of exacerbations of pulmonary disease.
Chronic obstructive pulmonary disease (COPD) is important both in the prognostic stratification of patients. Low values
PCT levels (<0.05 ng/mL) are associated with favorable clinical outcomes and shorter hospital stays.
tion and reduced need for ventilatory support (MEDINA, V. et al.). In contrast, ní-
Elevated levels of this biomarker correlate with greater clinical severity, increased
risk of hospitalization, higher likelihood of invasive mechanical ventilation, and worse outcomes
clinical findings demonstrate a higher bacterial infectious load and an exaggerated systemic inflammatory response.
generated (MEDINA, V. et al.). Accordingly, studies confirm that patients with exacerbation
COPD cells associated with bacterial infection show significantly higher levels.
elevated PCT levels when compared to those with non-bacterial exacerbations. (QIYUAN,
P. et al., 2024; SCHUETZ, 2023).

In addition to its prognostic value, the use of PCT as a therapeutic guide has proven to be beneficial.
effective in reducing the prescription and duration of antibiotic therapy, without compromising recovery.
Clinical patient experience (QIYUAN, P. et al.). Studies have shown that strategies based
PCT reduces antibiotic use in COPD exacerbations without increasing rates of
Treatment failure, mortality, or recurrence of exacerbations (HOULT et al., 2022). This
This approach demonstrates relevance, considering the prevailing scenario of bacterial resistance.
since reducing unnecessary exposure to antimicrobials is fundamental to the
preservation of antibiotic efficacy (HUEMER et al., 2020)

Furthermore, from a pathophysiological point of view, the clinical utility of PCT is valued for its characteristics, since its systemic production is primarily stimulated by toxins-in bacterial and inflammatory cytokines, remaining reduced in viral infections and in inflammations. Non-infectious chronic conditions, such as those present in exacerbated COPD with less signs of severity (SIVAPALAN et al., 2024). This characteristic offers an advantage in relation to to other frequently used inflammatory markers, such as C-reactive protein. reactive, which may present with nonspecific elevation in COPD patients due to inflammation. chronic underlying condition and the presence of systemic comorbidities, common in these patients. (NE-GEWO et al., 2015)

Thus, procalcitonin establishes itself as a useful tool in stratification. risk assessment, allowing for the early identification of patients with a higher probability of complications. cations and favoring targeted and individualized therapeutic interventions. Its use relates Based on clinical assessment and epidemiological context, it aligns with treatment goals. of COPD, which prioritize reducing the severity of exacerbations and optimizing outcomes. clinical aspects and the rational use of antibiotics (VOGELMEIER et al., 2020). These characteristics re-They emphasize the role of PCT as a biomarker of good prognosis and as an auxiliary tool in clinical decision-making, contributing to the optimization of the management of exacerbations of COPD. (HUEMER et al., 2020).

Final considerations

Based on the data from this review, it is suggested that PCT presents itself as a relevant biomarker. Advanced and promising in the management of exacerbated COPD. Its dosage allows differentiation between exacerbations. Differentiate between bacterial and non-bacterial infections, guide the need for antibiotic therapy, and reduce the risk of infection. complications associated with the overuse of antibiotics and provide stratification parameters-prognostic indication. Thus, the incorporation of this marker into clinical practice contributes both to Improving individualized care, as well as optimizing the healthcare system and reducing costs, mortality and antimicrobial resistance, representing an important step in treatment. Specific, effective treatment based on clinical and scientific evidence.

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