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Sonography of Brain Tumors in Infants

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Cranial sonograms of six children with brain tumors (one newborn, four infants, and one 4-year-old child) are presented. In four, sonography showed a large tumor mass and displacement of adjacent structures. In two, the tumors were demonstrated as areas of abnormal brain parenchymal echogenicity without obvious mass effect. Two of the tumors were diffusely echogenic, one was primarily cystic, and three were of mixed echogenicity. Areas of cystic degeneration and calcification within the tumors were well demonstrated. Correlation was made with cranial computed tomography (CT) in all patients; in each case sonography accurately demonstrated the location and extent of the tumor. Since sonography is used as a screening procedure in infants with a large head or an abnormal neurologic examination, sonography may be the first examination to demonstrate the tumor mass. However, since the sonographic features are not specific for neoplasms, further clarification of the process by CT should be recommended.

Sonography has become an important imaging method for the evaluation of the infant head. Its value in the recognition and follow-up of patients with hydrocephalus and intracranial hemorrhage has been well established [1–6]. However, little information is available about the sonographic appearance of brain tumors [1, 2, 7–9]. We present our experience with brain tumors in six patients.

Materials and Methods

Of 1528 children who had cranial sonograms at Children's Hospital Medical Center, Cincinnati, from May 1978 to November 1982, six patients with histologically proven brain tumors were identified. Five patients were under 1 year of age and one patient was 4 years old when the diagnosis was made. Cranial sonograms were obtained with a static or real-time scanner or both in axial, coronal, and sagittal planes. A 3.5 or 5.0 MHz transducer was used. In the five infants under 1 year old, the sonogram was obtained through the open sutures and fontanelles. In the 4-year-old child, sonography was possible because he had split sutures due to increased intracranial pressure. Sonographic findings were compared with computed tomographic (CT) findings in all six patients. Five patients had plain films of the skull and three patients had brain angiography. The patients' charts were reviewed for clinical information.

Results

Most patients presented with nonspecific symptoms of increased intracranial pressure. Sonographic and radiographic findings are summarized in table 1. There were four astrocytomas, one teratoma, and one ependymoma. In five of the six children, the tumor was supratentorial. In four (cases 1, 3, 4, and 5), sonography showed a large tumor mass and displacement of adjacent structures (figs. 1, 3, and 4). In two (case 2 and 6), there were no mass effects, and sonography demonstrated changes in brain parenchymal echoes and architecture (figs. 2 and

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TABLE 1: **Summary of Findings in Children with Brain Tumors**

Case No.	Skull Films	Location	Size (cm)	Echo Pattern	CT	Angiography	Pathology
1	None	Suprasellar	4.5 × 4	Mixed	Enhancing mass with low-density area	None	Astrocytoma
2	Split sutures; destruction of skull base	L thalamus	2.6 × 2.4	Echogenic	Enhancing mass	Possible tumor blush	Malignant glioma, probably astrocytoma
3	Macrocranium with intracranial calcifications	Post fossa	Large	Mixed with calcifications	Irregularly enhancing mixed-density mass with calcifications	None	Teratoma
4	Slightly split sutures	Suprasellar	4.4 × 6.8	Mixed	Enhancing mass with low-density area	Slightly vascular	Astrocytoma with secondary pseudocyst
5	None	R lat vent	6 × 6	Anechoic with localized thick wall	Thin-walled cystic mass with strong enhancing nodule	None	Papillary ependymoma
6	Split sutures; destruction of sella turcica	Suprasellar	2.2 × 3	Echogenic	Enhancing mass	Slightly vascular	Astrocytoma

Note.—All children had hydrocephalus. R = right; L = left; post = posterior; lat = lateral; vent = ventricle.

