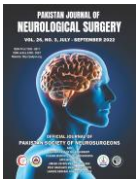

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Original Article

Clinical Outcomes of Craniotomy in the Management of Cranial Arachnoid Cyst: An experience from Ali Institute of Neurosciences, Irfan General Hospital Peshawar: A Retrospective Case Series

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ABSTRACT

Objective: Intracranial arachnoid cyst is a non-neoplastic clinical entity that develops due to the splitting or duplication of the membrane surrounding the arachnoid matter. Nonspecific symptoms are usually treated conservatively. If the symptoms are severe, progressive, and disabling, surgical intervention is indicated. We aimed to evaluate the effectiveness and clinical outcomes of craniotomy in the management of arachnoid cysts.

Material and Methods: A retrospective case series study was conducted at Ali Institute of Neurosciences, Irfan General Hospital from the records of the past 8 years. Clinical records were analyzed. Thirty-six patients were included in our study as they were diagnosed as having symptomatic and progressive symptoms which required surgical intervention. In those patients, the standard procedure of Craniotomy was performed. Clinical and neuroimaging outcome scales were used.

Results: Mean age of the participant was 9 years at the time of surgery. Most of the arachnoid cysts were located in the temporal area 20 (43%), followed by post fossa 4(9%). The majority of the patients (63%) were characterized in COS 1 on the clinical outcome scale while there was no patient in COS 4 category. More than half of the patients (54%) had the cyst reduced to less than 50% of the original volume (NOS 2) while 25 percent of patients had the cyst size reduced but was still greater than 50% (NOS 3).

Conclusion: Craniotomy, an open surgical procedure is an effective intervention in improving clinical and radiological outcomes. However, it is also associated with significant recurrence rates along with other complications.

Keywords: Arachnoid Cyst, Arachnoid, Craniotomy, Intracranial Arachnoid.

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INTRODUCTION

Intracranial arachnoid cyst is a non-neoplastic clinical entity that develops due to the splitting or duplication of the membrane surrounding the arachnoid matter and filling with a CSF-like fluid forming the cyst, the etiology of which is attributed to congenital or acquired causes.[1] One percent of all intracranial space-occupying lesions constitute arachnoid cysts. Intracranial arachnoid cysts are characterized by the symptoms owing to increased intracranial pressure, mass effect on surrounding and local structures, or rupture of the cyst. Symptoms most frequently reported in arachnoid cysts are headache, dizziness, vertigo, cognitive impairment, and epilepsy.[2] The first ever case of intracranial arachnoid cysts was reported by Richard Bright in 1831.[3] The prevalence of arachnoid cysts is reported to be 0.5% – 2.7% worldwide and is more prevalent in children as compared to the adult population as is evident by a large epidemiological study which reported the prevalence in children to be 2.6% as compared to adults (1.4%) while males are affected to a greater extent than females regardless of age.[4-5]

Mostly the arachnoid cysts are diagnosed incidentally on MRI and are usually asymptomatic. Nonspecific symptoms are usually treated conservatively. However, if the symptoms are severe, progressive, and disabling, surgical intervention is indicated and is an effective treatment option to relieve pressure on the affected areas. Different surgical interventions are used in the management of arachnoid cysts with each technique having a varied amount of advantages and disadvantages.[6] Surgical intervention techniques most commonly performed are excision of the cyst, cystoperitoneal shunting, or fenestration.[7] Craniotomy and endoscopy are the two main surgical options available to drain the cyst. Craniotomy is characterized by removing a portion of the skull and excision or fenestration of the cyst. While endoscopic surgery is minimally invasive but requires greater surgical expertise.[8] All of these procedures have a reported complication rate that ranges from 6% to 55%. Recurrence is commonly associated with excision or penetration of the arachnoid cyst through craniotomy.[5] In this case series study we aimed to evaluate the effectiveness and clinical outcomes of craniotomy in the management of arachnoid cysts in terms of success rate, recurrence, intra and post-op complications, and resolution of symptoms.

