Disease and Molecular Medicine

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Original Article

Investigation of Differences In CRP, PCT, WBC and MPV In Gram-Negative, Gram-Positive and Fungal Bloodstream Infections

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Abstract

Sepsis, which develops as a result of inflammatory response against infection, is a signicant cause of mortality, especially in patients in intensive care unit. Early diagnosis and effective treatment of bacterial infections is life-saving. The aim of this study was investigate the differences in C-reactive protein (CRP), procalcitonin (PCT), white blood cell count (WBC) and mean platelet volume (MPV) levels in bloodstream infections caused by Gram- negative (GN), Gram-positive (GP) or fungal agents. We retrospectively evaluatd the patients with bloodstream infections hospitalized between 01.01.2014 and 01.01.2016. Identification of microorganisms was performed in Microbiology Laboratory. Blood cultures were performed by using BACTEC 9120 (Becton Dickinson, USA) automatized blood culture system. CRP, PCT, WBC and MPV levels, which were investigated simultaneously with blood culture, of patients in whose blood culture growth occured were investigated. Mean PCT, CRP, WBC and MPV values were compared in patients with different infection agents. A total of 74 patients were investigated. There were 35 (47%) patients with Gram-negative, 26 (35%) patients with Candida and 13 (18%) patients with Gram-positive microorganisms. The most common GN microorganism agents were was Acinetobacter, *Candida albicans* was the most common fungal agent and coagulase-negative staphylococci (CoNS) was the most common GP agent. The highest PCT values were in patients with Klebsiella, *Escherichia coli* and Acinetobacter infections, respectively. CRP and PCT values were higher in GN bacteremias compared to GP and fungal infections. We think that CRP and PCT levels may be beneficial for differentiation of GN bacteraemia, GP bacteraemia and fungal infections aand may be considered as a factor which may guide empirical antimicrobial treatments.

Introduction

Sepsis is a clinical syndrome, which develops from inflammatory response against infection. It causes mortality significantly especially in intensive care unit patients. Starting to antimicrobial treatment on time is crucial. In these patients, according to blood culture results, antimicrobial treatment is determined. It is generally considered that infections caused by resistant microorganisms, increase in elder population, frequent use of invasive techniques and increase in surgical procedures may lead to higher incidence of sepsis. In some relevant studies, it has been reported that sepsis-related mortality rates vary between 30% and 60% (1,2,3).

Early diagnosis and effective treatment of bacterial infections are life-saving. The gold standard for diagnosis of bacterial infections is the cultivation of the agent in culture. However, in practical application, it may not always be possible to culture and cultivation of the agent and completion of culture may take time.

It has been reported that sensitivity and specificity of parameters such as WBC (white blood cell) and CRP (C-reactive protein), which are among classical markers of systemic inflammation, have limited benefit in such kind of bacterial infections. Recently, PCT (procalcitonin), as a specific and an early marker in sepsis and infections, have been the center of interest. Platelet activity and aggregation capacity can be determined by measurement of MPV (mean platelet volume). MPV is a parameter, which has been associated with diseases in many publications (4-7).

Our objective in this study was the investigation of differences in CRP, PCT, WBC and MPV levels in blood-

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stream infections in which Gram- negative (GN), Gram-positive (GP) or Fungal agents were determined as agents.

Materials and Methods

In this study, microorganisms, which were determined to be agents of bloodstream infections in Kanuni Sultan Süleyman Teaching and Research Hospital between 01.01.2014 and 01.01.2016, were retrospectively investigated by evaluating patient file notes, epicrises, nurse observation forms and laboratory results. Identification of microorganisms, which were isolated from blood cultures of the patients, was performed in KSSTRH Microbiology Laboratory. Blood cultures were investigated by using BACTEC 9120 (Becton Dickinson, USA) automatized blood culture system. Laboratory and clinical findings of all patients included in the study were evaluated together and patients who were diagnosed with bloodstream infection were included in the study. CRP, PCT; WBC and MPV levels, which were investigated simultaneously with culture, of patients in whose blood culture growth occurred were investigated.

Blood culture results of patients with bloodstream infections were divided into groups according to agent distribution as GN, GP, and fungal growth. Recorded mean PCT, CRP, WBC and MPV values of these groups were calculated and between-groups comparison was performed.

