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The relationship between level of procalcitonin and mortality in patients who have been followed for solid organ malignancy with febrile neutropenia

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ABSTRACT

Aims: Previous studies have demonstrated that certain laboratory indicators play a crucial role in the identification of infections and prognosis assessment in individuals afflicted with febrile neutropenia. The concentration of procalcitonin exhibits an elevation in the presence of bacterial and fungal infections, while remaining unaltered in the context of viral illnesses. The objective of this study was to assess the efficacy of procalcitonin as a diagnostic tool for detecting infection and predicting prognosis in patients with febrile neutropenia.

Methods: The present investigation involved a retrospective analysis conducted at a single center, focusing on a cohort of 61 patients who received treatment for febrile neutropenia. The study encompassed the analysis of patients' age, gender, current circumstances, and laboratory test results. Procalcitonin levels were evaluated in first day of hospitalization.

Results: The age range of the patients in the study varied from 18 to 84 years, with a median age of 58. Out of the whole sample, 29 individuals (47.5%) were female, while 32 individuals (52.5%) were male. Out of the total sample size, 27 patients (44.2%) were diagnosed with lung cancer, 13 patients (21.3%) were diagnosed with breast cancer, and 4 patients (14%) were diagnosed with testicular cancer. Out of the total patient population, 24 individuals exhibited microbiologically confirmed infections, while 9 patients presented with clinically characterized infections. Out of the total number of cases, 10 cases, accounting for 16.3% of the sample, led to fatality. The median procalcitonin values were 1.5 ng/ml in patients diagnosed with microbiologically confirmed infection and 0.6 ng/ml in those diagnosed with clinically suspected infection. Furthermore, it is worth noting that the median procalcitonin value among individuals with fever of unknown origin was found to be 0.6 ng/ml, with statistical significance indicated by a p-value of less than 0.001. The median procalcitonin level was found to be 17.70 ng/ml in instances resulting in mortality, whereas it was 0.56 ng/ml in cases without mortality ($p<0.001$).

Conclusion: We determined that procalcitonin must be routinely used in order to show enfection and mortality in patients with febrile neutropenia. Because procalcitonin is a sufficient and appropriate examination to show infection and mortality so it can be beneficial to decide treatment method, and hospitalization. Procalcitonin may also be more useful in predicting the prognosis of patients with febrile neutropenia.

Keywords: Febrile neutropenia, procalcitonin, oncology, infection, malignancy

INTRODUCTION

In cancer patients, the administration of intense and high-dose chemotherapy treatments can lead to the development of infectious complications that carry significant morbidity and death rates. Consequently, this issue presents itself as a crucial clinical concern. Bacterial and fungal infections are the primary contributors to both morbidity and mortality in individuals within this patient population.[1]

Distinguishing between fevers caused by infection and those caused by non-infectious factors poses a challenge in neutropenic individuals. In many instances, inflammation and infection may manifest with less pronounced clinical indications and symptoms than anticipated. Consequently, fever may serve as the sole discernible indicator of an infection. Determining the underlying cause of a fever may not always be feasible. The etiology of fever in neutropenic individuals is detectable in a mere 30-50% of cases, either through clinical or microbiological means. Conversely, in the other instances, the source of fever remains elusive and cannot be determined.

The timely identification and proper management of infections in individuals with febrile neutropenia are of utmost significance. Nevertheless, the insufficiency of clinical

and microbiological data in these individuals is a significant challenge in the diagnostic methodology.[2-4] The utilization of broad-spectrum empiric anti-bacterial medication has become a customary method for monitoring neutropenic patients with fever due to various justifications. Nevertheless, it is well acknowledged that this approach gives rise to other issues, including the development of resistance, secondary infections, financial implications, and potential toxicity.

