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Research Article

EVALUATION OF SERUM PROCALCITONIN LEVELS ON THE BASIS OF SEVERITY OF SEPSIS

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A B S T R A C T

Introduction: Sepsis and its complications are leading causes of mortality. It is becoming an often complication in hospitalized patients. Timely diagnoses and management is very important to reduce incidence of morbidity and mortality. Serum Procalciton in (PCT) levels are elevated in patients with bacterial infections and reported as useful biochemical marker. PCT can be a more accurate diagnostic parameter and reliable marker for sepsis and a better predictor of mortality.
Aim: To evaluate the level of Serum PCT in patients diagnosed for sepsis.
Material & Method: Total 75 subjects enrolled for the study were categorised on the basis of severity among three groups, Sepsis (n=25), Severe Sepsis (n=25) and Septic Shock (n=25). Serum PCT levels and other parameters were estimated for all enrolled subjects according to inclusion criteria. The results obtained were presented as mean ± SD and subjected to statistical evaluation. A p-value of ≤0.05 was considered statistically significant.
Result: Mean levels of PCT were found to be significantly increased in sepsis, severe sepsis and septic shock patients with p-value 0.0005.
Conclusion: The study suggests a strong correlation between severity of sepsis and PCT. The study further recommends evaluation of association of sepsis cause with the above markers.

INTRODUCTION

Sepsis is a life-threatening illness that occurs when a host's response to infection damages its own tissues and organs (Liu D *et al*., 2015). Accurate identification of sepsis is amajor challenge. Sepsis is a systemic immune response to microbial infections. It is defined as the presence (potential or documented) of an infection with systemic symptoms of the infection. The most common primary source of infection leading to sepsis is the lung, which account for about half of all cases, followed by the abdominal and urinary tract. Exact origin cannot be found & its severity is linked to mortality (Munford Robert S *et al*., 2014 and Dunja M *et al*., 2017).

During sepsis, microorganisms enter the bloodstream, multiply locally and directly, releasing various virulence factors into the blood (Livorsi DJ *et al*., 2011). These products can stimulate the release of endogenous sepsis mediators from endothelial cells, monocytes, macrophage, neutrophils and plasma cell precursor (Willey J *et al*., 2011).

Various mechanisms are thereby which immune cells secrete inflammatory proteins and damage host tissues and organs (Rimmelé T *et al*., 2016).

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Clinical symptoms of sepsis include tachycardia, tachypnea, fever, leucocytosis, etc. Usually severe sepsis is accompanied with hypoperfusion or dysfunction of at least one agency. Sepsis associated with multi-organ dysfunction syndrome (MODS) or hypotension is called septic shock. (Reinhart K *et al*., 2010)

PCT has been suggested as a more specific and broader prognostic marker. PCT is a precursor of the hormone calcitonin, physiologically synthesized by neuroendocrine cells (C cells in thyroid, lung, and pancreatic tissue) and enzymatically cleaved to calcitonin (immature), katacalcin, and the N-terminal region. Blood concentrations in healthy subjects contain very low amounts of PCT (<0.1 ng/ml in normal physiological conditions, PCT levels are low (< 0.5 ng/ml) (Becker KL *et al*., 2004).However, through a bacterial infection and systemic inflammatory response syndrome (SIRS), PCT is synthesized in various extra-thyroidal tissues increasing by 100,000fold due to the release of pro-inflammatory cytokines stimulated by the presence of bacterial toxins PCT is detectable within 2-4 hours of activation and peaks within12-24 hours. After reaching peak levels, circulating procalciton in concentrations decrease with a plasma clearance of 50% in approximately 11⁄2 days (Meisner M *et al*., 2014).

During sepsis, many tissues and immune cells can secrete PCT. The enhanced specificity of PCT and the publication of numerous clinical and interventional studies have contributed to the growing interest and implementation of PCT in the emergency room as a biomarker of host systemic response to invasion bacteria (Freund Y *et al*., 2012). Recently, PCT-based diagnosis of sepsis has been shown to be more discriminating than clinical sepsis diagnosis (Hur M *et al*., 2014).Therefore, PCT may be a good biomarker for accurately identifying patients with sepsis in the emergency room and with adverse outcomes. Interpretation of PCT concentration is shown in table no.1.

