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The Role of Endoscopic Fenestration Procedures for Cerebral Arachnoid Cysts

Recently, endoscopic procedures have been recommended as the first surgical option for cerebral arachnoid cyst (AC). The author reports seven ACs treated endoscopically and discuss the role of endoscopic fenestration. The age of the patients ranged from two to 62 years. Three ACs were located in the posterior cranial fossa, two in the suprasellar area, one in the middle cranial fossa, and one in the convexity. All cases were examined by cine magnetic resonance (MR) flow study. The patient's symptoms included headache, vomiting, dizziness, problems in balance, visual disturbance, and seizure. The author performed a cysto-cisternostomy or cysto-ventriculostomy via a single burr hole. The follow-up periods ranged from six to 18 months. There was no mortality or morbidity except one case of intracisternal bleeding during endoscopic procedure. Symptoms were relieved in all seven patients. Follow-up imaging studies revealed a decrease in the size or disappearance of the cysts. The results support that the minimal fenestration procedure as possibly as preserving the internal environment is valuable for the management of ACs.

Key Words: *Arachnoid cyst; Surgical procedures, endoscopic; Magnetic resonance imaging, cine*

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INTRODUCTION

Arachnoid cysts (ACs) are intra-arachnoid collections of cerebrospinal fluid (CSF) (1). They are regarded as a developmental abnormality of the arachnoid, originating from a splitting or duplication of this membrane (2). The natural history of ACs remains to be elucidated (3, 4); thus surgical treatment is still controversial (1, 5, 6). The spontaneous disappearance of these cysts has been reported, although the incidence is rare (5, 7). The cyst wall can be ruptured by a minor head injury, and the disappearance may occur quietly during a lifetime (8). Many operative procedures for the therapy of ACs have been recommended, however it remains controversial as to which is the best method. Recently, a few authors reported the successful management of ACs using the endoscopic system (9-11). This article discusses the possible role of endoscopic fenestration.

PATIENTS AND METHODS

Sixty seven patients with various intracranial lesions were operated on by a single operator using a neuroendoscopic system at our institution between January 1995 and December 1996. Of these, seven consecutive patients with ACs were treated endoscopically.

A prospective study of each case was performed, including neurological examinations and computerized tomogram (CT) or magnetic resonance (MR) imaging before surgery and at one, three, six, and 12 months postoperatively. The clinical characteristics of the patients are given in Table 1. There were three females and four males. The age of the patients at the time of diagnosis ranged from two to 62 years. Three cysts in the posterior cranial fossa, two in the suprasellar area, one in the middle cranial fossa, and one in the convexity. The patient's symptoms included headache, vomiting, nausea, dizziness, problems in balance, visual disturbance, and seizure. Neurological examination on admission found a disturbance in gait and urinary incontinence in case 1, cerebellar signs in case 4, and bitemporal hemianopsia in case 5.

CT and MR imaging demonstrated the mass effect of the cysts on neighboring brain tissue with flattening of gyri, compression of the ventricular system, and/or midline shift in all cases but case 5 treated with endoscopic procedure. A cine-phase contrast MRI was also performed to study the CSF flow dynamics in all cases.

Table 1. Clinical characteristics of 7 patients with cerebral arachnoid cysts

Case	Sex / Age	Clinical findings	Location	Procedure	Follow up	Outcome	Image change
1	M / 2	Gait disturbance	Suprasellar	Ventriculo-cysto-cisternostomy	21 Mo	No Cx	Cyst reduction
2	F / 14	Headache, dizziness	Middle fossa	Cysto-cisternostomy	18 Mo	Bleeding	Cyst reduction
3	F / 60	Seizure, generalized	Parietal	Cysto-ventriculostomy	14 Mo	No Cx	Cyst reduction
4	M / 60	Headache, cerebellar sign	Cerebellar	Cysto-cisternostomy	16 Mo	No Cx	Cyst disappeared
5	F / 62	Headache, visual defect	Suprasellar	Ventriculo-cystostomy	18 Mo	No Cx	Cyst disappeared
6	M / 32	Headache, dizziness	Cerebellar	Cysto-cisternostomy	12 Mo	No Cx	Cyst disappeared
7	M / 45	Headache	Cerebellar	Cysto-cisternostomy	16 Mo	No Cx	Cyst reduction

M, male; F, female; Mo, month; Cx, complication

OPERATIVE PROCEDURES

All procedures were performed under general endotracheal anesthesia. The field of operation was prepared and draped to allow immediate open microsurgical intervention in cases of complications. We used a rigid endoscope (Karl Storz GmbH & Co, Tuttlingen, Germany or Aesculap, Tuttlingen, Germany) with or without stereotaxic frame (CRW, Radionics, Burlington, U.S.A.).

