Microsurgical Fenestration of Intracranial Symptomatic Arachnoid Cyst, Our Experience With 13 Cases

A M Elshanawany, M H Ragab

Citation

Abstract
Background: Arachnoid cysts are non-neoplastic, benign, intra-arachnoidal extra-axial lesions filled with fluid similar to or exactly the same as cerebrospinal fluid. They represent 1% of all intracranial space occupying lesions. Most arachnoid cysts are clinically silent. They present mainly in childhood. The common anatomical locations of arachnoid cysts are the middle cranial fossa, posterior fossa, suprasellar, quadrigeminal cistern, interhemispheric and convexity. Management of arachnoid cyst is a point of controversy.

Objective: Evaluation of the microsurgical fenestration management option of arachnoid cysts regarding safety and outcome.

Patients and Methods: This is retrospective study including 13 patients with symptomatic arachnoid cysts in different anatomical locations, in the time period between "January 2015 and September 2017". The study was conducted in the neurosurgery department of Assiut University Hospitals. Pre-operative patients' characteristics included age, sex, cyst location and clinical presentation. The inclusion criterion is a symptomatic arachnoid cyst at any anatomical location as asymptomatic cysts were excluded. Also, CT and MRI brain were studied to determine cyst location and its relation to basal cistern. The surgical management was craniotomy and microsurgical cyst fenestration to communicate the cysts with surrounding basal cisterns. Post-operative patients' characteristics including clinical and radiological outcome and post-operative complications were evaluated during a follow up time ranged from "6 months to 28 months".

Results: The included patients were 9 males and 4 females. Age ranged between "one year to 61 years" old. The frequency of clinical presentation was increased head circumference and delayed milestones "6 patients", epilepsy "5 patients", and headache, blurred vision and papilledema in "6 patients". Middle cranial fossa arachnoid cysts were seen in "8 patients", suprasellar arachnoid cysts in "3 patients" and convexity arachnoid cysts in "2 patients". All patients with manifestations of increased intracranial tension showed marked post-operative improvement. Epilepsy was abolished in one patient and became less aggressive in the remaining 4 patients. No cyst recurrence during the follow uptime.

Conclusion: Microsurgical fenestration is an effective and safe method for treatment of symptomatic arachnoid cysts. It can be applied for both supratentorial and infratentorial arachnoid cysts. It has minor morbidity and mortality. More studies with big sample size are required to obtain statistically significant results.

INTRODUCTION
Arachnoid cysts are benign, non-neoplastic, extra axial, intra-arachnoidal lesions filled with fluid similar to or exactly the same as cerebrospinal fluid (CSF). They represent 1% of benign intracranial space-occupying lesions (1,2). They may be primary as congenital disorder or secondary as a sequel of hemorrhage or infection (3). Arachnoid cysts usually remain asymptomatic and may be discovered accidentally. They are symptomatic and require management in only 20% of patients. Sometimes, they disappear spontaneously (4). Management of symptomatic arachnoid cysts is a matter of controversy. Microsurgical cyst fenestration is an option. Other options include endoscopic cyst fenestration and insertion of cysto-peritoneal shunt.

PATIENTS AND METHODS
This retrospective study included 13 patients with symptomatic arachnoid cysts who required microsurgical fenestration in the neurosurgery department, Assiut University Hospitals, between "January 2015 – September
The inclusion criterion was a symptomatic arachnoid cyst at any anatomical location as asymptomatic cysts were excluded. Pre-operative patients' characteristics including age on admission, sex and clinical presentation were evaluated. Clinical presentations of all patients were recorded. Also, CT and MRI brain were studied to determine cyst location and its relation to basal cistern. Craniotomy was designed according to cyst location and its proximity to basal cisterns. For middle cranial cysts, pterional craniotomy and fenestrating the cysts to sylvian cistern, suprasellar cistern and pre-pontine cistern was performed. For suprasellar arachnoid cysts, lateral subfrontal craniotomy and fenestrating the cysts to sylvian and pre-pontine cisterns was performed. Convexity arachnoid cysts were fenestrated to the adjacent subarachnoid space. Post-operative patients' characteristics including clinical and radiological outcome and post-operative complications were evaluated during a follow up time ranged from "6 months to 28 months".

