Endoscopic Management of Posterior Fossa Arachnoid Cysts

Ahmed Zaher*, Mostafa M. Nabeeh and Mohamed Gomaa

Department of Neurosurgery, Mansoura University

ABSTRACT

Background: Posterior fossa arachnoid cysts constitute 10-11% of all intracranial arachnoid cysts and are considered to be the second most common after middle fossa arachnoid cysts. Their diagnosis, indications of surgical intervention and mode of surgical management are still points of debate. Objective: We report our experience in the management of posterior fossa arachnoid cysts using neuroendoscopic techniques. Our work aims to assess the efficacy and safety of endoscopic fenestration as a minimally invasive technique for the management of such cysts.

Patients & Methods: We retrospectively reviewed thirteen cases of posterior fossa arachnoid cysts managed by endoscopic cyst fenestration at the Department of Neurosurgery, Mansoura University Hospital during the period from January 2000 through March 2014. We reviewed clinical data, radiological images, operative details and postoperative clinical and radiological follow up.

Results: Our study included eight female and five male patients ranging in age from 10 months to 25 years (mean=60 months). Arachnoid cysts were located in the vermis, cisterna magna and foramen magnum regions in six patients, the cerebellopontine angle in three patients, the cerebellar hemisphers in two patients and supracereellar location in two patients.

Endoscopic cyst fenestration was the primary procedure in all cases. Mean postoperative follow-up was 34 months (range 6-118 months). Follow-up imaging studies showed complete remission or reduction of the cyst size in eleven patients (84.6%) while the cyst remained unchanged in only two patients (15.4%). The overall clinical improvement was attained in 77% of our patients with no mortality or major postoperative morbidity. Two patients required repeat surgery; one for insertion of cystoperitoneal shunt in a patient with foramen magnum residual cyst and the other was endoscopic third ventriculostomy to release persistent supratentorial hydrocephalus.

Conclusion: Endoscopic fenestration of posterior fossa arachnoid cyst is an effective and safe treatment option that carries minimal morbidity. It should be considered as a first line treatment for symptomatic posterior fossa arachnoid cysts, while cystoperitoneal shunt remains a salvage procedure after failure of endoscopic fenestration.

INTRODUCTION

Arachnoid cysts are benign cystic dilatation containing cerebrospinal fluid (CSF) -like fluid that does not have communication with the ventricular system. They arise from duplication of arachnoidal membranes and were first described by Bright in 1881. Intracranial arachnoid cysts are relatively seen frequently during our routine neurosurgical practice especially after widespread use of CT scanning and MR imaging which had shown a higher incidence of such lesions in the literature that was approximately, presumed to be 1% of all intracranial lesions. The posterior fossa arachnoid cysts represent the second most common location after middle fossa and are found in 10-11% of all cases.

Most of the arachnoid cysts remain asymptomatic and are not diagnosed until the adjacent neurological structures are compressed by the steady growth of the cyst resulting in clinical manifestation that varies according to cyst location. Posterior fossa arachnoid cyst may be manifested clinically by headache, increased head circumference, impaired cognitive function, behavioral changes, and focal symptoms like cerebellar ataxia, vertigo and vestibulo-cochlear manifestations.

The posterior fossa arachnoid cyst should be differentiated from other congenital cystic lesions of posterior fossa like Dandy-Walker malformation, Blake's pouch cyst by its lack of communication with the fourth ventricle and such differentiation has been facilitated by advancement of recent MRI techniques.

Different surgical modalities have been proposed for the treatment of intracranial arachnoid cysts. Stereotactic aspiration, cystoperitoneal shunt, marsupialization and cyst fenestration into the subarachnoid space or just observation and follow up are the most common treatment strategies.
None of the previous treatment option has been considered to be optimum and management of such lesion remains debatable and not well addressed in the literature till the moment. The recent development of endoscopic tools and widespread use of neuroendoscopic techniques have provided a minimally invasive surgical treatment modality for such lesions. In our study, we retrospectively reviewed thirteen patients of posterior fossa arachnoid cysts treated by endoscopic cyst fenestration to evaluate the role of endoscopy as a minimally invasive treatment modality for management of such cases.

