Case Report

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Cystic Brain Necrosis and Temporal Bone Osteoradionecrosis after Radiotherapy and Surgery in a Patient of Ear Carcinoma

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Key Words
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Brain cyst formation of temporal lobe induced by radionecrosis in ear carcinoma is rare. A 73-year-old man with basosquamous carcinoma of the left external ear canal received excision of tumor and postoperative radiation therapy in 1992. For osteonecrosis of the left temporal bone, a series treatment including oral and intravenous antibiotics and hyperbaric oxygen therapy was given in following years. Encephalomalasia of the left temporal lobe on brain computed tomography (CT) was noted in 1997. The patient suffered from headache, poor concentration, memory impairment, depressed mood, bad temper, and one 8 × 5 × 3.5 cm cystic lesion of the left temporal lobe with tempomandibular joint defect revealed by brain CT in 2001. Symptoms relieved after stereotactic aspiration of cystic fluid and external drainage (Omaya reservoir) insertion under magnetic resonance image by neurosurgeon. We report the progressive radionecrosis of temporal lobe and cyst formation, which caused the neuropsychological symptoms 10 years after radiotherapy.

Brain cyst of temporal lobe following radionecrosis in ear carcinoma which causes neuropsychological symptoms including pressure headache, poor concentration, memory impairment and personality change, is rare. At the same time, the combination of brain cyst with osteomyelitis of temporal bone makes the diagnosis and treatment more difficult. The similar findings in brain computed tomography (CT) of the patients with nasopharyngeal carcinoma who received radiation therapy were described by Lee *et al*.[1] In this report, we present a case with brain cyst of temporal lobe, who received aspiration and drainage and suffered from postoperative osteomyelitis of temporal bone with similar image findings.

CASE REPORT

A 73-year-old man suffered from bloody tinged discharge and otalgia of the left ear for 2 years intermittently. He went to our out patient department for help, where a fungating, ulcerative tumor mass over the auditory meatus with 0.5 cm medial extension to the auditory canal was found. Basosquamous carcinoma was diagnosed by pathology examination. Under the impression of the carcinoma of the external auditory canal, operation including tumor wide excision and reconstruction of the ear canal with full-thickness skin graft at the left ear was performed in July 1992 (Fig. 1). Post-operation radiation therapy with 5986 cGy was also given from October to December in the same year. However, left ear ca-

Fig. 1. Sketch of primary tumor and operation margin.

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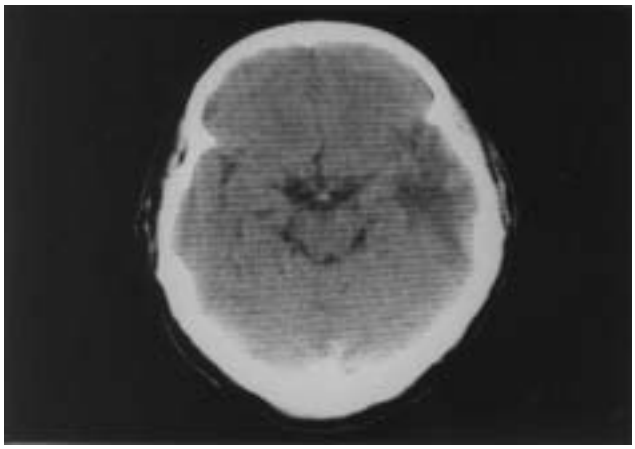

Fig. 2. Axial view of brain CT in 1996 revealed finger-like hypodensity over theleft temporal lobe.

