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PROCEEDING OF BIOMEDICAL IMAGE FOR DIAGNOSING FORMS OF ACUTE LEUKEMIA

Abstract. The article presents the importance of leukemia in human health and problems related to both diagnosis and therapy. The purpose of the article is to provide an information technology solution to this problem, thereby improving patient access and prognosis. A conceptual model of the expert system for the diagnosis of leukemia is proposed, which will reduce the ambiguity in the interpretation of research objects. Factors affecting the correct recognition of complex objects (detection of blast and non-blast blood cells) using an expert system based on computer microscopy methods are considered.

Key words: acute leukemia, diagnosis and therapy, biomedical imaging, imaging of blast and non-blast blood cells.

Relevance of research

Blood cancers, including leukemia, are a major global health concern because they affect people of all ages and demographics. The disease's annual incidence rate of 13 cases per 100,000 individuals illustrates how widespread it is and how much it strains international health systems (Begum et al, 2020). Acute leukemia, which makes up 1…2% of cases, is the deadliest subtype of malignant neoplasms. This cancer is associated with distinct demographic patterns: men are more susceptible than women, and the majority of victims are Caucasians (Rehman et al., 2018). While acute myeloid leukemia is more common in older adults, acute lymphocytic leukemia usually affects teenagers. Age is yet another crucial component (Singha et al., 2021). Moreover, chronic lymphocytic leukemia and chronic myelogenous leukemia differ in their epidemiological characteristics [1, 2, 3, 4].

The problem and aim of the study

There is no doubt that racial and ethnic disparities affect the prevalence of leukemia, with Caucasians having a larger risk than other racial groupings. The fundamental causes of the racial disparities in leukemia incidence have been the subject of extensive research (Singha et al., 2021). One important component that may account for these discrepancies is genetic predisposition. There is proof that some genetic mutations and circumstances increase the likelihood of developing leukemia (Vosberg & Greif, 2019). Caucasians may have greater rates of leukemia because some racial or ethnic groupings may have a higher prevalence of these genetic variants (Begum et al, 2020). Understanding the genetic underpinnings of leukemia across different ethnic groups is essential for more effective tailoring of diagnostic and treatment strategies [5, 6, 7].

Basic research materials

One of the first stages in the diagnosis of acute leukemia is the study of peripheral blood for the presence of blast cells. This procedure is associated with a number of difficulties, the main of which is the high variability of blast cells and the similarity of the images of some of them with non-blast cells, which causes errors in their classification. It should be noted that such an expert system serves as a tool for a hematologist in diagnosing acute leukemia.

The results

The result of the work of the expert system is a conclusion about whether a cell belongs to a certain type, indicating a probabilistic assessment, which requires the creation of the required volume of a representative reference sample of cell images. The peculiarity of the expert system under consideration is that, along with the knowledge of experts accumulated in it, a database is created based on the results of measuring quantitative characteristics obtained as a result of automated image processing. The authors developed an automated method for processing and isolating blast cells and software "Blood Rheology Analyzer" for a hematologist. In Fig. 1. An example of the processing of blast and non-blast cells is presented [8].

