



## A PROSPECTIVE STUDY ON PROCALCITONIN AS AN USEFUL BIOMARKER FOR PROGNOSIS OF SEPSIS AND GUIDE FOR ANTIBIOTIC THERAPY IN SICU PATIENTS

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### ABSTRACT

**Background of the study:** Sepsis is most common cause of death in surgical ICU patients. Early diagnosis and appropriate antibiotics play the major role in saving the patients. Procalcitonin helpful in early detection as well as to monitor the anti-microbial therapy. **Aims and Objectives:** To study on effectiveness of procalcitonin as a useful biomarker for prognosis of sepsis and guide for antibiotic therapy in SICU patients. **Material and Methods:** Cases admitted to GMKMC hospital Salem with signs of sepsis in SICU patients will be closely monitored from the day of admission to the day of discharge. On an average of 100 cases with signs of sepsis in ICU patients admitted between 2017 to 2019. **Results:** A Prospective study on Procalcitonin as a useful biomarker for prognosis of sepsis and guide for antibiotic therapy in SICU patients revealed the following findings. The mean age is 57.06 years with a standard deviation of 9.39 years. Majority of the participants were males (n=56, 56%) while the rest were females. Out of the 100 patients, 76 of them (76%) were blood culture positive while the remaining 24% were blood culture negative. 68 of them (68%) were pus culture positive while the remaining 32% were pus culture negative. Among the 100 patients, 66 of them (66%) were wound swab positive while the remaining 34% were wound swab negative. 42% were Klebsiella positive and remaining were various other organisms. The organisms were sensitive to Piptaz (50%) and Cefoperazone (48%). Procalcitonin is 100% sensitive and specific in predicting the prognosis in patients of surgical ICU. **Conclusion:** Procalcitonin levels rise rapidly in sepsis and typically peak earlier than C-reactive protein (CRP). They also decline more quickly in response to effective treatment. Consequently, procalcitonin is useful both for the early detection of sepsis and for monitoring the response to therapy, making it an ideal biomarker in the management of sepsis.

**Keywords:** Sepsis, Procalcitonin, CRP.

### INTRODUCTION

A systemic infection which evokes a strong response from the immune system is called as sepsis. In around one-third of the cases, the aetiology of the infection is unknown. World Health Organisation data says in 2020, there were 48.9 million cases and 11 million sepsis-related deaths worldwide, representing 20% of all global deaths(1).

Sepsis is a very serious and challenging disease in critical care medicine that can be of graded variety namely; from sepsis to severe sepsis and septic shock. Though sepsis can be caused by any of the microbes- bacteria, virus, parasites, and fungi ,bacteria is the most common etiologic agent for the infection and development into a full-blown sepsis(2). The conventional markers for the diagnosis and management of sepsis are White blood cell count, CRP (C-reactive protein), IL-1 (Interleukin-1). Other biomarkers that are elevated during sepsis are; TNF- $\alpha$  and IL-6. But these biomarkers lack sensitivity and specificity. They have low positive and negative predictive values(3). Procalcitonin have aid better in diagnosis and help in prognosis than CRP. Also, it will help



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differentiate between bacterial and viral meningitis(4).

#### Aims and Objectives of the Study:

To study the effectiveness of procalcitonin as a useful biomarker for prognosis of sepsis and guide for antibiotic therapy in SICU patients.

#### MATERIALS AND METHODS

**Study design:** Prospective Cross-sectional Study

**Place of study:** Govt Mohana Kumara Mangalam College and Hospital

**Study period:** 2017 to 2019

**Study population:** Patients who were admitted to GMKMC hospital Salem with signs of sepsis in SICU were closely monitored from the day of admission to the day of discharge.

#### Inclusion criteria:

- All the patients with signs of sepsis admitted in SICU.

