Arachnoidplasty for Traumatic Subdural Hygroma Associated With Arachnoid Cyst in the Middle Fossa
—Case Report—

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Abstract

A 5-year old boy presented with an arachnoid cyst in the middle cranial fossa with mild midline shift manifesting as headache and loss of activity. Computed tomography (CT) showed subdural hygroma. Burr-hole drainage was carried out and symptoms were improved postoperatively. However, recollection of subdural hygroma was found on follow-up CT 3 weeks after subdural drainage. He underwent craniotomy, and tearing of the outer wall of the arachnoid cyst was observed. The ruptured cyst wall was tightly closed by arachnoidplasty to prevent cerebrospinal fluid leakage. Arachnoidplasty was effective for traumatic subdural hygroma with arachnoid cyst for reconstruction.

Key words: arachnoid cyst, middle fossa, arachnoidplasty, subdural hygroma, head injury

Introduction

Arachnoid cysts account for 1% of all atraumatic intracranial space-occupying lesions, and most commonly occur in the middle cranial fossa.3,4 Subdural effusion is a known complication of arachnoid cysts, especially of posttraumatic origin.7,11-13 Surgical treatment of intracranial arachnoid cysts with mass effect remains controversial. Treatment options include burr-hole drainage,1) cyst shunting,2) craniotomy for fenestration (cystectomy),3,5) and endoscopic fenestration. Communicating arachnoid cysts especially in asymptomatic cases do not require any surgical treatment, but clinical follow up by serial computed tomography (CT) is sufficient.6,8,12) Each of these techniques has its proponents and debate continues regarding which surgical treatment is the most effective.2,3,6,9) However, these treatments are sometimes associated with postoperative complications such as subdural effusion, shunt dysfunction, and shunt infection.5,7,8,11,12) We report a pediatric case of arachnoid cyst in the left middle cranial fossa without subdural hematoma, which later showed subdural effusion with slight midline shift. We closed the outer wall of the arachnoid cyst by arachnoidplasty using Dexon mesh and fibrin glue to maintain the physiological pathway of cerebrospinal fluid (CSF) without shunting, resulting in resolution of the subdural hygroma.

Case Report

A 5-year-old boy visited our hospital because of a mild blow to the occipital region. Radiography 2 days after head injury showed a linear fracture in the occipital bone, and an arachnoid cyst was found in the left middle cranial fossa without subdural hematoma (Fig. 1). He was completely alert and free of complaint. One month after head injury, the patient suffered from nausea. Follow-up CT revealed subdural effusion with slight midline shift. Burr-hole surgery was carried out to insert a subdural drain. The CSF was xanthochromic and pressure was elevated.

Fig. 1 Bone image of computed tomography (CT) on admission revealing linear fracture (arrows, left). Initial CT scans showing no subdural effusion (center) and arachnoid cyst in the left middle cranial fossa (right).
Fig. 2 Repeated computed tomography scans 2 months after head injury revealing left convexity subdural effusion (left) and slightly diminished arachnoid cyst in the middle cranial fossa (right).

Fig. 3 Photographs demonstrating the surgical procedure of arachnoidplasty to close the orifice of arachnoid cyst toward the convexity. Outer wall of the cyst was defective (arrowheads, upper left). Inner wall of the cyst adjacent to the ambient cistern has been opened (arrow). Cyst wall covered with Dexon mesh (upper right) followed by additional thin-sliced gelfoam (lower left) and Dexon mesh soaked in fibrin glue. After filling the cyst cavity with saline through the tube, closure of the cyst wall was completed with fibrin glue (lower right).

Postoperatively, his daily activity was dramatically improved, and external drainage was continued for 4 days. CT revealed disappearance of the subdural hygroma. However, he complained of headache and nausea again one month after operation. CT showed slight increase of subdural hygroma with mild midline shift, and slight reduction of the arachnoid cyst (Fig. 2).

The patient underwent frontotemporal craniotomy. The dura was incised linearly. Care was taken not to injure any free vessels over the cyst wall. The subarachnoid space was widely opened, and the arachnoid wall was thickened compared to normal arachnoid membrane. The gross appearance of the CSF was watery clear. The outer wall of the arachnoid cyst showed wide defects (Fig. 3), and the inner wall of the cyst was also opened to the ambient cistern. Circulation of CSF bulk flow through the cyst wall was also observed. After filling the cyst cavity with saline through the tube, the defect of the outer wall was closed with Dexon mesh and thin-sliced gelfoam, followed by sealing with fibrin glue (arachnoidplasty) (Fig. 3). Subdural hygroma could be prevented by tight closure of the outer wall of the cyst. Postoperative clinical course was uneventful and he was discharged 10 days after operation.

Five months after arachnoidplasty, postoperative magnetic resonance (MR) imaging demonstrated that the subdural hygroma had disappeared completely compared to the preoperative MR imaging (Fig. 4), in spite of slight increase of the arachnoid cyst in the middle fossa.