Numerous inflammatory indicators have been examined in the assessment of infections in neutropenic individuals; however, their diagnostic utility has been determined to be restricted. The current understanding about the relevance of inflammatory indicators, particularly in the identification of patients at low risk, remains uncertain.[5] The patient population under consideration is characterized by the presence of well-established inflammatory markers, namely C-reactive protein (CRP), interleukin-6 (IL-6), and interleukin-8 (IL-8). The limitations of CRP include its delayed rise and its association with non-infectious inflammatory conditions. Interleukin-6 (IL-6) and Interleukin-8 (IL-8) have been identified as early and highly responsive indicators in severe infections, and have been highlighted as being more effective than C-reactive protein (CRP) in diagnosing febrile neutropenic patients. Nevertheless, it is important to acknowledge that in practical applications, these methods do have certain limitations. Specifically, they are susceptible to the influence of tissue injury, exhibit low levels of specificity, and incur substantial costs.[5] Consequently, there exists a necessity for cost-efficient novel biomarkers that have the potential to be valuable in the timely detection of infections within this specific patient population. These biomarkers should be unaffected by the activity of the underlying disease, accurately reflect the severity of infections, and possess the ability to differentiate between episodes of high and low risk for prognostic purposes.

Procalcitonin (PCT) is a prohormone protein composed of 116 amino acids and is widely recognized as a biomarker for bacterial infections.[6-8] According to reports, the measurement of serum procalcitonin levels has demonstrated potential utility in the timely detection of bacterial infections and in assessing the prognosis of individuals with febrile neutropenia.[9-11] The objective of this study was to assess the correlation between the first procalcitonin level during the commencement of a febrile neutropenia episode and the occurrence of infection and mortality in individuals with solid organ cancer.

METHODS

Ethics

The present investigation adhered to the ethical principles outlined in the 1975 Helsinki Declaration, subsequently revised in 2008. The research project received approval from the Scientific Research Assessment and Ethics Committee of the Antalya Training and Research Hospital, with the assigned approval number 44/26 and the date of approval being 19/06/2014.

Patients

A retrospective analysis was conducted on the clinical and laboratory characteristics of adult cancer patients who experienced febrile neutropenic episodes after undergoing chemotherapy. These patients were admitted to the Medical Oncology Clinic of Antalya Training and Research Hospital and received antibiotic treatment between January 2013 and December 2014. During the initial phase of hospitalization, the procalcitonin level was assessed, a comprehensive medical history was obtained, thorough systemic examinations were conducted, and a minimum of two blood cultures (obtained from different veins with a 30-minute interval), urine cultures, and cultures from relevant sites potentially harboring infection (such as sputum, wound, stool, catheter, etc.) were collected based on the patient's clinical presentation. This study included patients who met the criteria for febrile neutropenia, which included having an absolute neutrophil count of 500/mm^3 or less, or having a single oral body temperature of 38.3^{0}C or 38^{0}C for more than one hour in patients with an absolute neutrophil count of 500/mm^3 or less, or between 500 and 1000/mm^3 with an expected further decrease. Patients with solid organ malignancies and patients with hematologic malignancies who did not meet these criteria were not included in the study.

Treatment and Follow-up

Following the collection of culture samples from our patients, an antipseudomonal beta lactam antibiotic, specifically piperacillin-tazobactam, was administered empirically. This antibiotic was either given alone or in combination with an aminoglycoside, specifically Amikacin 1 g/24 h IV, as per the febrile neutropenia protocol of our clinic. Additionally, patients received 5 gr/6 hours IV of a medication in accordance with our clinic's protocol. Treatment adjustments were made based on the pathogens identified during treatment or in accordance with our protocol for patients experiencing persistent fever. In cases where patients exhibited persistent fever for 5-7 days, antifungals were introduced to the treatment regimen. Antibiotics were discontinued at appropriate times following a decrease in fever and the disappearance of clinical signs of infection.

Ferbile Neutropenia Etiologic Groups

The evaluation of febrile neutropenia events was conducted on three distinct etiologic groups.

1. Microbiologically defined infection (MDI) refers to an infection when the blood culture yields positive results, but no specific clinical source of the infection can be identified. Alternatively, MDI can also encompass cases where the blood culture may be positive or negative, but the causative microorganism is detected in the clinical focus.

2. Clinically defined infection (CDI) refers to a confirmed manifestation of infection that exhibits no growth when subjected to culture analysis.

3. Fever of unknown origin (FUO) refers to a condition in which there is an absence of evidence indicating the presence of a microbiologic or clinical agent or a specific site of infection.

