

Endoscopic Fenestration Procedures to Cerebral Arachnoid Cysts

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뇌지주막 낭종의 신경내시경적 개창술

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= 국문 초록 =

뇌지주막 낭종은 신경학적 증상을 발현하거나 증상이 악화되면 수술적 치료를 요한다. 수술은 개두술, 단락술 및 내시경 등을 이용한 천자술 등이 있으며 어떤 방법이 가장 좋은지는 논란이 많다. 이에 신경내시경을 이용한 개창술을 시행하여 그 결과를 알아보고자 하였다.

저자들은 뇌의 여러 부위에 발생한 뇌지주막 낭종 5예에 대해 신경내시경을 이용한 개창술을 시행하고 수술 전후의 상태를 신경학적 검사 및 방사선 영상 등을 이용하여 분석하였다. 환자들의 평균연령은 37세였으며(2세~60세), 남자 2명, 여자 3명이었다. 증상은 1예에서 보행장애를 보였고, 시야결손 1예, 간질 대발작 2예, 그리고 소뇌증상 1예였다. 수술 전후 뇌전산화 단층술, 뇌자기공명술 및 자기공명술을 응용한 뇌척수액 역동학 검사를 시행하였다. 신경내시경을 이용한 개창술은 낭종의 위치나 주위 뇌실 또는 뇌수조와의 해부학적 관계에 따라 변형하여 시행하였으며, 뇌실-낭종간 개창술 1예, 뇌실-낭종-뇌수조간 개창술 2예, 그리고 낭종-뇌수조간 개창술 2예였다.

수술은 4예에서 성공적으로 시행되었으며, 1예에서는 수술 중 출혈로 인해 개두술을 시행하였다. 수술 후 합병증은 없었으며, 추적관찰 중 신경학적 증상이나 방사선 영상 소견이 모두 호전되었다. 특히 1예의 거대 안상 낭종에서는 수술 직후 뇌척수액 역학 검사상 극적인 호전을 볼 수 있었다.

개두술을 이용한 뇌지주막 낭종 제거술이나 개창술은 보다 침습적인 방법이며, 단락술은 직접 보면서 하는 수술이 아니라 실패할 가능성이 내재한다. 반면에 내시경을 이용한 개창술은 비침습적으로 간편하고 안전하며 직접 낭종 안을 보면서 시술할 수 있고 그 결과가 다른 수술과 유사하므로 뇌지주막 낭종의 우선적인 수술 방법으로 적당하다.

중심 단어 : Cerebral arachnoid cysts · Endoscopic fenestration · Computed tomography · Magnetic resonance imaging.

Introduction

Arachnoid cysts are intra-arachnoid collections of

cerebrospinal fluid¹⁾²⁾. They are regarded as a developmental abnormality of the arachnoid, originating from a splitting or duplication of this membrane³⁾

Mostly congenital in origin, they once were estimated to account for approximately 1% of all atraumatic intracranial mass lesions⁴. With the advance of imaging techniques, the incidence rate seems to be higher. Common clinical onset includes headache, seizures, and focal neurological signs but asymptomatic cases are not rare³. Between 50% and 65% occur in the middle cranial fossa, with another 10% each in the suprasellar and quadrigeminal regions. The frontal convexities account for 5% and the posterior cranial fossa for about 8%.

Indications for treatment are the progression of symptoms, the presence of severe neurologic disorders, and endocrinologic dysfunction. Many operative procedures for the therapy of arachnoid cysts have been recommended, however it remains controversial as to which is the best method. They are stereotactic aspiration^{5,6}, cyst excision^{7,8}, cyst fenestration⁹, cystocisternostomy¹⁰, ventriculocystostomy¹¹, and cystoperitoneal shunting¹⁴. Recently a few authors reported successful management of arachnoid cysts using endoscopic system¹¹⁻¹⁵. We report on our experience with a series of five consecutive patients with arachnoid cysts treated endoscopically.

Materials and Methods

Five consecutive patients with arachnoid cysts were treated endoscopically at our institution between January 1995 and December 1996. A prospective study of each case was performed, including neurological examinations and CT or MR imaging before surgery and at 1, 3, 6, and 12 months postoperatively.

