# THE PROPHYLACTIC ACTION OF AEROIONIZATION IN ACUTE RADIATION SICKNESS

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The abundance of data indicating an increase of resistance to various harmful effects in animals that received aeroions [1-8] permitted us to assume that the use of positive and negative aeroionization would not be fruitless in radiation sickness.

## EXPERIMENTAL METHOD

White male rats weighing 150-200 g were used in the experiments. The animals of all groups were housed in a vivarium under similar conditions on a standard mixed diet.

Ionization was carried out by an electroeffluvial aeroionizator of Ravich's system. The prophylactic course of aeroionization included 7-28 treatments, each lasting 15-30 min daily at 500,000 ion/cm$^3$; the last treatment was $2^1/_2$-3 h before irradiation. The therapeutic course began on the day of irradiation and lasted 20 days (15 min daily).

The animals were irradiated with $Co^{60}$ $\gamma$-rays in a dose of 700 R at a rate of 305 R/min.

After irradiation, the animals were observed for 30 days; we studied the dynamics of death, body weight and temperature, gas exchange indexes, and peripheral blood picture.

Ten series of experiments were set up. In all we used 460 animals. A value of $P < 0.05$ was taken as the reliability criterion.

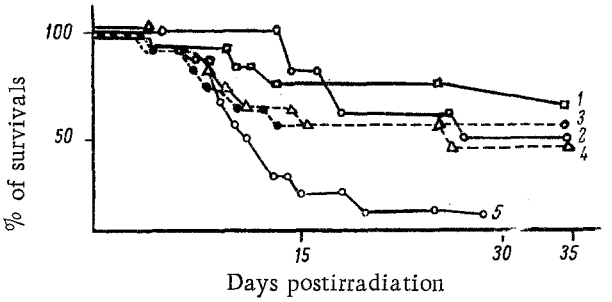


Fig. 1. Dynamics of the death of rats irradiated with $\gamma$-rays in a dose of 700 R after a preliminary course of positive or negative aeroionization, and of control animals that were only irradiated. 1,2) Positive aeroionization, 14 and 28 treatments during the spring with $\gamma$-irradiation; 3,4) negative aeroionization, 28 treatments during the spring with $\gamma$-irradiation; 5) irradiation control.

## EXPERIMENTAL RESULTS

According to the obtained data, the therapeutic courses of positive and negative aeroionization do not influence the dynamics of death of irradiated animals and in fact, do not change their state.

The use of prophylactic courses of positive and negative aeroionization that included 7, 10, 15, and 18 treatments lasting 15 and 30 min each at different seasons of the year (winter, fall, summer) proved to be without result. The rats that had received at first the prophylactic course of 15 treatments of positive or negative aeroionization and then (after irradiation) the therapeutic course did not differ from the control (only irradiated) animals.

The use of prophylactic courses during the spring yielded different results. The conduction of 14 and 28 treatments of positive aeroionization (15 min) during late spring (April-May) yielded definite results: the resistance of animals to radiation lesion upon irradiation with $Co^{60}$ $\gamma$-rays in a dose of 700 R increased. By the 20th day after irradiation 56-70% of the animals in these groups remained alive, and by the 30th day 50-60% of the animals, whereas all control rats died by the 30th day post-irradiation (Fig. 1).

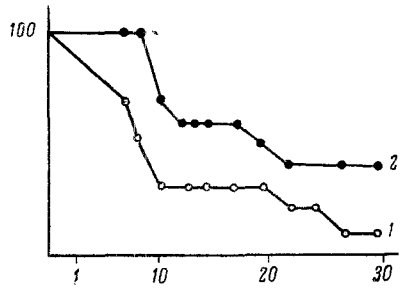


Fig. 2. Dynamics of the death of rats irradiated with γ -rays in a dose of 700R after a preliminary course of positive aeroionization, and of control animals only irradiated. 1) Irradiation control; 3) positive aeroionization, 28 treatments during the winter with subsequent γ -irradiation.

This result was obtained in 2 series of experiments set up during the same periods of different years, and therefore, it cannot be considered chance. Here, we can assume a certain regularity associated with a peculiarity of the effect of aeroions on rats during late spring.

The results of experiments set up during a different season permit the assumption that this peculiarity lies in an increase of sensitivity to aeroions, a lowering of the threshold of their effect on an organism. The fact is that if during the winter, fall, and summer the conduction of 14 and 18 treatments of positive aeroionization does not change the resistance of animals to radiation lesion, the use of 28 such treatments yields a definite favorable result. Thus, in the series of experiments set up in January-February, 50% of the experimental rats (that had received 28 treatments of positive aeroionization) and only 20% of the control rats were alive by the 30th day 40 and 10% respectively were alive (Fig. 2). The average life span of experimental animals was 12 days and of control animals (in this series of experiments) 8 days.

Thus, 14 and 18 treatments during the winter do not yield results, but a course of 28 treatments of positive ionization is effective. During the spring both courses (14 and 28 treatments) yielded a favorable result. We note that the result in both cases was approximately the same: the percent of animals that survived was 56-70 on the 20th day and 50-60 on the 30th day, whereas the life span of the animals that died that had received 14 treatments was even greater, 16 days as against 8.4.

