Procalcitonin Use in Sepsis Presentations Among Tertiary Care Patients

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Abstract

The severity of the illness and the decline in health status of critical patients determine the mortality rate in ICUs. Extremes of age, disease severity, and certain pre-existing comorbidities like diabetes are the factors that contribute to higher hospital death rates (e.g. Malignancy, Immunosuppressed status and patients on renal replacement therapy). Florence Nightingale recognised the need for clinical treatment outcome assessment for the first time in 1863. 2

Initially, the ability and judgement of the doctor was used to predict the outcome in critically ill patients. In order to improve procedures that are mostly based on evidence, the recent rapid rise of intensive care units has necessitated a quantitative evaluation and review of the outcomes. The first disease severity scores and outcome prediction models were created more than 25 years ago with the goal of determining the probability of fatality in critically sick patients. Since then, other Intensive Care unit scoring systems have been created, taking aetiology and varied scenarios into account. As a result, determining the prognosis is an essential component of managing any critically ill cases. 3

Introduction

The severity of a condition is assessed and predicted using a variety of grading systems in critical care facilities. Based on clinical and biochemical data, the scoring methods categorise critical cases according to their severity and place them in a particular risk group. In order to raise standards of care and outcomes, scoring systems have been established, and their implementation in ICUs is crucial. 4

Knaus et al. created the severity score and instrument known as the Acute Physiology and Chronic Health Evaluation II (APACHE II) in the US in 1985 for estimating mortality in ICU cases.

[5]

APACHE, SAPS (Simplified Acute Physiology Score), and other data collected on the first day of ICU admission are used to calculate the severity scores in intensive care units.

Score for Physiology, Mortality Probability Model (MPM). A scoring system often has two components: a severity score, which is a number (generally, the higher the score, the more severe the ailment), and a calculated mortality probability. 6,7 Clinical practitioners must understand the significance of severity scores and apply scoring systems to their everyday practise in addition to clinical observation and cutting-edge medical interventions.

The precursor to calcitonin, procalcitonin, contains 116 amino acids. In healthy individuals, serum procalcitonin concentrations are less than the detectable threshold (0.5 ng/ml), but they can rise to 1000 ng/ml in cases of sepsis or severe bacterial infection. 9 In instances in the critical care unit, the plasma concentration of procalcitonin is connected with the severity of infection since it has a half-life of 15-20 hours in the blood (ICU). 10

With this context in mind, the current study aims to investigate the relationship between serum procalcitonin levels in cases of sepsis, to determine APACHE II scores, and to correlate.

Objectives

- To estimate the levels of serum procalcitonin in patients with Sepsis

- To calculate APACHE II scores in patients with sepsis

- To correlate the levels of serum Procalcitonin levels with APACHE II

Score

Patients frequently spend up to 2-3 weeks in the hospital due to septic shock, which is the most common reason for ICU admission worldwide. Since the 1990s, sepsis patient mortality has remained high despite the use of proper antibiotic medication and enhanced life support. 15 Older people are a vulnerable group that are prone to a variety of infectious diseases. According to estimates, 21.4 million older persons were hospitalised between 1990 and 2002 with an infectious disease as their major diagnosis. Additionally, it is predicted that by 2050, 21.4% of the world's population would be 60 years of age or older.

16 Thus, it is anticipated that an increasing number of older people will suffer from sepsis syndrome and septic shock. For the elderly population, infections, sepsis syndrome, and septic shock are the worst health risks.

VARIOUS DEFINITIONS OF SEPSIS AND SEPTIC SHOCK

Assessing the Validity of Definitions

When the Gold Standard Doesn't Exist Instead of being a single disease, sepsis is a syndrome with a pathobiology that is yet unclear. Currently, a patient with a suspected infection can be diagnosed by a constellation of clinical signs and symptoms as having it. The task group looked for definitions and supporting clinical criteria that were precise and satisfied several domains of usefulness and validity because there isn't a single gold standard diagnostic test.

Improved Understanding of Sepsis Pathobiology

The complex host response to an invading infection known as sepsis may be considerably exacerbated by endogenous variables. 17 Inflammatory excess was the only factor considered when sepsis was first defined as an infection with at least two of the four SIRS criteria present. The reliability of SIRS as a description of sepsis pathobiology has been questioned, nevertheless. Nowadays, it is understood that sepsis involves early induction of both pro- and anti-inflammatory responses, as well as significant alterations in nonimmunologic pathways such as the cardiovascular, neuronal, autonomic, hormonal, bioenergetic, metabolic, and coagulation, all of which are significant in terms of prognosis. Even when it is severe, organ dysfunction is not accompanied by significant cell death. 18

The bigger picture highlights the enormous biological and clinical variation in affected people, with age, underlying comorbidities, concomitant injuries (including surgery), medications, and infection source adding to the complexity.

19 Neither animal models nor computer simulations can accurately recreate this diversity. Multichannel molecular markers, such as those found in transcriptomic, metabolomic, and proteomic data, will probably help characterise particular population subsets better with further validation. These characteristics may also aid in distinguishing sepsis from noninfectious traumas like trauma or pancreatitis, where endogenous variables may cause a comparable biochemical and clinical host response. 20

Variable Definitions

With a deeper understanding of the pathobiology at play, it has become clear that many of the terminology currently in use—such as "sepsis" and "severe sepsis"—are interchangeable, while others are redundant or unnecessarily specific (e.g., septicemia). The issue has been made worse by inconsistent methods used to choose ICD-9 and ICD-10 codes from the International Classification of Diseases, Ninth Revision.

Sepsis

The task team unanimously agreed that the existing method of using two or more SIRS criteria to diagnose sepsis was ineffective. White blood cell counts, body temperature, and heart rates all change in reaction to inflammation, the body's defence mechanism against infection or other threats. A dysregulated, life-threatening reaction is not always indicated by the SIRS criteria. There are many hospitalised patients who meet the SIRS criteria, even individuals who never get sick or have bad outcomes (poor discriminant validity). 25 Additionally, in Australia and New Zealand, 1 in 8 patients who were admitted to critical care units with infection and new organ

failure did not meet the minimum number of 2 SIRS criteria required to meet the definition of sepsis (poor concurrent validity), despite having prolonged courses with significant morbidity and mortality. The two categories of construct validity are discriminant validity and convergent validity; the SIRS criteria so fare poorly on both counts. 21

SIRS (Systemic Inflammatory Response Syndrome) [22]

Two or more of:

Temperature >38°C or <36°C Heart

rate >90/min

Respiratory rate >20/min or PaCO2 <32mmHg (4.3 kPa)

White blood cell count >12 000/mm3 or <4000/mm3 or >10% immature bands

APACHE II (Acute Physiology and Chronic Health Evaluation II)

The original APACHE, created in 1981, was modified into APACHE II (Acute Physiology and Chronic Health Evaluation II), which was first introduced in 1985. 5 An adult patient hospitalised to an intensive care unit will receive a score based on the severity of their illness and their likelihood of dying. This approach was created using data from 5815 critical care admissions made between 1979 and 1982 at 13 hospitals in the USA. A higher score was associated with greater severity and a higher chance of hospital death.

