Automatic Classification of Peripheral Neutrophils on Digital Images Analyzed by Artificial Intelligence

Wang, Jeffrey (School: Mayo High School)

Background: Accurate white blood cell classification and count in the peripheral blood is fundamental in diagnosing major diseases. It could be performed by an automated analyzer with limited sensitivity and specificity. Approximately 20% of automatic counts are flagged for a manual review. However, manual review is both time-consuming and inconsistent. There has been an increased demand for the development of automated blood cell classification systems by artificial intelligence. The objective of this experiment is to accurately classify neutrophils in peripheral blood smears collected from different disease statuses using a convoluted neural network (CNN). Materials and Methods: Neutrophils from 5 normal controls, 5 COVID patients, and 5 chronic myelomonocyic leukemia (CMML) patients were automatically identified and cropped by a CNN. The neutrophils were reviewed by two hematopathologists and classified into three groups: 1) verified neutrophils that were correctly identified; 2) neutrophils that were incorrectly identified; 3) The third group consists of exclusions, which were cells that could not be properly identified. In each disease category, cropped neutrophils in five additional cases were left unverified and used for model validation. Results: In the normal cases, 1834 out of 1855 neutrophils were verified to be correctly identified by the CNN. The accuracy of the normal cases was 99.6%. In the COVID cases, 2574 out of 2654 were verified, giving an accuracy of 99.9%. In the CMML cases, 1939 out of 2016 were verified, with an accuracy of 99.2%. Conclusions: Based on the data, this artificial intelligence (AI) program is able to successfully classify neutrophils in peripheral blood smears with a high rate of accuracy in different diseases.

Awards Won: