

**Serial MRI study of delayed brain injury induced by radiotherapy treatment for nasopharyngeal carcinoma**

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**Introduction:** Nasopharyngeal carcinoma (NPC) is common in Southern China, with incidence between 15 and 50 per 100000 (1, 2). The primary treatment for NPC is radiation therapy (RT), and radiation induced injury (RI) of temporal lobe is a late complication of RT. CT and MRI characteristics of RI of temporal lobe have been documented in the literature (3, 4, 5, 6). Typical RI in the temporal lobe includes white matter lesions, necrosis and cysts (7). The objective of this study is to investigate the longitudinal changes of RI of temporal lobe with serial MRI. Based on our clinical observation, we propose the hypothesis that RI has an initial developing phase and later decrease and resolution phase, with atrophy as the end stage of RI.

**Materials and Methods:** This is a retrospective study of 77 consecutive patients (60 males and 17 females) with age range of 33–80 years. These patients had known RI of the temporal lobes due to RT administered 2–10 years previously for NPC on MR with at least one further follow up MR for analysis. All MRI was performed using a 1.5T scanner. The basic MRI consisted of axial T1W, coronal T1W and T2W, and post contrast coronal T1W. Three radiation induced lesions were assessed: (1). White matter disease defined as abnormal signal intensity in the temporal lobe white matter on T2W images; (2). Necrosis defined as a contrast-enhanced focus in the temporal lobe, ranging from a small solid enhancing nodule to a large necrotic area with rim enhancement. (3). Cyst defined as a lesion of high T2 and low T1 signal intensity with a well-defined rim that does not enhance or shows only faint enhancement after contrast administration. MRI was reviewed by two radiologists in consensus. For each of the three lesions the temporal patterns were evaluated. The interval time between occurrence and changes of RI lesions was determined based on the serial MR images available.

**Results and Discussion:** In total there were 220 MRI exams. The average post RT duration for first MRI showing RI was 61.9 months. The median interval between the first MRI showing RI and second followed MRI was 11 months. White matter lesions (73%, 113 lesions out of 154 lobes), necrosis (59.7%, 92/154), and cysts (11.0%, 17/154) were identified. With the serial MRI, the instance for a white matter lesion, necrotic lesion, or cyst being static, increasing, decreasing, or having resolved as seen on the next followed-up MRI is listed in table 1, and the mean interval time is listed in table 2.

Table 1: Instance number of a lesion remaining static or changing its extent as seen on the next followed-up MRI

	static	increase	decrease	resolve
White matter lesion	31	38	29	2
Necrosis	17	28	34	9
Cysts	4	1	1	0

Table 2: Mean interval time for a lesion remaining static or changing its extent as seen on the next followed-up MRI (in months)

	static	increase	decrease	resolve
White matter lesion	19.9	19.7	27.6	20
Necrosis	27.6	18.6	28.9	34.9
Cysts	17.3	6	11	\

In 17 cases where white matter lesion decreased significantly or resolved completely, atrophy can be observed. The interval time from RI lesion to decrease or resolve for both white matter lesion and necrosis is longer compared to those of increase of the same lesion, indicating RI temporal changes have a lesion developing phase and followed later by a lesion resolving phase (Fig1). Our data also showed necrosis lesion is more likely to resolve than white matter lesions. The signal of cysts was mostly similar to the cerebrospinal fluid, though in three cases cysts show slightly higher T1 signal than CSF, indicating the possible presence of protein-containing components. In five instances, cysts were found with necrosis simultaneously during initial MRI presentation of RI lesions, while in 13 instances cysts were found after the initial MRI observed necrotic lesions. This evidence tends to agree with the viewpoint that the cyst represents a chronic or later stage of accumulation of fluid subsequent to body homeostasis in clearing tissue necrosis (4).

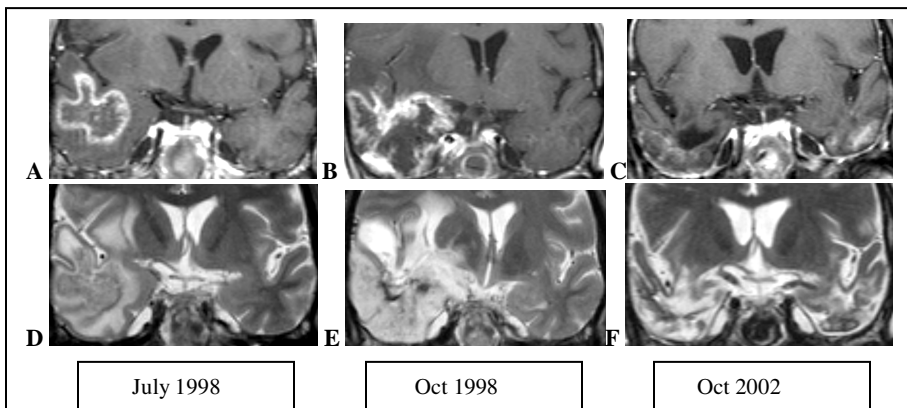


Figure 1, a 45-year-old man who had RT for NPC in 1994 underwent serial MR scan for RI. Coronal T1W post-contrast image shows necrosis in the right temporal lobe (A) which extended three months later (B) and decreased 4 years later (C). Coronal T2W images also demonstrates the extensive white lesion changes in the same region of the brain (D) which increased and was associated with great mass effect (E) before decreasing (F). Note that on the last MR scan RI in the left temporal lobe is increasing.

**Conclusions:** This study investigates the temporal changes of RI in the temporal lobe. Our results demonstrated that the RI lesions can remain static, increasing, decreasing or resolve, but overall the RI appears to demonstrate an initial developing phase and later resolving phase.

**References:** 1. Chan AT et al, Ann Ocol 2002; 13:1007-15. 2. Ho JHC. Int J Radiat Oncol Biol Phys 1978; 4:183-205. 3. King AD et al, Clin Radiol. 2000; 55:684-9. 4. Chan YL, et al, Acta Neurochir Suppl. 2005; 95:173-5. 5. Chong VF, et al, Am J Roentgenol. 2000; 175:431-6. 6. Nishimura R, et al. Radiat Med. 1992; 10:101-8. 7. Chan YL, et al. Radiology. 1999; 213:800-7