# PROGNOSTIC VALUE OF PLATELET INDICES IN SEPSIS: A RETROSPECTIVE OBSERVATIONAL STUDY


## Abstract

**Background:** Sepsis is a leading cause of morbidity and mortality in intensive care units (ICUs), early prognostication is critical for optimal management. Platelet indices—such as platelet count (PLT), mean platelet volume (MPV), and platelet distribution width (PDW)—are emerging as readily accessible biomarkers for risk stratification in sepsis.

**Methods:** This retrospective observational study included 114 adult patients diagnosed with sepsis (SOFA score ≥2) and admitted to the ICU at a tertiary care hospital between March 2024 and May 2025. Patients with confounding conditions such as age <18 years, pregnancy, recent transfusion, malignancy, chronic liver/kidney disease, autoimmune disorders, or use of antiplatelet/anticoagulant agents were excluded. Platelet indices were recorded on days 1, 2, and 3 of ICU admission. Associations between platelet indices, clinical outcomes (mortality and intubation requirement), and duration of ICU stay were analyzed using appropriate statistical tests.

**Results:** The majority of patients were in the 60–79 year age group, with pneumonia as the leading cause of sepsis. Overall ICU mortality was 31.6%, and 33.3% of patients required intubation. On day 1, patients who died had significantly lower PLT (1.31 ± 0.93 vs. 2.09 ± 0.93, $p<0.001$) and higher MPV (10.80 ± 1.59 vs. 10.13 ± 1.28, $p=0.019$) and PDW (16.88 ± 0.69 vs. 16.16 ± 0.77, $p<0.001$) compared to survivors. Similar associations were found in patients requiring intubation. The prognostic significance of these indices diminished after day 1. Comparative analysis with prior studies consistently demonstrated that early abnormalities in platelet indices are associated with increased mortality and need for mechanical ventilation in sepsis.

**Conclusions:** Early derangements in platelet indices—particularly lower PLT, higher MPV, and higher PDW—are strongly associated with mortality and respiratory failure in sepsis. Routine assessment of these indices upon ICU admission can serve as a valuable, cost-effective tool for early risk stratification and clinical decision-making in critically ill septic patients.



**Keywords:** *Sepsis; Platelet Count; Mean Platelet Volume; Platelet Distribution Width; Intensive Care Units; Mortality; Prognosis; Risk Assessment; Biomarkers; Critical Illness;*


## Introduction

Sepsis remains a major global health challenge and a leading cause of morbidity and mortality in intensive care units (ICUs) worldwide. Characterized by life-threatening organ dysfunction caused by a dysregulated host response to

infection, sepsis accounts for substantial healthcare resource utilization and is associated with high short- and long-term mortality rates, especially among elderly and immunocompromised populations. Early identification of patients at increased risk for adverse outcomes is crucial for prompt and targeted management strategies that can potentially improve survival [1-3].

Among the numerous biomarkers evaluated in the setting of sepsis, hematological parameters, particularly those derived from routine complete blood counts, have garnered increasing interest due to their accessibility, low cost, and potential prognostic value. Platelets, traditionally recognized for their role in hemostasis, have emerged as key players in the pathophysiology of sepsis, with recent evidence highlighting their contribution to immune modulation, endothelial dysfunction, and microvascular thrombosis. In this context, platelet indices such as platelet count (PLT), mean platelet volume (MPV), and platelet distribution width (PDW) have been studied as potential markers for the severity of illness and prognosis in septic patients.

Several studies have demonstrated that alterations in platelet indices may reflect the complex interplay between thrombopoiesis, platelet consumption, and inflammatory processes in sepsis[3-5]. A decreasing platelet count, for example, has been associated with increased disease severity and higher mortality, while changes in MPV and PDW may indicate enhanced platelet activation or production of younger, larger platelets in response to systemic inflammation. However, the clinical utility of these indices for early risk stratification remains an area of ongoing investigation, with variations observed across different patient populations and care settings.

Given the burden of sepsis and the need for simple, reliable prognostic tools, this study was undertaken to evaluate the association between platelet indices (PLT, MPV, PDW) and clinical outcomes—including mortality and the need for intubation—among patients with sepsis admitted to the ICU of a tertiary care hospital. By elucidating the temporal patterns and prognostic significance of these readily available hematological markers, we aim to contribute to the growing body of evidence supporting the integration of platelet indices into the routine assessment of septic patients.

## METHODOLOGY

This retrospective observational study was conducted in the Department of Emergency Medicine at Bapuji Hospital, India, from March 2024 to May 2025. The study aimed to investigate the prognostic significance of platelet indices in adult patients presenting with sepsis. All data were obtained from hospital medical records, and patient confidentiality was strictly maintained throughout the study.

Patients were included if they were aged 18 years or older and had clinical features suggestive of sepsis, with a Sequential Organ Failure Assessment (SOFA) score of 2 or higher, in accordance with the Sepsis-3 criteria. Patients were excluded if they were younger than 18 years, pregnant, had received a blood transfusion within the preceding 30 days, or had a history of malignancy, chronic liver disease (CLD), chronic kidney disease (CKD), or autoimmune diseases. Additionally, those who were receiving antiplatelet or anticoagulant medications at the time of admission were also excluded.

The minimum required sample size was calculated based on the formula $N = Z\alpha^2 S^2/d^2$, where $Z\alpha$ was set at 1.96 for a 95% confidence level, S was the standard deviation (123446.02), and d was the relative precision (10% of the mean value, with mean = 203328.57), as referenced from a previous study ("Utility of Platelet Indices as a Predictive Marker in Sepsis: An Observational Study From North East India" by Dibya J. Sharma et al.). Using these parameters and ensuring a power of 85%, the calculated minimum sample size was 114.

