**Letter to the Editor**

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# Prognostic value of red blood cell distribution width in acute pancreatitis patients admitted to intensive care units: an analysis of a publicly accessible clinical database MIMIC II

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To the Editor,

Red blood cell distribution width (RDW) is a routinely tested hematological parameter, which depicts the size variability of red blood cell [1]. In recent years, accumulated evidence has shown that RDW can be used in many aspects of clinical practice [2]. Our previous studies, for instance, have shown that RDW is a useful index to assess disease activity in primary Sjogren's syndrome [3] and systemic lupus erythematosus [4]. This may because that RDW was positively correlated with inflammatory markers like C-reactive protein (CRP) [5]. To present, four studies have reported that RDW was a prognostic index in acute pancreatitis (AP) [6–9], but some of the strong confounders, such as simplified acute physiology score I (SAPSI) and sequential organ failure assessment (SOFA), were not considered in these studies. It remains unknown whether RDW could provide prognostic value independent of SOFA and SAPSI.

In this study, we analyzed the association between RDW and hospital mortality by using a large clinical database named Multiparameter Intelligent Monitoring in Intensive Care II (MIMIC II, version 2.6). MIMIC II is a publicly accessible clinical database consisted of more than 30,000 ICU patients admitted to Beth Israel Deaconess Medical Center (Boston, MA, USA) from 2001 to 2008. The Institutional Review Boards of the Massachusetts Institute of Technology (Cambridge, MA, USA) and Beth Israel Deaconess Medical Center (Boston, MA, USA) approved the establishment of this database.

After completing a National Institutes of Health (NIH) web-based training course (Protecting Human Research Participants), an author (Z-D Hu, certification number: 1678079) was approved to access the database for research aims. The accessing process was well documented by Zhang [10].

We extracted data by using structure query language (SQL) with pgAdmin (version 1.12.3). The following four tables from MIMIC II were used in our study: ICD9, LABEVENTS, D_LABITEMS and ICUSTAY_DETAIL. ICD9 includes diagnosis records and was used to screen patients with AP (code=577.0 and sequence=1). D_LABITEMS and LABEVENTS record categories and results of laboratory tests. ICUSTAY_DETAIL records treatment outcome, simplified acute physiology score I (SAPSI) and sequential organ failure assessment (SOFA) scores. It is noted that a patient may receive a laboratory test more than one time during their hospitalization. In this case, only the initial test results were included in our final analysis.

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We used the Spearman approach to analyze the correlation between RDW and both SOFA and SAPSI. Continuous variables were compared using a Mann-Whitney U test. Receiver operating characteristics (ROC) curve analysis and a forward conditional logistic regression model were used to evaluate the correlation between RDW and hospital mortality. All the statistical analyses were performed using Sigmaplot 12.0 and SPSS 17.0. A p value <0.05 is defined as statistically significant.

A total of 162 AP patients were included into the present study and their clinical characteristics are showed in Table 1. Notably, RDW obtained from 151 patients (n=151) was 14.20% (IQR 13.30%–15.20%) and 43 of 151 patients had RDW higher than 15% (the upper limit of the reference range [2]).

We found that RDW was positively correlated with SAPSI (r=0.17, p=0.05) and SOFA (r=0.20, p=0.01). In addition, AP patients who died (n=17; 15.0%; IQR 13.75%–16.35%) in hospital had significantly higher RDW than survivors (n=134; 14.05%; IQR 13.20%–15.10%; p=0.03). Furthermore, RDW could be used to predict hospital mortality, with an AUC of 0.66 (95%CI: 0.52–0.81).

In a univariable logistic regression analysis, RDW significantly associated with hospital mortality. Furthermore, after SOFA and SAPSI were adjusted through a multivariable logistic regression analysis, RDW remained significantly associated with hospital mortality, with an odds ratio (OR) of 1.526 (95%CI: 1.004–2.317) (Table 2).

