TO COMPARE THE CLINICAL UTILITY OF SERUM ALBUMIN AS A PROGNOSTIC MARKER WITH PROCALCITONIN IN PATIENTS ADMITTED TO THE EMERGENCY DEPARTMENT – A RETROSPECTIVE STUDY

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Abstract

Introduction: Ability of biomarkers to accurately assess a patient's disease severity and prognosis in emergency department can predict the aggressiveness of the treatment given in due course of time. Serum procalcitonin (PCT) has been used as a marker of bacterial sepsis in critically ill patients and prediction of outcome after major trauma Systemic inflammation in response to infection, tissue injury or inflammatory disease down regulates the production of few proteins including the albumin.

Aim: To compare the utility of serum albumin as a prognostic marker with serum PCT in patients admitted in the emergency department.

Materials and Methods: This retrospective evaluation of data on patients admitted in emergency department of a government-run Tertiary Care Centre in Western Uttar Pradesh over a period of two months was performed to establish a relationship between their serum albumin levels and serum PCT levels. The analysis was performed on the data of 75 emergency admitted patients after considering the exclusion criteria and availability of serum albumin and PCT reports of patients. Patients were divided into two groups based on whether the serum PCT value was < 0.5 ng/mL or ≥ 2 ng/mL. The mean values of serum albumin were compared in the subgroups of patients defined by the level of serum PCT by unpaired t-test and spearman rank correlation coefficient was calculated to establish the correlation between serum albumin and serum PCT levels.

Results: A large number (88%) of the patients had hypoalbuminaemia with mean albumin level being 2.8 ± 0.6 g/dL. About 44% of patients had serum PCT level less than 0.5ng/mL, 24% had serum PCT level ≥ 0.5ng/mL to < 2ng/mL and 32 % patients had serum PCT level ≥ 2ng/mL. The mean value of serum albumin was lower among those with high serum PCT (> 2 ng/dL) as compared to those with Serum PCT value less than 0.5 ng/dL, that was significant statistically (p value < 0.001). The correlation coefficient between serum PCT and serum albumin levels was -0.442 which shows that both the parameters are negatively correlated and this finding was statistically significant.

Conclusion: The significant difference was observed between mean serum albumin values in the two groups based on whether the serum PCT value was less than 0.5 ng/mL and equal to or more than 2 ng/mL. The serum albumin levels of the patients

were negatively correlated with their serum PCT levels which was statistically significant. So this study concluded that the low serum albumin levels can also predict the severity of systemic inflammation.

Introduction

Survival of critically ill patients admitted in emergency department has improved significantly due to timely decision making which is directly based upon the various laboratory biochemical markers. Ability of biomarkers to accurately assess a patient's disease severity and prognosis in emergency department can predict the aggressiveness of the treatment given in due course of time.

The ideal biomarker should be easily available, technically easy to perform, quick turn-around time, inexpensive, highly specific, highly sensitive, and preferably highly correlated in quantitative terms with disease.

Serum procalcitonin (PCT) has been used as a marker of bacterial sepsis in critically ill patients. It is a precursor of calcitonin having 116 amino acids [1,2]. Half-life of procalcitonin is 25-30 hours. In healthy persons, PCT level increases more rapidly than other acute phase reactants from a very low baseline concentrations [3]. Bacterial lipopolysaccharide (LPS) has been shown to be a potent inducer of PCT release into the systemic circulation. PCT is used for early detection of sepsis and prediction of outcome after major trauma [4]. The increased levels of procalcitonin after inflammation is because of its production by the liver and other organs (adipocytes, lungs, muscles cells) and peripheral blood mononuclear cells, modulated by lipopolysaccharides and sepsis related cytokines (TNF-α, IL-2, IL-6) [5].

Systemic inflammation in response to infection, tissue injury or inflammatory disease down regulates the production of few proteins including the albumin. Acute response might also reflect increased capillary permeability and redistribution of albumin to extrcellular fluids.[6]

The aim of the present study is to compare the utility of serum albumin as a prognostic marker with serum PCT in patients admitted in the emergency department.

Materials and Methodology:

A retrospective evaluation of data on patients admitted in emergency department of a government-run Tertiary Care Centre in Western Uttar Pradesh over a period of two months was performed to establish a relationship between their serum albumin levels and serum PCT levels. Patient presented with history of fever and the total leucocyte count more than 15000 / mm^3, were included in the study. Patients with other causes for abnormal serum albumin levels like chronic liver disease, chronic renal disease and severe malnutrition were identified using Biochemical Reports and clinical history in the case reports and excluded from the study. Also, patients with cardiac symptoms or known cardiac illnesses were excluded to minimize its effect on serum PCT levels.

The analysis was performed on the data of 75 emergency admitted patients after considering the exclusion criteria and availability of serum albumin and PCT reports of patients. Samples of these patients were processed on Cobas e411 analyser (Electrochemiluminescence immunoassay) for quantitative determination of serum PCT [7]. Samples for serum albumin were processed on RX IMOLA analyzer by Randox.

