Comparative investigations on blood adrenocorticotropic hormone and cortisol changes after total body gamma irradiation of rabbits and pigs at 0.1 and 0.5 Gy

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Summary
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Ionizing radiation and the pathways of its deleterious effects on living beings are still of interest for investigators. The purpose of the present study was to investigate the dose-dependent alterations in blood plasma adrenocorticotropic hormone (ACTH) and cortisol in two animal species with different radiosensitivity after total body gamma irradiation within the dose range 0.1–0.5 Gy. The experiments were carried out with 10 male 3-month-old White New Zealand rabbits and 10 male pigs (Big White×Landrace crosses) at the age of 45 days. All animals were submitted to external gamma irradiation at doses of 0.1 Gy or 0.5 Gy. The results for blood hormonal assays showed that the total body gamma irradiation of both species at doses of either 0.1 or 0.5 Gy altered the activity of pituitary and adrenal glands. Pituitary changes were mainly functional and transient, whereas the higher exposure dose resulted in mainly structural changes in adrenal glands manifested by insufficiency of cortisol-secreting cells. It could be affirmed that the radiosensitivity of pituitary and adrenal secretory cells was different as could be seen from ACTH and cortisol secretion after irradiation of two species at two different doses of gamma radiation.

Key words: ACTH, cortisol, ionized radiation, pigs, rabbits

INTRODUCTION
The effects of ionized radiation upon the different organs and tissues of living organisms are still an object of interest for many researchers.

The existing data reported the response of specific systems to radiation and concluded that observed events occurred either directly, or indirectly via a unknown mechanism (Mizina, 2002; Keenan et al., 2003; Georgiev et al., 2005). The data of Korotkevich (1998) for the radiosensitivity of endocrine system, including the pituitary gland-thyroid gland-pancreas-adrenal glands-gonads are rather controversial.

Robinson et al. (2001) studied the effect of exposure at various doses upon the adrenocorticotropic function of adenopituitary gland – a central unit in adaptation mechanisms, are interesting. It was assumed that after irradiation, the influx of adrenocorticotropic hormone (ACTH) from the pituitary gland in blood circulation was impaired. The irradiation of mice...
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Hibited increase in both pigs and rabbits as followed: from baseline values of 212 ± 4.75 nmol/L (0.1 Gy) and 240 ± 5.38 nmol/L (0.5 Gy), to 360 ± 8.06 nmol/L and 325 ± 7.28 nmol/L, respectively by hour 2 (P≤0.01). In rabbits, the change was statistically significant (P≤0.05) from 336 ± 7.53 nmol/L to 412 ± 9.23 nmol/L (Group I) and from 342 ± 7.66 nmol/L to 442 ± 9.90 nmol/L (Group II). These high cortisol concentrations persisted up to the 3rd day after the irradiation.

The regression analysis showed a positive correlation between the reaction of both glands (pituitary and adrenals) in both animal species studied (Table 1).

**DISCUSSION**

The total body gamma irradiation at 0.1 and 0.5 Gy resulted in biphasic increase in blood ACTH and cortisol in rabbits and pigs, similarly to the results of others (De Groot et al., 2000; Georgiev, 2005). The first statistically significant elevation of ACTH occurred as early as the 2nd hour in both species as also shown by Pantic & Hristic (1975), Robinson et al. (2001), Georgiev et al. (2005).

The activation of pituitary hormone production and secretion lasted relatively shortly – up to the 1st day after the irradiation. Most probably, the short-time increase in ACTH was sufficient to induce a more prolonged activation of adrenal function, as confirmed by Litskevich (1995).

![Graph showing time course of blood ACTH and cortisol concentrations after irradiation of pigs at 0.1 Gy and 0.5 Gy. Legend: (---×---) ACTH+0.1 Gy; (---□--) ACTH+0.5 Gy; (- - × - -) cortisol+0.1 Gy; (- - □ - -) cortisol+0.5 Gy.](image-url)
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adrenal glands at a different extent. The blood concentrations of ACTH and cortisol allowed us to assume a different radiosensitivity for pituitary gland and adrenal glands with regard to the secretion of these hormones in the two animal species after exposure to different doses of ionizing radiation.

On the basis of experimental results, it could be concluded that pituitary changes were mainly functional and transient, whereas the higher exposure dose resulted in mainly structural changes in adrenal glands manifested by insufficiency of cortisol-secreting cells.

Although similar from a qualitative point of view, the quantitative changes in ACTH and cortisol demonstrated species-related differences. The reactions of pituitary gland and adrenal glands, as seen from the data on the quantity of secreted hormones, was stronger in pigs compared to rabbits, in which the changes were more gradual, especially after the 3rd day of irradiation at doses of 0.1 and 0.5 Gy.

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