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## METHODICAL APPROACH TO TEACHING STUDENTS MECHANISMS OF HEMOBLASTOSIS DEVELOPMENT AT THE DEPARTMENT OF PATHOPHYSIOLOGY

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### **Abstract**

This work is a fragment of the initiative research "The role of transcription factors, the circadian oscillator system and metabolic disorders in the formation and functioning of pathological systems" (№ 0119U103898).

The article is devoted to the problem of methodical approach to teaching the topic "Hemoblastosis" at the Department of Pathophysiology. Module 2 "Pathophysiology of organs and systems" begins with the study of the submodule "Pathophysiology of the blood system" for all students majoring in 222 "Medicine", 228 "Pediatrics" and 221 "Dentistry". One of the difficult topics for students to understand is the topic of "Hemoblastosis".

In Ukraine, the system of higher medical education is undergoing active innovative changes. This process is characterized by the introduction of new technologies and techniques in the educational process. Innovative forms and methods of teaching are developed and implemented.

The purpose of this work is to analyze the difficulties that students have when they studying the topic of "Hemoblastosis" and the development of methodological approaches to their elimination.

According to the WHO: cancer is one of the leading causes of death in the world: in 2012, there were 8.2 million deaths from cancer. Hemoblastosis accounts for approximately 8% of all malignancies and all together they are among the 6 most common types of malignant tumors. Acute leukemias account for about 50-60% of all leukemias, with acute myeloblastic leukemia being slightly more common than acute lymphoblastic leukemia. Chronic leukemias account for about 40-50% of all leukemias, with chronic lymphocytic leukemia being slightly more common than chronic myelocytic leukemia. Hemoblastosis is a relatively rare disease; mortality from them is 1.7-3.1 per 100,000 population. Among therapeutic diseases, leukemia occurs in 1.5-2.6% of cases. Recently, the incidences of hemoblastosis, especially acute, have increased in all countries.

**Keywords: teaching methods; students; hemoblastosis; leukemia; pathophysiology; medical education; innovation; education.**

According to the WHO: cancer is one of the leading causes of death in the world: in 2012, there were 8.2 million deaths from cancer. Hemoblastosis accounts for approximately 8% of all malignancies and all together they are among the 6 most common types of malignant tumors.

Acute leukemias account for about 50-60% of all leukemias, with acute myeloblastic leukemia being slightly more common than acute lymphoblastic leukemia [3]. Chronic leukemias account for about 40-50% of all leukemias, with chronic lymphocytic leukemia being slightly more common than chronic myelocytic leukemia.

Hemoblastosis is a relatively rare disease; mortality from them is 1.7-3.1 per 100,000 population. Among therapeutic diseases, leukemia occurs in 1.5-2.6% of cases. Recently, the incidences of hemoblastosis, especially acute, have increased in all countries. Therefore, the study of the pathogenesis of hemoblastosis is a topical issue today.

The purpose of this work is to analyze the difficulties that students have when studying the topic of "Hemoblastosis" and the development of methodological approaches to their elimination.

Hemoblastosis (from the Greek haima - blood, blast - growth + osis - pathological process, disease) - neoplastic clonal diseases arising from hematopoietic organs. Depending on whether the bone marrow is primarily damaged, hemoblastosis are classified into two large groups: leukemias and lymphomas. With the development of the latter, neoplastic clones primarily appear out of the bone marrow, often in the lymph nodes and only over time can spread to peripheral blood and other organs (including bone marrow) [5].

Leukemias (from the Greek leuk - white, indicates a relationship to leukocytes + oz - a pathological process, disease; in the English literature - leukemia) - are malignant tumors that arise from hematopoietic cells and primarily affect the red bone marrow [5].

Students have some difficulties in understanding the division of leukemia into acute and chronic, which is based not on the principle of classification according to the course of the disease, but in depending on the degree of cell differentiation [1]. Neoplastic cells of acute leukemia, gaining the ability to infinite uncontrolled growth, lose the ability to mature. Sometimes, only partial differentiation into intermediate forms is possible. At the same time at chronic leukemias leukemic cells along with ability to unlimited growth keep property to mature and give the further forms.

Acute leukemias are hemoblastoses with a more pronounced degree of tumor progression. This presupposes the possibility of transition as the progression of chronic leukemia to acute, and not vice versa.

The teacher should pay students' attention to the tumor nature of leukemia, the evidences of which are:

- the presence of atypical growth (unlimited and unregulated cell division) and differentiation (partial or complete inhibition of cell maturation);
- clonal nature of the disease (all leukemic cells, as well as cells of other malignant tumors, originate from a single cell);
- the multistage nature of the pathogenesis, which includes the stages of initiation (which is induced by various carcinogens), promotion (which leads to the appearance of neoplastic cells) and progression (over time, tumor cells become more and more malignant properties);
- the presence of different types of anaplasia [5].

