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MR Imaging of CSF-like Choroidal Fissure and Parenchymal Cysts of the Brain

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The purposes of this study were to delineate the MR characteristics of CSF-like parenchymal or fissural cysts of the brain and to correlate them with the clinical findings. Clinical data and MR images of 34 patients with these abnormalities were reviewed. Pathologic correlation was not available. Two types of cystic lesions were identified and separated by location: medial temporal lobe cysts arising in or near the choroidal fissure (26 patients) and parenchymal or pseudoparenchymal cysts not related to the choroidal fissure (eight patients). The choroidal fissure cysts simulated intraparenchymal cysts on axial images but their extraaxial location was well portrayed on the coronal images. Choroidal fissure cysts had a characteristic spindle shape on sagittal images. The other cysts were found in the temporal lobe (seven patients) or thalamus (one patient) and appeared parenchymal but situated close to the subarachnoid space. These lesions were round or ovoid. There was no abnormal enhancement in 10 patients studied with gadopentetate dimeglumine. Coronal images were most useful, revealing the cysts as focal CSF-intensity lesions expanding the choroidal fissure of the temporal lobe. All the cysts appeared to represent incidental findings that did not correlate with the clinical signs and/or symptoms that prompted the imaging evaluations.

The MR characteristics of CSF-like cysts are important to recognize so that they are not confused with other, more serious entities, such as intraaxial cystic tumors, infarctions, or parasitic lesions.

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Cysts of the CNS are categorized in a variety of ways. However, the most important consideration is whether the lesion is neoplastic or nonneoplastic. If it is nonneoplastic, it is then important to determine the potential clinical significance of the cyst. We have encountered a variety of cystic lesions involving the temporal lobe, including a group with strikingly similar imaging characteristics. We examined the MR characteristics and determined the clinical significance of these cysts with emphasis on lesions that invaginate the temporal lobe.

Patients and Methods

Thirty-four patients with CSF-like paramedian temporal lobe or basal ganglia cysts were prospectively identified over a 3-year period by one of the authors. All examinations included at least three sequences: T1-weighted spin-echo, 500-600/20-25/2 (TR range/TE range/excitations), intermediate spin-echo (2400-2700/30-40/1, 2), and T2-weighted spin-echo (2200-2700/60-90/1, 2). Section thickness was 5 or 7 mm. Without surgical exploration, we determined that the lesions were benign cysts on the basis that they had characteristics typical of cysts in the brain and other anatomic areas; that is, no detectable wall or associated soft-tissue mass, homogeneous consistency, signal intensity identical to CSF, absence of surrounding edema or gliosis, and lack of contrast enhancement (selected cases) [1, 2]. Gadopentetate-dimeglumine-enhanced MR imaging was performed in 10 patients. CT scans were obtained by us or were available for review in 20 patients. We obtained clinical correlation by conferring with the referring physician and by reviewing the patient charts. Follow-up MR examinations, made 2-24 months after the initial study, were acquired in 10 patients.

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Results

Two types of cystic lesions were identified: medial cysts that were shown to arise in or near the choroidal fissure on coronal images and parenchymal or pseudoparenchymal cysts not related to the choroidal fissure. All cysts were sharply demarcated from the adjacent brain. There was no discernible wall or evidence of surrounding gliosis. There was no evidence of mass effect or edema. The cysts were isointense with CSF on all sequences. None of the patients had surgery on the cysts or died during the period of the study; thus, there is no histopathologic correlation.

Group 1

Group 1 consisted of 26 patients in whom the cysts were identified in or near the choroidal fissure of the medial temporal lobe. These patients ranged in age from 5 to 74 years (mean, 38 years). There were 16 females and 10 males. The cysts were bilateral in two patients, and typically were ovoid in shape with the long axis in the anteroposterior plane parallel to the choroidal fissure (Figs. 1–5). The cysts typically appeared intraaxial on axial images but their relationship with the choroidal fissure was apparent on coronal images. On sagittal images the cysts were spindle-shaped (Figs. 1 and 2). Cyst size varied from $5 \times 4 \times 4$ mm to $30 \times 20 \times 18$ mm. The average size was $11.0 \times 8.7 \times 8.7$ mm. Gadopentetate-dimeglumine-enhanced MR imaging was performed in five of these patients and revealed no evidence of enhancement on T1-weighted images (Fig. 4). CT scans with and without contrast enhancement were available in 10 patients, while only noncontrast scans were available in five patients. The cysts were not seen owing to artifact in three patients. In the other eight patients the cysts appeared isodense (cursor

density measurements were not available) with CSF (Figs. 2 and 5).

