Platelets as a prognostic marker for sepsis
A cohort study from the MIMIC-III database

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Abstract
During sepsis, platelets dysfunction contributes to organ dysfunction. Studies on platelets dysfunction in the long-term prognosis of sepsis are lacking. The aim of this study was to assess the role of platelets in the long-term prognosis of sepsis patients.

A total of 4576 sepsis patients were extracted from MIMIC III Database. Survival was analyzed by the Kaplan-Meier method. Univariate and multivariate cox analyses were performed to identify prognostic factors. Significant prognostic factors were combined to build a nomogram to predict 1 year overall survival (OS). The discriminative ability and predictive accuracy of the nomogram were evaluated using the receiver operating characteristic curve (ROC) analysis and calibration curves used for sepsis.

The more abnormal the platelet level, the worse prognosis of patients. After final regression analysis, age, blood urea nitrogen, platelets, international normalized ratio, partial thromboplastin time, potassium, hemoglobin, white blood cell count, organ failures were found to be independent predictors of 1 year OS of sepsis patient and were entered into a nomogram. The nomogram showed a robust discrimination, with an area under the receiver operating characteristic curve of 0.752. The calibration curves for the probability of the prognosis of sepsis patients showed optimal agreement between the probability as predicted by the nomogram and the actual probability.

Platelet was an independent prognostic predictor of 1 year OS for patients with sepsis. Platelet-related nomogram that can predict the 1 year OS of sepsis patients. It revealed optimal discrimination and calibration, indicating that the nomogram may have clinical utility.

Abbreviations: BUN = blood urea nitrogen, Cr = creatinine, DBP = diastolic blood pressure, GCS = Glasgow coma scale, HR = Heart rate, ICD-9 = International Classification of Diseases, Ninth Revision, ICU = intensive care unit, INR = international normalized ratio, MIMIC-III = Medical Information Mart for Intensive Care III, OR = Odds ratio, OS = overall survival, PT = prothrombin time, PTT = partial thromboplastin time, ROC = the area under the receiver operating characteristic, RR = respiratory rate, SAPSII = patients’ simplified acute physiology score, SBP = systolic blood pressure, SOFA = sequential organ failure assessment, T = temperature, WBC = white blood cell count.

Keywords: nomogram, platelets, prognosis prediction, sepsis

1. Introduction
Sepsis is one of the leading causes of death worldwide and on average, $16.7 billion US dollars are spent to care for the severely septic patient each year, with costs projected to rise by 1.5% per year. Sepsis incidence rates are up to 535 cases per 100,000 person-years and rising. It was reported remains high death rates among hospitalized patients range between 30% and 45%. In 2017, an estimated 48.9 million (95% uncertainty interval 38.9–62.9) incident cases of sepsis were...
Sepsis is defined as a “life-threatening organ dysfunction caused by a dysregulated host response to infection.” Exaggerated response can lead to multi-organ failure (MOF), shock, and death. According to the new definition of sepsis, dysbalanced immune response and activation of the coagulation system during sepsis are fundamental events leading to sepsis complications and organ failure. The severity of organ dysfunction has a prognostic value, and in clinical practice is usually classified according to the Sequential Organ Failure Assessment (SOFA) score, a platelet is an important role in the SOFA score representing hematological function, hematological failure is common in patients with septic shock. Platelets catalyze the development of hyperinflammation, disseminated intravascular coagulation and microthrombosis, and subsequently contribute to multiple organ failure. Inappropriate intravascular coagulation and microthrombosis, and subsequent catalyze the development of hyperinflammation, disseminated intravascular coagulation and microthrombosis, and subsequently contribute to multiple organ failure.

Platelet dysfunction was an independent risk factor for the prognosis of patients with sepsis has been confirmed by study, but there is still a lack of large cohort studies and in the long-term prognosis of sepsis. This study is the first by a large clinical database to study the long-term prognosis of platelet dysfunction in patients with sepsis through the establishment of a nomogram. Therefore, the main objective of the present study by a large clinical database is to evaluate the impact of sepsis on the 1-year OS of patients and then develop a predictive nomogram to individually predict the probability of 1-year OS in sepsis patients. Further evaluation the discriminative ability and predictive accuracy of the nomogram using ROC analysis and calibration curves.