It is interesting that the use of negative aeroionization for the prevention of radiation damage was also without results. Although 14 treatments with negative ionization did not yield an effect even in April-May (unlike 14 treatments with positive aeroionization), the course of 28 treatments of negative ionization during the spring yielded a distinct, favorable result. By the 20th day post-irradiation in this series of experiments 50% of the animals had survived, and by the 30th day 40% of the animals, with a 100% death of control animals (see Fig. 1).

Apparently in this case the cause should be sought in the threshold of sensitivity which for positive ions is evidently lower than for negative. We previously arrived at this conclusion by evaluating the state of healthy animals that had received aeroions by such indexes as the gas exchange, peripheral blood picture, resistance to toxic doses of strychnine. As a result of this, during the spring when 14 and 28 treatments with positive aeroionization yields an effect, the use of only 28 treatments and not 14 treatments of negative aeroionization proved to be fruitful. Evidently, at different times of the year when the sensitivity to aeroions is in general lower, negative ionization yields an effect when more than 28 treatments are used.

By the time of irradiation the blood picture of animals that had received aeroions was already somewhat different from the control (see Table). In groups in which aeroionization had reduced the percentage of animal death after irradiation, the number of erythrocytes was on the average 112% of the control level. A substantial difference in the number of leucocytes before irradiation was noted only in one case—in the series of experiments carried out during the spring on animals that had received 28 treatments of positive aeroionization.

On the 7th day post-irradiation the number of erythrocytes in animals of the experimental groups was from 5,600,000 to 7,030,000 as opposed to 3,500,000 in the control. The number of erythrocytes in comparison with the initial level of experimental rats dropped by 16%, whereas in the controls, by 47%. During this same period the number of leucocytes of rats that received prophylactic courses of aeroionization was 1,120-2,500 as opposed to 700 in the control and only in one case, with positive aeroionization conducted during the winter, was it below the control, 370.

A statistically significant difference in the hemodynamic indexes between the experiment and the control was noted on the 14th-20th day post-irradiation, i.e., during the recovery period. On the 14th day post-irradiation the number of erythrocytes of mammals that had received aeroions was 4,310,000-6,170,000 as opposed to 2,330,000 in the control, whereas the number of leucocytes was from 2600 to 10,400 as opposed to 1700 in the control (see Table). Only with positive aeroionization carried out during the winter was the number of erythrocytes and leucocytes on the 14th day not different from the control.

State of Peripheral Blood Before and After Irradiation in Series of Experiments in Which Aeroionization Increased the Resistance of Animals to γ -Irradiation in a Dose of 700 R

| Experimental conditions | Statistical index | Erythrocytes (in millions) | | | Leucocytes (in thousands) | | |
|---|---|---|---|---|---|---|---|
| | | Before irradiation | 7th day post-irradiation | 14th day post-irradiation | Before irradiation | 7th day post-irradiation | 14th day post-irradiation |
| Control (γ -irradiadiation | $M_0 \pm m_0$ | 6.56±0.19 | 3.50±0.28 | 2.33±0.48 | 15.7±0.67 | 0.7±0.09 | 1.7±0.63 |
| Prophylactic course of positive aeroionization of 14 treatments (spring) | $M_1 \pm m_1$<br>$P_1$ | 7.29±0.27<br><0.05 | 7.03±0.26<br><0.001 | 4.44±0.56<br>=0.02 | 19.6±2.2<br>> 0.05 | 2.50±0.79<br><0.05 | 10.4±1.9<br><0.01 |
| Prophylactic course of positive aeroionization of 28 treatments (spring) | $M_2 \pm m_2$<br>$P_2$ | 8.24±0.20<br><0.001 | 5.93±0.61<br>=0.002 | 6.17±0.42<br><0.001 | 23.7±2.24<br><0.001 | 2.10±0.73<br>> 0.05 | 5.6±1.36<br><0.05 |
| Prophylactic course of positive aeroionization of 28 treatments (winter) | $M_3 \pm m_3$<br>$P_3$ | 6.71±0.15<br>> 0.5 | 5.60±0.36<br><0.001 | 2.16±0.35<br>> 0.5 | 8.90±0.42<br>0.001 | 0.37±0.005<br>0.01 | 1.55±0.30<br>0.5 |
| Prophylactic course of negative aeroionization of 28 treatments (spring) | $M_4 \pm m_4$<br>$P_4$ | 7.18±0.10<br><0.01 | 6.10±0.75<br><0.01 | 4.31±0.70<br><0.05 | 15.5±1.6<br>> 0.05 | 1.12±0.47<br>> 0.05 | 2.6±0.59<br>> 0.05 |

Thus, courses of positive and negative aeroionization can be used for prevention of radiation lesion with γ -irradiation of animals in a lethal dose. There is only a quantitative difference in the effect of positive and negative aeroions under the described experimental conditions and this difference lies in the fact that to obtain a favorable effect a shorter course of positive aeroionization is needed in comparison with the course of negative aeroionization. A similar effect of aeroions of a different charge sign has been described in the literature. It was demonstrated, for example, that in anematization of animals both positive and negative aeroions have this same, stimulating, effect on hematopoiesis.

Seasonal variations of the sensitivity of animals to an anti-irradiation effect (in this case to artificial aeroionization) evidently indicate that protective effects cannot normally be used without taking into account the initial state of the organism, its reactivity.

## SUMMARY

Prophylactic courses of positive and negative aeroionization may be employed for the prevention of radiation injury in lethal gamma-irradiation of animals. The difference in the positive and negative ions action proved to be only quantitative, i.e., as compared to the negative a shorter course of positive aeroionization was required.

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