MR Imaging of Intraventricular Neurocytoma

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Intraventricular neurocytoma (IN) is a benign primary CNS tumor of neuronal origin that is usually located within the lateral and third ventricles. It was first described by Hassoun et al. [1] in 1982. Although several terms such as intraventricular neuroblastoma or differentiated neuroblastoma have been used to describe tumors with the same histopathologic and ultrastructural features, intraventricular neurocytoma or central neurocytoma has been advocated as the most accurate and descriptive name [2].

The radiological and pathologic features of IN can be similar to other intraventricular tumors, especially oligodendroglioma. Many INs are misdiagnosed as oligodendrogliomas owing to their similar appearance under the light microscope [3].

We reviewed the MRI features of 10 cases of pathologically proven IN to determine if they have characteristic MRI features which allow a diagnosis before surgery and/or radiation therapy.

MATERIALS AND METHODS

Brain MRI studies of 10 patients with IN were reviewed retrospectively. There were 5 men and 5 women, from 16 to 48 years old (mean 34.6 years). The diagnosis was confirmed by both surgical excision and histopathology in all patients. MR images were obtained by a 1.5 T unit (General Electric, Milwaukee, Wisconsin) in all patients. T1-weighted (TR/TE 500-600/10-25) axial and sagittal images and T2-weighted (2000-3000/80-100) axial images were obtained. Contrast-enhanced T1-weighted images were obtained in all patients in one or more planes after intravenous injection of gadolinium-DTPA. MR images were reviewed with special respect to the location and signal characteristics of the tumors on T1WI and T2WI. Presence or absence of contrast enhancement in the solid portion of the tumor, cystic changes, hemorrhage, vascular signal void and ventricular dilatation were also evaluated. The degree of cystic change was defined as mild or moderate if the proportion of the cystic area of the tumor was greater than 25% or 50% respectively.

RESULTS

The clinical and MRI features of the patients are summarized in Table 1. Apart from the 2 patients with incidentally found tumors, all patients presented with headache. All tumors occurred in the lateral ventricle, with third ventricle extension in 4 of the 10 cases. Tumor size ranged from $2 \times 3 \times 2 \text{ cm}^3$ to $5 \times 7 \times 4 \text{ cm}^3$ with a mean largest diameter of 5.4 cm. Intratumoral cystic changes were noted in all patients, with 5 patients showing a moderate degree of cystic change and the other 5 showing a mild degree. The cystic components were of the same signal intensity to CSF on all pulse sequences. The solid portion of the tumor showed isointensity on T1-weighted images in all patients, with 9 showing isointensity and the remaining patient showing hypointensity on T2-weighted images. Post-contrast T1-weighted imaging revealed contrast enhancement in the tumor in 6 patients, and no contrast enhancement in the remaining 4 (Fig. 1 and Fig. 2). In 2 patients intratumoral hemorrhage was noted which showed hyperintensity on T1-weighted images and mixed signal intensities on T2-weighted images.
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DISCUSSION

Neurocytomas account for about 0.5% of primary brain tumors. They are usually slow growing and are considered low-grade malignant tumors. They are classified as WHO grade II [4, 5]. They are almost always primarily intraventricular but extraventricular tumors have been reported [6]. They tend to occur more frequently in young adults and have no sex predilection. The average age of reported patients is 31 years, ranging from 17 to 53 years [3]. Grossly, they are well-defined, lobulated masses lying adjacent to the foramen of Monro or septum pellucidum [7]. Necrosis and cyst formation are commonly found within the tumor [8]. Microscopically, IN may show features indistinguishable from oligodendrogliomas. Immunohistochemistry and electron microscopy show neuronal marker proteins such as synaptophysin, and neurosecretory granules and synapses respectively [4, 9].