2. Materials and methods

2.1. Database

Data from the MIMIC (Medical Information Mart for Intensive Care) Critical Care Database were used for conducting this study. Patients admitted to the ICU (intensive care unit) of Beth Israel Deaconess Medical Center from 2001-2012 were enrolled. The raw data were extracted using structure query language (SQL) with Navicat and further processed with R software. A blood platelets level ≥ 100 × 10^9/L and < 300 × 10^9/L was defined as platelet normal value in the MIMIC-III Database. The MIMIC III database (version 1.4) is publically available from https://mimic.physionet.org/. The MIMIC III database (version 1.4) is publically available from https://physionet.org/. Any researcher who adheres to the data use requirements is permitted access to the database.

2.2. Patient population

Inclusion criteria were as follows:

1. sepsis;
2. ≥18 and ≤89 years-old;
3. admission time ≥24 hours in the ICU.

Exclusion criteria:

1. patients with SOFA <2;
2. patients having no vital signs or record contains blood platelet levels were also excluded.

Sepsis was identified based on Martin criteria, a widely used method for identifying sepsis in electronic health record database. According to the definition of sepsis 3.0, based on sepsis diagnostic criteria of Martin criteria, we selected sepsis patients with SOFA ≥ 2 as our study inclusion patients.

2.3. Data extraction and management

Data distribution was tested using the Shapiro-Wilk test. Patient laboratory parameters as well as the mean value of vital signs were collected from each patient: age, sex, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), respiratory rate (RR), and temperature (T). The following biochemical test results were also collected from each patient: partial thromboplastin time (PTT), international normalized ratio (INR), prothrombin time (PT), white blood cell count (WBC), hemoglobin, platelet, blood urea nitrogen (BUN) and creatinine (Cr). Patients’ simplified acute physiology score (SAPSII), sequential organ failure assessment (SOFA), Glasgow coma scale (GCS) were also recorded. The maximum and minimum values of sodium, potassium and glu were retrieved during the first 24 hours of each patient’s ICU’s stay. The worst scores and laboratory parameters as well as the mean value of vital signs during the first 24 hours of ICU admission were used in this study.

2.4. Statistical analysis

Data distribution was tested using the Shapiro-Wilk test. Patient characteristics were described using median (interquartile range [IQR]), or frequency and percentage, as appropriate. A non-parametric test (Mann-Whitney U test or Kruskal-Wallis test) was applied for data with non-normal distribution or heterogeneity of variances. Categorical data were compared using the Pearson Chi-squared test, Kaplan-Meier curves were analyzed using log-rank tests. The Cox regression model was used to analyze the independent effects of various parameters on mortality. Based on the results from the final regression analysis, a nomogram for mortality probability was constructed. The performance of the nomogram was assessed by discrimination and calibration. The discriminative ability of the model was determined by the area under the receiver operating characteristic curve, which ranged from 0.5 (no discrimination) to 1 (perfect discrimination). The calibration of the prediction model was performed by a visual calibration plot comparing the predicted and actual probability of prognosis of sepsis patients. The nomogram was subjected to 1000 bootstrap resamples for-
internal validation to assess their predictive accuracies. Statistical significance was defined as $P < 0.05$. All statistical analyses were performed with and R software (version 3.4.3) (Fig. 1).

3. Results

3.1. Baseline patient characteristics and outcomes

A total of 4576 patients fulfilled the definition of sepsis 3.0 in the MIMIC-III database. Patients were divided into either a thrombocytopenia group (Platelet \(< 100 \times 10^9/L\) \((n = 1117)\), normal platelets group \((100 \leq \text{platelet} \leq 300 \times 10^9/L)\) \((n = 2686)\), thrombocytosis group \((\text{Platelet} > 300 \times 10^9/L)\) \((n = 773)\).

