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Research on the Correlation Between Dynamic Platelet Changes Combined with D-Dimer and Mortality Risk in Critically Ill Patients

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Abstract: *Objective*: To analyze the predictive value of dynamic platelet changes combined with D-dimer for the 28-day mortality risk in critically ill patients. *Methods*: A retrospective analysis was conducted on the clinical data of 500 critically ill patients admitted to the intensive care unit (ICU) of Shapingba District People's Hospital in Chongqing from August 2023 to August 2025. Data on the maximum relative decrease in platelet count within 72 hours of admission and peak D-dimer levels were collected to analyze their correlation. Patients were divided into a death group (171 cases) and a non-death group (329 cases) based on 28-day all-cause mortality. Confounding factors were adjusted for to confirm whether the maximum relative decrease in platelet count within 72 hours and peak D-dimer levels were independent risk factors for 28-day mortality in critically ill patients. Based on the confirmation, the optimal cut-off values for both were analyzed, and a dual-parameter rapid judgment table was constructed, followed by performance testing and value analysis. *Results*: The maximum decrease in platelet count within 72 hours and peak D-dimer levels in the 500 patients showed a moderate correlation ($r = 0.551$, $p = 0.012$). Multivariate logistic regression analysis revealed that age, serum lactate, APACHE II score, SOFA score, maximum decrease in platelet count within 72 hours, and peak D-dimer levels were independent risk factors for 28-day mortality in critically ill patients ($p < 0.05$). ROC curve analysis indicated that the optimal cut-off values for predicting 28-day mortality in critically ill patients were 20% for the maximum decrease in platelet count and 5 mg/L for peak D-dimer levels. The dual-parameter rapid judgment table constructed based on these values demonstrated good discrimination (AUROC = 0.852, 95% CI: 0.811–0.883) when tested using the Bootstrap method. The assessment time for 30 patients using the dual-parameter rapid judgment table was (41.05 ± 8.37) seconds, and the predicted 28-day mortality showed good consistency with actual mortality (Kappa value = 0.726, $p < 0.05$). Clinical retrospective analysis revealed that the use of the dual-parameter rapid judgment table could potentially avoid a mortality rate of 16.96%. *Conclusion*: The maximum relative decrease in platelet count within 72 hours and peak D-dimer levels are closely related to the 28-day mortality risk in critically ill patients. The dual-parameter rapid judgment table constructed by combining these two factors requires less assessment time and has high application value in predicting the 28-day mortality risk in critically ill patients, contributing to a reduction in mortality.

Keywords: Dynamic platelet changes; D-dimer; Intensive care unit; 28-day mortality; Dual-parameter rapid judgment

table

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1. Introduction

Patients in the intensive care unit (ICU) often face severe conditions such as pneumonia and sepsis, carrying a high risk of mortality. The rapid deterioration and variability of critically ill patients' conditions, along with the swift progression of multi-organ failure and a short therapeutic window, make early warning of mortality risk a core challenge in critical care medicine. Early and accurate identification of adverse prognosis risk in critically ill patients aids in clinical intervention and optimization of treatment strategies to reduce mortality risk. Coagulopathy, as a common pathophysiological process in critical illnesses such as sepsis, severe pneumonia, and trauma, is closely related to multi-organ failure and mortality in patients [1,2]. Increasing studies have found that decreased platelet count and elevated D-dimer levels are associated with adverse prognosis in critically ill patients [3]. However, some studies have also found that the dynamic trajectory of platelet consumption rate and D-dimer, compared to static values, can more accurately reflect the nature of microcirculatory disorders in patients [4,5]. To achieve rapid assessment of mortality risk in critically ill patients, this study will analyze the predictive value of dynamic platelet changes combined with D-dimer for the 28-day mortality risk in critically ill patients, optimizing patient coagulation management in the clinical ICU setting.

