

Application of Boron Neutron Capture Therapy as Salvage treatment to Recurrent Thyroid Papillary Carcinoma

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Abstract:

Thyroid cancer is the most common endocrine gland malignancy in Taiwan. Moreover, the incidence of thyroid cancer has increased four-fold in the past two decades. Thyroid cancer patients receive treatment as thyroidectomy, adjuvant radioactive iodine treatment (RAI) or radiotherapy depending on the histopathology and staging of tumor. In addition, Boron Neutron Capture Therapy (BNCT) may be a treatment choice for recurrent disease. This case study is to report treatment experience and results of BNCT on a patient with recurrent thyroid papillary carcinoma in Taiwan. This 70-year-old gentleman is a case of recurrent thyroid papillary carcinoma. Tracing back to his history, a palpable thyroid mass was noted during annual checkup in May, 2017. Fine needle aspiration revealed thyroid papillary carcinoma. He then underwent partial thyroidectomy on Jul.18, 2017 at local hospital. Surgical pathology confirmed left thyroid papillary carcinoma, pT3N0, stage III. After surgery, he was under thyroxine sodium supplement and visited outpatient department on a regular basis. However, follow-up PET/CT scan on Aug. 23, 2017 revealed residual tumor in the left thyroid bed, so he received salvage Tomotherapy with 5500 cGy in 29 fractions, from Sep.21 to Nov. 3rd, 2017 at another local hospital. After radiotherapy, he also took adjuvant radioactive iodine-131 twice (with dose of 30 mCi on Jan. 16, 2018 and 120 mCi on Jun. 28th, 2018). Follow-up PET/CT scan on Jun.29, 2018 still revealed residual lesion over left side of anterior neck. Due to remaining tumor, BNCT was chosen in attempt to salvage management. After we obtained approval from Institutional Review Board (IRB) of Taipei Veterans General Hospital (TVGH) and Taiwan's Food and Drug Administration, he underwent positron emission tomography using 4 borono s2 ¹⁸F fluoro phenylalanine (FBPA-PET), which revealed 2.22 in Tumor-to-Normal ratio (T/N) and 1.67 in Tumor-to-Blood ratio (T/B). BNCT was performed at the Tsing-Hua Open Pool Reactor (THOR) on Oct. 8th, 2018. He received a total dose of 450 mg/kg of L-[4-10borophenylalanine]

fructose (L-¹⁰BPA) via continuous intravenous infusion during the entire treatment. The blood boron concentration was 20.36 ppm at 2 hours just before epithermal neutron irradiation. Mean tumor dose of Gross Tumor volume (GTV) was prescribed as 23.72 Gy-E, and minimal tumor dose of GTV was prescribed as 21.04 Gy-E by the *THOR plan*. One month after BNCT, PET/CT on Nov. 8th, 2018 revealed evident regression of recurrent tumor at left thyroid region compared with pre-BNCT PET/CT, with maximum of standardized uptake value(SUV) decreasing from 17.8 to 11.7. Besides, thyroglobulin also dropped significantly from 55.6 ng/mL to 15.1 ng/mL. Patient stated there was no significant side effect after BNCT. For recurrent or refractory thyroid cancer, BNCT can be used as a salvage treatment modality. Since thyroid tumors usually locate at the surface of neck, patients presented with low T/N ratio can also be treated well if high neutron flux provided. Based on the treatment result of this case, BNCT is effective for recurrent thyroid papillary carcinoma.