RESULTS

The pre-operative patients' characteristics are summarized in tables (1, 2 and 3). There were 9 males (69.8%) and 4 females (30.8%)(Table 1). The mean age at surgery was 13.46 years (range one to 61 years). According to cyst locations, middle cranial fossa cysts were met in 8 patients (61.5%), suprasellar arachnoid cyst in 3 patients (23.1%) and convexity cyst in 2 patients (15.4%) (Table 2). Regarding middle cranial fossa cysts, we had 5 Galassi III types and 3 cases were of Galassi II type. All our suprasellar cysts were type I which means that they were non-communicating intra-arachnoidal cystic dilatations of Liliquest membranes. Regarding the frequency of clinical presentation, increased head circumference and delayed milestones were met in 6 patients (46.2%), epilepsy was seen in 5 patients (38.5%), and lastly, headache, vomiting and papilledema were seen in 6 patients (46.2%) (Table 3).

The patients with suprasellar arachnoid cyst (n=3) had previous ventriculo-peritoneal shunt for hydrocephalus. On post shunt follow up, the ventricles were well drained but the suprasellar cyst was markedly enlarged which necessitated microsurgical fenestration. Shunt patency was confirmed before cyst fenestration. For convexity cyst, there is no history of attacks of hemorrhage or meningitis or tumor excision. Those patients with large sized heads and increasing head circumference showed no more increase in their head circumference during the follow-up period. Also, a significant improvement in their milestones was noted.

The duration of symptoms to diagnosis in epileptic patients (n=5) ranged from 6 months to 2 years. Epilepsy was controlled by two drugs before surgery, but at two years post microsurgical fenestration follow up, one patient was completely drug independent while the remaining 4 became seizures free with only one medication.

Headache and papilledema were seen in 6 patients. They were the only clinical presentation in two patients who had a suprasellar arachnoid cyst. These two patients showed immediate post-operative resolution of headache and gradual resolution of papilledema on follow up. Headache and papilledema in conjunction with epilepsy were met in 4 patients (two middle cranial fossa cysts and 2 convexity cysts). These four patients showed immediate post-operative resolution of headache and gradual resolution of papilledema on follow up.

Radiological follow-up showed no immediate but gradual postoperative decrease in cyst size and mass effect. All the cysts began to show significant changes not less than one month post operatively. No cyst recurrence was detected during the follow-up period.

Regarding the post-operative complications, they all were transient and improved by medications or minor surgical maneuvers.

Three patients (23.1%) who were not known to be epileptic before suffered attacks of generalized tonic and clonic convulsions within the first week postoperatively that required anti-epileptic regimen for 3 months only and did not develop any seizures after drug discontinuation.

Four patients (30.8%) developed postoperative subgaleal collections that necessitated repeated aspirations (2-3 times) and tight bandage. This complication was seen after fenestration of middle cranial fossa cysts.

Two patients were complicated with postoperative asymptomatic subdural hygroma on follow-up imaging (table 4) after fenestration of a middle cranial fossa arachnoid cyst. Hygroma was asymptomatic and patients did not need any intervention during the period of follow up (Fig. 2).
Microsurgical Fenestration of Intracranial Symptomatic Arachnoid Cyst, Our Experience With 13 Cases

Table 1
Sex distribution

<table>
<thead>
<tr>
<th>Sex</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>9(30.8%)</td>
</tr>
<tr>
<td>Females</td>
<td>4(69.2%)</td>
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</table>