#### Exclusion criteria:

- Patients who were not willing to participate in the study
- Patients with known comorbid conditions at the time of admission like PLHIV, patients on ATT drugs, and Carcinoma

**Sample size:** This study includes 100 patients presenting with signs of sepsis.

#### METHODOLOGY

The following data was collected using a structured questionnaire: Age, demographic characteristics, socio economic status, patient complaints and duration of complaints. A detailed general examination was done. Systemic examination and basic investigations were done.

#### Investigations

Following specific investigations were done;

- a) Serum Procalcitonin at the time of;

- Diagnosis of sepsis
- On day 5
- On day 10
- and more if required

#### Serum Procalcitonin level detection by ELISA:

All the 100 samples were tested for Procalcitonin using ELISA with the help of

**Human Procalcitonin Elisa Kit** (Sincere Biotech, Beijing, China).

#### Statistical Analysis:

Data were analysed according to history, clinical examination, and investigation. Data were entered in excel sheet and analysed using SPSS v23. Frequencies and percentage analysis were done. Cross tabulation and Chi-square analyses were done to find the relationship and association between various variables.

#### Ethical Approval:

This study was approved by the Institutional Ethics Committee of Govt. Mohan Kumara Mangalam Medical College, Salem

#### RESULTS

A Prospective study on Procalcitonin as a useful biomarker for prognosis of sepsis and guide for antibiotic therapy in SICU patients revealed the following findings. The following figure-1 shows the age distribution of the participants. The mean age is 57.06 years with a standard deviation of 9.39 years. The median age is 56 years ranging between 38 years to 74 years? Out of the 100 patients, 76 of them (76%) were blood culture positive while the remaining 24% were blood culture negative. Out of the 100 patients, 68 of them (68%) were pus culture positive while the remaining 32% were pus culture negative, 80 of them (80%) were urine culture positive while the remaining 20% were urine culture negative. Among the 100 patients, 66 of them (66%) were wound swab positive while the remaining 34% were wound swab negative.

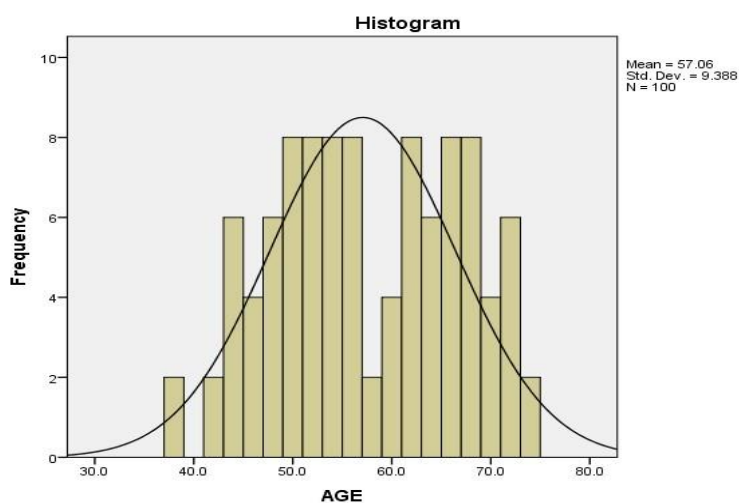


Fig-1 Age Distribution of Participants

Majority of the participants were males (n=56, 56%) while the rest were females. The following figure-2 shows the gender distribution of the patients.