MATERIAL AND METHODS

We retrospectively reviewed patients admitted at the Neurosurgery Department, Mansoura University Hospital with posterior fossa cysts through the period from January 2000 to March 2014. One hundred and twenty patients with posterior fossa cyst were admitted during such period, of them we recorded thirty three patients complaining from posterior fossa arachnoid cysts, and thirteen out of them had been treated by endoscopic cyst fenestration.

This study included those patients who had been admitted with symptomatic posterior fossa arachnoid cysts and treated with endoscopic cyst fenestration. We excluded all posterior fossa cysts with different diagnosis like tumor related cysts, other posterior fossa congenital cysts like Dandy-Walker cysts, mega cistern magna and Blake's pouch cyst.

Also quadrigeminal cistern arachnoid cysts were excluded as these are considered incisural cysts. Moreover, twenty cases of posterior fossa arachnoid cysts managed either conservatively (eight cases) and those treated with ventriculoperitoneal shunt insertion (nine cases) or cyst marsupialization and fenestration (three cases) were also excluded from our study.

A retrospective analysis was done for every case including demographic data, full history and neurological examination and preoperative radiological studies including computed tomography and magnetic resonance images.

Postoperative outcome has been defined both clinically and radiologically. To define clinical outcome, we considered symptoms of increased intracranial pressure, focal neurological symptoms and signs while symptoms of psychomotor retardation were not considered because they are not related to the changes of the size of the cyst. Clinical outcome was defined as improved, unchanged and worsened according to the previous considerations.

Radiological outcome was defined according to size of cyst on three months follow up MRI. Cyst was classified as disappeared, reduced in size or unchanged. Recorded postoperative complications such as infection, hemorrhage, subdural fluid collections and CSF leak were considered.

Operative technique:

All patients were operated upon under general anesthesia with endotracheal intubation and prophylactic intravenous antibiotic given before skin incision.

Planning of burr-hole location and surgical trajectory were the most critical keys for success of the surgical procedures. The entry site should be selected to provide a direct and linear pathway that allows shortest, in line access to the distal targeted cyst wall that will be fenestrated.

A 0°, 30°, 70° rigid lens endoscopes were used (Karl-Storz, rigid Gaab system). The endoscopic sheath has an outer diameter of 6 mm and 2 mm working channel.

After introduction of endoscopy within the cyst, a copious irrigation was thrown into the field to provide clear visualization and localization of the thin, transparent arachnoidal membrane to be fenestrated either into the cisternal or the ventricular compartment.

Fenestration of the cyst into a basal cistern was preferred; if not possible the ventricular target was an alternative. After selection of target site the fenestration started by bipolar coagulation to do the initial attenuation that allows a blunt instrument to perforate the cyst wall. After doing the initial communication, a progressive dilation and enlargement of the stoma was continued using Fogerty balloon dilatation, punches and sharp scissors to create a large stoma that secures free flow of CSF.

Any bleeding was controlled with continuous irrigation, bipolar coagulation and embolectomy catheter tamponade to ensure a relatively a vascular surgical field and fenestration site. To and fro movement of the free edges of the stoma after brief withholding of irrigation is a good intraoperative sign for adequate and successful cyst fenestration. The endoscope was withdrawn after proper irrigation; the endoscopic track was plugged with gel foam.

RESULTS

Our study included eight females and five males ranging in age from 10 months to 25 years (mean = 60 months), that had been treated by endoscopic fenestration for symptomatic posterior fossa arachnoid cysts. Our patients were followed up for periods ranging from 6 months up to 118 months (mean = 34 months).
Headache was the most common presenting symptom and was found in six cases (46%), followed by large sized head in four patients (31%), disequilibrium and gait unsteadiness in three patients (23%), dizziness in two patients (15%), cognitive impairment in two patients (15%), repeated vomiting in one patients (7.5%) and torticollis in one patient (Table 1).