Clinical Correlation: Group 1

The MR studies were performed to evaluate for suspected tumor, brain trauma, infarct, or demyelinating disease. Primary symptomatology included complex migraine headache syndrome (five patients) (Figs. 3 and 4), seizure disorder (five patients), gait disturbance/tremor (four patients), vertigo/hearing loss (three patients), head trauma (two patients) (Fig. 1), paresthesia (two patients), hemiparesis (three patients), visual scotomata (one patient) (Fig. 5), and positive HIV test (one patient) (Fig. 2). The combined imaging and clinical assessment was that the cysts could not explain the patients' signs or symptoms. Clinical follow-up without development of signs or symptoms referable to the cysts varied from 3–34 months (average, 17.8 months). In the five patients with seizures the clinical assessment was that the cysts were probably unrelated to the seizures since there were no focal electroencephalographic signs or physical manifestations of the seizure disorders that corresponded to the cysts.

Group 2

Group 2 was composed of eight patients in whom the cysts were unrelated to the choroidal fissure and appeared intra-parenchymal in that a definite communication with the sub-arachnoid space could not be identified on images in all three planes. There were seven women and one man, ranging in age from 18 to 61 years (average, 46 years). Five patients were studied with gadopentetate dimeglumine without evidence of enhancement. The cysts were isodense with CSF on CT scans with and without contrast in five patients.

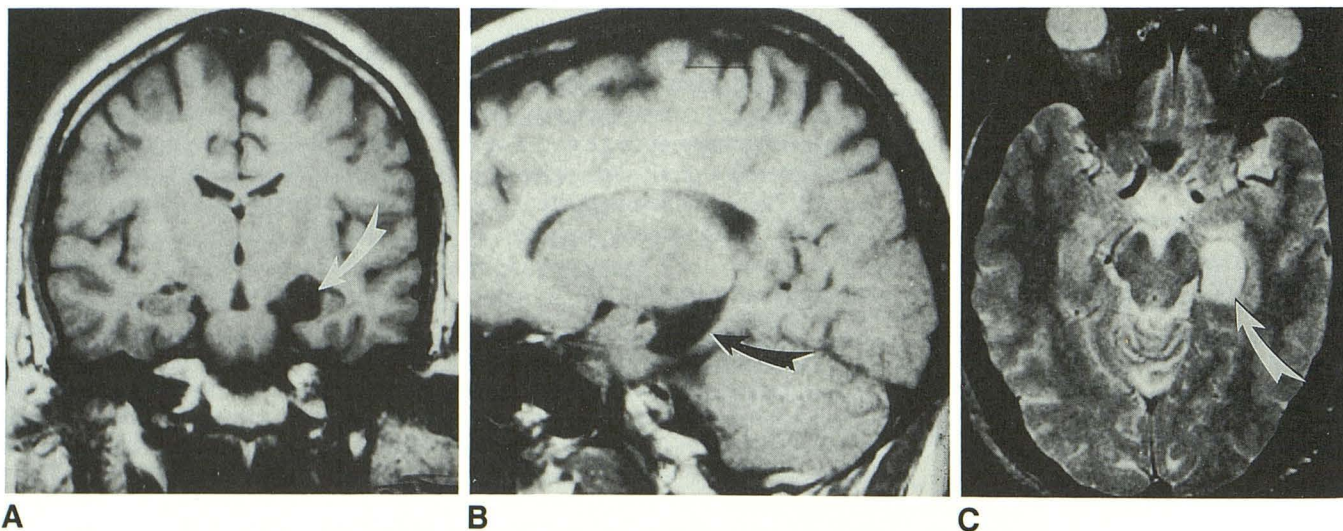


Fig. 1.—Left choroidal fissure cyst (arrows) in 36-year-old man who had CT scan (not shown) for head trauma. MR was obtained to evaluate hypodensity in left temporal lobe.

A, Coronal T1-weighted spin-echo image (600/20).

B, Sagittal T1-weighted spin-echo image (500/20) reveals typical spindle-shaped cyst.

C, Axial T2-weighted spin-echo image (2600/80).