Statistical Analysis

The formation of groups was based on the presence of infection and death, and a statistical comparison was conducted on the collected data. The descriptive statistics were reported in terms of frequency, percentage, mean, and standard deviation (SD) values. The Fisher's exact test, also known as the Pearson chi-square test, was employed to examine the associations among categorical variables. In the examination of the disparity in measurement values between the two groups, the normality assumption was assessed using the Shapiro-Wilk test. The Mann-Whitney U test was employed in cases when the data did not conform to a normal distribution, whereas the Student's t test was utilized when the data did conform to a normal distribution. The study employed

univariate and multivariate logistic regression analysis to examine the independent risk factors that influence prognosis. The findings were presented using Wald statistics, odds ratios, and 95% confidence intervals. Statistical significance was determined by considering p-values that were less than 0.05. The analyses were conducted using the SPSS 18.0 software suite.

Table 1. Participating patients' descriptive statistics

		n	%
Gender	Female	29	47.5
	Male	32	52.5
Age	Median (min.-max.)	58 (18-84)	
Stage	1	3	4.9
	2	9	14.8
	3	15	24.6
	4	34	55.7
Etiologic groups	Microbiologically defined infection	24	39.34
	Clinically defined infection	9	14.75
	Fever of unknown origin	**28**	**45.90**
Clinical Infections	None	39	63.9
	Dental Abscess	1	1.6
	Urinary tract infection	11	18.03
	Pneumonia	9	14.8
	Acute tonsillitis	1	1,6
Blood Culture	No growth	43	70.5
	Positive	18	29.5
Urine Culture	No growth	52	85.3
	Positive	8	13.1
	No sample	1	1.6
Sputum Culture	No growth	51	83.6
	Positive	4	6.6
	No sample	6	9.8
Tissue Culture	No growth	1	1.6
	Positive	1	1.6
	No sample	59	86.8
Diagnosis	Lung*	27	44.2
	Breast	13	21.3
	Testicular	4	6.5
	Colon	3	4.9
	Gastric	2	3.3
	Soft tissue	2	3.3
	Bone	2	3.3
	Brain	2	3.3
	Endometrial	2	3.3
	Others	4	6.55

*Non-small cell:21 Small cell:6

RESULTS

The study comprised a total of 61 participants, with ages ranging from 18 to 84 years (median age: 58). Of these participants, 29 (47.5%) were female and 32 (52.5%) were male. The majority of patients had advanced cancer. The study population exhibited a prevalence of lung cancer, breast cancer, and testicular cancer as the primary malignancies. The majority of patients exhibited clinical or microbiological evidence of infection. A total of 22 patients were identified with a clinical emphasis of infection, with urinary tract infection being the most prevalent. Blood cultures were collected from all patients, and it was found that 18 patients (29.5%) had growth in the culture. Additional descriptive characteristics of the study population can be found in Table 1. Among the agents cultivated in blood culture, 9 (50%) were identified as gram-positive, while the remaining 9 (50%) were classified as gram-negative. In urine culture, 6 (75%) of the agents were gram-negative, whilst 2 (25%) were gram-positive. Similarly, in sputum culture, 2 (50%) of the agents were gram-positive, while the other 2 (50%) were gram-negative. *Candida albicans* was identified in one of the two tissue culture samples, while the other sample exhibited no observable growth. The predominant pathogen identified in blood cultures was *Staphylococcus hominis*, while *Escherichia coli* was the most often isolated pathogen in urine cultures. Table 2 presents a comprehensive overview of the statistical data pertaining to the agents that were cultivated within the culture samples. After the administration of antibiotics, it was observed that the median length of fever was 1 day, while the median duration of neutropenia was 4 days. Furthermore, it was found that neutropenia persisted for a period of 10 days or more in only 3 instances. A mortality rate of 16.3% was observed among 10 individuals (Table 3).

Table 2. Growth results of the cultures taken

Blood culture results			
		n	**%**
Gram (+) bacteria	*Staphylococcus hominis*	5	8.2
	Staphylococcus aureus	2	3.3
	Staphylococcus epidermidis	1	1.6
	Staphylococcus warneri	1	1.6
Gram (-) bacteria	*Escherichia coli*	3	4.9
	Klebsiella peumonia	3	4.9
	Pseudomonas aeruginosa	2	3.3
	Salmonella	1	1.6
No growth		43	70.5
Urine culture results			
		n	**%**
Gram (+) Bacteria	*Staphylococcus haemolyticus*	1	1.7
	Streptococcus spp.	1	1.7
Gram (-) bacteria	*Escherichia coli*	4	6.7
	Pseudomonas aeruginosa	2	3.3
No growth		52	86.6
Sputum culture results			
		n	**%**
Gram (+) bacteria	*Staphylococcus aureus*	1	1.8
	Coagulase (-) Staphylococcus	1	1.8
Gram (-) bacteria	*Escherichia coli*	1	1.8
	Pseudomonas aeruginosa	**1**	**1.8**
No growth		**51**	**92.7**

