IMPACT OF CHRONIC LOW-DOSE RADIATION EXPOSURE ON GLUCOSE TOLERANCE IN THE BANK VOLE IN THE EXCLUSION ZONE AROUND OF THE CHORNOBYL NPP

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Background. Chronic low-dose ionizing radiation is an important environmental factor capable of affecting physiological processes in organisms, particularly the regulation of energy metabolism. The conditions of the Exclusion Zone around of the Chornobyl NPP provide a unique opportunity to study the long-term effects of radiation on wild animal populations. The aim of this study was to assess the effect of chronic radiation exposure on glucose tolerance in the bank vole (*Clethrionomys glareolus*) inhabiting the Exclusion Zone.

Methods. The study was conducted on bank voles (a total of 69 animals: 36 from control locations and 33 from contaminated areas) captured in natural habitats. Animals were trapped in control (uncontaminated) locations and in one of the most contaminated areas of the Exclusion Zone (the Red Forest), then transported to the laboratory where morphometric and gamma-spectrometric measurements were performed. The whole-life absorbed individual doses were estimated as 0.73 ± 0.04 mGy for control animals and 211.8 ± 28.7 mGy for animals from contaminated areas. Carbohydrate metabolism was assessed using a glucose tolerance test (GTT), had been adjusted for the model animal species. Each separate GTT included a balanced number of animals from control and contaminated locations with similar sex, body mass and estimated age as well fasting time. According to the protocol, animals were fasted overnight (from 8,5 till 21 hours, in averege 12 hours) with free access to water prior to the glucose tolerance test. Glucose loading (1 g/kg) was administered via intraperitoneal injection, taking into account body weight. Blood glucose levels were measured (OneTouchSelectSimple® glucometer) before glucose administration and at 15, 30, 60, 90, and 120 minutes after injection.

Results. The integral glycemic response was evaluated using the area under the curve (AUC) and statistical analysis included Student's t-test with Welch's correction, as well as Spearman's rank correlation analysis to assess the relationship between radiation dose and glucose metabolic parameters. The animals from radioactively contaminated areas exhibited significant changes in glycemic response compared to the control group. Peak glucose levels were lower in the animals from contaminated areas (15.06 ± 4.60 mmol/L) compared to the control bank voles (17.34 ± 3.85 mmol/L; $p < 0.01$). Similarly, AUC values were significantly reduced in the animals from contaminated areas compared to control animals (1068.18 ± 349.70 vs 1339.81 ± 381.67; $p < 0.01$), indicating a decreased overall glycemic response.

A comparative analysis of glucose concentrations between the control and contaminated groups at individual time points showed no statistically significant differences during the initial stages of the test (0 and 15 min; $p > 0.05$; Welch's t-test). Starting at the 30 minute, differences between the groups became statistically significant ($p < 0.05$; at some time points $p < 0.01$), with higher glucose levels observed in control animals. Analysis of the time profiles showed that peak glucose values in the contaminated group were reached earlier (primarily at 15 min), whereas in the control group the peak was more often observed at 30 min. This difference may indicate faster glucose utilization or clearance in animals from contaminated areas, which is consistent with the hypothesis of adaptive changes in energy metabolism under chronic radiation exposure.

Correlation analysis shown a negative relationship between individual total radiation dose and peak glucose level ($r = -0.31$; $p < 0.01$), as well as between dose and AUC ($r = -0.33$; $p < 0.01$), suggesting inclination to a dose-dependent pattern of the observed changes. Also, Spearman's correlation analysis showed that fasting glucose levels had a weak negative relationship with the integrated glycemic response (AUC: $r = -0.18$), indicating a minor contribution of this factor to the post-load glycemic response. In the context of the observed trend toward lower glucose levels at 0 min in the contaminated group ($p > 0.05$), it may be assumed that there are differences in basal energy metabolism, potentially involving increased glucose utilization during the overnight fasting period. At the same time, the lack of a clear association between fasting time and AUC is consistent with the hypothesis that this mechanism is not a major determinant of the overall glycemic response and requires further investigation.

Conclusion. Chronic low-dose radiation exposure is associated with a decreased glycemic response and altered glucose tolerance in the bank vole, which may indicate the formation of a specific metabolic profile as a manifestation of long-term adaptation to a stressful environment. Further studies are required to elucidate the mechanisms underlying these changes.