The clinical characteristics of the patients are given in Table 1. There were 3 females and 2 males. The

age of the patients at the time of diagnosis ranged from 2 to 62 years. Two cysts were located in the middle cranial fossa, 2 in the suprasellar area, and 1 in the posterior cranial fossa. The patient's symptoms included headache, vomiting, nausea, dizziness, balancing problems, visual disturbance, and seizure. The neurological examination on admission were gait disturbance and urinary incontinence in case 1, cerebellar signs in case 4, and bitemporal hemianopsia in case 5.

Computerized tomography(CT) and magnetic resonance(MR) imaging demonstrated a mass effect of the cysts on neighboring brain tissue with flattening of gyri, compression and the ventricular system, and/or midline shift in all cases except case 5. Cine-phase contrast MRI was also made to study CSF flow dynamics.

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 rigid endoscope(Karl Storz GmbH & Co, Tuttlingen, Germany and Aesculap, Tuttlingen, Germany) with or without stereotaxic frame(CRW, Radionics, Burlington, USA).

In 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 free-hand into the cyst to inspect. After orientation, fenestration procedure started. In case 2 and 4, a cystocisternostomy was performed by creating a wide

Table 1. Clinical characteristics of five patients with cerebral arachnoid cysts treated endoscopically

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	Disappeared
5	F/62	Visual defect, headache	Suprasellar	Ventriculo-cystostomy	12 Mo	No Cx	Cyst reduction

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

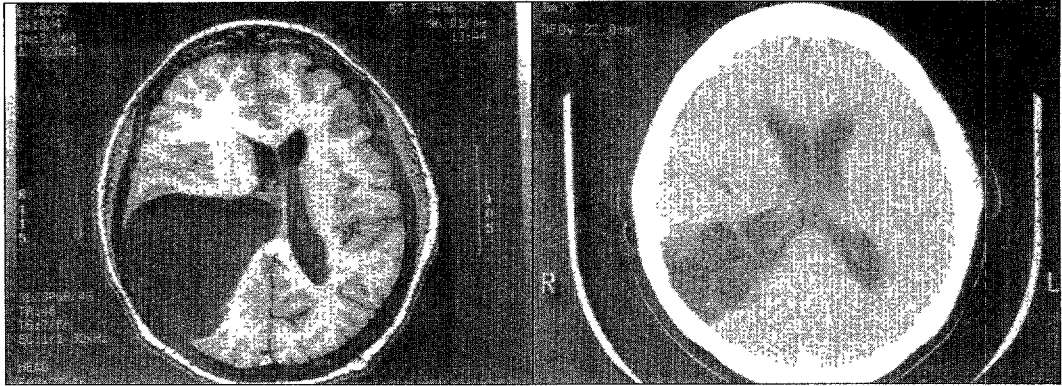


Fig. 1. Case 3. Left : Axial T1-weighted magnetic resonance(MR) image revealing an arachnoid cyst in the middle cranial fossa with compression of lateral ventricle and midline shift. Right : Axial computerized tomographic (CT) image obtained 18 months after surgery demonstrating cyst reduction and disappearance of midline shift.

