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Study of Mean Platelet Volume as a Prognostic Indicator in Sepsis

[1]Tejaswini K, [2]Srinivasa M
[1]Assistant Professor, [2]Professor
[1,2]Department of General Medicine,
[1]Sri Siddhartha medical college, Tumkur, [2]Mysore medical college, Mysuru

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ABSTRACT

Background

Sepsis is one of the leading causes of death worldwide.Rapid and precise diagnosis and appropriate antibiotic therapy is necessary to reducemortality and morbidity in patients with sepsis. Though several biomarkers and scoring systems have been evaluated, prognostic markers to quickly and precisely establish the diagnosis or prognosis of patients with sepsis and septic shock are yet tobe evaluated.

Aim and objectives

- To study the role ofMean Platelet Volume as a prognostic indicator in sepsis
- Comparison of Mean Platelet Volumevalues between survivors & non-survivors

Methodology

This is prospective observational study conducted in Mysore Medical college and Research Institute, Mysoreon 100 adult patients of both sex withdiagnosis of sepsis and admitted in the emergency wards and Intensive Medical Careunit. We have studiedMean Platelet Volume(MPV)in patients with sepsis and the values were compared among survivors and non-survivors groups. SOFA score and MPV values were correlated in predicting mortality

Results

A total of 100 subjects were selected among which 75 were survivors and 25 were non-survivors. The meanMean platelet volume was 11.62 among survivors and 13.34 among non-survivors at the time of admission and was found statistically significant(p=0.0001).Positive correlation with Pearson's correlation coefficient of r=0.75 was found when MPV was cross matched against SOFA score. HigherMPVvalues was associated with increased mortality in patients with sepsis

Conclusion:

Mean Platelet Volumecan be used as a simple, inexpensive and a novel prognostic marker inpatients with sepsis.

KEYWORDS: Sepsis, prognostic markers, MPV, SOFA Score.

I. INTRODUCTION

Sepsis is a life-threatening organ dysfunction resulting from dysregulated host responses to infection.[1] Data from the centre for Disease Control and Prevention reveals that sepsis is the leading cause of death in noncoronary intensive care unit patients and the tenth most common cause of death worldwide, the first being heart disease.[1]

Despite advances in intensive care and antimicrobial therapy, the incidence of sepsis and related mortality rate has increased over the last thirty years.[2] The mortality rate is estimated at 30% in sepsis and 80% in septic shock in the USA [3] and at 12.8% in sepsis and 45.7% in septic shock in Europe.[4] Reduced rates of reporting may affect estimations in developing countries.

The incidence of sepsis and septic shock continues to increase worldwide. The mortality increase has been attributable to patients' advanced age,pre-existing comorbidity, immunosuppressive diseases and therapies or infections withmulti-drug resistant bacteria, patients with chronic diseases for a long period, and those on medical treatment that circumvent host defences viz. in-dwelling catheters and mechanical devices.[4,5] Invasive bacterial infections are a prominent cause of death around the world-especially among children.[5]

Without consistent and reproducible criteria the extensive pathophysiologyassociated with sepsis is difficult to diagnose and treat. A delay in the diagnosis andtreatment of sepsis will result in the rapid progression of circulatory failure, multiple organ dysfunction and eventually death. Treatment guidelines are ambiguous. It involves a prolonged hospital stay for patients, while receiving complex therapy.

The in-hospital mortality risk of 10% in patients diagnosed with sepsis is widespread and

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those who develop septic shock increase their mortality risk greater than 40%.

Early diagnosis of severity of sepsis and appropriate treatment is essential for the survival of the patients. There are many biochemical markers, clinical parameters and scoring systems used to assess the severity and in predicting the mortality in patients with sepsis some of which include- estimating serum procalcitonin levels, clinical scoring systems like Sequential Organ Failure Assessment (SOFA), quick SOFA (qSOFA),Acute Physiology and Chronic Health Evaluation (APACHE II) scoring systems. The degree of severity is most often quantified by the Sequential Organ Failure Assessment (SOFA) score, which can predict the severity and outcome of multiple organ failure. However, calculating SOFA score is cumbersome. Moreover, assessment of the septic patient outcome during treatment needs to be focused on, as currently used clinical and biological criteria are undefined and inadequate for this purpose. The need for simple, cost effective and easily available, yet reliable markers has pushed researchers in identifying such markers for assessing the severity and predicting the prognosis of sepsis. Several inflammatory biomarkers have been evaluated in recent years with the high sensitivity, specificity, positive and negative predictive values for the early diagnosis of sepsis as available in literature. One such biomarker is the Mean Platelet Volume(MPV).

