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Laboratory risk factors for mortality in severe and critical COVID-19 patients admitted to the ICU

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ABSTRACT

Background : Several studies have reported clinical characteristics and risk factors for predicting adverse outcomes in COVID-19.4–6 However, data exclusively from the ICU especially in the low- and middle-income countries (LMIC) remain lacking. This study aimed to explore risk factors associated with mortality based on laboratory parameters at hospital admission in severe and critical COVID-19 patients admitted to the ICU.

Methods : This study is a retrospective cohort study.Data from the electronic medical records were collected retrospectively from all severe and critical COVID-19 patients requiring ICU admission in two designated COVID-19 hospitals in Jakarta, Indonesia. A multivariate logistic regression analysis was used to identify the predictors associated with ICU mortality. The model performance was evaluated by the area under curve (AUC) from the receiver operating characteristic (ROC) analysis.

Results : There were 334 patients admitted to the ICU with COVID-19 included in the statistical analysis. The ICU mortality rate was 75.1%, with 251 patients died in the hospital. Independent risk factors associated mortality including white blood cell count >13.9 x10^9/L (OR=2.41; 95% CI, 1.15-5.06, p=0.02), neutrophil to lymphocyte ratio >10.7 (OR=2.20; 95% CI, 1.20 – 4.03, p=0.011), and creatinine >0.8 mg/dL (OR=3.55; 95% CI, 2.05 – 6.17, p<0.001). The model yielded an AUC of 0.72 (95% CI, 0.659-0.780, p<0.0001) for predicting ICU mortality in severe and critical COVID-19 patients.

Conclusions : White blood cell, neutrophil to lymphocyte ratio, and serum creatinine on hospital admission are significant predictors of mortality in severe and critical COVID-19 patients admitted to the ICU.The ICU mortality rate during the second wave of the pandemic in this study was high.

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1 All demographic, clinical, laboratory, and outcome data were extracted from the electronic medical record. Demographic characteristics of patients (age and sex), comorbidities (hypertension, diabetes, chronic obstructive pulmonary disease, coronary artery disease, heart failure, stroke history, chronic kidney disease, and liver disease), length of stay, hemoglobin, platelet, C-reactive protein, Neutrophil to Lymphocyte Ratio (NLR), D-dimer, ureum, and creatinine were recorded using a standardized data collection form and verified by two physicians. The comorbidities and previous medical history from the medical record were reviewed by the physicians in charge.

2 Blood samples were collected within 24 hours of ICU admission to perform routine laboratory tests (blood count, coagulation profile, renal and liver function). The routine blood test (including hemoglobin count, platelet count, white blood cell count, and leukocyte differential count) were measured with Mindray BC-6200 automatic hematology analyzer. D-dimer, CRP, AST, ALT, ureum, and creatinine were measured with TMS50i Superior automatic clinical analyzer. All measurements were done within 2 hours after blood sampling.
SARS-CoV-2 was identified by RT-PCR. The specimens were collected from nasopharyngeal and oropharyngeal swabs.

3 Categorical variables were described as frequencies and percentages and were compared using the Chi-squared test or Fischer's exact test. Normality test was performed for continuous variables to determine their distribution. Continuous variables were presented in median (IQR) due to their distribution and compared using the Mann-Whitney test. Univariable and multivariable logistic regression was used to explore the risk factors associated with ICU mortality. Variables with a p-value<0.2 on the survivor vs. non-survivor group were selected for the multivariable logistic regression analysis. Three variables were subsequently removed to avoid model overfitting. We employed a backward selection method including seven variables (age, leukocyte, CRP, NLR, D-dimer, ureum, and creatinine). Only significant predictors ($p<0.05$) were kept in the final models.

4 We then evaluated the relationship when the variables were converted into a dichotomous group based on the optimal cut-off value from the receiver operator characteristic (ROC) analysis to maximize sensitivity and specificity. The performance of the prediction models was evaluated by the area under curve (AUC) from the ROC analysis. Odds Ratio (OR) with 95% confidence interval (CI) were used to report the association between exposure to the risk factors and mortality. Statistical analysis was done using SPSS for Windows Version 26.0.

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