APACHE III is an improved version of APACHE II that is built upon a bigger database. It has 18 physiological indicators, including ones related to chronic illness. The daily clinical updates are used as the basis for mortality prediction. 23 This score's broad range, from 0 to 299, makes utilisation challenging and time-consuming. A logistic regression statistical model, APACHE IV has 142 variables. 24 Its intricacy prevents it from being extensively used. As a result, APACHE II is frequently used and one of the scores that has been most thoroughly confirmed using online calculators. 25 The Simplified Acute Physiology Score (SAPS), which is similar to APACHE II, is a simplified form of the APACHE. 26

The abbreviation APACHE refers to the first two of the three categories that make up the Acute Physiology and Chronic Health Evaluation-II (APACHE-II) score system: "Acute Physiology," "Chronic Health Evaluation," and "Age." The first domain deals with "acute" modifications (within the first 24 hours of ICU admission) in physiological parameters like oxygenation (PaO2 in relation to FiO2), rectal temperature, mean arterial pressure, arterial pH, heart rate, respiratory

rate, serum sodium, serum potassium, serum creatinine, haematocrit, white blood cell count, and Glasgow Coma Scale (GCS). Consequently, it has a relationship to the 12 physiological, objective, and numerical indicators that are frequently monitored and recorded in critical care units. A score is assigned to each physiological parameter that is above and below the predetermined range. This score classifies the severity of physiological dysfunction in terms of numbers and can ultimately be used to forecast the outcome. Since it covers the majority of organ functions, it makes sense and has been proven to be a reliable prediction score. The second domain, known as "Chronic Health Evaluation," which is assessed based on previous health condition, is also included in the score and affects the result. Pre-existing co-morbidities have a maximum score of 5 out of a possible 71, which is a 7% mortality contribution. Similar to the second domain, "Age" will contribute 8.5% (6 of 71), and the combined contributions of "co morbidities" and "age" will total 15.5%. (11 of 71). Although the greatest total score is 71, in practise the APACHE upper limit won't go above fifty-five. Therefore, the overall contributions of these two variables will range from 0% to 20% or more. Age is one of the factors that adds depth to the APACHE score. Age plus chronic health issues will also significantly affect the prognosis for elderly people as they may have chronic health issues. 25

ETIOLOGY OF SEPSIS

Gram-positive organisms have become more frequent over time and are now almost as frequent as gram-negative infections as a cause of sepsis. This is probably because invasive procedures are used more frequently and a bigger percentage of infections are acquired in hospitals. [44] Bacterial resistance has likely risen over time as a result of more frequent use of broad-spectrum antibiotics in patients who are sicker and spend longer stays in the ICU. Antibiotic resistance is a problem that lengthens hospital stays and requires more time for mechanical breathing, while the impact on death is unclear. Different rates in various nations may be explained by differences in how the two primary measures to manage resistance (a more judicious use of antibiotics and the prevention of patient-to-patient infection) are implemented internationally. 45

An crucial factor in outcome is the type of bacterium producing severe sepsis. Although most recent research has indicated that gram-positive bacteria are becoming more common, the most recent European Prevalence of Infection in Intensive Care (EPIC II) study found that gram-negative bacteria were more prevalent (62.2% vs. 46.8%). 32 Staphylococcus aureus (20.5%), Pseudomonas species (19.9%), Enterobacteriacae (mostly E. coli, 16.0%),

and fungi (19%) were the most common infecting organisms, following patterns seen in earlier investigations. 9% of all infections were caused by Acinetobacter, with considerable regional differences in infection rates (3.7% in North America vs. 19.2% in Asia). Enterococcus, Pseudomonas, and Acinetobacter species were the only microbes identified in the multivariable logistic regression analysis as being linked with hospital mortality. 32 Table 2 provides an overview of the microbiologic outcomes of the EPIC II. 46

According to a significant meta-analysis of 510 studies, gram-negative bacteremia was linked to a greater mortality rate than gram-positive bacteremia.

Compared to Candida (43%) and Acinetobacter (40%) species, coagulase-negative Staphylococcus and E. coli caused the majority of bloodstream infections, although these were also associated with relatively low fatality rates (20% and 19%, respectively). However, the gram-negative bacillus Pseudomonas aeruginosa had the highest death of all (77%). Gram-positive pneumonia caused by Staphylococcus aureus had a higher mortality (41%) than that caused by the most frequent gram-positive (Streptococcus pneumoniae, 13%). This study illustrated the relationship between the infection site and the organism in influencing mortality and recommended for its inclusion in the risk classification of clinical trials. A third of individuals with severe sepsis, however, never have positive blood cultures. 47 The confusing impact of the situation in which an organism most frequently develops must also be considered before assigning causal risk to a specific organism. For instance, the high fatality rate associated with Acinetobacter may be explained by the bacteria's propensity to spread as a nosocomial infection during a protracted ICU course in patients with numerous comorbidities. The high related mortality may be explained by these characteristics rather than the organism's virulence. 48

Table 1: Types of organisms in culture-positive infected patients and associated risk of hospital mortality[46]

	Frequency (%)	OR (95% CI)
Gram-positive	**46.8**	
Methicillin sensitive *Staphylococcus aureus*	20.5	0.8 (0.6–1.1)
Methicillin resistant *Staphylococcus aureus*	10.2	1.3 (0.9–1.8)

Enterococcus	10.9	1.6 (1.1–2.3)
S. epidermidis	10.8	0.9 (0.7–1.1)
S. pneumoniae	4.1	0.8 (0.5–1.4)
Other Gram positive bacteria	6.4	0.9 (0.7–1.2)
Gram-negative	**62.2**	
Pseudomonas species	19.9	1.4 (1.2–1.6)
Escherichia coli	16.0	0.9 (0.7–1.1)
Klebsiella species	12.7	1.0 (0.8–1.2)
Acinetobacter species	8.8	1.5 (1.2–2.0)
Enterobacter	7.0	1.2 (0.9–1.6)
UnknownGram negative bacteria	22.0	0.9 (0.7–1.3)
Fungi		
Candida	17.0	1.1 (0.9–1.3)
Aspergillus	1.4	1.7 (1.0–3.1)
Unknown Fungi	5.6	1.9 (1.0–3.8)