The evolution of a leukemic cell from a normal one is a multistage process that has, like any other tumor process, three main stages: initiation, promotion, and progression.

Each stage of leukogenesis reflects a mutation that leads to the activation of a specific cellular oncogene; then activated oncogenes begin to "work" together, inducing a complete neoplastic cell phenotype. An important condition that promotes tumor transformation of hematopoietic tissue cells is a decrease in the activity of antioncogenes involved in antimutation ("antitransformation") mechanisms of antitumor protection. These genes provide or "blockade" of activated cellular oncogenes or their detection and elimination by enzymatic DNA repair systems.

It is important to understand the main manifestations of the progression of

hemoblastosis:

- transformation of hemoblastosis from monoclonal (relatively benign) to polyclonal (malignant);
- suppression of normal hematopoietic sprouts with the development of pancytopenia - anemia, thrombocytopenia, leukopenia;
- transition of leukemias from aleukemic form to leukemic;
- metastasis of lymphoma (and other hematosarcomas) to the bone marrow - "leukemization" of them;
- metastasis of leukemic cells into extraosseous hematopoietic tissue, as well as - outside the organs of hematopoiesis with the formation of leukemic infiltrates (in the skin, kidneys, meninges);
- reducing the number of relatively differentiated tumor cells and increasing their undifferentiated forms;
- reduction (loss) of enzyme (biochemical) and antigenic specificity of leukemic cells;
- increase in signs of cellular atypism;
- formation of resistance (refractoriness) to the influence of antitumor (in particular, cytostatic) drugs - "slippage" of hemoblastosis from treatment [4].

Particular attention should be paid to the common and distinctive features between leukemoid reactions and leukemias when considering the topic of hemoblastosis. Leukemoid reactions (from leukemia + Greek -id, aidos - similar) are characterized by a considerable increase in a number of various immature leukocytic forms (up to normal, non-tumorous blast cells) and, as a rule (but not always), by an increased number of leukocytes in the peripheral blood.

The term "leukemoid reactions" points out that the condition is considered not be a disease, but a reactive condition of the organism, certain changes in the blood and hematopoietic organs, which are similar to leukemias and other neoplasms of hematopoietic system [4]. These reactions refer to self-limited processes and do not transform in hemoblastoses, though they resemble hemoblastoses by their hemolytic characteristics.

Two types of leukemoid reactions are distinguished: myeloid (pseudoblastic, neutrophilic, eosinophilic) and monocytic-lymphocytic (monocytic, lymphocytic, plasmacytic). Lymphocytic leukemoid reactions are more common in children.

The mechanism of development of leukemoid reactions consists in polyclonal reactive focal hyperplasia of various normal lineages of leukopoiesis and mobilization of a large number of immature leukocytes, including their blast forms, from hematopoietic tissue into

blood. This is due, on the one hand, to an increase in the activity or content in the hematopoietic tissue of leukopoietic factors and / or a decrease in the level of agents that inhibit division and stimulate the maturation of cells, in particular keylons.

Signs of leukemoid reactions are the following changes in peripheral blood and bone marrow (Morozov V.T.):

1. Shift of WBC to the left with a significant number of band neutrophilic myelocytes (neutrophilic reactions).

2. Increase in the number of eosinophils (more than 20%) in the peripheral blood and bone marrow accompanied by increasing in the number of eosinophilic metamyelocytes, myelocytes or promyelocytes (eosinophilic reactions).

3. Increase in the number of monocytes in the peripheral blood (more than 15%) with the presence of promonocytes (monocytic reactions).

4. Increase in the number of lymphocytes in the peripheral blood up to 70% or more in the bone marrow with lymphadenopathy and splenomegaly (lymphocytic reactions).

5. Increase in the number of plasma cells in the myelogram and their appearance in the peripheral blood more than 2% (plasma cell reactions).

Accordingly, each type of leukemoid reaction may (though not necessarily) be accompanied by general leukocytosis (more than  $10-15 \times 10^9/L$ ). Reactive thrombocytosis and erythrocytosis are also possible. The bone marrow hematopoiesis in all cases is accompanied by activation of hematopoiesis, the number of myelokaryocytes in the bone marrow puncture increases.