Data extraction included demographic details, clinical characteristics, causes of sepsis, duration of ICU stay, clinical outcomes, intubation status, and laboratory values of platelet indices (PLT, MPV, PDW) on days 1, 2, and 3 of ICU admission. The distribution of continuous variables was assessed using the Kolmogorov–Smirnov test. For continuous variables with a normal distribution, mean and standard deviation (SD) were reported, while for non-normally distributed variables, the median and interquartile range (IQR) were presented. Categorical variables were described as frequencies and percentages. The student t test was applied to compare variables between groups. Statistical analyses were performed using SPSS software version 26.0. A p-value of less than 0.05 was considered statistically significant.

**Results:**

The study enrolled 114 critically ill patients admitted to the intensive care unit (ICU) with various infectious etiologies. The population was predominantly older, with 40.4% of patients aged 60–79 years, followed by 25.4% aged 40–59 years, 19.3% aged 18–39 years, and 14.9% aged 80 years or older. The most frequent cause of ICU admission was pneumonia (35.1%), underscoring the burden of respiratory infections among critically ill adults. Other notable causes included acute gastroenteritis (16.7%), urosepsis(18.4%), and cellulitis (14.0%), indicating a diverse spectrum of systemic and localized infections. Rarer etiologies, such as meningoencephalitis and cholecystitis, were also represented. The majority of patients (56.1%) experienced a relatively short ICU stay of 1–5 days, while 36.8% required 6–10 days, and only a minority (7.0%) had prolonged stays exceeding 10 days. These data provide a comprehensive overview of the demographic and clinical spectrum in the study cohort, reflecting the typical heterogeneity of critically ill patients with infectious diseases.

**Platelet Indices Over Time**

Serial evaluation of platelet indices was performed during the first three days of ICU admission. The mean platelet count (PLT) increased modestly from 1.86 ± 0.96 ×10^9/L on day 1 to 2.08 ± 0.85 ×10^9/L on day 3, suggesting partial recovery or stabilization of thrombopoiesis in some patients. Mean platelet volume (MPV) remained stable over the three days (10.34 ± 1.42 fL on day 1 to 10.37 ± 1.31 fL on day 3), indicating no significant acute change in platelet size, which may reflect the absence of marked consumptive or regenerative responses in the population as a whole. Platelet distribution width (PDW) also showed little variation (16.38 ± 0.81 on day 1 to 16.30 ± 0.99 on day 3), further suggesting that, at the group level, platelet heterogeneity did not change significantly over the initial ICU period. These findings point to relative stability in platelet indices among the entire cohort, though subsequent analyses explored their prognostic significance.

**Clinical Outcome**

Of the total cohort, 68.4% (n=78) survived and showed clinical improvement, while 31.6% (n=36) died during their ICU stay, reflecting a high mortality rate typical of critically ill populations with severe infections. Additionally, 33.3% (n=38) of patients required intubation and mechanical ventilation, highlighting the substantial respiratory support needs in this group. Two-thirds of patients (66.7%) did not require intubation. These outcomes underscore the severity of illness and the high-risk nature of the study population.

### Association of Platelet Indices with Outcome

Analysis of platelet indices in relation to patient outcomes revealed significant associations, particularly in the early phase of ICU admission. On day 1, patients who died had significantly lower mean platelet counts (1.31 ± 0.93 ×10^9/L) compared to those who improved (2.09 ± 0.93 ×10^9/L, $p<0.001$), and this association persisted on day 2 ($p=0.002$) but was not statistically significant by day 3 ($p=0.359$). Similarly, MPV was significantly higher in patients who died on day 1 (10.80 ± 1.59 fL) than in those who improved (10.13 ± 1.28 fL, $p=0.019$), though this difference was not maintained on subsequent days. PDW followed the same pattern, being significantly higher in the mortality group on day 1 (16.88 ± 0.69 vs. 16.16 ± 0.77, $p<0.001$) but not thereafter. These findings suggest that **early derangements in platelet indices, particularly lower platelet count and elevated MPV/PDW, are associated with increased mortality risk** among critically ill patients.

### Association of Platelet Indices with Intubation Status

A similar pattern was observed when analyzing the association of platelet indices with intubation status. On day 1, patients requiring intubation had significantly lower platelet counts (1.57 ± 1.17 ×10^9/L) compared to non-intubated patients (2.01 ± 0.81 ×10^9/L, $p=0.021$). These differences persisted on day 2 ($p=0.035$) but were not significant by day 3. In addition, MPV and PDW were significantly higher in the intubated group on day 1 (MPV: 10.75 ± 1.54 vs. 10.14 ± 1.32, $p=0.029$; PDW: 16.84 ± 0.70 vs. 16.16 ± 0.77, $p<0.001$). Again, these associations were not significant on days 2 and 3. These results indicate that **early platelet abnormalities—lower platelet count, higher MPV, and higher PDW—are predictive of the need for invasive respiratory support** in critically ill patients. The temporal pattern, with strongest associations on day 1, suggests that these indices may serve as early markers of disease severity and impending clinical deterioration.

## DISCUSSION

Sepsis remains a major cause of morbidity and mortality in the intensive care unit (ICU) worldwide, and early identification of patients at risk for adverse outcomes is essential for optimizing management. This study explored the prognostic significance of routine platelet indices—including platelet count (PLT), mean platelet volume (MPV), and platelet distribution width (PDW)—in patients with sepsis admitted to the ICU. By analyzing our findings in the context of existing literature, we aimed to better elucidate the value of these readily available hematological parameters for risk stratification, prediction of mortality, and the need for mechanical ventilation in critically ill patients.

### Demographics and Clinical Characteristics

In our study, we analyzed 114 adult patients admitted to the ICU with sepsis. The majority were in the 60–79 years age group, underscoring the increased susceptibility of elderly individuals to severe infections. Pneumonia was the most common cause of sepsis (35.1%), followed by urosepsis, acute gastroenteritis and cellulitis. The majority of patients (56.1%) had a relatively short ICU stay of 1–5 days.