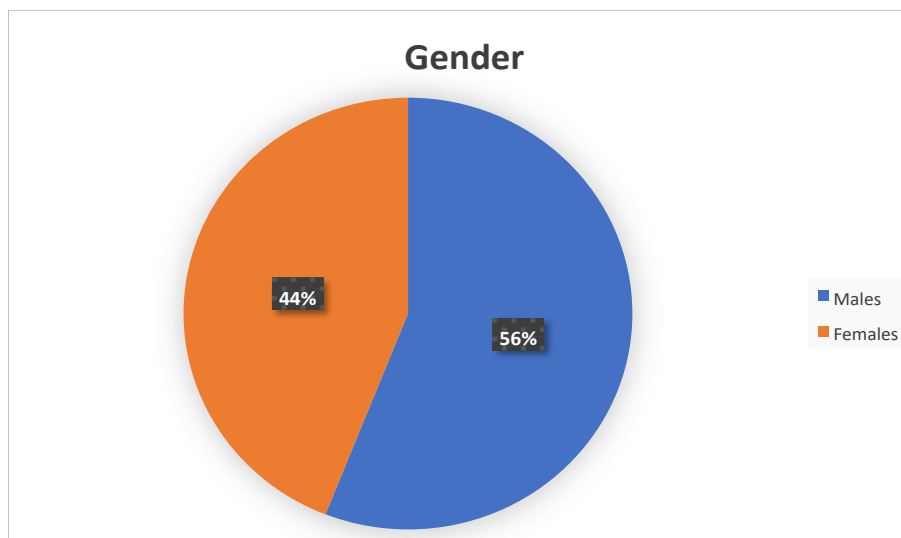


Fig-2 Gender Distribution of the Participants

42 of them (42%) were Klebsiella positive while 34 of them (34%) were E.coli positive. Pseudomonas was positive in 14% (n=14) of them while Proteus was present in 8% (n=8) of the total patients. The organisms were sensitive to Piptaz (n=50, 50%) and

Cefoperazone (n=48, 48%). CRP was positive in 47% of the cases and negative in 53% of the cases. Procalcitonin is 100% sensitive and specific in predicting the prognosis in patients of surgical ICU.

Table-1 Showing various Culture sensitivity of the patients

Parameter		Frequency	Percentage
Blood culture sensitivity	Positive	76	76
	Negative	24	24
Pus culture sensitivity	Positive	68	68
	Negative	32	32
Urine culture sensitivity	Positive	80	80
	Negative	20	20
Wound swab	Positive	66	66
	Negative	34	34

Table-2 Organism Isolated From the Cultures

Organism	Frequency	Percentage
Acinetobacter	2	2
E. Coli	34	34
Klebsiella	42	42
Proteus	8	8
Pseudomonas	14	14

#### Antibiotic Sensitivity

The organisms were sensitive to Piptaz (n=50, 50%) and Cefoperazone (n=48,

48%). The following table figure shows the antibiotic sensitivity.

Table-3 Antibiotic Sensitivity

Antibiotic Sensitivity	Frequency	Percentage
Cefoperazone	48	48
Meropenem	2	2
Piptaz	50	50

**Antibiotic Course**

The duration of antibiotics is mean=5.45 days (SD=1.28 days). Median is five days range between

5 and 11 days. Following table-4 shows the duration of antibiotics. C - reactive protein was positive in 47% of the cases and negative in 53% of the cases.

Table-4 Duration of Antibiotics

Characteristics	Antibiotic Course (Days)
Mean	5.45
Median	5
Mode	5
Standard Deviation	1.28
Minimum	5
Maximum	11

**Procalcitonin on day 0 and 5**

The Procalcitonin levels were elevated in all patients in Day 0 and decreased to 13% on Day 5. The following figure-3 shows the Procalcitonin levels