MSSA-Methicillin sensitive *Staphylococcus aureus*

MRSA-Methicillin resistant *Staphylcoccus aureus*

Site of infection

The most prevalent infection location and one that is most strongly linked to death are respiratory tract infections, notably pneumonia. The proportional significance of pneumonia has changed over time, nevertheless. [26] Pneumonia is more common in males and alcoholics, while genitourinary infections are more prevalent in women. 49 Abdominal, cutaneous, and soft tissue infections, infections of the central nervous system and endocarditis are other prevalent causes of infection. 50

RISK FACTORS

The two main categories of risk factors for severe sepsis are those associated with infection and those associated with organ dysfunction in the event that infection occurs. The majority of the risk factors for severe sepsis discussed in this paragraph are related to the risk of infection, while risk factors that make someone with an infection more likely to experience

acute organ dysfunction are less well known. 50

Considerable risk factors for severe sepsis include, for instance, age, male gender, black race, and greater load of chronic health disorders. Additionally, a current study found a negative correlation between socioeconomic status and the likelihood of blood stream infection. More than half of severe sepsis cases in persons over 65 years of age are caused by this condition, which has an increased incidence in older adults. In addition to having at least one chronic medical condition, more than half of people who acquire severe sepsis do so. Chronic obstructive lung disease, cancer, chronic renal and liver diseases, and diabetes patients are more likely to develop severe sepsis. Long-term care facility living, malnutrition, the usage of prosthetics, and immunosuppressive medicine and therapy are additional risk factors. In addition, as will be discussed further down, anomalies in the immune system's response to infection raise the risk of infection and severe sepsis. These anomalies could be a result of age-related conditions or chronic illnesses (i.e., immunosenesence). 51

Although there has been progress in our understanding of the clinical risk factors that affect sepsis susceptibility and outcomes, it is still unclear why some patients experience severe sepsis and pass away from the infection while others do not. So, in order to account for variation in susceptibility to infection and its results, genetic variables have been investigated. In comparison to cardiovascular disease, the results of infectious diseases may be more influenced by hereditary variables, according to a study by Sorensen and colleagues. 52 Adopted children who lost their original parents to infectious diseases had a 5.8-fold higher risk of passing away from illnesses, according to one study. When their biological parents passed away from cardiovascular causes, however, the chance of cardiovascular death increased by 4.5 times. Sepsis is a widespread and frequently fatal condition, hence a single gene-based Mendelian inheritance pattern is not expected to exist. Sepsis susceptibility, response, and outcome may all be influenced by the interactions of many genes with pathogens (environmental variables). Tumor necrosis factor (TNF), plasminogen activator inhibitor (PAI)-1, Toll-like receptor (TLR)-1 and TLR- 4, and the Mal functional variation necessary for downstream signalling of TLR-2 and TLR-4.40-42 are some of the potential genes that have demonstrated promise in preliminary research. The MASP2 and NOD2/TLR4 genotypes have been linked to bacteremia susceptibility and in-hospital mortality, respectively, according to a single centre study from Belgium. 53

Distribution of age in the study population and its relation with the outcome.

Total 75 patients diagnosed with sepsis were included in this prospective observational study. Of the total 75 patients, 47 patients were survivors and 28 patients were non-survivors. The mean age in the group of survivors was 55.17±16.61and the mean age in the group of non-survivors is 50.67±14.27. The differencebetween the two means is statistically insignificant (DF=23;_p'=0.89).

Table 2: Distribution of age in the study population and its relation with the outcome.

Age (in years)	Outcome					
	Survivors			Non-survivors		
Mean±SD	55.17±16.61			50.67±14.27		
	n=47	%	n=28	%	n=75	%
Male	31	65.9	16	34.1	47	62.7
Female	16	57.1	12	42.9	28	37.3
Total	47	62.7	28	37.3	75	100

Figure 1: **Distribution of outcome in the study population and its correlation with gender**
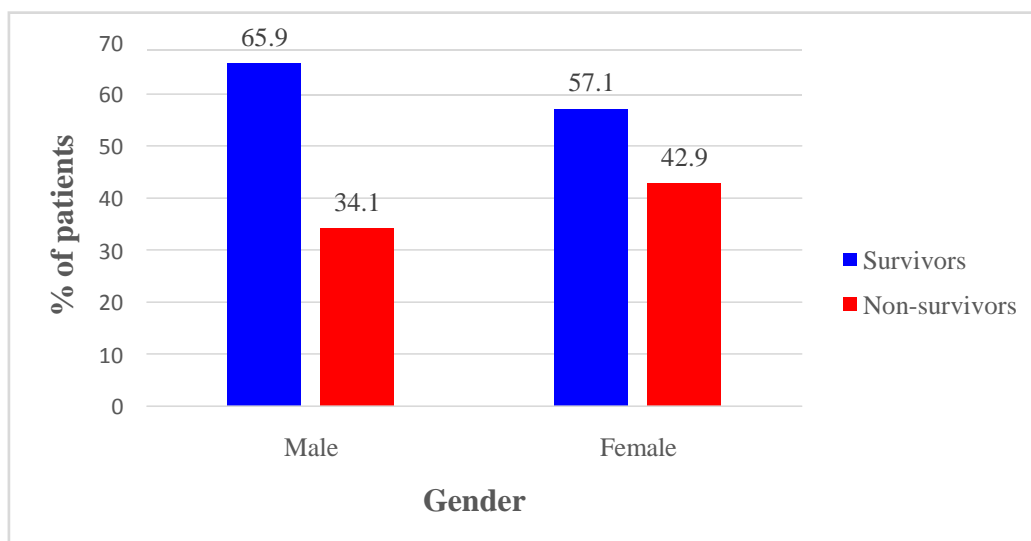
Distribution of comorbidities in study population and its correlation with the outcome

Total 75 patients, admitted to the intensive care unit with the diagnosis of sepsis, were enrolled in this prospective observational study. There was presence of comorbidity in 48 (64%) patients whereas 27(36%) patients didn't have any comorbidity. Total 48

(66.7%) had history of comorbidity of them, 24 (50%) survived and 24 (50%) succumbed. Amongst 27 (36%) patients who had no history of comorbidity, 23 (85.2%) survived and 4 (14.8%) patients died. The case fatality rate in the group of patients with comorbidities (50%) was higher as compared to that of patients without comorbidities (14.8%). The difference between the fatality rate of the two groups is statistically significant (DF=1; X^2=9.14; p'=0.0002).

