Pituitary Abscess with Panhypopituitarism Showing T1 Signal Hyperintensity of the Marginal Pituitary Area: A Non-invasive Differential Diagnosis of Pituitary Abscess and Pituitary Apoplexy

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Abstract

A 53-year-old man was hospitalized with general fatigue, headache, dizziness and polyuria. The laboratory findings revealed anterior hypopituitarism and central diabetes insipidus. He also showed eye movement disorder and facial sensory impairment. These symptoms were treated successfully with conservative medical treatment. Concurrently, abnormal pituitary MR imaging findings were revealed. Pituitary abscess was primarily suspected on MR imaging findings, although it was difficult to differentiate pituitary apoplexy by MR imaging findings, alone. In this report, we propose a new diagnostic approach of pituitary abscess, using a combination of CT, MR imaging and clinical manifestations, without either pituitary surgery or pituitary biopsy.

Key words: pituitary abscess, pituitary apoplexy, diabetes insipidus

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Introduction

Pituitary abscess is a rare but life-threatening disease. The outcome of pituitary abscess depends on early diagnosis. However, the correct diagnosis of pituitary abscess with neuroimaging is generally difficult. This report shows successful treatment of pituitary abscess with conservative treatment. In addition, we propose a new non-invasive diagnostic approach for pituitary abscess, using the density of computed tomography (CT), the dural enhancement of anterior skull base and clivus, the signal intensity of echo-planar gradient-recalled echo T2*-weighted MR imaging (T2* WI) of pituitary gland and clinical manifestations (e.g., diabetes insipidus).

Case Report

A 53-year-old man presented with dull occipital headache and dizziness, three days before admission to our hospital. The next day, difficulty of walking due to general malaise, and blurred vision were manifested in him. Thereafter, he subsequently had a persistent headache with diplopia, photophobia and numbness of the right face. On admission, he complained of continuous headache, general fatigue, polyuria, diplopia and numbness of the right face. On physical examination, his height was 165.9 cm and his body weight was 69.5 kg. His blood pressure was 128/76 mmHg and pulse rate was a regular 67/min. Multiple formation of dental caries was observed. Neurologically, reduced pupillary light reflex on the right, right ptosis, anisocoria (R: 3 mm, L: 2 mm), right oculomotor and trochlear nerve palsy (III, IV) and decrease of right facial sensation
(V2, V3) were exhibited. His urinary volume was 2,500-4,500 mL/day. Laboratory examinations revealed white blood cell count (WBC) 13,300/μL with differential neutrophils 72% and lymphocytes 18.3%. C-reactive protein was 3.33 mg/dL. Serum level of total protein was 7.2 mg/dL, lactate dehydrogenase 170 IU/L, uric acid 5.6 mg/dL and glucose 134 mg/dL. Serum electrolyte levels were Na 136 mEq/L, K 3.6 mEq/L and Cl 101 mEq/L. Anti-nuclear antibodies and anti-neutrophil cytoplasmic antibodies (MPO-ANCA, PR3-ANCA) were negative. Examination of cerebrospinal fluid (CSF) was within normal limits. No organisms were detected on gram staining and culture of blood and CSF. Measurement of serum hormones showed adrenocorticotropic hormone (ACTH) titer of <5 μg/mL (normal range 7.4-55.7), serum cortisol titer of 0.5 μg/mL (4.5-21.1), thyroid-stimulating hormone (TSH) titer of 0.061 μIU/mL (0.5-5.0), free thyroxine (T4) titer of 0.69 ng/dL (0.70-1.48), free triiodothyronine (T3) titer of 2.13 (1.71-3.71), serum prolactin (PRL) titer of 1.6 ng/mL (3.58-12.7), luteinizing hormone (LH) titer of 0.9 mIU/mL (1.22-7.05), follicle stimulating hormone (FSH) titer of 3.4 (2.00-8.30) and growth hormone (GH) titer of 0.5 ng/mL (>0.17). The diurnal variation of cortisol was at a low level (<0.5 μg/mL). Urinary free cortisol, 17-OHCS and 17-KS levels were 7.2 μg/day (11.2-80.3), 0.72 mg/day (2.1-11.5) and 1.20 mg/day (4.6-18.0), respectively, suggesting adrenal insufficiency.

