

MR imaging of cerebral radiation injury following carbon ion radiotherapy for head and neck tumors

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Introduction: Radiation-induced cerebral necrosis is one of the most serious complications of radiation-therapy for the treatment of head and neck tumors. In our institution, carbon ion radiotherapy have been performed for the head and neck tumors since 1994.

Purpose: To evaluate MR imaging and clinical presentation of cerebral radiation injury following carbon ion radiotherapy for head and neck tumors.

Materials and Methods: This was a retrospective study involving 30 patients (14 men, 16 women; age range, 21-71 years; mean age, 53 years) with cerebral radiation injury following carbon ion radiotherapy for head and neck tumor. Cerebral radiation injury was diagnosed on the basis of high intensity area on T2-weighted image and contrast enhancement on MR imaging within the radiation field which was reduced or stable more than three months, or that malignant disease or abscess was denied by positron emission tomography or the observation more than one year although the size was enlarged. The sites of primary lesions were 15 at nasal cavity/ nasopharynx/ paranasal sinus, 7 at skull base/ temporal bone, 3 at parotid gland, 3 at external/ middle ear and 2 at orbital fossa. Histopathology of the primary lesions were 6 with adenoid cystic carcinoma, 5 with adenocarcinoma, 5 with malignant melanoma, 4 with meningioma, 2 each with mucoepidermoid carcinoma, undifferentiated carcinoma, chordoma and 1 each with squamous cell carcinoma, acinic cell carcinoma, chondrosarcoma, fibrosarcoma. The primary lesions were received a raditaion dose of 48-70.4Gy and fraction number of 16-18. MRImaging was performed by using a 1.5-T MR imaging unit with a standard head coil. Axial T1-weighted spin-echo(SE), axial T2-weighted fast SE, and axial and coronal T1-weighted postcontrast SE imaging were performed. MR imaging of cerebral radiation injury was graded according to LENT SOMA tables as following; Grade 1: Edema demonstrated as high intensity area on T2-weighted image and focal contrast enhancement, Grade 2: Non-enhanced area or cystic lesion in the enhanced area, Grade 3: Focal necrosis with mass effect, Grade 4: Mass effect requiring surgical intervention.

Results: MR findings of radiation injury appeared as early as 2 months and as late as 64 months after carbon ion radiotherapy. The mean interval between irradiation and presentation was 27 months. First presentation site of radiation injury received full dose in 24 cases. In other 6 cases, the lesions received more than 50% of total dose. At first presentation, 19 cases showed Grade 1, 10 cases showed Grade 2 and one showed Grade 3. Eight cases showed clinical symptoms such as vertigo, convulsion or headache. Nine cases were treated with steroid. Two cases showed progression of the disease to Grade 4 during the observation period and received a operation. In these cases, however, no malignant tissues were found by the biopsy of the lesions. Six cases showed regression of the disease during observation period. Five of them, steroid were not administered. Radiation injury was first demonstrated as high intensity area on T2-weighted image and focal contrast enhancement within radiation field, especially in full dose area. Non-enhanced area was spread gradually in contrast-enhanced area and cystic lesion developed occasionally. In our study, 8 cases developed cystic lesions and 6 cases showed mass effect.

Conclusion: Characteristic MR findings in the radiation field are helpful to differentiate cerebral radiation injury from invasion or metastasis of the primary tumor. Two third of these cases with radiation injury following carbon ion radiotherapy did not require any treatment. In 5 cases (17%), radiation injury was reduced in size without any treatment.

References: LENT SOMA tables. Radiother Oncol 1995;35(1)17-60

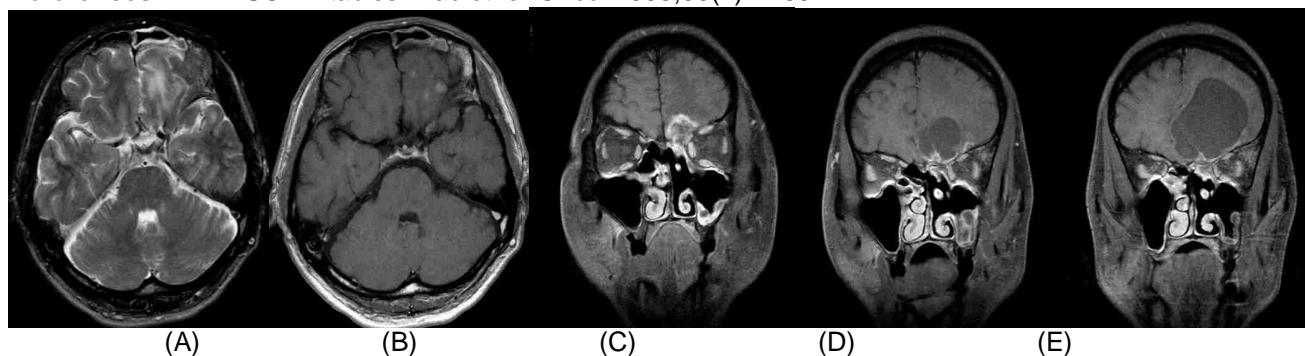


Figure 1. 47-years-old man treated with carbon ion radiotherapy for undifferentiated carcinoma of the ethmoid sinus. (A) T2-weighted and (B) Contrast-enhanced T1-weighted MR images of 26 months after radiation therapy show small spots of enhancement in the left frontal lobe and edema around it (Grade 1). (B) Coronal contrast-enhanced T1-weighted MR image 36 months after radiation therapy shows non-enhanced area in the enlarged enhancement (Grade 2). (C) Coronal contrast-enhanced T1-weighted MR image 56 months after radiation therapy shows cystic lesion with minimal mass effect (Grade 2-3). (D) Coronal contrast-enhanced T1-weighted MR images 62 months after radiation therapy shows large cystic lesion with mass effect requiring operation (Grade 4).