

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

The General Radiation Syndrome: Initial Reaction in the Monkey

THE initial reaction of the general radiation syndrome in man is characterized by a latent period, a period of acute disturbance and a recovery period. During the period of acute disturbance the predominating symptoms are fatigue, headache and nausea and some people vomit and have colonic evacuation^{1,2}. The duration of the latent period, that is, the time from the commencement of irradiation until the onset of symptoms, not the onset of vomiting, is dependent on the surface-dose, body-size and anatomical site of irradiation^{3,4}. Also a significant inverse relationship between dose-rate and the length of the latent period has been reported during the therapeutic administration of radiiodine⁵.

A monkey, the whole body of which was irradiated, presents evidence of an initial reaction in its general radiation syndrome^{6,7}. Observations were made of this reaction in monkeys and are reported here: (1) to show that signs indicative of the onset of the initial reaction, quite apart from vomiting, may be appreciated by an observer, thus allowing an accurate estimate to be made of the duration of the latent period, and to some extent of the period of acute disturbance; (2) to show that radiation dose-rate has an effect on the duration of the latent period.

Whole-body gamma irradiation was given to twelve healthy tuberculin-tested monkeys (*M. mulatta*) of both sexes (weight 3.7–11.5 kgm., mean 6.9 kgm.) and seven of these animals were re-irradiated after physiological recovery from the first exposure. The irradiation procedure was carried out in the cobalt-60 storage block of the Isotopes Division at the Atomic Energy Research Establishment, Harwell⁸. Variation in the dose-rate was achieved by increasing or decreasing the number and position of the sources of cobalt-60 arranged circumferentially, radially and longitudinally around the irradiation space. Dosage measurements before each exposure were made with a 100-r. Victoreen ionization chamber placed in a phantom made of bolus bags⁹. The mean whole-body dose calculated from these measurements was 450r. with two exceptions of 470r. and 480r. The animals were housed individually and allowed food (diet 41 rat cubes) and water until irradiated. The animals were trained to enter the handling cage, the irradiation cylinder, and to accept food from the hand. At no time were the animals restrained or harshly treated. After irradiation the animals were returned to their own living quarters and a close watch kept on their activity, behaviour and appetite. A cinematograph film was made of two animals.

The onset of the initial reaction could be readily detected by a quite sudden change in the animal. The monkey would hang wearily from the cage roof, head on chest, or sit dejectedly in a corner, and at times lie down on the floor of its cage. Loss of appetite accompanied this change. In most animals these signs would pass off only to return in a few minutes in an exaggerated form, accompanied by retching and vomiting. Waves of the latter signs recurred; but gradually their severity lessened, the interval

Table 1. THE DOSE, DOSE-RATE AND DURATION OF LATENT PERIOD IN NINETEEN IRRADIATED MONKEYS FOLLOWING WHOLE-BODY GAMMA RADIATION

Dose (r.)	Dose-rate (r./min.)	Latent periods (min.)
450	124.0	35, 34, 32
450	103.0	31, 36, 30
450	96.7	34, 33, 36, 31
450	53.0	31, 34, 28
480	15.0	75
470	14.5	80
450	13.0	108
450	7.0	90, 90, 75

between them lengthened and they ceased in 2 hr. or so. Appetite then returned, and no further vomiting was observed in the later course of the syndrome.

The time from the commencement of irradiation to the first observed change indicative of the onset of the initial reaction was recorded as the latent period (Table 1). It will be seen that as the dose-rate increased from 7.0 r./min. to 53.0 r./min. the duration of the latent period decreased from some 90 min. to about 30 min.; but its length was not altered by further dose-rate increments.

With the lower dose-rate irradiations the onset of the symptoms of the initial reaction in the monkey may be observed 10 min. or more before vomiting, but with the higher dose-rate exposures vomiting sometimes occurred with the first wave of symptoms. These observations suggest that dose-rate is another factor in the development of the initial reaction of the general radiation syndrome in the primate, although the number of monkeys exposed was small. A striking likeness is apparent between the initial reaction in the monkey and radiation sickness seen in therapeutic practice. There was no evidence that sex and previous irradiation, provided full recovery from the first exposure had been made, play a part in the development of the initial reaction of the general radiation syndrome in the monkey.

C. G. HUNTER

Department of Physiological Hygiene,
School of Hygiene,
University of Toronto,
Toronto, Ontario.

R. J. MUNSON

Medical Research Council,
Radiobiological Unit,
Atomic Energy Research Establishment,
Harwell, Didcot, Berks.

W. M. COURT BROWN

Group for Research into General Effects
of Radiation,
Medical Research Council,
Western General Hospital,
Edinburgh.

J. D. ABBATT

Radiobiology Department,
Atomic Energy Division,
General Electric Co.,
Erith, Kent.

¹ Court Brown, W. M., *Brit. Med. J.*, i, 802 (1953).

² Liebow, A. A., Warren, S., and DeCoursey, E., *Amer. J. Path.*, 25, 853 (1949).

³ Court Brown, W. M., and Mahler, R. F., *Science*, 118, 3062 (1953).

⁴ Court Brown, W. M., and Abbatt, J. D., *Brit. J. Rad.*, 28, 327 (1955).

⁵ Abbatt, J. D., Court Brown, W. M., and Farran, H. E. A., *Brit. J. Rad.*, 28, 331 (1955).

⁶ Eldred, E., and Trowbridge, W. V., *Radiol.*, 62, 65 (1954).

⁷ Haigh, M. V., and Paterson, E., *Brit. J. Rad.*, 29, 148, 339 (1956).

⁸ *Nature*, 173, 1067 (1954).

⁹ Corp, M. J., *Phys. Med. and Biol.*, 1, 370 (1957).