Pituitary hormone stimulating tests were performed as follows (Table 1): 500 μg of thyrotropin-releasing hormone (TRH), 100 μg of luteinizing hormone-releasing hormone (LH-RH), 100 μg of growth hormone releasing-hormone (GRH) and 100 μg of corticotropin-releasing hormone (CRH) were injected and serum hormones were measured before and at indicated times after injection. The responses of GH, PRL, ACTH, cortisol and TSH were markedly suppressed and the responses of LH and FSH were delayed. Although, rapid ACTH test showed no responses to exogenous ACTH (Table 2), ACTH-Z test (3days method) showed that urinary 17-OHCS and 17-KS responses to intramuscular adrenocorticotropic hormone (ACTH-Z: 0.5 mg/day i.m. for 3 days (7/9 - 7/11)) were good (Table 3). These results demonstrated that adrenal insufficiency was caused by anterior hypopituitarism. As he presented polyuria (2,500-4,500 mL/day) and pollakisuria (>12 times/day), water deprivation tests (twice: 6/30, 7/6) and hypertonic saline test were performed (Table 4). Although basal secretions of arginine vasopressin (AVP) were retained in each test, urinary concentrating abilities to water deprivation tests were suppressed. AVP response to hypertonic saline was poor, while plasma sodium concentration was retained in the normal range, and DDAVP injection restored urinary concentrating ability to normal. These findings were all contributory to the diagnosis of central diabetes insipidus. Furthermore, after ACTH-Z test (3-day method), his urinary volume increased to about 5,500 mL/day continually. Consequently, manifestation of masked diabetes insipidus by administration of ACTH-Z was indicated.

On non-contrast enhanced CT image of the sellar region showed a round homogeneous intrasellar mass with density equal to brain parenchyma (Hounsfield number: 40-60 HU).

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<th>Table 1. A Combined (CRH+GRH+TRH+LHRH) Anterior Pituitary Function Test</th>
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<td>GH (ng/mL)</td>
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<td>LH (mIU/mL)</td>
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<td>FSH (mIU/mL)</td>
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<td>TSH (μU/mL)</td>
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<td>cortisol (μg/dL)</td>
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GH: growth hormone, PRL: prolactin, ACTH: adrenocorticotropic hormone, LH: luteinizing hormone, FSH: follicle-stimulating hormone, TSH: thyroid stimulating hormone

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<th>Table 2. Rapid-ACTH Test</th>
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<td>cortisol (μg/dL)</td>
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<th>Table 3. ACTH-Z Test</th>
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<td>ACTH-Z: 0.5 mg/day i.m. for 3 days (7/9 - 7/11)</td>
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<td>7/4</td>
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<tr>
<td>17-OHCS (mg/mL)</td>
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<td>17-KS (mg/mL)</td>
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<tr>
<td>free cortisol (μg/dL)</td>
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17-OHCS : 17-hydroxycorticosteroids, 17-KS : 17-ketosteroids
Table 4. Water Deprivation Test and Hypertonic Saline Test

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<tr>
<th>after water deprivation for 12 hours</th>
<th>5% NaCl: 0.24ml/kg/min 10min i.v.</th>
<th>6/30</th>
<th>7/6</th>
<th>before</th>
<th>10 min</th>
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<tr>
<td>Osmo (mOsm/kg H2O)</td>
<td>286</td>
<td>307</td>
<td>Na (mEq/L)</td>
<td>146</td>
<td>153</td>
</tr>
<tr>
<td>Osmu (mOsm/kg H2O)</td>
<td>318</td>
<td>146</td>
<td>Osmo (mOsm/kg H2O)</td>
<td>294</td>
<td>308</td>
</tr>
<tr>
<td>AVP (pg/mL)</td>
<td>5.1</td>
<td>4.4</td>
<td>AVP (pg/mL)</td>
<td>4.3</td>
<td>3.2</td>
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Osmo : serum osmolality, Osmu : urine osmolality, AVP : arginine vasopressin

Figure 1. Pre-treatment MRIs and CTs of pituitary mass. Sagittal (A-E) and coronal (F-H) MR images, and sagittal, coronal and axial CT images (I-K). The pituitary marginal hyperintensity lesion (arrows) is shown in T1WI (A, F). Ring enhancement (arrow) and dural enhancement of anterior skull base, sella turcica and clivus (arrowhead) in Gd-enhanced T1WI (C, H). CT shows no high density area in intrasellar mass (I-K).