Table 3: **Distribution of comorbidities in study population and its correlation with the outcome**

| Comorbidity	Survivors		Non-survivors		Total	
	n=47	%	n=28	%	n=75	%
Present	24	50	24	50	48	64
Absent	23	85.2	4	14.8	27	36
Total	47	62.7	28	37.3	75	100
Serum. Procalcitonin level (ng/mL)	Total n=75			%		
≥2.0	61			81.3		
<2.0	14			18.7		
Total	75			100.0		

Distribution of serum procalcitonin in the study population and it correlation with the outcome A total of 75 patients were admitted to the intensive care unit with the diagnosis of sepsis. Amongst the 75 patients, 61(81.3%) patients had serum PCT levels ≥2ng/mL and 14 (18.7%) patients had serum PCT levels <2 ng/mL. Total 61 (81.3%) patients had PCT levels ≥2 ng/mL of them, 34 (55.7%) patients survived while 27 (44.3%) patients died. Of the total 11(15.3%) patients who had serum PCT levels <2ng/mL, 13 (92.8%) survived and 1 (7.2%) patient died. The case fatality rate in the group of patients with PCT≥2ng/mL was 44.3% and that in the group with serum PCT level <2 was 7.2%. The difference in the case fatality rates is statistically significant

(DF=1; X^2=6.7060; _p'=0.0096).

Table 4: **Distribution of serum procalcitonin in the study population and it correlation with the outcome**

Serum PCT (ng/mL)	Outcome				Total	
	urvivors (n=47)	%	-survivors(n=28)	%	(n=75)	%
≥2	34	55.7	27	44.3	61	81.3
<2	13	92.8	1	7.2	14	18.7
Total	47	62.7	28	37.3	75	100

Figure 2: **Distribution of serum procalcitonin in the study population and it correlation with the outcome**
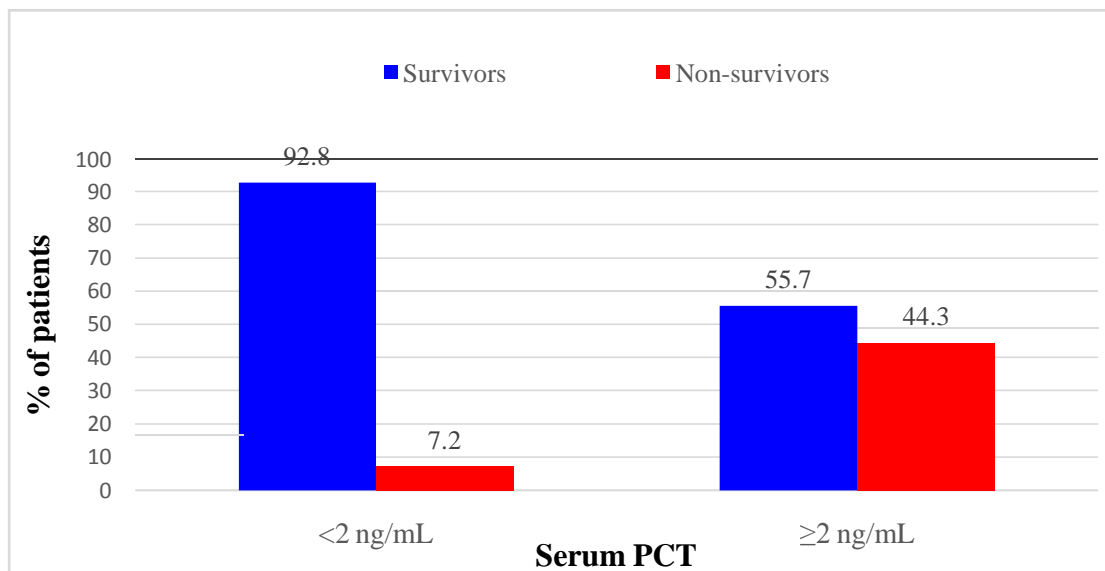
Distribution of serum procalcitonin level in the study population and its correlation with the outcome

Total 75 patients admitted to the intensive care unit with the diagnosis of sepsis were enrolled in this prospective observational study. Total 47 patients survived and 28 patients died due to the illness. The mean serum PCT level in the group of

survivors was 3.72±2.18 ng/mL with a median of 3.54 (2.3-4.35). The mean serum PCT level inthe group of non survivors was 8.8±3.80 ng/mL with a median of 8.75 (6.3-11.67). The serum PCT levels were higher in the group of non-survivors as compared to group of survivors. The difference between the mean serum PCT levels in the two groups is statistically significant (DF=-7.38 ; _p'<0.001).

Table 5: **Distribution of serum procalcitonin in the study population and it correlation with the outcome**

Outcome	Serum PCT (ng/mL)
	Mean±SD
Survivors (n=47)	3.7±2.18
Non-survivors (n=28)	8.8±3.8

Figure 14: **Distribution of serum procalcitonin in the study population and it correlation with the outcome**
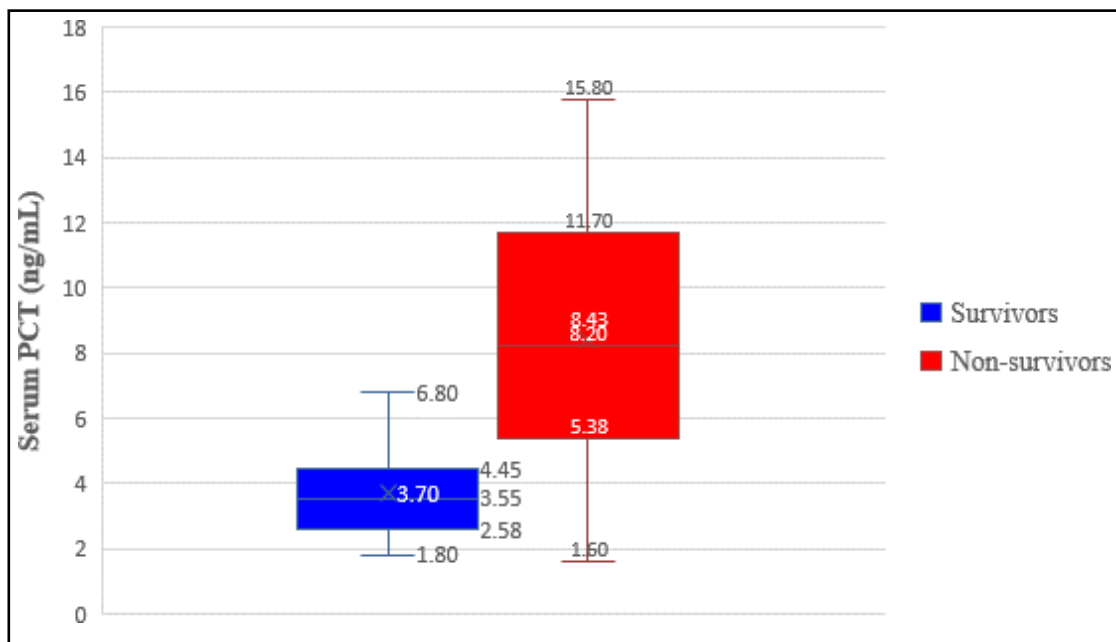

ROC curve of serum PCT level in study population for predicting outcome

Serum procalcitonin levels in the group of survivors and non-survivors were plotted using a Receiver Operating Characteristic (ROC) curve. Serum PCT had an AUROC of 0.846216 for predicting death, or area under the receiver operating

characteristic. The cutoff serum PCT level of 5 ng/mL showed a sensitivity of 92.6% and a specificity of 70% when used to predict death. For predicting death, the serum PCT value of 6ng/mL exhibited a sensitivity of 89% and a specificity of 81%.