In this work, the haemogram parameter MPV which is a part of acomplete blood count, easy to evaluate and which do not incur additional costs to routine analysis are studied in assessing prognosis in patients with sepsis

OBJECTIVES OF THE STUDY

- To study the role of Mean Platelet Volumeas a prognostic indicator in sepsis
- Comparison of the MPVvalues between survivors &non-survivors

II. MATERIALS & METHODS

A Prospective observational study was performed at Mysore medical college and Research Institute after obtaining approval from the ethical committee.Study period was one year from January 2018 to December 2018. Patients admitted with Sepsis in the Emergency department & various wards at K.R.Hospital Mysuru were included.

Sampling Procedure:

Patients with sepsis according to 'The Third International Consensus Definition 2016' satisfying the inclusion and exclusion criteria are recruited in the study. This includes a detailed clinical history, complete physical examination and baseline laboratory test. Blood samples were collected in two separate containers and sent for investigations including MPV. Blood cultures sent before administration of antibiotics. SOFA Score was recorded at the time of admission in ward or in ICU. MPV was measured at the time of admission, after 72hrs, after 7 days. Major adverse events during course were recorded including death. Correlation studies of MPV and SOFA Score was done. The data obtained was statistically analyzed Friedman test for the repeated measures, Chi square test to find the significance in categorical data and probability value <0.05 is considered significant.

Inclusion Criteria

- Patients admitted to ICU and Emergency ward who meet the criteria of Sepsis and Septic Shock
- Age more than 18yrs**.**
- Subjects who give valid informed written consent for the study

Exclusion Criteria:

- Bleeding >10% blood volume.
- Patients with anemia & other hematological disorder
- Patients with known chronic diseases
- Blood product transfusion in the previous week of admission.
- Patients with malignancies on Chemotherapy.
- Use of drugs known to change Morphology and Rheology of platelets
- Pregnancy

III. RESULTS AND ANALYSIS

A total of 100 subjects were selected among which 75 were survivors and 25 were non-survivors. Majority of subjects in survivors belonged to age group of 41-60 years whereas in non-survivors belonged to age group beyond 60yrs (Table 1)(Figure1). The mean age was 52.61 years in survivors group and 64 years in non survivors group. When compared statistically using unpaired t test, the difference in mean age between study groups was found to be significant ($p<0.05$).It showed that increase in age in sepsis patients is associated with increase in mortality.

Out of 100 subjects, 57 were males, 43 were females with male to female ratio of 1.3:1(Table 2)(Figure 2). Respiratory tract infection, urinary tract, blood stream were found to be the common source of infection both in survivor and non-survivor groups. . Respiratory tract was observed the most common in both the group.(Table 3)(Figure 3)

SOFA score analysis showed that the SOFA score was ≤ 5 for 85.3% of the survivors, the mean SOFA score being 3.86.The SOFA score for non-survivors was found to be high (between 10 and 15) and the mean was 10.64, higher the SOFA score, higher would be the mortality rate(Table 4 and 5)(Figure 4 and 5)

It is evident that majority of the study subjects in the survival group had a mean MPV of 11.62 at admission whereas in non-survivor group it was higher with mean MPVof13.34 (Table 6).The mean Mean Platelet Volume on the day of presenting illness was significantly higher in non survivors than survivors. Those patients who had a high Mean Platelet Volume during admission were associated with poor survival. In sepsis patients, when Mean Platelet Volume was cross matched against SOFA score, a positive correlation with Pearson's correlation coefficient of r=0.80 was found. In sepsis patients, the increase in levels of Mean Platelet Volume correlates with the increase in SOFA score 80% of times.The statistical significance was found to be p value is < 0.0001.(Table 7). It shows that higher the MPV higher is the mortality in patients with Sepsis

IV. DISCUSSION

Sepsis is a complex and deadly disease[1]. It is associated with acute organ dysfunction and high risk of mortality[1]. This syndrome requires urgent treatment and awareness[3]. Incidence of sepsis is high and remains one of the leading cause of death globally. [1]Our study was conducted in 100 patients admitted to the Emergency ward ICU and the mean age in both sex is 64 years which is comparable with studyconducted by Rahul PN et al the mean age is 64.2years[10] , study by Ebarhardt et almean age is 71years.[11]

The most common source of infection was respiratory tract which accounts for 33% followed by urinary tract infections in our study which is comparable with other studies conducted by Rahul PN et al and Ebarhardt et al.

