CHOLINESTERASE ACTIVITY OF THE SPINAL CORD OF ANIMALS AFTER X-RAY IRRADIATION

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Total cholinesterase activity varies in different structures of the spinal cord, being highest in the gray matter of the anterior and posterior horns. Phasic changes in the activity of this enzyme are observed 1, 24, and 48 h after whole-body x-ray irradiation in a single dose of 1200 R.

Disturbance of cholinesterase activity in radiation sickness has frequently been investigated [2, 4, 9, 12]. However, the character of its changes in the central nervous system and, in particular, in the spinal cord, has been inadequately studied.

The object of the investigation described below was to study cholinesterase activity in morphologically and functionally different regions of the spinal cord under normal conditions and to examine the dynamics of its changes at various times after whole-body x-ray irradiation of animals.

EXPERIMENTAL METHOD

Changes in cholinesterase activity were studied 1, 24, and 48 h after whole-body x-ray irradiation of cats with a single dose of 1200 R. The animals were irradiated with the RUM-11 apparatus under the following conditions: voltage 200 kV, anode current 15 mA, filters 0.5 mm Al+0.5 mm Cu, skin-focus distance 50 cm, no tube, dose rate 26.9 R/min. The spinal cord was removed and divided into morphological and physiological regions by a method developed in the writers' laboratory [6]. All operations were performed in a cold room. Weighed samples of the spinal cord were thoroughly homogenized in physiological saline. Cholinesterase activity was determined by an electrometric method [8] under the following conditions: temperature 25°C, medium tris-HCl buffer (pH 8.1), sensitivity of EPP-09M2 automatic writer 117 mm/pH unit, speed of motion of squared paper tape 1 mm/min, substrate acetylcholine chloride ($1 \cdot 10^{-2}$ M). The activity of the enzyme was expressed in micromoles of acetylcholine hydrolyzed by 1 g brain tissue per minute.

TABLE 1. Total Cholinesterase Activity (in μmoles acetylcholine hydrolyzed by 1 g tissue in 1 min) of Spinal Cord of Cats after Whole-Body X-ray Irradiation in Single Dose of 1200 R (M±m)

Time after irradiation (in h)	No. of expts.	Gray matter		White matter	Roots	
		anterior horns	posterior horns		ventral	dorsal
Normal	11	14,17±0,49	9,76±0,48	1,47±0,14	1,47±0,11	0,83±0,12
1	8	10,74±0,46	7,27±0,60	2,07±0,16	2,03±0,21	1,32±0,28
24	9	14,12±0,71	10,59±0,71	1,95±0,18	1,67±0,15	0,78±0,10
48	7	13,01±0,83	8,48±0,73	1,81±0,17	1,79±0,17	0,88±0,11

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EXPERIMENTAL RESULTS

The results given in Table 1 show that highest cholinesterase activity is observed in the gray matter of the anterior horns. Similar results for motoneurons of the spinal cord have been obtained by other workers [1, 5, 11].

A decrease in cholinesterase activity in the white matter of the anterior and posterior horns was observed 1 h after whole-body x-ray irradiation of the cats, but it returned to its normal level 24 h after irradiation. After 48 h, a tendency for the activity in the gray matter of the anterior and posterior horns to diminish was again observed. According to results obtained in this laboratory, the oxidative power of these tissues of the spinal cord is considerably increased at these times, the redox potential is reduced, and activity of proteolytic enzymes is increased [7]. There is reason to suppose that disturbances of the total cholinesterase activity of the spinal cord tissues are due to peroxides, free radicals, and other toxic products formed in the body through the action of ionizing radiation, which may have an inhibitory action on the enzyme.

Changes in cholinesterase activity in the white matter, and also in the ventral and dorsal roots after irradiation of the animals were less marked. In this case a tendency was seen for changes to take place in the opposite direction to those in the gray matter. These changes can be regarded as taking place because of the predominance of nonspecific cholinesterases in these structures, for the activity of these enzymes changes in the opposite direction to changes in true cholinesterase activity in the early stages after irradiation [3, 10].

It may accordingly be concluded that total cholinesterase activity undergoes different changes after exposure to ionizing radiation depending on the part of the spinal cord concerned and the time after irradiation.

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