MATERIAL AND METHODS

Study Design and Setting

A retrospective case series study was conducted at Ali Institute of Neurosciences, Irfan General Hospital from the records of the past 8 years (June 2014 till December 2021) with the consent from the ethical committee of the Hospital. Clinical records were analyzed for including the patients with non-probability convenience sampling.

Inclusion Criteria

All those patients included in our study who were diagnosed as having arachnoid cysts irrespective of age or gender through subjective (history of headache, dizziness, seizures, or other focal signs), objective and investigation findings such as MRI and undergoing craniotomy as the main surgical procedure.

Exclusion Criteria

Patients undergoing other surgical procedures were excluded from the study. Patients declining the consent to share their data were also excluded from our study.

Patient Management

A total of 58 patients were diagnosed as having intracranial arachnoid cysts during the period. Twenty-two patients were managed

conservatively as they presented with nonspecific mild symptoms which did not require surgical intervention. Thirty-six patients were included in our study as they were diagnosed as having symptomatic and progressive symptoms which required surgical intervention. In those patients, the standard procedure of Craniotomy was performed with informed consent.

Clinical and Radiological Outcomes

The clinical outcomes such as symptoms, MRI findings, and focal neurological deficits were recorded pre-op and after certain follow-ups after the procedures at weeks one, four, eight, and twelve.

The clinical outcome was assessed using the Clinical outcome scale (COS) ranging from COS 1 (Symptoms entirely disappear or are negligible), COS 2 (Symptoms still present but reduced), COS 3 (symptoms remain unchanged), and COS 4 (Increased in symptoms after surgical procedure) while neuroimaging outcome scale (NOS) was used for assessing the radiological outcomes ranging from NOS 1 (Cyst no longer visible on radiological investigation), NOS 2 (volume reduced to less than 50% compared to pre-op), NOS 3 (volume reduced but to greater than 50% compared to pre-op), NOS 4 (No change in volume as compared to post-op) to NOS 5 (Increased Size of cyst postoperatively).

Data Analysis

Demographic variables such as age, gender, and location of the cyst were recorded on a proforma. Data was analyzed by SPSS version 26 using descriptive statistics. Mean and standard deviations were used for the analysis of numerical data while frequency and percentages were recorded for categorical data. The Shapiro-Wilk test was used to assess the normality of the data.

Operative Technique and Patient Management

A Craniotomy flab was made under general anesthesia on the desired area of the arachnoid cyst. Different possible approaches were made in the form of Pterional craniotomy, convexity, mid-line craniotomy, posterior fossa, and cerebellopontine angle craniotomy. Durotomy was carried out and the arachnoid cyst was dissected, the outer layer was biopsied and internal CSF from the cyst was drained. A tiny vessel inside the cyst was coagulated and through sharp and careful dissection, the inner layer was also separated. Communication was made with the underlying nearby cistern. Hemostasis was secured and the dura was closed in water type fashion. The wound was then closed traditionally. The patient was kept in ICU for 24 hours after recovery from anesthesia.

RESULTS

Age & Gender Distribution

The majority of the participants were males 23 (64%) while 13 (36%) were females. The mean age of the participant was 9 years at the time of surgery (Ranging from 8 years to 36 years).

Treatments

A total of thirty-six patients (62%) out of 58 underwent craniotomy during the time frame while 22 (38%) were treated conservatively.

Location of Arachnoid Cyst

The results of Magnetic Resonance Imaging showed that most of the arachnoid cysts were located in the temporal area 24 (66%), followed by posterior fossa in 4 (11%), cerebellopontine angle in 3 (8%), suprasellar in 2 (6%), a pineal region in 1 (3%), petroclival area in 1 (3%) and parietal arachnoid cysts in 1 (3%). The majority of temporal arachnoid cysts were present on the left

side 25 (70%) while 11 (30%) were located on the right side of the brain.

Table 1: Demographic variables and location of arachnoid cysts.