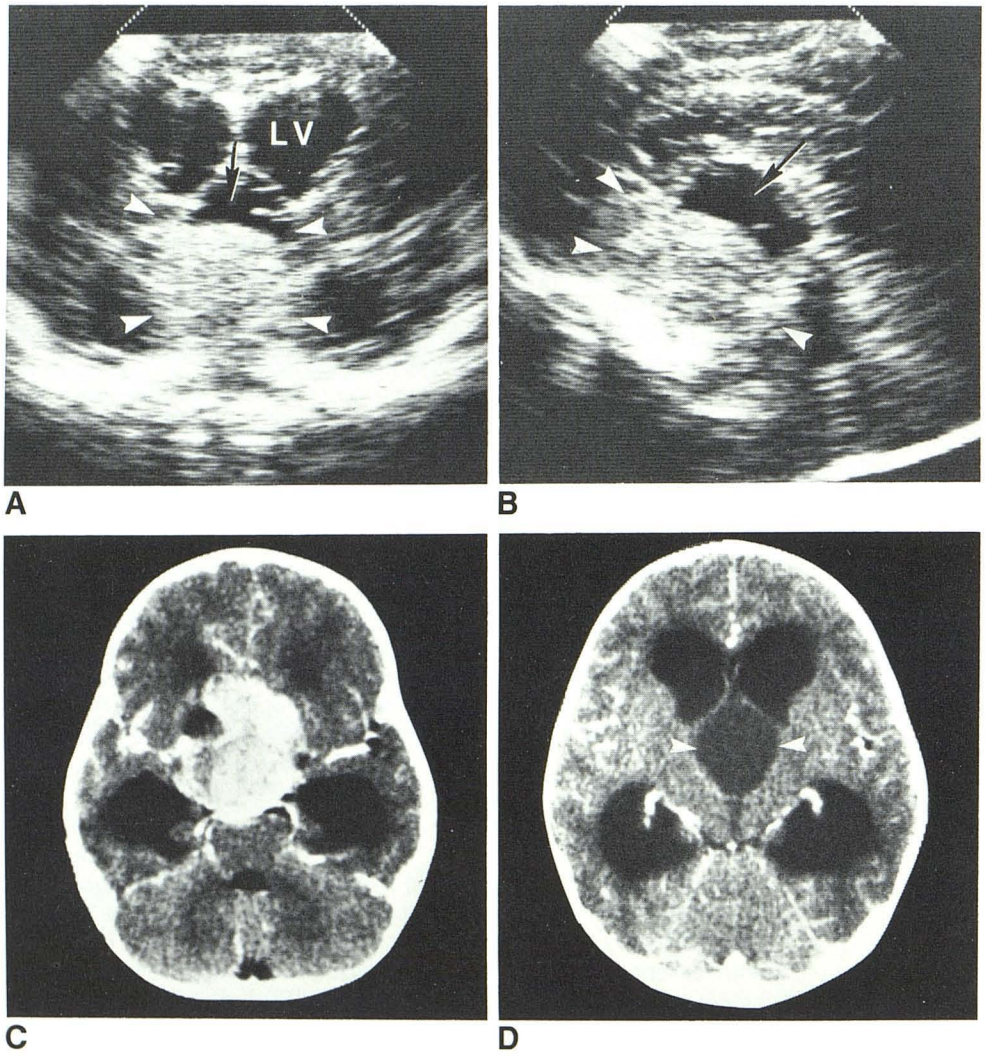

Fig. 1.—Case 1, suprasellar astrocytoma. Coronal (**A**) and midline (**B**) sagittal sonograms show large suprasellar primarily echogenic mass (*arrowheads*). Anechoic area (*arrow*) superior to echogenic mass does not have usual configuration of third ventricle. Lateral ventricles (LV) moderately enlarged. **C** and **D**, CT scans with contrast show enhancing suprasellar mass. Hypodense area (*arrowheads*) superior to solid mass has attenuation value higher than CSF and, therefore, was thought to be cystic part of tumor rather than third ventricle.