2. Materials and methods

2.1. General information

A retrospective analysis was conducted on the clinical data of 500 critically ill patients admitted to the Intensive Care Unit (ICU) of Shapingba District People's Hospital in Chongqing from August 2023 to August 2025. This was done to confirm whether the maximum relative decrease in platelet count and the peak D-dimer level were independent risk factors for 28-day mortality in critically ill patients and to construct a dual-parameter rapid assessment table. A random sample of 30 critically ill patients from August 2025 to March 2026 was selected to verify the consistency between the predicted results of the dual-parameter rapid assessment table and the actual mortality.

2.1.1. Inclusion criteria

(1) ICU stay of at least 72 hours;
(2) Age 18 years or older;
(3) Having at least three platelet count measurements and two D-dimer tests recorded within 72 hours after admission to the ICU.

2.1.2. Exclusion criteria

(1) Coexisting hematological malignancies or chronic liver failure;
(2) Death or voluntary discharge within 24 hours of admission;

(3) Missing clinical data relevant to this study.

2.2. Methods

(1) The maximum relative decrease in platelet count from three platelet measurements within 72 hours of admission was collected for the 500 critically ill patients, along with data on the peak D-dimer level. The correlation between the maximum decrease in platelet count and the peak D-dimer level was analyzed. After incorporating confounding adjustment factors and taking 28-day all-cause mortality as the endpoint event, patients were divided into a death group (171 cases) and a non-death group (329 cases). Confounding adjustment factors, as well as the maximum relative decrease in platelet count and the peak D-dimer level, were compared. Based on this, independent risk factors for 28-day mortality in critically ill patients were identified. Upon confirming that the maximum relative decrease in platelet count and the peak D-dimer level were independent risk factors for 28-day mortality in critically ill patients, a dual-parameter rapid assessment table was constructed, and its discriminatory performance was validated.

(2) The 28-day mortality rate of 30 critically ill patients was assessed using the dual-parameter rapid assessment table, and the consistency with the actual 28-day mortality of the patients was evaluated.

(3) All 28-day mortality cases among the 500 patients were screened out. The dual-parameter rapid assessment table was used to assess the risk of death, and the avoidable mortality rate was analyzed.

2.3. Observation indicators

(1) Endpoint outcome

28-day all-cause mortality during ICU stay.

(2) Platelet dynamics

Platelet count data at 24 hours, 48 hours, and 72 hours after admission were collected. The maximum relative decrease in platelet count at 72 hours was calculated as follows: |Minimum value within 72 hours - Baseline value / Baseline value.

(3) Coagulation and fibrinolysis indicators

These included the peak D-dimer level, as well as the baseline values of prothrombin time, activated partial thromboplastin time, and fibrinogen.

(4) Baseline confounding adjustment indicators

Age, gender, underlying diseases (hypertension, diabetes, coronary heart disease, stroke), serum lactate, albumin, duration of mechanical ventilation, APACHE II score, and SOFA score.

(5) Time required for operation

The time taken for 30 patients to complete the dual-parameter rapid assessment table was recorded.

(6) Avoidable mortality rate

If the dual-parameter rapid assessment table assessment result within 24 hours before death indicated a high risk, but no consultation or intervention was triggered in actual clinical practice, the case was classified as an avoidable death. The theoretical avoidable mortality rate was calculated as follows: Number of avoidable death cases / Total number of death cases × 100%.

2.4. Statistical methods

All statistical analyses of the data in this study were performed using SPSS 26.0 software. Measurement data conforming to a normal distribution were expressed as (mean ± standard deviation), and comparisons between two groups were made using the independent samples *t*-test. Count data were expressed as the number of cases (percentage) [n(%)], and the χ^2 test was used for comparisons. The Pearson method was used to analyze correlations. Multivariate logistic regression analysis was used to identify factors influencing 28-day mortality. The Receiver Operating Characteristic (ROC) curve was plotted to obtain the optimal cutoff value, and the Bootstrap method was used to evaluate the discriminatory performance of the dual-parameter rapid assessment table. The Kappa consistency test was used to assess the consistency between clinical predictions of 28-day mortality and actual outcomes. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Correlation analysis between the maximum relative decrease in platelet count at 72 hours and the peak D-dimer level

The maximum relative decrease in platelet count at 72 hours in the 500 patients was (19.85 ± 4.19)%, and the peak D-dimer level was (6.26 ± 1.45) mg/L. Correlation analysis using the Pearson method showed that r = 0.551 and $p = 0.012 < 0.05$, indicating a moderate correlation (r = 0.30–0.65).

