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Sonographic Diagnosis of Ascending Transtentorial Herniation of Posterior Fossa Cystic Masses

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In recent years, neonatal cranial sonography has been extensively used to diagnose intracranial hemorrhages, congenital anomalies, and intracranial masses despite such limiting factors as the size of the anterior fontanelle and lack of contrast enhancement similar to cranial CT [1]. While cranial CT during infancy lacks easy access to direct sagittal scanning, sonography offers multiplanar imaging capability. We have recently made use of cranial sonography to diagnose ascending transtentorial herniation of cystic masses of the posterior cranial fossa (cerebellar cyst and encysted fourth ventricle) in two infants. Sonographic features of ascending herniation noted on both our patients included identification of a portion of cystic mass above the tentorium and a waistlike narrowing of the mass at the level of the tentorial notch. Early identification of ascending herniation using these criteria could prevent many potentially serious neurologic complications caused by compression of vital structures around the tentorial incisura.

Case Reports

Case 1

A 3½-month-old boy was admitted for evaluation of rapidly increasing head size and lethargy of 1 month's duration. Physical examination and CT scan at birth showed the patient to have occipital meningomyelocele and a cystic mass in the posterior fossa. The meningomyelocele was excised at 6 weeks of age at a nearby hospital and the baby was discharged in satisfactory condition. The physical examination at our hospital revealed evidence of raised intracranial pressure. The initial sonographic examination (Fig. 1) revealed a posterior fossa cystic mass causing displacement of the cerebellar vermis with posterior coronal sections showing a portion of the mass above a line joining the medial free edges of the tentorium, which appeared to produce a waistlike narrowing of the mass (Fig. 1A). A CT scan with intrathecal metrizamide also demonstrated a posterior fossa cystic mass extending into the quadrigeminal plate cistern area and dilatation of the lateral and third ventricles. The fourth ventricle was displaced anteriorly by the mass. There was no communication between the subarachnoid and the cystic mass (Figs. 1C and 1D). The patient was successfully treated with surgical excision of the cyst and shunting of the lateral ventricles. The pathologic diagnosis was a neuroepithelial cyst.

Case 2

A 1½-month-old infant, born at 26 weeks gestational age (birth weight, 840 g), was being treated in the intensive care unit for respiratory distress, grade-3 germinal matrix hemorrhage with enlarging posthemorrhagic hydrocephalus (Figs. 2A and 2B), spontaneous ileal perforation, and patent ductus arteriosus.

Serial brain sonographic examinations, obtained after ventriculoperitoneal shunting, revealed a decrease in the size of the lateral and third ventricles, but the fourth ventricle continued to enlarge, compressing the posterior fossa contents and ascending cephalad through the tentorial notch in a manner similar to that in the previously described case (Figs. 2C and 2D). The diagnosis of trapped fourth ventricle with associated ascending transtentorial herniation was confirmed by CT scan, and the patient was successfully treated by shunting of the fourth ventricle.

Discussion

Descending herniation of the uncus and parahippocampal gyrus and ascending transtentorial herniation of the posterior fossa contents are well-known entities that can be diagnosed on angiography and CT. Ascending herniation of the posterior fossa contents can cause compression of many important structures. Compression of the branches of the superior cerebellar artery passing under the medial free edges of the tentorium can cause cerebellar infarction while compression of the vein of Galen can result in increased intracranial pressure from venous congestion [2]. With increasing use of neonatal cranial sonography, the establishment of sonographic criteria for ascending herniation should be of potential value in preventing the serious consequences of herniation. To the best of our knowledge, however, such criteria have not been discussed in the literature.

The sonographic appearance of ascending herniation was quite similar in both our cases. The posteriorly angled coronal images were most useful in identifying herniation (Figs. 1A

