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803.EMERGING TOOLS, TECHNIQUES AND ARTIFICIAL INTELLIGENCE IN HEMATOLOGY

Deep Learning Models for the Diagnosis of Acute Lymphoblastic Leukemia from Bone Marrow Images : A Comprehensive Literature Review

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Introduction:
Acute lymphoblastic leukemia (ALL) is an aggressive blood cancer that begins in the bone marrow. It is the most common childhood cancer and requires early and accurate diagnosis for optimal treatment outcomes. Through automated image analysis of peripheral blood smears and bone marrow biopsies, artificial intelligence (AI), particularly Deep Learning (DL), have opened new avenues for improving ALL diagnosis. While bone marrow testing is the gold standard for ALL confirmation, AI applications in diagnosing ALL from bone marrow images have received less attention in the literature than peripheral blood smears. This review aims to assess the current state of AI in ALL diagnosis using bone marrow aspirates and biopsies, with a focus on Deep Learning (DL) models such as Convolutional Neural Networks (CNNs).
Methods:
A comprehensive literature search, conducted on June 11th, 2023, covered major medical databases, including PubMed/MEDLINE, Scopus, Embase, and Web of Science. Relevant keywords like "acute lymphoblastic leukemia," "deep learning," and "neural network" were employed, without time frame restrictions. Articles were included if they assessed the metrics of AI applications for ALL diagnosis in bone marrow aspirates. Articles were excluded if they: (1) had different outcomes, (2) were reviews, (3) were abstracts only, or (4) only reported peripheral blood smear metrics.
Results:
The search yielded 496 articles. After eliminating duplicates (282), title and abstract screening on the Rayyan platform excluded 204 records, leaving 214 articles eligible for full-text screening. Ten relevant articles were ultimately included in the review. Diverse approaches were presented to enhance diagnostic accuracy and efficiency. One study achieved 100% accuracy in classifying leukemic cells using a unique Convolutional Leaky RELU with CatBoost and XGBoost (CLR-CXG) design. Another study employed transfer learning with CNNs, obtaining 95.3% accuracy for AML, ALL, and CML classification with DenseNet121. Furthermore, the novel "i-Net" model demonstrated 99.18% validation accuracy for white blood cancer segmentation and classification. Adaptive Multi-objective CAT algorithms achieved 99.45% accuracy in detecting bone marrow cancer cells. An AI-based system using deep learning exhibited 97.2% accuracy in diagnosing ALL, while a robust fuzzy logic algorithm combined with a radial basis function neural network achieved 82.93% accuracy in diagnosing ALL in developing countries. Additionally, AI technologies based on computer microscopy demonstrated 95% and 97.5% accuracy in diagnosing ALL and minimal residual disease, respectively. A computer-aided system achieved 97.78% accuracy in classifying ALL subtypes.
Conclusion:
The potential of AI-driven approaches, particularly deep learning models like CNNs, in improving ALL diagnosis from bone marrow images is highlighted in this review. Because of their superior sensitivity and specificity over peripheral blood smears, bone marrow samples are the gold standard for ALL confirmation. The morphological and cellular properties of bone marrow samples provide important information for disease classification and monitoring. While DL and CNNs have shown promise

in diagnosing ALL from peripheral blood smears, their use in bone marrow samples has yet to be investigated deeply. More research and external validation are required to fully realize AI's potential in ALL diagnosis from bone marrow specimens.

Disclosures No relevant conflicts of interest to declare.

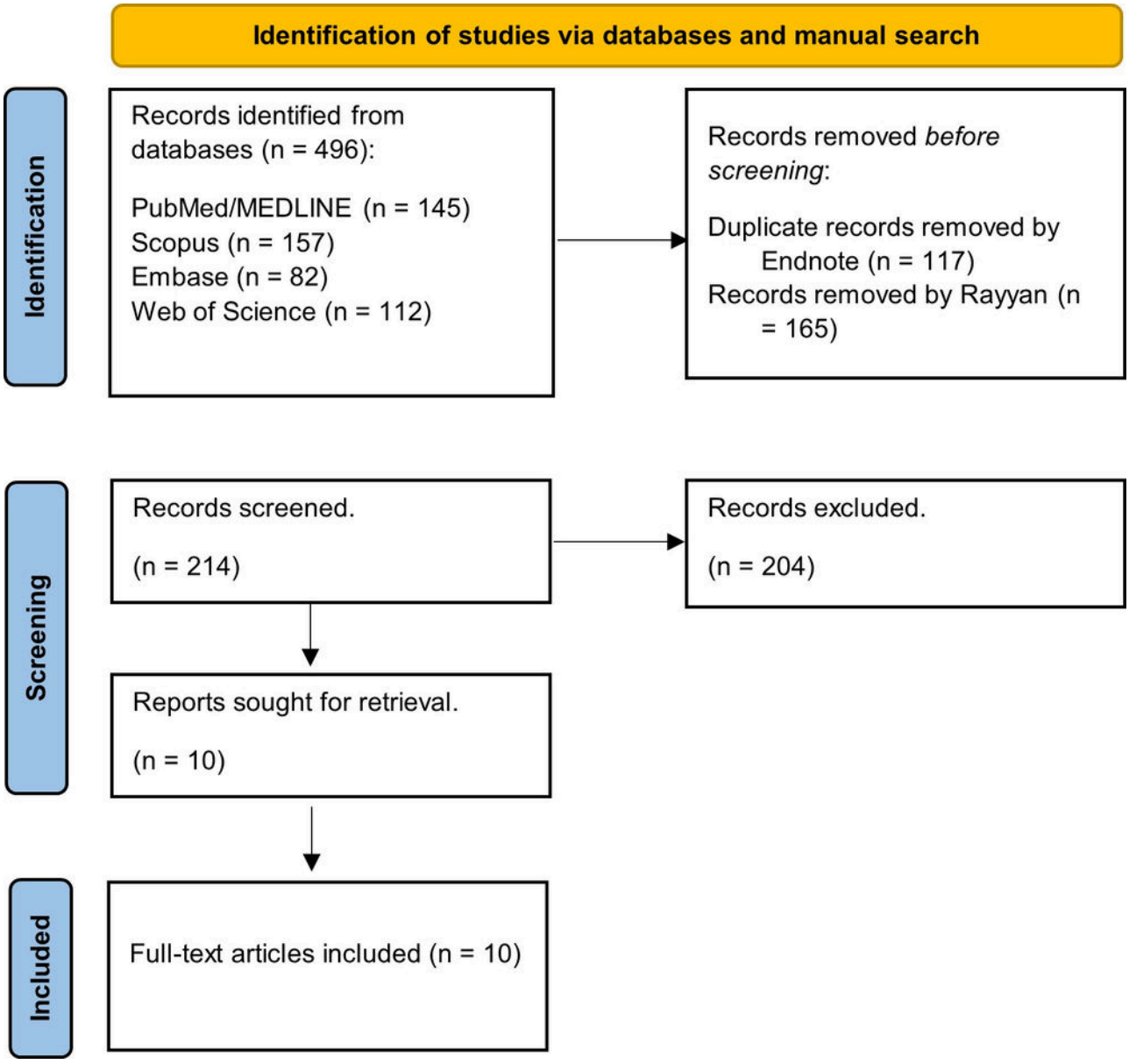

Figure 1

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