Treatment of Middle Cranial Fossa Arachnoid Cysts: A Systematic Review and Meta-Analysis

Yong Chen[1,2], Hong-Juan Fang[3], Zhi-Feng Li[1], Sheng-Yuan Yu[2], Chu-Zhong Li[2], Zhe-Bao Wu[4], Ya-Zhuo Zhang[2]

Key words
- Cystoperitoneal shunting
- Meta-analysis
- Microsurgical fenestration
- Middle cranial fossa arachnoid cysts
- Neuroendoscopic fenestration

Abbreviations and Acronyms
CI: Confidence interval
CSF: Cerebrospinal fluid
RCR: Rate of cyst reduction
RTC: Rate of total complications
RCSI: Rate of clinical symptom improvement
RLTC: Rate of long-term complications
RSTC: Rate of short-term complications

From the [1]Department of Neurosurgery, Yueyang Second People's Hospital, Yueyang; [2]Beijing Neurosurgical Institute, Beijing Tiantan Hospital, Beijing Institute for Brain Disorders Brain Tumor Center, China National Clinical Research Center for Neurological Diseases, Capital Medical University, Beijing; [3]Department of Endocrinology, Beijing Tiantan Hospital, Capital Medical University, Beijing; and [4]Department of Neurosurgery, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

To whom correspondence should be addressed: Ya-Zhuo Zhang, M.D., Ph.D. [E-mail: zyz2004520@yeah.net]

Yong Chen and Hong-Juan Fang are co–first authors.

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OBJECTIVE: **To review the literature and analyze the efficacy and safety of 3 surgical methods (neuroendoscopic fenestration, microsurgical fenestration, and cystoperitoneal shunting) for middle cranial fossa arachnoid cysts (MCFACs).**

METHODS: **We searched MEDLINE, PubMed, and Cochrane Central electronic databases and collected studies of patients with MCFACs treated with 1 of 3 surgical methods. Eligible studies reported the rate of clinical symptoms improvement (RCSI), rate of cyst reduction (RCR), rate of total complications (RTC), rate of short-term complications (RSTC), rate of long-term complications (RLTC), and other parameters.**

RESULTS: **Eighteen studies met the criteria. MCFACs were divided into 3 groups on the basis of surgical method: RCSI in group I (237 patients, neuroendoscopic fenestration) was 90% (95% confidence interval [CI]: 83%–95%); RCR: 76% (95% CI: 67%–84%); RTC: 28% (95% CI: 22%–34%); RSTC: 23% (95% CI: 17%–30%); and RLTC: 6% (95% CI: 3%–11%). RCSI in group II (144 patients, microsurgical fenestration) was 87% (95% CI: 75%–96%); RCR: 87% (95% CI: 70%–97%); RTC: 49% (95% CI: 30%–68%); RSTC: 44% (95% CI: 21%–68%); RLTC: 3% (95% CI: 0%–12%). RCSI in group III (93 patients, cystoperitoneal shunting) was 93% (95% CI: 66%–99%); RCR: 93% (95% CI: 66%–99%); RTC: 20% (95% CI: 5%–42%); RSTC: 10% (95% CI: 0%–31%); RLTC: 15% (95% CI: 9%–23%). RLTC differed significantly between the 3 groups ($P = 0.005$); RTC and RSTC between group I and group II ($P = 0.002$).**

CONCLUSIONS: **All 3 surgical methods are effective for MCFACs, but considering safety, neuroendoscopic fenestration may be the best initial procedure.**

INTRODUCTION

Arachnoid cysts account for 1% of all intracranial space-occupying lesions,[1] and the most common site is the middle cranial fossa.[2] Arachnoid cysts can be classified as primary developmental cysts or as secondary cysts that develop later in life after a primary insult to the brain. Primary arachnoid cysts are thought to arise from a developmental aberration in cerebrospinal fluid (CSF) flow that results from splitting of the arachnoid membrane at gestational week 15.[3] Robinson[4] proposed that an alternative developmental explanation for middle cranial fossa arachnoid cysts was temporal lobe agenesis. Secondary arachnoid cysts are much less common but may occur after trauma, infection, surgery, or intracranial hemorrhage.[5]

Depending on whether there is a communication with the circulating CSF, middle cranial fossa arachnoid cysts can be divided into communicating intracranial arachnoid cysts and noncommunicating intracranial arachnoid cysts.[6,7] According to the Galassi classification system,[8] middle cranial fossa arachnoid cysts are divided into 3 categories: type I, small spindle-shaped cysts limited to the anterior middle cranial fossa; type II, medium-sized lesions usually triangular or quadrilateral in shape that occupy the anterior and central part of the middle cranial fossa and extend along the sylvian fissure; and type III, huge cysts, oval or round in shape, that almost fill the middle cranial fossa and extend toward the hemisphere through numerous areas.

