Chronic Subdural Hematoma Associated With Arachnoid Cyst
—Two Case Reports With Pathological Observations—

Takeshi TAKAYASU,1 Kunyu HARADA,1 Shigeru NISHIMURA,1 Jun ONDA,1 Tohru NISHI,2 and Hisashi TAKAGAKI1

1Department of Neurosurgery, Kitakyushu General Hospital, Kitakyushu, Fukuoka; 2Nishi Neurosurgery Clinic, Kitakyushu, Fukuoka

Abstract
Arachnoid cysts are well known to induce chronic subdural hematoma (CSDH) after head injury. However, histological observations of the arachnoid cyst and hematoma membrane have only been rarely described. An 8-year-old boy and a 3-year-old boy presented with CSDH associated with arachnoid cyst. Surgical removal of the hematoma and biopsy of the hematoma membrane and cyst wall were performed. Clinical courses were good and without recurrence more than 1.5 years after surgery. Histological examination suggested that the cysts did not contribute to hematoma development. Pediatric hematoma membranes, similar to adult hematoma membranes, are key in the growth of CSDH. Therefore, simple hematoma evacuation is adequate as a first operation for CSDH associated with arachnoid cyst.

Key words: chronic subdural hematoma, arachnoid cyst, hematoma membrane, cyst membrane, hematoma evacuation

Introduction
Arachnoid cysts are common in clinical practice, and modern neuroimaging methods have increased the incidental detection of asymptomatic cases. Arachnoid cysts account for about 1% of non-traumatic intracranial mass lesions, and in general the clinical course is stable. However, arachnoid cysts sometimes cause symptoms such as headaches, seizures, cranial deformities, and neurological deficits. Arachnoid cysts most commonly occur in the middle cranial fossa and have a slight predilection for the left side. Arachnoid cyst is well known to cause chronic subdural hematoma (CSDH), especially in young patients. Head injury is regarded as an important factor in hematoma induction. Several studies have suggested that the cyst is less compliant than normal brain tissue, and thus traumatic impact can easily spread to the cyst wall, bridging veins, and unsupported vessels around the cyst. Bleeding from damaged vessels then forms the subdural hematoma. Hemorrhage can occur from bridging veins not only ipsilaterally but also contralaterally. Some contralateral and bilateral CSDHs have been reported.

Here, we describe 2 cases of arachnoid cyst and CSDH with membrane biopsies and histological findings.

Case Reports
Case 1: An 8-year-old boy presented with headache, nausea, and general fatigue. He had fallen from a set of stairs 3 months earlier. Neurological examination found no abnormalities. Laboratory values were normal except for slight anemia (hemoglobin 11.7 g/dl). Head computed tomography (CT) and magnetic resonance (MR) imaging revealed left CSDH with midline shift (Fig. 1A–C). Hematoma evacuation was performed via a small craniotomy. The outer membrane was confirmed to be underneath the dura mater (Fig. 2A). Biopsy of the outer membrane and the cyst wall were performed, and histological examination revealed that the outer membrane consisted of thick collagenous bundles accompanied by marked inflammatory infiltration and numerous neocapillaries (Fig. 3). However, the cyst wall consisted of collagen fibers without angiogenesis (Fig. 4). He was discharged without symptoms and showed normal development. Follow-up MR imaging at about 1.8 years showed no recurrence of hematoma (Fig. 1D, E).

Case 2: A 3-year-old-boy presented with a head injury...
caused by an accidental fall from 2 m. He suffered transient amnesia just after the accident, but had recovered at presentation. He complained of headache, but vital signs and neurological signs were normal. Head CT and MR imaging showed left subdural hematoma with a slight midline shift (Fig. 5A–F). A previously asymptomatic arachnoid cyst which had been diagnosed at age 1 year was recognized in the left middle temporal fossa. Follow-up CT after conservative management for 9 days showed the hematoma with slight midline shift persisting (Fig. 5G, H). His headache remained and radiological examination showed no resolution, so burr hole irrigation was performed on the same day. The outer membrane was seen under the dura mater. Hematoma pressure was high and xanthochromic fluid was evacuated. The outer membrane was biopsied and histological examination showed that the membrane consisted of collagen fibers and fibroblasts, but little inflammation and few macrocapillaries (Fig. 6). He was discharged without neurological deterioration, and showed normal development without recurrence 1.5 years after the surgery (Fig. 5I, J).