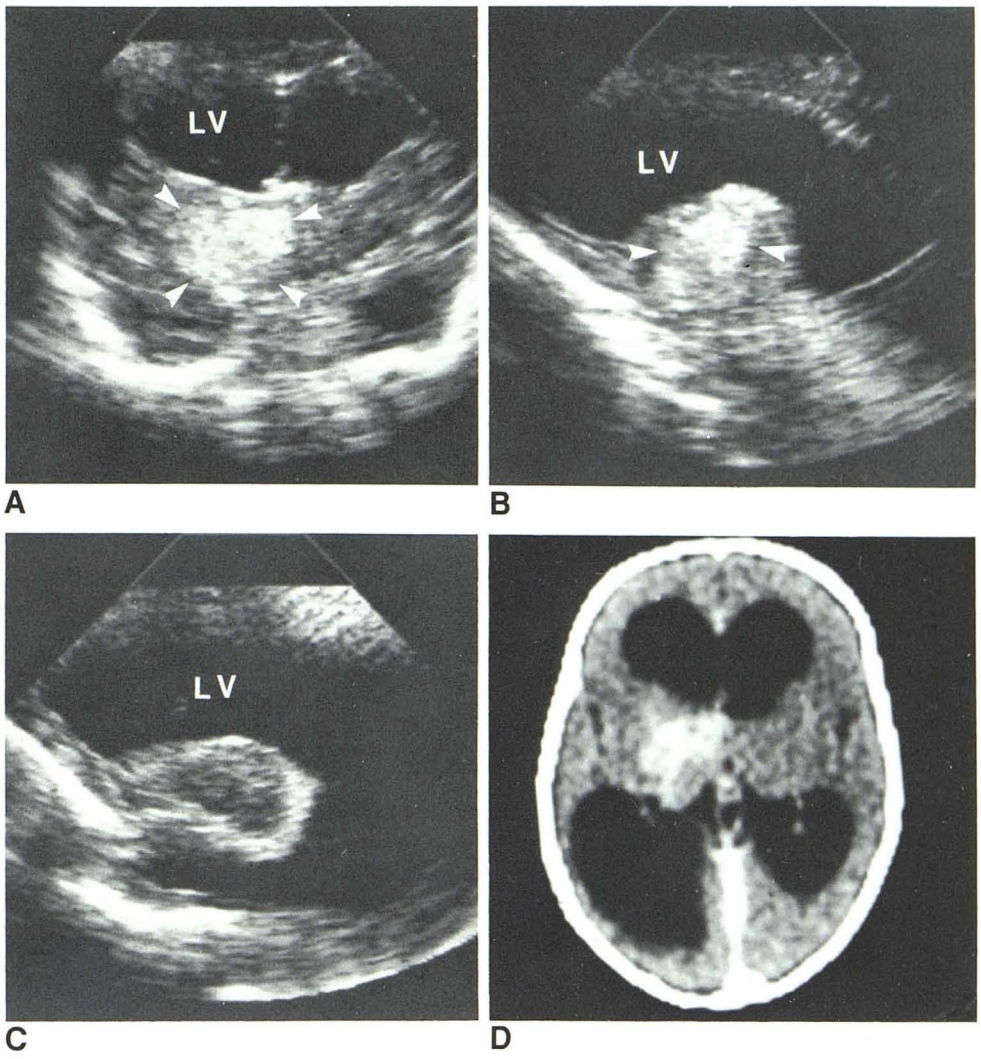

Fig. 2.—Case 2, left thalamic malignant glioma, probably astrocytoma. Coronal (**A**), left parasagittal (**B**), and right parasagittal (**C**) sonograms show echogenic tumor (*arrowheads*) in region of left thalamus compared with normal right thalamus without obvious displacement of adjacent structures. Moderate dilatation of lateral ventricles (LV) without enlargement of third and fourth ventricles indicates obstruction at foramina of Monro. **D**, CT scan with contrast shows enhancing tumor in region of left thalamus and moderate dilatation of lateral ventricles. (Reprinted from [2].)

5). Two tumors (cases 2 and 6) were diffusely echogenic (figs. 2 and 5); two others (cases 1 and 4) had both echogenic and anechoic areas (fig. 1). The posterior fossa teratoma (case 3) was primarily echogenic with small cystic areas as well as areas of high-level echoes with acoustic shadowing representing calcifications or ossifications (fig. 3). The ependymoma of the lateral ventricle (case 5) was demonstrated as a large cystic mass within the dilated ventricle with localized areas of irregularly thickened wall (fig. 4). Obstructive hydrocephalus proximal to the site of tumor was seen in all six patients. When compared with the CT scan, sonography accurately demonstrated the location and extent of the tumor.

Discussion

Brain tumors in infants were considered rare [11, 12]. Since the advent of CT scanning, however, the number of brain tumors diagnosed in infancy has increased significantly [13]. Brain tumors in infancy differ from tumors in childhood in histopathologic type, location, and symptoms and signs at presentation [11, 13–16]. They are more common in the supratentorial compartment in infants than in older children, and are more commonly neuroectodermal in origin [11,13–15]. The accurate clinical diagnosis of brain tumors in infants is often difficult because these tumors cause nonspecific symptoms and signs without localizing neurologic abnormalities. An enlarging head with symptoms of increased intracranial pressure and seizures are the most common clinical manifestations [13].