Table 2
Cysts anatomical locations

<table>
<thead>
<tr>
<th>Cyst location</th>
<th>Number</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Middle cranial fossa</td>
<td>8 (61.5%)</td>
<td></td>
</tr>
<tr>
<td>Suprasellar</td>
<td>3 (23.1%)</td>
<td></td>
</tr>
<tr>
<td>Convexity</td>
<td>2 (15.4%)</td>
<td></td>
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</tbody>
</table>

Table 3
Frequency of clinical presentation

<table>
<thead>
<tr>
<th>Clinical presentation</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>Increase head circumference</td>
<td>6 (46.2%)</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>5 (38.5%)</td>
</tr>
<tr>
<td>Headache and papilledema</td>
<td>6 (46.2%)</td>
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Table 4
Postoperative complications

<table>
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<tr>
<th></th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>Subgaleal CSF collection</td>
<td>4 (30.8%)</td>
</tr>
<tr>
<td>Immediate postoperative seizure</td>
<td>3 (23.1%)</td>
</tr>
<tr>
<td>Subdural hygroma</td>
<td>2 (15.4%)</td>
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Table 5
Frequency of clinical presentation related to cyst location

<table>
<thead>
<tr>
<th>Cyst location</th>
<th>No. of patients: 8(6 Males- 2 Females)</th>
<th>Epilepsy: 3 patients</th>
<th>Increase head circumference: 4 patients</th>
<th>Headache and papilledema: 2</th>
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<tbody>
<tr>
<td>Middle cranial fossa</td>
<td>Galassi II: 3 cases</td>
<td></td>
<td>Galassi III: 5 cases</td>
<td></td>
</tr>
<tr>
<td>Suprasellar cyst</td>
<td>No. of patients: 3(2 Males-1 Female)</td>
<td>Epilepsy: no patients</td>
<td>Increase head circumference: 1</td>
<td>Headache and papilledema: 2</td>
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<tr>
<td>Convexity cyst</td>
<td>No. of patients: 2 (2 females)</td>
<td>Epilepsy: 2</td>
<td>Increase head circumference: no patients</td>
<td>Headache and papilledema: 2</td>
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Table 6
The pre-operative patients' characteristics

<table>
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<tr>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Increase head circumference</th>
<th>Epilepsy</th>
<th>Headache and papilledema</th>
<th>Cyst location</th>
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<tbody>
<tr>
<td>Case 1</td>
<td>1</td>
<td>+ve</td>
<td>-</td>
<td>-</td>
<td>Middle cranial fossa</td>
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<tr>
<td>Case 2</td>
<td>3</td>
<td>-</td>
<td>+ve</td>
<td>-</td>
<td>Suprasellar</td>
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<tr>
<td>Case 3</td>
<td>2</td>
<td>+ve</td>
<td>-</td>
<td>-</td>
<td>Middle cranial fossa</td>
</tr>
<tr>
<td>Case 4</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>+ve</td>
<td>Middle cranial fossa</td>
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<tr>
<td>Case 5</td>
<td>2</td>
<td>+ve</td>
<td>-</td>
<td>-</td>
<td>Suprasellar</td>
</tr>
<tr>
<td>Case 6</td>
<td>2</td>
<td>+ve</td>
<td>-</td>
<td>-</td>
<td>Middle cranial fossa</td>
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<td>Case 7</td>
<td>1</td>
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<td>-</td>
<td>-</td>
<td>Middle cranial fossa</td>
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<td>Case 8</td>
<td>2</td>
<td>+ve</td>
<td>-</td>
<td>-</td>
<td>Middle cranial fossa</td>
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<td>Case 9</td>
<td>7</td>
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<td>+ve</td>
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<td>Suprasellar</td>
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<tr>
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<td>+ve</td>
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<td>Middle cranial fossa</td>
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<td>Case 11</td>
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<td>+ve</td>
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<td>Convexity</td>
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<td>Case 12</td>
<td>34</td>
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<td>+ve</td>
<td>+ve</td>
<td>Middle cranial fossa</td>
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<tr>
<td>Case 13</td>
<td>61</td>
<td>-</td>
<td>+ve</td>
<td>+ve</td>
<td>Convexity</td>
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</table>

Figure 1a
CT brain of 3 months old child with congenital hydrocephalus

Figure 1b
CT brain at age of 2.5 years(after 2 years of shunt insertion) showing well drained ventricles but a large suprasellar cyst
Figure 1c
MRI brain (T2 coronal cuts) at 2.5 years (after 2 years of shunt insertion) showing well drained ventricles but a large suprasellar cyst.

