Explainable AI for Rapid and Simple Differential Diagnosis of Inflammatory Conditions Using Combined Myeloid Activation Test, Complete Blood Count, and CRP Analysis

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Inflammatory conditions in patients have various causes and require different treatments. Bacterial infections are treated with antibiotics, while these medications are ineffective against viral infections. In addition, autoimmune diseases such as lupus or rheumatoid arthritis, and graft-versus-host disease (GVHD) after allogeneic stem cell transplantation, require immunosuppressive therapies such as glucocorticoids, which may be contraindicated in other inflammatory states. In this study, we employ a combination of straightforward blood tests to devise an explainable AI for distinguishing between bacterial infections, viral infections, and autoimmune diseases/GVHD disease. We analyze peripheral blood from 80 patients with inflammatory conditions and 38 without inflammatory conditions (controls). Complete blood count, CRP analysis, and a rapid flow cytometric test for myeloid activation markers CD169, CD64, and HLA-DR, performed without washing steps, are utilized. A two level XAI presented in the figure distinguishes first between normal controls and inflammatory conditions in level 1 (L1) and, secondly, between the types of inflammatory conditions in level 2 (L2). C50 rules (CRAN.R-project.org/package=C50) pruned by ABCanalysis [1] are used to distinguish between normal controls and inflammatory conditions in L1. A new bivariate decision tree (bi-DT) using Simpson impurity [2] is employed in L2. Inflammatory conditions can be distinguished using an XAI with an overall accuracy of 90%. Bacterial infection ($n = 30$), viral infection ($n = 26$), and autoimmune diseases & GVHD ($n = 24$) were differentiated with accuracies of 93%, 88%, and 75%, respectively. The CD169 parameter was most crucial for C50 and bi-DT classification as it is used in 68% of cases to assign the correct diagnosis. Physician treatment decisions for patients with inflammatory conditions can be effectively guided by a straightforward, easily implemented XAI based on promptly acquired blood parameters.
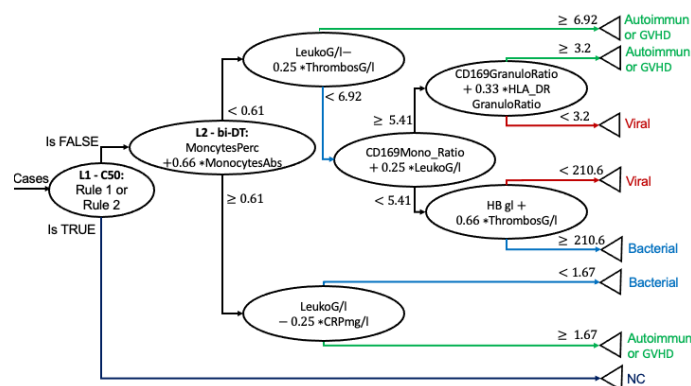
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