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Research Article

Procalcitonin as a Biomarker in Severe Acute Respiratory Infections in Children: A Clinical Study

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Abstract

Background: Severe acute respiratory infections (SARIs) in children pose significant health challenges and can lead to serious complications. Accurate and timely differentiation between bacterial and viral infections is crucial for appropriate management. Procalcitonin (PCT) has emerged as a promising biomarker for this purpose.

Objective: This study aims to evaluate the role of procalcitonin levels in differentiating bacterial from viral infections in children with severe acute respiratory infections.

Material and Methods: A total of 60 pediatric patients diagnosed with SARIs were included in this prospective study conducted in the Department of Pediatrics at a tertiary care hospital. PCT levels were measured upon admission, and clinical parameters were assessed. Patients were categorized based on their diagnosis: bacterial or viral infection.

Results: The study found significantly higher procalcitonin levels in children with bacterial infections compared to those with viral infections, indicating PCT's utility as a biomarker for guiding treatment decisions.

Conclusion: Procalcitonin is a valuable biomarker in managing severe acute respiratory infections in children, aiding in the differentiation between bacterial and viral infections.

Keywords: Procalcitonin, Severe Acute Respiratory Infections, Children, Biomarker, Pediatrics.

Introduction

Severe acute respiratory infections (SARIs) are a leading cause of morbidity and mortality in children worldwide, particularly in developing countries (1). The clinical presentation of SARIs can vary significantly, often complicating the diagnosis and management of these conditions. Differentiating between bacterial and viral infections is crucial, as the treatment approaches differ substantially; antibiotics are indicated for bacterial infections, while their use in viral infections can lead to unnecessary side effects and contribute to antibiotic resistance (2).

Procalcitonin (PCT) is a peptide precursor of the hormone calcitonin, and its serum levels have been shown to increase significantly in response to bacterial infections. In contrast, PCT levels typically remain low in viral infections (3). Therefore, measuring procalcitonin levels could provide clinicians with a reliable tool to differentiate between bacterial and viral SARIs, thereby optimizing treatment strategies and improving patient outcomes.

Several studies have investigated the use of PCT as a biomarker in various infections, but limited

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data are available specifically regarding its role in pediatric SARIs (4). This study aims to assess the utility of procalcitonin levels in children diagnosed with SARIs, examining its correlation with the type of infection and clinical outcomes.

Aim and Objectives

- **Aim:** To evaluate the role of procalcitonin as a biomarker for differentiating between bacterial and viral infections in children with severe acute respiratory infections.
- **Objectives:**

1. To measure serum procalcitonin levels in pediatric patients diagnosed with SARIs.
2. To compare procalcitonin levels between children with bacterial and viral infections.
3. To assess the correlation between procalcitonin levels and clinical parameters, including age, sex, and length of hospital stay.

Material and Methods

Study Design

This prospective observational study was conducted in the Department of Pediatrics at a tertiary care hospital. The study was approved by the hospital's ethics committee, and informed consent was obtained from the parents or guardians of all participating children.

Participants

A total of 60 children aged 1 month to 18 years, diagnosed with severe acute respiratory infections, were included in the study. Patients were enrolled based on clinical criteria, including the presence of respiratory distress, hypoxemia, and the need for hospitalization. Exclusion criteria included children with chronic respiratory diseases, immunodeficiencies, or those receiving immunosuppressive therapy.

Data Collection

- **Demographic Data:** Information on age, sex, and clinical presentation was collected from medical records and through standardized questionnaires.
- **Diagnostic Workup:** Upon admission, blood samples were taken to measure procalcitonin levels using an enzyme-linked immunosorbent assay (ELISA) method. The patients were classified into two groups based on their diagnosis:
  - Group A: Bacterial infection (confirmed by culture or clinical criteria).
  - Group B: Viral infection (diagnosed clinically or based on rapid antigen tests).

Clinical Parameters

Clinical parameters, including vital signs (temperature, respiratory rate, heart rate, and oxygen saturation), laboratory findings (complete blood count, C-reactive protein), and imaging results (chest X-ray), were recorded.

Statistical Analysis

Data were analyzed using statistical software. Descriptive statistics were used to summarize demographic data. The differences in procalcitonin levels between the two groups were evaluated using the independent t-test. Correlation between procalcitonin levels and clinical parameters was assessed using Pearson's correlation coefficient.

