

## Platelet counts and its course for predicting in-hospital mortality in intensive care unit

Mohammad Hossein Rahimi-Rad<sup>1</sup>, Mohammad Amin Valizade Hasanloei<sup>2\*</sup>,  
Shahryar Sane<sup>3</sup>, Nasim Alidayi<sup>4</sup>, Shaghaiegh Rahimi-Rad<sup>5</sup>

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### Abstract

**Background & Aims:** Recent studies have shown that thrombocytopenia (TP) is associated with poor outcomes in patients with pneumonia, burns, and H1N1 influenza. The aim of this study is to determine the impact of platelet count trends and TP on mortality in intensive care unit (ICU) patients.

**Materials & Methods:** TP was defined as  $<150,000$  platelets/ml. In this study, 300 patients who had been admitted to the ICU for internal diseases were evaluated for platelet counts on the day of admission and following days to assess the presence of TP. Comparisons were made between patients who died in the ICU and those who were discharged for presence of TP, mean platelet counts, and changes in platelet counts. Platelet count trends were evaluated with repeated measurement tests.  $P < 0.05$  was significant.

**Results:** Of 300 patients, 131 (43.7%) had TP upon admission to the ICU. The rates of TP were 60% among patients who died as compared to 34% among surviving patients ( $p < 0.001$ , risk ratio = 3.07, 95% CI 1.88–5.01). Mean platelet counts on admission day and all four of the following days were significantly lower in patients who died than patients who survived ( $p < 0.001$ ). On the days after admission, platelet counts tended to increase in surviving patients and decreased among non-surviving patients.

**Conclusion:** TP is commonly observed in ICU patients. TP diagnosis and trends of decreasing platelet counts over time are each predictors of mortality among ICU patients. Because platelet counts are inexpensive and readily available, our findings suggest that their use helps inform clinical decision-making in patients with critical illness.

**Keyword:** platelet count, thrombocytopenia, outcome, intensive care unit

**Address:** Department of Anesthesiology and critical care, Imam-Khomeini hospital, Ershad Blv, Urmia, Iran

**Tel:** +98 914 143 8399

**Email:** aminvalizade@yahoo.com

### Introduction

Thrombocytopenia (TP) has an incidence ranging from 13.0% to 76.6% in intensive care units (ICU)

patients (1-3). Causes of TP in ICU include increased platelet consumption, bone marrow suppression, abnormal sequestration of platelets, nutritional

<sup>1</sup> Department of internal medicine, Pulmonologist, Full professor of Urmia university of medical sciences, Urmia, Iran

<sup>2</sup> Department of anesthesiology, Fellow ship of intensive care medicine, Associate professor of Urmia university of medical sciences, Urmia, Iran (coresponding author)

<sup>3</sup> Department of anesthesiology, Fellowship of neuroanesthesia, Assistant professor of urmia university of medical sciences, urmia, Iran

<sup>4</sup> Medical Doctor, Urmia university of medical sciences, Urmia, Iran

<sup>5</sup> Intern of medicine, Tabriz university of medical sciences, Tabriz, Iran

deficiencies, medication effects, hemo dilution, and the presence of disseminated intravascular coagulation (DIC) (4). Sepsis is the leading cause of TP in ICU patients (5). TP is a powerful predictor of mortality in patients with sepsis and septic shock, and its severity correlates with the severity of illness (6). In addition to platelets' roles in hemostasis, they may play a role in the pathophysiology of inflammation and infection (7). Recent findings have shown that platelets play roles in neuroscience, inflammation, infection, and cancer (8). However, its prognostic significance is unresolved (9). Recent studies have shown an association between TP and high mortality in pediatric and adult patients with burns, community-acquired pneumonia (10). and H1N1 Influenza (11). A few studies have associated TP with poor outcomes in both adult and pediatric ICU patients (12-15).

To the best of our knowledge, there are few studies on the impact of TP and platelet count trends in purely medical non-hematologic patients. The goals of this study were to evaluate the impacts of platelet counts and TP on mortality in near-homogeneous, medical, non-hematologic patients.

## Materials and Methods

This study was performed in the ICU of the Imam-Khomeini Teaching Hospital in Urmia, Iran. In this retrospective cohort study, patients who were admitted to ICUs for internal diseases had their platelet count data extracted from hospital chart reviews. Patients with hematologic and/or oncological diseases, surgery unit patients, and patients who did not have CBC upon admission to the ICU were excluded from the study. Platelet counts of  $<150,000/\text{ml}$  were defined as a TP diagnosis. According to platelet counts, patients were

classified into one of three groups: 1) without TP, defined as a platelet count  $>150,000/\text{ml}$ ; 2) mild TP, with a platelet count between  $50,000/\text{ml}$  and  $150,000/\text{ml}$ ; and 3) severe TP, with a platelets count  $<50,000/\text{ml}$ .