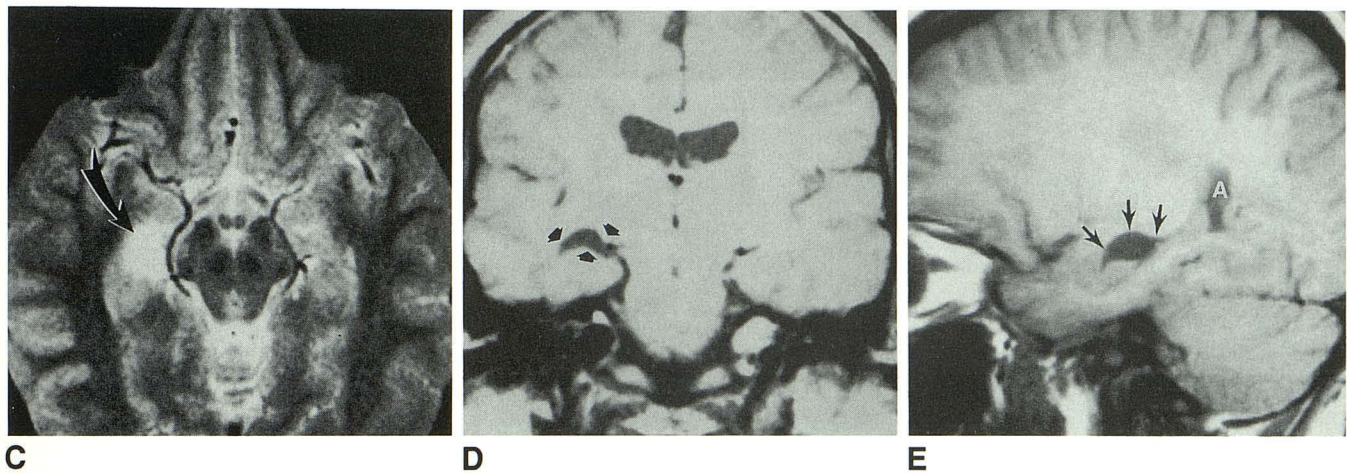
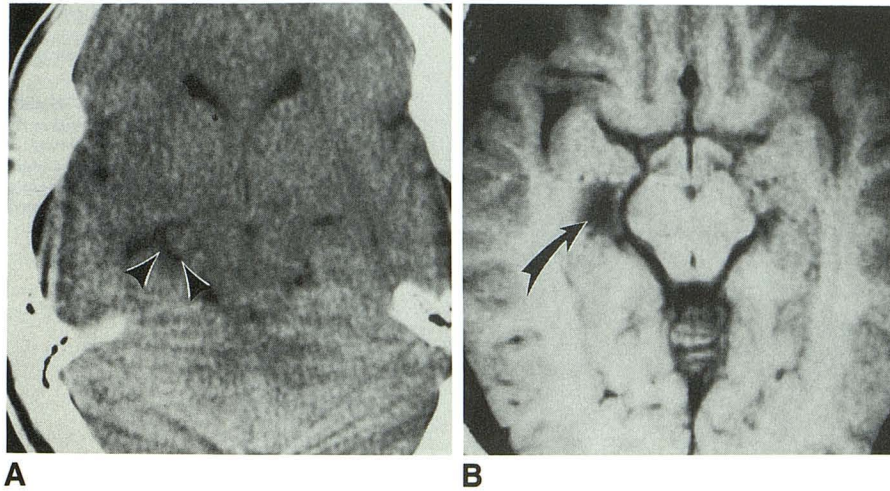


Fig. 2.—Right choroidal fissure cyst (*arrows*) in 31-year-old HIV-positive man who had MR after CT demonstrated lesion in right temporal lobe. **A**, Noncontrast CT scan. Poorly demarcated right temporal lobe lesion (*arrowheads*) is difficult to differentiate from ventricle. **B–E**, MR images clearly reveal characteristics of cyst in all three planes. The cyst appears intraparenchymal on axial images. Axial T1-weighted spin-echo image (600/20) (**B**). Axial T2-weighted spin-echo image (2600/80) (**C**). Coronal T1-weighted spin-echo image (600/20) (**D**) most clearly shows cyst origin in choroidal fissure. Sagittal T1-weighted spin-echo image (600/20) (**E**) reveals typical spindle-shaped cyst. (**A** = atrium of lateral ventricle.)