In our series the cyst was located in retro cerebellar, cisterna magna and foramen magnum regions in six patients, cerebellopontine angle in three patients, cerebellar hemisphere in two patients and two patients had supra cerebellar cysts (Table 2). Our procedures included endoscopic cystocisternostomy to either cistern magna in five cases, prepontine cistern in two cases or quadrigeminal cistern in one case (Fig. 1) and cystovenriculostomy to the fourth ventricle in two cases while third ventriculocystostocisternostomy was done in only one patient (Fig. 2, Table 3).

As regard clinical outcome; symptoms of intracranial hypertension, increased head size and torticollis improved in all patients (100%), while ataxia and disequilibrium improved only in one patient (33%) and remained unchanged in two. Finally dizziness improved in one patient with no clinical worsening for any patient. The overall clinical improvement was recorded to be 77% (Table 1).

Radiological outcome obtained from three months follow up MRI showed complete remission of the cyst in three patients (23%), reduction in cyst size in eight patients (62%) while the size of the cyst remain unchanged in two patients (Table 3).

In our study we did not repeat endoscopic procedure for the cyst fenestration, nevertheless endoscopic third ventriculostomy was done to resolve persistent supratentorial hydrocephalus in one patient even with postoperative reduction of the cyst size while a cystoperitoneal shunt was inserted in another patient with cisterna magna cyst after failure of endoscopic fenestration to improve the patients symptoms and the cyst remained unchanged in the postoperative radiological studies.

No mortality or permanent neurological morbidities were recorded in our patients. The complications were minor including CSF leak in two patients, subdural fluid collection in two patients, subcutaneous fluid collection in one patient and only one patient had wound infection. All complications were treated conservatively.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Preoperative (%)</th>
<th>Postoperative (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>6 (46%)</td>
<td>0</td>
</tr>
<tr>
<td>Increased head size</td>
<td>4 (31%)</td>
<td>0</td>
</tr>
<tr>
<td>Gait instability, ataxia</td>
<td>3 (23%)</td>
<td>2</td>
</tr>
<tr>
<td>Dizziness</td>
<td>2 (15%)</td>
<td>1</td>
</tr>
<tr>
<td>Repeated vomiting</td>
<td>1 (7.5%)</td>
<td>0</td>
</tr>
<tr>
<td>Torticollis</td>
<td>1 (7.5%)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>23%</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Vermis, cisterna magna and foramen magnum</td>
<td>6</td>
</tr>
<tr>
<td>Cerebellopontine angle</td>
<td>3</td>
</tr>
<tr>
<td>Cerebellar hemispheres</td>
<td>2</td>
</tr>
<tr>
<td>Supra cerebellar</td>
<td>2</td>
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</table>
Table (3): Endoscopic procedures, cyst location and radiological outcome

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Total number</th>
<th>Cyst location</th>
<th>Remission or improvement</th>
<th>Unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cysto-cisternostomy to cisterna magna</td>
<td>6</td>
<td>Cisterna magna</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>retrocerebellar foramen magnum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cysto-Ventriculostomy to 4th ventricle</td>
<td>2</td>
<td>Cerebellar hemisphere</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Ventriculo cystostomy to posterior 3rd ventricle+ETV</td>
<td>1</td>
<td>Supracerebellar</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cysto-Clisernostomy to prepontine cistern</td>
<td>3</td>
<td>CPA</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cysto-Cisternostomy to quadrigeminal cistern</td>
<td>1</td>
<td>Supracerebellar</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13</strong></td>
<td></td>
<td><strong>11 (84.6%)</strong></td>
<td><strong>2 (15.4%)</strong></td>
</tr>
</tbody>
</table>

