Interrelationship between PCT Levels and SOFA Score in Sepsis Patients – A Hospital based Study

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ABSTRACT

Introduction: Sepsis can be a result of any class of microorganisms. Microbial invasion of bloodstream is not essential, since local inflammation can also elicit distant organ dysfunction and hypotension.Procalcitonin the biologically active precursor of the calcium-modulating hormone calcitonin, has been shown in diverse studies to be closely associated with the human host response to bacterial infection.The sepsis-related organ failure assessment (SOFA) score is an evaluation system of multiple organ dysfunctions. Six organ systems are evaluated on a scale of 1–4 each.The aim of present study is to study the interrelationship between the SOFA score and PCT levels amongst the patients with sepsis.

Material and methods: The present prospective hospital based study was conducted for a period of 1 year from January 2013 to February 2014. In this study a total of 102 patients were enrolled. Complete demographic details were obtained from all the patients including age, sex, occupation and socioeconomic status. Any past or family history of diabetes, hypertension or asthma was recorded. Complete general examination of the patient with systemic evaluation was noted and tabulated. Blood and other secretions of the body were tested. VIDAS (ELFA) test was used for estimation of procalcitonin. Procalcitonin levels of greater than 10 ng/ml were regarded as severe sepsis. The sepsis-related organ failure assessment (SOFA) score is an evaluation system of multiple organ dysfunctions. Six organ systems (Respiration PaO2/FiO2, Coagulation, Liver, Renal, cardiovascular, central nervous system) were evaluated as a scale of 1–4 each. The arithmetical sum of these six parameter is the value of the SOFA score.All the data was statistically analysed using SPSS software. A p value of less than 0.05 was considered statistically significant

Result: In this study a total of 102 patients were enrolled who satisfied the inclusion criteria. Majority of the patients were in the age group of 51-60 years (26.5%) followed by the age group of 61-70 years (25.5%).The male to female ratio was 2.18:1.The Mean value of SOFA Score in sepsis group was 5.54, in severe sepsis were 8.81 and in septic shock was 9.7, which is significant suggesting that the SOFA Score in severe sepsis and septic shock is significantly higher as compared to the group of patients with sepsis. There were 11 patients with less than 0.5ng/ml of procalcitonin level whose mean SOFA score was 2. 15 patients of moderate SIRS showed a mean SOFA score of 5.6.

Conclusion: The mean SOFA scores in the sepsis, severe sepsis and septic shock groups were 5.54, 8.8 and 9.7 respectively. Mean SOFA scores in the normal PCT level group, moderate SIRS, in the severe SIRS group, in the severe bacterial SIRS group was 2, 5.6, 7, 10 respectively

Keywords: Bacterial, Microbial, Procalcitonin, Prospective, sepsis

INTRODUCTION

Sepsis is defined as the presence of two SIRS criteria in association with clinical evidence of infection. Severe sepsis is defined as the presence of sepsis and organ dysfunction, and septic shock was defined as sepsis and hypotension. Sepsis can be a result of any class of microorganisms. Microbial invasion of bloodstream is not essential, since local inflammation can also elicit distant organ dysfunction and hypotension. In fact, blood cultures yield bacteria or fungi in only 20%-40% of cases of severe sepsis and 40%-70% of cases of septic shock.[1] Patients with systemic infection and organ dysfunction or shock are often difficult to distinguish from patients with similar clinical signs and laboratory finding, but without infection. The established biological markers of inflammation (leukocytes, C-reactive protein) may often be influenced by parameters other than infection and may only be slowly released during progression of an infection. Positive bacteriological results may be caused by contamination and negative results do not exclude sepsis. Since these common clinical and laboratory measurements lack sensitivity and specificity, other tests are needed to give an early marker of the infectious cause of a generalized inflammatory response to allow early diagnosis and for the use of specific treatment.[2]

Procalcitonin the biologically active precursor of the calcium-modulating hormone calcitonin, has been shown in diverse studies to be closely associated with the human host response to bacterial infection. In 1999 Michael Meisner et al conducted a study in which comparison of procalcitonin (PCT) and C-reactive protein (CRP) plasma concentrations at different sepsis-related organ failure assessment (SOFA) score was done. Forty patients of an anesthesia and surgery intensive care unit in a tertiary care institute were included in the study when SIRS or sepsis criteria according to the ACCP/SCCM definition were fulfilled for a period no longer than 24 hours. In this study PCT, CRP, SOFA score and APACHE II score were determined daily on observation day 1 to 5 and on days 8 and 15. Patients were kept on follow up for 28 days and were then assigned to survivors and non-survivors. Fourteen patients had a lethal outcome. Higher PCT concentrations were associated with severity of multiple organ dysfunction syndrome (MODS) as assessed by SOFA score.[3] The sepsis-related organ failure assessment (SOFA) score is an evaluation system of multiple organ dysfunctions.