Arachnoid cysts are CSF-filled spaces lined with arachnoid membranes. Most are asymptomatic; however, symptomatic cysts predominate in the pediatric population, causing mass effect or hydrocephalus.[9] Symptoms associated with arachnoid cysts include headaches, rapid head growth, developmental delay, precocious puberty, amenorrhea, seizures, and focal neurologic deficits.[10] In children, the most common presenting symptoms are signs of

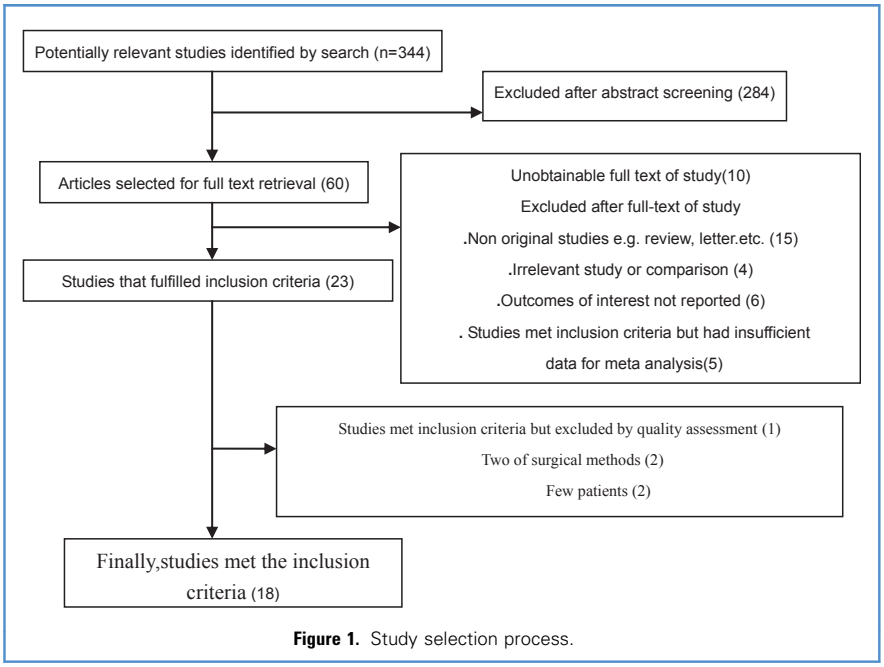

Figure 1. Study selection process.

increased intracranial pressure followed by increased head circumference, mental developmental delay, and seizures.[11] Although there are reports of arachnoid cysts regressing spontaneously, treatment is advocated for symptomatic cysts.[12]

The natural history of middle cranial fossa arachnoid cysts in children is not well defined, and there appears to be some consensus that asymptomatic arachnoid cysts should not be treated. Greater use of magnetic resonance imaging and computed tomography has led to an increase in the number of incidentally diagnosed arachnoid cysts. This poses difficulties for clinicians when selecting treatment strategies because the symptoms of arachnoid cysts often are clinically vague and the risks of surgery are not negligible. Most arachnoid cysts remain static and clinically silent, whereas others may spontaneously disappear, expand, rupture, exert mass effects, or promote hydrocephalus.[13-16] The indications for surgical treatment of middle cranial fossa arachnoid cysts are a matter of debate. The rationale for preemptive treatment in children, or the necessity of surgery in patients with "common" symptoms such as headache, is still being discussed.[17,18]

Currently, there are 3 main surgical methods for symptomatic middle cranial fossa arachnoid cysts: cystoperitoneal shunting, microsurgical fenestration, and neuroendoscopic fenestration, and the best and most effective surgical procedure has not been determined because each of these techniques has specific advantages. It is important to remember that children with middle cranial fossa arachnoid cysts are being treated for a benign condition. Avoiding significant complications associated with major surgery, including neurologic deficits, subdural hematomas, or hygromas, is of great importance in this group. Although shunt placement is potentially a safer option, it harbors potential risks such as infection, blockage, and, more importantly, lifelong dependence on the shunt, which should not be underestimated.

In this study, middle cranial fossa arachnoid cysts were divided into 3 groups according to the surgical method used for treatment. We wished to understand the efficacy and safety of the 3 surgical

Table 1. The Original Data of Neuroendoscopic Fenestration in 11 Studies Before 2016

Study	No. Cases	Follow-up Time, months	RCSI	RCR	RTC	RSTC	RLTC	Mean Age, years	Mean Surgical Time, minutes
Schulz et al., 2015[23]	20	24	17/20	17/20	8/20	2/20	6/20	7.8	NA
Fernandez, 2013[24]	28	NA	NA	24/28	4/28	0/28	1/28	NA	30–60 minutes
Turhan et al., 2012[25]	16	37.75	16/16	16/16	7/16	0/16	5/16	9.29	NA
El-Ghandour, 2012[26]	32	55.2	28/32	23/32	6/32	3/32	6/32	3.6	NA
Karabagli et al., 2012[27]	20	53	18/20	10/20	1/20	5/20	1/20	8.5	NA
Gui et al., 2011[40]	32	26	25/27	24/32	6/32	0/32	5/32	7.8	NA
Spacca et al., 2010[29]	40	21	37/40	29/40	8/40	4/40	4/40	7.8	NA
Di Rocco et al, 2010[28]	17	23	17/17	11/17	6/17	2/17	3/17	4.4	NA
Karabatsou et al., 2007[30]	11	28	10/11	10/11	2/11	0/11	1/11	15.8	NA
Godano et al., 2004[31]	11	48	11/11	7/11	2/11	0/11	1/11	4	NA
Hopf et al., 1998[32]	10	14	5/10	NA	3/10	0/10	0/10	31	NA

RCSI, rate of clinical symptoms improvement; RCR, rate of cyst reduction; RTC, rate of total complications; RSTC, the rate of short-term complications; RLTC, the rate of long-term complications; NA, not available.