MRI analysis of temporal lobe epileptogenic tumors

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Purpose

Tumoral epilepsy originated in temporal lobe were often refractory or drug-resistant epilepsy. The patient with tumoral epilepsy would receive good prognosis through surgical treatment. MR imaging became one of the most important tools in the selection of patients with drug-resistant epilepsy for surgery and played a key role in characterizing and localizing the onset zone. We analyzed the data of the patients with epileptogenic tumor in temporal lobe, in order to highlight the characteristics of these tumors thereby enhancing our clinical and imaging awareness.
Methods and Materials

Clinical data: Medical records of thirty-nine patients with epileptogenic tumor in temporal lobe were retrospectively analysed between March 2008 and September 2012 at Beijing Sanbo Brain Hospital, including 15 females and 24 males, age range from 1 to 39 years (mean 17.6 years). All patients underwent MRI scanning and obtained post-operative pathological results. CT scanning was performed on 22 patients of the group. Clinical data of these patients were reviewed, including onset age of seizures, course of epilepsy, seizures types and pathologic type.

Image evaluation: Brain MR scanning was performed on all patients by Philips Achieva 1.5 T MR Systems, using 8 channel head coil. Routine MR brain scan included transverse T1WI, transverse and coronal T2WI, transverse, coronal and sagittal fluid attenuated inversion recovery (FLAIR), as well as gadolinium-enhanced T1WI of transverse, coronal and sagittal scan for all of patients. MR performance and data of all patients were analyzed by two senior medical image physicians to determine location, signal intensity of T1WI, T2WI, FLAIR, cystic-solid components and enhanced features of the tumors. Length, width and height of the tumors were measured according to T2WI and FLAIR images and average diameters of the lesions were obtained. The patients were divided into two groups of #3.0 cm and >3.0 cm of the lesion diameter. 22 patients received CT scan to determine whether these lesions were accompanied by calcification. By the temporal horn of the lateral ventricle the lesions were divided into medial and lateral temporal lobe groups.

Statistical Analysis: The difference of cystic-solid component, MRI enhancement characteristics and the size of tumors among various pathologic types, and the difference of the impact of the epileptogenic tumors located in the medial and lateral temporal lobe on the hippocampal structure were analyzed by #2-test. Relationship between the temporal lobe tumor type and onset age of epilepsy was analyzed by correlation test. p<0.05 was considered statistically significant. The statistic process was conducted with SPSS 13.0.
Results

The mean onset age of 39 patients with tumor-associated temporal lobe epilepsy was 9.4 years old (ranging from 6 months to 32 years). The patients were under 18 years old in 36 cases (92.3%), the other three were over 18 years old, whose onset ages were 19, 21, 32 years old, respectively. The mean duration from first seizure to diagnosis of brain tumors was 98.8 months (ranging 3-396 months). Most patients (35 cases, 89.7%) had over one year’s history of epilepsy. The complex partial seizures were in 29 (74.4%) cases, 11 (28.2%) of whom were associated with generalized tonic-clonic seizures (GTCS) and another 2 (5.1%) with absence seizures (petit mal seizure). 5 cases (12.8%) and 2 cases (5.1%) were GTCS and tonic seizures, respectively. There were 3 cases with simple partial seizures, including a patient (2.6%) associated with GTCS and another (2.6%) with absence seizures. Twenty-four (61.5%) patients had only one seizure type and fifteen (38.5%) had more than one types of seizures.

Histopathologic results of temporal lobe epilepsy in our group included:

24 gangliogliomas (61.5%, Fig.1 and Fig. 2), 5 astrocytomas (12.8%), 3 oligodendrogliomas (7.7%, Fig. 3 and Fig. 4), 3 dysplastic neuroepithelial tumor (DNET) (7.7%), an angiocentric glioma(Fig. 5 and Fig. 6), a pleomorphic xanthoastrocytoma(Fig. 7 and Fig. 8),

an extraventricular neurocytoma associated with hamartoma and an anaplastic astrocytoma. There was mild positive correlation between pathologic types of the temporal tumors and onset age of patients ($r=0.333, P=0.038$). Besides mean onset age of three patients with DNET
was 23 years (16, 21 and 32 yrs) and 1 with ganglioglioma was 19, the other patients were children whose onset ages were #18 years.