In the cortical cysts, a burr hole was made according to the best trajectory obtained from imaging and the dura was opened. The outer membrane was coagulated and incised. The endoscopy was inserted freehand into the cyst to explore. After orientation, fenestration procedure started. At the end of procedure, the fimbrial catheter was placed to prevent obstruction. In case 2, 4, 6 and 7, a cysto-cisternostomy was performed by creating wide openings with monopolar coagulator, scissor, and Forgaty balloon catheter to maintain them patent. In case 3, a cysto-ventriculostomy was done. In suprasellar cysts (case 1 and 5), a burr hole was placed at the right Koch's point and the ventricle was punctured by 12.5 Fr peel-away catheter (Codman, Randolph, U.S.A.). The rigid ventriculoscope was inserted and fenestration was performed. A ventriculo-cystostomy was performed in the bulged floor of the third ventricle (Fig. 1). Minor bleeding was easily controlled with copious irrigation. But in one case of middle fossa cyst (case 2), significant bleeding occured. Because this prevented orientation and a safe operation, the endoscopic operation had to be abandoned and an open craniotomy was performed. The follow-up periods ranged from six to 18 months.

RESULTS

There was no mortality and morbidity except one case of intracisternal bleeding during endoscopic procedure (case 2). Symptoms were relieved in all seven patients. The follow-up MR images or CT scans revealed a de-

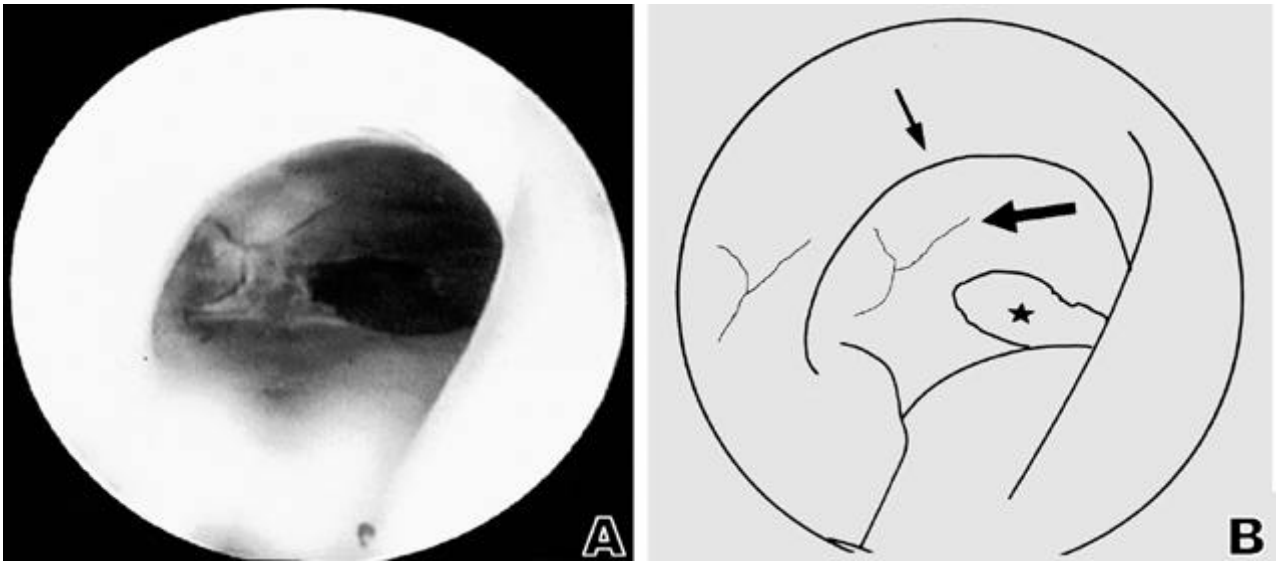

Fig. 1. Operative findings in case 5. A) View of suprasellar arachnoid cyst through the endoscope. B) Schematic drawing of view through endoscope. Optic chiasm (thin arrow), arachnoid cyst (thick arrow), sellar space (asterisk).