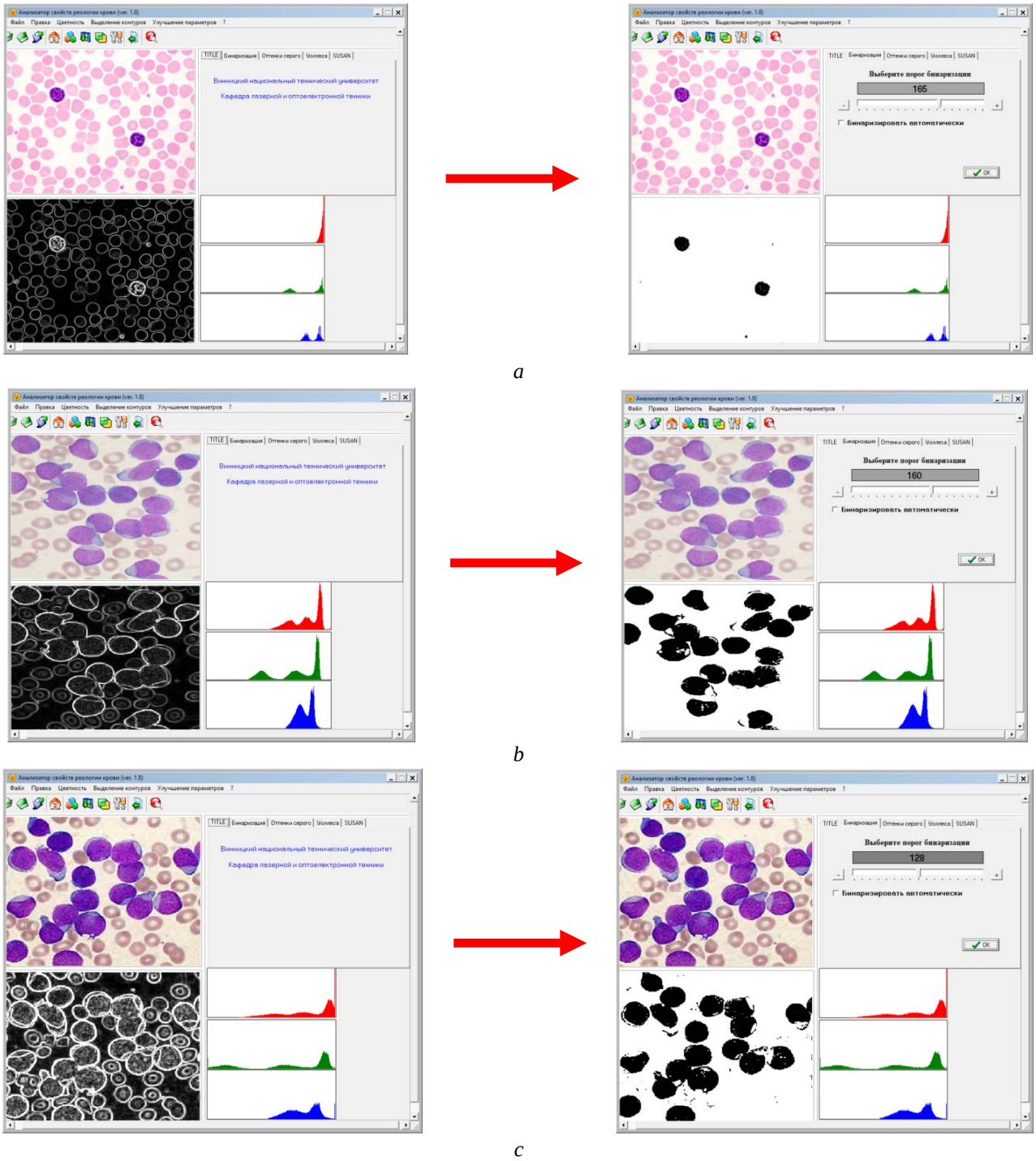

Fig. 1. Example of processing blast and non-blast cells: determination of blast cells against the background of lymphocytes (*a*); an example of an atypical monoclear (*b*); determination of blast cells (*c*)

Conclusions

The introductory chapter established the context for this paper by stressing the significance of leukemia in healthcare and the challenges associated with both diagnosis and therapy. The paper ultimate objective is to provide an information technology solution to these issues, thereby improving patient care and prognosis. A conceptual model of an expert system for the diagnosis of acute leukemia is proposed, which will reduce the ambiguity in the interpretation of research objects. Factors influencing the correct recognition of complex objects (images of blast and non-blast blood cells) using an expert system based on computer microscopy methods are considered.

The upcoming chapters will address the impact of the suggested information technology system on the diagnosis and treatment of acute leukemia in addition to a thorough study of the research methodology, data analysis, and conclusions.

References

1. Abdeldaim, A. M., Sahlol, A. T., Elhoseny, M., & Hassanien, A. E. (2018). Computer-aided acute lymphoblastic leukemia diagnosis system based on image analysis. Advances in Soft Computing and Machine Learning in Image Processing, 131-147.
2. Ahmed, I. A., Senan, E. M., Shatnawi, H. S. A., Alkhraisha, Z. M., & Al-Azzam, M. M. A. (2023). Hybrid techniques for the diagnosis of acute lymphoblastic leukemia based on fusion of CNN features. Diagnostics, 13(6), 1026.
3. Ansari, S., Navin, A. H., Sangar, A. B., Gharamaleki, J. V., & Danishvar, S. (2023). A customized efficient deep learning model for the diagnosis of acute leukemia cells based on lymphocyte and monocyte images. Electronics, 12(2), 322.
Arber, D. A., Borowitz, M. J., Cessna, M., Etzell, J., Foucar, K., Hasserjian, R. P., ... & Vardiman, J.
4. W. (2017). Initial diagnostic workup of acute leukemia: guideline from the College of American Pathologists and the American Society of Hematology. Archives of pathology & laboratory medicine, 141(10), 1342-1393.
5. Wójcik W. et al.: "Information Technology in Medical Diagnostics II," *Taylor & Francis Group.CRC Press, Balkema Book*, London, 2019.
6. Wójcik W. et al.: "Information Technology in Medical Diagnostics", *CRC Press*, 2017.
7. Л. Цзіньцюн, С.Павлов. «Експертна біоінформаційна система діагностики форм гострого лейкозу на основі аналізу біомедичної інформації», ІТКІ, вип. 58, вип. 3, с. 84–93, Груд 2023.
8. С. В. Павлов, Й. Р. Салдан, О. В. Карась, і С. В. Тимчик, «Аналіз методів і систем діагностики діабетичної ретинопатії», *Опт-ел. інф-енерг. техн.*, вип. 46, вип. 2, с. 135–141, Груд 2023.

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