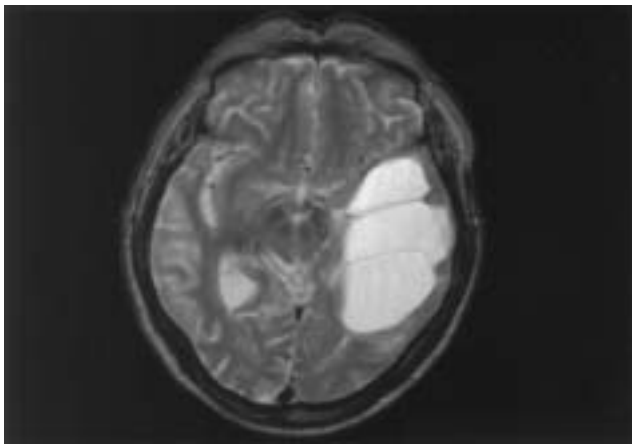

Fig. 3. Axial view of brain T2-weighted MRI showed a huge cystic lesion with septum.

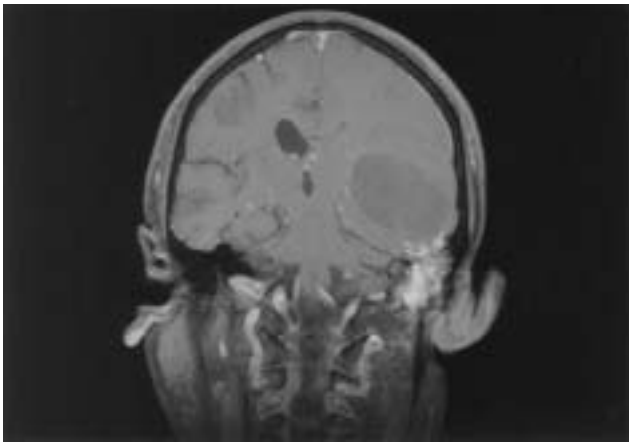

Fig. 4. Coronal view of brain T1-weighted MRI showed the cystic lesion and osteomyelitis of temporomandibular joint.

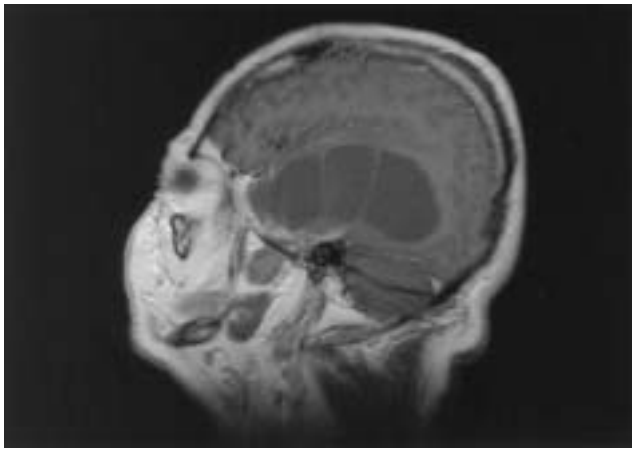

Fig. 5. Sagittal view of brain T1-weighted MRI showed huge cyst with multiple septula.

nal stenosis with perforation of the eardrum was noted in a regular follow-up, and tympanoplasty and canaloplasty with full-thickness-skin-graft was performed in February 1993. No tumor recurrence was reported by pathology examination. Unfortunately, otorrhea, swelling and erythema of the left periauricular area persisted in spite of prolonged oral antibiotics treatment. Discharging cavity over the left anterior canal wall with temporomandibular joint erosion was found.

Osteoradionecrosis of the temporal bone was impressed, and confirmed by study of osteomyelitis including Galium-67 citrate scan (Ga-67) and Technetium-99m methylene disphosphonate (Tc-99m-MDP) scans, while repeated biopsy did not show tumor recurrence. The patient received serial management including oral and intravenous antibiotics, local treatment from 1993 to 1997. Brain CT in 1996 revealed hypodensity lesion at left the temporal lobe without neuropsychological symptoms (Fig. 2). Hyperbaric oxygen (HBO) therapy for osteomyelitis was also given in November 1997. Then he was regularly followed in our outpatient department. In October 2001, he suffered from pressure headache, poor concentration, dizziness, memory impairment, depressed mood, bad temper, loss of interest in usual activities and pessimistic thinking for months. At first he went to the department of neurology for help, but in vain. Through a consulting psychiatrist, he was admitted under the impression of affective disorder. At the same time, left otorrhea was still noted. After CT examination of temporal bone and brain, defect of the left temporomandibular joint and

