Patients Activation Following Boron Neutron Capture Therapy at Tsing Hua Open-pool Reactor in Taiwan

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Introduction: Tsing Hua Open-pool Reactor (THOR) provides a stable neutron source for treatment in Taiwan. Boron neutron capture therapy (BNCT) is one of the particle therapy. The therapy effectiveness is dependent on the boron-containing drugs in the tumor. However, in addition to boron capture reaction in the tumor, other elements in the tissue or metal implants will be activated during treatment. Therefore, the patients are radioactive following BNCT. At the radiation protection viewpoint, this study focuses on the staff and accompanying person radiation exposure and analyze the activated radionuclide.

Materials and Methods: Following BNCT, the equivalent dose rate in the irradiated surface and away from 30 cm was measured using gamma dose-rate meter. It was estimated every ten minutes until the patients left the treatment center. During the procedure, the patients underwent measurements away from 40 cm in 20 minutes using calibrated high purity germanium (HPGe) to identify which elements were activated.

Results: The surface equivalent dose rate of most patients is about 60-70μSv/h following BNCT, but a few of the patients are higher than 100μSv/h. However, the equivalent dose rate dropped to below 20μSv/h when all patients left the treatment center about one hour after the end of treatment. The half-life of total radionuclides is roughly 20-30 minutes. The chief activated radionuclides are ^{49}Ca, ^{24}Na and ^{38}Cl, and a few patients have ^{42}K, ^{56}Mn, ^{116m}In, ^{51}Ti, and ^{52}V. Perhaps, these radionuclides are the main reason for some patient who has higher surface equivalent dose rate.

Conclusion: The patients are radioactive after receiving boron neutron capture therapy. For all patients, completing BNCT immediately, the gamma equivalent dose rate of close to the surface is about 10μSv/h. For a few patients with metal implants, it is necessary to pay more attention to the change of the gamma dose rate after the treatment. Whether it is accompanying person or radiation workers, the radiation dose received from patient activation is lower than the limit of radiation protection regulations.

Acknowledgments: It is gratefully acknowledgment for all participated people, including Nuclear Science and Technology Development Center in National Tsing Hua University and Department of Oncology, Taipei Veterans General Hospital in Taiwan.

Keyword: Patients activation, Radiation protection, Gamma dose-rate, Radionuclides