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Symptomatic And Radiological Evaluation Of Patients Undergoing Surgical Treatment And Follow-Up With The Diagnosis Of Sylvian Arachnoid Cyst

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Abstract

Objective: Arachnoid cysts are the most common intracranial cysts, constituting 1% of all intracranial space-occupying lesions. In this research, we aimed to analyze the treatment process, radiological findings, and clinical follow-up in our institution, who underwent surgical treatment with the diagnosis of arachnoid cyst cases in the last decade.

Method: In this study, a total of 27 children who were admitted to Kartal Lütfi Kırdar City Hospital, University of Health Sciences due to arachnoid cyst cases and treated surgically by the Neurosurgery Clinic in the last decade have been analyzed retrospectively. The location of the arachnoid cyst before the operation, the classification of Galassi, age, gender, symptoms and signs, surgical technique, whether it is accompanied by additional pathology, whether it receives medical treatment, whether post-operative early or late complications develop, the need for the second operation, the change of symptoms and radiological findings in the postoperative period were recorded from patient files.

Results: Almost half of the patients (44.4%) were diagnosed incidentally, while 16.7% were female and 52.4% were male. However, the distribution of diagnoses between both genders was similar (p=0.12). When the additional pathologies in the cases were examined, an arachnoid cyst around the brain stem in 1 male patient and exophthalmos of the left eye in 1 male patient was detected. There was no additional pathology in the girls. The preoperative volumes were similar to those measured in the third month. The third-month volume was larger than the sixth-month and first-year volumes, and the sixth-month and first-year measurements were similar (preoperative ~ 3rd month > 6th month ~ 1 year, p=0.003).

Conclusion: As a result, it is important to evaluate all parameters, such as clinical findings, radiological findings, and location of the patients together. The most important goal in surgical treatment is to ensure normal brain development.

Keywords: Arachnoid Cyst, Cerebrospinal Fluid, Shunt, Endoscopy, Brain Development.

INTRODUCTION

Arachnoid cysts (AC) are benign lesions usually detected incidentally due to imaging techniques that have become widespread in recent years. Most arachnoid cysts remain asymptomatic, and surgical intervention is performed for cysts that cause mass impact or hydrocephalus symptoms. It has yet to understand why cysts grow fully, and it is often unpredictable to predict in which cases this will occur (1).

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Arachnoid cysts are the most common intracranial cysts, constituting 1% of all intracranial space-occupying lesions. Arachnoid cysts can be divided into two congenital and acquired arachnoid cysts (2).

Congenital arachnoid cysts are formed due to deviations in cerebrospinal fluid (CSF) flow during the formation of the primitive arachnoid membrane in early embryonic life. As the neural tube develops, it is surrounded by a loose primitive mesenchyme. The space between the outer layer of this mesenchyme, which will form the dura and arachnoid, and the inner layer, which will form the pia, begins to fill with CSF from the 15th week. Arachnoid cysts occur after the formation of the subarachnoid distance by splitting or doubling the end opening, which will form the pia and arachnoid cover, and filling the clear CSF fluid into it (3).

In acquired arachnoid cysts, cerebrospinal fluid is trapped in the arachnoid scar tissue after trauma, bleeding, chemical irritation, tumor, or inflammatory events. So, the fluid inside the cyst can be stained with hemosiderin and contain inflammatory cells (4). Almost 90% of arachnoid cysts are in the supratentorial space, especially in the middle cranial fossa (60%). Other regions are quadrigeminal cisterna, floodlit regions, and convexities (5). Thirty % of middle cranial fossa cysts are large cysts that cover almost the entire temporal fossa, sometimes extending to the frontal convexity (6).