Variables		Frequency/Percentages
Patients diagnosed with Arachnoid cyst	Treated with craniotomy	36 (62%)
	Treated conservatively	22 (38%)
Gender	Male	23 (64%)
	Female	13 (26%)
Age	Mean age	9 Years (8 – 36)
Location of arachnoid cyst	Temporal	24 (66%)
		Right 11 (30%) Left 25 (70%)
	Posterior fossa	4 (11%)
	Cerebellopontine angle	3 (8%)
	SupraSellar	2 (6%)
	Pineal area	1 (3%)
	Petroclival area	1 (3%)
	Parietal arachnoid cyst	1 (3%)

Symptoms at Presentation

Patients diagnosed with arachnoid cysts presented with a variety of nonspecific symptoms depending on the area of the brain involved. The most frequent symptom reported by the patients was headache 16 (45%) followed by seizures 7 (19%), symptoms of raised intracranial pressure 4 (11%), hydrocephalus 3 (8%), cerebellar syndrome 3 (8%), ataxia 1 (3%), vertigo 1 (3%) and decreased vision 1 (3%).

Table 2: Presenting symptoms of Cranial arachnoid cyst.

Symptoms of Arachnoid Cyst	Frequency/ Percentages
Headache	16 (45%)
Seizures	7 (19%)
Symptoms of Raised Intracranial Pressure	4 (11%)
Hydrocephalus	3 (8%)
Cerebellar Syndrome	3 (8%)
Ataxia	1 (3%)
Vertigo	1 (3%)
Decreased Vision	1 (3%).

Clinical and Radiological Outcomes after Craniotomy

Participants in our study undergoing craniotomy exhibited good clinical and radiological outcomes as evidenced by their decreased or completely diminished symptoms and improved radiological features.

The majority of the patients (63%) were characterized as COS 1 on the clinical outcome scale as is evident from the table while there was no patient in the COS 4 category showing excellent clinical outcomes of craniotomy in arachnoid cysts. As 15 patients did not have pre and post-radiological investigations available so neuroimaging outcomes were assessed for 21 patients the results of which demonstrated that more than half of the patients 13 (60%) had the cyst reduced to less than 50% of the original volume (NOS 2), while 5 (25%) percent of patients had the cyst size reduced but was still greater than 50% (NOS 3) as highlighted in table 3.

Table 3: Clinical and Neuroimaging outcome scales score

Clinical Outcome Scale (COS)	Categories	Frequency/ Percentages
	COS 1	22 (63%)
	COS 2	10 (28%)
	COS 3	4 (10%)
Neuroimaging Outcome Scale (NOS)	NOS 1	3 (15%)
	NOS 2	13 (60%)
	NOS 3	5 (25%)

Complications of the Procedure/ Recurrence and Mortality Rate

No severe complications leading to additional surgery were encountered in our participants. Twenty-eight percent of the participants experienced some complications. The

complications reported were CSF leak in 3 (8%), subdural hematoma in 1 (3%), and subdural hygroma in 2 (6%). No mortality was reported in our series of patients.

Table 4: Complications of Procedure/Recurrence

Complications/Recurrence	Frequency/ Percentage
Number of patients experiencing complications	10 (28%)
CSF leak	3 (8%)
Subdural Hematoma	1 (3%)
Subdural Hygroma	2 (6%)
Mortality	0 (0)%

DISCUSSION

The increased use of radiological investigations especially MRI has led to an increased number of diagnosed cases of arachnoid cysts.[9] The clinical presentation and degree of disability due to arachnoid cyst is varied and therefore the choice of treatment remains a challenge. In some patients presenting with symptoms such as headache or seizure, medical treatment is warranted while in patients having more severe symptoms such as focal neurological deficits, hydrocephalus, or symptoms related to increased intracranial pressure along with radiological findings suggestive of large cysts are recommended to undergo surgical intervention.[6] The surgical intervention most commonly used for arachnoid cysts according to literature is craniotomy with either removal of the cyst or microsurgical fenestration. The endoscopic approach is minimally invasive and has decreased chances of associated complications and faster recovery but requires higher surgical skills and expertise.[10] In the current study clinical outcomes of craniotomy were assessed in the treatment of arachnoid cysts the results of which demonstrated improved clinical and radiological outcomes.

