A series of 20 cases of arachnoid cysts in the posterior fossa is reported. Classification was made according to the location of the cysts. Accurate clinical localization was only possible with cysts in the cerebellopontine angle. Ventriculography and pneumoencephalography were the most helpful investigations for making the diagnosis. Treatment consisted of suboccipital craniectomy and complete removal. There were four operative deaths. The remaining 16 patients had essentially complete recoveries.

**Key Words**  
- arachnoid cyst  
- infratentorial  
- ventriculography  
- suboccipital craniectomy

Although supratentorial arachnoid cysts are often asymptomatic and may be an incidental finding at autopsy, the more rare infratentorial arachnoid cysts give rise to symptoms. This paper reviews the experience at the Mayo Clinic with arachnoid cysts in the posterior fossa.

The first description of a supratentorial intracranial arachnoid cyst was given by Quain in 1855. Arachnoid cysts in the posterior fossa were first reported by Maunsell in 1889. Under the term "chronic cystic arachnoiditis," Craig described the clinical picture of this entity which he attributed to an inflammatory reaction of the leptomeninges. Since that time, a number of case reports of arachnoid cysts in the posterior fossa have appeared in the literature. The hypotheses offered to explain the development of these cysts have included congenital malformation, infection, trauma, increased intraventricular pressure, and embryonic rests. Arachnoid cysts also have been described in association with tumors in the posterior fossa and are presumably produced by some form of transudate.

### Analysis of Cases

We studied the records of all patients with cystic intracranial lesions seen at the Mayo Clinic between 1932 and 1972. Twenty patients were found to have an arachnoid cyst in the posterior fossa (Table 1). The age of the patients at the time of diagnosis ranged from 2 to 66 years; five patients were in the pediatric age group (less than 15 years old).

#### Anatomical Location

The patients have been grouped according to the anatomical location of the cyst (Fig. 1). Thirteen of the cysts were large, measuring more than 5 cm in diameter, and some of these extended into adjacent anatomical regions. The locations of the cysts were six in the cerebellopontine angle,
Infratentorial arachnoid cysts

### TABLE 1

<table>
<thead>
<tr>
<th>Location</th>
<th>Case No.</th>
<th>Sex, Age (yrs)</th>
<th>Postulated Cause</th>
<th>Outcome</th>
</tr>
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<tbody>
<tr>
<td>cerebellopontine angle</td>
<td>1</td>
<td>F 14</td>
<td>trauma</td>
<td>sig. improvement</td>
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<tr>
<td></td>
<td>2</td>
<td>F 48</td>
<td>unknown</td>
<td>sig. improvement</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>F 44</td>
<td>otitis media; mastoiditis</td>
<td>sig. improvement</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>F 49</td>
<td>postinflammatory</td>
<td>sig. improvement</td>
</tr>
<tr>
<td></td>
<td>5</td>
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<td>otitis media</td>
<td>sig. improvement</td>
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<tr>
<td></td>
<td>6</td>
<td>M 56</td>
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<td>sig. improvement</td>
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<tr>
<td>inferior midline</td>
<td>7</td>
<td>M 36</td>
<td>ectopic choroid tuft</td>
<td>complete remission</td>
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<tr>
<td></td>
<td>8</td>
<td>M 18</td>
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<td>sig. improvement</td>
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<td>M 66</td>
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<td>11</td>
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<td>12</td>
<td>F 23</td>
<td>postinflammatory</td>
<td>sig. improvement</td>
</tr>
<tr>
<td>superior midline</td>
<td>13</td>
<td>M 14</td>
<td>postinflammatory</td>
<td>complete remission</td>
</tr>
<tr>
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<td>14</td>
<td>M 43</td>
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<td>complete remission</td>
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<td>15</td>
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<td>unknown</td>
<td>died</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>F 2</td>
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<td>died</td>
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<td></td>
<td>17</td>
<td>F 9</td>
<td>postinflammatory</td>
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<td>M 36</td>
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<td>sig. improvement</td>
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<td></td>
<td>20</td>
<td>F 41</td>
<td>diverticulum</td>
<td>complete remission</td>
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</table>

Six in the inferior midline, one in the superior midline, four over the hemispheres, two in the tentorial notch, and one in the region of the clivus. Three patients who had an arachnoid cyst of the posterior fossa were excluded from this series because the cyst was found in association with an intracranial neoplasm; two of these patients had a pontine glioma and the other had a menigioma.

**Clinical Characteristics**

Clinical localization of the lesion was most often made for cysts in the cerebellopontine angle. Five of these six patients had a combination of symptoms and neurological signs that were diagnostic of a tumor in that location. With cysts in the other sites, however, the usual presenting symptoms and signs were those of increased intracranial pressure (headache, vomiting, and choked discs). Two prominent features in the clinical picture were the influence of posture on the symptoms and the episodic character of the symptoms. Twelve of the patients complained of severe exacerbation of symptoms with head-turning, stooping, or twisting. Fourteen patients displayed an episodic clinical profile lasting for 2 or more years. The duration of symptoms before diagnosis averaged more than 4 years (range, 10 days to 33 years).

