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The Radiosensitivity of Cells of the Hemopoietic System*

By

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Much research has been done on the hemopoietic system which has been found as one of the most radiation sensitive. Similarly many results have been obtained on the radiation response of the peripheric blood cells, the bone marrow and the mammalian foetus. (Ref. 1 to 4).

In the present research attempts are made to investigate the sensitivity of different cells of the hemopoietic system, using cells from livers of embryonic mice, known as the only hemopoietic organ in the intra-uterine life. (Ref. 5)

Material and method.

For this investigation pregnant white mice (Type XVII) irradiated on the 17th day of gestation were used. The mice were anesthetized with ether and exposed to X-rays from a 200 Kv. - 5 m.a. X-ray machine with a dose of 100 r. A lead shield was used during irradiation to protect one-half of the uterus against the effects of the irradiation. The animals were sacrificed 44 hours after irradiation, blood from the livers of their embroys gently squeezed out, and several blood films prepared on microscopic glass slides. The films were stained by the Giemsa and peroxidase methods, and a blood formula was established for each embryo.

A number of pregnant mice were used as controls.

The following table shows the blood-formula for one of the control embryos.

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Table I

Percent blood - formula of a non - irradiated embryo

(19th. day after gestation)

No. of Slide	Megaloblast	Pronormo blast	Basophylic normoblast	Polychromatic	Nucleotead
1	1	8	36	33	22
2	3	10	36	30	21
3	2	9	32	34	23
4	1	8	35	32	24
5	2	10	31	35	22
6	1	8	31	34	26
Averags	2±50%	9±10%	33.5±7%	32.5±7%	23.5±10%

Table I shows a considerable regularity of the blood - formula applied to the intra - uterine life, with an error of the order 10%, except for megaloblasts. Even a qualified hematologist cannot, as a rule, determine the percentage of these cells from bone marrow of an adult animal with better than a 15% error.

Table II shows the percent distribution for 1,700 cells found in the embryonic livers of the non-irradiated parts of the uterus. (No. I toIV).

Table II

Percent blood-formula for non-irradiated embryos

(18th. day of gestation)

Embryo number	M.G.	MB.LB	M.Y.C.	P.N	B.N	Ch.N	Nucl.	Total of Cells	Number
I	0.5	6,5	14.5	1	24	42.5	11		200
II	1.3	17	41.5	5	16	11.6	7		300
III	2.6	7.4	53.6	4	14.2	13.8	4.6		1000
IV	2	3.5	18.5	1.5	24.5	31.5	7.5		200
Averages	1.6	8.6	31.9	2.6	19.9	24.8	7.5		1700

M.G - Megaloblast

MB.LB - Myeloblast plus Lymphoblast

M.Y.C. - Myelocyte

P.N - Polymorphonuclear

B.N - Basophylic normoblast or Orthochromatic

Ch.N - Polychromatic

Nucl. - Nucleotead

Table III shows the percent distribution for 2,000 cells found in the livers of the irradiated embryos. (No V to VII)

Table III

Percent blood-formula for irradiated embryos

(18th. day of gestation)

Embryo	M.G	MB.LB	M.Y.C.	P.N	B.N	Ch.N	Nucl.	Total number of cells
V	0.1	2.7	6.8	0.3	13.4	33.2	43.5	1,000
VI	0	1.4	22.8	4.2	0.6	10.6	60.8	500
VII	0.2	2.8	7.2	4	26.6	37	25.8	500
Averages	**0.1**	**2.3**	**12.3**	**2.8**	**13.5**	**27**	**43**	**2,000**

Comparison between the results in Table II and III gives a clear picture about the degree of sensitivity of different hemopoietic cells, exhibited in Table IV.

Sensitivity is defined as the ratio of the difference between the average number of non-irradiated cells and that of irradiated cells and the number of non-irradiated cells, expressed as a percentage.
(Example for myeloblastes: 8.6-2.3=6.3 is 73%of 8.6)

Table IV

Different sensitivities of hemopoietic cells

Name of cell	Percent of sensitivity
Megaloblast	93%
Myeloblast and Lymphoblast	73
Myelocyte	61
Basophylic normoblast	32
Polychromatic	-8
Polymorphonuclear	-70
Nucleotead	-460

Table IV shows:

1. The radiosensitivity is higher for white cells than for red ones.

2. The most sensitive cells among the white cells are the megaloblast, followed by myeloblastes, lymphoblastes and myelocytes.

3. For the red cells the most sensitive are the basophylic normoblasts, followed by chromatophylic normoblasts and finally the nucleoteads cells.

4. The only resistant cells among the white cells are the polymorpho-nuclear cells.

These four points have been demonstrated with some accuracy. It has been shown that the radiosensitivity for cells which are capable to divide and differentiate is higher than for the cells which lack these properties.

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Summary

The following results were obtained after a comparison of the blood formula percentages of irradiated and non-irradiated hemopoietic cells in the livers of the embryonic mice.

1. The radiosensitivity is higher for white cells than for red ones.
2. The most sensitive cells among the white cells are the megaloblast, followed by myeloblastes, lymphoblastes and myelocytes.
3. For the red cells the most sensitive are the basophylic normoblasts, followed by chromatophylic normoblasts and finally the nucleoteads cells.
4. The only resistant cells among the white cells are the polymorphonuclear cells.

These four points have been demonstrated with some accuracy. It has been shown that the radiosensitivity for cells which are capable to divide and differentiate is higher than for the cells which lack these Properties.

Resumé

Des comparaisons ont été établies entre les formules sanguines des cellules hémopoiétiques de foies embryonnaires de souris irradiées et non-irradiées et les résultats suivant ont été obtenus.

1. La radiosensibilité des cellules de lignée blanche est plus élevée que celle des cellules de lignée rouge.
2. La cellule la plus sensible parmie les cellules de lignée blanche est la megaloblast suivie de la myeloblast, de la lymphobiast et de la myélocytes.
3. Pour les cellules de lignée rouge la sensibilité est dans l'ordre suivant: la normoblast basophyle, suivie, de la normoblast chromatophyle et finalement des hématies nuclées.
4. L'unique cellule radiorésistante parmie les cellules de lignée blanche est la cellule polymorphonucléaire.

Ces quatres points ont été verifiés avec une certaine exactitude. Il a été démontré que la radiosensibilité des cellules qui presentent la possibilité de se diviser et de se différencier, est plus importante que celle des cellules n'ayant pas ces propriétés.

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