Intracranial arachnoid cysts are benign, non-genetic cavities containing sterile secretions similar to cerebrospinal fluid surrounded by the arachnoid membrane (7). In community-based studies, arachnoid cysts have been reported to constitute approximately 1% of all intracranial space-occupying lesions (8). Arachnoid cysts are detected in 75% of cases in childhood (9). The majority of the data on the frequency of arachnoid cysts were obtained by evaluating neuroradiological examinations. Eskandary et al. (10) reported the presence of arachnoid cysts in only seven cases (0.23%) in their study, in which they evaluated random findings in computed tomography (CT) examinations of 3000 trauma patients. Similarly, Katzman et al. (11) retrospectively examined magnetic resonance images (MRI) obtained from 1000 healthy asymptomatic volunteers and found the frequency of arachnoid cysts to be 0.3%. In a study evaluating brain magnetic resonance examinations, 2500 healthy men aged between 17 and 35 were examined, and arachnoid cysts were detected in 1.7% of the cases (12).

Arachnoid cysts are found in 66% of the middle fossa, 17% of the posterior fossa, and 17% of the suprasellar, frontal, cerebral convexity, interhemispheric fissure, and quadrigeminal cistern (8). The clinical manifestations of arachnoid cysts are often nonspecific and variable. The findings are related to the size of the cyst, its anatomical localization, and effect on cerebrospinal fluid flow. The most common symptoms are headache, seizures, dizziness, gait disturbance, nausea-vomiting, tinnitus, double vision, growth retardation, and swelling in the calvarium caused by increased intracranial pressure and compression of neuronal tissues (1).

Various surgical approaches have been applied to arachnoid cyst cases for many years. These treatment protocols have advantages and disadvantages themselves and are still debated. Within the scope of this research, we aimed to analyze the treatment process, radiological findings, and clinical follow-up of the pediatric-age population in our institution who underwent surgical treatment with the diagnosis of arachnoid cyst cases in the last decade.

METHOD

In this study, a total of 27 children who were admitted to Kartal Dr. Lütfi Kırdar City Hospital, University of Health Sciences due to arachnoid cyst cases and treated surgically by the Neurosurgery Clinic in the last decade have been analyzed retrospectively. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Ethics committee approval has been granted from our institution with protocol number 514/188/15.As this was a retrospective analysis no informed consent has been obtained from the legal relatives of all participants.

The location of the arachnoid cyst before the operation, the classification of Galassi, age, gender, symptoms and signs, surgical technique, whether it is accompanied by additional pathology, whether it receives medical treatment, whether post-operative early or late complications develop, the need for the second operation, the change of symptoms and radiological findings in the postoperative period were recorded from patient files (Figure 1, Figure 2).

The sylvian arachnoid cysts were sometimes symptomatic, while some were detected incidentally. All had radiologically preoperative and postoperative CT and/or MRI images. Periodic clinical and radiological imaging (changes in cyst size at months 3 – 6 and 12), symptomatic improvement, additional medical treatment, surgical method, age, gender, localization, postoperative early and late-term complications, and Sylvian Galassi Classification were evaluated. Patients were called to outpatient clinic control at the end of the 3, 6, and 12 postoperative months and their neurological status and radiological course were noted.

Statistical Analysis

The data were analyzed via SPSS 25 (IBM Inc., Armonk, NY, USA) software. The descriptive statistics were elaborated with frequency and percentage values for categorical data and mean and standard deviation for numerical data. The chi-square test performed categorical data comparisons between independent groups, and numerical data comparisons were performed by the Student T test. Numerical data comparisons between dependent groups were made by repeated measurements analysis of variance, and post-hoc paired comparisons were made by Tukey test. A 5% Type-I error value ($p<0.05$) was accepted as the limit of statistical significance.

In order to reach at least 80% power in the primary outcome variable analyses, at least 24 patients should be enrolled in the study with 5% type-1 error and bidirectional hypothesis design. When the 10% non-response/data loss rate is added to this number, it is calculated that the total sample size of the study should be 27 patients. Sample size calculation was performed with G*Power 3.1 software.

