Diagnosis and Treatment of Brainstem Abscess Using Magnetic Resonance Imaging and Microsurgical Aspiration —Case Report—

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Abstract

A 6-year-old boy presented with a pontine abscess initially misdiagnosed as brainstem glioma, but he deteriorated rapidly and developed new symptoms of respiratory distress. Magnetic resonance (MR) imaging revealed a rapidly growing mass lesion in the pons. Microsurgical evacuation of the abscess *via* a suboccipital retromastoid approach resulted in neurological improvement and resolution of the lesion on MR images. Brainstem abscess can be successfully treated with early, accurate diagnosis based on MR imaging and appropriate microsurgical and antibiotic management.

Key words: brainstem, abscess, computed tomography, magnetic resonance imaging, surgical treatment

Introduction

Brainstem abscess is rare and was usually fatal until two decades ago.^{1,7-9,12,13,15,18,19,26} Brainstem tumors are relatively common in the pediatric age group, and the vast majority are brainstem gliomas. Early, accurate diagnosis of brainstem mass lesions has been possible since the introduction of computed tomography (CT), and magnetic resonance (MR) imaging is even more accurate. However, differential diagnosis is not always easy based on the characteristic MR imaging appearances alone. These new neuroimaging methods and neurosurgical techniques have recently improved the prognosis.^{2,4-6,10,11,14,16,20,21,23-25}

We describe a pediatric patient with a brainstem abscess, which was initially misdiagnosed as glioma, and discuss the differential diagnosis of brainstem lesions with ring enhancement on MR images and microsurgical treatment of brainstem abscess.

Case Report

A 6-year-old boy who had been in good health developed headaches, vomiting, and gait disturbance on June 30, 1992. These symptoms became progressively worse so he visited a local hospital on July 8. CT revealed a round mass lesion in the right pons. He had no past history of acute or chronic infectious diseases. He was admitted to the local hospital with suspected brainstem glioma 9 days after onset. T₁-weighted MR images showed enlargement of the mass lesion on July 14. Ring enhancement was evident following administration of gadolinium-diethylenetriaminepenta-acetic acid (Gd-DTPA) (Fig. 1).

He was referred to our department on July 21. On admission, he was slightly lethargic but arousable and fully oriented. Neurological examination showed right Vth to VIIIth cranial nerve pareses, truncal ataxia, and left hemiparesis. His body temperature was 36.8°C and his white blood cell count was 20,000/mm³ with negative reaction to C-reactive protein testing (<0.1 ng/dl). There were no signs of

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Fig. 1 *left*: Axial T₁-weighted MR image on admission, showing a lesion with a low-intensity core in the right brainstem. *right*: MR image with Gd-DTPA showing ring enhancement of the lesion.

Fig. 2 T₁-weighted MR images with Gd-DTPA showing marked enlargement of the lesion, accompanied by collapse of the fourth ventricle and hydrocephalus, 1 day before the first operation. *left*: axial view, *right*: sagittal view.

meningeal irritation.

Under the diagnosis of brainstem glioma, steroids and glycerol were administered and radiochemotherapy was started. He received 2 mg of betamethasone. He also received a single intravenous course of carboplatin (300 mg) and etoposide (100 mg) on July 22. A total of 8 Gy local irradiation was given over 4 days. Despite these treatments, he became drowsy and developed bilateral total ophthalmoplegia. The cranial nerve deficits progressed to include right IIIrd to Xth cranial nerve pareses. He deteriorated further and developed consciousness disturbance and respiratory distress. MR images showed a dramatic increase in the size of the lesion and hydrocephalus on July 29 (Fig. 2). A brainstem abscess was suspected because of his clinical course

and the MR imaging appearance of the lesion. Radiation therapy was discontinued. Antibiotic administration was started on July 30, the same day as surgical evacuation of the mass lesion was performed.

The right cerebellopontine angle was exposed *via* a right suboccipital retromastoid approach. A large, white, swollen area was evident on the dorsolateral surface of the pons. The swollen area was punctured with a 20 gauge cannula at the junction of pons and middle cerebellar peduncle. The wall of the abscess cavity was penetrated at a depth of 5 mm and whitish pus was aspirated. The abscess cavity was then irrigated using a physiological saline solution mixed with gentamicin. The swollen area immediately collapsed. Gram's stain showed gram-positive rods and culture of the abscess fluid yielded *Fusobacterium*.