3.2. Comparative analysis of confounding adjustment factors, as well as the maximum relative decrease in platelet count and the peak D-dimer level, between the death group and the non-death group

As shown in **Table 1**, there were statistical differences in age, serum lactate, maximum relative decrease in platelet count at 72 hours, peak D-dimer level, duration of mechanical ventilation, APACHE II score, and SOFA score between the death group and the non-death group ($p < 0.05$).

Table 1. Comparative analysis of confounding adjustment factors, as well as the maximum relative decrease in platelet count and the peak D-dimer level, between the death group and the non-death group

Variable		Death group (n = 171)	Non-death group (n = 329)	χ^2/t	*p*
Age (years)		62.43 ± 7.67	57.61 ± 6.53	7.367	< 0.001
Gender [n(%)]	Male	82 (47.95)	169 (51.37)	0.525	0.469
	Female	89 (52.05)	160 (48.63)		
Hypertension [n(%)]	Yes	58 (33.92)	106 (32.22)	0.147	0.701
	No	113 (66.08)	223 (67.78)		
Diabetes [n(%)] No	Yes	38 (22.22)	71 (21.58)	0.027	0.869
	No	133 (77.78)	258 (78.42)		
Coronary heart disease [n(%)]	Yes	53 (30.99)	91 (27.66)	0.610	0.435
	No	118 (69.01)	238 (72.34)		
Stroke [n(%)] No	Yes	36 (21.05)	61 (18.54)	0.454	0.500
	No	135 (78.95)	268 (81.46)		
Serum lactate (mmol/L)		7.75 ± 1.83	3.49 ± 1.18	31.482	< 0.001
Albumin (g/L)		24.06 ± 6.77	25.19 ± 7.05	1.723	0.085
Maximum 72h platelet decrease (%)		24.45 ± 3.07	17.46 ± 2.24	29.033	< 0.001
Peak D-dimer (mg/L)		9.43 ± 2.11	4.61 ± 1.17	32.857	< 0.001

Prothrombin time (s)	13.46 ± 4.65	12.85 ± 3.77	1.581	0.114
Activated partial thromboplastin time (s)	35.85 ± 10.42	34.91 ± 9.67	1.217	0.224
Fibrinogen (g/L)	3.12 ± 1.08	2.98 ± 0.96	1.481	0.139
Duration of mechanical ventilation (d)	12.05 ± 3.11	8.66 ± 2.25	13.959	< 0.001
APACHE II score	19.31 ± 1.26	15.85 ± 1.09	31.891	< 0.001
SOFA score	10.61 ± 1.18	8.07 ± 0.96	25.898	< 0.001

3.3. Multifactorial logistic regression analysis of factors influencing 28-day mortality in critically Ill patients

Using 28-day mortality as the dependent variable (0 = no, 1 = yes), and age, serum lactate, maximum decrease in platelet count within 72 hours, peak D-dimer level, duration of mechanical ventilation, APACHE II score, and SOFA score (all using original values) as independent variables, a multifactorial logistic regression analysis was conducted. As shown in **Table 2**, age, serum lactate, APACHE II score, SOFA score, maximum decrease in platelet count within 72 hours, and peak D-dimer level were identified as independent risk factors for 28-day mortality in critically ill patients ($p < 0.05$).