In our study Mean sofa score is 3.86 in survivors and 10.6 among non survivors. Those patients with scores less than 5 had a better survival rate and short duration of hospital stay. Those patients with the SOFA scores above 10 had a high mortality rate.

In our study Mean MPV among survivors was 11.62 and 13.34 among non survivors which is comparable with other studies conducted by Ebarhardt et almean MPV among survivors it was 11.6 in survivors and 13.1 among non survivors. In study conducted by Rahul PN et al mean MPV among survivors was 11.6 and 13.1 among non survivors. So in our studythe mean MPV on the day of presenting the illness was significantly higher in non survivors than survivors. Those patients who had a high MPV during admission were associated with increased mortality.

Based on the changes in Mean Platelet Volume during admission, after 72 hours and after 7 days it was evident that majority of the study subjects in the survival group had a mean RDW of 13.62 at admission,13.5 after 72 hours and 13.18 after 7 days. In the non survivors group, theMean Platelet Volume was 16.35 during admission, 16.18 after 72 hours, and 16 after 7 days. From this we might conclude that the increase in Mean Platelet Volume at admission in sepsis patients was associated with a significant increase in death outcome. No statistical significant conclusion could be made among these group as far as Mean Platelet Volumefrom baseline to 72 hours and after 7 days of hospitalization is concerned.(Table 6)(Figure 6)

Mean Platelet Volume is an indicator which can vary in sepsis under the influence of TNF-α, IFN-δ, IL-1β, IL-6, the pro inflammatory cytokines which are released during the inflammatory process. These cytokines cause structural and functional changes of platelets with volume variation. This may be accounted for an increased value of MPV.[7]

V. CONCLUSION

Mean Platelet Volume was found to be higher in patients with sepsis. On comparing these values MPV was found to be significantly higher in non-survivors than in survivors. High MPV was associated with high SOFA score and increased mortality.

Hence this can be simple, inexpensive and a novel prognostic marker of sepsis and its associated mortality

Table 1: Age distribution

Age groups	Survivors	%	Non-survivors	%
18-40	14	18.7	0	0
41-60	44	58.7	12	52

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>_60	17	22.7	13	48
TOTAL	75	100	25	100

Figure1: Age distribution

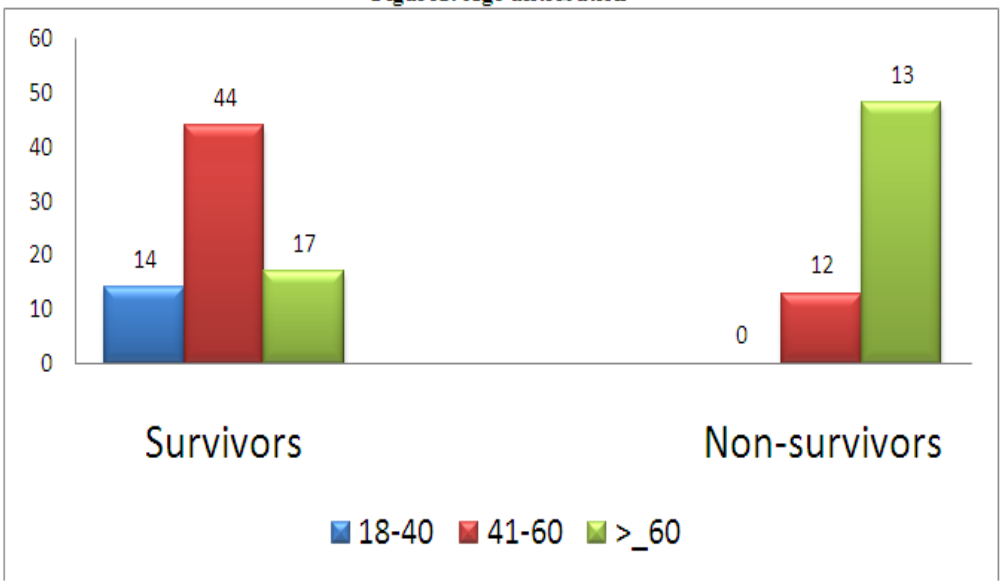

Table 2:Gender status

Gender Status	Survivors	%	Non-survivors	%
MALE	40	53.3%	17	68
FEMALE	35	46.7%	8	32
TOTAL	75	100%	25	100%
P value Chi square test	0.2			