Postoperatively, ear examination revealed right chronic suppurative otitis media. His level of consciousness and left hemiparesis improved, but other neurological findings remained unchanged. MR imaging revealed a residual abscess. The abscess was again aspirated *via* the same approach on August 13. A drain was placed in the abscess cavity for postoperative drainage. Large doses of intravenous antibiotics were continued (imipenem 0.5 g/day and cilastatin sodium 0.5 g/day). His neurological state gradually improved until he could walk alone. He was transferred to the pediatric department on November 19, because of anaphylactoid purpura with nephrotic syndrome of unknown origin. Antibiotic therapy was discontinued on February 9, 1993 when MR imaging with Gd-DTPA showed a

Fig. 3 Axial T₁-weighted MR image with Gd-DTPA 6 months after the second operation. A residual pinpoint structure remained in the right pons when antibiotics were discontinued.

marked decrease in the size of the lesion (Fig. 3). He was discharged after resolution of his anaphylactoid purpura on July 20, 1993. He had no cranial nerve paresis or motor weakness. His total intelligence quotient was 107 according to the Wechsler Intelligence Scale for Children. He returned to school with mild truncal ataxia as the only neurological deficit.

Discussion

Brainstem glioma is generally hypointense to normal white matter and is associated with pontine swelling, cisternal effacement, and fourth ventricular displacement on non-enhanced T₁-weighted MR images. Administration of Gd-DTPA causes inhomogeneous enhancement of the tumor.²²⁾ Ring-like enhancement

may occur in cystic glioma of the brainstem which is more common than abscess in this location.¹¹⁾ Our patient's lesion showed MR imaging characteristics compatible with brainstem glioma, leading to the initial misdiagnosis. However, the subacute onset and rapid progression of symptoms as well as the acute enlargement of the mass lesion on MR images were unusual for glioma and suggested an abscess.

The ring enhancement associated with an abscess is generally quite uniform in shape and thickness, but that associated with neoplasms has a more complex shape and is irregularly marginated, with variable thickness. However, abscess and neoplasm are often very difficult to differentiate with only one examination. Both CT and MR imaging should be

Table 1 Successful treatment of brainstem abscess

Case No.	Author (Year)	Age (yrs), Sex	Signs and symptoms	Operation	Route of infection	Bacteria culture	Follow-up duration	Outcome	First diagnosis
1	Van Gilder <i>et al.</i> (1974) ²³⁾	25, M	CND, UMN, HP	open	otitis	<i>Proteus mirabilis</i>	8 mos	good	abscess
2	Danziger <i>et al.</i> (1974) ⁵⁾	0.7, F	hydro	1st open, 2nd open	lung	<i>Staphylococcus pyogenes</i>	8 mos	good	glioma
3	Massina <i>et al.</i> (1977) ¹⁴⁾	2.5, F	ataxia, hydro, low-grade fever, HP, CND, UMN	open	unknown	<i>Staphylococcus epidermidis</i>	2 yrs	good	abscess
4	Russell and Shaw (1977) ²¹⁾	10, F	HA, CND	open	otitis	unknown	3 mos	fair	glioma
5	Vaquero <i>et al.</i> (1980) ²⁴⁾	13, M	CND, HP	medication	unknown	unknown	1 yr	excellent	abscess
6	Dake <i>et al.</i> (1986) ⁴⁾	68, F	fever, hydro, HP, ataxia	open	unknown	unknown	2 mos	good	abscess
7	Nauta <i>et al.</i> (1987) ¹⁶⁾	7, F	hydro, fever, diarrhea	stereotactic	teeth	<i>Haemophilus paraphrophilus</i>	?	good	abscess
8		32, M	CND, HP, hydro	1st stereotactic, 2nd stereotactic	unknown	<i>Staphylococcus</i>	?	good	abscess
9		3, F	HA, HP	1st stereotactic, 2nd stereotactic	unknown	<i>Bacteroides fragilis</i>	?	good	abscess
10	Kashiwagi <i>et al.</i> (1987) ¹¹⁾	16, M	CND, UMN, HA	1st open, 2nd burr hole	unknown	<i>Streptococcus milleri</i>	?	good	glioma
11	Rossitch <i>et al.</i> (1988) ²⁰⁾	54, F	HA, CND, ataxia, UMN, HP	1st stereotactic, 2nd stereotactic	otitis	<i>Staphylococcus</i>	2 mos	good	abscess
12	Abernathy <i>et al.</i> (1989) ²⁾	64, F	CND, UMN, HP, ataxia	stereotactic	unknown	<i>Cryptococcus</i>	6 mos	good	abscess
13	Fujino <i>et al.</i> (1990) ⁶⁾	25, M	fever, CND, UMN, HP	stereotactic	lung	<i>Streptococcus intermedius</i>	?	good	abscess
14	Jamjoom (1992) ¹⁰⁾	10, M	fever, HA, malaise, HP	1st open, 2nd burr hole	unknown	<i>Streptococcus milleri</i>	?	good	abscess
15	Wang <i>et al.</i> (1992) ²⁵⁾	9, F	fever, dizziness, UMN, HP	medication	heart	unknown	?	good	abscess
16	Present case	6, M	fever, HA, CND, UMN, HP	1st open, 2nd open	otitis	<i>Fusobacterium</i>	1 yr	good	glioma