Patients with IN may have symptoms related to progressively increasing intracranial pressure such as headache, dizziness, blurred vision, memory loss, nausea and vomiting. Papilledema, decreased visual acuity, and paresis are common presenting signs. However, 2 patients in our series were asymptomatic and the tumor was an incidental CT finding, which has been previously reported [3].

On MRI, IN are mainly isointense to gray matter on both T1WI and T2WI [3, 9]. Our imaging findings did not differ much from those (Fig. 3). Serpiginous signal void areas, presumably representing blood vessels, were demonstrated in 4 patients.

Table 1. Summary of Clinical and MRI Features.

<table>
<thead>
<tr>
<th>Case/Age /Sex</th>
<th>Clinical Features</th>
<th>Size (cm)</th>
<th>Location of Tumor</th>
<th>SI of solid portion on T1WI</th>
<th>Contrast Enhancement</th>
<th>Cystic Change</th>
<th>Hemorrhage</th>
<th>Ventricular Dilatation</th>
<th>Vascular Signal Void</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/37/M</td>
<td>Incidentally found</td>
<td>2 × 3 × 2</td>
<td>LV (SP, lat wall)</td>
<td>Iso</td>
<td>–</td>
<td>–</td>
<td>++</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2/32/M</td>
<td>Sudden onset headache</td>
<td>4 × 6 × 5</td>
<td>LV &amp; 3rd V</td>
<td>Iso</td>
<td>–</td>
<td>+</td>
<td>++</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>3/38/M</td>
<td>Headache, diplopia</td>
<td>5 × 7 × 4</td>
<td>Bil. V (SP) &amp; 3rd V</td>
<td>Iso</td>
<td>Hypo</td>
<td>+</td>
<td>++</td>
<td>Bil. V</td>
<td>+</td>
</tr>
<tr>
<td>4/48/M</td>
<td>Severe headache</td>
<td>3 × 5 × 5</td>
<td>LV (SP)</td>
<td>Iso</td>
<td>–</td>
<td>++</td>
<td>–</td>
<td>LV</td>
<td>–</td>
</tr>
<tr>
<td>5/30/M</td>
<td>Explosive headache, blurred vision</td>
<td>4 × 4 × 6</td>
<td>RV (SP)</td>
<td>Iso</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>RV</td>
<td>–</td>
</tr>
<tr>
<td>6/16/F</td>
<td>Severe headache, vomiting</td>
<td>3 × 4 × 5</td>
<td>RV (SP, lat wall)</td>
<td>Iso</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>7/43/F</td>
<td>Incidentally found</td>
<td>3 × 2 × 3</td>
<td>RV</td>
<td>Iso</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>8/42/F</td>
<td>Insidious onset headache</td>
<td>4 × 6 × 5</td>
<td>RV (SP, lat wall)</td>
<td>Iso</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>9/25/F</td>
<td>Severe headache, vomiting</td>
<td>4 × 4 × 7</td>
<td>Bil. V (SP) &amp; 3rd V</td>
<td>Iso</td>
<td>++</td>
<td>–</td>
<td>Ros</td>
<td>Bil. V</td>
<td>+</td>
</tr>
<tr>
<td>10/35/F</td>
<td>Severe headache</td>
<td>5 × 5 × 6</td>
<td>LV &amp; 3rd V</td>
<td>Iso</td>
<td>–</td>
<td>++</td>
<td>–</td>
<td>Bil. V</td>
<td>–</td>
</tr>
</tbody>
</table>

(LV, left lateral ventricle; RV, right lateral ventricle; 3rd V, third ventricle; SP, septum pellucidum; lat wall, lateral wall; Bil. V, bilateral ventricles; SI, signal intensity; T1WI, T1-weighted images; iso, isointensity; hypo, hypointensity; +, mild degree; ++, moderate degree)

Figure 1. Case 10. a. Axial noncontrast-enhanced and b. Contrast enhanced T1-weighted and c. T2-weighted MR images show a heterogeneous tumor in the left lateral ventricle originating from the septum pellucidum producing hydrocephalus. The solid portion of the tumor is isointense on all pulse sequences and shows no contrast enhancement. Numerous cystic spaces within the tumor are also seen.