The epileptogenic tumors located at medial and lateral temporal lobes were found in 28 (71.8%) and 11 (28.2%) patients, respectively. Twenty patients (71.4%) of them with medial temporal lobe tumors involved hippocampal region, including 17 slightly high signal on T2WI and Flair images, 2 with compressed hippocampus deformation and 1 with performance of hippocampal sclerosis proved by hisopathology, whereas there was only one involving hippocampal region in tumor of lateral temporal lobe. The incidence of the medial temporal lobe epileptogenic tumors group involving hippocampus was significantly higher than that of the lateral group (#2=12.349#P=0.000). MRI of a patient in the study showed a solid-occupying lesion in right medial temporal lobe with nodular enhancement and ipsilateral hippocampi involvement. Postsurgery pathology proved ganglioglioma associated with focal cortical dysplasia and hippocampal sclerosis(Fig. 9 and Fig. 10).

Distribution of histopathologic types in medial and lateral temporal lobe tumor groups is shown in Table1. Histopathologic types of medial and lateral temporal lobes tumors did not have significant difference (#2=12.349#P=0.129).

<table>
<thead>
<tr>
<th>Types</th>
<th>Medial</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>gangliogliomas</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>astrocytomas</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>oligodendrogliomas</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>DNET</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Others</td>
<td>2*</td>
<td>2**</td>
</tr>
</tbody>
</table>
*an angiocentric glioma and an extraventricular neurocytoma associated with hamartoma.

**a pleomorphic xanthoastrocytoma and an anaplastic astrocytoma.

Tumors showed as cystic-solid component in 18 cases (46.2%), mainly solid in 12 (30.8%), and mainly cystic tumor in 9 (23.1%) according to T1WI, T2WI and FLAIR characteristics. The tumor showed no contrast enhancement in 25 cases (64.1%), 13 (33.3%) with mild enhancement and apparent enhancement in one patient. Among 22 patients performed with CT scanning, calcification were found in 12 cases, including 9 gangliogliomas, one astrocytoma, one oligodendrogloma and one DNET.

The summary of tumor manifestation and size on MRI and pathologic type is seen in table 2.

**Table 2: Tumor pathology and morphology**

<table>
<thead>
<tr>
<th>types</th>
<th>n</th>
<th>%</th>
<th>lesions component</th>
<th>enhancement</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cystic-solld</td>
<td>cystic-solid</td>
<td>no Partial-mild</td>
</tr>
<tr>
<td>ganglioglioma</td>
<td>24</td>
<td>64.1</td>
<td>12 5 7</td>
<td>14 10 13 10</td>
<td>1</td>
</tr>
<tr>
<td>astrocytoma</td>
<td>5</td>
<td>12.8</td>
<td>1 2 2</td>
<td>4 1 5 #</td>
<td>#</td>
</tr>
<tr>
<td>DNET</td>
<td>3</td>
<td>7.7</td>
<td>3 # #</td>
<td>3 # 1 1 1</td>
<td>1</td>
</tr>
<tr>
<td>oligodendroglioma</td>
<td>3</td>
<td>7.7</td>
<td>1 1 1</td>
<td>2 1 1 2</td>
<td>#</td>
</tr>
<tr>
<td>Others*</td>
<td>4</td>
<td>10.3</td>
<td>1 1 2</td>
<td>2 2** 2</td>
<td>#</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>14.753</td>
<td></td>
<td>7.276 14.753</td>
<td></td>
</tr>
<tr>
<td>P*</td>
<td>0.395</td>
<td>0.402</td>
<td></td>
<td>0.395</td>
<td></td>
</tr>
</tbody>
</table>

*including a pleomorphic xanthoastrocytoma# 1 anaplastic astrocytoma#

an angiocentric glioma and an extraventricular neurocytoma with hamartoma#

**a pleomorphic xanthoastrocytoma showed complete enhancement.

"-"showed non case#
Fig. 1: Gangliogioma: Coronal FLAIR image showed slight hyperintense in right medial temporal lobe.

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Fig. 2: Gangliogliomas: Coronal enhanced T1WI of Fig.1 showed no enhancement in the lesion.
**Fig. 3:** Oligodendroglioma: Coronal FLAIR showed a cystic lesion with hypointense in left medial temporal lobe surrounding by slightly hyperintense.
**Fig. 4:** Oligodendroglioma: Sagital contrast enhanced T1WI of Fig.3 showed no enhancement of the lesion.

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Fig. 5: Angiocentric glioma: Axial T2WI showed a cystic-solid lesion with T2WI hyperintense in left medial temporal lobe.
**Fig. 6:** Angiocentric glioma: Enhanced Axial T1WI of Fig.5 showed no contrast enhanced lesion in left medial temporal lobe.

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Fig. 7: Pleomorphic xanthoastrocytoma: Axial Flair showed swollen cortex with slightly hyperintense in left lateral temporal lobe.

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Fig. 8: Pleomorphic xanthoastrocytoma: Axial enhanced T1WI of Fig.7 showed a nodular enhanced lesion in left lateral temporal lobe.