ETV=endoscopic third ventriculostomy

Table 4: Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSF leak</td>
<td>2</td>
</tr>
<tr>
<td>Subdural fluid collection</td>
<td>2</td>
</tr>
<tr>
<td>Subcutaneous fluid collection</td>
<td>1</td>
</tr>
<tr>
<td>Wound infection</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 1: a-f: Supracerebellar arachnoid cyst. a: Preoperative MRI: supracerebellar cyst with cerebellar tonsil descent into the foramen magnum; b: Preoperative CT scan of the same patient; c: Intraoperative endoscopic view of the anterior wall of the cyst d: Postoperative MRI showing remission of cyst and improvement of tonsillar herniation; e: Postoperative CT scan with remission of the cyst; f: Endoscopic view after fenestration of the anterior wall of the cyst.
DISCUSSION

Arachnoid cyst is a pathological disorder in which a discrete sac lined with arachnoidal cells and filled with a CSF like fluid create intracranial dynamic changes owing to displacement and shifting of nearby neurological structures. It may be associated with intracranial hypertension \(^{12,17}\).

Posterior fossa has been found to be the second common location for arachnoid cyst that stands for 10-11% of all cases \(^{5,6,7}\). Although arachnoid cysts are relatively seen more frequently nowadays especially with modern era of radiological investigation but the development and natural history of such lesions are still controversial \(^{2,8}\).

The origin and etiology of the arachnoid cyst has been discussed in the literature. Arachnoid cysts most probably are formed by splitting of arachnoid membranes as a result of local alternation of CSF flow and pressure; however infection, trauma and CSF dynamic changes are different hypotheses that tried to explain their origin \(^{7,19}\). Inflammatory and ependymal cells had been reported to be found in the wall of the arachnoid cyst in sporadic cases but histological examination with light and electron microscopy proved duplication of arachnoid membrane in the majority of cases \(^{20}\).

The clinical presentations of arachnoid cysts are closely related to the expansion of their sizes which was explained by many authors \(^{21}\). Intracystic hemorrhage, ball valve mechanism that has been observed by different surgeons during endoscopic procedures, an active secretion from the cyst wall and passive diffusion into the cyst by different osmotic gradient between extra and intracystic components are different theories that explain the progressive cyst growth, but none of them had been proven yet \(^{22}\).

Diagnosis of posterior fossa arachnoid cyst and its differentiation from other posterior fossa cysts has been refined with the recent advancement of MRI techniques especially cine phase MRI \(^{9}\). In our study we used high resolution CT and different MRI techniques to diagnosis our cases and our clue of diagnosis was sharp well defined extra axial posterior fossa sac containing fluid of same density or signal intensity comparable with that of CSF with no enhancement after contrast administration. In some cases, we used diffusion MRI technique to distinguish arachnoid cyst from epidermoid tumor in suspicious cases which demonstrated suppression of signal intensity with lack of restrictions of water molecules diffusion that is diagnostic for arachnoid cyst.
Manifestations of intracranial hypertension were the most common presenting symptoms (46%) in our patients followed by progressive head enlargement in (31%), gait instability and ataxia in 23%.

Other series reported hearing loss, facial nerve palsy and signs of brain stem compression as presenting symptoms of posterior fossa arachnoid cysts while these clinical findings were not recorded in our patients. However, according to our findings, clinical presentation is not always influenced by the location of the cyst in the posterior fossa e.g. cerebellopontine angle location may not present by hearing loss or facial nerve palsy.

Many reports found lack of direct correlation between the morphological and clinical behavior in most posterior fossa arachnoid cysts, therefore there is no intimate association between the presence of posterior fossa arachnoid cysts and the development of clinical manifestations. Our study proved the previous observation as we found only twenty five symptomatic posterior fossa arachnoid cysts that need surgical intervention out of thirty three cases of posterior fossa arachnoid cyst. The remaining eight cases were just observed and followed.

Our indications of surgical intervention were based on worsening of clinical sign and symptoms in addition to radiological signs of compression and displacement of neurovascular elements. Some authors believe that all arachnoid cysts exerting a mass effect even asymptomatic should be surgically treated to avoid the possible risks of neural compression; however all patients in our study were symptomatically manifest.