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Score points	1	2	3	4
1. Respiration PaO2/FiO2	<400	<300	<200 with respiratory support	<100 with respiratory support
2. Coagulation Platelets (×10/mm³)	<150	<100	<50	<25
3. Liver Bilirubin(mg/dl)	1.2–1.9	2.0–5.9	6.0–11.9	>12.0
4. Cardiovascular Hypotension (mm Hg)	MAP <70mmHg	Dopamine or dobutamine in any dose	Dopamine>5 or epinephrine 0.1 (µg/ml) or norepinephrine 0.1 (µg/ml)	Dopamine >15, epinephrine > 0.1 (µg/ml) or norepinephrine >0.1 (µg/ml)
5. Central nervous system Glasgow Coma Scale	13–14	10–12	6–9	<6
6. Renal Creatinine (mg/dl) or urine output	1.2–1.9	2.0–3.4	3.5–4.9 or <500 ml/24 h	>5.0 or <200 ml/24 h

Table-1: SOFA score

Age (yrs) (Decade wise)	Number	Percentage (%)
10-20	5	4.9
21-30	9	8.8
31-40	5	4.9
41-50	23	22.5
51-60	27	26.5
61-70	26	25.5
71-80	6	5.9
More than 80	1	1.0
Total	102	100.0

Table-2: Age wise distribution of patients

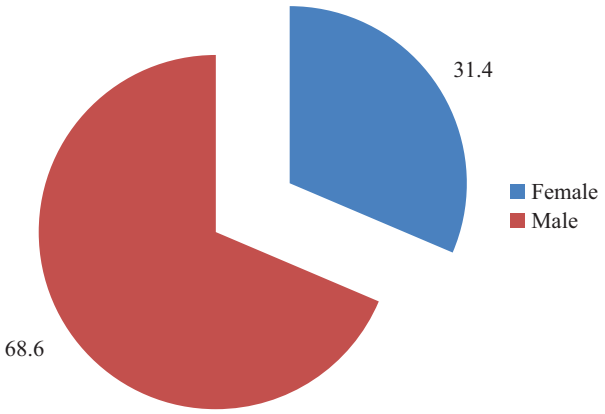

Figure-1: Gender wise distribution of patients.

Six organ systems are evaluated on a scale of 1–4 each. The arithmetical sum of these six is the value of the SOFA score. The aim of present study is to study the interrelationship between the SOFA score and PCT levels amongst the patients with sepsis.

MATERIAL AND METHODS

The present prospective hospital based study was conducted for a period of 1 year from January 2013 to February 2014. In this study a total of 102 patients were enrolled. The study was conducted in the Department of Microbiology and Department of Medicine, Dayanand Medical College and Hospital Ludhiana. Ethical committee clearance was obtained from the institute and all the patients were informed about the study and a written consent was obtained from all.

Complete demographic details were obtained from all the patients including age, sex, occupation and socioeconomic status. Any past or family history of diabetes, hypertension or asthma was recorded. Complete general examination of the patient with systemic evaluation was noted and tabulated. Blood and other secretions of the body were tested. Approximately 10 ml of blood was obtained aseptically and used for estimation of complete blood count and blood culture. Liver and kidney function tests were performed. Patient's sputum was collected in sterile containers and examined. Clean catch mid stream urine samples were send if patient was self voiding or after clamping the Foleys catheter, if patient was catheterized. The samples were processed according to the standard procedures.

VIDAS (ELFA) test was used for estimation of procalcitonin. Procalcitonin levels of greater than 10 ng/ml were regarded as severe sepsis. The sepsis-related organ failure assessment (SOFA) score is an evaluation system of multiple organ dysfunctions. Six organ systems (Respiration PaO2/FiO2, Coagulation, Liver, Renal, cardiovascular, central nervous system) were evaluated as a scale of 1–4 each. The arithmetical sum of these six parameter is the value of the SOFA score. Table 1 shows the SOFA score calculator. Patients were followed up for a period of 4 weeks and their SOFA score was also estimated at the time of discharge.

STATISTICAL ANALYSIS

All the data was statistically analysed using SPSS software. A p value of less than 0.05 was considered statistically significant. Mean of SOFA score was calculated for each patient and compared.

RESULTS

In this study a total of 102 patients were enrolled who satisfied the inclusion criteria.

Table 2 shows the age wise distribution of patients. Majority of the patients were in the age group of 51-60 years (26.5%) followed by the age group of 61-70 years (25.5%). The minimum age of a patient in our study was 18 years whereas the maximum age of a patient was 83 years. Only 1 patient was aged more than 80 years.

Figure 1 shows the gender distribution of the patients. Out of the total number of patients, there were 70 (68.6%) males and 32 (31.4%) females.The male to female ratio was 2.18:1.

Table 3 shows the Mean value of sepsis related organ failure assessment (SOFA) score was calculated in each group of sepsis. The Mean value of SOFA Score in sepsis group was

5.54, in severe sepsis were 8.81 and in septic shock was 9.7, which is significant suggesting that the SOFA Score in severe sepsis and septic shock is significantly higher as compared to the group of patients with sepsis.

