INTRODUCTION
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Biological species including man are continuously exposed throughout their lives to ionizing radiation both from natural and artificial sources (Publication Division, Government of India, 1958; United Nations Report of U.N. Scientific Committee, 1958). The fact that ionizing radiations such as x-rays and the radiations from radioactive materials cause biological damage became apparent soon after their discovery at the end of the nineteenth century.

Until the end of the 1939-1945 war the expansion in the use of ionizing radiation was chiefly in the fields of the various applications of x-rays and the medical uses of the radiations from radium. By 1932, however, it had been discovered to be possible to produce radioactive elements by artificial methods. This ultimately led to the discovery of the phenomenon of nuclear fission, leading in its practical application to the development of nuclear weapons and to the controlled use of nuclear energy for peaceful purposes. These developments are largely responsible for the fact that it is now possible to obtain radioactive forms of all the elements and many of these have already found important practical applications. These applications extend to-day into almost every branch of science and technology, and consequently the number of persons exposed to ionizing radiations in the course of their duties is now very much
larger than it was only 20 years ago. It seems likely that the development of the applications of ionizing radiations will continue, so that in future larger fractions of population in highly industrialized societies will need to be considered as radiation workers.

The development of atomic energy both for weapons and for peaceful purposes has also meant that large fractions of the population of a country can be exposed to ionizing radiations. Such exposure can result, for example, from fall-out or from the consequences of an accident at a nuclear power station and thus place the whole population potentially in hazard.

The nature and extent of bodily damage, however, depends on radiation dose, rate of exposure and the extent of body exposed. Acute illness is produced by whole body exposure to radiations, namely, from a detonating atomic bomb as happened during the bombing of Hiroshima and Nagasaki (Hersey, 1946; U.S. Strategic Bombing Survey, 1947; Nobuo, K., 1953), fall-out radiation as experienced by Marshallese people in 1954 (Conard, 1960), and patients continuously exposed for radiotherapy of malignancies or to depress the immune response in connection with tissue transplantation (Miller et al., 1957).

The effects of radiation on the whole body may be seen in the short term, immediately after or within a few days of irradiation,
as the acute radiation syndrome. In addition, long after recovery from these early effects is complete and they have been forgotten, the individual may suffer long-term or delayed effects; there may also be genetic effects that are passed on to future generations without affecting the individual. These late effects arise also from continuous low-intensity chronic irradiation or a succession of small sub-acute doses. While genetic effect expresses itself in generations to come, late effects manifest themselves in old age, the immediate effects of radiation are regarded as acute illness of immediate concern and are treated as a medical emergency. It is, perhaps, expected that much more information as clues to the understanding of primary lesions of radiation damage could be obtained from lesions of acute radiation illness and the recovery process than late or genetic lesions modified through years by the body's own homeostatic mechanism.

Depending on dose, the acute illness may give rise to three distinct radiation syndromes—the Central Nervous System (CNS) Syndrome, the Gastrointestinal (GI) Syndrome and the Bone-marrow Syndrome, although there is a considerable overlap between them in the transitional zone. CNS syndrome seen at very large doses (near 10,000 rads) is presumably due to direct injury and killing of cells causing hyper-activity and disturbances of CNS when the animal dies after 1-2 days. Over the large dose range 500-10,000 rads, the gastrointestinal syndrome kills the animals within 3-5 days. The cells
lining the gut are killed, and food materials can not be absorbed, although the cause of death is not so much malnutrition as the severe loss of fluid and sodium through the damaged gut. Doses of 200-500 rads result in an overall picture of radiation injury to several systems, and death is not a certainty. The animals which do succumb may die (after about 10-15 days) of infection and blood loss resulting from the haematopoietic or bone marrow syndrome or from a secondary cause that becomes increasingly difficult to determine the longer the animals survive. These facts have meant that as the dose of radiation is increased the effects upon G.I. system become increasingly more marked followed by the effects on the central nervous system. In fact, deaths due to acute exposure, both in man and animal, are found to be mostly due to involvement of gastrointestinal system. Of the total gastrointestinal tract, it is the small intestine which is particularly sensitive to radiation. Although a colossal literature on the subject has been published yet much remains to be known as to the mechanisms of damage, repair and the protection of biological system from radiation. It is hoped that a study at the organ level will be specially revealing in understanding the basic radio-biological processes involved during whole-body radiation. The present interest has, therefore, been focused on studying the effects of radiation on G.I. system with special reference to small intestine on the morphological, functional and metabolic aspects with a view to knowing more about the mechanism of damage, recovery and the principles of modification of the physio-pathological changes produced during exposures to ionizing radiation.
AIMS AND OBJECTS

The aim of the present thesis work is to delineate the lesions produced in radiosensitive tissues following an acute whole body exposure to ionizing radiation, designed to be carried out in the small intestine at the morphological, functional and metabolic level, with the idea to determine their inter-relationship. The aim of the present work is also to study the alterations produced by protective agents, such as low temperature, to such changes produced by radiation.

The object of the work, therefore, will be:

(1) to enumerate more fully the damages produced in intestinal mucosa in animals exposed to whole-body ionizing radiation and their functional correlation,

(2) to help to evolve a practical, sensible and yet effective means of radioprotection, the purpose being to protect people against accidental exposure, patients exposed to radiations either for radiotherapy of malignancy or to depress immune system for purpose of organ transplantation etc., besides, those to be involved in nuclear warfare,

(3) to know the mechanisms involved in such protection and also to know which of the various target or targets of radiation damage should be particularly taken care of and are essential for radioprotection, and

(4) to know, retrospectively, more about the mechanisms of radiation damage.