Variables with missing data are relatively common in the MIMIC III database. The percentage of missing values for lactate (19.0%), albumin (40.7%), pH (22.8%), SpO2 (27.2%) were significant, which were excluded from this study. The percentage of missing values of PTT (7.9%), INR (7.3%), PT (7.3%) were <10%, and the other variables included were <1%. We replaced any missing values of the included variables with their mean values. The detailed process of data extraction is shown in Figure 2 (Supplementary Material 2, http://links.lww.com/MD/F150).

The baseline patient characteristics and outcomes for the patients are summarized in Table 1. Differences in age, HR, SBP, RR, T, Cr, BUN, glucose, hemoglobin, platelets, INR, PT, PTT, WBC, potassium_max, sodium_min and sodium_max between the 3 groups were statistically significant. The incidence of mechanical ventilation, renal replacement therapy, norepinephrine, epinephrine, organ failures (renal, hepatic, cardiovascular, respiratory, hematologic) (Supplementary Material 3, http://links.lww.com/MD/F151) and the score of SAPSII, SOFA were significantly higher in patients with thrombocytopenia group more than in patients with other two groups. Besides, hospital mortality and 1 year mortality in thrombocytopenia group and thrombocytosis group up to (44.9%, 62.5%) and (28.3%, 51.4%) were higher in patients with normal platelet group.

3.2. Platelet was an independent prognostic predictor

Survival analysis was conducted to explore the impact of platelet on prognosis. Patients in the normal platelet group had better long-term survival rates (Fig. 3). Furthermore, we performed univariate analysis of the base-line variables, laboratory tests and organ failure. Age, sex, Cr, BUN, glucose, hemoglobin, platelets, PTT, INR, PT, WBC, sodium, potassium, and organ failure were analyzed in the univariate analysis, and the factors significantly correlated with overall survival were adjusted for in the multivariate analysis. According to our results, age, BUN, hemoglobin, platelets, PTT, INR, WBC, potassium_min, renal failure, hepatic failure, cardiovascular failure, respiratory failure
remained independent prognostic factors for sepsis patients ($P < .01$ or $P < .05$) (Table 2).

3.3. Development of the prognostic scoring model

The prognostic nomogram included all the significant independent factors of the Cox proportional hazards regression model in the training cohort. It established scoring criteria according to the hazard ratio (HR) values of all prognostic factors and gave a score for each level of prognostic factors. By adding up the scores associated with each variable, and projecting total scores to the bottom scale, probabilities can be estimated for 1 year OS. With the aid of a nomogram, it was possible to effectively predict prognoses according to individual patient characteristics. The prognostic nomogram for 1 year OS is shown in Figure 4.

3.4. Validation of the nomogram

Validation of the nomogram was performed using bootstrap analyses with 1000 resamples, processed internally. Analysis of the internal validation cohort for nomogram-based predictions of OS. These findings indicate that the nomogram model was reasonably accurate. The internal calibration curves demonstrated good agreement between the predicted and observed values for 1 OS in both the training and validation cohorts (Fig. 5).

3.5. Discrimination of the nomogram

Internal validations were conducted on the nomogram. Consequently, internal validation of the training set revealed that the area under the receiver operating characteristic curve of the nomogram in OS prediction was 0.752 (95% CI, 0.738–0.766) (Fig. 6).