Table 2. Multifactorial logistic regression analysis of factors influencing 28-day mortality in critically ill patients

Variable	β	SE	Wald	*p*	OR	95% CI
Age	0.979	0.362	7.295	0.007	2.661	1.308–5.414
Serum lactate	1.280	0.423	9.133	0.003	3.596	1.568–8.247
Maximum 72h platelet drop	1.380	0.407	11.511	0.001	3.975	1.791–8.822
Peak D-dimer	1.468	0.405	13.142	0.000	4.342	1.963–9.604
Duration of mechanical ventilation	0.443	0.411	1.163	0.281	1.558	0.696–3.488
APACHE II score	1.505	0.410	13.456	0.000	4.502	2.015–10.059
SOFA score	1.407	0.379	13.768	0.000	4.083	1.942–8.584

3.4. Construction of a dual-parameter rapid assessment table

The optimal cutoff values for predicting 28-day mortality in critically ill patients were determined through ROC curve analysis (**Figure 1**). The optimal cutoff value for the maximum decrease in platelet count within 72 hours was 20%, and for the peak D-dimer level, it was 5 mg/L. Based on these findings, a dual-parameter rapid assessment table (**Table 3**) was constructed, incorporating platelet count reduction score + D-dimer score, with a total score ranging from 0 to 2. A score of 0 indicates low risk (routine monitoring), a score of 1 indicates moderate risk (daily coagulation review), and a score of 2 indicates high risk (immediate clinical department consultation).

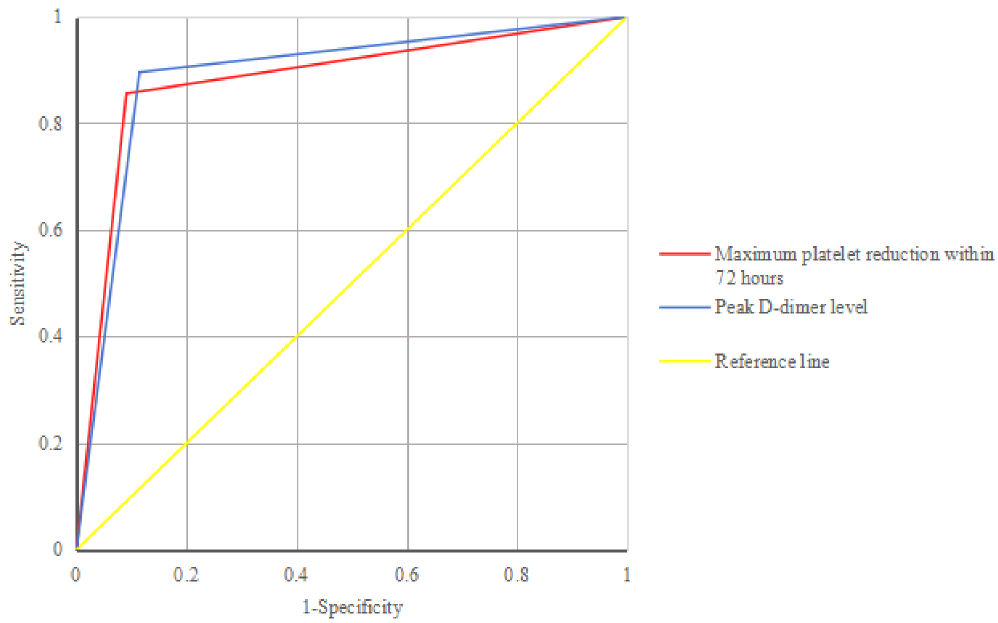

Figure 1. ROC Curve for Predicting 28-Day Mortality Risk in Critically Ill Patients Using the Maximum Platelet Reduction within 72 Hours and Peak D-Dimer Level.

