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SOME PATHOLOGICAL ASPECTS IN VARIOUS WBCs DISORDERS

Diana - Elena Maftei, Ioana - Melina Porumb

***Key words**: leukemias, normal, pathological, blood smear, blood count*

INTRODUCTION

WBCs are mainly produced in the bone marrow, but several types of WBCs are also made in the: lymph nodes, spleen, and thymus gland. Once formed, WBCs travel through the bloodstream and lymphatic vessels to fight infection in the entire human body.

By the time of birth, more than 90% of all new blood cells are formed in the bone marrow. During childhood, the marrow of all bones contributes to hematopoiesis. During adulthood, hematopoietic marrow is limited to certain bones (e.g., pelvic bones, vertebral column, ends of the femur, skull, ribs, and sternum). Hematopoietic cells derive from pluripotent stem cells that are capable of both self-renewal and differentiation. Under normal circumstances, the stem cells provide hematopoietic cells for the entire life span [5].

Hematology is, by definition, the study of blood and blood disorders. It is a top research field, combined with innovative immunological and molecular tools, based on monoclonal antibodies -a promising immunotherapeutic strategy to improve leukemias, among other diseases. There is a growing necessity for individual therapy and treatment. Monoclonal antibodies are proven to be a promising immunotherapeutic strategy to improve ALL patients' outcome for future. There's still a need for individualized cure with effective drugs, [8].

Leukemia is a cancer of the white blood cells (WBCs). In leukemia, the WBCs do not function like normal WBCs. Leukemic cells are released in the blood stream, where they clutter as well, in most cases of leukemia. These types of cells may enter and remain in the liver, spleen, lymph nodes, or other organs. At the same time, a great number of leukemic cells in the blood stream may indicate a diagnosis of leukemia [3].

The classification of leukemias (by white blood cell type or onset – acute or chronic) corresponds to the maturity degree of the predominant cell type present in bone marrow and peripheral blood. There is a large variety of pathological cells in acute or chronic leukemia, therefore it is difficult to detect the type of cells involved in the leukemic processes. In acute leukemia, cancer cells divide quickly. In chronic leukemia, the disease progresses slowly. Leukemia is also classified by the type of cell that's affected. Leukemia involving myeloid cells is called myeloid leukemia. Myeloid cells are immature blood cells that would normally turn into granulocytes or monocytes. Leukemia involving lymphocytes is called lymphocytic leukemia. The four main types of leukemia are: acute lymphocytic leukemia (ALL) - it is the most common form of childhood leukemia; acute myelogenous leukemia (AML); chronic lymphocytic leukemia (CLL). This is the other most common form of adult leukemia; chronic myelogenous leukemia (CML) (People older than 65 years old have a higher risk of this type); Hairy cell leukemia is a very rare subtype of CLL [9-12].

Most changes in the white blood cell count are due to an increase or decrease of cells of the myeloid series. By definition, a leukocytosis is present if leukocytes are increased to more than 10,000/μL; in leukopenia leukocytes are below 4000/μL, [5].

Acute myelogenous leukemias (AMLs) are severe hematological cancers that require, in most cases, urgent treatment. AML is hardly ever found in children and young adults; the incidence of AML increases with advancing age, the average age being between 60 and 70 years.

Despite all treatments with cytostatic drugs, only few patients can be cured nowadays. In adults, about 80% of all acute leukemias belong to the AML group. In most cases of AML, no etiological agent can be identified. Nevertheless, for some people there is a genetic or an acquired predisposition to develop AML. Several constitutional cytogenetic abnormalities have been linked to the start and development of acute myelogenous leukemias. A 10-fold increase in the ocurreence of AML has been noticed in children with Down syndrome. Fanconi anemias, Bloom syndrome, and other severe conditions are linked to a high risk of developing AML. Exposure to chemicals (e.g., benzene) or to ionizing radiation augments the risk of AML (Plate 1, fig. 3) [5].

Acute lymphoblastic leukemias (ALLs) are blood cancers defined by cytomorphology, cytochemistry, immunological, and molecular markers (Plate 1, fig. 4, 5). The first event in ALL is the alteration and proliferation of a lymphoid stem cell. The phenotype of ALL blasts is triggered by the

origin stem cell and its degree of differentiation. An abnormal gene expression leads to an incomplete or improper expression of differentiation markers. Most cases of ALL are characterized by cytogenetic aberrations (e.g., translocations, deletions, inversions). These cytogenetic abnormalities help in accurate diagnosis [2, 3, 7].