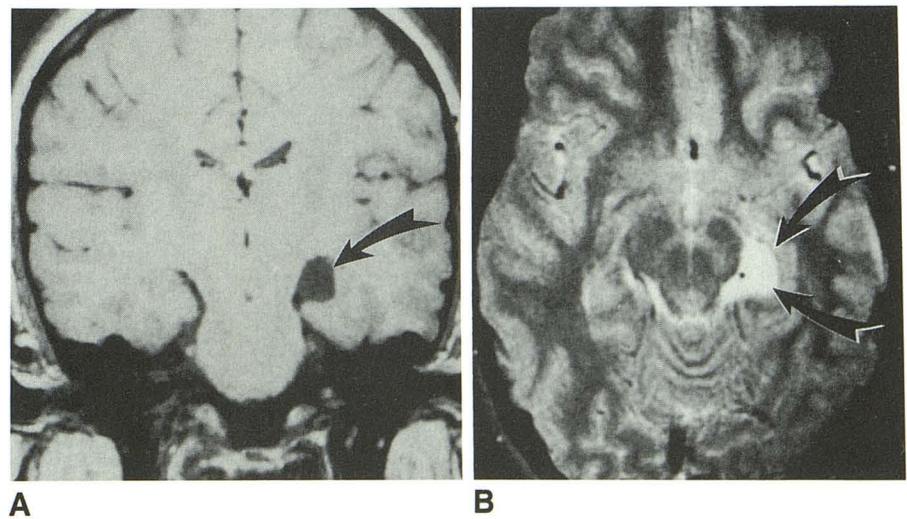


Fig. 3.—Left choroidal fissure cyst (*arrows*) in 13-year-old girl who had MR for evaluation of complex migraine headache and paresthesia. **A** and **B**, Typical appearance of cyst between mesial temporal lobe and brainstem is seen on coronal T1-weighted spin-echo image (600/20) (**A**) and axial T2-weighted spin-echo image (2500/80) (**B**).

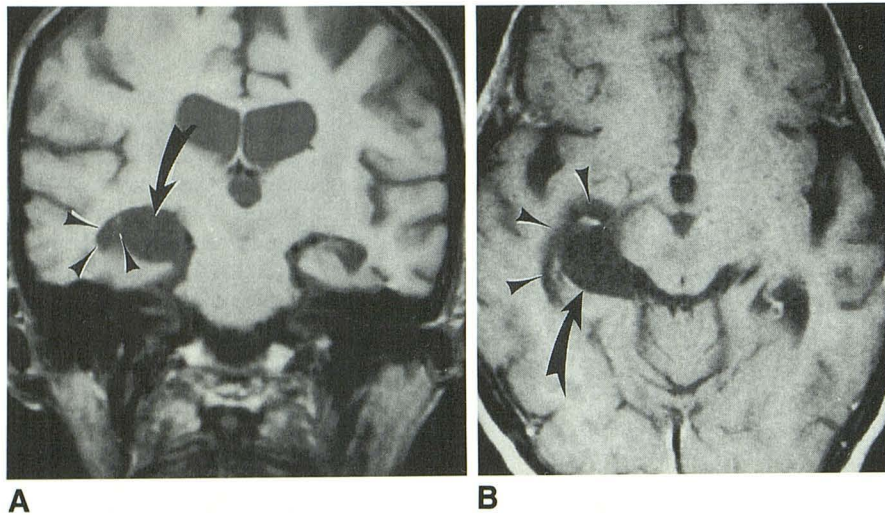


Fig. 4.—Right choroidal fissure cyst in 74-year-old woman with cerebral atrophy who was evaluated for migraine headaches and depression.

A and B, Large cyst (arrows) medial to temporal tip of lateral ventricle (arrowheads) is seen on coronal T1-weighted spin-echo image (600/25) (A) and gadopentetate-dimeglumine-enhanced axial T1-weighted spin-echo image (500/20) (B). There is no enhancement of lesion.

