β-RADIATION OF THE FETAL FLUID IN MAN

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The question concerning the role of micro-doses of radioactive radiations as a biologic factor arose soon after the biologic action of macro-doses of radioactive radiations had been established.

As early as 1903 A. P. Sokolov [7] pointed out the connection between the therapeutic properties of natural climatic and balneologic factors and the presence of radioactive elements and increased atmospheric ionization.

The well-known experiment performed by Zvaardemaker on isolated frog heart demonstrated that the heart could pulsate for a long time only when the Ringer solution contained potassium ions.

Potassium is the only radioactive element which is concentrated in the organism of man and animals in amounts considerably in excess of its average content in the earth's crust. It possesses radioactivity which belongs to the isotope K^{40}, which constitutes 0.012% of the total amount of potassium.

Suggestions were made in a number of published works [5, 7] on potassium content of organs and tissues that the physiologic importance of potassium might be connected to a considerable degree with its radioactivity.

Micro-quantities of other radioactive elements besides potassium are contained in animal and plant organisms. In the case of man these gain access by way of food, water and air. Radiation from these micro-quantities of radioactive elements in the human organism constitutes less than 2% of potassium radiation [1].

Furthermore, animal and plant organisms contain artificially radioactive carbon isotope C^{14} formed as the result of cosmic ray action. It is present in amounts around 10^{-9}% of the total amount of carbon. To this should also be added the continuous action of cosmic radiation.

In recent years there have appeared in the literature views suggesting that animal and plant organisms were not indifferent to these radiations of very weak activity [3, 6].

Some investigators attempted to prove by direct experimental means that changes in the micro-doses of radioactive radiations caused changes in the development of organisms. They encountered great difficulties, however, since at the present time it is impossible to create conditions completely excluding penetrating radiations.

Another line of research lies along studies and accumulation of data concerning micro-radiations of radioactive elements contained in organisms. Correlation of data obtained under natural conditions can, albeit indirectly, lead to correct conclusions regarding the role of micro-doses of radioactive radiations.

One of the links in such a chain of investigations can be a study of radioactivity of fetal fluid in man.

S. P. Vinogradova [2] studied the biologic, physical and chemical properties of fetal fluid and G. P. Mushegj [4] directed his attention to certain biologic aspects of this fluid. In 1927-1928 G. G. De-Metz tried to determine the radioactivity of human fetal fluid. However, he obtained negative data which may have been connected with poor sensitivity of the method employed by him, and the question remained unresolved.

EXPERIMENTAL

The present work is devoted to studies of radioactivity of fetal fluid. Samples of fetal fluid obtained from several therapeutic establishments were subjected to counter examinations. The fluid used was in the form of light dispersed medium, uncontaminated by blood.

TABLE 1

Radiation Activity of Fluid in Which a Female Fetus Developed

Therapeutic establishment	Number of case history	Mineral residue 100 ml fluid in g	Specific activity of mineral residue in Cu units	Activity referred to 100 ml fluid in Cu units
Protection Maternity and Childhood	1756	0.625	$1.33 \cdot 10^{10}$	$0.84 \cdot 10^{10}$
October Hospital	1961	0.644	$1.28 \cdot 10^{10}$	$0.82 \cdot 10^{10}$
" "	2313	0.680	$1.07 \cdot 10^{-10}$	$0.73 \cdot 10^{-10}$
" "	2380	0.636	$1.00 \cdot 10^{10}$	$0.64 \cdot 10^{10}$
" "	2061	0.615	$1.02 \cdot 10^{10}$	$0.63 \cdot 10^{-10}$
" "	57	0.621	$1.00 \cdot 10^{-10}$	$0.62 \cdot 10^{-10}$
Protection Maternity and Childhood	1760	0.722	$0.80 \cdot 10^{10}$	$0.58 \cdot 10^{-10}$
October Hospital	2315	0.654	$0.88 \cdot 10^{-10}$	$0.57 \cdot 10^{-10}$
" "	2371	0.570	$1.00 \cdot 10^{10}$	$0.57\ 10^{10}$
" "	2339	0.615	$0.93 \cdot 10^{-10}$	$0.57 \cdot 10^{-10}$
Protection Maternity and Childhood	1756	0.480	$1.16 \cdot 10^{10}$	$0.56 \cdot 10^{-10}$
October Hospital	6/№	0.599	$0.88 \cdot 10^{10}$	$0.53 \cdot 10^{10}$
" "	2131	0.570	$0.90 \cdot 10^{-10}$	$0.51 \cdot 10^{-10}$
" "	351	0.668	$0.76 \cdot 10^{-10}$	$0.51 \cdot 10^{-10}$
" "	121	0.636	$0.74 \cdot 10^{-10}$	$0.47\ 10^{10}$
" "	302	0.570	$0.80 \cdot 10^{10}$	$0.45 \cdot 10^{-10}$
" "	53	0.600	$0.74 \cdot 10^{-10}$	$0.45 \cdot 10^{10}$
" "	223	0.588	$0.74 \cdot 10^{-10}$	$0.44 \cdot 10^{10}$
" "	2404	0.577	$0.68 \cdot 10^{10}$	$0.34 \cdot 10^{-10}$
Average			$0.93 \cdot 10^{-10}$ cu	$0.57 \cdot 10^{-10}$ cu