Similar demographic and clinical trends were observed in several other studies. In the study by Sharma DJ et al. [4], 100 adult sepsis patients were included, with a mean age of 48.05 ± 19.27 years—slightly younger than our cohort—and a slight male predominance (52%) with pneumonia (23%) and urinary tract infections (18%) as the leading etiologies, paralleling the trends seen in our study. Guclu E et al. [5] included 145 sepsis patients, also reporting a male predominance (57.9%) and a median age of 69 years [IQR: 49.5–78.0], closely matching the age distribution in our study. Respiratory infections were again the most common source of sepsis, and both medical and surgical patients were represented. Sharma S et al. [6] recruited 100 patients aged 21–90 years (mean age 48.3 ± 16.3 years), with the 31–40 and 41–50 year age groups being the most commonly affected. This study also reported a higher proportion of male patients (63%), consistent with trends in other cohorts. Saharia HK et al. [7] evaluated 102 sepsis patients, with a mean age of 57.02 ± 19.43 years in those who died and 60.27 ± 20.38 years in survivors, with no significant age difference between groups. The overall in-ICU mortality rate in their study was 31.4%, while 68.6% of patients improved—figures that are broadly similar to those seen in our population. Finally, Gupta A et al. [9] analyzed 177 sepsis patients with a mean age of 51.9 ± 18.2 years and a slight male predominance (57.6%). Most patients in their study fell within the 40–60 year age group (41.8%). Across these studies, there is consistency in the observation that sepsis disproportionately affects older adults and males, with respiratory infections and pneumonia being the leading causes of ICU admission. These demographic patterns provide important context for interpreting platelet indices and outcomes in sepsis.

**Platelet Indices and Mortality**

In our study, stratification by clinical outcome revealed that patients who died (31.6% of the cohort) exhibited significantly lower platelet counts (PLT) and higher mean platelet volume (MPV) and platelet distribution width (PDW) on day 1 of ICU admission compared to survivors. These associations were statistically significant (PLT, $p<0.001$; MPV, $p=0.019$; PDW, $p<0.001$). The predictive relationship between lower PLT and mortality persisted on day 2, though differences in MPV and PDW became non-significant in subsequent days, and by day 3, none of the indices were significantly associated with mortality. These findings highlight the prognostic importance of early platelet abnormalities in sepsis, particularly at ICU admission.

Comparable trends were observed in previous studies. Sharma DJ et al. [4] reported that 35% of their patients had thrombocytopenia on admission, with non-survivors experiencing persistently lower and declining platelet counts from day 1 to day 3, while survivors saw an increase in platelet count over the same period. Furthermore, PDW decreased among survivors but increased among non-survivors, and MPV declined in survivors but rose in non-survivors, with all these changes being statistically significant ($p<0.001$). These dynamic shifts closely mirror the temporal patterns noted in our cohort.

Guclu E et al. [5] found that 35.2% of sepsis patients died within a 28-day follow-up. Although thrombocytopenia was more common in non-survivors, this difference was not statistically significant. Importantly, however, PDW was significantly higher in non-survivors (p=0.001), and both MPV and PDW emerged as independent risk factors for sepsis mortality in multivariate analysis, further underscoring their clinical value as prognostic markers.

Similarly, Sharma S et al. [6] reported a survival rate of 76% and found that non-survivors had more pronounced reductions in total leukocyte count and platelet count from day 1 to day 7, supporting the association between falling platelet indices and worse outcomes in sepsis.

Saharia HK et al. [7] demonstrated that patients who died had consistently lower platelet counts, higher PDW, and higher MPV throughout the first five days of ICU admission. Plateletcrit (PCT) was also significantly lower, and the Platelet to Large Cell Ratio (PLCR) was consistently lower in non-survivors, reinforcing the prognostic relevance of dynamic platelet indices.

In the study by Taha RS et al. [8], non-survivors had lower PLT and PCT, but higher MPV and PDW at all measured time points compared to survivors. Importantly, MPV (cut-off >10.9) and PDW (cut-off >14) demonstrated high sensitivity and specificity for mortality prediction, and both were identified as significant predictors of mortality in univariate and multivariate analyses, alongside procalcitonin.

Lastly, Gupta A et al. [9] confirmed the strong prognostic value of platelet indices in sepsis. Non-survivors had significantly higher MPV and PDW, and lower PCT compared to survivors, with PCT showing the best predictive value for mortality at a cutoff ≤0.22. The discriminatory ability of MPV, PCT, and PDW for mortality prediction was deemed acceptable.

Taken together, these findings from our study and previous research consistently indicate that early abnormalities in platelet indices—particularly lower platelet count, elevated MPV, and increased PDW—are closely associated with increased mortality risk in sepsis. The strongest predictive value is observed early in the course of ICU admission, underscoring the importance of early assessment and continuous monitoring of platelet indices for timely risk stratification in critically ill patients with sepsis.

Taken together, our study demonstrates that **early changes in platelet indices—particularly lower PLT and elevated MPV and PDW on the first day of ICU admission—are associated with both increased mortality and greater likelihood of intubation**. However, the predictive value of these parameters diminishes over time, highlighting the importance of early assessment. The stability of platelet indices in the overall cohort, despite these subgroup differences, further underscores the relevance of dynamic, early changes as opposed to absolute values alone.

## Conclusion

This study demonstrates that early alterations in platelet indices, specifically lower platelet count and elevated mean platelet volume and platelet distribution width, are significantly associated with increased mortality and the need for intubation

among critically ill patients with infectious diseases. These associations were most pronounced on the first day of ICU admission and diminished over subsequent days, highlighting the prognostic value of early assessment. The stability of platelet indices in the overall cohort suggests that pronounced deviations are markers of poor prognosis rather than general features of ICU admission.