**X-ray Studies**

Skull roentgenograms were made on each patient preoperatively. In nine there was evidence of increased intracranial pressure, and in 11 there was no abnormality. A left retrograde brachial angiogram was performed in one patient, and it revealed an avascular mass in the left cerebellopontine angle.

Ventriculography and fractional pneumoencephalography were the most helpful investigations for making the diagnosis. Ventriculography was performed on 13 patients and showed dilatation of the third and lateral ventricles in all. In one case of arachnoid cyst of the tentorial notch there appeared to be a communication between the cyst and the posterior aspect of the third ventricle. Fractional pneumoencephalograms demonstrated abnormalities in all four patients on whom this examination was performed.
Fig. 1. Anatomical locations of arachnoid cysts.  


B. Left hemispheric cyst.  

C. Clivus cyst.  

D. Tentorial notch cyst.  

E. Superior midline cyst.  

F. Inferior midline cyst.
Infratentorial arachnoid cysts performed; there was no ventricular filling in three cases, and there was a circumscribed lesion of the posterior fossa in three cases. One of the arachnoid cysts studied partly filled with air injected into the lumbar subarachnoid space.

The cerebrospinal fluid (CSF) was normal in 12 of the 16 patients examined. In the remaining four patients there was a slight increase in protein content (concentration < 100 mg/100 ml); and in addition, one had a mild pleocytosis (25 lymphocytes/mm³). Attempts to culture bacteria and fungi, including injections into animals in search for acid-fast bacilli, failed to demonstrate any pathogenic organisms.

Operative Findings

All 20 patients underwent suboccipital exploration in the upright sitting position. Nineteen were found to have a discrete thin-walled cyst compressing the neighboring structures. One patient whose cyst was not found at exploration died 12 hours postoperatively; autopsy disclosed a tentorial notch cyst. Free communication of the cyst with the ventricular system was observed in one patient at the time of operation; this patient had a tentorial notch cyst communicating with the third ventricle. One inferior midline cyst contained a tuft of choroid plexus tissue, to which the production of the contained fluid was attributed. Complete removal of the cyst lining and establishment of free communication between the fourth ventricle and the subarachnoid pathways were carried out whenever possible.

It was not always clear at the time of operation whether these cysts lay between the two arachnoidal layers, between the pia mater and the visceral arachnoid, or between the dura mater and the parietal arachnoid. The cyst walls were thin and some were only slightly thicker than normal arachnoid. Microscopic examination of the cyst walls demonstrated arachnoid tissue, usually with some fibrous thickening but without any evidence of an inflammatory infiltrate or ependymal lining. An occasional thin-walled vessel was seen within some of the membranes. Arachnoidal adhesions were present in the vicinity of the cyst in nine cases. The fluid of all cysts was clear and colorless, resembling normal CSF.

Origin of Cysts

The causes of the arachnoid cysts remained obscure in most of our cases. Birth trauma associated with intracranial bleeding probably played a role in at least one case, a 14-year-old girl, who at birth had right hemiparesis and right facial weakness which were attributed to a difficult delivery. None of our patients had symptoms suggestive of a previous central nervous system infection. One patient, who had a cyst in the cerebellopontine angle, had had bilateral, acute, purulent otitis media prior to the onset of his neurological symptoms. A second patient, also with a cerebellopontine angle cyst, had had severe otitis media and mastoiditis on the same side as the cyst more than 10 years previously.

An associated congenital abnormality was present in two cases. One patient with an inferior midline cyst and one with a hemispheric cyst that extended into the inferior midline region had a persistent inferior medullary velum. Another patient, a 2-year-old girl, had an abnormally large head from birth, which probably was related to a prenatal arachnoid cyst.

A communication between the posterior third ventricle and a tentorial notch cyst in one patient suggested that the cyst may have developed as a diverticulum of the third ventricle secondary to increased intraventricular pressure. However, the patient's symptoms resolved completely after removal of the cyst.

Mortality

There were four postoperative deaths. One patient had cardiac arrest during the operation and died shortly thereafter. A second patient died 12 hours postoperatively, and autopsy revealed a large blood clot in the posterior fossa compressing the brain stem. A third patient had a high fever 2 days after the operation and died on the third day; autopsy failed to demonstrate any evidence of an infection of the central nervous system. The remaining patient died 12 hours postoperatively, and autopsy demonstrated an arachnoid cyst of the tentorial notch.
Follow-up

Follow-up of the remaining 16 patients has ranged from 6 months to 15 years (≥ 2 years for 14). Eleven were significantly improved with only minor residual symptoms, and five had a complete remission. There have been no recurrences. The patients with relatively short duration of symptoms prior to diagnosis tended to have the best surgical results.