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**Fig. 9:** Gangliogliomas with focal cortical dysplasia and hippocampal sclerosis: Coronal T2WI showed slight high signal of right medial temporal lobe (MTL).

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**Fig. 10:** Gangliogliomas with focal cortical dysplasia and hippocampal sclerosis: Enhanced coronal T1W1 of Fig.9 showed nodular enhanced lesion of right MTL.

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Conclusion

Approximately 8.3% to 25.6% temporal lobe epilepsy was resulted from temporal lobe tumor [1]. The onset age of most patients with temporal lobe epilepsy were in childhood and adolescence [2]. The tumor-related temporal lobe epilepsy was also more common in childhood, accounted for 92.3% (36/38) in our patient group. Mean duration from first seizure to the diagnosis of temporal lobe tumor was 98.8 months, suggesting the course of tumor-related temporal lobe epilepsy could be quite long.

Complex partial seizure was the most common seizure type in the study and was the only type of more than half of the patients (74.4%, 29 cases), where 13 patients (44.8%) were associated with secondary GTCS (11 cases) or with absence seizures (2 cases). 61.5% patients had only one seizure type, including complex partial seizure, simple partial seizure, GTCS and tonic seizure, whereas the other 38.5% had more than one types of seizures, including secondary GTCS and absence seizures.

Epileptogenesis of various brain tumors had significant differences. Epileptogenic effect of low-grade tumors was significantly higher than that of high-grade tumors [3]. In this study, ganglioglioma was the most common epileptogenic tumor (64.1%) in temporal lobe, followed by astrocytoma (12.8%), DNET (7.7%) and oligodendrogliomas (7.7%).

The majority of temporal lobe tumors-related epilepsy in this group were complex partial seizure in childhood and adolescence. Gangliogliomas located at temporal lobe had the same clinical features as with other temporal cortex tumors like low-grade astrocytoma and DNET [4].

Epileptogenesis of these tumors was not up to their histopathologic types but to locating the same brain lobe, i.e. temporal lobe. In contrast to primary symptoms of high intracranial pressure and local nervous system damages of other brain tumors, the temporal lobe epileptogenic tumors had similar characteristics of slow-growing and a long course of disease.

MRI found the majority of temporal tumors in our group were small tumors involving temporal cortex with a mean diameter of #3cm (94.9%), usually with a long course of epilepsy (mean 17.6 years), suggesting they belong to slow-growing tumor. The low-grade and slow-growing tumors were more common in children and adolescents, whose longer survival period permitted enough time for the tumors to induce functional change in the area, and then develop epileptogenic lesion[5-6].

Temporal epilepsy may be divided into medial and lateral temporal parts[7] according to the anatomic location. Mediotemporal lobe structure was related the most closely with epilepsy. Literatures reported that medial temporal lobe epilepsy accounted for more than 60% of temporal lobe epilepsy [2.8], and often associated with hippocampal sclerosis. Mediotemporal lobe tumors in our group accounted for 71.8%(28), 71.4% (20) of which showed by MRI a slightly high signal of T2WI and FLAIR, hippocampal deformation, etc.
The incidence of hippocampal involvement in medial temporal epileptogenic tumors was significantly higher than that of lateral temporal group.

By observing the tumors’ features of T1WI, T2WI and FLAIR images and enhanced performance in our group, it was found that only DNET showed a characteristic of multiple small cystic lesion in cortex area without contrast enhancement. The other various types of temporal epileptogenic tumor showed that the proportion of cystic-solid component and enhanced characteristics of the lesions had no significant difference on MRI. Calcification was often found in ganglioglioma by CT. Lesions associated with calcification in 9 patients with gangliogliomas in our group were detected by CT. So in case of suspecting temporal epilepsy due to tumors, CT scanning might help to determine the nature of some temporal tumors according to whether they had calcification in lesion. In addition to two high-grade tumors, including pleomorphic xanthoastrocytoma and anaplastic astrocytoma, temporal lobe epileptogenic tumor was more common in low-grade tumor (94.9%) [9]. Correlation analysis found mild positive relationship between temporal lobe tumors in our group and their onset ages of epilepsy. Except for three patients with DNET whose average onset age was 23 years old, other temporal lobe epileptogenic tumors in the group were onset in childhood (ages #18 years).

In short, the majority of temporal lobe epileptogenic tumors were small tumors with slow growing and primarily involving medial temporal lobe. Ganglioglioma accounted for more than half of temporal lobe epileptogenic tumors. The most common seizure type was complex partial seizure with or without GTCS in the group. We found that medial temporal epileptogenic tumors were more likely to involve hippocampal structure than lateral temporal tumors. MRI played an important role in detecting and evaluating temporal lobe epileptogenic tumors.
References


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