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Role of procalcitonin in predicting occurrence of bacteraemia: About 109 cases

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Abstract

The aim of this study was to evaluate procalcitonin (PCT) levels in the predicting of bloodstream infections in a large population of patients with positive blood cultures (BC) in the unit care of Avicenna military hospital of Marrakech.

Material and Methods: This prospective study was carried out using clinical and routine laboratory data collected at the Clinical Microbiology and biochemistry from laboratory of Avicenna military hospital – Marrakech, Morocco, between January 2019 and December 2021.

Results: 109 cases were collected from laboratory data of Avicenna military hospital in Marrakech. Most of patient were male with 79 cases (72.5%), blood cultures were positive in all cases. Procalcitonin were positive in the majority of patients with a 105 cases (96%). *Klebsiella* sp. was the most frequent germ in gram negative bacilli with a rate of 25 cases (23%) Coagulase-negative *Staphylococcus* was the most frequent germ in gram-positive cocci with a rate of 23 cases (21%).

Keywords: Bacteraemia; Screening; Procalcitonin; Blood culture

1. Introduction

Sepsis is a life-threatening condition that arises when the body's response to an infection injures its own tissues and organs [1].

Early diagnosis and rapid bacterial identification are essential for timely and appropriate clinical management [3-5]. Blood cultures (BC) are considered the gold standard for detecting pathogens in patients with sepsis, however, given the time required, it cannot be applied to make early therapeutic decisions [6].

Procalcitonin (PCT) is a biomarker with a potential role in diagnosis and prognosis of bacterial infections, since its values appeared strictly correlated with the development of severe bacterial infections [7–9]. Systematic use of PCT has been proposed as part of the initial diagnostic pathway and for monitoring antibiotic treatment response and duration, especially in critically ill patients [10, 11].

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Aim of this study was evaluation of PCT levels in predicting occurrence of bloodstream infections in a large population of patients with positive blood cultures (BC).

2. Material and methods

This prospective study was carried out using clinical and routine laboratory data collected at the Clinical Microbiology and biochemistry from laboratory of Avicenna military hospital – Marrakech, Morocco, between January 2019 and December 2021.

Measurement of PCT level Serum PCT levels were measured using an automatic analyser (ARCHITECT c4000-Abbott), according to the manufacturer’s instructions. The lower detection limit of the assay was 0.05 ng/ml and assay sensitivity was 0.09 ng/ml.

Statistical analyses were performed using Microsoft Excel 2016.

3. Results

In our study, 109 cases were collected. These were patients hospitalized in the intensive care unit with suspected sepsis in whom blood cultures were taken and procalcitonin was measured.

30 cases were female (27.5%) and 79 cases were male (72.5%), blood cultures were positive in all cases.

The microbiological study of the blood cultures allowed the isolation of gram-negative bacilli in 53 cases (49%) and gram-negative cocci in 56 cases (51%).

The procalcitonin assay was negative in 4 cases (4%) and positive in 105 cases (96%).

With a mean of 10.78 ng/ml and extremes ranging from 0.02 ng/ml to 1035.12 ng/ml.

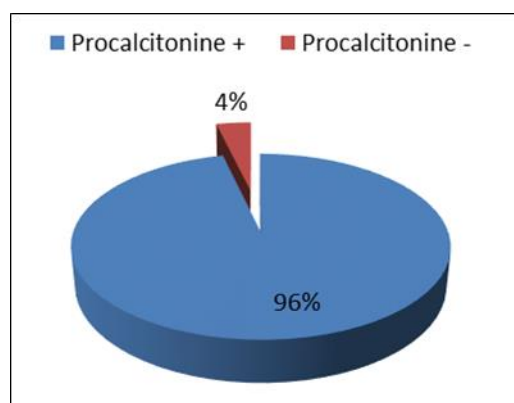


Figure 1 Procalcitonin results

Klebsiella sp. was the most frequent germ in gram negative bacilli (GNB) with a rate of 25 cases (23%) followed by *acinetobacter boumannii* with a rate of 14 cases (13%).