Figure 1d
MRI brain (T1 sagittal cuts) at 2.5 years (after 2 years of shunt insertion) showing well drained ventricles but a large suprasellar cyst.

Figure 1e
Immediate post-operative CT brain showing moderate size reduction after microsurgical fenestration.

Figure 1f
CT brain at (axial cuts) 6 months follow up showing marked cyst size reduction after microsurgical fenestration.

Figure 1g
CT brain at (sagittal and coronal cuts) 6 months follow up showing marked cyst size reduction after microsurgical fenestration.

Figure 1h
CT brain (axial cuts) at 20 months follow up showing maintained reduced cyst size.
Microsurgical Fenestration of Intracranial Symptomatic Arachnoid Cyst, Our Experience With 13 Cases

**Figure 1i**
CT brain (sagittal and coronal cuts) at 20 months follow up showing maintained reduced cyst size.

**Figure 2a**
CT brain of one year old male child with large middle cranial fossa arachnoid cyst (Galassi III).

**Figure 2b**
Immediate post-operative CT brain showing moderate size reduction after microsurgical fenestration.

**Figure 2c**
CT brain at 4 months follow up showing marked cyst size reduction after microsurgical fenestration but subdural hygroma

**DISCUSSION**
Arachnoid cysts are benign, non-neoplastic, extra-axial, intra-arachnoid lesions filled with fluid similar to or exactly like cerebrospinal fluid (CSF) and represents 1% of benign intracranial space-occupying lesions (1,2). It may be primary congenital lesions or secondary lesions. Secondary arachnoid cysts are following meningitis, cranial hemorrhage or tumor excision (3,4).

Usually arachnoid cysts remain asymptomatic and could be discovered accidentally and sometimes disappear.
spontaneously but in 20% they are symptomatic and require treatment (5). Arachnoid cysts are classified by their location into supratentorial and infratentorial arachnoid cysts. Supratentorial arachnoid cysts are further divided into: middle cranial fossa, sellar arachnoid cyst, interhemispheric and ventricular cysts. Infratentorial arachnoid cysts are further divided into cerebellopontine angle, supracerebellar, infracerebellar and clivus cysts (6).

Galassi et al. classified middle cranial fossa arachnoid cysts into three types. This division depends on cyst size and amount of brain compression and shift of midline. Type I refers to small cysts that are restricted to the anterior part of middle cranial fossa. Type II: in which cyst displaces the temporal lobe and extend to occupy sylvian fissure. Type III: occupy whole middle cranial fossa and compress temporal, parietal and frontal lobes with large shift of the midline (7). Miyajima et al. classified suprasellar arachnoid cysts into two types. Type I: non communicating intra-arachnoid cyst of Liliquist membrane and type II: is cystic dilatation of interpeduncular cistern. Both cysts differ in its relation with bifurcation of basilar artery. Type 1 pushes bifurcation of basilar artery against brainstem while in type 2 bifurcation of basilar artery occurs within the cyst (8). In our study, we found 5 cases of Galassi type III and 3 cases of Galassi type II in cases of middle cranial fossa cysts. In suprasellar arachnoid cysts, all our cases were type I as the cysts were non communicating intra-arachnoidal cystic dilations of the Liliquist membrane.