In practice, there is often a need to differentiate leukemoid reactions and leukemia. Common in their characteristics, as follows from the above, is only a similar hematological picture (significant increase in the peripheral blood of the number of immature forms of leukocytes up to blast cells, rejuvenation of bone marrow, in both cases may develop general leukocytosis, sometimes hyperleukocytosis). The differences are due to the fundamentally different nature of leukemoid reactions and leukemias: leukemoid reactions are reactive, self-limiting, polyclonal processes, while leukemias are neoplastic diseases caused by uncontrolled monoclonal proliferation of atypical leukemic cells. Therefore:

- the mechanism of leukemoid reactions is associated with the activation of the proliferation of normal (at least - without signs of atypism) cells of the leukocyte lineage, the pathogenesis of leukemia includes the mechanisms of transformation of normal hematopoietic bone marrow cells into a neoplastic cell;

- in leukemoid reactions there are no (in contrast to leukemias) antigenic markers of neoplastic cells;

- leukemoid reactions are not characterized by genetic, in particular chromosomal, abnormalities in cells (for example, the "Philadelphia" chromosome is typical of the adult variant of chronic myelogenous leukemia);

- in the bone marrow with the development of leukemoid reactions there is focal hyperplasia of normal leukopoiesis cells, with leukemia - generalized tumor hyperplasia of hematopoietic tissue;

- myeloblasts in acute myeloblastic leukemias often predominate in the picture of peripheral blood, in pseudoblastic leukemoid reactions - only present;

- for acute myeloblastic leukemia is characterized by leukemic failure (hiatus leukaemicus), not typical for leukemic reactions of the myeloid type;

- for chronic myelogenous leukemia is characterized by "basophilic-eosinophilic association", not typical for leukemoid reactions of the myeloid type;

- in leukemoid reactions, as a rule, there is a large number of leukocytes with toxic granularity, which is absent in leukemia, or occurs in small quantities.

In the conclusion, it should be noted that the teacher of the Department of Pathophysiology should pay attention to a detailed consideration of the etio-pathogenesis of hemoblastosis, when considering the topic of "Hemoblastosis", emphasizing the tumor nature of these diseases[2]. Given the limited information in the textbook about the mechanisms of leukemic reactions, the teacher should emphasize the mechanisms of these reactions, common and distinctive features with leukemia, which will be useful in the practice of future physicians and improve the quality of training of medical professionals [6].

## References

1. Akimov OYE, Kostenko VO. Optymizatsiya vykladannya dystsypliny «Patofiziolojiya» iz urakhuvannyam vyklykiv suchasnosti [Optimization of teaching the discipline "Pathophysiology" taking into account the challenges of today]. In: Suchasna medychna osvita: metodolojiya, teoriya, praktyka [Modern medical education: methodology, theory, practice]: materialy Vseukr. navch. - nauk. konf. z mizhnar. uchastyu, Poltava, 19 bereznya 2020 r. ; 2020.p.7–8. (Ukrainian).

2. Akimov OYE, Mishchenko AV, Solovyova NV, Kostenko VO. Orhanizatsiya samostiynoyi roboty studentiv pry vyvchenni patofiziolojiyi v umovakh dystantsiynoho navchannya [Organization of students' independent work in the study of pathophysiology in

the context of distance learning]. In: «Medychna nauka v praktyku okhorony zdorov'ya» ["Medical science in health care practice"]: Zbirnyk materialiv Vseukrayins'koyi naukovo-praktychnoyi konferentsiyi molodykh uchenykh, Ukrayina, Poltava, 2020. p. 39–40. (Ukrainian).

3. Akimov OYE, Nazarenko SM, Zakolodna OE, Yelinska AM. Vazhlyvist' rozuminnya studentamy osnovnykh ponyat' zahal'noyi nozolohiyi pry vyvchenni patolohichnoyi fiziolohiyi [The importance of students' understanding of the basic concepts of general nosology in the study of pathological physiology]. In: Mekhanizmy rozvytku patolohichnykh protsesiv i khvorob ta yikhnya farmakolohichna korektsiya [Mechanisms of development of pathological processes and diseases and their pharmacological correction]: zb. materialiv III Nauk.-prakt. inernet-konf. z mizhnar. uchastyu, Kharkiv, 19 lystopada 2020 r .; 2020 . p. 43. (Ukrainian).

4. Kostenko VO, Akimov OYE, Yelins'ka AM, Koval'ova IO. Patofiziolohiya systemy krovi: navchal'nyy posibnyk [Pathophysiology of the blood system: a textbook]. L'viv: «Mahnoliya 2006»; 2020. 164 p. (Ukrainian).

5. Kubyshkin A.V. General and Clinical Pathophysiology. Nova Knyha Publishers; 2011. 656 p.

6. Nazarenko SM, Yelinska AM, Denysenko SV, Akimov OYE, Zakolodna OE. Rol' kafedry patofiziolohiyi v osvitr'omu protsesi studentiv medychnoho fakul'tetu [The role of Pathophysiology Department in the educational process of medical students]. In: Mekhanizmy rozvytku patolohichnykh protsesiv i khvorob ta yikhnya farmakolohichna korektsiya [Mechanisms of development of pathological processes and diseases and their pharmacological correction]: zb. materialiv III Nauk.-prakt. inernet-konf. z mizhnar. uchastyu, Kharkiv, 19 lystopada 2020 r .; 2020 . p. 210–211. (Ukrainian).