MOUSE SKIN REACTION FROM 40 MeV HELIUM IONS

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40 MeV ^{4}He ion beam from the Cyclotron at the Institute of Physical and Chemical Researches is applied to ICR mouse skin. ICR mouse left upper thigh inner surface skin is irradiated from 2,000 rads to 12,000 rads with the ion beam and the macroscopical and microscopical skin reactions were observed periodically. Since the range of 40 MeV Helium ion beam is less than one mili-meter, little significant dose dependency of macroscopic skin reaction was observed. Microscopical studies revealed the decrease of hair follicles, sebaceous and sweat grands. Little change occured by two weeks after irradiation. When radiated more than 2,000 rads erosion occurs in two or three weeks. The erosion heals in five or six weeks. But complete epilation remains. More skin hypertrophy occurs when radiated more. Microscopical observation reveals the dose dependency of the decreased number of glands and cells even after skin healing.

Material and Method

The Institute of Physical and Chemical Researches Cyclotron accelerates various light and heavy nuclides ranging from proton to oxygen. Because of insufficient penetration range ^{4}He beam was selected for this study. ^{4}He beam energy released from this cyclotron varies from 16 to 52 MeV. For higher penetration the beam selected is rather high energy but steady, which is 40 MeV. The chemical and biological channel is used for this irradiation which is called C_4 and guides the beam into experimental area S. At the end of the channel the scattering apparatus is equipped which is developped by Dr. Yatagai and is shown in Figure 1. The beam is scatered by thin gold foil and is monitored with Farady cup current in the center. The beam position is monitored with solid state detectors and additional Farady cups which can be connected to the vacuum windows on the both sides of central Farady cup. The materials are irradiated through the low dose rate vacuum windows. Because of inconsistency of dose rate from each windows only horisontal diagnal two windows are employed. Certainly dose rate in a window has gradient from inner side to outer side. Hence materials are rotated 180 degree at the half of irradiation dose. The dose was calibrated by TDL lods (National 100M8) with Cobalt-60 Gamma ray.

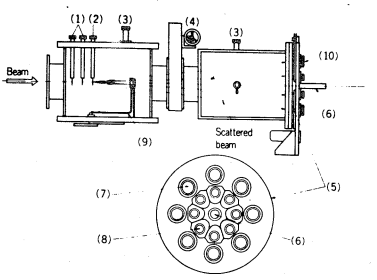

Fig. 1. Scheme of new apparatus for biological irradiations. (1) Slit (2) Scattering foil (3) Vacuum gauge (4) Gate valve (5) End of vacuum chamber (6) Faraday cup (7) Vacuum windows for low-dose irradiations (8) Vacuum windows for high-dose irradiations (9) Arm to suspend a solid state detector (10) Sample holders.

Through one centi-meter diameter round hole made on a five mili-meter thick acryl plate, lt. upper thigh inner surface skin is radiated. The mouse employed is ICR strain and is kept in the institute animal installation.

The change of mouse skin was recorded periodically. Mice are periodically sacrificed to obtain irradiated skin specimens. The specimens are made into microscopic study preparations. ^{4}He ion radiation dose applied to the skin ranges from 2,000 rads to 12,000 rads.

Results

1. Dose Count Current

40 MeV ^{4}He ion beam is fairly stable. The study was repeated four times in total. When the beam position is in the center of scattering foil, Cobalt-60 gamma ray calibrated one rad corresponded to 20-23 scattering ^{4}He ion count detected by a solid state detector placed in the direction of 40 degree to the axis of down stream beam. One rad also corresponded to 0.52-0.55 nano-Ampere Farady cup current placed in the center axis 80 centi-meter apart from the target foil. Monitoring with Farady cup current is more consistent, in which beam deviation from the center can not be detected. Hence the dose was monitored with the current with scattering helium count recorded.

2. Depth Dose

Depth dose was measured with TLD and the results is shown in figure 2. 50 % depth dose of plateau is approximately 0.08 g/cm..

3. Macroscopic skin reaction

The skin was irradiated from 2,000 rads to 12,000 rads. In one week epilation starts. In two week complete epilation in all groups and in high dose groups (above 4,000 rads) at the same time erosions occur. In four weeks erosions heal. Higher dose group takes a little longer. In five weeks all erosins heal any way. Even the skin irradiated with 12,000 rads heals. Skin hypertrophy follows. The higher dose induces the more hypertrophy.

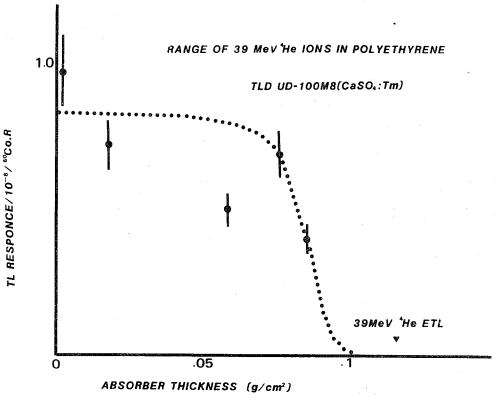

Fig.2 Range of 39 MeV ^{4}He Ions in Polyethyrene

4. Microscopic skin reaction

Quantative study is possible only with microscopic cell counting. Right now cell density change of basal cell layer, cell number decrease of a hair follicle and decreased hair follicle number are being studied. The quantative results have not been summarized. Qualitatively cell number in a hair follicle decreases with increased dose. Hair follicle itself decreases its number.