Our findings support the utility of routinely measured platelet indices as accessible, cost-effective biomarkers for early risk stratification in the ICU setting. Identifying patients at greater risk for adverse outcomes using these hematological parameters may enable more aggressive monitoring and timely interventions, potentially improving clinical outcomes. Future prospective, multicenter studies are warranted to validate these observations and explore the underlying mechanisms linking platelet abnormalities to critical illness severity and outcome.

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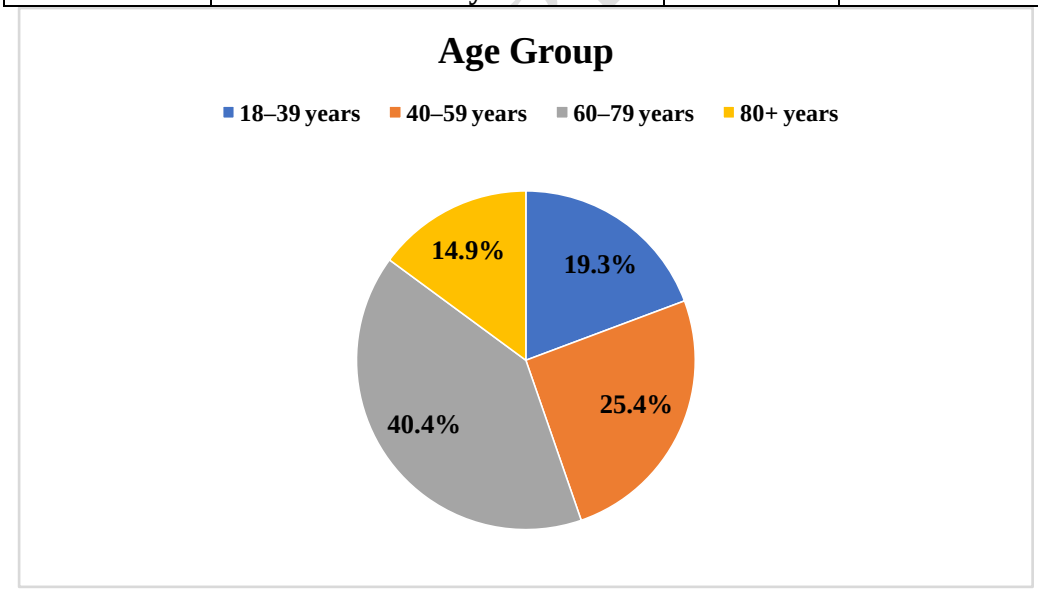
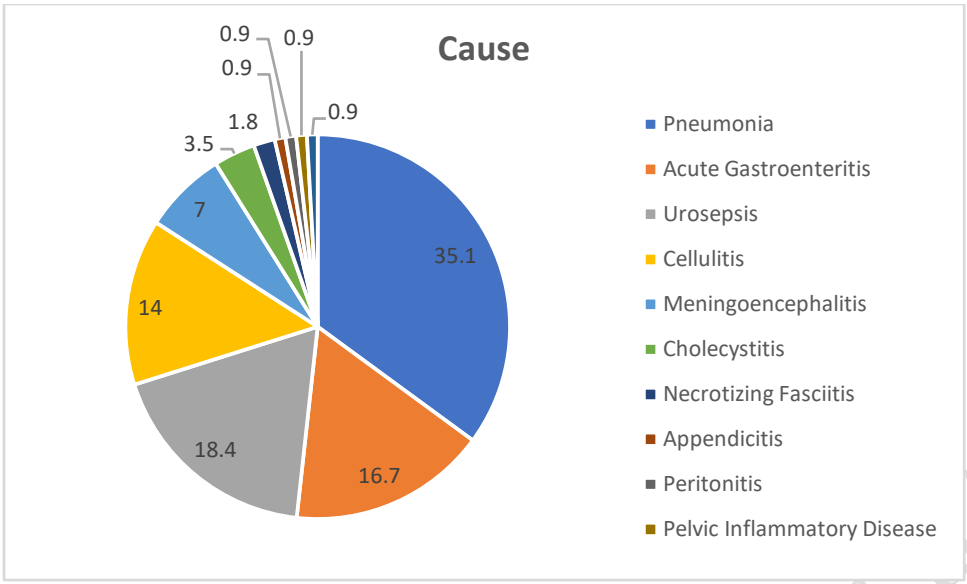
**Table 1. Characteristics of the study population**

| Characteristics | | Frequency | Percentage (%) |
|---|---|---|---|
| **Age** | **18–39 years** | 22 | 19.3 |
| | **40–59 years** | 29 | 25.4 |
| | **60–79 years** | 46 | 40.4 |
| | **80+ years** | 17 | 14.9 |
| **Cause** | **Pneumonia** | 40 | 35.1 |
| | **Acute Gastroenteritis** | 19 | 16.7 |
| | **Urosepsis** | 21 | 18.4 |
| | **Cellulitis** | 16 | 14.0 |
| | **Meningoencephalitis** | 8 | 7.0 |
| | **Cholecystitis** | 4 | 3.5 |
| | **Necrotizing Fasciitis** | 2 | 1.8 |
| | **Appendicitis** | 1 | 0.9 |
| | **Peritonitis** | 1 | 0.9 |
| | **Pelvic Inflammatory Disease** | 1 | 0.9 |
| | **Renal Abscess** | 1 | 0.9 |
| **ICU Stay** | **1–5 days** | 64 | 56.1 |
| | **6–10 days** | 42 | 36.8 |
| | **>10 days** | 8 | 7.0 |