Table 1 Interpretation of PCT concentration. (Meisner M. 2014)

PCT (µg/L)	Interpretation
<0.05	Healthy adult
0.05-<0.5	Systemic infection is unlikely although localized infection is possible
0.5-<2.0	Systemic infection is possible but other conditions (e.g. major trauma, recent surgery, severe cardiogenic shock) may also induce significant PCT rises.
2.0-<10.0	Systemic infection is likely
≥10.0	High likelihood of severe bacterial sepsis or septic shock

The present study was therefore, planned to evaluate the role of serum Pro-calcitonin levels in sepsis, severe sepsis and septic shock patients and to compare the prognostic ability of PCT as a biomarker.

MATERIAL & METHOD

The study was conducted in the Department of Biochemistry in Mahatma Gandhi Medical College & Hospital. This study was conducted after approval by the Organizational Ethics Committee (IEC). Total 75 Patients diagnosed for SEPSIS, visiting the Inpatient Department (IPD) of General Medicine fulfilling the inclusion criteria were enrolled for the study. Informed consent was obtained before the patient was included in the study.

Patients enrolled in the study were between15- 65 years, either gender, Patients diagnosed with sepsis, Patients who participated willingly and signed consent document.

Patients who were excluded from the study were with co-morbidities of severe liver dysfunction, patients with cardio and cerebro-vascular disease, blood system disease, patients with renal replacement therapy, malignant tumor, diabetes, pregnant and lactating women.

Blood samples for all subjects were collected using standard aseptic technique and analysed for Serum PCT by ELFA (Enzyme-Linked Fluorescent Assay) technique using Vitros 5600 Dry Chemistry Analyzer. Total 75 subjects enrolled for the study were grouped on the basis of severity among Sepsis (n=25), Severe Sepsis (n=25) and Septic Shock (n=25). The results obtained during the study were presented as mean ± SD. The result of various parameters in above sub-group was assessed by applying One-way ANOVA. For all statistical evaluation P-value ≤0.05 was considerable as statically significant.

RESULT

Total 75 patients clinically diagnosed for sepsis were enrolled in the study. The study population was grouped on the basis of severity of sepsis. 25 patients contributed to the sepsis group, 25 to severe sepsis and remaining 25 belonged to septic shock group.40% patients were under the age group of 25-45 years and 44% patients were present >45 years age group.

The mean age of total population was 42.02±13.95 years while it was 47.6±10.32, 40.4±13.79 & 38.08±15.88 years respectively in sepsis, severe sepsis and septic shock patients groups. In the study, on applying one way ANOVA test between three groups of sepsis cases it was found statistically significant (p value) as shown in table 2.

Table 2 Mean age of Patient in Group Based on Condition

	Population Mean (Mean + SD)	Sepsis (Mean + SD)	Severe Sepsis (Mean + SD)	Septic Shock (Mean + SD)	F-value	p-value
Age (Years)	42.02±13.95	47.6±10.32	40.4±13.79	38.08±15.88	3.36	0.040

p-value as obtained on applying One way ANOVA

Table 3 Distribution of cases on the basis of Procalcitonin

Parameter	Sepsis	Severe sepsis	Septic shock	F-value	p-value
PCT (ng/ml)	0.97±0.41	3.79±0.94	33.10±53.32	8.34	0.0005

p-value as obtained on applying One way ANOVA

In this study 69.33% were males and 30.66% were females. When cases were further distributed on the basis of severity, 80% males and 20% females contributed to sepsis group (n=25), 60% males and 40% % females in severe sepsis (n=25), 68% males and 32% females in septic shock (n=25).

PCT level in sepsis group was 0.97±0.41, in severe sepsis was 3.71±0.94 and in septic shock 33.10±53.32 (table 3; fig.1) and it was statistically significant.