Figure 3: ROC curve of serum PCT level in study population for predicting outcome
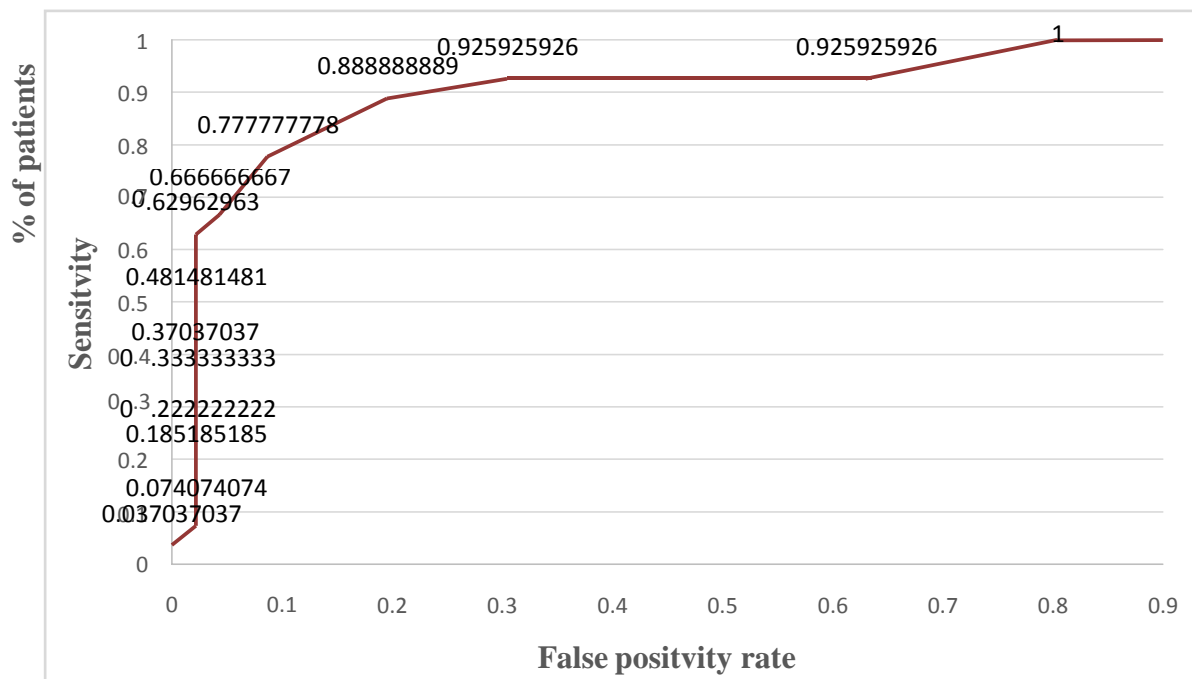
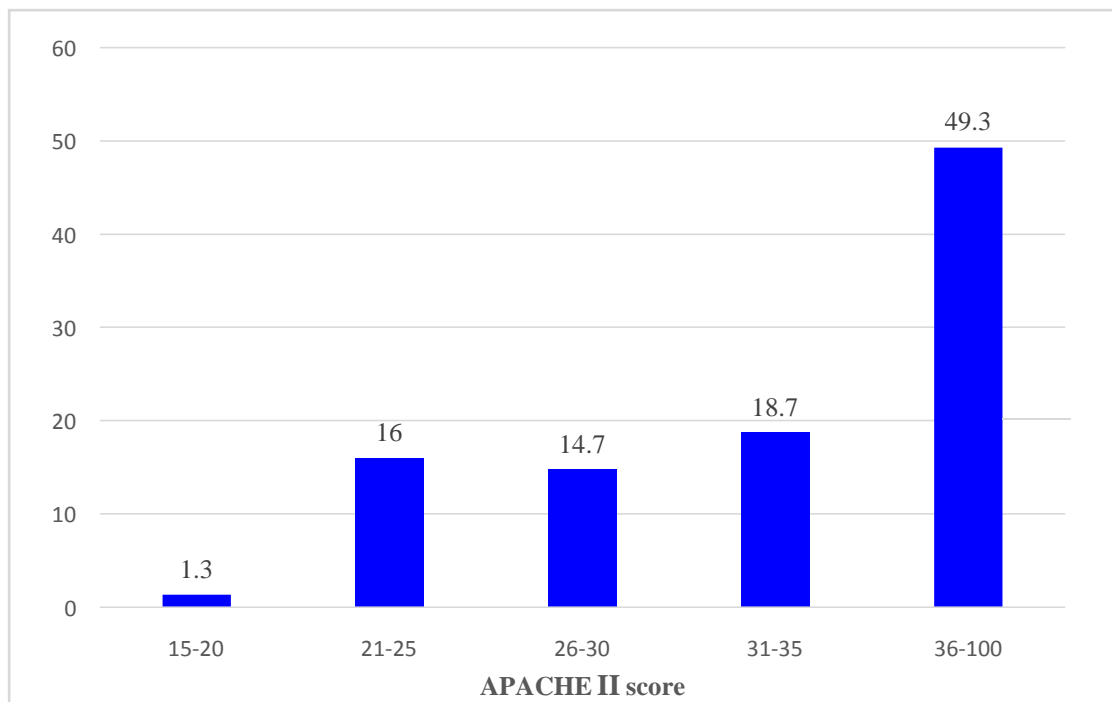**Frequency distribution APACHE II score in study population**

In the 75 patients in the study group (100%) who had APACHE II scores, 37 (49.3%) had scores between 36 and 100, while 14 (18.7%) had scores between 31 and 35.

