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Letter to the Editor

Artificial Intelligence Increases Reliability in Diagnostic Hematooncology

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Dear Editor,

Diagnostic hematooncology is based on diverse methods of cellular and molecular analysis. Precise cytomorphological features have been defined for the classification of hematolymphoid neoplasms and many non-neoplastic conditions. Bone marrow has the most complex cytology pattern that is formed by more than 200 types of cells. The correct evaluation and interpretation of peripheral blood, as well as bone marrow smears, is an indispensable component of multidisciplinary diagnostics of nearly 200 known hematolymphoid disorders.[1,2] Optical microscopy remains the reference gold standard method in the analysis of blood cells. This labor-intensive, as well as, time-consuming analysis requires the expertise of highly skilled, experienced professionals, and it is accompanied by inter-expert variability related to the subjectivity of the evaluation.[3,4]

Recently an unprecedented development has been made in automated image classification and artificial intelligence (AI) supported decision-making. The diagnostic application, as well as, the integration of almost perfect virtual morphology using the whole slide imaging technology, including cell recognition and classification algorithms based on systems of both machine and deep learning (subdomains of AI) represents a real revolution in the morphological analysis of blood cells. The whole slide imaging enables the acquisition of digital data from an entire slide within a few minutes. It is routinely applied in histopathology but in hematological cytopathology, it requires much higher magnifications (100× oil immersion objectives).[1,3] AI algorithms not only avoid misclassification, identifying details that might escape the human eye, but may also open completely unconventional ways of interpretation of image data with the knowledge of the group cellular context of the populations analysed.[5,6]

Different commercial products exist for the pre-classification of peripheral blood cells in routine laboratory practice. The most widespread CellaVision system (Lund, Sweden) can fully scan a peripheral blood smear, search for cells, record cell images, pre-classify cells, and display them on a computer screen. A professional then inspects the suggested cell classification.[6] Morphogo (Zhiwei, Hangzhou, China) is a unique CE-IVDR (In vitro Medical Devices Regulation), UKCA (UK Conformity Assessed Marking) and TGA (Therapeutic Goods Administration) certified automatic cytopathological device with integrated scanning hardware and machine learning-driven software. It can fully scan peripheral blood and bone marrow smears. The self-innovative AI cell recognition algorithm is capable of locating and pre- classifying nucleated cells (and abnormal red blood cells in peripheral blood), as well as, performing statistical analysis to release a myelogram to assist with the diagnosis of hematological diseases. The device also stores complete data information in the form of digital pictures.[4,6] The large validation studies have proved that Morphogo has a high accuracy in cell classification including robust and stable consistency with professional hematopathologists, reaching a seemingly superhuman level in some cases.[4,7] This system is a leading device in digitizing bone marrow, with AI-based morphodiagnostics and its routine implementation having a significant impact on the workflow of hematology laboratories.[6] Morphogo has been in use since 2019. Unlike other platforms (e.g., Scopio, DeepHeme), Morphogo is commercially available and IVDR certified for bone marrow diagnostics. Primarily, the information that has been published about Morhogo's use is related to bone marrow cytology, including the necessary validation data in the Asian population.[4,6,7] In addition, it may be assumed that within mature lymphoid neoplasms, further training and improvement of recognition algorithms could allow, as well as facilitate, the subclassification into specific diagnostic entities.[8] A large margin also remains for AI-supported reliable recognition of lineage dysplastic changes.

Advantages of the whole slide imaging and automated digital analysis review include unprecedented processing speed, remote access, reduction of fatigue, significant improvement of morphology education, as well as, training, in addition to, standardization, harmonization and quality assurance that eliminates the assessment subjectivity. Image digitization also brings a significant reduction in reviews of peripheral blood slides at the optical microscope, as well as, related savings in time and costs. Virtual slides do not deteriorate over time, have minimal storage requirements,

Abbreviations: AI, artificial intelligence; BM, bone marrow.

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are more accessible, as well as, being available for reviews, consultations and publications along with the creation of digital image archives, extensive databases and libraries.[1,3,5,6]

However AI is not used routinely in flow cytometry, AI-assisted classifiers have been already designed for quantitative immunophenotyping in hematooncology and automated quantification of minimal residual disease.[6,9,10]

AI-facilitated diagnostics has enormous potential for the next improvement and the innovative transformation of the practice of hematopathology. In the near future, we will see relevant implementation intending to overcome the diagnostic equivalence with conventional analysis in routine practice, including standardization in staining methods, image colour and size, cell recognition, qualitative evaluation, as well as, process harmonization and standardization.[1,3,6] Before the general implementation of AI in bone marrow cytomorphology and systemic integration of this method into multidisciplinary diagnostics, further high-quality validation studies must be performed, including the evaluation of the interpretative validity of digital morphology. Reliable validation data for the Caucasian population are still lacking and limitations of the method, as well as, problem diagnostic areas are not well identified. Another pre-implementation challenge is the standardization of the digital morphology of the bone marrow. The storage of digital data places considerable demands on the capacity of storage, as well as, on both backup systems and cybersecurity. Researchers and medical professionals should also be cognizant of the relatively high cost of digital morphology systems and devices.

Although technological progress using AI cannot be stopped in bone marrow diagnostics, a highly skilled morphologist will always be essential for cell reclassification and diagnostic interpretation, with expert assessment remaining the cornerstone of cytomorphological diagnosis in hematooncology.[5,6]

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Conflict of interest

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Author contributions

Initial drafting of the manuscript (DS, RD, KCH). Revision of the manuscript draft (DS). All authors have made a significant contribution to this study and have approved the final manuscript.

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