Discussion

Arachnoid cysts probably occur in both a congenital and an acquired form. Acquired cysts may develop secondary to adhesive arachnoiditis or trauma or as a diverticulum of the third ventricle, fourth ventricle, or the temporal horn of the lateral ventricle.

Trowbridge and French postulated that some cysts form from embryonic rests. These rests then develop into rudimentary secretory organs or into a highly developed, mature choroid plexus. The incarceration of the ectopic tissue in such a manner impedes the free circulation of fluid, leading to the formation of an arachnoid cyst. Such a situation may have been present in one of our patients whose cyst contained a tuft of choroid plexus.

Gardner, et al., believed that arachnoid cysts in the region of the foramina of Luschka and Magendie, Arnold-Chiari malformation, Dandy-Walker syndrome, and thick arachnoidal bands around cerebellar tonsils and medulla are merely different expressions of the same process, namely, failure of the outlets of the fourth ventricle to develop normally in the rhombencephalic roof. In another article, Gardner, et al., stated that “these four hindbrain expressions of atresia occur in adults in varying degrees and combinations and frequently are accompanied by congenital scoliosis, basilar impression and syringomyelia.”

In our experience there has been little evidence to suggest an association between arachnoid cysts of the posterior fossa and the Arnold-Chiari malformation, Dandy-Walker syndrome, or thickened arachnoidal bands around the cerebellar tonsils and medulla. None of our patients had an associated congenital scoliosis or basilar invagination; however, one patient had syringomyelia. In a recent review of 80 cases of Arnold-Chiari malformation in the adult at the Mayo Clinic, Yanagihara was unable to find a single case with an arachnoid cyst or diverticulum of the fourth ventricle.

An inflammatory reaction in the leptomeninges secondary to the presence of blood, infection, or a contiguous inflammation has frequently been suggested as the underlying cause of the formation of arachnoid cysts. Dott thought that these cyst-like collections of fluid are open proximally, where the appropriate artery pumps CSF into them. The cysts are supposedly closed distally by adhesive arachnoiditis from birth trauma, an allergic reaction to blood or tumor transudate, or infection. Horrax described five patients in whom a cystic collection of CSF occurred in the lateral recess of the posterior fossa after otitis media. He believed that the arachnoid had been involved by extension of the inflammatory process from the middle ear.

An adhesive arachnoiditis probably played a role in the formation of some of the cysts reported here: there had been previous head trauma in one patient and acute purulent otitis media in two patients. Adhesive arachnoiditis near the cyst was found in six additional patients, suggesting prior inflammation even though there was no history of head trauma or infection. Microscopic examination of the cyst membranes failed to reveal signs of an inflammatory reaction. However, inflammation subsequently replaced by fibrosis could have occurred with a subclinical infection or with a small amount of subarachnoid bleeding subsequent to mild head trauma. It is of interest to note that the adhesions were adjacent to the cysts, suggesting a very localized reaction.

Infratentorial cysts may form as diverticula from the mesial wall of the temporal horn of the lateral ventricle or from the anterior or posterior wall of the third ventricle. Such diverticula usually are formed secondary to increased intraventricular pressure produced by an obstructed cerebral aqueduct. Removal of a cyst produced by this mechanism is not curative. One of the two tentorial notch cysts in our series communicated with the third ventricle, and yet there
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was no evidence of a primary aqueductal obstruction. Cyst removal resulted in the complete remission of symptoms.

The walls of these cysts are composed, in whole or in part, of arachnoid. However, it is difficult to determine the contribution made by the pia mater and ependyma in the formation of a cyst because of the chronic changes that have taken place. The occasional presence of thin-walled vessels in the wall of a cyst would suggest that the arachnoid is not the only membrane involved or that there was a previous inflammatory reaction. Ependymal epithelium in a segment of the cyst wall has previously been reported by Gardner, et al., and Matson. The relatively long duration in most of the cases indicated a benign course. Variation in the size of the cyst, possibly related to movement of CSF through a small orifice, would explain the episodic character of the symptoms. Trowbridge and French suggested that these features are produced by a "ball valve" obstruction of the cyst, similar to the phenomena observed with tumors of the third ventricle.

Treatment of arachnoid cysts of the posterior fossa consists of suboccipital craniectomy and excision. The operation is essentially curative; however, mild residual symptoms may persist if the central nervous tissue has been severely compressed by the cyst. It is extremely important to make a diligent search of the posterior fossa in order to rule out the occurrence of multiple cysts; these have been reported in cases of arachnoid cysts in association with atresia of the outlets of the fourth ventricle.

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