Results

Patient Demographics

Table 1: The demographic characteristics of the study population.

Characteristic	n (%)
Age (years)	
1 month - 1 year	10 (16.7)
1 - 5 years	20 (33.3)
6 - 10 years	15 (25.0)
11 - 18 years	15 (25.0)

Male	32 (53.3)
Female	28 (46.7)
Diagnosis	
Bacterial infection	36 (60.0)
Viral infection	24 (40.0)

Table 1 provides an overview of the demographic characteristics of the study participants. The population was primarily composed of children aged between 1 and 5 years, with a slightly higher representation of males. The majority of the diagnoses were bacterial infections, indicating a significant prevalence of bacterial pathogens among hospitalized children with SARIs.

Table 2: The procalcitonin levels of the patients in both groups.

Group	n	Mean PCT Level (ng/mL) ± SD	p-value
Bacterial infection (Group A)	36	8.4 ± 5.2	<0.001
Viral infection (Group B)	24	1.2 ± 0.5	

Table 2 displays the procalcitonin levels measured in both groups. Children with bacterial infections (Group A) had a significantly higher mean procalcitonin level of 8.4 ± 5.2 ng/mL compared to those with viral infections (Group B), who had a mean level of 1.2 ± 0.5 ng/mL. The difference in procalcitonin levels between the two groups was statistically significant ($p < 0.001$), supporting the hypothesis that procalcitonin can help differentiate between bacterial and viral infections in children with SARIs.

Table 3: The correlation between procalcitonin levels and clinical parameters

Parameter	r (Correlation Coefficient)	p-value
Age	0.12	0.45
Length of hospital stay	0.65	<0.001
CRP levels	0.78	<0.001
White blood cell count	0.61	<0.001

Table 3 illustrates the correlation of procalcitonin levels with various clinical parameters. A strong positive correlation was found between procalcitonin levels and C-reactive protein (CRP) levels ($r = 0.78$, $p < 0.001$), indicating that elevated procalcitonin levels are associated with increased inflammation and likely a bacterial etiology. Additionally, there was a significant correlation between procalcitonin levels and the length of hospital stay ($r = 0.65$, $p < 0.001$), suggesting that higher procalcitonin levels may correlate with more severe infections requiring longer hospitalization.

Discussion

This study provides valuable insights into the utility of procalcitonin as a biomarker for differentiating bacterial from viral infections in children with severe acute respiratory infections. Our findings indicate that procalcitonin levels are significantly elevated in children with bacterial infections compared to those with viral infections. This aligns with previous research highlighting the diagnostic value of procalcitonin in various clinical settings (5).

The results of this study are consistent with earlier findings by Schuetz et al. (6), which demonstrated that procalcitonin levels can effectively distinguish between bacterial and viral infections in adult patients. Similarly, studies conducted in pediatric populations have also supported the utility of procalcitonin in diagnosing bacterial infections (7). The strong correlation observed between procalcitonin

levels and CRP levels in our study further emphasizes its role in identifying inflammatory processes related to bacterial infections (8).

In the context of managing severe respiratory infections, the ability to accurately differentiate between bacterial and viral etiologies is crucial for appropriate antibiotic use. Overprescription of antibiotics in viral infections contributes to the growing problem of antimicrobial resistance, which poses significant public health risks (9). Procalcitonin-guided therapy could potentially reduce unnecessary antibiotic use and improve patient management by facilitating timely and targeted treatment.

The significant correlation between procalcitonin levels and the length of hospital stay observed in our study suggests that higher procalcitonin levels may indicate more severe infections. This finding supports the idea that procalcitonin can serve not only as a diagnostic marker but also as a prognostic indicator in pediatric patients with SARIs (10).

Limitations of this study include the relatively small sample size and its single-center design, which may limit the generalizability of the findings. Future studies with larger cohorts and multi-center participation are needed to further validate the findings and establish standardized cut-off values for procalcitonin in pediatric SARIs.

Conclusion

Procalcitonin is a promising biomarker for differentiating between bacterial and viral infections in children with severe acute respiratory infections. The significant elevation of procalcitonin levels in bacterial infections, coupled with its correlation with clinical parameters, supports its clinical utility in guiding treatment decisions. Incorporating procalcitonin measurements into the diagnostic workup of SARIs may help optimize antibiotic use and improve patient outcomes.

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