4. Discussion

In this study, we found that in the group with abnormal platelet level, especially in the group with thrombocytopenia, the higher the incidence of respiratory, circulatory, renal and liver, coagulation system failure, the higher the use of vasoactive drugs, the higher the incidence of renal replacement therapy and mechanical ventilation, high mortality, and the worse the prognosis. There was a correlation between abnormal platelet value, a model was
| Baseline variables          | Thrombocytosis group | Normal platelets group | Thrombocytopenia group | P     |
|----------------------------|----------------------|------------------------|------------------------|-------|
| **Baseline variables**     | n = 773              | n = 2686               | n = 1117               |       |
| Age                        | 56.9 (68.7–78.1)     | 56.4 (68.2–79.0)       | 50.7 (61.6–73.3)       | <.001 |
| Sex (%)                    |                      |                        |                        |       |
| Female                     | 347 (44.9)           | 1102 (41.0)            | 466 (41.7)             | .158  |
| Male                       | 426 (55.1)           | 1584 (59.0)            | 651 (58.3)             |       |
| Ethnicity (%)              |                      |                        |                        |       |
| White                      | 563 (72.8)           | 1914 (71.2)            | 777 (69.6)             | .265  |
| Black                      | 62 (8.0)             | 255 (9.5)              | 91 (8.1)               |       |
| Asian                      | 16 (2.1)             | 64 (2.4)               | 33 (3.0)               |       |
| Others                     | 132 (17.1)           | 453 (16.9)             | 216 (19.3)             |       |
| Admission type (%)         |                      |                        |                        |       |
| Emergency                  | 715 (92.5)           | 2468 (91.9)            | 1018 (91.1)            | .350  |
| Elective                   | 23 (3.0)             | 68 (2.5)               | 40 (3.6)               |       |
| Urgent                     | 35 (4.5)             | 150 (5.6)              | 59 (5.3)               |       |
| **Vital signs**            |                      |                        |                        |       |
| HR                         | 79.6 (90.5–102.7)    | 78.6 (80.6–102.6)      | 82.4 (94.3–106.5)      | <.001 |
| SBP                        | 101.4 (110-121.1)    | 101.6 (109.6-121.0)    | 99.6 (107.6–118.2)     | <.001 |
| DBP                        | 50.8 (56.8–63.4)     | 51.8 (57.2–64.0)       | 51.6 (57.9–64.4)       | .112  |
| MAP                        | 66.6 (72.2–79.8)     | 67.3 (73.0–80.0)       | 67.0 (72.8–80.0)       | .367  |
| RR                         | 17.6 (20.7–24.1)     | 17.5 (20.1–23.5)       | 17.4 (20.8–24.7)       | .003  |
| T                          | 36.4 (36.9–37.4)     | 36.4 (36.9–37.4)       | 36.3 (36.8–37.3)       | <.001 |
| **Laboratory parameters**  |                      |                        |                        |       |
| Cr (mg/dl)                 | 0.8 (1.3–2.3)        | 1.0 (1.4–2.5)          | 1.0 (1.5–2.7)          | <.001 |
| Gla (mg/dl)                | 91 (108–135)         | 89 (108–132)           | 84 (104–127)           | <.001 |