In this study, we found that RDW in AP patients was 14.20% (IQR 13.30%–15.20%); and 43 of 151 patients had RDW higher than 15%. Because 15% is usually considered as the upper limit of reference range for RDW [2], our results suggest that AP patients had higher RDW compared with healthy individuals. It would be very valuable for further studies to investigate whether RDW is a risk factor for AP.

We found that RDW was significantly higher in AP patients who died in hospital, which was consistent with previous studies [6–9]. However, the AUC of RDW to predict hospital death was 0.66, which seems lower than that was reported by Senol et al. (AUC=0.817, 95% CI: 0.689–0.946) [6] and Yao et al. (AUC=0.846, 95% CI: 0.727–0.964) [9]. The inconsistence may be due to the difference of disease severity in patients included in this study and previous studies. In our study, all patients were admitted to intensive care unit, while other studies enrolled patients admitted to hospital, which means patients in our study may have more severe disease.

Although the previous four studies [6–9] have reported the prognostic value of RDW in AP, one strength of our study should not be ignored. In a multivariable logistic regression analysis, we found that RDW was associated with hospital mortality after SOFA and SAPSI were adjusted, indicating that RDW may provide prognostic information independent of SOFA and SAPSI.

In conclusion, our work indicates that RDW can be used to predict hospital mortality for AP patients admitted to intensive care unit. RDW may provide additional prognostic information beyond SOFA and SAPSI. Since

**Table 1:** Clinical characteristics of the subjects.

| | Survivors | | Non-survivors | | p-Value |
|---|---|---|---|---|---|
| | n | Results | n | Results | |
| Age, years | 145 | 60±23 | 17 | 72±17 | <0.01 |
| Gender, M/F | 145 | 82/63 | 17 | 12/5 | 0.31 |
| Albumin, g/L | 91 | 33±8.0 | 13 | 29±7.4 | 0.13 |
| Amylase, IU/L | 108 | 639±889 | 14 | 407±619 | 0.17 |
| $Ca^{2}$+, mmol/L | 101 | 2.05±0.31 | 13 | 1.95±0.23 | 0.16 |
| Creatinine, µmol/L | 135 | 113±148 | 16 | 200±125 | <0.01 |
| Glucose, mmol/L | 126 | 8.8±4.4 | 16 | 10.3±5.6 | 0.31 |
| Lipase, IU/L | 106 | 1228±2340 | 15 | 501±649 | 0.26 |
| Hemoglobin, g/L | 134 | 127±22 | 17 | 126±22 | 0.83 |
| Platelet count, $\times 10^9$/L | 135 | 262±125 | 17 | 247±92 | 0.69 |
| RDW, % | 134 | 14.2±1.3 | 17 | 15.1±1.8 | 0.03 |
| WBC, $\times 10^9$/L | 135 | 13.39±6.26 | 17 | 18.12±9.92 | 0.05 |
| SAPSI | 137 | 12.8±4.8 | 16 | 19.4±6.2 | <0.01 |
| SOFA | 140 | 4.6±3.6 | 17 | 10.2±5.4 | <0.01 |

Continuous variables are presented as mean±standard deviation, and categorical data are presented as absolute number. RDW, Red blood cell distribution width; WBC, white blood cell count; SAPSI, simplified acute physiology score I; SOFA, sequential organ failure assessment.

**Table 2:** Multivariable logistic regression analysis for the relationship between RDW and hospital mortality.

| | Univariable | | Multivariable | |
|---|---|---|---|---|
| | OR (95%CI) | p-Value | OR (95%CI) | p-Value |
| RDW (per 1%) | 1.518 (1.087–2.119) | 0.014 | 1.526 (1.004–2.317) | 0.044 |
| SOFA (per 1) | 1.359 (1.182–1.562) | <0.001 | 1.360 (1.164–1.588) | <0.001 |
| SAPSI (per 1) | 1.286 (1.141–1.450) | <0.001 | – | – |

RDW, Red blood cell distribution width; SAPSI, simplified acute physiology score I; SOFA, sequential organ failure assessment; OR, odds ratio; CI, confidence interval.

our work is a retrospective design and the sample size is small, further prospective studies with large sample size are needed to evaluate the prognostic value of RDW in AP.

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