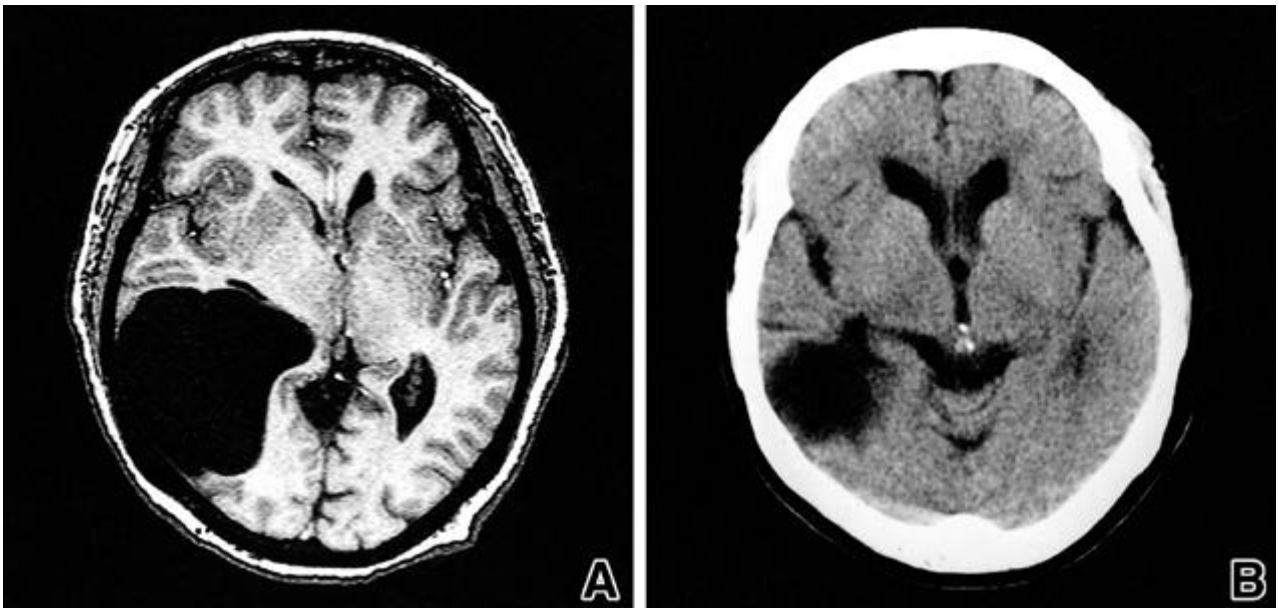

Fig. 2. Radiologic findings in case 3. A) Axial T1-weighted magnetic resonance (MR) image revealing an arachnoid cyst in the middle cranial fossa with compression of lateral ventricle and midline shift. B) Axial computerized tomographic (CT) image obtained 18 months after surgery, demonstrating cyst reduction and disappearance of midline shift.

crease in the size of the cysts (Fig. 2). The neurologic examinations were unremarkable in three patients. Gait disturbance in case 1, cerebellar sign in case 4, and bitemporal hemianopsia in case 5 disappeared. At the 12-month follow up, seizure disappeared and no antiepileptic drugs were required in case 3. Other subjective symptoms were improved remarkably in all patients. All cysts showed asynchronous CSF pulsation without specific in- or out jet-flow on cine MR CSF flow images preoperatively. Outstanding improvement of trans-aqueductal ventricular flow was visible postoperatively in case 1.

DISCUSSION

The development and natural history of ACs remain controversial. Improved understanding of the natural history is a prerequisite to rational therapy (12). Several mechanisms for the acute increase have been postulated. The first mechanism is a tear in the deep layer of the cyst wall, which causes a one-way valvular arrangement facilitating the inflow of CSF and blocking its egress (13). Caemaert et al. (10) and Santamarta et al. (2) found this tear with endoscopy. They said that the arterial inflow and elasticity of the cyst wall was responsible for cyst enlargement. The second mechanism is hemorrhage within the cyst and the subdural space (6, 14). The third mechanism is the secretory capacity of cyst walls (15). The ultrastructural evidence of microvilli on the cyst luminal surface could support the theory of active secretion (16). However, it may also be interpreted only as a reactive arachnoid differentiation, providing an absorptive mechanism. Other mechanisms considered included indirect hydrodynamic effects from both the arterial and venous system, CSF pulse waves resulting from disturbed CSF circulation and CSF entrapment in arachnoid loculations (17, 18). The concept of a ball-valve mechanism in the expansion of AC has attained broad agreement (4, 17, 19).