Discussion

Traumatic subdural effusions or hygromas have been regarded as another origin of CSDH, and an association between arachnoid cysts and subdural hygromas has been reported. One mechanism for the pathogenesis of hygromas is that head injury causes a connection between the cyst and the subarachnoid space. Flow of cerebrospinal fluid (CSF) into the cyst with a flap-valve mechanism increases the size and pressure of the cyst, which leads to rupture of the cyst. Another mechanism is direct rupture of the cyst into the subdural space. Traumatic impact or sudden temporary rise in intracranial pressure brings about the rupture. Arachnoid cyst can even rupture spontaneously. Subdural hygromas caused by arachnoid cyst are not always unilateral, and bilateral hygromas can transform into bilateral CSDH. The pathogenesis of evolution of subdural hygromas into CSDH and the mechanism of hematoma enlargement has been discussed, mostly in adult cases without arachnoid cyst. CSF in the subdural space forms a fibrous outer membrane under the dura mater. Then, a local inflammatory reaction induces angiogenesis in the membrane. These immature vessels,
so-called macrocapillaries, have greater permeability and fragility, and high function of fibrinolysis. Therefore, hematoma develops from exudation and repeated bleeding.

The outer membrane has rarely been described in pediatric patients. A case of CSDH associated with arachnoid cyst had a typical outer membrane consisting of granulation tissue accompanied by inflammatory infiltration. Some studies have described that the membranes in children and in adults are similar, and were not associated with arachnoid cyst. The pathological findings in Case 1 also showed macrocapillaries and active inflammation, indicating that the outer membrane and its macrocapillaries are also key in the growth of pediatric CSDH. In addition, repeated bleeding from the outer membrane can explain the slight anemia. On the other hand, in Case 2, only collagen fibers, little inflammation, and few new vessels were observed. Fibrous neomembranes consist of layers of 3 to 7 fibroblasts, and can be seen by Day 5. The formation of granulation tissue with delicate vascular channels oc-
curs in the next 10 to 20 days after the injury.\textsuperscript{10} The outer membrane can be classified into 4 types according to the histological features.\textsuperscript{12} Case 2, which was surgically treated on Day 9, was considered to be immature and had the potential to change into a hemorrhagic-inflammatory membrane.

Histological observation of arachnoid cyst complicated with CSDH has only rarely been described.\textsuperscript{8} In the present case, the cyst wall contained no macrocapillaries, although the entire sample was not studied, only a biopsy. The histological findings of the cyst wall in another case were similar to a thick arachnoid membrane without macrocapillaries.\textsuperscript{13} These findings suggest that the cyst wall did not contribute to hematoma enlargement.

Recent clinical studies have recommended only the removal of CSDH without surgery for the arachnoid cyst.\textsuperscript{1,2,11,13,17} Since the most common symptoms, headache and vomiting, are caused by the increased intracranial pressure, simple decompression is adequate. Cyst removal or fenestration at the time of drainage is unnecessary for previously asymptomatic cysts. A craniotomy was performed in Case 1, because we thought that the cyst wall separated the hematoma cavity from the intracystic hematoma. However, a recent study reported that intracystic hematomas contain only blood breakdown products from the related hematoma that filters through the membranes.\textsuperscript{2} Therefore, in retrospect, even if the cyst wall had not torn, craniotomy and cyst fenestration were unnecessary for Case 1. In Case 2, the low density appearance on CT suggested that the hematoma was nearly a hygroma, so conservative management was initially chosen and spontaneous resolution was expected. However, because the symptoms persisted and follow-up CT did not show improvement, surgical drainage was performed. Otherwise, brain atrophy might have occurred due to increased intracranial pressure, because the brain of an infant is soft and developing.\textsuperscript{9} In addition, the subdural effusion appeared isointense on T\textsubscript{1}-weighted MR imaging, which suggested the presence of slight amounts of blood. Xanthochromic fluid was also revealed during the operation, which suggested the presence of slight amounts of blood. Xanthochromic fluid was also revealed during the operation, which suggested the presence of slight amounts of blood. Xanthochromic fluid was also revealed during the operation, which suggested the presence of slight amounts of blood.

Both patients made good recoveries without surgery on arachnoid cyst, and had no recurrence for more than 1.5 years. In agreement with previous studies about therapy, and according to the present histological findings, because arachnoid cyst does not contribute to hematoma development and because pediatric outer membranes are similar to adult outer membranes, simple hematoma evacuation is adequate as a primary operation for CSDH associated with arachnoid cyst.

References

19) Suzuki M, Takahashi S, Sonobe M, Kuwayama N: Arachnoid cyst of the middle cranial fossa combined with...


Address reprint requests to: Takeshi Takayasu, MD, Department of Neurosurgery, Graduate School of Biomedical Sciences, Hiroshima University, 1–2–3 Kasumi, Minami-ku, Hiroshima, Hiroshima 734–8551, Japan.
e-mail: ttakayasu-nsu@umin.ac.jp