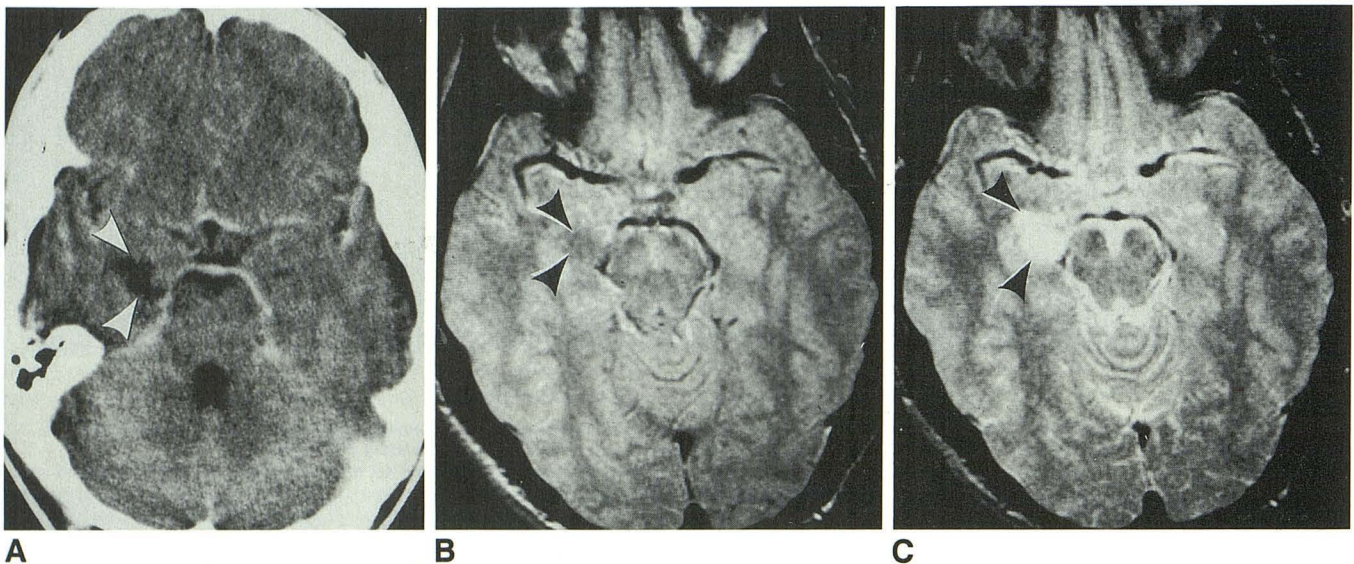


Fig. 5.—Right choroidal fissure cyst (arrowheads) in 27-year-old man with visual scotomata. A-C, CSF-density cyst was discovered on contrast CT scan (A). Cyst is isointense with CSF on axial proton-density-weighted spin-echo MR image (2600/30) (B) and axial T2-weighted spin-echo MR image (2600/80) (C).

The cysts in this group were more rounded and irregular in shape than those in Group 1. They varied in size from $6 \times 5 \times 5$ mm to $20 \times 12 \times 22$ mm. Five patients had cysts near the sylvian fissure (Figs. 6 and 7). These patients (ages 42, 48, 49, 54, and 61) had lesions that were just inferior to the sylvian fissure and in three cases were indented or invaginated by a branch of the middle cerebral artery. On T1-weighted images this appearance simulated a giant aneurysm. Two patients (ages 58 and 31) each had a cyst just superior to the temporal tip of the lateral ventricles. These did not appear to communicate with the ventricles or with the adjacent subarachnoid space. One patient (66 years old) had a septated cyst extending into the thalamus (Fig. 8) measuring $25 \times 15 \times 15$ mm, which did not appear directly related to the choroidal fissure or the adjacent ventricle.

Clinical Correlation: Group 2

None of these patients had seizure disorders. Of the five patients with cysts near the sylvian fissure one was evaluated for diplopia, one for hearing loss, one for paranasal sinus disease, one for mild head trauma, and one for vertigo. This subgroup of patients has been followed clinically for an average of 17 months (4–24 months) without development of symptomatology related to the temporal lobe. A 31-year-old woman had MR imaging for evaluation of hemifacial pain. The cyst was unrelated to her symptoms. She has been followed for 6 months. A 55-year-old woman had a cystic lesion in the thalamus. It appeared septated and did not change over a 3-year period. The patient was originally evaluated for migraine headache and had no signs or symptoms that were related

Fig. 6.—Left juxtasyllian cyst in 49-year-old woman who had CT for evaluation of sinus disease. This lesion was incidentally detected and further evaluated with pre- and postcontrast MR.

A, Axial T2-weighted noncontrast spin-echo image (2600/80) shows loop of middle cerebral artery (small curved arrow) indenting cyst (large arrow).

B, Gadopentetate-dimeglumine-enhanced coronal T1-weighted spin-echo image (600/20) shows no abnormal enhancement in or around cyst (large arrow).