Table 3. Several characteristics of febrile neutropenic episodes	
	n:61
Fever (°C) * [a]	38.4
Hypotension (SBP<90 mmHg) *	6(9.8%)
Pulse(beats/min) [a]	94
Neutrophil (/mm³) * [a]	200
Platelets (x1000/mm³) * [a]	93
Hemoglobin (g/dl) * [a]	9.5
Elevated liver enzymes (ALT>50 U/L) *	5(8.2%)
Renal dysfunction (GFR<60 ml/min.) *	11(18%)
Duration of fever[a fi] (day)	1
Duration of neutropenia[a fi] (day)	4
Mortality count	10(16.3%)
CRP (mg/dl)	160
ESH (mm/h)	70

*: Values monitored at the time of admission, [a]: Median, [fi]: Patients other than those who died without fever and/or recovery from neutropenia, SBP: systolic blood pressure, ALT: alanine aminotransferase, GFR: glomerular filtration rate, CRP: c-reactive protein

The study examined many factors including age, procalcitonin levels, neutrophil count, C-reactive protein levels, sedimentation rate, hemoglobin levels, blood urea nitrogen levels, creatinine levels, aspartate aminotransferase levels, alanine aminotransferase levels, presence of fever, duration of fever, and duration of neutropenia (excluding exitus) in three distinct groups: FUO, CDI, and MDI. Based on the conducted tests, it was seen that there was a significant difference between at least one group and the other group, as shown by the PRC (p=0.022) and CRP (p=0.012) values. Based on the results of the pairwise comparisons, it was determined that the observed differency can be attributed to FUO and MDI. The study observed that patients with microbiologically confirmed illnesses exhibited elevated levels of procalcitonin and C-reactive protein (p<0.05) as seen in Table 4.

A substantial statistical difference was observed in the procalcitonin levels between patients who were discharged and those who died. The study found that patients with procalcitonin levels exceeding 2 had a mortality rate of 47.1%, which was significantly higher compared to individuals with levels below 2, who had a mortality rate of 4.5% (p<0.001). Furthermore, upon analyzing the numerical value of procalcitonin, it was revealed that individuals who were ex had a significantly greater median value (p<0.001). The mortality rate among patients with clinically defined infection was 11.1%, while the mortality rate among those without clinically defined infection (FUO+MDI) was 17.3%. However, statistical analysis revealed that this difference was not statistically significant (p=0.999). The mortality rate among patients diagnosed with a microbiologically identified infection was found to be 29.2%, whereas the mortality rate for patients without a microbiologically characterized infection (FUO+CDI) was 8.1%. The observed disparity between the two percentages exhibited statistical significance, as evidenced by a p-value of 0.04. There was no statistically significant difference observed in the prognoses of patients with fever of unknown cause compared to those without fever of unknown cause (MDI+CDI) (p=0.092) (Table 5).

Table 5. Analysis of variables making a difference according to prognosis						
		Alive		Dead		
		n	%	n	%	p
Gender	Female	24	82.8	5	17.2	
	Male	27	84.4	5	15.6	
PRC group	≤2	42	95.5	2	4.5	**<0.001**
	>2	9	52.9	8	47.1	
PRC median (min-max)		0.56 (0.04-100)		17.70 (1.47-100)		**<0.001**
Neutrophil grup	≤100	24	80.0	6	20.0	0.508
	101-500	24	92.3	2	7.7	
	>500	3	60.0	2	40.0	
CDI	No	43	82.7	9	17.3	0.999
	Yes	8	88.9	1	11.1	
MDI	No	34	91.9	3	8.1	**0.040**
	Yes	17	70.8	7	29.2	
FUO	No	25	75.8	8	24.2	0.092
	Yes	26	92.9	2	7.1	

PRC: procalcitonin, CDI: clinically defined infection, MDI: Microbiologically defined infection, FUO: fever of unknown origin

