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Optimal Radiotherapy for Intracranial Germinomas: Dose, Volume and the Need of Systemic Chemotherapy

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Introduction

Central nervous system germ cell tumor in children and adolescents is a type of brain tumor occurring among specific populations. The incidence of this disease in East Asia, including Japan, Korea and Taiwan, is much higher than that in Western countries [1]. Among germ cell tumors, germinoma is one of the most common tumors; however, its pathogenesis still remains unknown. Based on imaging features, age, tumor location, and changes in level of tumor markers in the blood (ß-hCG and α-fetoprotein), the disease can be diagnosed clinically. Guidelines for effective treatments have also been gradually established. In recent years, the number of published studies has increased, and definitive evidence has revealed the high sensitivity of germinomas to both radiotherapy and chemotherapy. Nevertheless, radiotherapy is considered to be the primary radical treatment, and systemic chemotherapy cannot replace radiotherapy as the sole therapeutic method [2]. Moreover, surgery can only play the role in providing the pathological characteristics of the tumors. Because this type of tumor is highly sensitive to radiation, appropriate selection of total radiation dose, fraction size, and irradiation volume has been a focus of research on in children and adolescents worldwide. In Taiwan, at our research institute, we have treated more than one hundred cases of intracranial germinoma in children and adolescents over the past decade [3]. By establishing digital registered records, we found that this type of tumor has excellent patient survival rates and tumor control, in addition to disease control. Moreover, the quality of life of patients after the treatment is also critical. After radiotherapy and chemotherapy, many patients experience various acute and chronic adverse effects caused by the treatment. Large-scale and high-dose radiotherapy (covering the entire brain and spinal cord), in particular, can often cause side effects that influence intellectual and learning ability in many children and adolescent patients [4], decrease in growth hormone levels, and even a high incidence of vascular diseases, as well as the occurrence of secondary tumors. By analyzing previous records at our institute, we found that the recurrence rate of germinoma is low, and it mainly occurs in the primary location and the ventricular systems firstly. It rarely recurs in extracranial spinal cord regions, which only account for about less than 10% of all cases of recurrence [3,5]. Therefore, for patients with no signs of tumor dissemination, radiation, mainly focusing on the entire ventricular system as well as the primary site by high precision technique, is highly recommended, and the radiation dose for primary tumor does not need to be as high as the traditional dose, which is generally above 45-50 Gy. Increasing evidence shows that a primary radiation dose of 30-36 Gy (a treatment dose of 1.8-2.0 Gy per day) plus whole ventricular irradiation with 20-24 Gy can also achieve excellent tumor control (during the treatment, continuous imaging examination can demonstrate the obvious improvement of tumors), and no further systemic chemotherapy is needed [6]. This treatment greatly improves the quality of life of children and adolescents after treatment, allowing them to return to their homes and schools. Appropriate adjustment of radiotherapy can not only result in good treatment outcomes, but also reduce treatment-related side effects, making it a therapeutic concept and model that should be promoted.

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