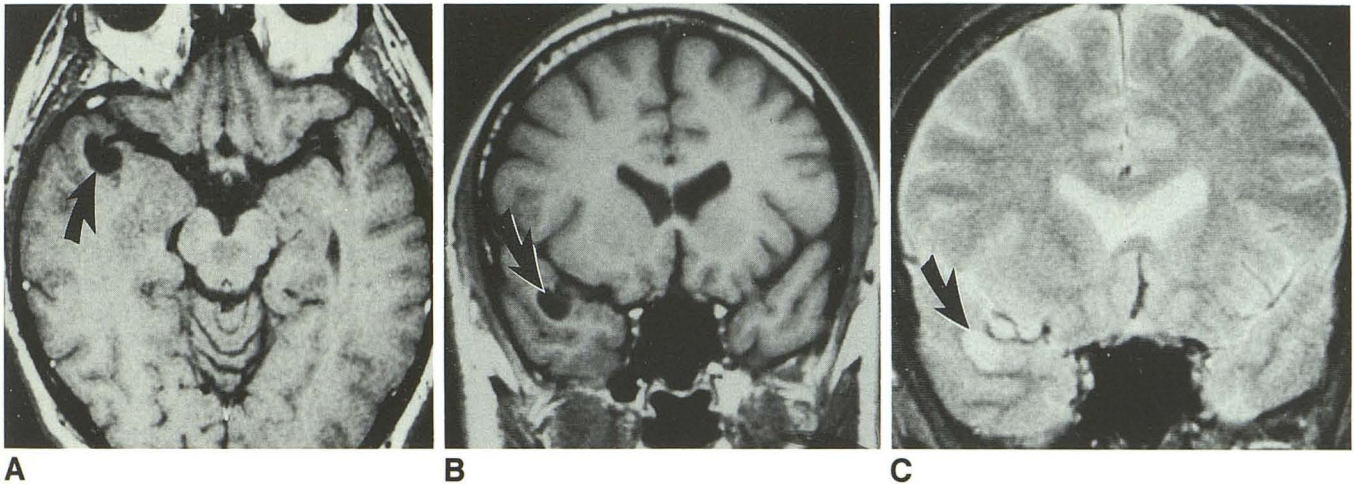
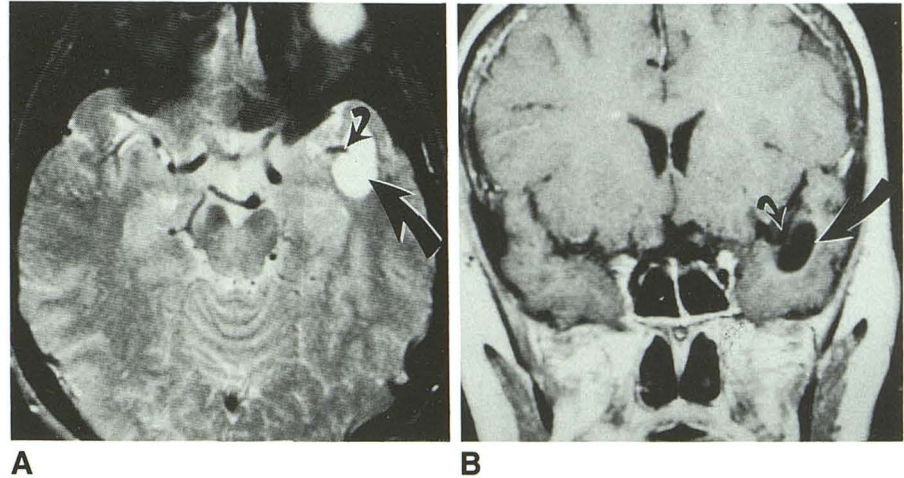


Fig. 7.—Right juxtasyllian cyst (arrows) in 54-year-old man. Note similarity in shape and location to Figure 5. Branch of middle cerebral artery indents cyst. Also note similarity to aneurysm.

A-C, Axial T1-weighted spin-echo image (600/20) (A). Coronal T1-weighted spin-echo image (600/20) (B). Coronal T2-weighted spin-echo image (2500/80) (C).

to the thalamus. There was no histopathologic proof of this lesion or of the other cysts.

Discussion

The improved soft-tissue contrast and lack of artifact that is inherent in the MR imaging process has allowed the visualization of minute anatomic and pathologic features of the brain that were not previously detectable. As previously unrecognized benign lesions are detected they must be differentiated from the pathologic lesions with which we are more familiar. We used a combination of three methods to determine that the lesions we encountered represented benign cysts. First, we required that they have characteristics that are typical of cysts in the brain and other anatomic areas; that is, no detectable wall or associated soft-tissue mass, homogeneous consistency, signal intensity identical to CSF, absence of surrounding edema or gliosis, and lack of contrast

enhancement [1, 2]. Second, we correlated the cysts with clinical signs and symptoms. And, finally, when possible, we determined that no change in cyst size occurred by obtaining follow-up MR or by comparing MR with previous CT scans.