Direct measurement of radiation activity of fetal fluid is exceedingly difficult owing to its low intensity. Therefore, in order to obtain values characterizing radiation activity in curie units (cu) studies were carried out on ashed dry residues obtained by preliminary evaporation.

The measurements revealed that specific activity, i. e., activity referred to 1 g ahsed mineral residue, varied within the range of 0.20×10^{-10} to 1.33×10^{-10} cu.

Activity referred to 100 ml of fluid correspondingly varied within the range of 0.13×10^{-10} to 0.84×10^{-10} cu.

The activity measured in the present work was chiefly contributed by potassium as the apparatus used could record only beta-radiation with electron energy not less than 100,000 electron-volts (10^{-5} ev). Even

TABLE 2

Radiation Activity of Fluid in Which a Male Fetus Developed

Therapeutic establishment	Number of case history	Mineral residue in 100 ml fluid in g	Specific activity of mineral residue in Cu units	Activity referred to 100 ml fluid in Cu units
Protection of Maternity and Childhood	1778	0.732	$0.63 \cdot 10^{-10}$	$0.46 \cdot 10^{-10}$
October Hospital	224	0.733	$0.60 \cdot 10^{-10}$	$0.44 \cdot 10^{-10}$
" "	2376	0.655	$0.63 \cdot 10^{-10}$	$0.41 \cdot 10^{-10}$
" "	2400	0.643	$0.63 \cdot 10^{-10}$	$0.40 \cdot 10^{-10}$
" "	1983	0.680	$0.59 \cdot 10^{-10}$	$0.40 \cdot 10^{-10}$
" "	2241	0.729	$0.53 \cdot 10^{-10}$	$0.38 \cdot 10^{-10}$
" "	2243	0.607	$0.60 \cdot 10^{-10}$	$0.36 \cdot 10^{-10}$
" "	2378	0.680	$0.53 \cdot 10^{-10}$	$0.36 \cdot 10^{-10}$
" "	359	0.626	$0.45 \cdot 10^{-10}$	$0.33 \cdot 10^{-10}$
" "	74	0.605	$0.53 \cdot 10^{-10}$	$0.32 \cdot 10^{-10}$
" "	273	0.600	$0.53 \cdot 10^{-10}$	$0.31 \cdot 10^{-10}$
" "	184	0.550	$0.50 \cdot 10^{-10}$	$0.28 \cdot 10^{-10}$
" "	2132	0.550	$0.51 \cdot 10^{-10}$	$0.28 \cdot 10^{-10}$
" "	226	0.535	$0.50 \cdot 10^{-10}$	$0.27 \cdot 10^{-10}$
" "	6/№	0.636	$0.20 \cdot 10^{-10}$	$0.13 \cdot 10^{-10}$
Average			$0.53 \cdot 10^{-10}$ cu	$0.33 \cdot 10^{-10}$ cu

if other radioactive elements were present in the fluid their radiation must be so small that changes in activity caused by them would lie within the limits of experimental error which in these experiments did not exceed 10%.

It was found that radiation of fluid in which a female fetus had been developing (Table 1) was considerably higher than that of fluid in which a male fetus had been developing (Table 2).

SUMMARY

It was experimentally proved that the activity of β-radiation of the fetal fluid is different depending upo the sex of the embryo.

Thus, radiation activity of the fluid in which a fetus of the female sex (Table 1) was developing, was found to be significantly higher than that of the fluid in which a fetus of the male sex was developing (Table 2).

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