Table 5: **Frequency distribution APACHE II score in study population**

Frequency distribution of APACHE II Score	Total (n=75)	%
15-20	1	1.3
21-25	12	16
26-30	11	14.7

31-35	14	18.7
36-100	37	49.3
Total	75	100.0

Figure 4: Frequency distribution APACHE II score in study population
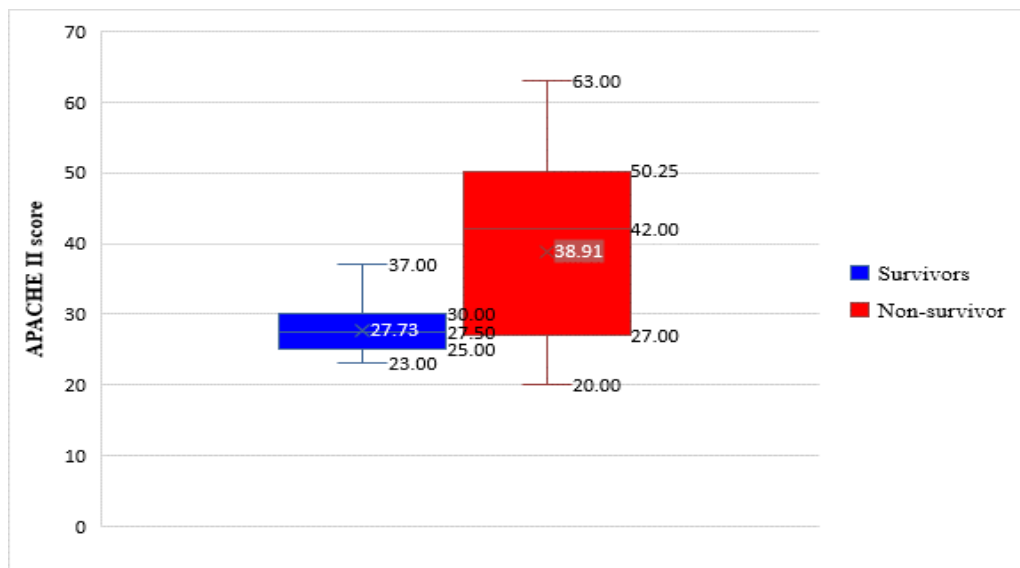

Distribution of APACHE II score in the study population and it correlation withthe outcome

Total 75 patients admitted to the intensive care unit with the diagnosis of sepsis, were enrolled in this prospective observational study. Total 47 patients survived and 28 patients were non-survivors. In the group of survivors, the mean APACHE II score was 28.95±4.07 with the median APACHE II score of 28 (26 -32.5). Total 28 patients belonged to the group of non-survivors and the mean APACHE II score in this group was 41.25±12.75. The median APACHE II score in the group of non survivors was 44(29-52.25). The mean APACHE II score in the group of non-survivors is higher than that of survivors. The difference between the mean APACHE II score of the two groups is statistically significant (df=-6.12507; _p'<0.00001).

Table 6: **Distribution of APACHE II score in the study population and it correlation with the outcome**

Outcome	APACHE II Score
	Mean±SD
Survivors (n=47)	28.95±4.07
Non-survivors (n=28)	41.25±12.75

Figure 5: **Distribution of APACHE II score in the study population and it correlation with the outcome**

Distribution of APACHE II score in the study population and it correlation withthe outcome

Total 75 patients, admitted to ICU with the diagnosis of sepsis, were enrolled to this prospective observational study. Total 53 (70.7%) patients had APACHE II score ≥30 and 22 (29.3%) patients had APACHE II Score <30.Amongst the 22 (29.3%) patients

who had APACHE II score <30, 20 (90.9%) survived and 2 (9.1%) patients died. Total 53 (70.7%) patients had APACHE II score ≥30 of them, 27 (50.9%) survived and 26 (49.1%) died. The case fatality rate of patients with APACHE II score <30 was 2.7% as compared to 34.6% in the group of patients APACHE II score ≥30.The difference between the case fatality rates of the two groups is statistically significant (DF=1; X^2=10.61399; _p' value=0.00112).

Receiver operating characteristic curve of APACHE II score was plotted in the two groups of survivors and non-survivors. The area under receiving operating

characteristic(AUROC) of APACHE II score for predicting mortality was 0.819909.APACHE II score of 35 had sensitivity of 70.4 % and specificity of 69.6% for predicting mortality. APACHE II score of 40 had sensitivity of 70.4% and specificity of 91% for predicting mortality in the study population.

Table 7: **Distribution of APACHE II score in the study population and it correlation with the outcome**

APACHE II score	Outcome				Total	
	Survivors	%	Non survivors	%	n=75	%
<30	20	90.9	2	9.1	22	29.3
≥30	27	50.9	26	49.1	53	70.7
Total	47	62.7	28	37.3	75	100