The cysts that we discovered appeared to fit into two groups. Group 1 consisted of spindle-shaped or ovoid cysts whose shape and location indicated probable origin in the choroidal fissure (Figs. 1–5). The location of these cysts may be a clue to their development. The anatomy of this area has been described in exquisite detail by Naidich et al. [3]. The choroid fissure is the CSF space between the fimbria of the hippocampus and diencephalon. It is normally a shallow fissure that curves posterosuperiorly from the anterior temporal lobe to the atrium of the lateral ventricle. The tela choroidea is a double layer of the pia mater that invaginates through the choroid fissure to reach the lateral ventricles. Developmental errors may occur at the time of formation of primitive choroid plexus anywhere along the choroid fissure, thus forming a cyst. The cysts may be of the neuroepithelial or arachnoid

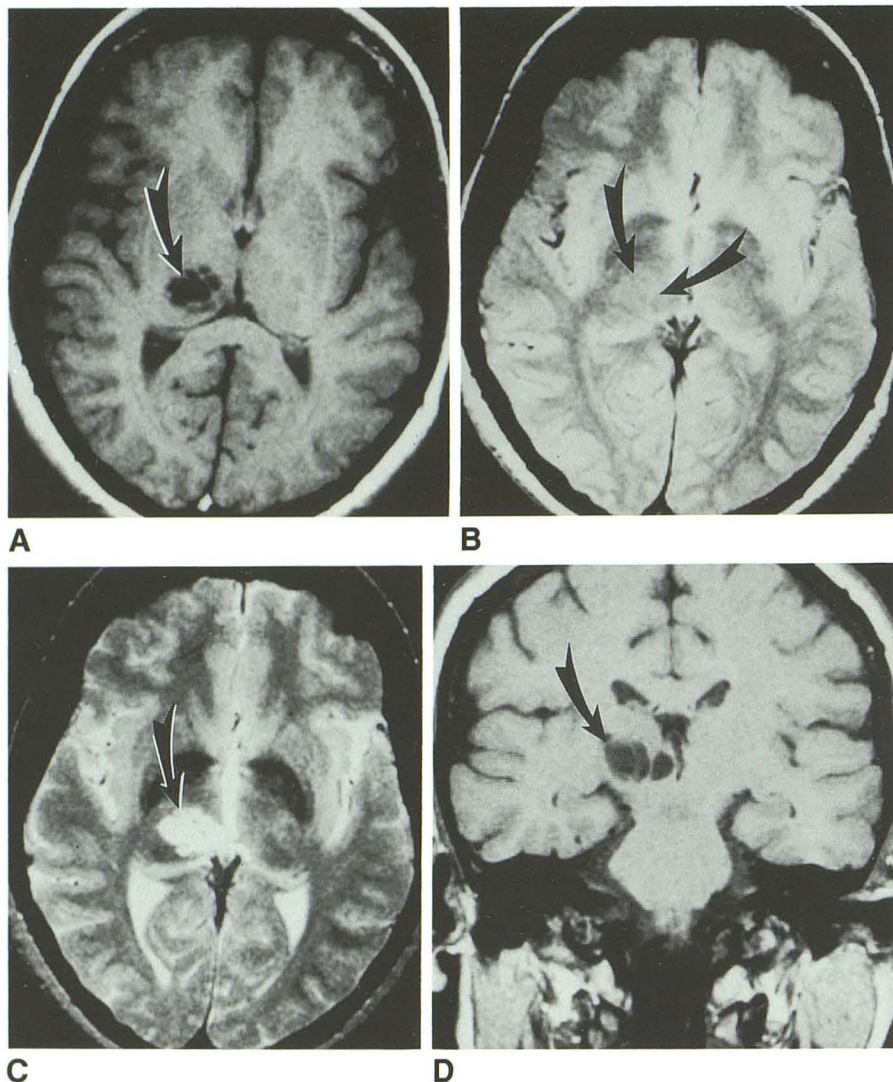


Fig. 8.—Right thalamic multiseptated cyst (arrows) in 66-year-old woman with migraine headaches. There was no change in this lesion over a 3-year period. Note isointensity of cyst with CSF.

A–D, Axial T1-weighted spin-echo image (500/20) (A). Proton-density-weighted spin-echo image (2500/30) (B). T2-weighted spin-echo image (2500/80) (C). Coronal T1-weighted spin-echo image (600/20) (D).

type. Focal temporal lobe hypoplasia adjacent to the choroidal fissure could lead to ex vacuo enlargement of the fissure with resultant accumulation of CSF, which could simulate a cyst in some patients. Cysts could be acquired if adhesions developed as a result of hemorrhagic or inflammatory arachnoiditis.