Coagulase-negative *Staphylococcus* was the most frequent germ in gram-positive cocci (GPC) with a rate of 23 cases (21%) followed by *Staphylococcus aureus* with a rate of 15 cases (13.5%).

The average PCT level is apparently very high in gram-negative bacteria (GNB) with a level of 33.6 ng/ml for *serratia* sp. followed by *acinetobacter boumannii* with a level of 27.9 ng/ml and 27.7 ng/ml for *Enterobacter cloacae*.

Table 1 Median PCT levels corresponding to pathogens isolated from two or more BCs with monomicrobial infection

	Number/ percentage	Median PCT level (ng/ml)
GNB		
Klebsiella sp.	25 (23%)	4.3
Acinetobacter boumannii	14 (13%)	27.9
Escherichia coli	4 (3, 5%)	5.72
Enterobacter cloacae	4 (3, 5%)	27.7
Pseudomonas aeruginosa	3 (2, 5%)	2.06
Serratia sp.	3 (2, 5%)	33.6
GPB		
Staphylococcus coagulase négative	23 (21%)	8.27
Staphylococcus aureus	15 (13, 5%)	8.6
Enterococcus sp.	9 (8%)	4.9
Streptococcus sp.	9 (8%)	9.4

4. Discussion

A lot of studies interested to show relationship between PCT levels and bacteraemia [11,12,13,14,15] and all showed its positive predictive value in diagnostic of bacteraemia and that join our study results that showed PCT was positive in 96% of cases and the mean of the value of PCT was high specially in GNB.

PCT production can be directly induced by inflammatory cytokines [16] and lipopolysaccharide, that is one of the most important cell wall component of GN bacteria, is precociously recognized by innate immune system via toll-like receptor 4 (TLR4), while lipoteichoic acid (LTA), a cell wall component of GP bacteria, is recognized by toll-like receptor 2 (TLR2) [17,18].

PCT can be a useful biomarker to detect bacterial etiology at initial stages of infection, but a major limitation is represented by the lack of identification of causative bacteria. A study conducted in acutely febrile patients reveals that PCT levels could be helpful also in differentiating bacterial from non-bacterial infections [19], and other studies have reported association between higher PCT levels and GN bacteremia, if compared to GP bacteremia [20–22].

For most patients with positive BC the microbiological tests and the new microbiological techniques, like MALDI-TOF, are generally available during the first 24–48 h, but data about susceptibility usually require another 1–2 days. During this time, decisions about choice of antimicrobial regimens and source control of infection are only based on clinical judgment. Considering available data, no definitive conclusions support use of PCT, compared to CRP or other markers, in management of early-stage sepsis [23,24].

It was also observed that PCT levels were high in Gram-negative septicaemia when compared to Gram-positive and candida septicaemia. The sample size was found to be inadequate for making meaningful comparisons when the patients were categorized into groups based on the organisms causing septicaemia.

Identification of septic patients in critical care population represents a great challenge to clinicians, because most of the patients that are treated in ICU-s for some time often have signs of SIRS and are susceptible to infections since they are immunocompromised [25,26].

Since bacteremia is indicative of severe bacterial infection, blood culture (BC) have been considered the gold standard in identification and consequent treatment decision in patients with sepsis [27,28,29,30]. However, the delay in obtaining the results of BC makes this diagnostic procedure unsatisfactory, hence new strategies to detect presence of bacteria in blood, such as PCR- SF have been developed [27,28,30]. Although very appealing, due to prompt results in

comparison to BC, use of PCR has been limited, since it is expensive and requires special equipment and technical expertise, and that makes a place to procalcitonin as an accessible biomarker [27,29,30,31].

5. Conclusion

In conclusions, our data confirmed previous observations about the role of PCT in predicting BC results in large patients with bacteraemia.

PCT levels can be useful not only for distinguishing between GNB and GPB infections, but also between GNB or GPB bacterial species.

We also acknowledge that this study had limitations and, therefore, recommend that additional prospective research be performed to address these limitations and confirm these findings.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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