Figure2: Gender status

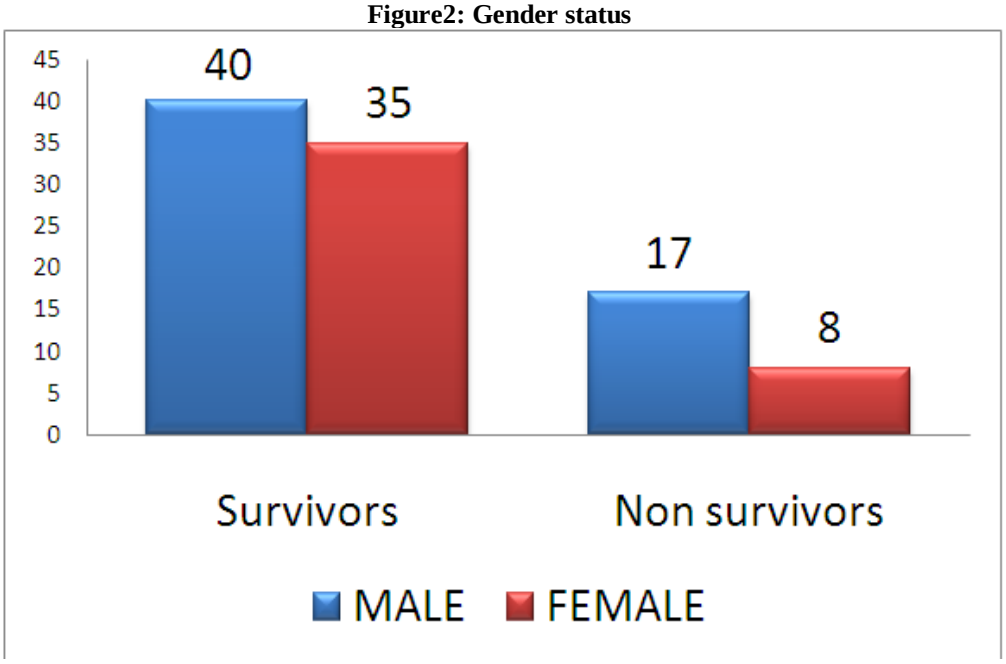

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Table 3:Source of infection

Source of Infection	Survivors	%	Non-survivors	%
Respiratory	24	32	9	36
Urinary Tract	18	24	5	20
Abdominal	13	17.3	3	12
Soft tissue	7	9.3	6	34
Blood Stream	13	17.3	2	8
TOTAL	75	100%	25	100%

Figure 3:Source of infection

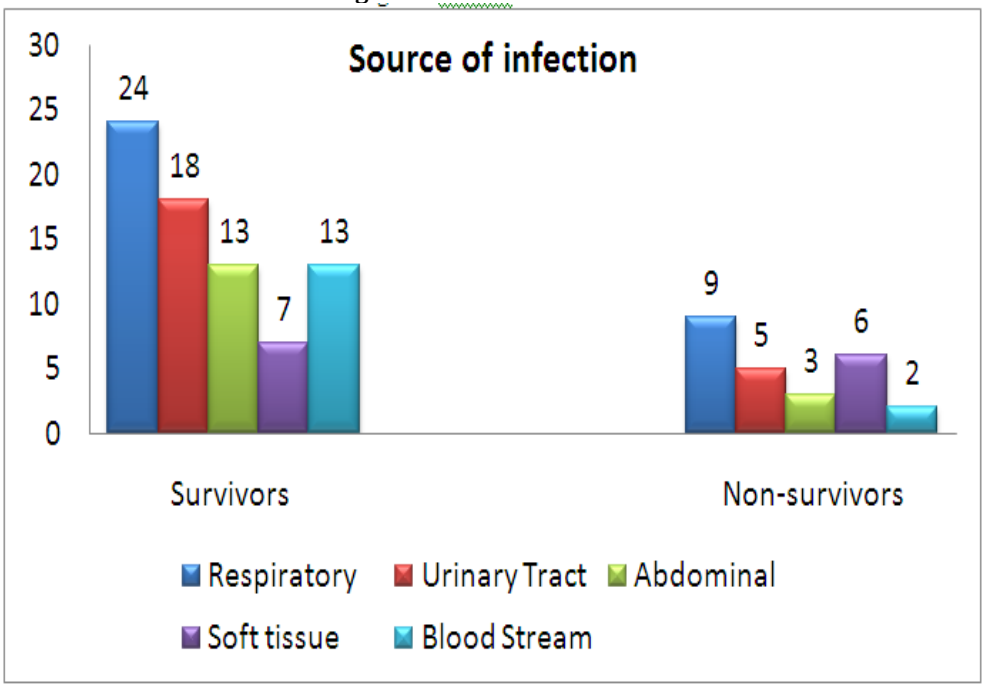

Table4:SOFA Score

SOFA SCORE	Survivors	Percentage	Non survivors	Percentage
<_5	64	85.3	2	8
6-10	11	14.7	8	32
11-15	0	0	15	60
>15	0	0	0	0
Total	75	100%	25	100%