Considering a serum PCT level of 2 ng/ml or above as a marker of severe sepsis/ septic shock [8], the utility of serum albumin in predicting the same, was evaluated in this study.

Statistical analysis

Data was analyzed by using Microsoft Excel 365, Statistical Package for the Social Sciences (SPSS) for windows version 23. Comparison between the mean data of serum albumin, based on the Serum PCT < 0.5 ng/ml and > 2ng/ml, was done by unpaired t-test. Value of serum PCT was not distributed normally, hence Spearman rank

correlation coefficient was calculated to establish the correlation between serum albumin and serum PCT levels. The serum albumin levels were presented as means ± SD with p-value of <0.05 being indicative of statistical significance.

Results:

Most (60%) of the patients admitted in emergency department were over forty years of age, while about a quarter of patients were less than 30 years, with mean age being 45.1 ± 14.7 ***years***. Male patients were slightly higher in number than females. A large number (88%) of the patients had hypoalbuminaemia with mean albumin level being 2.8 ± 0.6 g/dL. About 44% of patients had serum PCT level less than 0.5ng/mL, 24% had serum PCT level ≥ 0.5ng/mL to < 2ng/mL and 32 % patients had serum PCT level ≥ 2ng/mL. The median serum PCT level was 0.7 ng/mL lying within the interquartile range of 0.08 to 3.4 ng/mL.

Table 1: Distribution of Study Subjects based on their Sociodemographic and Clinical Characteristics

Characteristics	**Frequency (Percentage)** **N=75**
Age (in years)	
Less than 30	18 (24.0)
31-40	12 (16.0)
41-50	19 (25.3)
51-60	15 (20.0)
>60	11 (14.7)
Sex	
Male	40 (53.3)
Female	35 (46.7)
Serum Albumin Level	
Serum Albumin <3.5 g/dL	66 (88)
Serum PCT Level	
Less than 0.5ng/mL	33 (44)
0.5ng/mL to <2ng/mL	18 (24)
2ng/mL and above	24 (32)

Table 2: Central Tendency of Quantitative Variables

Characteristics	**Mean± SD**
Age (in years)	45.1 ± 14.7

Serum Albumin (g/dL)	2.8 ± 0.6
Characteristics	**Median Value (IQR)**
Serum PCT (ng/mL)	0.7 (0.08-3.4)

Table 3: Table Showing the Association between Categorical Sociodemographic and Clinical Variables and Serum Procalcitonin Levels of Studied Subjects

Characteristics	**Number of Participants based on Serum PCT Values**		**p-value**
	Less than0.5ng/mL(N=33) N (Row %)	2ng/mL and above (N=24) N (Row %)	
Age (in years)			
Less than 30	3 (16.7)	9 (50)	0.2
31-40	7 (58.3)	4 (33.3)	
41-50	9 (47.4)	4 (21.1)	
51-60	8 (53.3)	5 (33.3)	
>60	6 (54.5)	2 (18.2)	
Sex			
Male	16 (40)	15 (37.5)	0.548
Female	17 (48.6)	9 (25.7)	

Table 4: Table showing Comparison between Quantitative Variables based on Serum Procalcitonin Levels of studied subjects.

Characteristics	**Serum PCT Values**		**p-value**	**Correlation Coefficient (with serum PCT levels)**
	Less than 0.5ng/mL (N=33) Mean ± SD/ Median (IQR)	2ng/mL and above (N=24) Mean ± SD/ Median (IQR)		
Age (in years)	48.9 ± 13.5	41.2 ± 14.7	0.147	-0.255*
Serum Albumin Level (g/dL)	3.06 ± 0.54	2.38 ± 0.65	<0.001	-0.442**

Majority of patients in both the sub groups were having hypoalbuminemia, but the mean value was lower among those with high serum PCT (> 2 ng/dL) as compared to those with Serum PCT of 0.5 ng/dL or less. This finding was found to be statistically significant (p value < 0.001).

The correlation coefficient between serum PCT and serum albumin levels was -0.442 which shows that both the parameters are negatively correlated and this finding was statistically significant.

Discussion:

As we are living in a developing country, purpose of this study was to search a low cost but sensitive biomarker that can predict the severity of a systemic inflammation.

This study had revealed that serum PCT and serum albumin levels are negatively correlated and this finding was statistically significant which means, a low albumin concentration is associated with a high PCT levels and it can be used as a marker for severity of a systemic inflammation.

Bouadma L et al concluded that the PCT concentration increases in the blood of patients with infectious disease [9].

In a meta-analysis of systemic inflammatory response syndrome, PCT had 77% sensitivity and 79% specificity in differentiation of bacterial and non-bacterial infection [10].

PCT is produced and increases sharply in patients with infectious diseases affecting the lungs, thyroid gland, kidney, skin, and various other internal organs.[11,12]

The study conducted by Zhou G and Ho KM reported that PCT-positive patients showed significantly higher rates of mortality and intensive care unit re-entry [13].

The study conducted by *Blomberg J et al* showed that a low serum albumin and high CRP values at the time of gastrostomy are associated with a significantly increased 30-day mortality rate, that favours our study [14].