Table 4. Analysis of the differences of infection groups according to numerical variables*							
	FUO	CDI	MDI	p	p^{1-2}	p^{1-3}	p^{2-3}
Age (year)	55 (18-84)	52 (25-70)	58.5 (21-75)	0.346			
PRC (µg/L)	0.4 (0.1-32.8)	0.6 (0.0-89.1)	1.5 (0.1-100)	0.022	0.392	0.020	0.999
Neutrophil (/mm³)	200 (0-1000)	300 (0-700)	100 (0-900)	0.308			
CRP (mg/dl)	97.5 (15-350)	132 (43-376)	196.5 (40-398)	0.012	0.262	0.011	0.999
ESH (mm/h)	56 (32-98)	70 (70-140)	84 (30-150)	0.200			
Hemoglobin (g/dL)	9.6 (5.9-13.3)	9 (8.4-11.1)	9.3 (5.4-13.8)	0.979			
BUN (mg/dL)	16.5 (4-37)	13 (2-54)	25 (7-137)	0.058			
sCrea (mg/dl)	0.8 (0.5-2.4)	0.9 (0.5-2)	1 (0.6-9.2)	0.310			
AST (U/L)	16 (10-337)	15 (8-29)	17 (7-163)	0.490			
ALT (U/L)	16 (2-219)	12 (4-43)	14.5 (6-76)	0.661			
Fever (°C)	38.4 (38.1-39.5)	38.6 (38.2-39.5)	38.4 (38-39.6)	0.257			
Fever duration (day)	1 (1-4)	1 (1-2)	1 (1-4)	0.845			
Neutropenia duration (day)	4 (1-13)	3 (2-7)	4 (2-21)	0.191			

*Median (minimum-maximum), FUO: fever of unknown origin, CDI: clinically defined infection, MDI: Microbiologically defined infection, PRC: procalcitonin, CRP: C-reactive protein, ESH: eritrocyte sedimentation rate, Sed.: sedimentation, BUN: blood urea nitrogen, sCrea: serum kreatinin, AST: aspartate aminotransferase, ALT: alanine aminotransferase

Table 6. Univariate and multivariate analysis of whether procalcitonin levels and groups are independent risk factors in predicting prognosis

	Univariate analysis					Multivariate analysis				
	Wald	p	OR	95% C.I.		Wald	p	OR	95% C.I	
				Lower	Upper				Lower	Upper
PRC	8.166	**0.004***	1.034	1.010	1.057	2.108	0.147	1.030	**0.990**	**1.071**
PRC groups (>2/≤2)	11.272	**0.001***	18.667	3.381	103.060	6.949	**0.008***	21.460	2.195	209.773

PRC: procalcitonin, OR: odds ratio

There was no statistically significant difference observed in the procalcitonin readings between patients with (CDI) and without (MDI+FUO) clinically diagnosed infection (p=0.611). The procalcitonin values of patients diagnosed with microbiologically characterized infection (MDI) were found to be significantly higher compared to individuals without microbiologically confirmed infection (FUO+CDI) (p=0.006). Patients who presented with a fever of unclear origin exhibited significantly lower levels of procalcitonin compared to patients who did not have a fever of unknown origin (MDI+CDI) (p=0.021).

The evaluation of whether procalcitonin level serves as an independent risk factor for predicting prognosis was initially conducted by univariate analysis, which revealed a significant association with prognosis (p<0.05). The multivariate logistic regression model did not provide support for this finding. The study found that patients with a procalcitonin value above 2 had a significantly greater death probability compared to individuals with a procalcitonin value less than or equal to 2, with a relative risk of 21.46 (95% CI 2.19–209.77) (Table 6).

The locations exhibiting the greatest sensitivity and selectivity values were identified by the utilization of receiver operating characteristic (ROC) analysis, which assessed the diagnostic efficacy of procalcitonin in determining prognosis. When a threshold value of 1.44 was used for the PRC, the sensitivity and selectivity were determined to be 100% and 78.43%, respectively. Additionally, the area under the curve (AUC) was calculated to be 0.931, indicating statistical significance (Figure).