Options for surgical management of arachnoid cysts remain controversial. Those options include either microscopic cyst excision with marsupialization and open fenestration of the cyst, shunt placement, stereotactic cyst aspiration or endoscopic fenestration. Advantages and disadvantages of each surgical modality had been extensively discussed.

Stereotactic puncture of the cyst is associated with inadequate fenestration and insufficient communication with the subarachnoid space which facilitates cyst expansion and recurrence. Although cystoperitoneal shunt is the simplest and least demanding technique but it may be complicated by shunt dependence, shunt infection, obstruction and proximal tube malposition especially in small posterior fossa. The shunt should be considered only in case of recurrence or re accumulation of arachnoid cyst. In our study we inserted cystoperitoneal shunt in a case of cisterna magna cyst after failure of endoscopic fenestration to improve the patient's symptoms.

Even though open craniotomy reported good outcome for excision of cyst wall or marsupialization with cyst fenestration but it carries the risk of meningitis, neural tissue injury with subsequent neurological deficit, subdural hematoma and edema of the posterior fossa that may lead to a devastating outcome. Moreover, cyst recurrence has been reported in some patients; therefore, the relative risk of such procedures is not justified especially when the clinical symptoms of the patient are minor and not life threatening.

Some authors found difficulties with endoscopic techniques related to vascularity and toughness of the arachnoid membrane. We overcome such difficulty by proper preoperative planning of the burr-hole placement, trajectory and site of fenestration. Intraoperatively, under good visualization we select the target area for fenestration that should be thin and transparent with no large blood vessel. Small size of instruments and their limited movement inside the endoscopic working channel and lack of bimanual control are limiting factors during endoscopic surgery especially during control of bleeding which could obscure the endoscopic procedure. Our technique of clear vision inside the cyst depends mainly on continuous profuse irrigation, avoiding vascularized membranes, coagulation of membrane before fenestration and tamponade by the embolectomy catheter.

Gangemi et al. in their comparative study and after reviewing the literature they found that the success rates of endoscopic cyst fenestration, microsurgical marsupialization and fenestration by craniotomy and shunting of the cyst are almost similar and recorded them as 83%, 86%, 90% respectively. They concluded that endoscopic procedure should be performed first and a microsurgical technique to be considered as a next step when endoscopic fenestration fails.

To our knowledge our work is considered to be the largest series of posterior fossa arachnoid cysts treated by endoscopic fenestration and all cases reported in the literature were sporadic and only 18 cases of posterior fossa arachnoid cyst treated by endoscopic fenestration were published. It has been reported that remission and reduction of cyst wall in the previously published case series was achieved in 15 patients (83.3%) out of 18 patients.

In our series; the manifestations of intracranial hypertension improved in all patients while dizziness improved in one out of two of patients and ataxia improved only in two out of three patients with overall clinical improvement in 77%. Radiological reduction of cyst size either totally or partially had been achieved in eleven patients (84.6%) with only two posterior fossa cysts remaining unchanged in size in postoperative follow up MRI despite clinical improvement in one of them. These results are comparable with those previously published in the literature and reviewed by Gangemi et al.

Our series included no major postoperative complication and all the complications encountered in our study were minor including two cases of postoperative CSF leak, two cases of subdural fluid...
collection, one case of wound infection, and one case of subcutaneous fluid collection, all complications were treated conservatively.

Our study for endoscopic fenestration of posterior fossa cysts provides good clinical and radiological outcome and supports the previous reports that advise endoscopic cyst fenestration to be the first line of treatment in posterior fossa arachnoid cysts.

CONCLUSION

Endoscopic approach for posterior fossa arachnoid cysts should be considered as a minimally invasive alternative to traditional surgical modalities of such entity. We recommend such effective and safe technique that carries minimal morbidity as a first treatment option for symptomatic posterior fossa arachnoid cysts and cystoperitoneal shunts could be reserved only for residual or recurrent cases.

Disclosure:
The authors declare that they have no financial or other conflicts of interest in relation to this research and its publication.

REFERENCES