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Figure4:SOFA SCORE

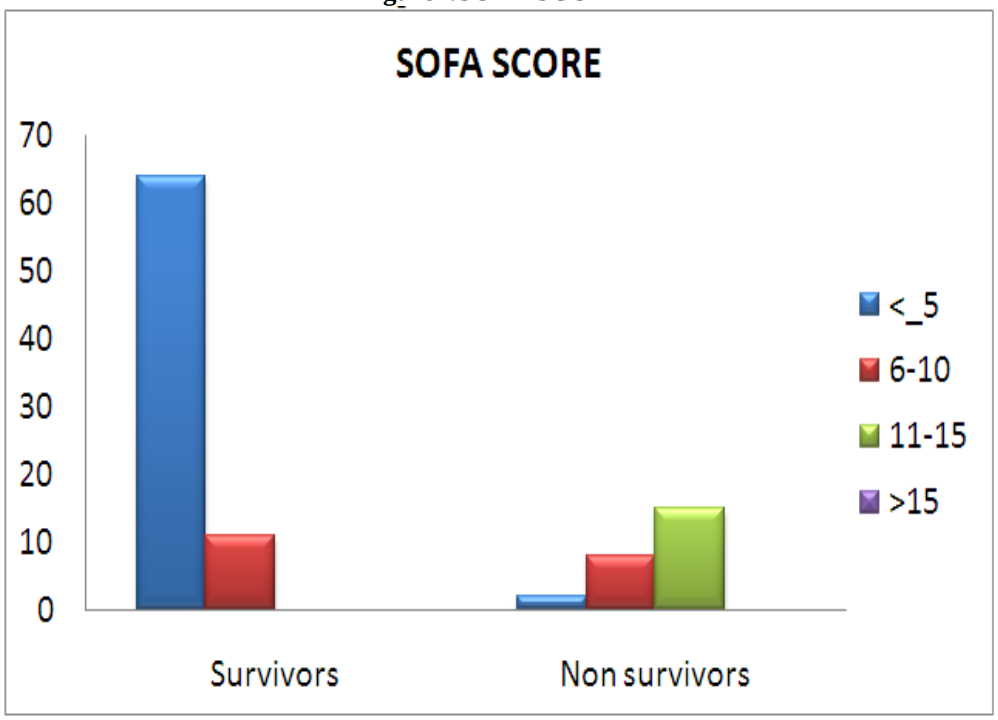

Table5:SOFA Score distribution

SOFA SCORE	Survivors	Non survivors
Mean	3.86	10.64
SD	1.44	3.03
P value	<0.0001	

Figure 5: SOFA Score distribution

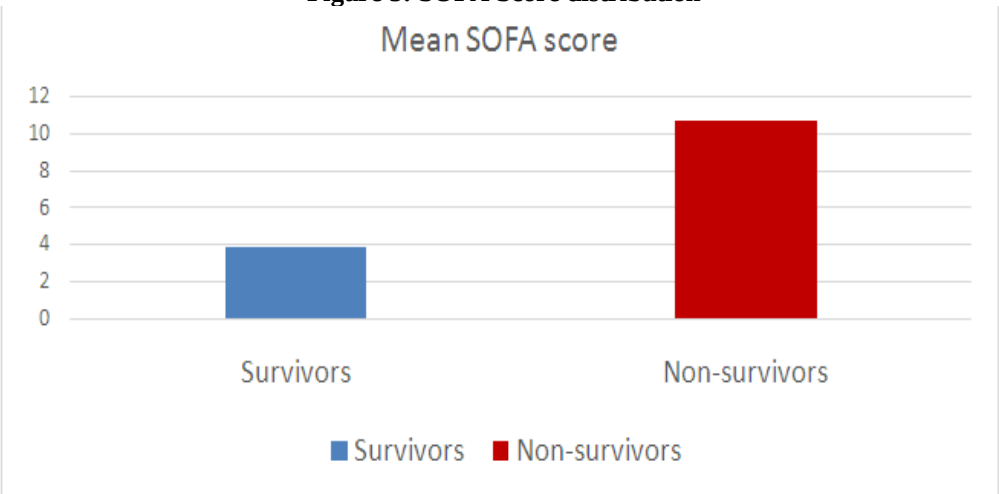

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Table 6:Variation of MPV

MPV		At Admission	After 72hrs	After 7 days
Survivors	Mean	13.62	13.5	13.18