Assicot et al concluded that the PCT concentration in blood is elevated by systemic infection, especially bacterial infectious disease causing severe illness, but not by local infection and concluded that PCT can be applied for diagnosis of various bacterial infectious diseases [15].

Higashikawa et al investigated the serum procalcitonin (PCT) and albumin (Alb) as prognostic biomarkers in elderly patients at risk of bacterial infection and concluded that the combined measurement of serum PCT with serum albumin is expected to be a valuable tool to assess prognosis in these patients that favours this study [16].

This study had few limitations such as it was based on the measurement of single dependent variable which is serum PCT. Bigger sample size may be more predictive than the current study. As this study was an observational study and not an interventional/randomized study, complete adjustment for all confounding factors was almost impossible.

Conclusion:

The significant difference was observed between mean serum albumin values in the two groups based on whether the serum PCT value was less than 0.5 ng/mL and equal to or more than 2 ng/mL. The serum albumin levels of the patients were negatively correlated with their serum PCT levels which was statistically significant. So this study concluded that the low serum albumin levels can also predict the severity of systemic inflammation.

Authors' contributions:

Sonali Chaurvedi contributed to conception and study design. Sandeep Singh Soam did data collection, drafted the manuscript and revised it. Shruti Singh performed statistical analysis. All authors read and approved the final manuscript.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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References:

1. Weinschenk NP, Farina A, Bianchi DW. Premature infants respond to early-onset and late onset sepsis with leukocyte activation. J Pediatr. 2000;137:345–350.

2. Chiesa C, Panero A, Rossi N. Reliability of procalcitonin concentrations for the diagnosis of sepsis in critically ill neonates. Clin Infect Dis. 1998;26:664–672.

3. Athhan F, Akagunduz B, Genel F, Bak M, Can D. Procalcitonin: A marker of neonatal sepsis. J Trop Pediatr . 2002;48:10–14.

4. Carrol ED, Thomson AP, Hart CA. Procalcitonin as a marker of sepsis. Int J Antimicrobe Agents. 2002;20:1

5. Spapen, H.D., Hachimi-Idrissi, S., Corne, L. et al. 2006. Diagnostic markers of sepsis in the emergency department. Acta. Clin. Belg., 61(3):138–42.

6. Carl A Burtis, Edward R Ashwood, David E Bruns. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 5th ed. Saunders, an imprint of Elsevier (Philadelphia); 2012. Chapter 21, Amino acids, peptides and proteins, p 523-24.

7. cobas e 411 analyzer. Available from: https://diagnostics.roche.com/global/en/ products/instruments/cobas-e-411-ins-502.

8. Meisner M. Procalcitonin (PCT) – A new innovative infection parameter. Biochemical and clinical aspects. Thieme Stuttgart, New York 2000, ISBN: 3-13-105503-0.

9. Bouadma L, Luyt CE, Tubach F, et al. Use of procalcitonin to reduce patients' exposure to antibiotics in intensive care units (PRORATA trial): a multicentre randomized controlled trial. Lancet 2010; 375, 463–474, doi:10.1016/s0140-6736(09) 61879-1.

10. Gilbert DN. Procalcitonin as a biomarker in respiratory tract infection. Clin Infect Dis 2011; 52(Suppl 4): S346–S350, doi:10.1093/ cid/cir050.

11. Becker KL, Nylen ES, White JC, et al. Clinical review 167: Procalcitonin and the calcitonin gene family of peptides in inflammation, infection, and sepsis: a journey from calcitonin back to its precursors. J Clin Endocrinol Metab 2004; 89: 1512 1525, doi:10.1210/jc.2002-021444.

12. Linscheid, P, Seboek D, Nylen ES, et al. In vitro and in vivo calcitonin I gene expression in parenchymal cells: a novel product of human adipose tissue. Endocrinology 2003; 144, 5578–5584, doi:10.1210/en.2003-0854.

13. Zhou G and Ho KM. Procalcitonin concentrations as a predictor of unexpected readmission and mortality after intensive care unit discharge: A retrospective cohort study. J Crit Care 2016; 33: 240–244, doi:10.1016/j.jcrc.2016.02.006.

14. Blomberg J, Lagergren P, Martin L, et al. Albumin and C-reactive protein levels predict short-term mortality after percutaneous endoscopic gastrostomy in a prospective cohort study. Gastrointest Endosc 2011; 73: 29–36, doi:10.1016/j.gie.2010.09.012.

15. Assicot, M, Gendrel D, Carsin H, et al. High serum procalcitonin concentrations in patients with sepsis and infection. Lancet 1993; 341, 515–518.

16. Toshihiro Higashikawa, Masashi Okuro, Keiichirou Ishigami, Kunihiro Mae, Ryusho Sangen, Takurou Mizuno, Daisuke Usuda, Atushi Saito, Yuji Kasamaki, Akihiro Fukuda, Hitoshi Saito, Shigeto Morimoto, Tsugiyasu Kanda et al. Procalcitonin and albumin as prognostic biomarkers in elderly patients with a risk of bacterial infection. Journal of International Medical Research 0(0) 1–9.