Figure 6 : **Distribution of APACHE II score in the study population and it correlation with the outcome**
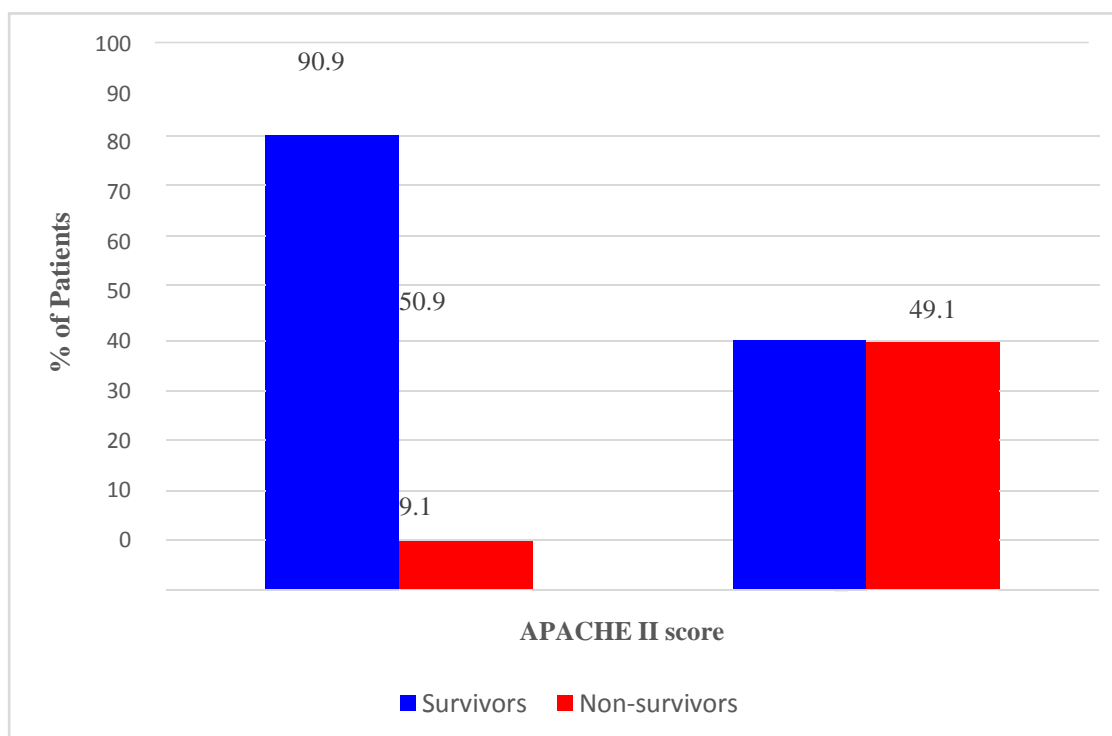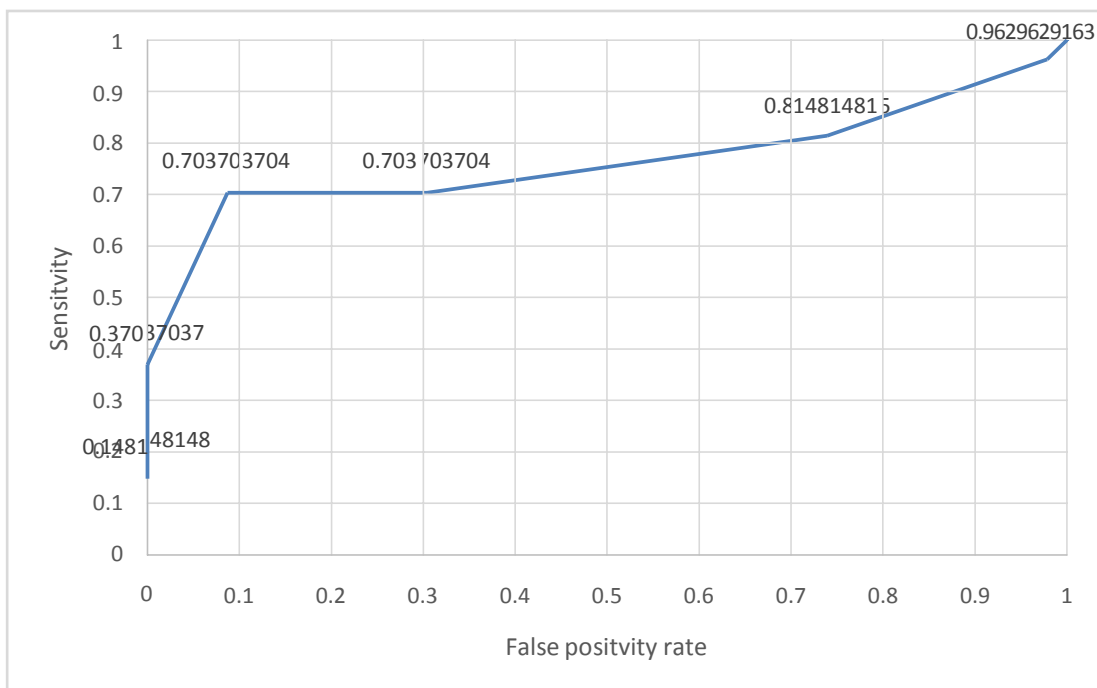
Figure 7: ROC curve for APACHE II score and its association with predictionof outcome

Distribution of APACHE II scores in the study population and its associationwith the corresponding serum PCT level.

The association between the APACHE II score and Serum PCT levels was evaluated with Spearman's rank correlation coefficient. There was positive correlation between APACHE II score and serum PCT values (_r'=0.457, _p'<0.001)

Figure 8: Graph showing association between APACHE II score and PCT
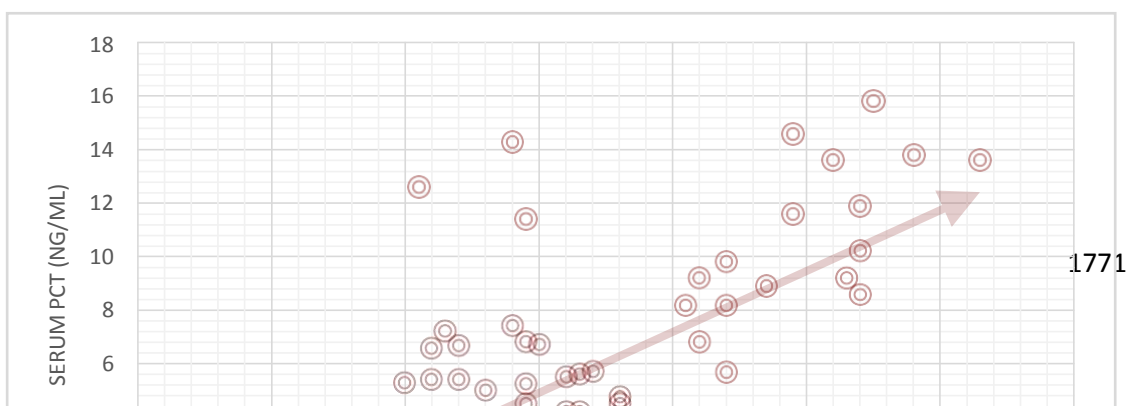
Distribution of APACHE II score and serum procalcitonin levels in the stu

dypopulation

A total 75 patients, admitted to the intensive care unit with the diagnosis of sepsis, were enrolled in this prospective observational study of. Total 24 (32%) patients had APACHE II score <30 and 51 (68%) patients had APACHE II score ≥30. Total 24 (32%) patients had APACHE II score <30 of them, 14 (58.3%) patients had serum PCT level ≥2ng/mL and 10 (41.7%) patients had serum PCT level <2ng/mL . Amongst 51 (68%) patients who had APACHE II score ≥30, 47 (92.2%) patients had serum PCT level ≥2ng/mL and 4 (7.8%) patients had serum PCT serum PCT level