A spontaneous disappearance of AC has been noted to be associated with head injury (5, 7). It is natural that the size of the cyst could not change without tearing the wall, even in cases of head injury. As absorption of the subdural fluid proceeded, cyst fluid leakage into the subdural space could be absorbed (7). Yokoyama et al. (20) scintigraphically showed such a communication. Another cause of spontaneous resolution was thought to be due to a communication between the cyst and the subarachnoid space (5, 7). This communication can be visible at cine PC MR imaging in spontaneously regressed ACs after head injury in our hospital. It is still an open question whether spontaneous resolution of AC is caused by direct transport through the cyst wall (15) or a valve-like mechanism (16) through a communication.

Diagnostic tools of ACs are computerized tomogram (CT), magnetic resonance imaging (MRI), contrast CT (6, 12), radioisotope scintigram (20), and recently cine PC MR imaging (2). Diagnostic evaluation should include, not only the initial identification of intracranial ACs but also the detection of mass effect, determination of the

type of communication between cyst and subarachnoid space and recognition of the presence, location and severity of obstructive hydrocephalus and cisternal block (21).

Controversy exists concerning the treatment of ACs. There is no doubt that surgical treatment is necessary for patients with raised intracranial pressure and corresponding clinical symptoms, even if the communicating type, and those complicated by intracystic or subdural hemorrhage (5). Few authors (3, 6) believe that all ACs exert a mass effect, even if asymptomatic and should be surgically managed to avoid potential risks of compression on surrounding brain structures (3), cyst rupture (22) and intracystic or subdural hemorrhage (14). ACs combined with subdural hematoma or fluid collection should be followed-up and if communication is inadequate, they should be considered as a surgical candidate. Conservative management can be considered for those patients complaining of mild symptoms or presenting cranial deformity alone.

ACs most commonly have been treated by cyst fenestration/resection (23) or by cystoperitoneal shunting (1, 10); however, controversy continues regarding which surgical treatment is the best. If a cyst fenestration/resection is performed, histopathological diagnosis becomes possible and a tumor may be excluded. But with these procedures, the recurrence of the cyst is often seen (22, 24), and it may be complicated by intraparenchymal or subdural hemorrhage, aseptic meningitis, and by the inability to treat hydrocephalus (6, 25). Shunting procedure can be used as the first step in the management of middle cranial fossa cysts, because this method is simple, safe, and effective. However, this is a blind procedure with the risk of failure in getting inside the cyst (10), and is also accompanied by a higher incidence of additional surgical procedures (23, 26). Another complications cannot be negligible. They include inability to treat multiloculated cysts and any associated lesions, recurrence (6, 27), infection, and shunt-dependency. The frequent need for multiple procedures (19, 21) and the postoperative complications reported after these two conventional treatment of intracranial ACs emphasize the difficulties involved in determining the appropriate management of this simple problem.

Endoscopic techniques can replace open surgery or shunting procedures with similar or even better results. The reports of successful endoscopic treatment of ACs have gradually increased (1, 9-11, 28). It proved to be an effective and safe technique also in the author's series. The symptoms of the patients treated endoscopically were relieved completely. In all patients, the size of the cyst decreased remarkably after surgery. The maintenance of opening is very important. Caemaert et al. (10) prefer a wide endoscopic fenestration into the lateral ventricle using a Nd-YAG laser. This opening should be as large as possible (10-15 mm) to prevent later closing. Schroeder et al. (28) perforated the cyst wall by means of bipolar coagulation and enlarged the perforation with a Fogarty catheter. To prevent closure of the opening by scarring, they subsequently inserted a fimbrial catheter. The multiple perforations were made by coagulator and enlarged with a Fogarty catheter and scissor as large as possible to maintain the openings patent in author's series. In one case, the fimbrial catheter was placed to prevent obstruction by scarring.

Although the follow-up period is too short to make statements on long-term outcome, the author suggest the minimally invasive endoscopic approach as the first therapy of the choice for treatment of ACs. Should the endoscopic procedure fail, established treatment options can subsequently be performed without additional risk.

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