Table 4 shows Mean value of SOFA score was calculated in each group divided according to PCT levels. There were 11 patients with less than 0.5ng/ml of procalcitonin level whose mean SOFA score was 2. 15 patients of moderate SIRS showed a mean SOFA score of 5.6. There were 45 patients of severe SIRS who presented with a mean score of 10. Therefore, as the levels of PCT increases, the SOFA SCORE (mean) also increased correspondingly.

Table 5 shows mean value of SOFA score patients at 4 weeks of followup after discharge. In our study mean SOFA score in expiredpatients was 9.2 and in alive patients were 6.5, suggesting SOFA score can also be used as prognostic marker.

PCT ng/ml	Number	Sofa score mean
Normal (<0.5)	11	2
Moderate SIRS (≥0.5 to < 2.0)	15	5.6
Severe SIRS (≥2 to <10)	31	7
Severe Bacterial SIRS (≥ 10)	45	10
Total	102	24.6

Table-4: Mean value of sofa score in each group (divided according to PCT value).

	Sofa (mean)
Death	9.2
Alive	6.5

Table-5: Mean value of sofa score patients at 4 weeks of followup after discharge.

Sofa score	Number	Mean
Sepsis	39	5.54
Severe Sepsis	43	8.81
Septic Shock	20	9.70
Total	102	24.05

Table-3: Mean value of sofa score in each group.

DISCUSSION

Levels of procalcitonin play a critical role in sepsis detection. Procalcitonin (PCT) covers the features better as compared to other, more commonly used biomarkers, and thus, the current hype on PCT has a solid scientific basis. A superior diagnostic accuracy of PCT has been shown for a variety of infections, e.g. respiratory tract infections, meningitis, acute infectious endocarditis and pancreatitis. Importantly, a PCT based therapeutic strategy can safely and markedly reduce antibiotic usage in lower respiratory tract infections, the major cause of sepsis. Being a hormokine mediator, immune neutralization of PCT might offer new hope for more effective treatment options in sepsis. Calcitonin is produced by the thyroid C-cells and has an important role in calcium homeostasis.[7] The first mention of Procalcitonin in sepsis appeared in the report of 1983 mentioning its elevated levels in toxic shock syndrome (TSS) caused by staphylococcal aureus.[4] However, it was Assicot et al who in 1993 first described PCT as a new marker for infection.[5] The diagnostic accuracy of PCT is better than C reactive protein or interleukin 6.[6,7] But the diagnostic value of IL 6 is higner than PCT incases of acute infections, incases of chronic infections PCT remains a highlt specific marker.[8] In a study conducted by Schuetz P et al, the predictive value of PCT decreases during first 72 hours in ICU. This was in contrast to a study conducted by Y Matsumura et al in which they reported that PCT levels at discharge predict mortality.

Assicot et al published data in 1993 demonstrating high levels of procalcitonin in children with severe bacterial infections in contrast with those who had absent, localized or viral infections.[5] Levels were shown to decrease with antibiotic therapy. Following the initial work by Assicot group, other published data supported the notion that serum procalcitonin levels were dramatically elevated in patients with bacterial[9,10] and malarial infection.[11]

According to the results of this study, majority of the patients enrolled in this study are aged between 51-60 years of age. The mean age of male patients was 52.8 years And that of female patients was 53.7 years. This shows that sepsis most commonly occurs in the older agegroup in present study. In a study conducted by Sudhir U et al, majority of the patients were aged between 50 to 59 years.[2] In a study conducted by Meynaar IA, the mean age of patients with sepsis was 65 and those with SIRS were about 62 years.[12] In this study there was a higher percent of male population that was affected as compared to female population. In a study conducted by Todi et al in 12 centres in India also showed male predominance in sepsis.[13] In another similar study conducted by Sinha et al, the male to female ratio was similar to that of our study. Their study showed a male: female of 2.3:1.[14]

In our study SOFA score was calculated in all patients divided according to sepsis and PCT levels. The mean SOFA scores in the sepsis, severe sepsis and septic shock groups were 5.54, 8.8 and 9.7 respectively. Similarly the mean SOFA scores in the normal PCT level group, moderate SIRS, in the severe SIRS group, in the severe bacterial SIRS group was 2, 5.6, 7, 10 respectively. It was found that higher SOFA score levels were associated with significantly higher serum PCT plasma concentrations. Similar results have been found in various studies worldwide.[15-17]

CONCLUSION

Procalcitonin levels are directly related not only to the severity of sepsis but also to the outcome at time of discharge and at 4 weeks of follow up. Hence it may be concluded that PCT levels have a high sensitivity and specificity for diagnosing severity of sepsis and also an accurate prognostic marker in this setting.The mean SOFA scores in the sepsis, severe sepsis and septic shock groups were 5.54, 8.8 and 9.7 respectively.Mean SOFA scores in the normal PCT level group, moderate SIRS, in the severe SIRS group, in the severe bacterial SIRS group was 2, 5.6, 7, 10 respectively.

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