SPSS version 22 (IBM) was used for the analysis. Continuous variables are presented as the mean  $\pm$  SD and were compared using Student's t-test. Chi-square tests were used to compare the prevalence of TP among non-surviving and surviving patients. Platelet count trends were evaluated by repeated measurement tests.  $P < 0.05$  was considered statistically significant.

## Results

Of 300 patients, 43.7% met the criteria for TP on admission day. The mortality rate in the ICU was significantly higher among TP than non-TP patients ( $p < 0.001$ , odds ratio=3.07, 95% CI 1.88–5.01). All five CBC showed significantly higher mortality rates in TP than non-TP patients, and in severe TP patients compared to mild TP patients. Table 1 shows a comparison of the three groups.

From the 300 total patients, 108 (36%) died in the ICU, and 192 (64%) were discharged from hospital. The mean platelet count among non-surviving patients was significantly lower than among surviving patients ( $p < 0.001$ ). Table 2 shows a comparison of the mean platelet counts for non-surviving and surviving patient groups. All CBCs showed lower mean platelet counts among non-surviving patients than surviving patients.

Both the non-surviving and surviving patient groups showed decreased platelet counts in the second CBC, but the group who lived showed a trend of increased platelet counts, while the non-surviving group had decreasing platelet counts (Figure 1)

**Table 1:** Shows prevalence and comparison death rate among thrombocytopenic and non- thrombocytopenic patients

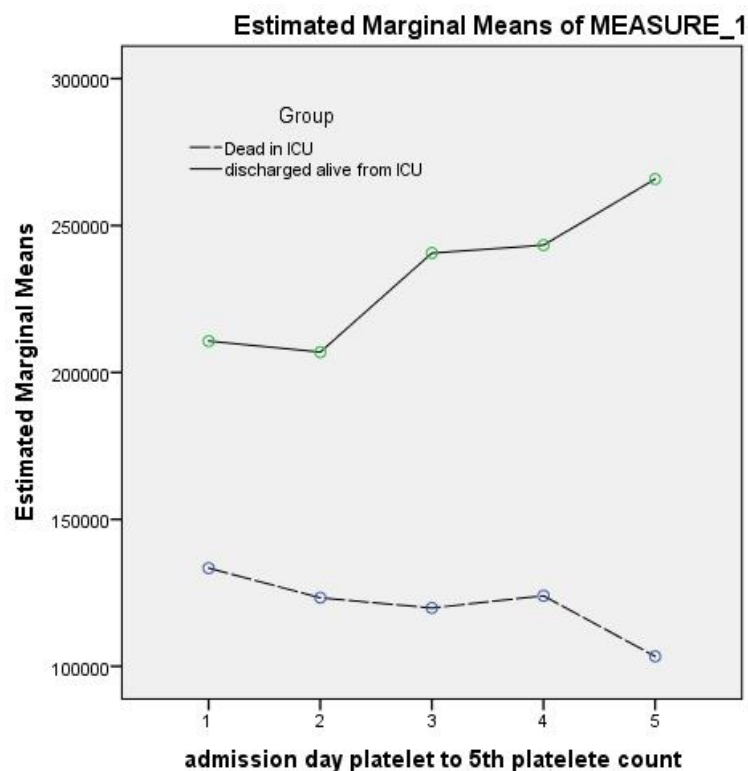
	Died in hospital n (%) <sup>∞</sup>	Discharged alive from hospital n (%) <sup>∞</sup>	Total n(% of all)	Risk ratio* <sup>∞</sup>
First Non-thrombocytopenic	42 (24.9)	127 (75.1)	169 (56.3)	
Any TP<150000/ml	66 (61.1)	65 (33.9)	131 (43.7)	3.07(1.88-
50000< TP<150000	49 (48.0)	53 (52.0)	102 (324.0)	5.006)
TP<50000	17 (58.6)	12 (41.4)	29 (907)	
2nd Non-thrombocytopenic	23 (21.5)	84 (78.5)	107 (35.7)	
2 <sup>nd</sup> Any TP<150000/ml	85 (78.7)	108 (56.3)	193 (64.3)	4.930 (2.66-
2 <sup>nd</sup> 50000< TP<150000	73 (42.0)	101 (58.0)	174 (58.0)	9.13)
2 <sup>nd</sup> TP<50000	12 (63.0)	7 (36.8)	19 (6.3)	
3rd Non-thrombocytopenic	22 (31.0)	49 (69.0)	71 (48.3)	
3 <sup>rd</sup> Any TP<150000/ml	97(89.8)	155(80.7)	252(84.0)	2.60 (1.32-5.12)
3 <sup>rd</sup> 50000< TP<150000	27 (49.1)	28 (50.9)	55 (37.4)	
3 <sup>rd</sup> TP<50000	14(66.7)	7(33.3)	21(7.0)	
4 <sup>th</sup> First Non- thrombocytopenic	11(22.9)	37(77.1)	48(16.0)	
4 <sup>th</sup> Any TP<150000/ml	97(38.5)	155(61.5)	252(84.0)	7.92 (3.16-
4 <sup>th</sup> 50000< TP<150000	22 (62.9)	13 (37.1)	35 (36.8)	19.86)
4 <sup>th</sup> TP<50000	11(91.7)	1(8.3)	12(4.0)	
5 <sup>th</sup> Non-thrombocytopenic	7 (25.0)	21 (75.0)	28 (51.9)	
5 <sup>th</sup> Any TP<150000/ml	20(76.9)	6 (23.1)	26 (48.1)	10.00 (2.86-
5 <sup>th</sup> 50000< TP<150000	12 (66.7)	6 (33.3)	18 (33.3)	34.9)
5 <sup>nd</sup> TP<50000	8(100)	0(0)	8(14.8)	

