C00-2366-4

DAMAGE AND REPAIR IN SKIN FOLLOWING
EXPOSURE TO RADIOACTIVE PARTICLES

Progress Report

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TECHNICAL PROGRESS REPORT

- 1) Principal investigator devoted 21% time to this project since beginning of current term.
- 2) Principal investigator expects to devote 21% time during remainder of current term.
- 3) Reports

Abstract submitted to Radiation Research Meeting
(May 1975, Miami, Florida).

TITLE: Interaction of "hot particles" and ultraviolet radiation
in skin carcinogenesis. (AEC Report No. C00-2366-3)

- 4) Work during current term.

A) Technical and Hardware

The preparation and aquisition of ⁹⁰Sr -silicate microspheres was anticipated in the previous progress report. The microspheres and facilities for their handling were subsequently made available at Oak Ridge National Laboratories, and a quantity of this material was sorted, packed, and sent to the Radiation Safety Office of Temple University Health Sciences Center. Simple holders were fashioned for applying the particles to skin, and these were put into immediate use. Animal experiments are described below.

Two additional holders were also developed for use with the particles. One is used for holding a particle at pre-determined distances from the surface being exposed (figure 1). The rationale for this study was detailed in the original proposal; in brief, the object is to test the hypothesis that

biologically effective dose is significantly modified by the size of particle (and not just nuclide content) because of the angle of entry, and therefore depth of penetration, of the radiation into skin.

The second holder (figure 2) was designed to expose pig skin to an array of 9 particles of pre-determined size. It has made possible a more efficient use of time and materials.

In addition to other dosimetry techniques described previously, we have begun to adapt TLD-teflon disc exposures to our needs for dose-averaging information.

B) Studies on mice.

Acute studies have involved evaluation of early changes after skin exposure to particles of various sizes for a number of exposure periods. One result was the selection of a set of 6 particles with similar characteristics, and an arbitrary exposure period, for use in a late effect study. The exposure period was 10 minutes, enough to produce erythema and dry desquamation, but not ulceration. The six particles were used in an experiment designed to evaluate possible interaction between hot particle exposure and ultraviolet radiation (UVR) in skin carcinogenesis. The criteria chosen for the experiment included the following: the UVR should be adequate to produce tumors in half the mice by about 18-22 weeks; the UVR should be able to be delivered within a 10 week period; age of mice at the time of particle exposure should be controlled; the sequence of UVR and ^{90}Sr application should be tested both ways; and UVR should be tested both in the presence and absence of ^{90}Sr -induced acute changes. All skin exposures to both UVR and the ^{90}Sr

particles for this experiment have been completed. The groups are as follows:

- I. UVR only (for 10 weeks, beginning at 6-8 weeks of age).
- II. ^{90}Sr microsphere only, to mice 6-8 weeks of age
- III. ^{90}Sr microsphere only, to mice 16-18 weeks of age
- IV. ^{90}Sr at 6-8 weeks; after 4 weeks, begin 10 weeks UVR
- V. UVR for 10 weeks, then ^{90}Sr (at age 16-18 weeks)
- VI. ^{90}Sr at 6-8 weeks, immed. begin 10 weeks UVR

A preliminary experiment showed that 10 weeks of defined exposures were adequate to produce tumors. Furthermore, the rate was high enough to conform to anticipated lifetime of the animals, but low enough to be susceptible to enhancing factors, if present. Results of the preliminary experiment (no ^{90}Sr) are shown in figure 3, and it is expected that group 1 of the present experiment will conform to the lower curve (solid lines) of the experiment shown in figure 3. The data will be available in the next few months. A computer program has been developed for handling and analysis of survival, prevalence, and tumor yield data.

C) Studies on miniature swine

Twelve animals have received ^{90}Sr -microsphere exposures at a number of skin sites; the animals are being observed regularly for changes. Subsequent to the hot particle exposure, two of the pigs have been exposed daily to full spectrum simulated solar visible and ultraviolet radiation. This part of the program will be significantly expanded in the remainder of this year and in the coming year.

Figure 1. Device developed for holding a single particle at pre-determined distance from irradiated surface.

Figure 2. Device for holding an array of 9 particles. Each particle is affixed to the end of a brass bolt. The bolt is then threaded through the aluminum plate. The plate is stored in the radiation-absorbing cradle when not in use.

Figure 3. Mice were exposed daily to ultraviolet radiation from an FS40T12 lamp. One group (dashed line) was exposed for 36 weeks; the other, (solid line) was exposed for only 10 weeks. Carcinogenesis is measured by Prevalence (mice with one or more tumors/survivors) and by tumor yield (total tumors present/survivors). Tumors continued to develop after UVR exposure ceased.

SECOND ANNUAL PROGRESS REPORT

Support Period Ending 31 July 1975

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ABSTRACT

The second year of this project has been devoted to preparation of applicator devices for use with ^{90}Sr microspheres, and use of the devices in the dosimetry of, and biological responses to, hot particle exposures. Studies on cellular damage and repair, and on computer programs for tissue dose distributions have been continued. Several groups of mice have been exposed to either hot particles, or ultraviolet radiation, or both. The possibility of interaction in carcinogenesis will be evaluated. Miniature swine are being observed for both early and long-term effects of skin exposures.