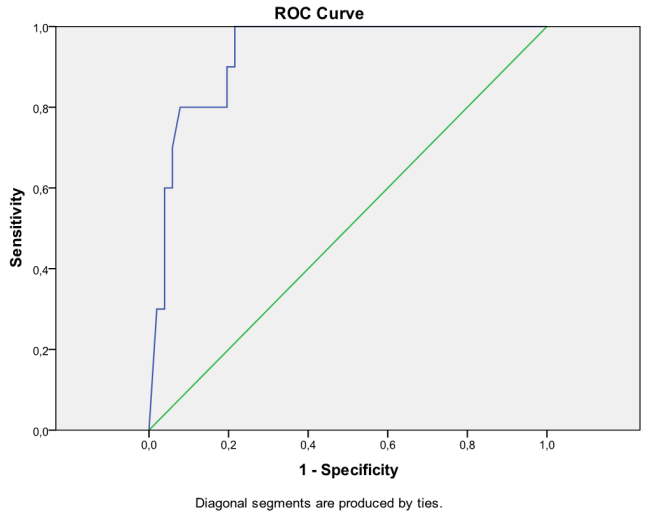

Figure. ROC curve for a cut off value of 1,44 for procalcitonin

DISCUSSION

In contemporary medical practice, the administration of high doses of chemotherapy in cancer treatment has been observed to induce immunosuppression, particularly neutropenia. Consequently, patients undergoing such treatment are rendered susceptible to the development of severe and unusual infections. Bacterial and fungal infections are identified as the primary factors contributing to morbidity and mortality in patients of this nature.[1] Due to the potential for rapid progression and high death rates associated with infection in neutropenic patients, it is imperative to promptly conduct clinical and microbiological assessments in these individuals presenting with fever. Consequently, initiating empirical antibiotic therapy without delay is crucial.[1,12,13] In the case of these individuals, distinguishing between a severe infection and the etiology of fever is frequently challenging. Inflammation and infection often manifest with less conspicuous clinical indications and symptoms than anticipated, with fever frequently serving as the sole indicator of infection in the majority of instances. Hence, there has been a demand for expedient and straightforward markers that can detect the existence of infection, aid in excluding infection, and forecast the prognosis of infected individuals. Consequently, investigations have been undertaken to address this matter.

The assessment of patient prognosis during and after episodes of febrile neutropenia has emerged as a significant focal point in recent years. In order to achieve this objective, it has been feasible to categorize individuals into two distinct groups: high risk and low risk. This classification is accomplished by taking into account a range of characteristics, such as the Multinational Association for Supportive Care in Cancer (MASCC) guidelines. Furthermore, multiple laboratory markers have demonstrated their utility in assessing the presence of infection and predicting the prognosis of these patients. The utilization of procalcitonin as a diagnostic marker for infection remains limited in the context of febrile neutropenia patients, despite its recent emergence as a potential indicator. In contrast to cytokines such as tumor necrosis factor (TNF) and IL-6, the levels of procalcitonin exhibit elevation specifically in cases of bacterial and fungal infections, while remaining unaffected in instances of other forms of inflammation, including viral infections, organ transplant rejection, and autoimmune illnesses.[14-16] Persson et al.[17] shown that the assessment of plasma procalcitonin and IL-6 levels in individuals with febrile neutropenia has the potential to provide valuable guidance for treatment decisions. Previous studies have demonstrated that this test exhibits a high degree of sensitivity and specificity when distinguishing between bacterial and fungal infections. Additionally, it has been established as a prompt and reliable method for distinguishing early invasive bacterial infections in pediatric emergency cases.[16,18] Indeed, it was discovered that its ability to predict infectious etiology in sepsis was superior to that of CRP and IL-6.[19] The findings of this study indicate that serum procalcitonin levels were substantially higher than C-reactive protein (CRP) levels (p=0.008) in febrile neutropenic adult patients with severe illness. The mean procalcitonin value was 118. In a separate comparative investigation, the efficacy of procalcitonin was

assessed in relation to other biomarkers including CRP, IL-6, IL-8, soluble TNF receptor II, and soluble IL-2 receptor levels among pediatric cancer patients. The findings of this study indicated that procalcitonin exhibited greater utility as an indicator of infection in febrile neutropenic patients compared to the aforementioned parameters.[20] Secmeer et al.[21] conducted a study wherein they examined 60 instances of febrile neutropenia. Their findings suggested that both C-reactive protein (CRP) and procalcitonin levels could serve as indicators of the infection's severity. However, procalcitonin was deemed more suitable for determining the initial course of treatment due to its earlier elevation compared to CRP. A further investigation examining the relationship between procalcitonin and CRP revealed that serum procalcitonin exhibited superior performance in detecting febrile neutropenia episodes and demonstrated a higher positive predictive value compared to CRP. In contrast, it was observed that CRP had superior efficacy in identifying such attacks, as well as a larger negative predictive value in comparison to procalcitonin.[22]