CND: cranial nerve dysfunction, HA: headache, HP: hemiparesis, hydro: hydrocephalus, UMN: upper motor neuron signs.

used to make a diagnosis, together with the clinical features.

Solitary brainstem abscess is estimated to constitute less than 1% of all intracranial abscesses²¹⁾ and was found in only four of 330,000 autopsy cases.²⁶⁾ However, pediatric brainstem abscess is more common, with two of 22 cases of intracranial abscess in a recent series.¹⁷⁾ For children under 16 years, otolaryngological disease is the major aetiological factor, although brainstem abscesses can develop from hematogenous metastasis from remote foci or by direct extension from adjacent structures, usually the ears.²³⁾

The infectious source in our patient was not detected preoperatively because of the lack of associated clinical signs. This is not unusual because the infectious source remains unknown in 37% of brainstem abscesses, compared with 10–18% of brain abscesses in other locations.¹⁰⁾ Once the abscess is encapsulated, infectious and meningeal signs are usually absent and almost half of the patients with brainstem abscess have normal cerebrospinal fluid findings.⁸⁾ We did not perform a cerebrospinal fluid examination because of the risk of brainstem herniation with lumbar puncture.

Fifteen patients who survived brainstem abscess have been reported (Table 1). Six were males and nine were females ranging in age from 8 months to 68 years (mean 22.6 yrs). Ten (63%) of the 16 survivors were 16 years old or under including our patient. Four cases were otogenic in origin, two pulmonary, one cardiogenic, one odontogenic, and the other eight were of unknown origin. None demonstrated the onset of classical contralateral hemiparesis seen in brainstem glioma.

Only two patients were treated conservatively.^{24,25)} The remaining 14 underwent aspiration of pus in addition to antibiotic therapy. Twelve cases yielded positive bacterial cultures that were used to select appropriate antibiotics. Open surgical procedures were used to drain the abscess in eight patients and stereotactic aspiration was used in the remaining six. Comparison of results from non-surgical, open surgical, and stereotactic treatments for brainstem abscess is difficult. Large, completely formed, ring-enhancing lesions usually require surgical intervention.³⁾ In our patient, an open microsurgical approach to the lateral pontine lesion was safely carried out, rather than the traditional approach through the floor of the fourth ventricle. The retromastoid approach visualized the swollen pons directly and allowed aspiration at the junction of the pons and middle cerebellar peduncle, avoiding unnecessary brainstem injury. In contrast, stereotactic aspiration

could only have provided diagnostic confirmation, a specimen for bacterial culture, and mass reduction. Non-surgical treatment offers no such advantages.

Brainstem abscess is rare and may not present with the typical signs and symptoms of infection or an obvious infectious source, but symptoms of fever, headache, and vomiting without classical contralateral hemiparesis. Brainstem abscess is potentially curable with appropriate management, and should be considered in the diagnosis of mass lesions in the brainstem.

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