| Hemoglobin (g/dl)          | 8.4 (9.5–10.7)       | 8.8 (10.0–11.3)        | 7.8 (8.9–10.2)         | <.001 |
| Platelets (× 10^9/L)       | 336 (276-451.5)      | 138 (177–224.2)        | 37 (59–78)             | <.001 |
| PT (s)                     | 28.6 (33.9–47.7)     | 29.8 (36.4–47.7)       | 33.6 (42.1–59.6)       | <.001 |
| INR                        | 1.2 (1.4–2.0)        | 1.2 (1.5–2.0)          | 1.4 (1.8–2.4)          | <.001 |
| PT (s)                     | 13.8 (15.4–19.0)     | 14.0 (15.8–19.0)       | 15.1 (17.7–22.6)       | <.001 |
| BUN (mg/dl)                | 18 (28–49)           | 19 (30–49.2)           | 21 (34–55)             | <.001 |
| WBC (× 10^9/L)             | 13.4 (18.2–25.25)    | 10.1 (14.6–20.9)       | 5.5 (10.5–17.4)        | <.001 |
| Potassium_min (mmol/L)     | 3.5 (3.9-4.4)        | 3.4 (3.8–4.2)          | 3.3 (3.7–4.1)          | .704  |
| Potassium_max (mmol/L)     | 4.1 (4.5–5.0)        | 4.0 (4.4–5.0)          | 3.9 (4.4–4.9)          | <.001 |
| Sodium_min (mmol/L)        | 133 (137–140)        | 134 (137–140)          | 133 (137–140)          | .001  |
| Sodium_max (mmol/L)        | 136 (139–142)        | 137 (140–143)          | 136 (140–143)          | <.001 |
| **Score system**           |                      |                        |                        |       |
| SAPSII                     | 32 (42–53)           | 32 (42–53)             | 37 (47–59)             | <.001 |
| SOFA                       | 3.0 (5.0–7.0)        | 4.0 (6.0–9.0)          | 6.0 (9.0–12.9)         | <.001 |
| GCS                        | 14 (15–15)           | 13 (15–15)             | 14 (15–15)             | .008  |
| **Outcome (%)**            |                      |                        |                        |       |
| Mechanical ventilation, n (%) | 444 (57.4)           | 1471 (54.8)              | 691 (61.9)             | .135  |
| Renal replacement therapy, n (%) | 32 (4.1)             | 169 (6.3)               | 159 (14.2)             | <.001 |
| Vasopressors, n (%)        |                      |                        |                        |       |
| Norepinephrine             | 319 (41.3)           | 1158 (43.1)            | 566 (50.7)             | <.001 |
| Dopamine                   | 98 (12.7)            | 365 (13.6)             | 154 (13.8)             | .762  |
| Epinephrine                | 19 (2.9)             | 97 (3.6)               | 52 (4.7)               | .006  |
| **Organ failure, n (%)**   |                      |                        |                        |       |
| Renal                      | 436 (56.4)           | 1600 (59.6)            | 743 (66.5)             | <.001 |
| Hepatic                    | 35 (4.5)             | 235 (8.7)              | 254 (22.7)             | .001  |
| Cardiovascular             | 308 (39.8)           | 1126 (41.9)            | 551 (49.3)             | <.001 |
| Respiratory                | 430 (55.6)           | 1461 (54.4)            | 699 (62.8)             | <.001 |
| Hematologic                | 53 (6.9)             | 465 (17.3)             | 585 (52.4)             | <.001 |
| 1 OS                       | 397 (51.4)           | 1178 (43.9)            | 698 (62.5)             | <.001 |
| Hospital mortality         | 219 (28.3)           | 609 (21.9)             | 502 (44.3)             | <.001 |

