Predictive score for Dengue infection with complete blood count parameters, including the new monocyte distribution width with a retrospective single center derivation and validation study

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INTRODUCTION

Monocytes play a crucial role in viral infection as part of innate immune response, hence frequent monocytes in various viral diseases. Monocyte distribution width (MDW) has been recently approved as good marker to complete blood count (CBC). It is recently approved for early detection of sepsis. We have noticed high MDW in Dengue patients. This study aimed to describe MDW change in Dengue infection and to develop predictive score for early detection of Dengue patients.

METHODS

We retrospectively retraced data of adult patients with acute fevers who had CBC and Dengue serology (NS1 antigens, IgM and IgG) performed during September 2019 to May 2020 at Thammasat University Hospital. Medical records were reviewed. MDW was compared between groups. Patients were randomly divided into training and validation set. Predictive score was developed from the training set and validated in the validation set with multivariable analysis.

RESULTS

A total of 411 patients, with Dengue infection in 127 patients (30.5%), were included in the analysis. The median (interquartile range) of MDW in Dengue patients were higher than non-Dengue patients (25.7% (23.5 - 27.6) vs 24.9% (22.9 - 27.6), P < 0.001). In patients with confirmed Dengue infection, MDW increased with severity. Training & validation set included 216 and 215 patients with 60 and 61 Dengue infection, respectively. Independent predictive factors of Dengue infection were white blood cell < 4 x 10^9/L (score 1), platelet < 100 x 10^9/L (score 1) and MDW > 24% (score 1). No clinical features were independently predictive of Dengue infection. The area under receiver-operating-characteristic curve (95% confidence interval) of the predictive score in the training and validation set was 0.839 [0.779 - 0.898] and 0.792 [0.674 - 0.811], respectively. With the cut-off score 1, the sensitivity and specificity of the score were 92.2% and 80.8% in the training set and 88.8% and 41.1% in the validation set.

Conclusion: MDW increase in patients with Dengue infection and also increase with Dengue severity. We have developed and internally validated a simple predictive score for Dengue infection based on only results from CBC and MDW. Further large-scale external validation study is required to confirm the utility of our predictive score.

Figure 1 Study flow diagram

Figure 2 Monocyte distribution width by Dengue vs. non-Dengue and by severity (N=431)

Table 1 Patients’ characteristics

Table 2 Regression analyses for prediction of Dengue infection (stepwise backward)

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Dengue prediction score

Comprising 3 variables, 1 score each
1. Leukopenia less than 4x10^9/L
2. Monocyte distribution width > 24%
3. Platelet less than 100x10^9/L

Figure 3 Receiver-operating characteristic curve showing performance of the model in both training and validation test.

Table 3 Number of patients classified by Dengue severity and Dengue score

Figure 4 ROC curve for training set

Figure 5 ROC curve for validation set

Dengue score

0 129 111 1 D 0
1 125 27 4 0
2 44 2 17 1
3 6 13 10 1

False negative 16/127 (12.6%): DHCP 5 pts, 3/5 had MDW > 24% DF 11 pts, no patient with MDW >24
False positive 6/304 (2.0%): Viral exanthem 3, virus not identified Acute pyelonephritis 1 Sepsis 1