\*Risk ratio is for cohort patients with a platelet count <150,000/ml vs. platelet count ≥150,000/ml. <sup>∞</sup> All p-values p < 0.005

**Table 2:** Comparison of mean platelets count in died patients and survived patients

	Died in ICU n=108 (36.0%)	Discharged alive from ICU n=192 (64%)
Mean platelets count on admission day	146888,89	212692.92
2 <sup>nd</sup> Mean platelets count	123636.36	208532.26
3 <sup>rd</sup> Mean platelets count	116269,84	214047,62
4 <sup>th</sup> Mean platelets count	113931,89	241019,61
5 <sup>th</sup> Mean platelets count	103370,37	265814,081

All p values p < 0.001



**Figure 1:** Trends in platelet counts among non-surviving patients (dashed line) and surviving patients (continuous line)

## Discussion

In present study, 43.7% of the patients had TP upon admission to the ICU, and the mortality rate was significantly higher for patients with TP.

In a study by Williamson et al (3), TP was observed in 13.3% of patients upon admission to the ICU, and was associated with mortality rates of 14.3%, compared to 10.2% in patients without TP. In a study on Korean ICUs, 28-day mortality was higher in patients with new-onset TP compared to those who did not develop TP (7). Vandijck et al (13) showed TP to be a poor prognostic tool in surgical and medical ICU patients. In patients with TP, the mortality rate in the ICU was 33.8%, compared to 9.3% in patients without TP (1). Stephan et al (14) reported an occurrence of TP among 35% of surgical ICU patients with a mortality rate of 38%, compared to a 20% mortality rate in non-TP patients. TP had negative influences on the outcomes of patients with severe community-acquired pneumonia (15).

In our study, patients with severe TP exhibited higher mortality rates than patients with mild TP. Stauss et al (10) reported that TP (<50,000 platelets/ml) was significantly associated with higher mortality rates in patients with community-acquired pneumonia. Prina et al (16) reported that, among patients with community-acquired pneumonia, patients with TP more commonly presented with severe sepsis, septic shock, a need for invasive mechanical ventilation, and ICU admission, pleural effusion and empyema. Among 60 patients with H1N1 influenza, those with TP had higher mortality rates (11). Among acute kidney injury patients requiring dialysis in the ICU, survivors showed significantly higher platelet counts upon admission to the ICU compared to the non-survivors (17). In patients with acute exacerbation of chronic obstructive pulmonary disease, TP was associated with higher mortality and a greater likelihood of requiring mechanical ventilation (18). Tridente et al (19) had reported that TP during the first 2, 3, 5, and 7 days of an ICU stay was consistently

associated with mortality in the ICU, in the hospital, at 28 days, and at 6 months.

François et al (20) suggested that abnormal platelet counts could be better predictors of outcome than abnormal white blood cell counts, They contribute to platelet ability to release inflammatory, anti-inflammatory, and angiogenic factors (21). White blood cells are well-known for their roles in defending against pathogenic organisms (22) and platelets can recruit leukocytes and progenitor cells to sites of injury. The problematic consequences of white blood cell recruitment include tissue injury, organ dysfunction, and hypoxia (23). Platelets facilitate white blood cell responses, largely via P-selectin, which promotes leukocyte-platelet binding. Similar to the interactions of white blood cells with inflamed endothelia, white blood cells can firmly adhere and roll on a template of adherent platelets, and then transmigrate through the adherent platelets (21).

In our cohort study, more severe TP was found to be independently associated with a higher risk of hospital mortality. In a study by Akca et al (24) platelet count changes in the critically ill had a biphasic pattern in survivors and non-survivors that was similar to our study.

Crowther et al (2) also found that the development of TP was significantly associated with mortality and a longer duration of mechanical ventilation in critical care patients.

It is important to consider platelet count when assessing disease severity, and incorporate this measurement into scoring systems for disease severity. For example, the sequential organ failure assessment score (SOFA) (25) and mortality score (26) which are used for predicting the outcome in ICUs, have included platelet counts in their system parameters. However, the Acute Physiology and Chronic Health Evaluation scoring system II (APACHE II) (27) does not utilize platelet counts in its system.

**Conclusion:** TP is common both upon admission to the ICU and during ICU stays among medical, non-hematologic patients, and is associated with an increased risk of mortality. Because it is cheap and readily available without extra-cost, platelet counts can help to predict poor outcomes among ICU patients.

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