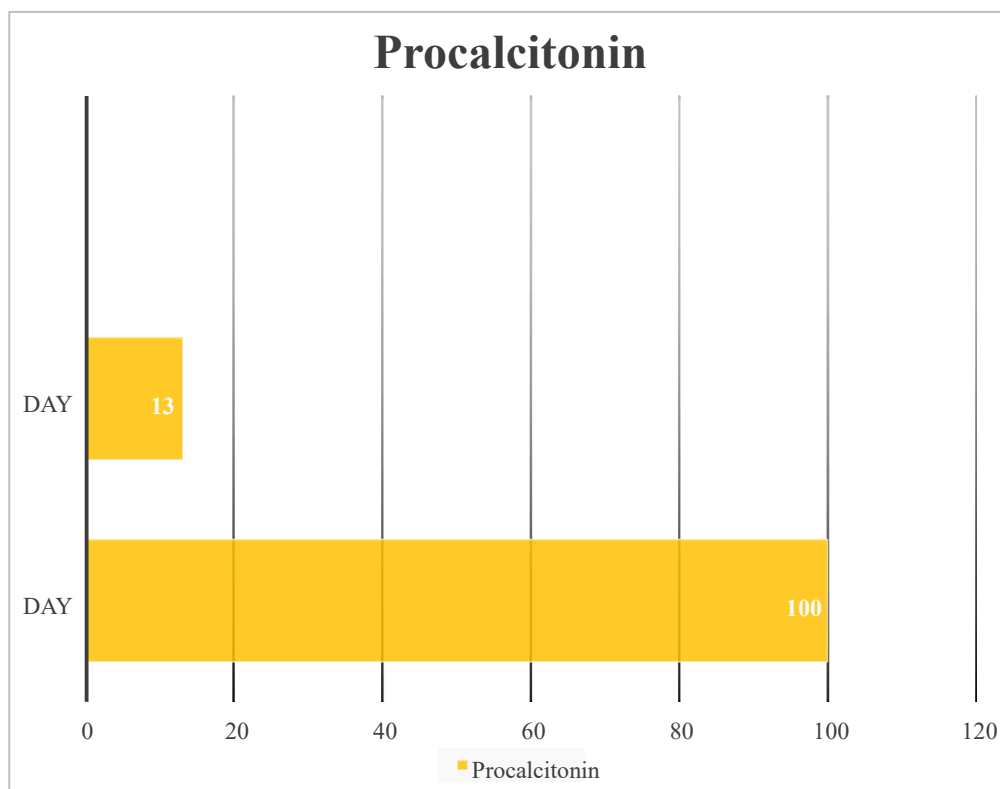


Fig -3 Procalcitonin Levels on Day 0 And 5

**Duration of Stay in the Hospital**

The mean duration of stay in the hospital is six days with a standard deviation of 1.15 days ranging between 5 and 11 days. The following figure-4 shows the duration of stay in the hospital. Out of 100 patients, 87 were cured and 13 of them expired. Figure-5 shows the outcome of the illness.

**Sensitivity and Specificity of Procalcitonin test**

The table-5 shows the sensitivity and specificity of Procalcitonin in predicting the prognosis in patients of surgical ICU. Procalcitonin is 100% sensitive and specific in predicting the prognosis in patients of surgical ICU.

