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Surgical techniques in radiation induced temporal lobe necrosis in nasopharyngeal carcinoma patients

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ABSTRACT

Background: Radiation induced brain injury ranges from acute reversible edema to late, irreversible radiation necrosis. Radiation induced temporal lobe necrosis is associated with permanent neurological deficits and occasionally progresses to death.

Objective: We present our experience with surgery on radiation induced temporal lobe necrosis (RTLN) in nasopharyngeal carcinoma (NPC) patients with special consideration of clinical presentation, surgical technique, and outcomes.

Method: This retrospective study includes 12 patients with RTLN treated by the senior author between January 2010 and December 2014. Patients initially sought medical treatment due to headache; other symptoms were hearing loss, visual deterioration, seizure, hemiparesis, vertigo, memory loss and agnosia. A temporal approach through a linear incision was performed for all cases. RTLN was found in one side in 7 patients, and bilaterally in 5. 4 patients underwent resection of necrotic tissue bilaterally and 8 patients on one side.

Results: No death occurred in this series of cases. There were no post-operative complications, except 1 patient who developed aseptic meningitis. All 12 patients were free from headache. No seizure occurred in patients with preoperative epilepsy. Other symptoms such as hemiparesis and vertigo improved in all patients. Memory loss, agnosia and hearing loss did not change post-operatively in all cases. The follow-up MR images demonstrated no recurrence of necrotic lesions in all 12 patients.

Conclusion: Neurosurgical intervention through a temporal approach with linear incision is warranted in patients with radiation induced temporal lobe necrosis with significant symptoms and signs of increased intracranial pressure, minimum space occupying effect on imaging, or neurological deterioration despite conservative management.

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1. Introduction

Nasopharyngeal carcinoma (NPC) is the most malignant nasopharyngeal tumor. It occurs more frequently in Southern China, specifically in the Canton province. The incidence of NPC in Canton province is 25 times higher than that in the rest of the world, thus NPC is often called Canton cancer. NPC is also found in some parts of Southeast Asia, the Mediterranean basin, and Alaska [1]. According to a study by Cao et al., the incidence NPC is as high as 27.2 per 100,000 person-years in men in China [2]. Radiation therapy is the most effective treatment. With a radiation dose between 66 and 70 Gray(Gy), 5 years survival rate may reach 80% [3]. The most frequent complication of the radiation is brain necrosis, with an incidence of approximately 2–4% [4]. This complication does influence patient quality of life. Many regions of the supra or infratentorial can be affected by radiation, such as the temporal lobes, frontal lobes, brain stem, and cerebellum. Patients who harbor temporal lobes necrosis are particularly at risk for transtentorial herniation given the limited space of the middle cranial fossa.

According to the time symptoms emerge, radiation induced temporal lobe necrosis (RTLN) can be divided to three stages [5]: 1 – acute phase: symptoms appear within one month of radiation therapy, 2 – subacute phase: symptoms appear in 1–6 months, 3 – chronic phase: symptoms appear more than 6 months after radiation therapy.

There two types of therapeutic treatment for RTLN in NPC patients. The first method is conservative, which is indicated for most patients or in medically unstable patients. Conservative treatment includes: steroids, osmotic diuretics such as mannitol and furosemide, hyperbaric oxygen therapy, Bevacizumab (Avastin) and anticoagulation (heparin, warfarin, antiplatelets), etc. If conservative management does not change the symptoms or they become more severe, suggesting brain herniation, surgery is the most effective tool. In spite of the simplicity of the RTLN operation, careful patient selection is very important. Because the majority of these patients are old or systemically ill, timing of surgery and the extension of the resection while preserving the functional areas of the temporal lobe are mandatory too.

In this study we present our experience with surgery of RTLN in NPC patients with non-life threatening edema or occupying mass effect with special consideration of clinical presentation, surgical techniques, and outcomes.

2. Materials and methods

2.1. Patient population

We retrospectively reviewed the data of 12 NPC patients with RTLN treated by the senior author (L.F.C.) in our neurosurgical center between January 2010 and December 2014. We excluded radiation induced brain necrosis due to other skull and brain pathology, e.g. AVM, glioma, meningioma, etc. The diagnosis of RTLN in NPC patients was established based on tumor histopathology, which was initially performed by transnasal endoscopy in the Ear, Nose and Throat (ENT) department prior to radiation therapy. Our cohort included 12 patients; all are males, aged 42–64 years (mean, 53.5 years). The initial radiation dose ranged between 66 and 75 Gy, (mean, 70 Gy). There were no repeated radiation therapy cases due to NPC recurrence. Radiotherapy was performed using two-dimensional radiotherapy (2DRT) or intensity-modulated radiotherapy (IMRT) in our institute or others. With an interval time between last course of radiation therapy and initial symptoms of 2–17 years (mean, 7.6 years). The initial symptom for which they sought medical help was headache, sometimes accompanied by vomiting; other symptoms were hearing loss, visual deterioration, seizure, hemiparesis, vertigo, short and long memory loss and agnosia. The most important demographic and clinical features of the patients included in this study are outlined in Table 1.

2.2. Neuro-imaging studies

Radiographic evaluation included brain Magnetic Resonance Imaging (MRI) scans as well as Computed Tomography (CT). The nature of the RTLN, its extensions and relationship to neighboring structures were studied using MR images, as MRI appears to have higher sensitivity than CT in diagnosing RTLN. CT scans, with the aid of bone algorithm, were obtained for analysis of bone involvement. Magnetic resonance spectroscopy (MRS) and Diffusion Weighted MRI (DWI) are best suited to differentiate between RTLN and recurrence of NPC, post radiation second primary intracranial malignancies, hematogenous cerebral metastasis and brain abscess.

2.3. Surgical technique

The patient is placed in a supine position and the ipsilateral shoulder is raised with a cushion to facilitate head rotation. The head is fixed in a three-pin Mayfield head holder with a single pin placed in the frontal area to allow free manipulation during the procedure.

After precise orientation, the borders of the craniotomy and incision are marked with a sterile pen. We use a straight line incision 1 cm in front of the tragus to avoid injury to the neurovascular structure of the pre-auricular region. The inferior border of this incision starts at the level of the zygomtic arch and the upper border ends ~2–3 cm above the pinna with a small anterior curve to facilitate retraction of the edges of the skin incision with the temporalis muscle for wide exposure later.

A craniotome is used to create a 34 mm (width) × 55 mm (height) bone flap. In intradural stage, for cystic lesions, we began by tapping and aspirating the fluid inside the cyst with a ventricular cannula. We then resected the inferior temporal lobe along the inferior temporal sulcus to the Sylvain fissure. Our resection of the normal temporal lobe tissue did not exceed 4 cm in the dominant side and 5 cm in the non-dominant side, to prevent any post-operative complications. We removed some, not all, of the cystic wall and tried to ensure communication the cyst with neighboring ventricles or arachnoid cisterns (ambient cistern) to prevent reformation of the cyst and reaccumulation of the fluid causing relapse of the cyst. For solid tumors, we resected the inferior temporal lobe as in cystic lesions, and tried to remove all necrotic tissue and enhanced lesion found on MRI to prevent