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Absorbed Dose Distribution of Ho-166 Patch

Chul Woo Joh[1] Seok-Nam Yoon[1], Joon-Kee Yoon[1], Young-Sil An[1], Sun-Pyo Hong[1], Kwang-Shin Park[1], Mi-Hwa Kim[1], Kyung-Sik Choi[1], Hyun-Soo Han[2], Kyung-Bae Park[2], Jei-Man Ryu[3], Dong-Hyuk Shin[3], and Sung-Joon Ye[4]

[1] Ajou University, [2] Korea Atomic Energy Research Institute, [3] Dong-Wha Pham. Ind. Co., Ltd, [4] Seoul National University

cwjoh@ajou.ac.kr

The purpose of our study was to estimate an absorbed dose distribution of 166Ho coated patch for skin cancer therapy. The 165Ho patch was irradiated to convert 165Ho to 166Ho in the research nuclear reactor at Korea Atomic Energy Research Institute. 165Ho(NO3)35H2O (2.4g) and an equal amount of polyurethane were completely dissolved in a solvent mixture of 4 ml dimethyformamide(Merck, Muchen, Germany) and 40 ml tetrahydrofuran at room temperature. The solution was cast on an aluminum dish maintained horizontally. Then the solvent was evaporated and dried at room temperature. The 165Ho patch which was cut into various sizes and shapes was irradiated to convert 165Ho to 166Ho in the research nuclear reactor at Korea Atomic Energy Research Institute(KAERI; Taejon, Korea). The patch was when coated on 0.1 mm microfilm with adhesive tape. Ho-166 has 26.8 hours physical half-life and emits high-energy beta particles. Maximum and average range of beta particles are about 8.6 and 1.2 mm in tissue respectively. We used GafChromic film for the measurement of beta dose from Ho-166. The exposed films were read for the optical density using a videodensitometer. Then the absorbed dose was obtained using a calibration curve generated utilizing known radiation source. Monte Carlo simulations in coupled photon/electron transport were performed independently for the same patch geometry using MCNP5 code(Los Alamos National Laboratory). Only beta-emitting spectra were considered as input histories, and thus a contribution of emitting photons to the total dose was neglected. Absorbed dose rate (Gy/min) was plotted as a function of activities per area concentration(GBq/cm2) at patch surface. The absorbed dose rate for different area concentration activities revealed a linear relation. The absorbed dose rate was 13.8 Gy/min/GBq/cm2 at skin surface and the coefficient of determination R2 was 0.9916. Absorbed dose distribution plotted as a function of distance from the patch surface depicted rapid fall near the skin surface. The similar results were found of the Monte Carlo simulations. The absorbed dose distribution of 166Ho patch appeared to be nearly ideal for skin irradiation since beta range is very short avoiding unnecessary radiation to surrounding normal tissues. With these results one can easily calculate dwell time to deliver a desired absorbed dose to any point with a known concentration of 166Ho patch.

Keywords : Absorbed Dose, Monte Carlo Simulation, Ho-patch