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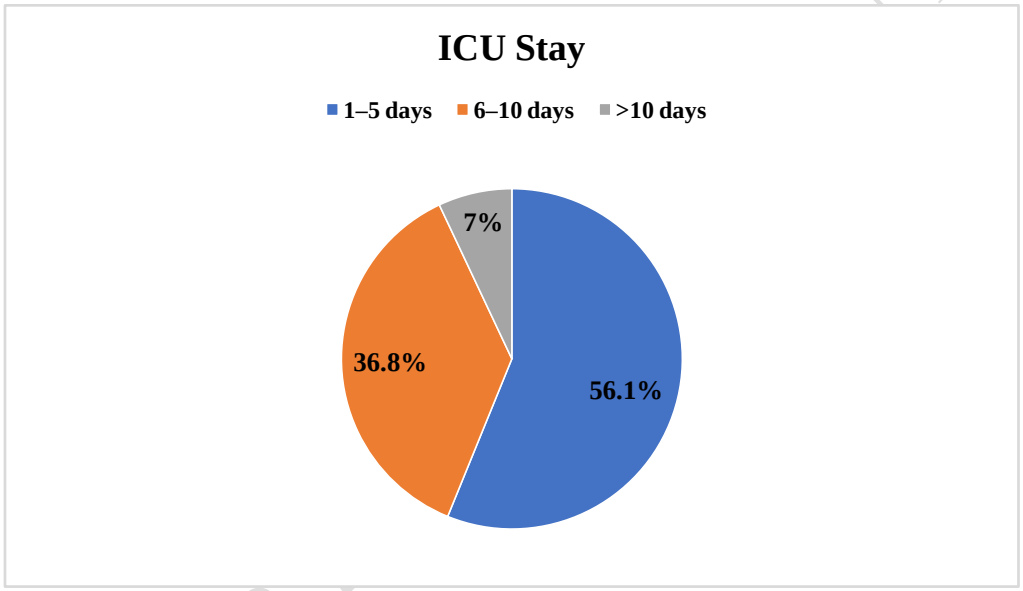


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319 **Table 2. Platelet indices over time (Mean ± SD)**

| Time Point | PLT | MPV | PDW |
|---|---|---|---|
| **Day 1** | 1.86 ± 0.96 | 10.34 ± 1.42 | 16.38 ± 0.81 |
| **Day 2** | 1.89 ± 0.90 | 10.40 ± 1.22 | 16.37 ± 0.96 |
| **Day 3** | 2.08 ± 0.85 | 10.37 ± 1.31 | 16.30 ± 0.99 |

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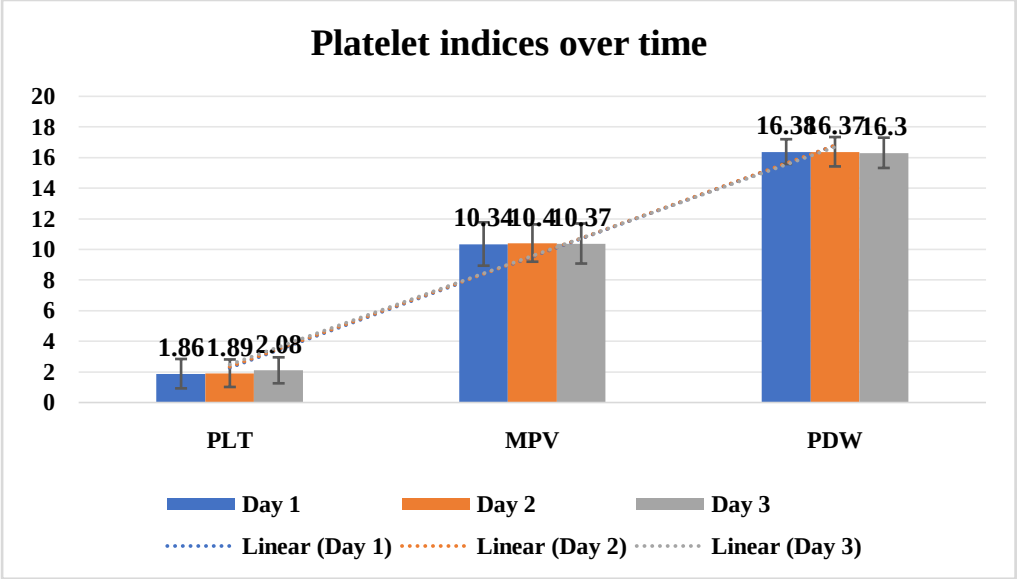


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322 **Table 3. Clinical outcome**

| Clinical outcome | | Frequency | Percentage (%) |
|---|---|---|---|
| **Outcome** | **Improved** | 78 | 68.4 |
| | **Death** | 36 | 31.6 |
| **Intubation Status** | **Yes** | 38 | 33.3 |
| | **No** | 76 | 66.7 |

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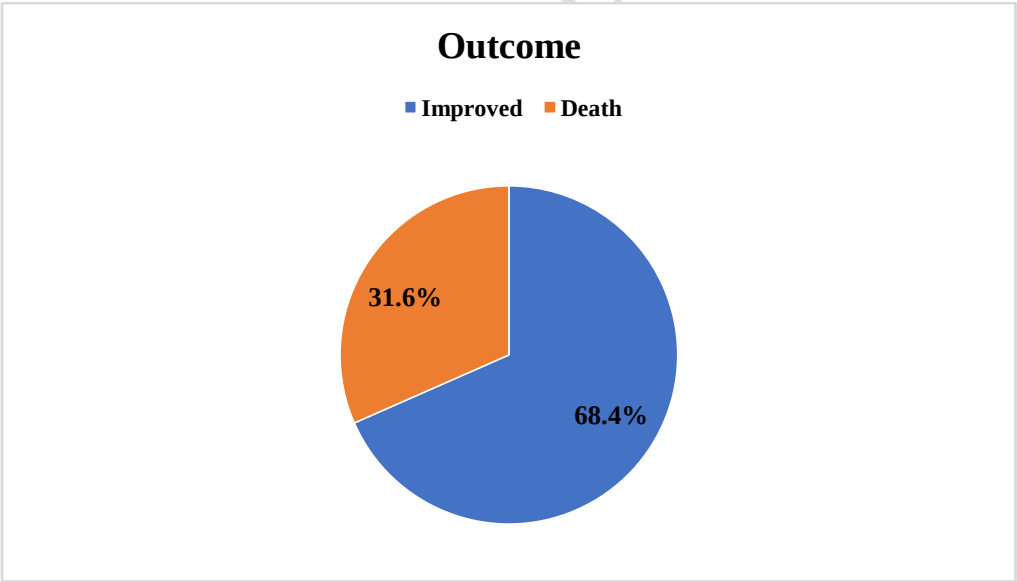