RESULTS

A total of 27 patients have been enrolled in this retrospective analysis. The age distribution of the patients was two months to 18 years, with a mean age of 7.8±6.6 years. The mean age of girls was 7.5±6.6 years, and the boys were 7.8±6.7 years, with no difference by gender ($p=0.92$). The localization of cysts was detected on the right side in 18.5% of the cases and on the left side in 81.5%. Additionally, 3.7% of the cysts were located in the supra-infra regions, while 96.3% were located supratentorial region.

When the grade distribution of the disease was examined, it was seen that 3.7% of the cases had Type 1, 29.6% had Type 2, and 66.7% had Type 3 disease. In the comparisons between the genders, the grade distribution was similar (p=0.43). The most common symptom was a seizure (14.8%), followed by a headache (11.1%), but 48.1% of the patients were asymptomatic (Table 1).

Table 1. Symptoms Of Patients At Admission

	Total		Female		Male		p-value
	n	%	n	%	n	%	
Symptoms							0,23
Headache	3	11,1	1	16,7	2	9,5	
Headache & syncope	1	3,7	1	16,7	-	-	
Sucking disorder + prolongation of sleep time	1	3,7	1	16,7	-	-	
Vomiting & syncope	1	3,7	-	-	1	4,8	
Seizure	4	14,8	1	16,7	3	14,3	
Syncope	1	3,7	-	-	1	4,8	
Psychomotor retardation (not speaking) & seizure	1	3,7	-	-	1	4,8	
Syncope & seizure	2	7,4	1	16,7	1	4,8	
Asymptomatic	13	48,1	1	16,7	12	57,1	

Almost half of the patients (44.4%) were diagnosed incidentally, while 16.7% were female and 52.4% were male. However, the distribution of diagnoses between both genders was similar (p=0.12). When the additional pathologies in the cases were examined, an arachnoid cyst around the brain stem in 1 male patient and exophthalmos of the left eye in 1 male patient was detected. There was no additional pathology in the girls.

When the early complications in the patients were examined, the postoperative hematoma was observed in 1 patient, frontoparietal subdural hygroma was observed in 4 patients, and wound CSF consolidation was observed in 1 patient. In contrast, no early complications were observed in 21 patients. The distribution of these early complications did not differ significantly between the genders. Fenestration was performed in 23 patients, and a cystoperitoneal shunt was inserted in 4 (Table 2).

Table 2. Complications And Type Of Surgery

	Total		Female		Male		p-value
	n	%	n	%	n	%	
Early complications							0,29
Postoperative hematoma	1	3,7	-	-	1	4,8	
Frontoparietal subdural hygroma	4	14,8	1	16,7	3	14,3	
Wound CSF collection	1	3,7	-	-	1	4,8	
None	21	77,8	5	83,3	16	76,2	
Surgery method							0,89
Fenestration	23	85,2	5	83,3	18	85,7	
Cystoperitoneal shunt	4	14,8	1	16,7	3	14,3	

Twenty-four patients became asymptomatic in the postoperative period, seizures decreased in 1 patient, continued in 1 patient, psychomotor retardation improved in 1 patient, and the patient started to speak. The patients were given levetiracetam (n=2), tegretol (n=1), and valproic acid (n=1) for medical treatment, and no additional medical treatment was applied in 23 patients (Table 3).

Table 3. Clinical Course And Medical Treatments Of Patients-1

	Total		Female		Male		p-value
	n	%	n	%	n	%	
Postoperative clinical recovery							0,25
asymptomatic	24	88,9	5	83,3	19	90,5	
seizures decreased	1	3,7	1	16,7	-	-	
Seizures continued	1	3,7	-	-	1	4,8	
Psychomotor retardation improved, and started to speak	1	3,7	-	-	1	4,8	
Medical treatment							0,23
Levatracetam	2	7,4	-	-	2	9,5	
Tegretol	1	3,7	1	16,7	-	-	
Valproic acid	1	3,7	-	-	1	4,8	
None	23	85,2	5	83,3	18	85,7	

The preoperative volumes were similar to those measured in the third month. The third-month volume was larger than the sixth-month and first-year volumes, and the sixth-month and first-year measurements were similar (preoperative ~ 3rd month > 6th month ~ 1 year, p=0.003).