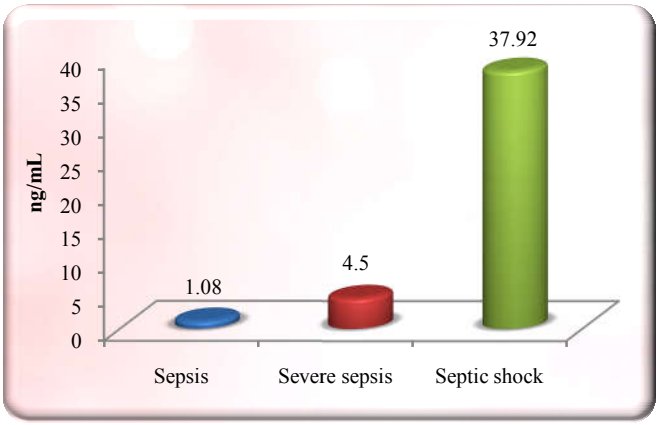

Figure 1 Distribution of cases on the basis Procalcitonin

DISCUSSION

The study population consists of a diverse group of critically ill adult patients with sepsis (n=75), admitted to the medical ICU. Role of serum PCT was evaluated that can be used as a predictor of sepsis. The diagnostic accuracy of PCT from a clinical perspective was explored.

The Incidence of sepsis was more in elder patients (>55 years) that contributes 21% of population enrolled in the study (figure 1). The similar age distribution pattern was found in a western study that reported a higher incidence of sepsis in patients aged above 57 years (Martin GS *et al*., 2003). According to the epidemiological study done on sepsis patients, the mean age was 54.9 years (Todi S *et al*., 2007).

Table no.2 represented the mean age of total population and sub-groups and it was statistically significant with the p-value 0.040. 69.33% males (n=52) and 30.66% females (n=23) contributed to the total enrolled subjects. Tupchong K *et al*., 2014found a slightly higher percentage of males affected with sepsis compared to females in the present study (Sudhir U *et al*., 2011).

When the levels of PCT were compared in sub-groups based on severity, it was found to be significantly raised with progression of severity (table 3; figure 1) with p-value0.0005 (figure no. 2). Brunkhorst *et al*., 2000 in their study reported that serum PCT levels increase with the increasing severity of the inflammatory response to infection. The abovementioned study demonstrates serum PCT as among the most promising sepsis markers in critically ill patients, capable of complementing clinical signs and routine lab parameters suggestive of severe infection at the time of ICU admission. According to Karlsson S *et al*., 2010, PCT concentrations were higher in more severe forms of severe sepsis, but a substantial concentration decrease was more important for survival than absolute values. In his study he quoted that PCT concentrations are elevated in patients with blood culture-positive infections and septic shock, but single values have no predictive value for patient outcome. Another study by Cui N *et al*., 2019 concluded that Serum PCT have good clinical diagnostic and prognostic value for patients with sepsis and septic shock. Kinetic studies of PCT and CRP can improve sensitivity and accuracy when evaluating the prognosis of patients with sepsis and those with septic shock. Jekarl DW *et al*., 2019 indicate that PCT could support and predict the unfavourable prognosis of sepsis based on SEPSIS-3, whereas diagnostic potential of PCT requires further evaluation.

In the present study incidence of sepsis was higher in elder patients. Males are the most affected one with the sepsis. Serum PCT found to be an outstanding indicator and also promising marker for sepsis patients. Our findings indicated that the PCT play important role in early diagnosis and management of sepsis.

CONCLUSION

The current study was attempted to put forward the fact that PCT levels may offer more insight into the prognosis and management of sepsis patients. Early diagnosis of progression of sepsis can be helpful in timely management of critical patient.PCT levels were evaluated to assess its role as prognostic markers in patients of sepsis.

The study demonstrates serum PCT to be among the most promising sepsis marker in critically ill patients. It is capable of complementing clinical signs and suggestive of severe infections at the time of ICU admission. The study proposes a strong correlation between severity of sepsis and PCT.

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