Results

In our study, when agent distribution of a total of 74 patients was investigated, it was determined that 35 (47%) Gram-negative, 26 (35%) Candida and 13 (18%) Gram-positive microorganisms were the agents. Whereas the most common agent among GN microorganism was determined to be Acinetobacter, *Candida albicans* was the most common agent among fungal infections and coagulase-negative staphylococci (CoNS) was the most common agent among Gram-positives.

CRP, PCT, WBC and MPV values by agent distribution are shown in Table 1. When it was investigated

according to species of microorganism, although our amount was not so many, the highest PCT values were determined for Klebsiella, *Escherichia coli*, and Acinetobacter, respectively.

Discussion

Sepsis is an uncontrolled generalized inflammatory response and also includes hemostatic mechanisms. Sepsis is a condition affecting other biological systems, as well as immune system. Blood gas analysis, electrolytes complete blood count, coagulation tests and markers such as CRP and PCT are important for diagnosis and follow-up of sepsis. MPV is the most commonly used parameter among indices related with platelets and shows bone marrow response (8,9).

In our study, the highest CRP, PCT, and MPV values were determined in GN infections and in agent distribution, the highest PCT values were determined for Klebsiella, Escherichia coli and Acinetobacter, respectively.

In a previously conducted meta-analysis, it was demonstrated that PCT is more superior to CRP in the differential diagnosis of bacterial infections (10).

In a study in which we previously conducted in our hospital and compared systemic and localized infections, PCT was determined to be significantly higher than other parameters in systemic infections (11).

When relevant studies were investigated; in the study conducted by Guo et. Al, PCT value was determined to be significantly higher in GN agents compared to GP and Candida, similarly to our study, in 262 sepsis attacks. In that study, it was determined that whereas mean PCT value was 26.7 in GN agents, 1.12 in Candida agents and 0.84 in GP agents, CRP value was 145.2 in GNs, 117 in Candida and 145.2 in GPs. Additionally, in this study, when agent distribution was considered, the highest PCT values were determined in Klebsiella, Escherichia coli, Acinetobacter, and Pseudomonas, respectively (12).

In the study conducted by Charles et.al, PCT level, again, was determined to be significantly higher in patients with GN bacteremia compared to the ones with

Table 1. Laboratory results by infection agent				
	CRP(mg/L)	PCT (ng/mL)	WBC (x10³/Ul)	MPV(fl)
Gram-negative bacteria	160.7	5.1	11850	8.3
Gram-positive bacteria	113.6	2.9	12330	7.9
Candia	**136.2**	**2.5**	13695	8.2

GP bacteremia (13).

In another relevant study, patients were divided into five groups according to blood culture results and the highest PCT value was determined in GN bacteremia group (mean 2.2 ng/ml) and the lowest value was determined in negative blood cultures (mean 0.3 ng/ml) and PCT value was reported to be important in categories of pathogens (14).

Also in a relevant study which was conducted in our country and included 88 bacteriemic episodes, whereas it was observed that PCT was 1.25 in the bacteriemic group and 0.20 in the non-bacteriemic group, mean CRP was determined to be 64 in the bacteriemic group. In the same study, mean PCT was reported to be 0.94 and mean CRP was reported to be 92 in GP bacteremias, however, mean PCT was reported to be 1.94 and mean CRP was reported to be 99 in GN bacteremias (15).

Whereas in a study involving hematology patients, PCT value was reported to be higher in GN bacteremias compared to GP bacteremias in the patient group having WBC value > 1.0 x 10(9)/l but PCT values were similar in the patient group having WBC < 1.0 x 10(9)/l, in the study of Leli et.al, similarly, it was reported to be significantly higher in GN bacteremia compared to GP and fungal infections (16,17).

In our study, mean MPV values were determined to be within normal range in each of three groups. In a relevant study, it was reported that alterations in MPV levels, therefore, may be a beneficial prognostic marker for bloodstream infections (18).

In a study which was conducted in our country and investigated determination of the value of platelet count and mean MPV in early diagnosis of late-onset neonatal sepsis in newborns, MPV levels of cases of the patient group was determined to be significantly higher compared to the control group (19).

In conclusion, similarly to previous studies conducted, it was determined in our study that CRP and PCT values were higher in GN bacteremias compared to GP and fungal infections. We are in thought of that PCT and CRP levels may be beneficial for differentiation of GN bacteremia, GP bacteremia, and fungal infections and for providing prognosis and may be considered as a factor which may guide during empirical antimicrobial treatments.

Declaration of Interest: The authors declare no conflict of interest

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