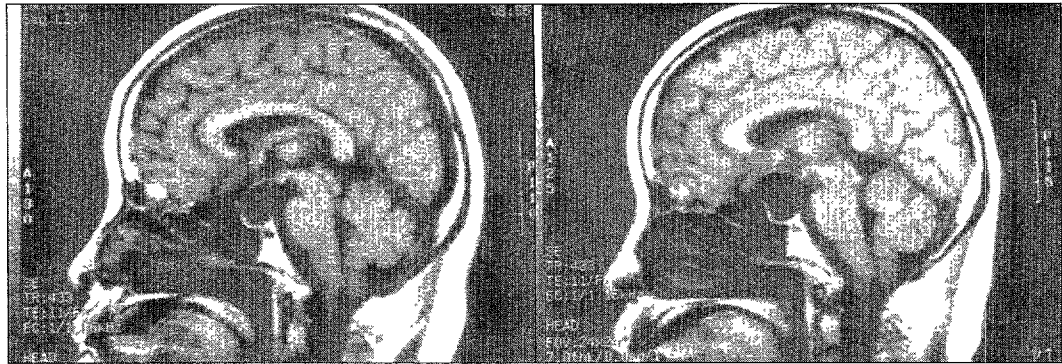


Fig. 2. Case 5. Left : Sagittal T1-weighted magnetic resonance(MR) image revealing an arachnoid cyst in the pituitary fossa extending to suprasellar region with compression of optic chiasm. Right : Sagittal T1-weighted magnetic resonance(MR) image obtained 12 months after surgery demonstrating cyst reduction and release of chiasmatic compression.

opening with monopolar coagulator, scissor, and For-gaty balloon catheter. In case 3, a cysto-ventriculos-tomy was done(Fig. 1). In suprasellar cysts(case 1 and 5), a burr hole was placed at right Koch's point and the ventricle was punctured by 12.5Fr peel-away catheter(Codman, Randolph, USA). The rigid ventriculoscope(Aesculap, Tuttlingen, Germany) was inserted and fenestration procedure was performed. A ventriculo-cystostomy was performed in the bulged floor of the third ventricle(Fig. 2).

Minor bleeding was easily controlled with copious irrigation. But in one case of a middle fossa cyst(case 2), significant bleeding occurred. 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 6 to 18 months.

Results

There was no mortality and morbidity. Symptoms were relieved in all 5 patients. The follow-up MR images or CT scans revealed a decrease in the size of the cysts, and neurologic examinations were unremarkable in 3 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. Especially, outstanding improvement of trans-aqueductal ventricular flow was visible postoperatively in case 1.

Discussion

Development and natural history of arachnoid cysts remain controversial. There are two main hypotheses supported by objective findings : the active fluid secretion and the pulsatile pump³. There is ultrastructural evidence of microvilli on the cysts luminal surface¹⁶. This fact could support the active secretion theory. However, it may also be interpreted only as a reactive arachnoid differentiation providing an absorptive mechanism. Caemaert¹⁴ and D. Santamarta³ found the slit in the cyst with endoscopy. They reported the mechanism what cysts enlarge could be explained by the presence of a slit in their wall that would act a functional one way valve. And the arterial inflow and elasticity of the cyst wall is responsible for an cyst enlargement.

The treatment of arachnoid cysts is another interesting and controversial subject. Arachnoid cysts most commonly have been treated by cyst fenestration/resection⁸⁾⁹⁾¹⁷⁾¹⁸⁾ or by cystoperitoneal shunting¹⁴⁾¹⁹⁾, however, controversy continues regarding which surgical treatment is best. Open surgery for removal or fenestration is considered as a rather aggressive and often infective procedure¹¹⁾. Shunting is a blind procedure with the risk of failure in getting inside the cyst because the wall of the cysts is tough enough to deviate the catheters tangentially¹⁴⁾, and it is accompanied by a higher incidence of additional surgical procedures and the disadvantage of life-long shunt dependence⁸⁾²⁰⁾. Endoscopic techniques can replace open surgery or shunting procedures with similar or even better results.

The reports of successful endoscopic treatment of arachnoid cysts are gradually increased²⁾¹¹⁻¹⁵⁾²¹⁾. It proved to be an effective and safe technique in our series. The symptoms of the patients treated purely endoscopically were relieved completely. In all pa-

tients the size of the cysts decreased remarkably after surgery. In cases of traumatically perforated cysts, these were not operated and spontaneously healed after several months as in operated cases. It supports the minimal fenestration procedure as possible as preserving internal environment is very valuable for the management of cerebral arachnoid cysts. The maintenance of opening is very important. Caemaert, et al.¹⁴⁾, prefer a wide endoscopic fenestration into the lateral ventricle using a Nd-YA-YAG laser. The opening should be as large as possible(10–15mm) to prevent later closing. Schroeder, et al.²¹⁾, 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 basic mechanism of cyst formation is the one-way slit valve. We believe that the proportion of opening to cyst volume may be more important than the absolute size of opening.