BUN = blood urea nitrogen, Cr = creatinine, DBP = diastolic blood pressure, GCS = Glasgow coma scale, HR = heart rate, INR = international normalized ratio, OS = overall survival, PT = prothrombin time, PTT = partial thromboplastin time, RR = respiratory rate, SAPSII = Patients’ simplified acute physiology score, SBP = systolic blood pressure, SOFA = sequential organ failure assessment, T = temperature, WBC = white blood cell count.
established to predict the 1 year OS of patients with sepsis, and the visual nomogram was used to show it, so as to better predict the 1 year OS of patients with sepsis. The results showed that nomogram has good discrimination and calibration ability.

Table 1 shows that HR and RR in the group with thrombocytopenia were significantly higher than those in the group with normal platelet level, the group with thrombocytosis with SBP, SpO2 value were significantly lower than that of the other two groups (P<.01 or P<.05). The circulation and Table 2

### Univariate and multivariate analysis of risk factors to 1 year OS.

|                     | Univariate analysis | Multivariate analysis |
|---------------------|--------------------|----------------------|
|                     | P      | OR      | Lower  | Upper  | P      | OR      | Lower  | Upper  |
| Age                 | <.001  | 1.021  | 1.018  | 1.024  | <.001  | 1.024  | 1.020  | 1.027  |
| Sex                 | .599   | 1.023  | 0.941  | 1.111  | .847   | 0.997  | 0.970  | 1.026  |
| Cr(mg/dl)           | <.001  | 1.072  | 1.054  | 1.090  | <.001  | 1.004  | 1.003  | 1.006  |
| BUN(mg/dl)          | <.001  | 1.010  | 1.009  | 1.011  | .415   | 1.000  | 0.999  | 1.001  |
| Glu(mg/dl)          | .009   | 1.000  | 1.000  | 1.001  | .001   | 0.947  | 0.925  | 0.968  |
| Hemoglobin(g/dl)    | <.001  | 0.910  | 0.890  | 0.930  | <.001  | 1.097  | 1.083  | 1.112  |
| Platelet(X109 /L)   | 100–300(reference)| 1.000  |        |        | <.001  | 1.000  |        |        |
|                     | <.001  | 1.730  | 1.575  | 1.900  | <.001  | 1.684  | 1.517  | 1.871  |
|                     | .001   | 1.211  | 1.081  | 1.357  | .022   | 1.145  | 1.019  | 1.286  |
|                     | <.001  | 1.097  | 1.038  | 1.157  | <.001  | 1.067  | 1.045  | 1.089  |
|                     | <.001  | 1.007  | 1.006  | 1.009  | <.001  | 1.004  | 1.003  | 1.005  |
|                     | <.001  | 1.015  | 1.012  | 1.019  | .382   | 0.998  | 0.994  | 1.002  |
|                     | <.001  | 1.002  | 1.001  | 1.003  | .027   | 1.002  | 1.000  | 1.003  |
|                     | <.001  | 0.994  | 0.986  | 1.001  | <.001  | 1.217  | 1.133  | 1.309  |
|                     | .679   | 0.998  | 0.991  | 1.006  | .016   | 1.135  | 1.024  | 1.258  |
|                     | <.001  | 1.216  | 1.341  | 1.484  | <.001  | 1.215  | 1.148  | 1.363  |
|                     | <.001  | 1.186  | 1.150  | 1.222  | .159   | 0.928  | 0.836  | 1.030  |
| Renal failure, n(%) | <.001  | 1.746  | 1.596  | 1.909  | <.001  | 1.455  | 1.285  | 1.648  |
| Hepatic             | <.001  | 3.443  | 2.859  | 4.418  | <.001  | 1.251  | 1.148  | 1.363  |
| Cardiovascular      | <.001  | 1.617  | 1.489  | 1.756  | <.001  | 1.794  | 1.639  | 1.936  |
| Respiratory         | <.001  | 1.927  | 1.766  | 2.103  | <.001  | 1.312  | 1.196  | 1.439  |
| Hematologic         | <.001  | 1.312  | 1.196  | 1.439  | <.001  | 1.312  | 1.196  | 1.439  |

Cr=creatinine, INR=international normalized ratio, OS=overall survival, PT=prothrombin time, PTT=partial thromboplastin time, WBC=white blood cell count.

Figure 3. Kaplan-Meier survival curves for patients with normal and abnormal platelet indices were compared and log-rank test were assessed for significance.
**Figure 4.** Nomograms for the prediction of the 1 year OS in patients with sepsis. To use the nomogram, first, the position of each variable on the corresponding axis should be found. Next, a line to the points axis for the number of points should be drawn. Then, the points from all the variables should be added. Finally, a line from the total points axis should be drawn to determine the overall survival probabilities at the lower line of the nomogram. The total points projected to the bottom scale indicate the % probability of the 1-year survival. BUN = blood urea nitrogen, INR = international normalized ratio, OS = overall survival, PTT = partial thromboplastin time.

**Figure 5.** The calibration curves for the predictions of 1 year OS and the validation. The dashed line represents perfect correspondence between the probabilities predicted by the nomogram (x-axis) and calculated by Kaplan-Meier analysis (y-axis), respectively. OS = overall survival.
mediated alteration of endothelial cell glycoalkyx can also favor platelet adhesion. 

Besides, leukocyte infiltration in the septic kidney has been widely shown in animal models and septic patient; leukocyte depletion seems to reduce renal injury. P-selectin stored in α-granules of platelets and in endothelial cells is involved in leukocyte recruitment in septic kidney. Blocking P-selectin protects mice from AKI by attenuating neutrophil recruitment into the kidney. 