The diagnostic utility of procalcitonin in individuals with febrile neutropenia has been met with skepticism due to the potential release of procalcitonin from leukocytes. However, recent studies have demonstrated that procalcitonin synthesis and release can occur in cases of immunosuppression and leukopenia, provided there is adequate stimulation.[6,11,23] Moreover, elevated levels of procalcitonin have been observed in neutropenic patients during the initial phases of infection.[14,24,25] In a study conducted by Ruokonen et al.,[14] it was noted that there was a rapid increase in procalcitonin levels within a span of 8 hours following the initiation of fever. In the present investigation, it was observed that the procalcitonin levels of 37 patients upon admission to the hospital exceeded the established normal threshold of 0.5 ng/ml.

Elevated levels of procalcitonin have been found to be correlated with the severity of infection, making it a potential biomarker for monitoring patients with severe infections, sepsis, and multiple organ dysfunction syndrome (MODS).[6,26-30] Due to the aforementioned factors, procalcitonin has been well acknowledged as a dependable indicator in distinguishing between bacterial and non-bacterial inflammation.[7,28,30] In the conducted investigation, it was shown that individuals with a procalcitonin (PCT) level greater than 2 ng/ml exhibited a notably elevated incidence of bacterial growth in both blood and urine cultures, in contrast to patients with a PCT level equal to or less than 2 ng/ml. Furthermore, in accordance with our findings, previous research has also observed considerably elevated procalcitonin levels in febrile neutropenic patients with confirmed infection when compared to the group without bacterial infection.[9,20,25]

Evidence exists indicating a correlation between the specific bacteria responsible for infection and the levels of procalcitonin in individuals experiencing febrile neutropenia. According to the available reports, there is a notable elevation in procalcitonin levels in cases of bacteremia attributed to gram-negative bacteria.[9,11,14,20,24] Nevertheless, our study did not yield any statistically significant disparity when comparing procalcitonin levels between the gram-positive and gram-negative groups based on the microorganism type (p=0.95). This lack of significance may be attributed to the limitations of our measuring device, which reported procalcitonin values exceeding 100 ng/ml as ">100 ng/ml" and subsequently treated them as 100 ng/ml in our study.

Evidence indicates that there exists a correlation between the severity of infections in neutropenic patients and serum procalcitonin levels, comparable to those with intact immune systems.[20,23,24,26] In the present investigation, it was shown that the levels of procalcitonin exhibited a statistically significant increase in the cohort characterized by microbiologically confirmed illnesses (p=0.022). Additionally, a statistically significant elevation in mortality rates was seen within the aforementioned patient group (p=0.40). The findings of this study provided evidence to support the notion that there exists a correlation between serum procalcitonin levels and the degree of infection severity in neutropenic individuals. Moreover, it was suggested that measuring serum procalcitonin levels could serve as a valuable tool in diagnosing severe infections and assessing the prognosis of patients within this specific population.

The present study is subject to certain limitations, including its retrospective design, its execution within a singular institution, and its inclusion of a limited patient cohort.

CONCLUSION

Elevated blood procalcitonin levels were seen in 37 (60.6%) febrile neutropenic individuals upon admission. The observed increase in procalcitonin levels was determined to be notably greater in cases of MDI or CDI compared to cases of FUO. This finding suggests that procalcitonin could potentially serve as a valuable tool for promptly diagnosing known illnesses. The data indicates that there was a notable increase in mortality rates in episodes when procalcitonin levels above 2 ng/ml, so supporting the notion that elevated procalcitonin levels may be indicative of an unfavorable prognosis. Based on a comprehensive analysis of our study findings and existing literature, it is evident that the frequent utilization of procalcitonin as a significant parameter is warranted for the purpose of indicating infection and mortality rates among patients afflicted with febrile neutropenia. The inclusion of infection and mortality data in the assessment can greatly facilitate the determination of appropriate treatment modality, namely the decision between outpatient or inpatient care upon hospital admission.

ETHICAL DECLARATIONS

Ethics Committee Approval: Antalya Training and Research Hospital Scientific Research Assessment and Ethics Committee (Date: 19/06/2014, Approval No: 44/26).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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