MATERIAL AND METHODS

This present study was conducted in a group of 209 patients investigated in 2020. Laboratory analyses have been performed in the New Central Med Lab (Bacău). The study aimed to monitor the distribution of investigated patients by normal values of WBCs versus the subjects with WBCs alterations, either leukopenia, or leukocytosis, the distribution of subjects by gender, age, urban/rural environment. Thereby, tests for a quantitative and qualitative assessment of hematological parameters were performed: complete blood count, cytological blood smear analysis, hemoleucogram. The blood smear cytologic examination is a valuable observation, that is prior in the diagnosis of hematological disorders. The blood smears were fixed and coloured May Grünwald - Giemsa (Plate 1, fig. 1-5).

The thorough examination of proper blood smears serves for diagnosis purpose, together with the hemoleucograms. In certain cases, data provided by automatic hemoleucograms may imply a specific diagnosis. There are certain medical conditions that are characterized by a normal cell count, yet an abnormal cell morphology. Blood smears are a valuable mean in the diagnosis and assessment of anemia, inflammation, infections, hereditary red cells abnormalities, and other lymphoproliferative and myeloproliferative disorders.

Complete blood count is a quantitative evaluation method that investigates blood cells and was performed with the high-quality HEMIX-5/60 completely automatic hematology analyzer (Plate 1, fig. 6). It serves for *in vitro* diagnosis in clinical laboratories, and indicates 26 hematological parameters, including a precise 5 - type leukocyte assessment (LYM%, MON%, NEU%, EOS%, BAS%) based on flow cytometry optic laser analysis. The HEMIX-5/60 inner database displays file storage for 100.000 patients, data regarding the result quality control, calibration, including notices and warnings, pie charts, or bar charts.

RESULTS AND DISCUSSIONS

There are three types of white blood cells: granulocytes, lymphocytes, and monocytes. Neutrophils are granulocytes, along with eosinophils, and basophils. The leukocyte count can be of reactive or malignant nature. Reactive leukocytosis may involve neutrophils, eosinophils, and basophils, as well.

A drastic increase in leukocyte count exceeding 100.000 cells/μL, indicates hyperleukocytosis. It is a characteristic of leukemias and lymphoproliferative disorders (LPD), along with vascular occlusion, leukostasis, and ischemia. LPDs are classified as acute lymphoblastic leukemia, lymphoma, chronic lymphocytic leukemia, and monoclonal gammopathies.

Body response to a bacterial infection is represented by the clutter of neutrophils at the infection site, prior to by the formation of an exudate. Thereby, neutrophilia is constantly linked to bacterial infection. Severe infections translate into a waste of a large number of netrophils inside tissues, and the stock decreases. There is a low incidence of neutropenia, nevertheless.

Eosinophilia characterizes allergies or parasitic conditions. Basophilia is present in disorders such as chronic granulocytic leukemia, myelofibrosis, and policitemia vera.

Monocytosis is commonly associated to infections, inflammation, or hematological malignancy, e.g. Hodgkin and non-Hodgkin lymphoma.

Limfocytosis occurs in: viral infections; bacterial infections; parasitosis; hypersensitivity; other pathological conditions, e.g.: splenectomy, hyperthyroidism, metastatic melanoma.

Decrease in leukocyte count mostly impends on neutrophil number. Eosinopenia are rare, indicating acute allergies, and infectious diseases. Basopenia are not known as autonomous.

Monocytopenia displays the increased risk of. Treatment with hematopoietic stem cell transplantation may be necessary. It is frequently caused by bone marrow aplasia (a reduction in pluripotent stem cells). Lymphopenia is most often a result of HIV or other viral infection, of glucocorticoids, cytotoxic medication, radiotherapy, and of anti-lymphocytic serum [1-5].

This study was conducted on a group of 209 patients investigated in 2020. Laboratory determinations have been performed in the New Central Med Lab (Bacău). The preliminary results were statisically processed and represented in the attached graphs (Plate 2).

The results provided during the coronavirus pandemic did not comprise bone marrow smears, that will represent the topic a future scientific study regarding leukemias.

Of all the target pacient group, 61% were female, and 39% were male subjects.

We noticed that 60 male patients and 100 female patients displayed normal values in the leukocyte counts. Distribution after age decades showed that most pacients were elderly, within the 61-70 years old age segment.

Numeric distribution of the investigated subjects by leukocyte count alterations displayed that

29 patients developed leukopenia, and 20 had leukocytosis.

An increase in leukocyte count indicates an inflammatory response, or an infection. A leukocyte cell number over 25.000 cells/μL proves a leukemic path, a bone marrow response to an infectious agent, or to some intense inflammatory stimuli.

Hyperleukocytosis indicates leukemia and lymphoproliferative disorders. Some medical procedures and certain medication may lead to leukopenia.

CONCLUSIONS

In our medical research, of all the target pacient group, 61% were female, and 39% were male subjects.

We observed that 60 male patients and 100 female patients displayed normal values in the leukocyte counts.

Distribution after age decades showed that most pacients were elderly, within the 61-70 years old age segment.

