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Editorial

Proton Therapy: A Radiological Approach for Treating Tumors

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Editorial

According to international cancer statistics, about 45% of malignant tumors can be cured with radiotherapy contributing 18%. The main disadvantages of conventional radiation therapy are acute and advanced adverse reactions. Proton is the forefront technology of radiotherapy, and has been proposed that proton therapy for tumors [1]. Compared with conventional radiotherapy, proton therapy reduces the radiation dose to normal tissues, kill tumor cells more accurately, protects the tissues and tissues around the tumor, and reduces acute and late radiation damage, which is beneficial for improving the quality of life of tumor patient [2].

The proton accelerator is used to generate a high-energy proton beam, and injected into the human body under precise control. Then, the proton beam begins to release energy [3]. The initial attenuation is small, and it is low flat. At a certain depth, the energy is released sharply, a Bragg peak simultaneously formed [4]. The depth is energy-dependent with a unique dose-attenuating property that is of great significance for the radiation therapy of pediatric tumor patients, and reduce the probability of causing secondary primary tumors after irradiation of surrounding normal tissues [5].

Proton is an excellent technique for tumors. Several national guidelines consider proton therapy is an optimaradiation modality for treating pediatric tumors and reducing treatment toxicities [6,7]. Most pediatric tumors are embryogenic tumors. Radiation therapy can easily cause many adverse reactions, such as growth arrest, neurocognitive disorders, secondary primary tumors, endocrine gland dysfunction, scoliosis [8]. However, proton therapy has great clinical advantages in the treatment of pediatric tumors without abovementioned adverse reactions, which can reduce the dose of proton entering and exiting the body, and protect important tissues around the tumor such as the brain stem, spinal cord [6,9].

Recent works on the proton therapy show that it is an expert in the treatment of breast cancer [10]. Although radiotherapy plays an important role in the treatment of breast cancer, the heart will be exposed to radiation during treatment that may increase the incidence and mortality of cardiovascular disease. The clinical trial about the comparison of proton and photon radiotherapy for breast cancer was showed by Dr. Hahn. The results indicated that proton therapy could reduce cardiac stress, cardiotoxicity, and had the potential to reduce the incidence of radiation-related diseases, which was superior to photon radiotherapy. Meanwhile, the clinical data in the treatment of breast cancer indicates that compared with intensity modulated radiation therapy, the overall cardiac stress of proton is reduced by 8-18 times, the clinically significant dose of cardiac is reduced by 50%, and therapy he relative risk of heart disease or other coronary events in different ages is reduce by 50-83%. After 5 years of treatment, 97% of breast-irradiated patients had no breast cancer recurrence, and 90% of patients had an ideal breast remodeling effect [11].

According to the reports, proton therapy can improve preliminary clinical outcomes in the treatment of skull base chordomas and chondrosarcomas [12]. Adjuvant photon-based proton therapy has been used extensively to improve local tumor control in patients with skull base chordomas [13]. A clinical study shows that high-dose, double-scattered 3D conformal proton therapy alone or following surgical resection for skull-base chondrosarcoma is an effective treatment [14]. Proton have better physical properties providing clear dosimetric advantages that allows for dose intensification without compromising the dose limitations of nearby critical structures and decreasing a patient's integral dose [15-17]. Grosshans reported the out comes of patients treated with spot-scanning proton therapy. Median RT dose was 69.8 Gy and median follow-up of 27 months, the rate of local control was 90% [18]. A study by Hug reported the outcomes of 33 skull base chordomas patients with a median dose of 70.7 Gy (RBE). Median follow-up was 33.2 months. Local control at 3 and 5 years were 67% and 59%, respectively [19].

Proton therapy also have some minor drawbacks. The proton line concentrates the energy in the Bragg-peak region, so the larger the field area, the greater the unevenness of the dose distribution and the greater the adverse radiation reaction. A study by Mc Govern show that proton therapy was performed in 31 children with atypical teratoma/rhabdomyoid tumor of the central nervous system. It was found that 16% of the children had the changes of brainstem imaging after radiotherapy combined with clinical appearance, some patients had grade 1-2 skin adverse reactions, such as erythema and alopecia, and 3-4 grades of adverse reactions (especially during combined chemotherapy), including septicemia, death, neutrophil reduction and pus, etc [20]. Proton therapy was also performed in patients with thymoma, Grade 2 adverse reactions were observed, including dermatitis, pneumonia, fatigue, esophagitis and so on [21]. Although proton therapy has the superiority of dose-distribution, the extensive research on adverse reactions and long-term effects are still needed.

At present, proton therapy is safer and more effective than traditional radiotherapy, which has a very broad prospect. With the

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further application of proton therapy, we believe that more tumor patients can enjoy the progress brought by technology of cancer treatment. The side effects are greatly reduced, the treatment effect will be better.

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