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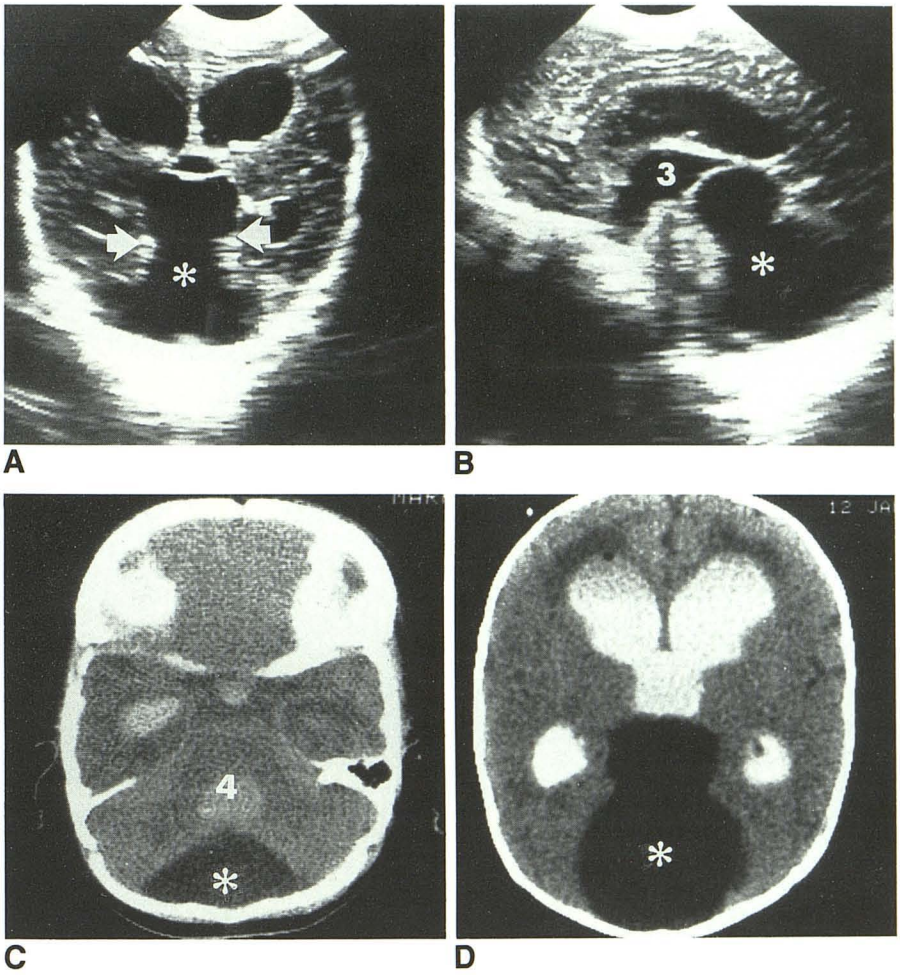

Fig. 1.—Case 1.
A–D, **Coronal (*A*) and midline sagittal (*B*) CT scans show large posterior fossa cystic mass (*asterisk*) herniating supratentorially through tentorial notch (*arrows*). Also note waistlike narrowing of mass on coronal scan (*A*). Posterior aspect of third ventricle (3) is displaced anteriorly by mass with dilatation of lateral ventricles. Metrizamide-enhanced CT scans (*C* and *D*) show posterior fossa cyst (*asterisk*), which does not communicate with fourth ventricle (4).**

and 2D), although the midline sagittal images provided more information on the compression effects of the mass on the midbrain and the contents of the posterior fossa. In both patients, the ascending herniation was diagnosed on the coronal images by identifying a portion of the mass rostral to an imaginary line joining the medial free edges of the tentorium (Figs. 1A and 2D). Also noted was a figure-8 configuration of the mass caused by relatively narrow normal tentorial incisura. The CT findings of ascending herniation varied from the extension of the mass in the quadrigeminal cistern area to an abnormally high position of the mass on the axial CT scans. These findings are quite typical of ascending herniation [3]. We believe that the figure-8 deformity of a herniated lesion may not be identified easily with a solid posterior fossa mass. However, if a portion of a solid posterior fossa mass is identified above an imaginary line joining the medial free edges of the tentorium on the posteriorly angled coronal sonographic sections, ascending herniation must be strongly suspected.

Both patients presented with signs and symptoms of increased intracranial pressure. The first patient had a neuroepithelial cyst that showed sonographic features of ascending herniation. The patient responded well to surgical excision of the mass and ventricular shunting. The second patient, who had posthemorrhagic hydrocephalus, developed a trapped fourth ventricle and subsequent ascending herniation after ventriculoperitoneal shunting of the lateral ventricles. A trapped fourth ventricle (also known as isolated fourth ventricle) is a secondary condition usually resulting from the fourth ventricle being isolated from the rest of the ventricular system owing to postshunting kinking of the aqueduct of Sylvius and obstruction of the foramena of Luschka and Magendie. This is usually followed by continued production of the CSF by the choroid plexus trapped within the isolated fourth ventricle resulting in continued dilatation of the fourth ventricle [4].