Numeric distribution of the investigated subjects by leukocyte count alterations displayed that 29 patients developed leukopenia, and 20 had leukocytosis.

The enclosed data are preliminary, and the analysis of bone marrow smears will represent the topic of a future scientific study regarding leukemias. The types of leukemia will be assessed by blood and bone marrow smears observations.

ABSTRACT

A medical survey was conducted on a group of 209 patients investigated in 2020. Laboratory determinations and analyses have been performed in the New Central Med Lab (Bacău). In this study, the purpose was to monitor the distribution of investigated patients by normal values of WBCs versus the subjects with WBCs alterations, either leukopenia, or leukocytosis, detect certain types of leukemia, the distribution of subjects by gender, age, urban/rural environment. Thereby, tests for a quantitative and qualitative assessment of hematological parameters were performed: complete blood count, cytological blood smear analysis, hemoleucogram. The blood smear cytologic examination is a valuable observation, that is prior in the diagnosis of hematological disorders. The blood smears were fixed and stained May Grünwald – Giemsa.

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AUTHORS' ADDRESS

MAFTEI DIANA – ELENA - 'Vasile Alecsandri' University of Bacău, Faculty of Sciences, no 157 Mărăşeşti Street, Bacău, Romania, e-mail: diana.maftei@ub.ro;

PORUMB IOANA – MELINA, Synevo Romania Laboratory, Bucharest, Romania, e-mail: melinaporumb@gmail.com.

Plate 1

Fig. 1. May-Grünwald-Giemsa (MGG)staining

Fig. 2. Blood smear stained May-Grünwald-Giemsa

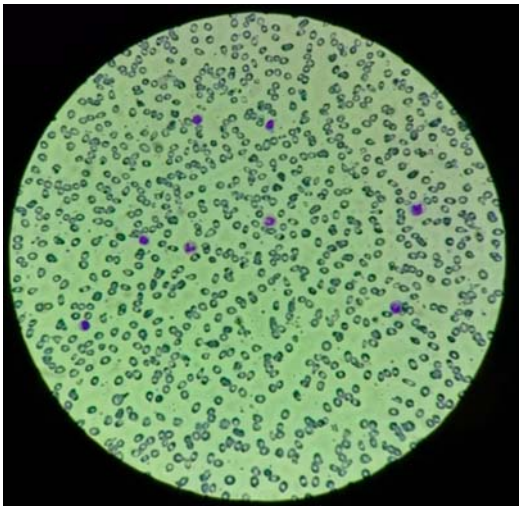


Fig. 3. Blood smear indicates acute myeloid leukemia; MGG staining; x40

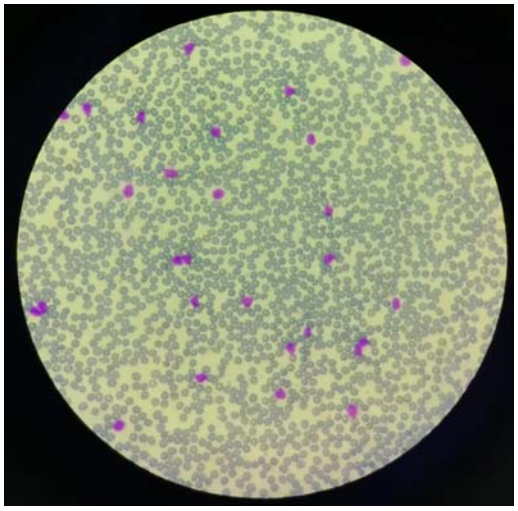


Fig. 4. Blood smear indicates acute lymphoid leukemia; MGG staining; x40

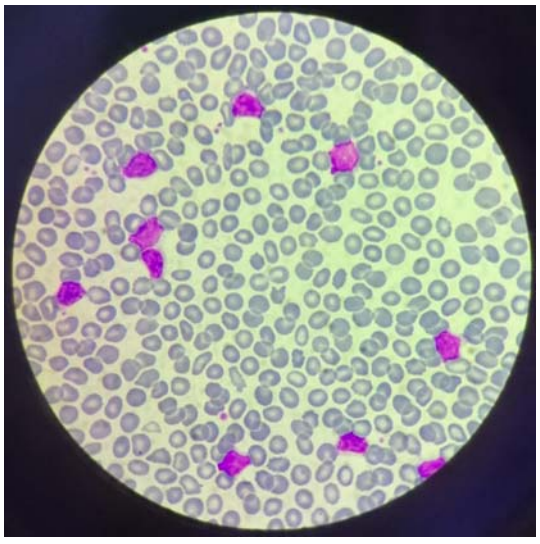
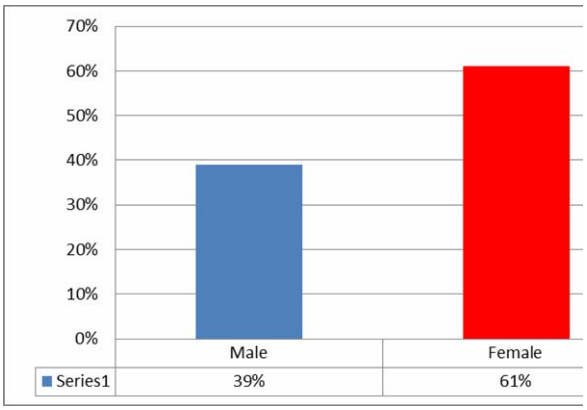