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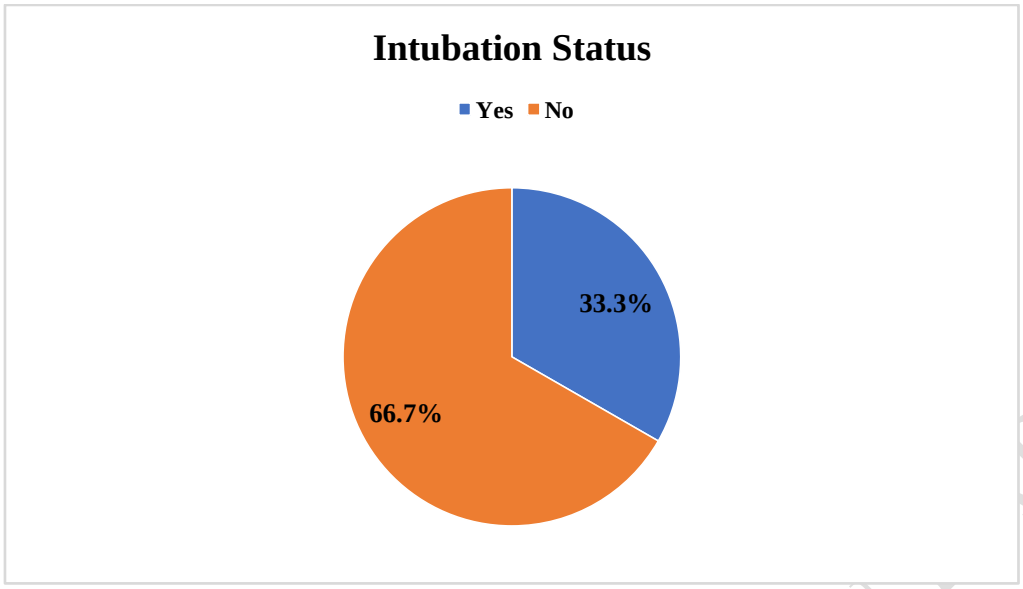
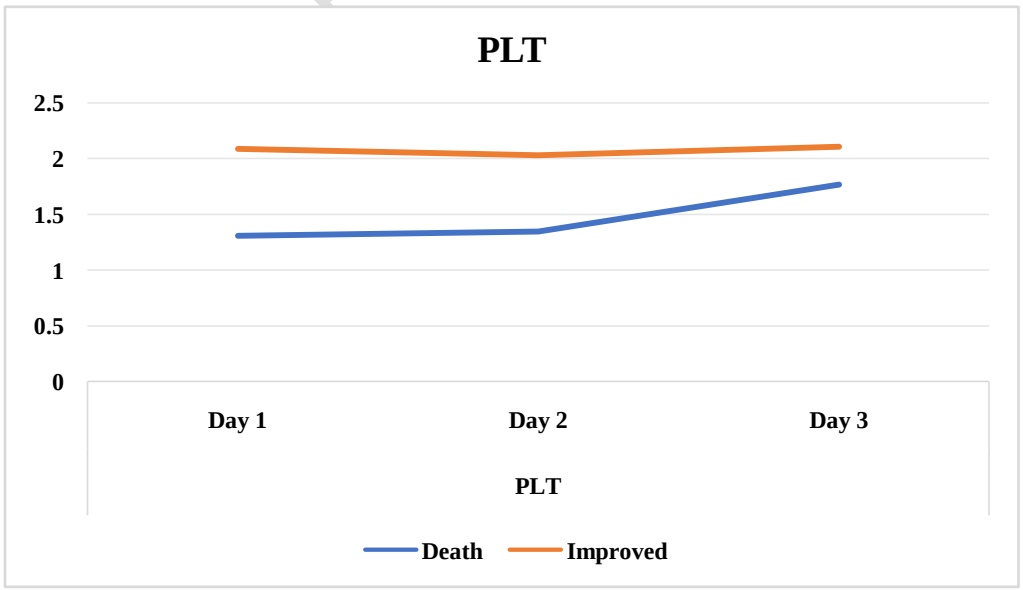
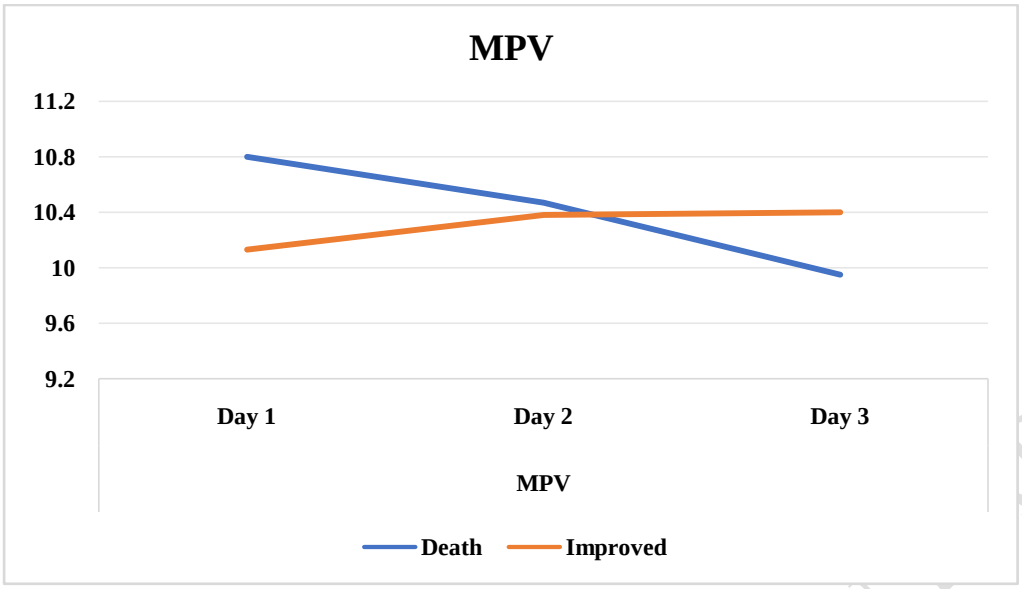