one 8 × 5 × 3.5 cm cystic lesion over the left temporal area were found (Figs. 3-5). Stereotactic aspiration of cystic fluid under magnetic resonance image (MRI) was performed in the same month. A total of 70 mL xanthochromic fluid without pus was aspired. Cytology showed no malignant cells, and the culture had no bacteria growth. Clinical symptoms also improved. One month later, symptoms recurred and the temporal lobe cyst still revealed in brain MRI. Stereotactic aspiration with external drainage (Omaya reservoir placement) was done in November 2001. The patient was regularly followed in outpatient department, and fluid was aspired fluid via Omaya catheter every 1-2 months when symptom recurred.

DISCUSSION

Carcinomas of the external auditory canal are rare neoplasms (< 1% of all head and neck malignant neoplasms).[2] Biopsy in our case revealed the basosquamous carcinoma, also known as keratotic basal cell carcinoma, which is believed to be 1 variant of basal cell carcinoma and is thought to be more biologically aggressive than other types of basal cell carcinoma.[3] The main goal of treatment is complete eradication of the tumor, thus surgical excision is the first-choice therapy. However, due to poor ulcerative auricular tumor margin and possibility of residual tumor in our patient, radiotherapy was also given. Testa *et al*.[2] demonstrated that the 5-year survival rates were 65% for patients who underwent surgery, 29% for patients who underwent radiotherapy, and 63% for patients who underwent a combination of surgery and radiotherapy. Hence, local irradiation was performed after consultation with radiotherapist to minimize the possibility of residual or recurrent tumor.

After completing radiotherapy, a series of complications including osteoradionecrosis and non-osteitic complications (external canal stenosis, poor canal skin with bare bone exposure) were noted in following months. Smouha *et al*.[4] presented a series of cases that illustrate the spectrum of non-osteitic complications of radiation therapy, including external canal stenosis, otitis media with effusion, chronic suppurative otitis media with or without cholesteatoma, sensorineural hearing loss, vestibular impairment, and facial nerve paralysis. Osteoradionecrosis and secondary infection caused by the breakdown of external canal skin was a rare but potentially lethal complication of radiotherapy to the cranial vault and surrounding tissue. The underlying pathological process first described by Ewing in 1926 is a slowly progressive avascular necrosis, initiated by obliterative endarteritis.[5] Two studies were used to evaluate the osteoradionecrosis in this patient; they work in different ways. Tc-99m-MDP bone scintigraphy is used in the initial evaluation of a patient with suspected osteomyelitis for the first time, and the result will remain positive for a long time after successful treatment of osteomyelitis because of the continuing process of bone repair. Ga-67 scan is used to assess the resolution of established osteomyelitis, and whether antibiotic therapy can be discontinued. Ga-67 scans often take up to 6 months to return to normal after successful treatment.[6] Oral and intravenous antibiotics were given according to sensitivity test. Repeated infection of the necrotic bony tissue and temporal bone occurred in the following time, possibly due to incomplete skin coverage. After considering the advantages and the risk of tumor recurrence, hyperbaric oxygen therapy was applied to our patient to potentiate wound healing 5 years after radiation therapy, as the possibility of carcinoma recurrence is relatively low after such therapy. The mechanisms of HBO therapy include: hyperoxygenation, vasoconstriction without hypoxia, pressure effects, antimicrobial activity, enhancement of fibroblastic proliferation, improvement of osteoclastic function, and increased red cell deformability. However, the possibility of increasing metastatic spread from a malignancy after HBO has been raised, but has never been proven.[7]

