Subarachnoidal Abscess Associated with Bacterial Meningitis in Infants

—Two Case Reports—

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Abstract

Two infants, an 11-month-old boy and a 7-month-old girl, presented with subarachnoidal abscess associated with severe bacterial meningitis refractory to intensive managements with antibiotics. Computed tomography (CT) revealed bifrontal extracerebral low-density areas and remarkably enhanced surfaces of the bilateral frontal lobes postcontrast. Surgical exploration disclosed thick pus accumulation in the subarachnoid space which required curettage. The boy developed appropriately for his age, but the girl showed severe psychomotor retardation because of additional complications such as subdural fluid collection and hydrocephalus associated with the subarachnoidal abscess. Appropriate early neurosurgical management of subarachnoidal abscess is essential for satisfactory psychomotor development. Postcontrast CT should be performed to detect the subarachnoidal abscess as early as possible, and extensive craniotomy to remove the subarachnoidal pus accumulation performed to preserve psychomotor development.

Key words: bacterial meningitis, subarachnoidal abscess, subdural empyema, surgery

Introduction

New antibiotics have improved the prognosis of infantile bacterial meningitis, but this serious condition may still result in severe psychomotor retardation, especially if complications such as subdural fluid collection, subdural empyema, or brain abscess develop which require neurosurgical treatment.^{5,9,14)} The neuroradiological characteristics of these disorders have been extensively described and various neurosurgical strategies have been discussed.^{1,3,4,6-8,10-12,15)}

We describe two unusual cases of subarachnoidal abscess associated with severe bacterial meningitis in infants, an association previously not reported.

Case Reports

Case 1: An 11-month-old boy developed high fever,

nausea, and vomiting. A few days later, he suffered generalized convulsions and was admitted to a local hospital. Examination of cerebrospinal fluid revealed increased cell count ($5850/\text{mm}^3$) of which 90% were neutrophils, and increased protein content (110 mg/dl), but bacterial cultures were negative. Treatment with antibiotics was started under a diagnosis of bacterial meningitis, but his physical condition did not improve. He was transferred to the Department of Pediatrics in our hospital.

Despite further intensive management with antibiotics, his condition did not improve and generalized convulsions occurred several times. Computed tomography (CT) disclosed bifrontal extracerebral low-density areas, and the surfaces of the bilateral frontal lobes were enhanced postcontrast (Fig. 1). Subdural empyema associated with bacterial meningitis was suspected, so exploratory surgery was performed through a bifrontal craniotomy. No subdural fluid collection was observed. The most significant operative finding was accumulation of very thick pus in the subarachnoid space, which entirely

Received December 20, 1993; Accepted March 24, 1994

Fig. 1 Case 1. Postcontrast CT scans showing bifrontal extracerebral low-density areas and enhanced surfaces of the bilateral frontal lobes appearing as a "bumpy" pattern similar to that of the cerebral gyri.

Fig. 2 Case 1. Intraoperative photograph showing the bilateral frontal lobes entirely covered with thick pus, but no subdural fluid collection.

covered the bifrontal lobes (Fig. 2). The arachnoid membrane was excised and the accumulated pus, which had formed a dense layer that could not be aspirated, was removed by extensive curettage. Special care was taken not to injure the pia mater.

The cortical surface was hyperemic.

The postoperative course was uneventful. One week after the operation, his fever disappeared and the convulsions were controlled. One year later, he was doing well with psychomotor development appropriate for his age.

Case 2: A 7-month-old girl was admitted to a local hospital with high fever, vomiting, and generalized convulsions. Examination of cerebrospinal fluid showed 22,900 cells/mm³ of which 85% were neutrophils. The protein content was normal, but the glucose level was very low (3.0 mg/dl). These findings indicated bacterial meningitis. *Haemophilus influenzae* were identified in cultures from the cerebrospinal fluid. Her condition did not improve with antibiotic treatment, so she was transferred to our hospital for further evaluation and management 10 days after onset of symptoms.

On admission, CT showed collection of subdural fluid on the left, and a slight shift of midline structures to the right. The bifrontal extracerebral spaces were open, with the spaces appearing as slightly low-density areas apparently different to the subdural fluid. The surfaces of the bilateral frontal lobes and the interhemispheric surfaces were remarkably enhanced postcontrast (Fig. 3). On the same day, a bifrontal craniotomy was performed and xanthochromic fluid was aspirated from the left subdural area. The surfaces of the bilateral frontal lobes were entirely covered with dense pus. The arachnoid membrane was excised widely, and the pus accumulated in the subarachnoid space, which was thick, dense, and could not be aspirated, was removed by extensive curettage. The exposed cortex was hyperemic. An external subdural drainage was placed on the left side. One month later, CT disclosed ventricular dilatation, so a ventriculoperitoneal shunt was performed.

Her physical condition gradually improved, and she was discharged 2 months after admission. One year after discharge, psychomotor development assessment showed she was considerably retarded.

Discussion

Subarachnoidal abscess associated with bacterial meningitis in infants is extremely unusual. The term "subarachnoidal abscess" is not commonly used, and is not well defined. The lesions in our patients were confined to relatively localized areas, so we used the term "subarachnoidal abscess" rather than "empyema."

Subarachnoidal abscess can be considered a fulminant type of bacterial meningitis. The neuro-

Fig. 3 Case 2. Postcontrast CT scans showing a subdural fluid collection on the left, enlarged bilateral subarachnoid spaces, and enhanced surfaces of the bifrontal lobes and bilateral interhemispheric spaces.

radiological findings of bacterial meningitis are: the cerebral cortex is enhanced postcontrast due to engorgement and dilatation of vessels, the blood-meningeal barrier is abnormal due to inflammation around the superficial vessels of the leptomeninges, and contrast material leaks into the subarachnoid space from newly formed capillaries.^{2,10,13} Enlargement and enhancement of the cerebrospinal fluid space may also be seen in the early phase of bacterial meningitis.² These findings are quite similar to those in our patients. Such evidence suggests that a pathological situation such as subarachnoid abscess would be more frequently associated with severe bacterial meningitis. Although most cases of bacterial meningitis respond well to antibiotics, the pathological conditions in some cases advance further. The development of subarachnoid abscess should be suspected in a patient with bacterial meningitis when response to antibiotics is poor, convulsions occur repeatedly, and postcontrast CT reveals thick enhanced cortical surfaces.

Subarachnoid abscess must be distinguished from subdural empyema before surgical treatment. One characteristic CT finding of subarachnoid abscess is an enlarged subarachnoid space appearing

as a slightly low-density area. Another is remarkable enhancement of the surface of the cerebral cortex resulting in a "bumpy" pattern similar to that of the cerebral gyri. In contrast, CT scans of subdural empyema patients show the surface of the cerebral cortex is smooth.^{6,8,10,12,15}

Subdural empyema can be treated by simple aspiration or external drainage as a first step,^{4,6,8,11} with craniotomy required only when these procedures are ineffective. In contrast, the content of the subarachnoid abscess is thick and dense and cannot be aspirated or drained. Cerebral cortex in contact with a subarachnoid abscess will soon be damaged, resulting in very poor psychomotor development in infants. In our Case 2, the bacterial meningitis was much more severe, requiring more complicated neurosurgical procedures and resulting in serious retardation of psychomotor development. If the presence of a subarachnoid abscess is suspected in infantile bacterial meningitis based on the clinical and/or radiological findings described previously, especially postcontrast CT, a wide bilateral craniotomy should be performed as soon as possible to excise the arachnoid membrane and remove the pus accumulated in the subarachnoid space by extensive curettage. This is the best strategy to preserve the development of the infantile cerebrum.

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