Many investigators of intracranial tumors in early infancy have considered them to be congenital in origin, even though some cases do not show any clinical signs and symptoms until some time after birth [11, 14, 15]. These tumors have been divided into three groups [14]: (1) definite congenital tumors—those present or producing symptoms at birth or within the first 2 weeks of life; (2) probable congenital tumors—those present or recognized within the first year of life; and (3) possible congenital tumors—those detected after age 1 year, although initial symptoms can be traced back to the first year of life. According to these criteria, the huge

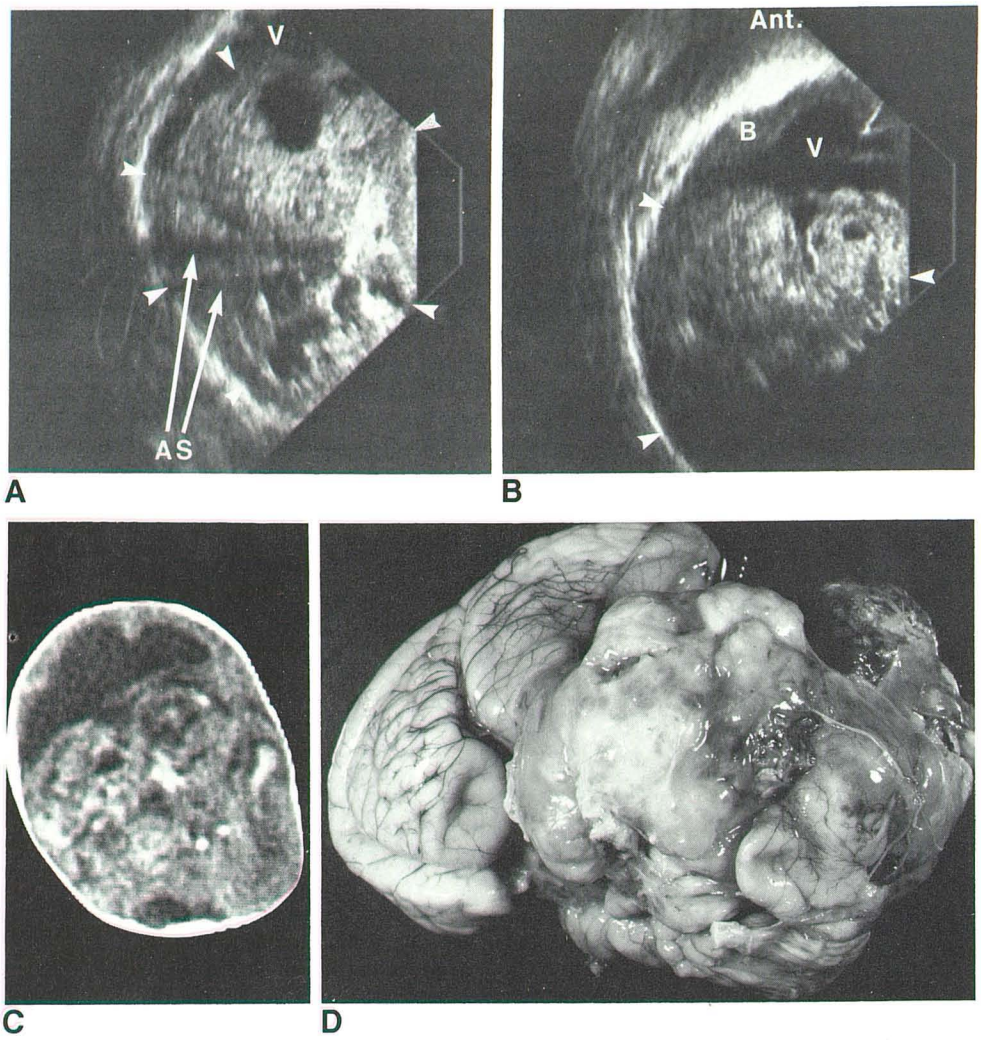

Fig. 3.—Case 3, posterior fossa teratoma. Axial sonograms (**A** and **B**) and CT scan (**C**). Large primarily echogenic tumor mass (*arrowheads*), with anechoic areas and echogenic areas with acoustic shadowing (AS) representing calcifications, occupies posterior two-thirds of head. Normal brain (B) and dilated ventricles (V) displaced and compressed anteriorly by tumor mass. **D**, Brain specimen shows large teratoma posteriorly and brain anteriorly. (Reprinted from [10].)

posterior fossa teratoma in case 3 and the ependymoma in case 5 can be defined as definite congenital tumors. The astrocytomas in cases 1, 2, and 4 can be classified as probable congenital tumors.