In adults, the physical signs of enlarging posterior fossa mass and midbrain compression can be seen with ascending herniation. However, in the newborn these signs can be difficult to elicit before advanced herniation takes place. The clinical findings may be obvious with rapidly progressive herniation. But with slowly advancing herniation, the signs can be delayed until advanced distortion and compression of the normal structures around the incisura occur [1]. We believe that by using our criteria, the sonographer should be able to diagnose ascending herniation of the posterior fossa cystic-

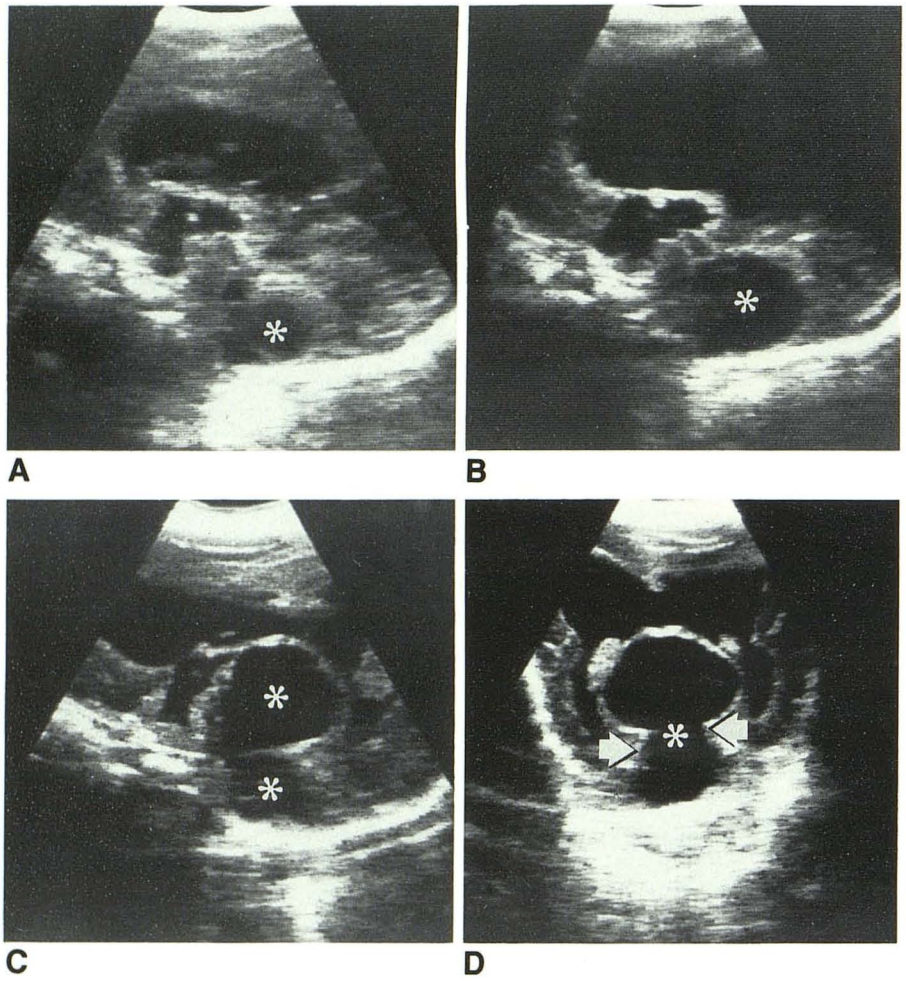

Fig. 2.—Case 2.
***A–D*, Midline sagittal CT scans (*A* and *B*) obtained 2 weeks apart, before ventricular shunting, show enlarging generalized hydrocephalus. After shunting, sagittal (*C*) and coronal (*D*) scans showed significant decrease in size of lateral ventricles and ascending herniation of enlarged, trapped fourth ventricle (*asterisk*) through tentorial notch (*arrows*).**

masses on the neurosonogram. Such a diagnosis would be of help in preventing further neurologic damage.

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