Short Communications

Effects of whole-body X-irradiation on the cholinesterase activity in liver and bone marrow of the guinea pig

In a previous communication[1] we reported on the early effects of whole-body X-irradiation on the cholinesterase activity in the blood of guinea pigs. A decrease of cholinesterase activity in plasma was found, but no significant alteration of acetylcholinesterase activity in the red corpuscles could be demonstrated. Since it may be supposed that the plasma cholinesterase changes could be connected with or possibly even preceded by similar changes in the liver, the chief site of synthesis of plasma proteins, and in organs engaged in haematopoiesis, we felt it worth-while to extend the investigation to include also the liver and bone marrow.

30 male guinea pigs with a mean body weight of 350 g were exposed to 400 R of X-irradiation (260 kV, 10 mA, filter 4 mm Al + 0.4 mm Cu, focus to target distance 40 cm, dose rate 123 R/min). 15 animals were killed at 24 h, and 15 animals at 48 h after irradiation; 15 animals served as nonirradiated controls.

Bone marrow was prepared from the hind legs after perfusion of the legs with normal saline. The marrow obtained was weighed and the activities of AChE and ChE were determined according to the method described by TAMMELIN *et al.*[2-4], using acetyl-β-methylcholine iodide and buturylcholine iodide as substrates for the determination of AChE and ChE activity, respectively. 0.1 g of bone marrow was mixed with 7.5 ml of buffer solution[1], and 3 ml of the marrow-buffer solution + 0.3 ml of substrate solution were used for the determination of activity.

1 g of finely cut liver (perfused) was homogenized in 10 ml of buffer solution. The enzyme activities were determined in the same way as for bone marrow.

AChE and ChE activities in erythrocytes and plasma were determined according to the separated-blood method described earlier[1].

The results are presented in Fig. 1. The changes in the activities of the two cholinesterases in blood are in accordance with the results obtained in our previous study[1], although a lesser degree of statistical significance was obtained in the present material. In the liver no statistically significant changes in the activities of the cholinesterases have been found.

In the bone marrow the activity of both AChE and ChE is altered in the way that within 24 h the ChE activity increases up to about 150 % of that of the control animals and remains high during the following day. The AChE activity on the other hand, after two days is only about 70 % of that of the controls. The statistical significance of the values is indicated in the figure. In this connection it should be pointed out that, to our knowledge, there are no reports earlier in the literature about the occurrence of ChE in bone marrow[5].

Abbreviations: ChE, (pseudo)cholinesterase or butyrylcholinesterase; AChE, true acetylcholine-esterase.

Since no changes in the ChE activity in the liver could be demonstrated, the present investigation does not give any clue to a possible connection of a liver damage due to irradiation with the reduced ChE activity in plasma.

The alteration of the cholinesterase activities in the bone marrow indicates an influence of ionizing radiation on the metabolism of cholinesterases in this tissue.

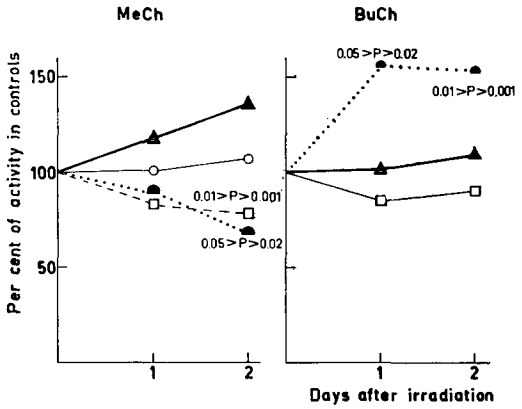

Fig. 1. ○, changes in cholinesterase activities in blood corpuscles; □, plasma; △, liver; ●, bone marrow of irradiated (400 R) guinea pigs. The values are expressed in per cent of normal activity values as determined by the hydrolysis of acetyl-β-methylcholine and butyrylcholine for AChE and ChE activity, respectively. Values of probability (P) are indicated for those points for which statistically significant differences from the normal material have been obtained.

It could be discussed, whether the cholinesterases are synthesized in the bone marrow, or if ChE is merely taken up in the marrow from the blood plasma, one mechanism or the other then being damaged by the ionizing radiation. The question of synthesis of the enzymes in the bone marrow implied by our results opens up a possibility to investigate from a new point of view the role of ChE in tissues. Concerning the possibility of an uptake of ChE in the bone marrow, the finding that the ChE activity in plasma diminishes after irradiation is of interest.

These results have been published as a contribution to the research on the effects of ionizing radiation on enzyme systems *in vivo* and to the discussion of the role of ChE for which enzyme neither a specific function nor a naturally occurring substrate has yet been demonstrated[6].

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