The sonographic finding of brain tumors in most cases is an easily recognized mass that affects adjacent structures and causes obstructive hydrocephalus. In the patient with a left thalamic astrocytoma the tumor mass presented as an area of increased echogenicity in the left thalamus without displacement of adjacent structures (fig. 2). Careful comparison of the echogenicity and architecture of one hemisphere to the other led to discovery of the tumor located on one side of the brain. All the solid tumors we examined had higher-intensity echoes than adjacent normal brain and could be well defined on sonography. Areas of cystic degeneration and necrosis within the tumor were demonstrated as anechoic areas. Because brain tumors in infancy usually occur in the central neural axis, ventricular obstruction occurs early [16, 17]. Sonography not only identifies the ventricular dilatation, but also demonstrates the location of the obstruction. Tumor location on one side, however, may lead to asymmetric ventricular dilatation, as in our case 5, in which one anterior horn was isolated by brain displacement secondary to the large tumor mass (fig. 4).

Although our observations correlate well with CT findings, the sonographic findings of brain tumors are not specific. The distinction between echogenic solid tumors and other intracranial masses such as hematoma, abscess, and granuloma can be difficult. The differentiation between hemorrhagic tumors and hematoma secondary to arterial venous malformation, ruptured aneurysm, or other causes is even more difficult. Nevertheless, the sonographer should be familiar with these features, since sonography is widely used as a screening procedure in infants with a large head or an abnormal neurologic examination. When a neoplasm is suspected on sonography, further investigation with CT for more specific diagnosis is indicated. However, if a brain tumor is suspected clinically, CT scan should be the first study to be performed.