Besides the immediate side effects in this case, the delayed effect of brain radionecrosis with cyst formation was also noted 10 years later. It is an infrequent complication of the treatment of extracranial neoplasms with radiotherapy. Pardo-Minda *et al*.[8] reported 1 case with basal cell carcinoma arising from the skin around the ear and destroying the auricle. Rottemberg *et al*.[9] have presented 6 cases of delayed cerebral radionecrosis and reviewed 19 other reported cases that were produced by radiotherapy for several types of extracranial tumor. The latent period, between radiation therapy and the onset of

symptoms ranged from 4 to 31 months, and the patients developed symptoms attributable to cerebral radiation necrosis. Three hypotheses have been advanced to explain the pathology of cerebral radiation necrosis: (1) a vascular hypothesis – the brunt of radiation damage is borne by small and medium-sized blood vessels in the brain, causing tissue necrosis secondary to ischemia; (2) a glial hypothesis – radiation-induced mutation in glial cells, particularly oligodendroglial cells, is responsible for the prominent white matter damage and the frequently observed demyelination; and (3) an immunological hypothesis – irradiated cells release antigens into the brain, and the necrosis and vascular changes observed pathologically result from a hypersensitivity response to released antigen.[11]

Reviewing the brain images in our patient, finger-like hypodensity lesion at the left temporal lobe shown by brain CT scan 4 years after radiotherapy. No neuropsychological symptoms were noted at that time. The late temporal lobe necrosis after radiation therapy for nasopharyngeal carcinoma is more common than other extracranial neoplasms. In the series by Lee *et al*,[1] the incidence rate was reported about 1.03%, and the latent interval ranged from 9 months to 16 years, with the median observation period being 33 months. Presenting symptoms included dizziness, impairment of memory, personality changes, temporal lobe epilepsy, headache, mental confusion, diplopia, and dysphasia. Two distinctive manifestations in brain CT have been observed, (1) finger sign presenting with finger-like hypodense shadows and (2) cyst sign presenting with cyst-like shadows. Eighty-eight percent of patients with the cyst sign had latent intervals of more than 7 years. Furthermore, the initial finger sign subsequently became cyst-like in 7 deteriorating cases. In this patient, the huge cystic lesion noted 9 years later after radiation therapy revealed the later stage in the disease process.

The neuropsychological symptoms of the patient included pressure headache, poor concentration, dizziness, memory impairment, depressed mood, bad temper, loss of interest in usual activities and pessimistic thinking compatible with the injury of temporal lobe. For patients who developed temporal lobe necrosis after radiotherapy, memory, language, motor ability, and executive functions were significantly impaired, although their general intelligence remained relatively intact.[10] Corticosteroid is the initial treatment of choice for symptomatic lesions, but surgical intervention may be required if there are progressive neurological deficits. In the series of Lee *et al.*,[1] 19.4% complete and 15.3% partial responders were reported, but all presented with finger sign in brain CT. In consideration of the huge cyst formation, local condition of bare bone exposure and TM joint erosion in our case, stereotactic aspiration with external drainage was performed instead of more extensive surgical debridement of temporal bone and removal of brain cystic lesion. Symptoms relived after the aspiration but recurred 1-2 months later when fluid accumulated. Bederson *et al*.[11] described fenestration and shunting into ventricles without excise of the cyst in the case of radiation-induced bilateral cystic temporal radiation necrosis. The memory deficit and the psychologic symptoms resolved dramatically after operation.

In conclusion, the complication of latent radionecrosis of temporal lobe in the radiation treatment of ear carcinoma is rare. Besides treatment of the osteonecrosis of temporal bone, latent cerebral necrosis should be rule out when non-specific neurological symptoms occur. Considering the osteonecrosis of temporal bone, the surgical resection of cystic lesion may be withheld. Drainage of cyst is the choice to relieve the neurological symptoms.

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