Table 3. Two-parameter rapid judgment table

Predictive factor	Definition	Judgment
Maximum platelet reduction within 72 hours	≤ 20%: score 0 > 20%: score 1	Score 0: Low risk, routine monitoring; Score 1: Moderate risk, daily coagulation monitoring required; Score 2: High-risk, case requiring immediate clinical department consultation.
Peak D-dimer level	≤ 5mg/L: score 0 > 5mg/L: score 1	
Composite risk score	Maximum platelet reduction score within 72 hours + D-dimer peak value score (Total score ranged from 0 to 2)	

3.5. Performance evaluation and value analysis of the dual-parameter rapid assessment table

3.5.1. Bootstrap validation of discrimination efficacy

The dual-parameter rapid assessment table was validated through 300 bootstraps resampling, yielding an AUROC of 0.852 with a 95% confidence interval (CI) of 0.811 to 0.883, surpassing the preset threshold of 0.82. This indicates good discrimination and high stability of the table.

3.5.2. Consistency analysis between operational time and clinical prediction of 28-day mortality

The time required to assess 30 patients using the dual-parameter rapid assessment table was (41.05 ± 8.37) seconds. The predicted 28-day mortality outcomes using the table were compared with the actual 28-day mortality outcomes, and a Kappa consistency test revealed a Kappa value of 0.726 ($p < 0.05$), indicating good consistency.

3.5.3. Clinical retrospective analysis

Among 500 patients, 171 died within 28 days. Of these, 29 deaths could have been potentially avoided, resulting in an avoidable mortality rate of 16.96%.

4. Discussion

Critically ill patients often experience intense stress, such as sepsis or severe trauma, which can easily trigger excessive activation of the systemic coagulation system [6]. This, in turn, leads to widespread microthrombus formation in systemic microvessels, causing microcirculatory obstruction and insufficient perfusion in multiple tissues throughout the body. This exacerbates multi-organ failure due to ischemia and hypoxia, significantly increasing the risk of death [7]. Therefore, coagulation function indicators hold significant value in assessing the mortality risk of critically ill patients.

Current research has identified that early dynamic changes in platelet count and D-dimer levels are more closely associated with the prognosis of critically ill patients than static values [8,9]. Therefore, quantifying the temporal synergistic effects of platelets and D-dimer and establishing a real-time mortality risk prediction model based on dynamic data could provide a decision-making window for anticoagulation therapy and platelet transfusion, which is of urgent clinical significance for achieving precise coagulation management in the intensive care unit. In this study, the maximum platelet reduction within 72 hours and the peak D-dimer level in 500 patients showed moderate correlation ($p < 0.05$). Early excessive consumption of platelets in critically ill patients leads to a decrease in their count, while secondary hyperfibrinolysis results in an increase in D-dimer levels. Both changes are mediated by coagulation dysfunction [9,10]. Although the pathological mechanisms underlying these changes are closely related, they are not completely synchronized, resulting in a moderate correlation between the two. This also suggests that their synergistic effect can complement information and more accurately predict mortality risk. After adjusting for confounding factors, the maximum platelet reduction within 72 hours and the peak D-dimer level remained independent risk factors for 28-day mortality in critically ill patients ($p < 0.05$), indicating their potential value in predicting mortality risk. After determining the optimal cutoff values for both indicators through ROC curve analysis, a dual-parameter rapid assessment table was constructed. The Bootstrap method confirmed its good discrimination (AUROC = 0.852, 95% CI: 0.811 to 0.883). The time required to assess 30 patients using the table was (41.05 ± 8.37) seconds, and the predicted 28-day mortality outcomes showed good consistency with the actual outcomes (Kappa value = 0.726, $p < 0.05$). Clinical retrospective analysis using the table revealed an avoidable mortality rate of 16.96%. This indicates that the dual-parameter rapid assessment table is not only easy to operate but also performs well in predicting the 28-day mortality risk of critically ill patients, which is of great significance for reducing mortality.

5. Conclusion

In summary, the maximum relative reduction in platelet count within 72 hours and the peak D-dimer level are closely associated with the 28-day mortality risk of critically ill patients. The dual-parameter rapid assessment table constructed based on these two indicators requires less operational time and has high application value in predicting the 28-day mortality risk of critically ill patients, contributing to a reduction in mortality. However, its long-term stability and generalization ability require further validation through multicenter, large-sample prospective studies in the future.

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Disclosure statement

The authors declare no conflict of interest.

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