The scores of SAPSI and SOFA in patients with thrombocytopenia group were significantly higher than those in the other two groups (P<.01), the days of hospitalization and 1-year mortality (44.9%, 62.5%) were significantly higher than those in patients with normal platelet level (26.0%, 43.9%) and those in patients with elevated platelet level (28.3%, 51.4%). It seems that the more serious the condition of patients with thrombocytopenia, the worse the prognosis of patient's. However, thrombocytosis was only related to the long-term of sepsis patients. It is consistent with previous research results of Sheng Zhang, their study shows that patients with abnormally low PLT value had higher APACHE II and SOFA scores than those with normally PLT indices, indicating that patients with above-mentioned abnormally PLT indices were likely to have more severe illness. And in our study is that lower platelet count or plateletcrit is associated increased risk of mortality, the result is consistent with several other studies in Zhongheng Zhang and colleagues, which are in support to our findings. These results support the notion that Abnormal platelet value is related to adverse clinical outcomes.

Through univariate and multivariate analysis, it was found that both the thrombocytosis and thrombocytopenia were independent risk factors for the long-term prognosis of sepsis patients (Table 2). The 1-year survival analysis of sepsis patients showed that the prognosis of platelet abnormality group was poor (Fig. 3). Therefore, when establishing platelet related model, the platelet value of all patients should be included to observe the death risk score of patients at different levels. The possible explanation for the link between platelet indices and mortality is inflammatory response, previous studies have shown that IL-18 and IL-35 are negatively correlated with platelets, suggesting that inflammatory factors may be involved in the pathophysiological process of severe sepsis accompanied by thrombocytopenia. It is widely accepted that inflammatory response is significantly associated with adverse clinical outcomes in sepsis patients.

After completing univariate and multivariate analyses, we found that age, BUN, hemoglobin, platelets, PT, INR, WBC, potassium min, renal failure, hepatic failure, cardiovascular failure, respiratory failure remained independent prognostic factors were independent prognostic risk factors for sepsis patients and were entered into nomogram, nomogram plays an important role in modern medical decision-making, which is a graphical presentation of statistical prediction models. Therefore, only easily accessible and measurable factors could be considered. Our cohort study shows that the nomogram showed a robust discrimination, with an area under the receiver operating characteristic curve of 0.752 (Fig. 6). The calibration curves for the probability of the prognosis of sepsis patients showed optimal agreement between the probability as predicted by the nomogram and the actual probability (Fig. 5). It revealed optimal discrimination and calibration, indicating that the nomogram may have clinical utility. This model has the potential to assist clinicians in assessing patient 1 year OS.
5. Limitations

There were also some limitations in our study. To begin with, the nomogram establishment was based on retrospective information from the MIMIC dataset, which might cause possible selection bias, our study is retrospective in nature and bears inherent limitations of such study design. The result shows a linkage between abnormal platelet count and mortality, but the causal relationship of them cannot be determined based on the present study. abnormal platelet may be a reflection of the severity of illness rather than the cause of death. Secondly, certain critical clinic indicators related to prognosis, such as lactate and albumin information were excluded, because there were some patients missing many certain values. Thirdly, our study only included data available online and more external validation is still required.

6. Conclusion

In conclusion, our study shows that patients with thrombocytopenia had a higher SAPSII, SOFA score, the incidence of mechanical ventilation and renal replacement therapy, organ failures and mortality. Our study once again confirms the results of previous studies that the less platelets level, the more severe the disease and the worse the prognosis that patients with normal platelets. Besides, new findings from our study that thrombocytopenia and thrombocytosis were both independent risk factors for the long-term prognosis of sepsis patients and for the first time to construct a long-term prognosis nomogram for sepsis. The proposed nomogram was easily used clinical tools that facilitate the popularization of patient counseling and personalized treatment. However, it is necessary to further mine the unknown prognostic factors to optimize the nomogram, and more external validation is still required.

Author contributions

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