Discussion

Subdural hematomas and hygromas are known complications of arachnoid cysts in the middle cranial fossa, occur ipsilateral and contralateral to the leptomeningeal cyst, and may be associated with preceding head trauma. Head
injury is a well-known precipitating factor in clinical deterioration.\textsuperscript{1,7,11–13} Several mechanisms for acute increase in intracranial pressure have been postulated.\textsuperscript{12,13} Acute and chronic hygroma may develop after rupture of the cyst and fluid evasion into the subdural spaces, occasionally observed in children.

Both arachnoid cyst in the middle cranial fossa and subdural hygroma resolve after subdural drainage if the basal cistern is not dilated by cyst rupture.\textsuperscript{1} Conservative management has been selected for patients with few or no symptoms.\textsuperscript{31} Spontaneous reduction and disappearance of the cyst can occur.\textsuperscript{6,13} In the present case, initial CT revealed no subdural hygroma, so the patient was conservatively observed. Delayed subdural fluid collection caused elevated intracranial pressure causing headache and nausea. Burr hole drainage failed to resolve the problem.

Maintenance of physiological CSF circulation requires wide opening of the basal cistern and tight closing of the outer wall of the cyst. Aggressiveness of cyst fenestration is considered to be an important determinant of the success of therapy. Review of 50 children who underwent key hole craniotomy for fenestration of temporal arachnoid cysts suggested that a microsurgical keyhole approach to arachnoid cyst fenestration is a safe effective method for treating middle fossa cysts, and that better control of hemostasis can be obtained compared with an endoscopic approach.\textsuperscript{5} Fenestration into the basal cistern offers a greater chance of success in successfully eliminating the need for shunt placement.\textsuperscript{3,20} In the present case, CSF bulk flow and communication between ambient cistern and cyst cavity was confirmed.

Our hypothesis is shown in Fig. 5, eliminating the CSF dynamics of posttraumatic subdural hygroma associated with arachnoid cyst in the middle cranial fossa. In the present case, we first tried to decrease the subdural fluid collection by burr-hole drainage, and the symptoms of elevated intracranial pressure improved postoperatively. However, symptoms recurred without drainage and subdural fluid collection was found by repeat CT. The outer wall of the cyst was torn by the minor head injury, which caused a one-way valvular arrangement facilitating the inflow but blocking the outflow of CSF.\textsuperscript{12}

Fluid transduction from the cyst cavity to subdural space might gradually increase the size of the subdural hygroma and the persistence of intracranial hypertension after head injury for long periods. Establishment of communication between cyst cavity and basal cistern should be considered an essential step in the treatment. Selective opening of the basal cistern combined with a limited resection of the outer wall might be useful to reconsider.\textsuperscript{11} In addition, interruption of the communication to subdural space through outer wall of the cyst may also be considered as a second step in the operation. A tear in the outer membrane of the cyst resulting in a fluid collection has been confirmed at operation.\textsuperscript{49} Excision of the arachnoid membranes and perforation into the basal cisterns are essential since subdural hygroma was caused by rupture of the outer membrane and escape of CSF into the subdural space. However, closure of the ruptured outer membrane has not been attempted. As shown in Fig. 3, the apparently outer wall of the arachnoid cyst was completely defective in the present case. We considered that closure of the outer membrane of the arachnoid cyst associated with subdural hygroma caused by mild head injury might be necessary to prevent expansion of the subdural space, resulting in increased intracranial pressure. Since bleeding can be more easily controlled in addition to direct visualization of the lesion during surgery, we believe that craniotomy has advantages over Burr hole or endoscopic surgery.

Six patients with non-communicating arachnoid cyst in the middle cranial fossa underwent arachnoidplasty.\textsuperscript{10} The ruptured point in the outer wall of the arachnoid cyst was tightly sutured by nylon threads, and a favorable outcome was attained in the long-term follow up without complications including postoperative subdural hygroma. Tight closure of the ruptured outer wall of the cyst might be essential to prevent CSF flow towards subdural space in the convexity. Therefore, we decided to carry out “arachnoidplasty” using Dexon mesh and thin-sliced gel-foam soaked with fibrin glue to attain tight closure. After cyst fenestration along the basal cistern and making a route for the CSF pathway, isotonic saline was filled into the cyst cavity, and the outer wall of the ruptured cyst was tightly closed by the “arachnoidplasty” technique. Postoperatively subdural hygroma was successfully prevented. Postoperative subdural hygroma is usually not observed following general surgical operations such as frontotemporal craniotomy via the pterional approach, but postoperative external hydrocephalus occasionally occurs, probably due to increased intracranial pressure resulting in bulk flow toward the convexity.

In our opinion, cyst rupture may produce a “flap valve” with flow preferentially directed outward, again leading to cyst expansion and subdural hygroma leading to mass effect. Partial closure of the subarachnoid spaces may also explain why external drainage or shunt implantation may not be sufficient to control the clinical manifestations. We emphasize that “arachnoidplasty” may be quite useful for complete tight closure of the outer walls following selective surgical opening of the basal cistern for the treatment of posttraumatic subdural hygroma associated with arachnoid cyst in the middle cranial fossa. The present case suggests that this surgical technique may provide prevention of subdural effusion and rapid decompression of the adjacent brain structures.

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Reference

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