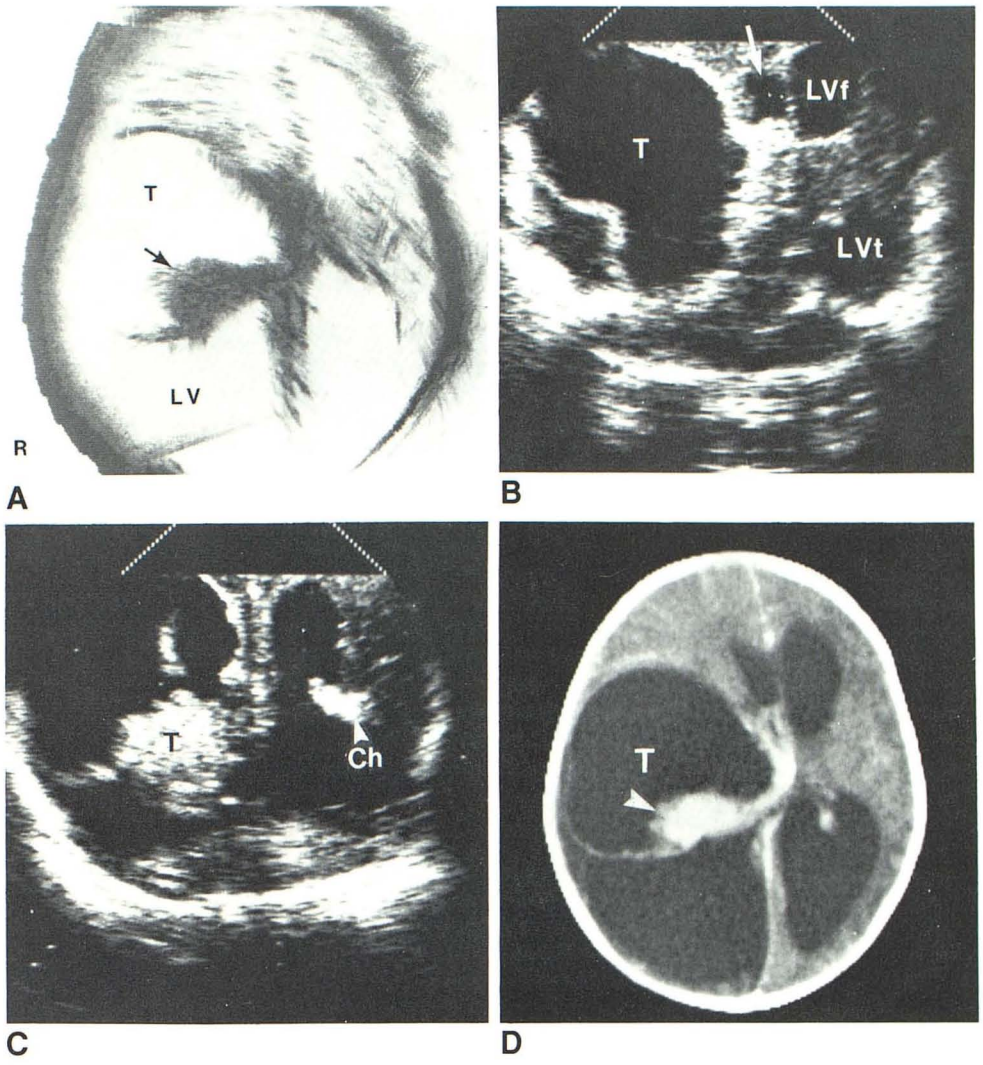

Fig. 4.—Case 5, papillary ependymoma. **A**, Axial sonogram shows large cystic tumor mass (T) with localized thick wall (*arrow*) within markedly dilated right lateral ventricle (LV). Moderate dilatation of left lateral ventricle and midline shift seen. **B**, Coronal sonogram shows cystic part of tumor (T) and isolated, shifted frontal horn of right lateral ventricle (*arrow*). Frontal horn of left lateral ventricle (LVf) enlarged and displaced to left. LVt = temporal horn of left lateral ventricle. **C**, More posterior coronal sonogram. Note analogy between left choroid plexus (Ch) and echogenic part of tumor (T), initially suggesting right choroid plexus papilloma. **D**, CT scan with contrast demonstrates cystic tumor (T) within markedly dilated right lateral ventricle (LV) with enhancing nodule (*arrowhead*). Moderately enlarged, shifted left lateral ventricle and isolated frontal horn of right lateral ventricle shown.

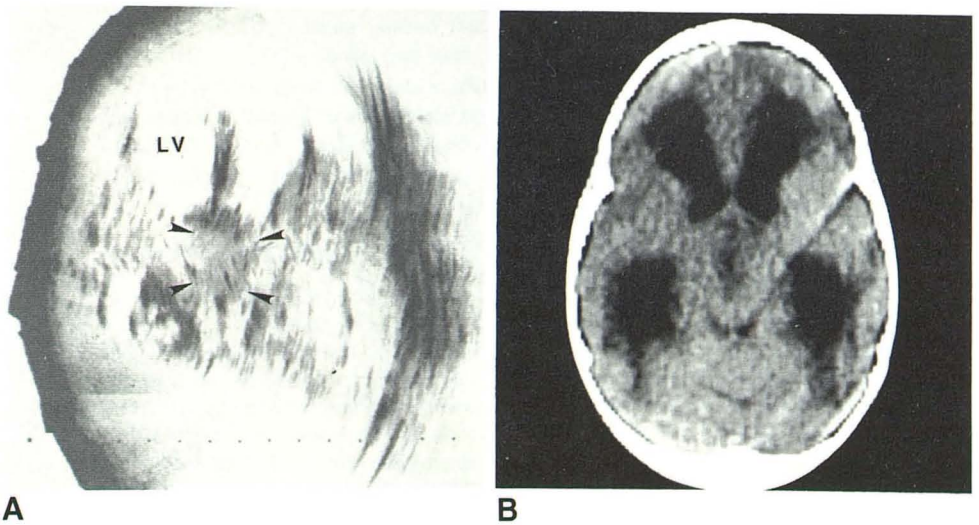

Fig. 5.—Case 6, suprasellar astrocytoma. **A**, Axial sonogram shows subtle echogenic mass in suprasellar area (*arrowheads*) without significant displacement of adjacent structures. Lateral ventricles (LV) moderately dilated. **B**, Precontrast CT scan shows suprasellar mass that enhanced slightly on postcontrast scan (not shown) and moderate enlargement of lateral ventricles.

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