Neuroepithelial cysts have features of primitive ependyma and/or choroid plexus [4]. They are lined by epithelium and may or may not have a basement membrane [5]. Choroid plexus cysts measuring less than 10 mm in diameter are common [6]. Cysts arising in the choroid fissure may be similar to choroid plexus cysts. Sequestration of neuroectoderm and vascular pia mater could lead to cyst formation [5]. Another explanation is that of an ependymal diverticulum that "pinches off," giving rise to an isolated ependymallined cavity [7].

Arachnoid cysts are formed between the layers of the arachnoid or between the dura and the arachnoid and usually are not lined by epithelium [8]. The cysts in our patients may

develop in the arachnoid space surrounding the penetrating pial vessels or between the arachnoid and the dura.

Group 2 was composed of seven patients with benign noninflammatory, nonneoplastic cysts that were either true parenchymal cysts or communicated with the subarachnoid space through a small opening [9] or through a diverticulum of the subarachnoid space (Figs. 6–8). The cysts were indented by a branch of the middle cerebral artery in two cases (Figs. 6 and 7), possibly indicating a point of communication of the cyst with the investing arachnoid sheath around the vessel. True parenchymal cysts are considered rare and must be differentiated from cystic neoplasm, cystic encephalomalacia, porencephalic cysts, dermoid cysts, epidermoid cysts, abscess, and parasitic cysts [4]. Intracerebral benign cysts have been reported mostly in the cerebral hemisphere, thalamus, midbrain, and cerebellar vermis [4, 5, 10, 11]. Thalamic cysts with pathologic correlation and imaging characteristics similar to those in one of our patients have been reported in the literature. In two cases the cysts had no epithelial lining

(however, histologic material was very limited) [10] and in one case a single layer of epithelium was identified [4]. None of these cysts could be attributable to previous infarction or hemorrhage.

The development of these intraparenchymal cysts is difficult to explain. They appear less common than the cysts occurring near the choroidal fissure and they are more likely to raise concern of a cystic neoplasm, parasitic cyst, or old infarction. The diagnosis of a benign neuroepithelial cyst is one of exclusion in these patients. They most likely develop as a result of sequestration or infolding of neuroectodermal tissue [9, 12] or possibly as a manifestation of a local neuronal migration disorder [13, 14]. The latter is more likely to be associated with localized neurologic and intellectual deficits.

An extensive search of the pathologic, medical, and radiologic literature failed to uncover a report of cyst formation in the choroidal fissure. Rengachary and Watanabe [15] reported the location of 208 arachnoid cysts. They stated that the sylvian fissure is the most common location and that all the cysts in their study were associated with arachnoid cisterns; however, they did not report on any cysts in the choroidal fissure. Friede and Yasargil [13] in a study of 17 intracerebral cysts that did not communicate with the ventricular system mentioned cysts in the ambient cistern without further elaboration. The lack of previous reports may reflect their small size, benign clinical nature, and possible collapse or compression at the time of autopsy.

Clinically, both groups of patients in our study presented with a variety of symptoms unrelated to the temporal lobe. However, there were five patients in whom a seizure disorder was the reason for the scan (15%). It was clinically determined that the cysts were probably not related to the seizure disorders. In these patients and in the others, we concluded that the cysts were incidental findings unrelated to the patients' symptomatology; however, since we have no pathologic correlation, we believe that limited follow-up examinations are probably indicated for most of these lesions. The follow-up interval will be determined by the individual clinical setting. We would generally recommend more frequent examinations with the parenchymal cysts than with the choroidal fissure cysts. We have no evidence of enlargement of the cysts or subsequent development of neurologic signs or symptoms in our patients. However, we recognize that such enlargement is possible as a result of chronic CSF pulsation, ball-valve effect, or heterotopic choroid plexus and cyst loculation. Symptoms may occur from the compressive effects of a cyst. Nakasu et al. [10] reported neurologic deficits in two patients with benign thalamic cysts. Both patients improved after surgical drainage procedures.

We believe that the use of T1-weighted, T2-weighted and proton-density-weighted sequences in every patient is nec-

essary. The use of gadopentetate dimeglumine depends on the individual case, but is useful to exclude a defect in the blood-brain barrier along the margins of the lesions. Contrast enhancement would be considered suspicious for a neoplastic or inflammatory cyst.

In summary, we have described a series of CSF-like cysts that, in our opinion, are benign and important to recognize so that they are not confused with intraaxial cystic tumors, infarctions, parasitic lesions, and other entities that have significant clinical implications.

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