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Serum Procalcitonin and C-reactive Protein Level as Markers of Bacterial Infection

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ABSTRACT

Background: C-reactive protein (CRP) and procalcitonin (PCT) are useful diagnostic tools used to estimate the risk of bacterial infection and the severity of the infection. The accurate diagnosis of bacterial infection is crucial to avoid unnecessary antibiotic use and to focus on the appropriate therapy.

Aim of the work: this study aimed to summarize the sensitivity and specificity of both PCT and CRP and their serum levels as markers in bacterial infection

Methods: scientific websites were used to search for articles such as Pubmed and Google Scholar. Several keywords were used to obtain all possible articles about the subject.

Conclusion: overall accuracy of PCT markers is higher than that of CRP markers in differentiation of bacterial infections

Keywords: prolactonin, C - reactive protein, markers, bacterial infection

INTRODUCTION

Bacterial infection is primarily a clinical concept that may require the use of supportive bedside or laboratory tests to confirm or exclude. There are two broad factors that are always necessary to confirm the diagnosis: inflammation or systemic dysfunction and direct or indirect evidence of a compatible bacterial pathogen. Inflammation may be localized or result in a systemic inflammatory response syndrome (SIRS). However, these definitions have recently been criticized; e.g. in one study of >100 000 patients with confirmed infection and organ failure, 12% did not meet the criteria for SIRS[1].

MATERIALS AND METHODS

In the current review, we used the internet to get the articles related to our subject, we used several key words like prolactonin, C - reactive protein, markers, bacterial infection. Scientific web sites were used for researching for articles such as Pubmed, Google Scholar and research Gate. We obtained 23 articles between 1992-2017.

Bacterial infection and Sepsis

Bacterial infection can cause sepsis [2]. Sepsis with acute organ dysfunction, namely severe sepsis is a major threat to life [2,3]. Early institution of an appropriate antimicrobial regimen in infected patients is associated with a better outcome [4] and hence early diagnosis of bacterial infection is of primary importance. However, some patients with an infection have minimal or even no symptoms or signs. Not all patients who had septic demonstrated an infection and the widespread administration of antibiotics to all these patients carries problems of antibiotic resistance, of drug toxicity and of increased medical costs. There is a need for an effective and accurate biochemical marker to support, or exclude the diagnosis of infection.

Bacterial resistance

Emerging bacterial resistance to antimicrobial therapeutics calls for more stringent efforts to reduce antibiotic overuse [5]. Towards this aim, there has been considerable interest in antibiotic stewardship programs aimed to reduce antibiotic overuse by tailoring antibiotic therapy to individual needs of patients [6, 7]. Despite the successful implementation of diagnostic biomarkers in different fields of medicine (for example, D-dimers in pulmonary embolism, natriuretic peptides in acute heart failure, troponin in myocardial infarction), accurate and timely diagnosis of bacterial infections remains a challenge [8,9]. Reliable clinical and/or microbiological parameters from easy to obtain specimens that may be used to diagnose bacterial infections and rule out other infections not in need of antibiotic therapy have been largely lacking.

The main disadvantages of many current microbiological methods are diagnostic delays (for example, culture methods), suboptimal sensitivity (for example, blood cultures) and low specificity due to contamination (for example, sputum cultures), whereas others are not amenable to routine diagnostics due to their invasive nature (for example, lung biopsy).

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Among several markers of inflammation and sepsis, procalcitonin (PCT) and C-reactive protein (CRP) markers are being studied to investigate their accuracy for the diagnosis of bacterial

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infections.

CRP is an acute-phase reactant and CRP level measurements are frequently used to aid in the diagnosis of bacterial infections. CRP is synthesized by the liver within 4–6 h after stimulation and peaking only after 36 h, mainly in response to IL-6, which is produced not only during infection but also in many types of inflammation [10] and binds to polysaccharides in pathogens, activating the classical complement pathway.

It lacks specificity for bacterial infections [11]. This is partly explained by the heterogeneity of different infections and the complex interaction of different pro- and anti-inflammatory mediators of the host response aimed at combating invading pathogens during systemic infections, which depend on timing, type, extent and site of the underlying infection.Therefore, the common problem for CRP is its nonspecific nature and the correlation between CRP and the severity of disease is not always clear [12, 13].On the other hand, there is a great interest in procalcitonin (PCT) as a potentially more specific marker for bacterial infection. It is a polypeptide present normally in the plasma in minimal levels (< 0.5 ng/ml). PCT is produced widespread in response to endotoxin or mediators released in response to bacterial infections (including interleukin (IL)-1β, tumor necrosis factor (TNF)-α and IL-6) and strongly correlate with extent and severity of bacterial infections [14]. PCT secretion begins within 4 h after stimulation and peaks at 8 h [14-16], Since up-regulation of PCT is attenuated by interferon (INF)-γ, a cytokine released in response to viral infections, PCT is more specific for bacterial infections and may help to distinguish bacterial infections from viral illnesses [17- 20].

In a meta-analysis done to evaluate the specificity and sensitivity of PCT vs CRP, it was found that PCT markers had significantly higher accuracy than do CRP markers for discriminating bacterial infections from non-infective causes of inflammation[21]. Sensitivity for PCT markers was 88%, compared to 75% for CRP markers. Specificity for PCT markers was 81% which was also higher than for CRP markers that was 67% [21].

Also, evaluating diagnostic markers for bacterial infections versus viral infections. PCT markers were also found significantly better than CRP markers at differentiating bacterial infections from viral infections. Sensitivity for PCT markers was 92%, compared with 86% for CRP markers, However, specificities were comparable 73%vs. 70% for PCT vs. CRP markers respectively [21].For the diagnosis of blood stream infections and bacteremia, studies found a high diagnostic performance of PCT [22-24]. To distinguish blood contamination from true blood stream infection in patients with growth of coagulase-negative staphylococci in their blood cultures, PCT demonstrated a better discriminatory ability compared to WBC and CRP [22]. At a cut-off of 0.1 ug/L, PCT had a very high sensitivity to exclude true infection. Two other studies, focused on the use of PCT to predict bacteremia infections in patients with CAP [23] and urinary tract infections (UTI) [24].In UTIs, evidence for the utility of PCT comes primarily from the pediatric literature, where it has a similar sensitivity but superior specificity compared to CRP for the prediction of pyelonephritis in children with febrile UTIs [25].Also, PCT was related to the appearance and severity of bacterial infection in ICU patients. Thus, PCT might be an interesting parameter for the diagnosis of bacterial infections in ICU patients [26]. Few studies have investigated the use of PCT in intra-abdominal infections [28- 34]. While, PCT showed promise as a marker to exclude perforation and ischemia in obstructive bowel syndrome [30], the utility in acute appendicitis [29] and pancreatitis [31, 34] was limited and PCT was more helpful as a prognostic marker for severe disease and adverse outcome.Therefore, based on the several studies done before and the results reported, we observed that PCT levels were more accurate markers for bacterial infection than were CRP levels.

CONCLUSION

We can conclude that the overall accuracy of PCT markers is higher than that of CRP markers in differentiation of bacterial infections. Although the cost of performing an assay for determination of PCT levels is double that for determination of CRP levels, the differences in accuracies is sufficiently great for PCT markers to be considered for widespread use in clinical practice.

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