	SD	0.63	0.62	1.29
Non Survivors	Mean	16.35	16.18	16
	SD	0.96	1.01	1.01
P Value		<0.001	<0.001	<0.001

Figure 6:Variation of MPV

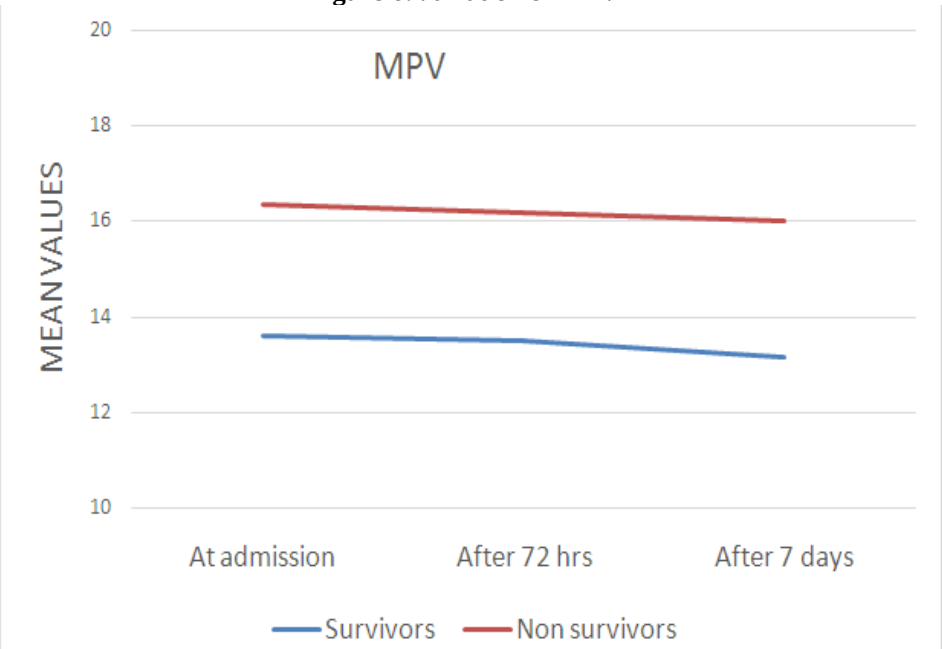
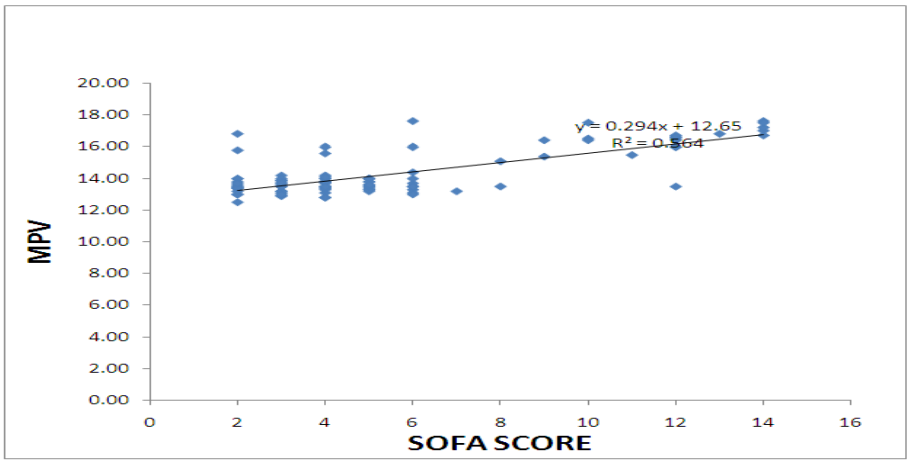


Table 7:Correlation of MPV with SOFA Score

MPV Vs SOFA Score Correlation	
Pearson's R	0.75
R Square	0.63
F statistic	190.826
P value	<0.0001

Figure7:Correlation of MPV with SOFA Score



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