CHEMILUMINESCENCE OF MOUSE LIVER AFTER ADMINISTRATION OF A CARCINOGEN

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Changes in the intensity of chemiluminescence of the liver were observed at different times after injection of 9,10-dimethyl-1,2-benzanthracene into mice. The possible connection between the observed phenomena and the formation and accumulation of the endogenous carcinogen in the liver is examined.

KEY WORDS: liver; chemiluminescence; carcinogens.

A quencher of mitogenetic radiation is known to appear in the mouse liver as early as the fourth day after injection of a carcinogen (9,10-dimethyl-1,2-benzanthracene; DMBA) into the region of the thigh [8]. The characteristics of this quenching agent have been described previously [2, 3]. In the liver tissue it is protein-bound and, for its action to be demonstrated, preliminary hydrolysis of the tissue proteins at a certain pH is necessary. The quenching agent enters the blood stream much later, evidently after its formation in the spleen. The earlier formation of the quenching agent in the liver suggests that the response of this organ to the carcinogen must be exhibited as a more general and earlier shift in the metabolic state of the cells of the liver. Chemiluminescence of living systems in ultraviolet (mitogenetic radiation) and visible light (very weak radiation) is a fine indicator of the structural and energetic state of the systems and, in some cases, it is evidence of the participation of certain substances in metabolism [2, 4].

The object of this investigation was to study radiation from the liver in vivo in the early stages after administration of a carcinogen to animals.

EXPERIMENTAL METHOD

Radiation of the liver was measured on a photoelectronic multiplier (FÉU-18-A) by the method described previously [5, 7]. The carcinogen (DMBA), in a dose of 0.5-0.7 mg in 0.5 ml sunflower oil, was injected subcutaneously into the thigh of the mice. Control animals received an injection of the solvent. Radiation was recorded at different times after injection of the carcinogen. The experimental and control mice were investigated simultaneously. As a result the liver was spontaneously extruded by the animals through a short incision in the abdominal wall in an undamaged form. If slight wounding of the liver, expulsion of a loop of intestine, or parasitic diseases were found, the mice were not used for the experiments. From the moment of exposure and through the period of the experiment the liver was irrigated with warm (38°C) Ringer's solution. All the trunk muscles were covered with black paper, in which a hole was made to correspond to the surface of the liver. The mouse, placed in dark box connected to the camera, was carefully centered in front of a quartz lens; during measurements over a period of half an hour the filters (quartz, glass, and ebonite) between the lens and multiplier were changed every 10 sec. In this way the ratio between the ultraviolet and visible components in the emission spectrum could be judged.

EXPERIMENTAL RESULTS AND DISCUSSION

Chemiluminescence of the liver under the experimental conditions used contained only a visible component, for there was no real difference between the number of pulses when the quartz and glass filters were

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TABLE 1. Mean (M ± m) Intensity of Radiation of Mouse Liver (number of pulses per 300 sec)

Time after injection of carcinogen, days	Control	Experiment
1	26,2±10,3 (10)	41,1±7,0 (10)
2—4	28,1±7,4 (6)	28,7±7,9 (13)
5—9	27,6±3,8 (19)	18,3±3,2 (28)
10—15	35,8±5,8 (10)	66,5±12,6 (8)

Legend. Number of animals in parentheses.

used. The mean differences between the total number of pulses corresponding to quartz and glass, divided by two, and the number of pulses reflecting the background noise of the FÉU-18-A instrument are given in Table 1.

Against the background of an almost constant intensity of radiation in the control mice, in the experimental mice the intensity of radiation changed with time. Between the fifth and ninth days after injection of the carcinogen it fell sharply ($P < 0.05$), but between the 10th and 15th days it increased considerably ($P < 0.01$). The wide time intervals of the transitions are evidently attributable to individual reactions of the animals.

Examination of the results from the standpoint of those of previous investigations [1, 6, 8] suggests that the small increase in emission on the first day (compared with the control) is explained by penetration of a carcinogen possessing chemiluminescence over a wide region of the spectrum into the liver cells. Besides luminescence, much of the excitation energy of the molecules of the carcinogen must be expended at the start of the chemical processes leading to the formation of metabolites specific for the process of malignant change. An increase in the scale of these chemical conversions may bring about a gradual lowering of the intensity of radiation. As a result of the deflected course of metabolism, an endogenous carcinogen also with the property of chemiluminescence over a wide region of the spectrum is formed and gradually accumulates [1, 9]. This latter may also bring about an increase in the intensity of radiation by the 10th day. Further experimental investigations are necessary in order to prove these hypotheses.

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