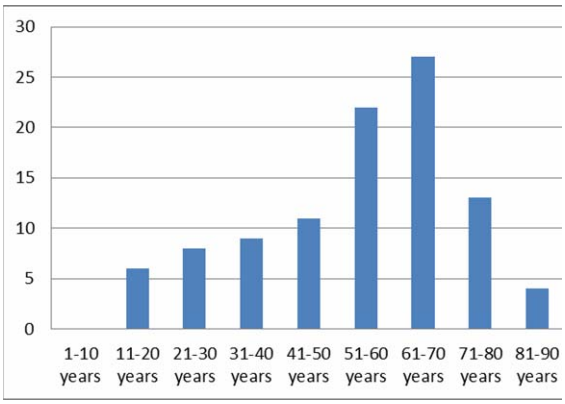
Fig. 5. Blood smear indicates acute lymphoid leukemia; MGG staining; x100

Fig. 6. HEMIX-5/60 analyzer

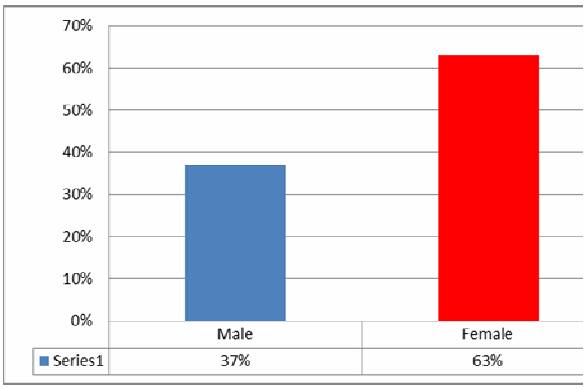
Plate 2



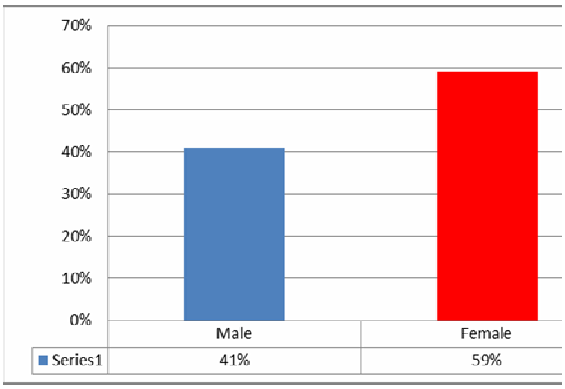
Percentage distribution of patients investigated by gender



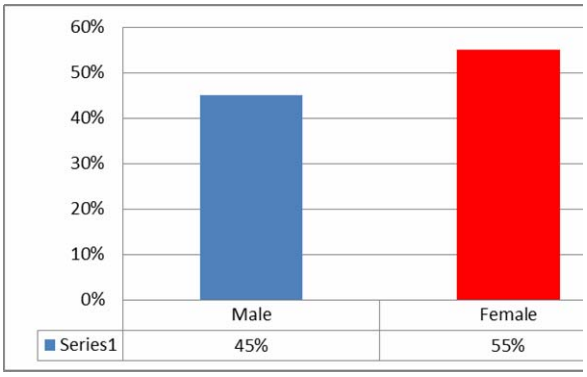
Percentage distribution of patients investigated by age segments



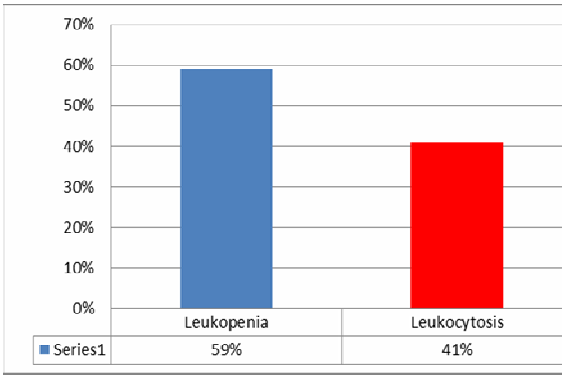
Percentage distribution by gender of patients with normal WBCs counts



Percentage distribution by gender of investigated leukopenia patients



Percentage distribution by gender of investigated leukocytosis patients



Percentage distribution of investigated patients by leukocyte numeric alterations