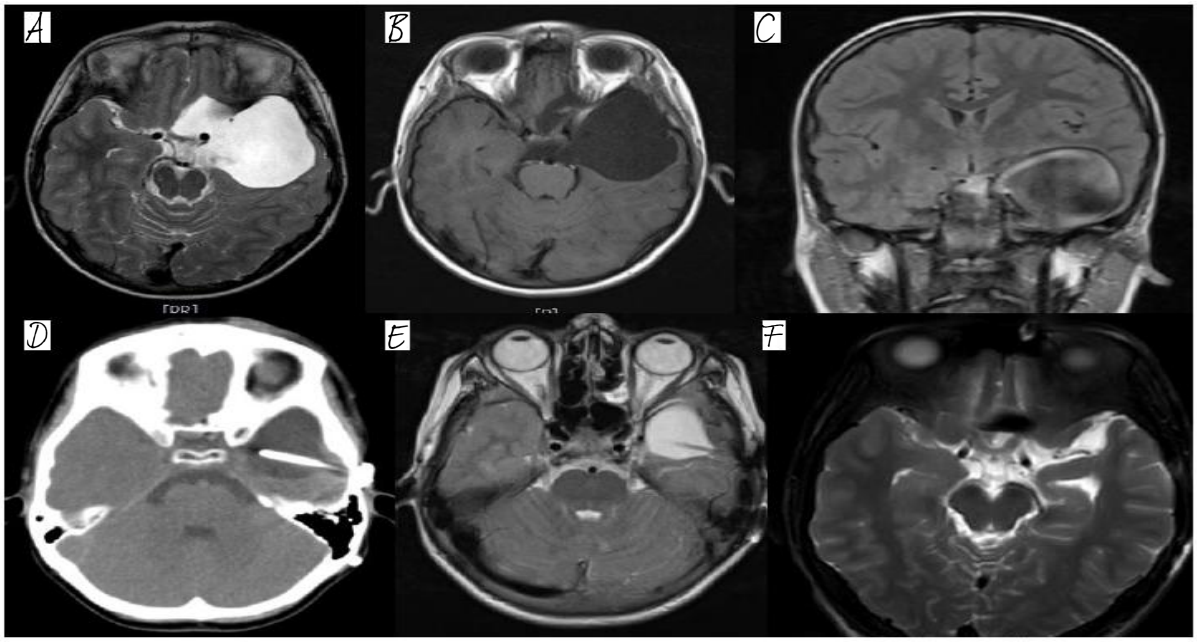

Figure 2. A 17-year-old male patient applied with a complaint of seizures. After fenesteration, seizure complaints resolved in the postoperative 1st month, and after the 15th month, the cyst was almost completely resorbed and the midline shift improved. A. Preop MRIT2 sequence axial section B. Preop MRI T1 sequence sagittal section C. Preop MRI Flair coronal section D. Postop 1st day CT axial section E. Postop 15th month MRI T2 sequence axial section F. Postop 3 years.

DISCUSSION

Arachnoid cysts are benign brain lesions with cerebrospinal fluid accumulation under the arachnoid fossa. Intracranial arachnoid cysts were first described by Bright in 1831 as serous cysts of the brain (13). The arachnoid cyst originates from the incomplete detachment of the peri medullary network (endo meninges) in the early stage of embryogenesis or repetition of the arachnoid membrane during development. Substantial evidence shows that arachnoid cysts are developmental and distinguish them from benign cysts such as porencephalic, leptomeningeal, and neuroepithelial cysts. They constitute 0.75–1% of non-traumatic intracranial lesions, and 50% to 60% occur in the middle cranial fossa (14).

The mechanism of enlargement and symptomaticization of arachnoid cysts is still under investigation. The potential enlargement of these cysts is assumed to be multifactorial: direct fluid secretion from the cyst, arterial vibrations via a one-way valve, and intracystic fluid accumulation induced by an osmotic gradient attempt to explain the mechanism of cyst formation and enlargement (15). In the large-scale study of Al-Holou et al., 11738 cases were examined, and it was observed that all patients with enlarged cysts were younger than four years old, and the cyst size of older children generally remained constant (16).

