EFFECTS OF HEAVY X-IRRADIATION TO THE SPLEEN ON THE SURVIVAL OF MICE

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脾臓への強照射が生存に及ぼす影響について

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マウスを全身照射に依る造血系障害によつて殺す場合に脾臓部を遮蔽すると致死効果を大いに減ずることが出来る．これは遮蔽された部分に残存する造血系が再生能力を維持して造血能の再建を促すのがその原因であると説明されている．これと反対に造血系の一部に重大な障害を与えれば全身的な障害が起るかも知れない．若いマウスでは脾臓が造血系の一つである．この臓器に対する照射が全身障害を起すべきクリテイカルな線量がどの位であるかを知るために我々はこの実験を行つた．

その結果は 12.000 r までの脾臓への照射はマウスを血液の障害によつて殺さないことが判つた．全身障害は殆んど認められず体重の増加は正常であつた．

It is known that the shielding of the spleen of mice during total-body irradiation reduces heamatopoietic injury (e.g., bone marrow death) of irradiated animals (1). The phenomenon is explained by a recovery of hematopoietic foci surviving irradiation in shielded spleens (2). On the contrary heavy systemic injuries may occur if a severe injury is produced in a part of haematopoietic system. The purpose of this experiment is to know a critical dose, if any, of X-rays to the spleen of young mice responsible for systemic effects.

MATERIAL AND METHOD

Litter-mated dd colony albino mice, male and female, eight weeks of age, weighing 25 to 29 grammes were used throughout experiments. Animals were anesthetized by intraperitoneal injection of 0.1 to 0.15 cc of 5% Mintal. After exteriorization of the spleen, a total body was shielded by a 3 mm lead screen except the spleen which was irradiated through a window of 1.5 cm in diameter perforated in the lead screen. Irradiation was

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followed by closure of abdominal wall and intraperitoneal administration of a small amount of penicillin. Each animal was housed one per cage of 25°C and maintained on solid diet (Oriental Yeast Co.) and water ad lib.

Conditions of irradiation: 200 Kvp X-ray, 2 mm Al filter added, TSD=30 cm, Field size=48 cm^2. Dosimetry was carried out by a Toshiba Dopth Dose Rate Meter calibrated against a substandard Victoreen dosimeter. Exposure dose to the spleen was 2,000, 10,000 and 12,000 r with a dose rate of 400 r/min.

RESULTS

1. 2,000 r to the spleen. Five treated and three control animals survived one month and no sign of systemic injury was observed.

2. 10,000 r to the spleen. All of 5 exteriorized and irradiated animals survived for one month. Rate of an increase in body weight was identical in treated and control groups. There was no significant difference in weight of spleens in both groups but the organ was tightly encapsulated by the peritoneum in treated animals.

3. 12,000 r to the spleen. Twenty out of 21 animals in exteriorized group survived a month after irradiation. One mouse died on the third day of experiment. The cause of death was not radiation-induced hematological injury but was general weakness due to surgical procedures.

These experiments demonstrated that X-ray doses up to 12,000 r to the spleen did not induce acute hematological death in irradiated mice: systemic injury was not evidenced and the rate of increase in body weight being normal, i.e., 25.7±2.8 g (20 animals) before irradiation and 27±3.5 g (16 animals) one month after irradiation.

4. Irradiated spleen reduced its size: a mean weight of the spleen three days after irradiation of 12,000 r was 60.8±7.4 mg for a mean body weight of 22.8±1.2 g. It was considerably below control value of 116 mg for a mean body weight of 23.9 g. Spleens regained their weight gradually during a month after irradiation, weighing 89.0±29.8 mg for body weight of 27.8 (Table 1).

Table 1

	A mean spleen weight(mg)	A mean body weight (g)
Control	116	23.9
Mice on the 3rd day after irradiation of 12,000 r	60.8± 7.4	22.8± 1.2
Mice on the 30th day after irradiation of 12,000 r	89.0±29.8	27.8

It is not possible to measure directly the weight of the spleen before and after irradiation in the same organism. Therefore, a product of longer and shorter axis of a spleen was compared immediately before and one month after irradiation. The former was 82±17 and the latter 50±13, respectively. From these data it was concluded that the recovery of the spleen had not been complete during the first one month after irradiation.

CONCLUSION AND DISCUSSION

Direct X-irradiation up to 12,000 r to surgically exteriorized spleen did not produce acute heamatologic death in mice. The spleen itself, however, atrophied after irradiation and a dose of 12,000 r was sufficiently critical to the organ but was not so to the health of a whole organism.

Larger doses may induce significant systemic injures, but our present technique of anaesthesia and output of our X-ray machine do not allow us to perform experiments with larger doses which require longer than half an hour.

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