(Fig. 3). Serpiginous signal void areas, presumably representing blood vessels, were demonstrated in 4 patients.
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Previously described. In our series, MRI revealed isointensity with heterogeneous areas in most of the patients. The heterogeneous intensities may represent calcifications, cystic spaces and vascular flow voids [3, 10-12]. Cystic change is a common finding in IN, and is present in over 90% of reported cases [3, 10]. Although calcification is a characteristic and frequent finding of IN, it is poorly shown on MRI when compared with CT [10]. The degree of contrast enhancement of the solid portion is generally mild to moderate [3, 10-11]. Intratumoral hemorrhage is uncommon in IN [3, 10]. However, it may cause the symptoms seen in IN. One of our patients (case 2) presented with sudden onset headache. An MRI performed after admission (Fig. 3) revealed inhomogeneous high signal intensities within the intraventricular tumor on T1WI, suggestive of subacute hematoma and this was proved during surgery.

IN should be differentiated from other intraventricular tumors such as meningioma, ependymoma, giant cell astrocytoma, choroid plexus papilloma and oligodendroglioma. The differential diagnosis is dependent on the age of the patient and the location of the tumor [13]. Patients with meningioma are usually older than 30 years and those with choroid plexus papilloma are usually young children [3, 10]. Choroid plexus papillomas often show intense contrast enhancement. The typical locations of intraventricular meningioma, ependymoma and giant cell astrocytoma are the trigone region, the fourth ventricle and the region of the foramen of Monro respectively, which are all different from that of IN [3, 10, 13]. Intraventricular astrocytomas may calcify and show peritumoral edema, which is uncommon in IN [3]. Existing radiologic descriptions indicate that intraventricular oligodendroglioma may not be distinguishable from IN [3]. However, no tumor hemorrhage was reported in the largest series of intraventricular oligodendrogliomas [14]. Thus the presence of tumor hemorrhage, as demonstrated in some cases of IN, including ours, may exclude a diagnosis of oligodendroglioma.

In conclusion, IN is an uncommon, slowly growing neoplasm that arises in the anterior part of the lateral and/or third ventricles of young adults. It is often associated with symptoms and signs of increased...
intracranial pressure. Characteristic MR findings include a main solid portion with intratumoral cystic changes and broad attachment to the septum pellucidum and/or lateral wall of the lateral ventricle. MRI is helpful in defining tumor extension, which is important in preoperative planning. Although IN is a relatively rare lesion, it should be considered in the differential diagnosis of intraventricular lesions in the presence of such typical MR findings. However, a definitive diagnosis requires immunochemical study and electron microscopy.

REFERENCES

腦室內神經細胞瘤的磁振造影研究

嚴寶勝 黃敏政 衛優遊 吳樹鏵 黃浩輝 陳耀亮 萬永亮
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為探討磁振造影對腦室內神經細胞瘤的診斷價值，我們回顧性分析10例經手術及病理確認的腦室內神經細胞瘤的磁振造影表現。其中5位男性及5位女性，平均年齡34.6歲。所有影像在1.5 Tesla的磁振造影掃描器下取得，同時對於該腫瘤的所在位置、訊號密度，顯影強化形態，腫瘤內囊狀變化及出血性進行分析。所有腫瘤皆由側腦室或透明隔長出往腦室內蔓延，它們均含有大小不一的腫瘤內囊狀變化。腫瘤實質在T1WI及T2WI下表現為等信號。顯影強化可見於6例。血管信號流空可見於4例及腫瘤內出血可見於2例。腦室內神經細胞瘤在磁振造影下有一定的特徵，了解這些特徵有助於術前診斷及指引手術的實施。

關鍵詞：腦，腫瘤；神經細胞瘤，磁振造影