<2ng/mL .Thus 47 (77.05%) patients with APACHE II score ≥30 had serum PCT ≥2ng/mL as compared to 14 (22.95%) patients who had APACHE II score <30 and serum PCT ≥2ng/mL . Significant association exists between APACHE II score and serum procalcitonin levels (DF=1; X^2=6.42; _p'=0.011).
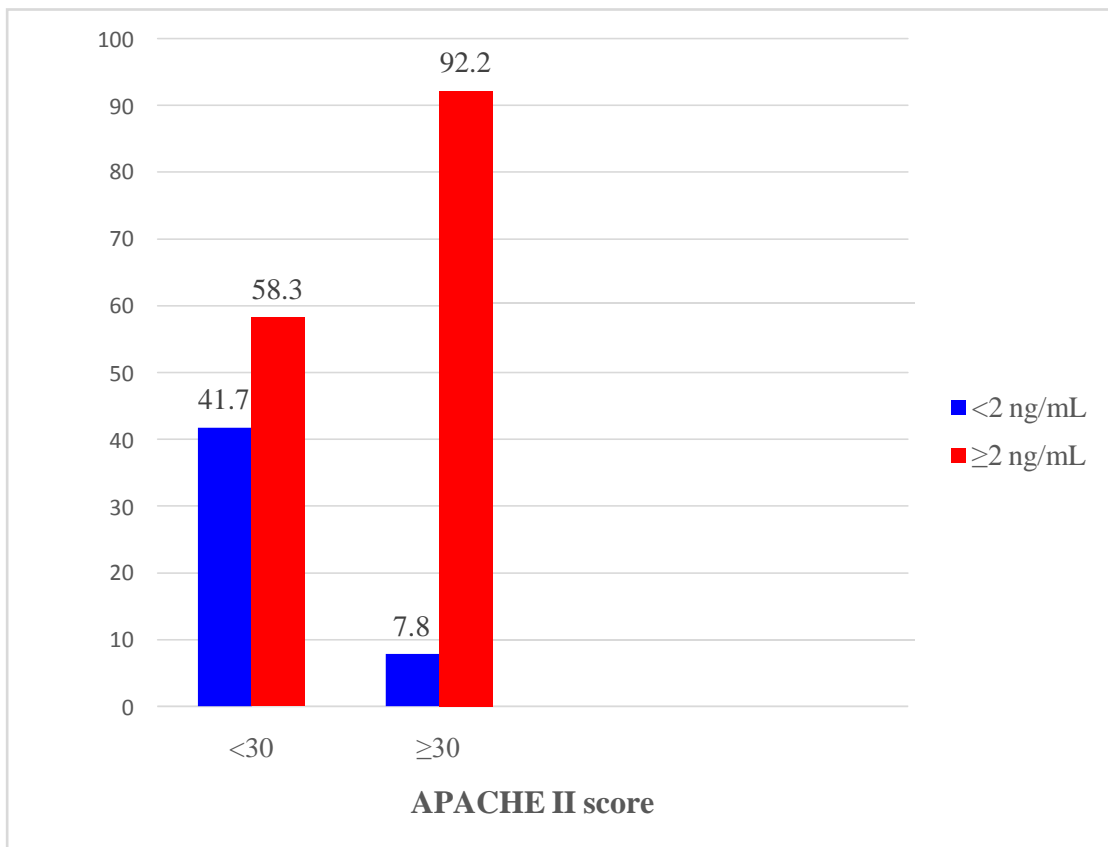
Table 8: **Distribution of APACHE II score and serum Procalcitonin levels in thestudy population**

APACHE II Score	Procalcitonin level				Total	
	≥2.0 ng/mL n=61	%	<2.0 ng/mL n=14	%	n=75	%
<30	14	58.3%	10	41.7%	24	32

≥30	47	92.2%	4	7.8%	51	68
Total	61	81.3	14	18.7%	75	100

% of pateints

Figure 8: **Distribution of APACHE II score and serum procalcitonin levels in the study population**

Summary

This study was a prospective observational non interventional cohort study conducted in the ICU of Krishna Institute Of Medical Sciences And Research Hospital, Karad, this study was carried out over the period of 18 months. Total 75 patients diagnosed

with sepsis were included in this study to evaluate association between APACHE II score and serum procalcitonin levels in these patients.

Following observations were made in this study

1.   A total of 75 patients, admitted to the intensive care unit with the diagnosis of sepsis, were included in the prospective observational study. Of them 47 (62.7%) were males and 28 (37.3%) were females.

2.   The majority of the people were in the age group of 61-70 years (33.3%) followed by 26-40 years (20.9%). The mean for age in the study population was 55.4 (±14.8) years.

3.   Total 48 (64%) patients had comorbidities and 27 (36%) patients didn't have comorbidities. Diabetes mellitus type was found to be the commoner comorbidity with prevalence of 27.8 % followed by hypertension with prevalence of 12.5%.

4.   The mean serum PCT level in the group of survivors was 3.7±2.18 with a median of 3.54 (2.34-4.35).

5.   The mean serum PCT level in the group of non survivors was 8.8±3.8 with a median of 8.75 (6.3-11.67).

6.   The serum PCT levels were higher in the group of non survivors as compared to group of survivors and the difference between the mean serum PCT levels of the two groups was statistically significant.

7.   61(81.3%) patients had serum PCT levels ≥2ng/mL and 14 (18.7%) patients had serum PCT levels <2 ng/mL.

8.   The case fatality rate amongst the group of patients with PCT ≥2 ng/mL was 44.3% and that in the group with PCT level <2ng/mL was 7.2%. The sensitivity of serum PCT for predicting mortality is 96.4% and specificity is 27.7%. The PPV is 44.2% and NPV is 92.9%. The difference between the case fatality rates of the two groups is statistically significant.

9.   The serum PCT level of 5 ng/mL when used as cut off for predicting outcome had sensitivity of 92.6% and specificity of 70%. The serum PCT value of 6ng/mL had sensitivity of 89 % and specificity of 81% for predicting outcome.

10.   In the study population of 75(100%) patients, majority of the patients 37 (49.3%) had APACHE II score in the range of 35-100 followed by 14 (18.7%)patients had APACHE II score in the range of 31-35.

11.   The mean APACHE II score was 28.95±4.07 in the group of survivors and

41.25±12.75 in the group of non survivors. Thus, the mean APACHE II score of non survivors was higher than the survivors and the difference was statistically significant.

12.   Total 53 (70.7%) patients had APACHE II score ≥30 and 22 (29.3%) patients had APACHE II Score <30. The case fatality rate of patients with APACHE II score <30 was 2.7% as compared to 34.6% in the group of patients APACHE II score ≥30. Therefore, a positive correlation was observed between APACHE II score ≥30 and mortality. The sensitivity of cut off of APACHE II score ≥30 for predicting mortality was 92.9% and specificity was 42.6%. The PPV was 49.1% and NPV was 90.9%.

13.   APACHE II score of 35 had sensitivity of 70.4 % and specificity of 69.6% for predicting mortality. APACHE II score of 40 had sensitivity of 70.4% and specificity of 91% for predicting mortality in the study population.

Conclusions

Sepsis continues to be a cause of mortality in majority of the patients receiving intensive care treatment. In the present study we evaluated the association between serum Procalcitonin and various factors associated with sepsis such as organism isolated from the clinical samples, severity of the sepsis and APACHE II score. It was observedthat higher serum Procalcitonin levels were associated with significant mortality, thus establishing its role as a marker of prognosis and outcome. The patients with greater levels of serum Procalcitonin had higher APACHE II scores. Higher serum Procalcitonin levels were associated with bacterial sepsis.

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