**Table 4. Association of platelet indices with outcome (Mean ± SD)**

| Parameter | Day | Death | Improved | p-value |
|---|---|---|---|---|
| **PLT** | **Day 1** | 1.31 ± 0.93 | 2.09 ± 0.93 | **<0.001** |
| | **Day 2** | 1.35 ± 0.83 | 2.03 ± 0.85 | **0.002** |
| | **Day 3** | 1.77 ± 1.34 | 2.11 ± 0.81 | 0.359 |
| **MPV** | **Day 1** | 10.80 ± 1.59 | 10.13 ± 1.28 | **0.019** |
| | **Day 2** | 10.47 ± 0.82 | 10.38 ± 1.30 | 0.777 |
| | **Day 3** | 9.95 ± 0.62 | 10.40 ± 1.35 | 0.421 |
| **PDW** | **Day 1** | 16.88 ± 0.69 | 16.16 ± 0.77 | **<0.001** |
| | **Day 2** | 16.64 ± 0.61 | 16.30 ± 1.02 | 0.176 |
| | **Day 3** | 16.48 ± 0.60 | 16.29 ± 1.02 | 0.643 |



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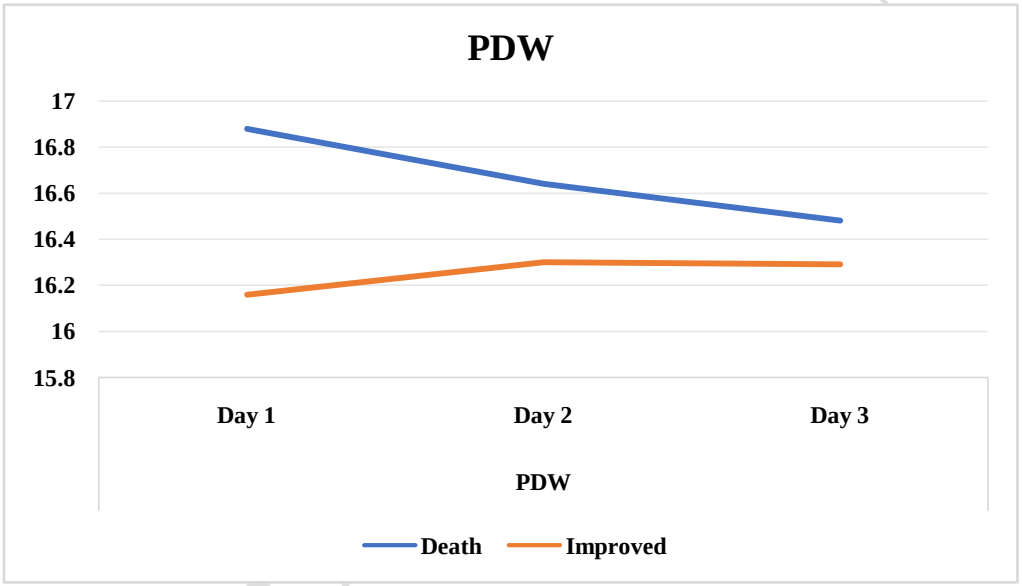


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333 **Table 5. Association of platelet indices with intubation status (Mean ± SD)**

| Parameter | Day | Intubation | No intubation | p-value |
|---|---|---|---|---|
| **PLT** | **Day 1** | 1.57 ± 1.17 | 2.01 ± 0.81 | **0.021** |
| | **Day 2** | 1.53 ± 0.97 | 2.00 ± 0.87 | **0.035** |
| | **Day 3** | 1.88 ± 1.07 | 2.11 ± 0.82 | 0.409 |
| **MPV** | **Day 1** | 10.75 ± 1.54 | 10.14 ± 1.32 | **0.029** |
| | **Day 2** | 10.44 ± 0.78 | 10.39 ± 1.32 | 0.863 |
| | **Day 3** | 10.08 ± 0.63 | 10.41 ± 1.38 | 0.441 |
| **PDW** | **Day 1** | 16.84 ± 0.70 | 16.16 ± 0.77 | **<0.001** |
| | **Day 2** | 16.62 ± 0.59 | 16.30 ± 1.04 | 0.175 |
| | **Day 3** | 16.51 ± 0.57 | 16.27 ± 1.04 | 0.459 |