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

References

- 1) Ciricillo SF, Cogen PH, Harsh GR, et al : *Intracranial arachnoid cysts in children. A comparison of the effects of fenestration and shunting. J Neurosurg* 1991 ; 74 : 230-235
- 2) Ciricillo SF, Edwards MSB : *Intracranial arachnoid cysts, in Rengahary SS, Wilkins RH(eds) : Principles of Neurosurgery. London : Wolfe 1994 : p51.1-51.11*
- 3) Santamarta D, Aguas J, Ferrer E : *The natural history of arachnoid cysts : Endoscopic and cine-mode MRI evidence of a slit-valve mechanism minim. Invas Neurosurg* 1995 ; 38 : 133-137
- 4) Harsh GR IV, Edwards MSB, Wilson CB : *Intracranial arachnoid cysts in children. J Neurosurg* 1986 ; 64 : 835-842

- 5) Iacono RP, Labadie EL, Johnstone SJ, et al : *Symptomatic arachnoid cyst at the clivus drained stereotactically through the vertex. Neurosurgery 1990 ; 27 : 130-133*
- 6) Pell MF, Thomas DG : *The management of infratentorial arachnoid cyst by CT-directed stereotactic aspiration. Br J Neurosurg 1991 ; 5 : 399-403*
- 7) Dei-Anang K, Voth D : *Cerebral arachnoid cyst : a lesion of the child's brain. Neurosurg Rev 1989 ; 12 : 59-62*
- 8) Oberbaur RW, Haase J, Pucher R : *Arachnoid cysts in children : a european co-operative study. Childs Nerv Syst 1992 ; 8 : 281-286*
- 9) Artico M, Crevoni L, Salvati M, et al : *Supratentorial arachnoid cysts : clinical and therapeutic remarks on 46 cases. Acta Neurochir 1998 ; 132 : 75-78*
- 10) Barth A, Seiler RW : *Surgical treatment of suprasellar arachnoid cyst. Eur Neurol 1994(Letter) ; 34 : 51-52*
- 11) Pierre-Kahn A, Capelle L, Brauner R, et al : *Presentation and management of suprasellar arachnoid cysts. Review of 20 cases. J Neurosurg 1990 ; 73 : 355-359*
- 12) Auer LM, Holzer P, Ascher PW, et al : *Endoscopic neurosurgery. Acta Neurochir 1988 ; 90 : 1-14*
- 13) Caemaert J, Abdullah J, Calliauw L : *Endoscopic diagnosis and treatment of para and intra-ventricular cystic lesions. Acta Neurochir Suppl 1994 ; 61 : 69-75*
- 14) Caemaert J, Abdullah J, Callauw L, et al : *Endoscopic treatment of suprasellar arachnoid cysts. Acta Neurochir 1992 ; 119 : 68-73*
- 15) Cohen AR : *Endoscopic ventricular surgery Pediatr Neurosurg 1993 ; 19 : 127-134*
- 16) Go KG, Houthoff HJ, Blaauw EH, et al : *Arachnoid cysts of the sylvian fissure. Evidence of fluid secretion. J Neurosurg 1984 ; 60 : 803-813*
- 17) Hanieh A, Simpson DA, North JB : *Arachnoid cysts : a critical review of 41 cases. Childs Nerv Syst 1988 ; 4 : 92-96*
- 18) Sato H, Sato N, Katayama S, et al : *Effective shunt-independent treatment for primary middle fossa arachnoid cyst. Childs Nerv Syst 1991 ; 7 : 375-381*
- 19) Martinez-Lage JF, Poza M, Sola J, et al : *Congenital arachnoid cyst of the lateral ventricles in children. Childs Nerv Syst 1992 ; 8 : 203-206*
- 20) Lange M, Oeckler R : *Results of surgical treatment in patients with arachnoid cysts. Acta Neurochir 1987 ; 87 : 99-104*
- 21) Schroeder HWS, Gaab MR, Niendorf WR : *Neuroendoscopic approach to arachnoid cysts. J Neurosurg 1996 ; 85 : 293-298*