SUMMARY AND CONCLUSION
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Chapter-I:

In this chapter literature on biological effects of ionizing radiation with an emphasis on gastrointestinal syndrome have been extensively reviewed. The chapter begins with an enumeration of various sources from which man can receive ionizing radiation and its nature. Besides, the present review includes a summary of observations made on harmful effects of ionizing radiation followed by mechanism of interaction of ionizing radiation with biological tissues at molecular, cellular and organ levels. In the end, literature on radiation damage leading to gastro-intestinal syndrome have been summarised in relation to morphological, biochemical and physiological changes in gastro-intestinal tract. Lastly, a brief review on modification of radiation effects by chemical protective agents and various others has been presented bringing out clearly the purpose and object of the present work.

Chapter-II:

In this chapter materials and methods used in the present thesis work, in general, have been presented in detail. The chapter deals with choice of animals, preparation of animals and the experimental design in the first instance, followed by a detailed description of the techniques & methods of animal irradiation and of inducing hypothermia in animals used in the investigation. The chapter ends with a brief comment.
Chapter III:
The chapter deals with the author's observations on morphological and functional changes in the small intestine of rats following exposure to whole-body ionizing radiation. The chapter starts with a brief introduction on the purpose of the investigation with results presented in four sections. The first section deals with details of morphological changes including some macroscopic observations, the second presents a study on DNA content, the third on absorptive function and the fourth on the glycolytic function of intestinal mucosa. Each section ends with a brief comment on the results obtained.

Chapter IV:
In this chapter the effects of lowering body temperature on morphological and functional changes produced by ionizing radiation in the small intestine of rats have been presented. The presentation has been done in four sections as in the previous chapter with a brief introduction at the beginning of the chapter stating the object of the whole presentation. The four sections describe the extent and nature of radio-protection offered by hypothermia on the morphological and functional alterations produced in intestine of rats exposed to radiation. A short comment on the results obtained appears at the end of each section.

Chapter V:
The chapter presents a deeper insight into the morphological aspects of intestine in normal and hypothermic rats following whole-body exposure to
radiation. As such the chapter deals with electron microscopic study of the intestinal mucosa with particular attention to brush border (microvilli), mitochondrial structure, lysosomal bodies, nucleus and the nuclear membrane. The changes produced by radiation and the protection offered by cold have been carefully enumerated and adequately illustrated. A short comment has been incorporated at the end of the chapter on the observations made at the ultrastructural level.

Chapter VI:

The chapter gives a critical discussion on the results embodied in the various chapters with the object of bringing into light more facts on the mechanism of radio-protection by hypothermia and retrospectively of radiation damage to intestine. The discussion has been based primarily on the observations made in the alterations produced by whole-body ionizing radiation on the morphology, absorptive and glycolytic functions of intestine of normal and hypothermic rats. The nature of information, based on which the thesis work has been concluded are both qualitative and quantitative. All quantitative data have been subjected to careful statistical analysis in order to arrive at a rational conclusion. The works of contemporary workers, relevant to the present thesis work, have been duly taken into account and critically analysed while presenting the discussion.

The discussion begins with an introduction of intestine as a cell renewal system. The effects of whole body radiation on intestine, as a cell renewal system, have been briefly reviewed identifying clearly the
radiosensitive and radio-resistant compartments of intestine, as determined by Bergonie's law. The destructive effects of radiation and the protection offered by hypothermia on the destructive process, as observed in the present investigation, have been briefly recapitulated and the differential nature of the destructive process and hypothermic protection on the proliferative and functional compartments have been stressed. Derangement in the feedback mechanism in the intestine following radiation has been demonstrated and that the mechanism, though depressed, is not completely knocked-off when animals are cooled prior to radiation. The current knowledge on the normal feedback control in intestine (i.e., existing between the functional and the proliferative compartments) has been discussed with supportive evidence in the light of number-of evidences have been put forward from the results of the present investigation on intestine at the structural and functional level and from survival rate data obtained by others that hypothermia has a radioprotective effect and the effect that is held responsible for increasing the survival rates of animals has a basis at the organ, tissue and the cellular level. The mechanism, based on which hypothermia exerts its radio-protective action have been thoroughly discussed arguing clearly how the protection has been achieved in the proliferative and the functional compartments with the mechanism or mechanisms involved in each. Due stress has been laid on the fact that while structurally hypothermia protects the proliferative compartment of intestine, the crypt, according to Bergonie's law, its protective mechanism for the functional compartment, the villi, is
quite different. The essential properties of a radio-protective agent in relation to a cell renewal system have been outlined in detail in the light of the protective effect of hypothermia as observed at the intestinal mucosal level, which indicate that if an agent is to act as a radio-protective agent it has to protect the proliferative and functional compartments simultaneously from the destructive effects of radiation, maintaining the cell kinetic relationship between the two compartments for all times to come.

A detailed analysis of the functional changes produced by radiation and their protection by cold has been done with a view to assessing the degree of protection offered by the cold on the function and activity of intestine. The analyses indicate that both the absorptive and glycolytic functions of intestine which are depressed by radiation are protected by hypothermia, the protection being more for the absorptive than for the metabolic function. Moreover, when compared with hypothermic controls, the above protective effects of cold are found to be only partial. The reasons for the above differential behaviour of hypothermia on functional parameters have been considered in detail and the dependence of the absorptive function on both structure and cell metabolic activity has been held responsible for the event. The fact that the existence of an equally high correlation of the absorptive function with intestinal structure and its cell metabolic activity and relatively depressed absorptive function of intestine in hypothermic irradiated rats compared to hypothermic controls.
in the presence of an equally extensive absorptive surface under the two conditions evoked interest to look into details of intestinal mucosa at the ultrastructural level have been discussed in detail.

The discussion has been concluded by a critical analysis of the data obtained so far with the electron microscopic findings of the intestinal mucosa observed in normal, irradiated and protected group of animals. Finally, the mechanism of radio-protection by hypothermia and retrospectively of radiation damage have been discussed critically based on present observations including electron microscopic findings and the works reported so far pointing out clearly the scope of further work in the field.