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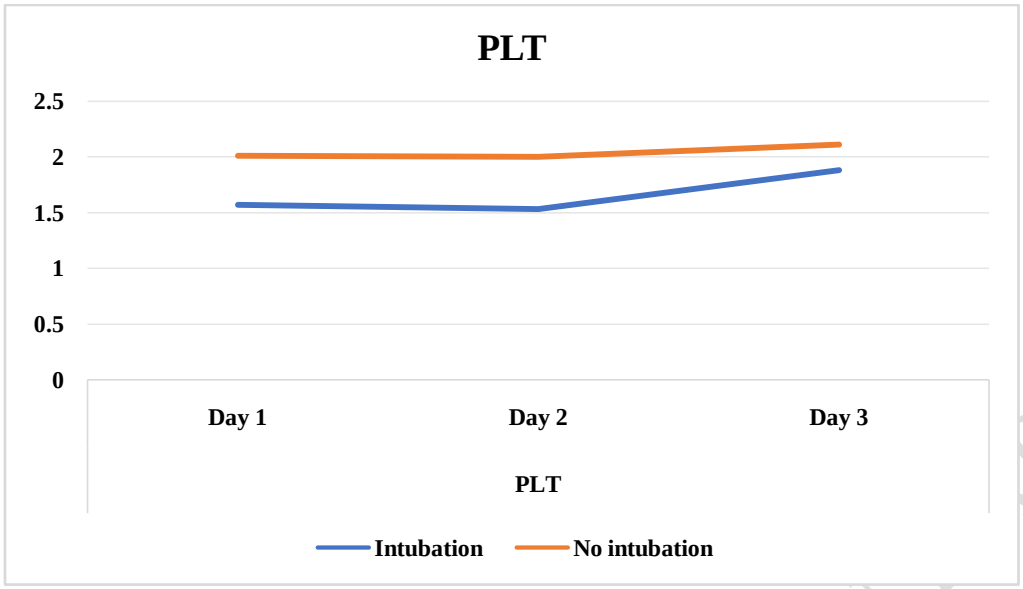


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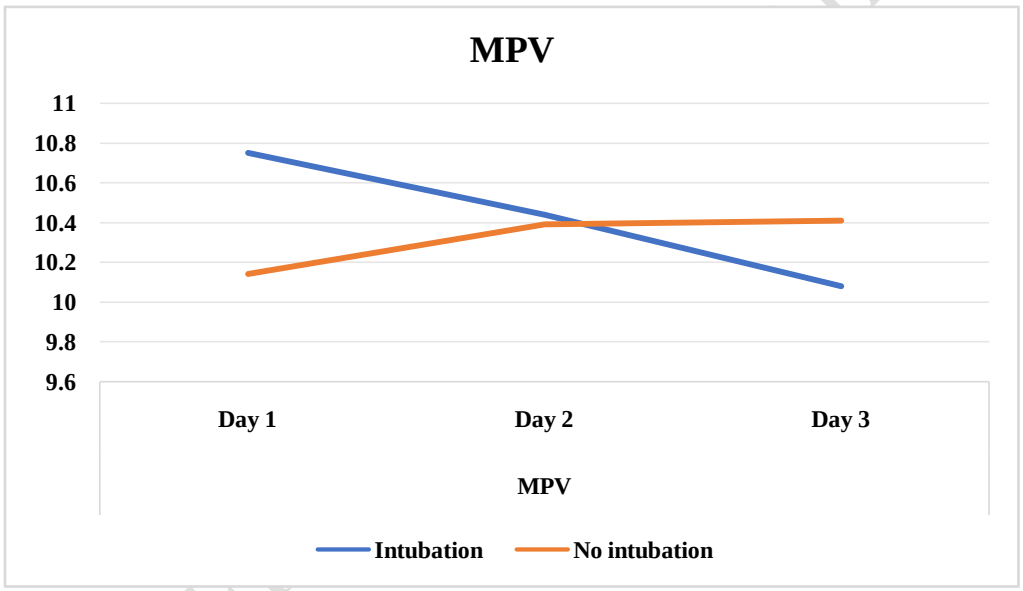


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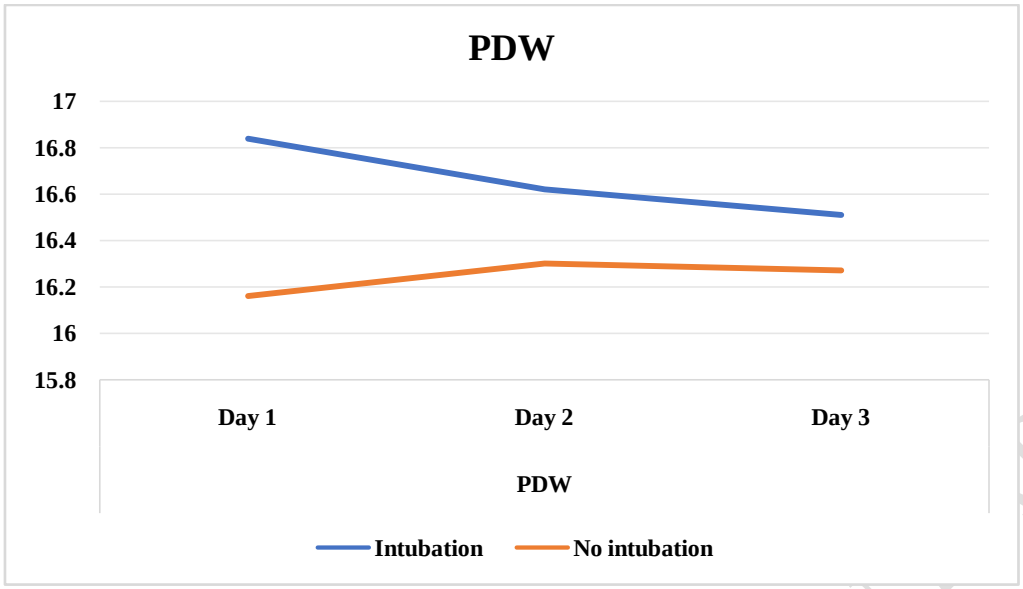


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