Headache, epileptic seizure, mental retardation, growth retardation, proptosis, motor deficit, increased intracranial pressure, visual impairment, and macrocephaly are among the most common symptoms. It may occur in the optic chiasm, and arachnoid cysts close to it. There may be focal neurological symptoms. The most common focal symptom is an epileptic seizure. Seizures may be partial or generalized. Previous literature reported epileptic seizure and headache is the most common symptoms, especially in middle cranial fossa arachnoid cysts. In some studies, there is a relationship between cyst size and type and frequency of seizures, and surgical treatment has been shown to reduce the frequency of seizures (14). Our study determined that the most common symptom in symptomatic patients was a seizure (14.8%), followed by headache (11.1%), and no symptoms were observed in 48.1% of the cases.

Another issue related to arachnoid cysts is that they can cause neuromotor developmental delay. There are studies on this. For example, Locatelli et al. detected retardation in 2 of 30 (6.6%) patients (17). In our study, when the additional pathologies in the cases were examined, psychomotor retardation was found in 1 male patient and exophthalmos of the left eye in 1 male patient. Following surgery, the patient with psychomotor retardation improved and started to speak.

Complications may occur due to arachnoid cysts. The most common are; subdural hematoma, hygroma, and intracystic hemorrhage. Studies show that arachnoid cyst is five times more common in patients with subdural hematoma and hygroma than in the normal population. Subdural hematoma and hygroma are usually seen on the side of the cyst. Still, they can be seen on the opposite side. The possible cause of this bleeding is fragile bridging veins and leptomeningeal vessels in the cyst wall, thinning of the calvarium, trauma, and sensitivity to trauma (18).

Discussions on treatment for arachnoid cysts continue. Some studies emphasize the conservative approach in asymptomatic patients. General approach; Periodic computed tomography and/or cranial MRI follow-up should be recommended every six months for the first two years in cases detected incidentally or previously followed up. If the cyst is stable in size and symptomatically, this period can be reduced to once a year (19). Approximately 60-80% of arachnoid cysts consist of symptomatic cases. Al-Holou et al. reported that larger

initial size, location, and symptom status were important parameters for surgery. They did not operate on patients over four years of age (16).

The main goal in surgical treatment is to open the cisterns and create a connection to the cyst, reduce the pressure effect, and remove the obstruction on the normal CSF pathways. There has yet to be a consensus on the surgical method. There was no significant difference in morbidity rates between different techniques. Lee and Ra reported in their study that clinical and radiological improvement was between 85.7 and 100% in patients who underwent surgical treatment (20).

The location of the cyst is important for the treatment approach. For example, suprasellar arachnoid cysts, which constitute 16% of arachnoid cysts in the pediatric age group, bring difficulties in microsurgery due to the anatomical proximity of critical structures such as optic chiasma, hypothalamus, and pituitary gland. In these situations, the endoscopic approach may offer a safe and effective method for cyst fenestration (21). One of the major limitations of using transsphenoidal endoscopic arachnoid cyst fenestration is CSF leakage which occurs in 21.4% of intrasellar arachnoid cysts undergoing transsphenoidal surgery (22). Some studies have advocated a trans ventricular endoscopic approach for the fenestration of suprasellar arachnoid cysts to prevent this complication. Ventriculocystostomy (VC) and ventriculocystocisternostomy (VCC) are surgical approaches that differ in basal cistern fenestration, as in both (23). These two techniques have been compared, and most authors agree that fenestration of the basal cisterns offers better outcomes due to the risk of secondary aqueductal occlusion due to chronic mesencephalic compression by the cyst, which limits the effectiveness of ventriculocisternotomy alone. These cysts in the fossa can be safely treated with open microsurgery and endoscopic methods (21 – 23).