The latest evidence has illustrated the significance of endoscopic procedures over traditional craniotomies due to several reasons. As the location of arachnoid cysts is close to the ventricular system and arachnoid cisterns, endoscopic fenestrations have gained popularity as they easily fenestrate the CSF space without undergoing wide exposure as is true for craniotomy.[11] A six-year duration study conducted from 2012 to 2018 including four patients with prior shunt failure performed for suprasellar arachnoid cysts concluded that endoscopic fenestration is an effective and safe surgical procedure for failed prior shunts.[12] Endoscopic surgery is associated with improved clinical outcomes due to increased visualization and decreased rate of re-exploration and failure.[13]

The results of our study elaborated that male patients had a higher rate of prevalence of 23 (64%) of arachnoid cysts as compared to females of 13 (36%). Left-sided cysts in the temporal area were also greater in 25 (70%) as compared to the right side 11 (30%). The findings of our study are consistent with the work done by K Wester the results of which also demonstrated the gender distribution with male to female ratio of 3:1 and increased prevalence in the left side of the middle fossa.[14] Literature also supports the increased cases of arachnoid cysts diagnosed in males while the sidedness could be attributed to the increased significance of the dominant hemisphere (left side).

A study conducted in the USA showed that the majority of patients (79.1%) undergoing craniotomy for cyst removal demonstrated improvement in the clinical sign and symptoms while also radiological findings of 85.7% of patients suggested decreased volume of cyst postoperatively.[15] One such study used a clinical outcome scale (COS) and a neurological outcome scale (NOS) for quantifying the clinical and radiological outcomes as used in our study. The results demonstrated that fifty-six percent of patients were symptom-free in the follow-up examination (COS 1).[16] These findings are also

consistent with our study which illustrated that patients had improved clinical and radiological outcomes as the majority of patients 22 (63%) were categorized in COS 1 in which Symptoms entirely disappeared or were negligible at the time of follow-up. Also, the radiological aspect was improved as 13 (60%) of the patient were in the category NOS 2 illustrating that the cyst reduced to less than 50% of the original volume.

A study conducted in India showed that 25% of the arachnoid cysts were present in the temporal region, followed by retro cerebellar, quadrigeminal, and suprasellar cysts while the most frequent symptom reported at the time of presentation was headache and vomiting 16 (28%) with other associated symptoms of seizures, blurring of vision and focal neurological deficits.[17] Headache was also reported to be the most frequent symptom 16 (45%) in our study followed by seizures 7 (19%) while in contrast a large proportion 24 (66%) of temporal arachnoid cysts were reported In our study as evident by radiological investigation.

In our patients, only 28% of patients experienced mild complications, the most common of which was CSF leak was reported in 3 (8%), subdural hematoma in 1 (3%), and subdural hygroma in 2 (6%). No patient experienced any serious complications with a zero-mortality rate. In contrast, another study showed that hygroma was reported as the most common complication (n = 18) out of which 15 cases were resolved spontaneously. The recurrence rate reported was 11.8% while no recurrence was reported in our study.[16]

LIMITATIONS AND FUTURE RECOMMENDATIONS

One of the limitations of our study is the retrospective observational design as there is no comparative or control group to compare the effectiveness of the procedure with other surgical techniques. Future studies involving a larger sample with both treatment and control groups along randomization with further strengthen our knowledge of the subject. Endoscopic surgery outcomes should be determined in our set of patients and compared with open interventions.

CONCLUSION

Surgical decompression is the accepted and recommended treatment option for symptomatic and progressive arachnoid cysts. The results of our study concluded that craniotomy, an open surgical procedure is an effective intervention in improving clinical and radiological outcomes. However, it is also associated with significant recurrence rates along with other complications.

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Additional Information

Disclosures: Authors report no conflict of interest.
Ethical Review Board Approval: The study was retrospective.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Mumtaz Ali, & Abdul Haseeb Sahibzada	1. Study design, methodology and paper writing.
2.	Ramzan Hussain, & Akram Ullah	3. Data collection and calculations.
3.	Mumtaz Ali, Arif Hussain, & Sajid khan	4. Analysis of data and interpretation of results.
4.	Muhammad Zubair, & Amjad Ali	5. Literature review and referencing.
5.	Sajid khan, Mumtaz Ali, & Abdul Haseeb Sahizada	6. Editing and quality insurer.