Pathogenic variations in T1 signal hyperintensity in the sellar region may be related to blood, the concentration of proteins, fat, calcification, or a paramagnetic substance (1). In this report, the patient’s sellar lesion demonstrated marginal T1 signal hyperintensity andringed enhancement of the pituitary mass (Fig. 2). Three months later, the patient demonstrated the recovery trend of anterior hypopituitarism. Administration of hydrocortisone (15 mg/day) was reduced to 10 mg/day after four months and discontinued gradually from eight to ten months later. Administration of levothyroxine sodium (25 μg/day) was reduced gradually to 12.5 μg/day after four months and discontinued after eight months. Administration of testosterone enanthate (250 mg/month) was discontinued after sixteen months. Over the two years, the patient has remained asymptomatic with only DDAVP replacement therapy.

Discussion

Pathogenic variations in T1 signal hyperintensity in the sellar region may be related to blood, the concentration of proteins, fat, calcification, or a paramagnetic substance (1). In this report, the patient’s sellar lesion demonstrated marginal T1 signal hyperintensity and ringed enhancement. Although the diagnosis of pituitary abscess was made, it was difficult to rule out pituitary apoplexy by MR imaging, alone. Therefore, we propose a new diagnostic approach for the diagnosis of pituitary abscess using a combination of CT, MR imaging and clinical manifestations, without either...
Pituitary apoplexy is more often due to acute degenerative changes turning into pre-existing pituitary adenoma. MR imaging pattern of pituitary apoplexy, in the early course, depicts a pituitary mass that has heterogeneous signal intensity, with predominant hyperintensity on T1-weighted MR images and predominant hypointensity on T2-weighted MR images (2). The sedimentation of blood products may exhibit a fluid-fluid level pattern at a later stage of pituitary apoplexy (2). Methemoglobin caused by hemorrhagic transformation, may be represented on MR images by subtle hyperintensity of T1 signal. MR imaging pattern of pituitary abscess depict pituitary mass with characteristic rim enhancement and associated adjacent inflammatory reaction (3). Pituitary abscess shows various signal intensity on T1-weighted MR images. The signal intensity of pituitary abscess on T1-weighted MR images may be affected by protein content of abscess. Indeed, appearance of T1 signal hyperintensity of pituitary abscess is observed mainly at the periphery (an intrinsically hyperintense rim) like that in brain abscess. This finding may reflect paramagnetic T1 shortening due to the presence of heterogeneously distributed free radicals that are products of the respiratory burst produced by actively phagocytosing macrophages in the capsule wall (4). Meanwhile, T1 signal hyperintensity observed in the center of the abscess may correspond to a small amount of blood breakdown products in the proteinaceous purulent contents of the abscess (5). In this case, peripheral T1 signal hyperintensity and central T2 signal hyperintensity with ringed enhancement was demonstrated (Fig. 1) and neither heterogeneous signal intensity nor a fluid-fluid level pattern was recognized in the course of follow-up. Hence, pituitary abscess was primarily suspected. However, in cases of T1 hyperintensity of sellar region, it is difficult to distinguish pituitary abscess from pituitary apoplexy, because pituitary apoplexy also, occasionally, shows the ringed enhancement pattern (5, 6).

Thickened sphenoid sinus mucosa on MR imaging may suggest a pituitary apoplexy with a higher rate of cranial nerve deficits and hypopituitarism (7). Although sphenoid sinus mucosal thickening was slightly observed in this case, it is known that pituitary abscess also shows the inflammatory change of sphenoid sinus (3). Moreover, pituitary abscess shows the peripheral dural enhancement of sella turcica (especially clivus) (8, 9). In this case, the dural enhancement of anterior skull base and clivus was more evident than that of sphenoid sinus. This may suggest the influence of the inflammation from pituitary abscess or the congestion of venous plexus at anterior skull base and clivus.

It has been reported that pituitary abscess shows hypersignal intensity on diffusion-weighted imaging (DWI) (10, 11). However, pituitary apoplexy also shows hypersignal intensity on DWI due to ischemic injury or deposit of blood-derived substances (12). Therefore, it is impossible to distinguish pituitary abscess from pituitary apoplexy by using DWI, alone.