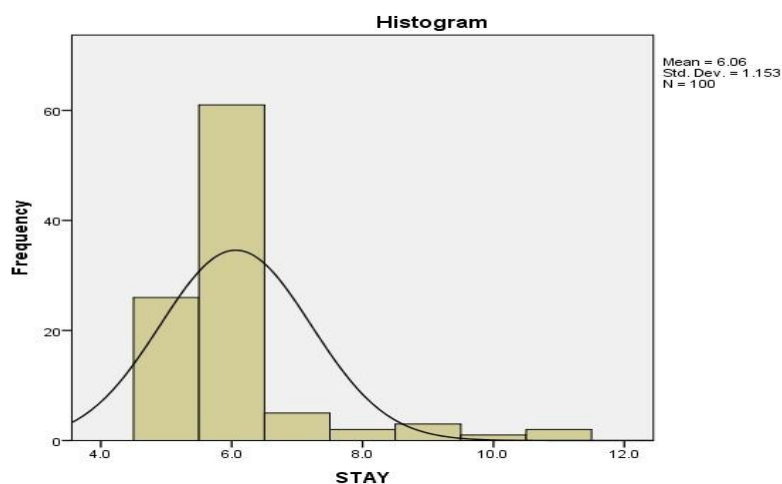


Fig-4 Duration of stay in the hospital

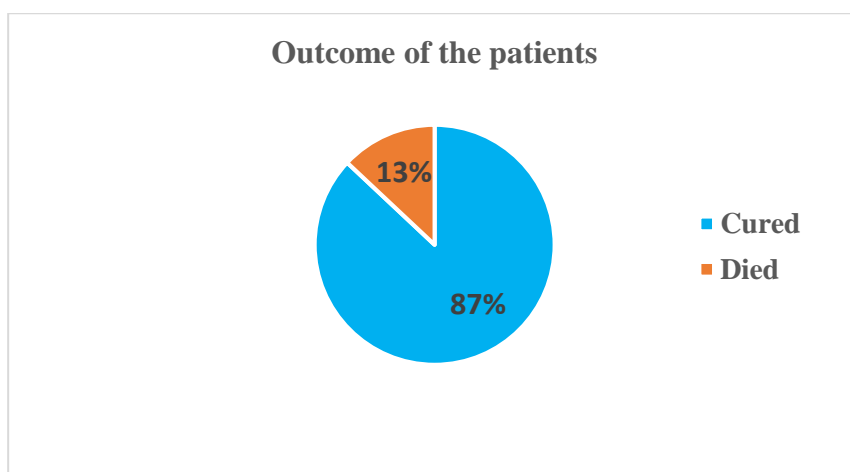


Fig-5 Outcome of the patients

Table-5 Sensitivity and Specificity of Procalcitonin test

Sensitivity and Specificity of Procalcitonin	Frequency/ Percentage
No. of true-positive findings	13
No. of true-negative findings	87
No. of false-positive findings	0
No. of false-negative findings	0
Sensitivity (%)	100
Specificity (%)	100
Accuracy (%)	100
Positive predictive value (%)	100
Negative predictive value (%)	100

## DISCUSSION

The outcome of the illness largely depends on the time of diagnosis and initiation of prompt treatment. When the diagnosis or treatment is delayed due to any reason, the outcome and prognosis is very poor and may affect all the organs, a condition called as the Systemic Inflammatory Response Syndrome (SIRS). Early initiation on antimicrobial therapy is crucial in getting a better outcome. The recent advancements in the field of molecular biology may

aid in screening the biomarkers during the acute phase of sepsis(5). But these bio-makers lack sensitivity and specificity. They have low positive and negative predictive values(3). Procalcitonin have aid better in diagnosis and help in prognosis than CRP. Also, it will help differentiate between bacterial and viral meningitis(4). The gold standard for the confirmation of bacterial infection in sepsis is through blood culture. But the time taken for a bacterial culture is too long to delay treatment. This

may lead to a loss of golden time(6). Procalcitonin is a propeptide that is a hormokine (so named because the mature protein has a hormonal basis) which is related to a cell mediated host response(7). Its half-life is 25–30 hours(8). PCT is elevated only in bacterial infections making it ideal for systemic bacterial infections(9). Daily estimations may be an important tool for follow-up(10). Another meta-analysis and systemic review on 30 studies in 2013 showed that - PCT has a mean sensitivity of 0.77 (95% CI 0.72-0.81) and PCT has a specificity of 0.79 (95% CI 0.74-0.84) (11). Increasing serum PCT levels is associated with poor prognosis and decreasing levels is seen as a sign of recovery(12). Procalcitonin is 100% sensitive and specific in predicting the prognosis in patients of surgical ICU in this study.

### CONCLUSION

This prospective study has revealed that Procalcitonin is a useful biomarker for prognosis of sepsis and guide for antibiotic therapy in SICU patients. The levels of procalcitonin in sepsis rises rapidly and tends to peak sooner than CRP. They also return to baseline sooner in response to treatment. PCT levels are diagnostic of systemic bacterial disease. They also retain diagnostic value in critically ill patients, supporting their use in the evaluation and management of severe infections in this population. Biomarkers are potential diagnostic and prognostic tools for clinical practice and their research must be promoted in regular clinical practice.

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