Di Rocco et al. reviewed endoscopic interventions' results, complications, and limitations on arachnoid cysts in this region. They defined the main limitation of the endoscopic approach in this region as the anatomical proximity of the cyst to the basal cisterns and critical structures within the temporal lobe (24). They emphasize using a small diameter endoscope to reach the planned area safely. In general, both open and endoscopic surgical approaches assume a relatively greater operative risk than cystoperitoneal shunt due to the technical aspects of these procedures. For example, the incidence of subdural effusion with microsurgery and endoscopic intervention for arachnoid cysts ranges from 2 to 40% and sometimes requires further surgical treatment with a subduroperitoneal shunt (25).

Although shunt therapy is a potentially safer option, it does involve risks such as infection, occlusion, and, more importantly, lifelong shunt dependence that should not be ignored. Reports of endoscopic cyst fenestration were relatively rare ten years ago. Still, since then, there has been a huge increase in surgeons' comfortable and routine using the endoscope to approach these lesions. Recent data suggest that many centers use the endoscopic approach as a first-line treatment for arachnoid cysts in children (26). Open craniotomy for cyst excision or fenestration can free the patient from the shunt. However, the inherent risks of open craniotomy should be considered in a patient with only minor symptoms associated with an arachnoid cyst. In addition, this procedure is only sometimes effective, and cyst recurrence has been reported. Other major complications include meningitis, hemiparesis, oculomotor paralysis, subdural hematomas, seizures, and death (27).

Discussions on the treatment of arachnoid cysts have been going on for years. And with the imaging methods that have become widespread recently, the possibility of encountering them incidentally is increasing. Although the cysts are benign, considering their formation mechanisms and the patient-specific, sometimes they only contain CSF and do not increase

intracranial pressure. Sometimes they can appear with symptoms ranging from ambiguous to ambiguous symptoms mass effects. Our opinion on this issue is that surgical treatment cannot be denied. Still, considering the patient, it is necessary to have close clinical and radiological follow-ups for a while. In addition, psychomotor tests are started after the diagnosis is made during the follow-up. Psychomotor tests are performed periodically throughout the follow-up and/or treatment process, and it can be a serious guide in illuminating the approach to arachnoid cysts.

The cyst should be connected to the subdural space and cisterns, especially in operations performed with craniotomy and endoscopy. Considering the mechanism of cyst formation in patients who do not have adequate mouthing with cisterns, we also observe macroscopically that it is highly likely that the cyst content and volume will increase again. In addition, we found that if the cysts and cisterns are not mouthed, there is a negative pressure effect on the cerebral tissue and a vacuumed parenchyma image. Therefore, we believe it is significant to prioritize surgery, especially in the early period, in patients with a diagnosed sylvian arachnoid cyst if the symptoms started before the operation was planned and if the cyst size was followed up and symptoms that other reasons could not explain. We found that the surgical results were statistically significant when we looked at the symptomatic and radiological results and follow-ups of 27 operated on in our study.

CONCLUSION

As a result, it is important to evaluate all parameters, such as clinical findings, radiological findings, and location of the patients together. The arachnoid cyst is detected with accompanying symptoms such as headache, hydrocephalus, and seizure with EEG findings compatible with cyst location, endocrinological findings, visual symptoms, symptoms due to mass effect, bone destruction, and surgical treatment can be considered. The most important goal in surgical treatment is to ensure normal brain development.

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Conflict of Interest: The authors declare that they have no competing interests.

Ethical Declaration: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Ethics committee approval has been granted from our institution. As this was a retrospective research no informed consent has been obtained from participants.

Note: This article was produced from the thesis of the same name and presented as an oral presentation at a national congress.

Abbreviations

AC	: Arachnoid Cysts
CSF	: Cerebrospinal Fluid
CT	: Computerized Tomography
MRI	: Magnetic Resonance İmaging
SGC	: Sylvian Galassi Classification
SPSS	: Statistical Package for the Social Sciences
VC	: Ventriculo Cystostomy
VCC	: Ventriculo Cysto Cisternostomy

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