After intracerebral hemorrhage, hemoglobin is metabolized to oxyhemoglobin, deoxyhemoglobin, methemoglobin and hemosiderin, and magnetic characteristics will greatly change (13). In this case, CT showed the intrasellar pituitary mass that was isodense to brain parenchyma (Hounsfield number: 40-60 HU) and no high density area at the time of admission (Fig. 1 CT, June 2006). By the CT images, if intrasellar hemorrhage was presented, this isodensity area indi-
cated the change to hemosiderin wholly. However, on both T1-weighted and T2-weighted MR images of pituitary at the time of admission and during the course of treatment (Figs. 1, 2, June, early July, late July, October 2006), there was no evidence of the change to hemosiderin. Small areas of signal loss on gradient echo T2-weighted MR images (T2*WI) indicate previous intracerebral extravasation of blood and are related to intracerebral bleeding-prone microangiopathy of different origins (14). T2*WI could detect intratumoral hemorrhage in pituitary adenoma as various dark appearances (15). In this case, T2-weighted MR images showed no obvious low intensity area at both inner and outer area of the intrasellar mass (Fig. 1). On the other hand, pituitary abscess presents a heterogeneous low density lesion on CT imaging, and disappearance of T1 hyperintensity of the pituitary posterior lobe (6, 16, 17). Therefore, in this case, CT and MR imaging findings were consistent with pituitary abscess rather than pituitary apoplexy.

Primary pituitary abscess is the most frequent type of pituitary abscess, but secondary pituitary abscesses caused by pituitary adenoma, Rathke cleft cyst or craniopharyngioma, have been reported. Typical Rathke cleft cysts appear as nonenhancing well demarcated intrasellar lesions. Cyst with a high protein content demonstrate homogeneous hyperintense on T1-weighted MR images and, often, a hypointense on T2-weighted MR images (18, 19). Craniopharyngiomas typically appear as intrasellar or suprasellar heterogeneously enhancing lesions with a tripartite structure of solid, calcified, and cystic components (20). The cyst may contain a high concentration of protein and have a hyperintense on T1-weighted MR images. By contrast enhancement MR imaging and clinical manifestations, neither Rathke cleft cysts nor craniopharyngiomas were consistent with the sellar lesion of this case. This case showed the inflammatory response with neutrophilia. Pituitary apoplexy often shows systemic inflammatory response, but it does not exhibit a neutrophil predominance generally. In this case, the rampant dental caries may be the source of pituitary abscess and systemic inflammatory reaction. Although, lymphocytic hypophysitis also shows the inflammatory reaction, radiological imaging of lymphocytic hypophysitis usually indicate the enlargement of the pituitary stalk and the pituitary gland, hypointense intrasellar mass on T1-weighted MR images and homogeneous enhancement on Gd-enhanced MR images (21). Additionally, lymphocytic hypophysitis is prevalent in women and it is often complicated by other autoimmune diseases.

The typical symptoms of pituitary apoplexy include sudden severe headache (high frequency), nausea, vomiting, oculomotor nerve palsy, reduced vision, visual field defect (almost half) and disturbed consciousness (few) (22). In pituitary apoplexy patients, about a half of the patients manifest the anterior-hypopituitarism, and only a low percentage of the patients develop diabetes insipidus (23). Headache, endocrine abnormalities and visual changes are the most common clinical indicators of pituitary abscess (24). Diabetes insipidus is also observed in about a half of the patients with pituitary abscess (5, 25-27). The present patient was diagnosed as pituitary abscess not only by neuroradiological findings but also based on the clinical manifestations such as developing diabetes insipidus.

In general, surgical drainage is recommended for the management of pituitary abscess, as the first-line therapy. In the present case, neither pituitary surgery nor a pituitary biopsy was performed because of the patient’s condition, but we succeeded in the conservative treatment of pituitary abscess as a result of the early diagnosis. Some groups have reported the conservative treatment of pituitary abscess with antibiotics (28, 29). In the future, successful treatment of pituitary abscess with conservative treatment may increase due to early diagnosis using our diagnostic approach (Table 5). However, follow-up MR imaging is essential for the detection of recurrence of pituitary abscess. It should be realized that conservative treatment for this disease is not yet established, and therefore should be employed only when the condition of the patient permits such treatment.

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