In this study, males are more affected than females (9 males and 4 females). Children below 16 years old represent the majority of our patients. They were 9 patients of 13 (69.2%). Middle cranial fossa arachnoid cysts are the most common (61.5%).

In the literatures, male predominance in cases of arachnoid cyst is reported with ratio of 2:1 (9,10). Symptomatic arachnoid cysts are seen more frequently in children (11). Middle cranial fossa represents the commonest site for arachnoid cysts in both adults and children, it represents 50% (12,13).

In our study, increase intracranial tension was the most common clinical presentation. In children, it was in form of increase head circumference and delayed milestones whereas in adults, it was in form of headache and papilledema. Al Holou WN et al. reported an increase of intracranial tension as the most frequent clinical presentation of arachnoid cysts (14). According to Boutarbouch M et al., it is rare for arachnoid cysts to present with increase intracranial tension (15). All these symptoms responded well for microsurgical fenestration.

Epilepsy is a common association with arachnoid cysts and its association may be incidental (16). This study included 5 patients who presented with epilepsy. Their epilepsy was difficult to be medically controlled and more than one antiepileptic drug was needed to control seizure before surgery. At two years post microsurgical fenestration follow up, one patient was completely drug independent while the remaining 4 became seizures free with only one medication.

As the association between epilepsy and arachnoid cyst is common, it may be incidental in many cases. Therefore, careful selection of cases should be considered (17). Sajko T et al., reported a young male with medically refractory temporal lobe epilepsy. Patient seizure was controlled after microsurgical fenestration of sylvian arachnoid cyst (18).

In our study, 4 patients (30.8%) developed postoperative CSF subgaleal collections that were managed conservatively and improved. Also, asymptomatic subdural hygroma was encountered in two patients (15.38%). Hygroma did not appear immediately postoperatively, it was discovered accidentally during routine follow up imaging and did not need any surgical intervention.

Arachnoid cyst recurrence was not encountered in this series during the two years follow-up time. Levy et al, in his series of 50 patients with microsurgical fenestration of arachnoid cyst, reported rate of complications as follow: 10% of patients had meningocele, 4% developed subdural hygroma, 2% developed wound infection and 6% developed cranial nerve palsy (19). Okano and Ogiwara, in their series of 28 cases of microsurgical fenestration, reported early postoperative hygroma in 23 patients (82.1%) that disappeared spontaneously in 19 patients (83%) and reduced in size in 3 patients (13%) at the long-term follow-up. Only one patient (4%) required an additional subdural-peritoneal shunt (20).

Regarding our experience with microsurgical fenestration of the arachnoid cyst in this thirteen patient's series, we feel that this method is a safe way to treat an arachnoid cyst. This approach allows wide cyst exposure, good hemostasis, removal of large part of the wall and good exposure of surrounding subarachnoid cisterns allowing adequate
Microsurgical fenestration of intracranial symptomatic arachnoid cyst, our experience with 13 cases

Fenestration. This approach allows good control of surrounding neurovascular structures.

In a single study conducted with 29 patients with symptomatic arachnoid cysts, fenestration was done either microsurgically or endoscopically. It was concluded that endoscopic fenestration of an arachnoid cyst is not superior to microsurgical cyst fenestration. Furthermore, the latter seems safer (21). Tamburrini et al. in 2008 analyzed the results of a questionnaire administered to 60 pediatric neurosurgical centers regarding the preferred surgical option to treat a child with large temporal arachnoid cyst. They concluded that craniotomy and microsurgical fenestration of the arachnoid cyst represented the preferred surgical option (66.6%), while 28.8% of the participant suggested pure or assisted endoscopic cyst fenestration as the primary surgical procedure. Cyst shunting was suggested by only three centers (22).

CONCLUSION

Microsurgical fenestration is an effective and safe method for the treatment of symptomatic arachnoid cysts. It can be applied for both supratentorial and infratentorial arachnoid cysts. It has minor morbidity and mortality. More studies with big sample size are required to obtain statistically significant results.

References

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