Organizing Posterior Fossa Hematomas Simulating Developmental Cysts on Prenatal Imaging
Report of 3 Cases

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Objective. We encountered 3 organizing tentorial hematomas simulating posterior fossa lesions such as Dandy-Walker, dermoid, or arachnoid cysts. We sought to correlate the clinical and pathologic features that allow distinction of developmental cysts from hematomas in the posterior fossa on imaging.

Methods. Prenatal sonograms in all fetuses and fetal magnetic resonance scans in 2 of the 3 were reviewed. One case proceeding to term had serial imaging up to age 11 months. Two cases had complete neuropathologic evaluation after termination. Maternal records were reviewed. Results. In each case, the ultrasonographic findings were reminiscent of a developmental cyst but with echogenic debris, a rim, or both. Magnetic resonance imaging suggested tentorial hemorrhage in 2, 1 also with falcine hemorrhage. Serial prenatal and postnatal imaging showed resolution in the surviving case. Pathologically, 2 fetuses had organizing tentorial hematomas causing brain displacement. Calcifications, white matter damage, germinal matrix hemorrhage, and brain stem necrosis were also present. One mother had von Willebrand disease. Conclusions. Tentorial hematomas, with or without maternal coagulopathy, should be considered in the prenatal ultrasonographic diagnosis of cystlike posterior fossa abnormalities containing echogenic material. Fetal magnetic resonance imaging can suggest blood products. Hypoxic-ischemic brain damage may be concurrent; however, resolution of the hematoma, with no apparent neurologic sequelae, can occur. Key words: brain abnormalities; fetal magnetic resonance imaging; pathologic correlation; posterior fossa cysts; prenatal ultrasonography.

Abbreviations
HASTE, half-Fourier single-shot turbo spin-echo; MR, magnetic resonance

Posterior fossa subdural hematomas in neonates are uncommon and usually attributed to trauma during delivery.1,2 A few cases of posterior fossa subdural or intradural hematomas have been reported in stillbirths and in infants born by cesarean delivery, indicating that nontraumatic mechanisms of posterior fossa hemorrhage must also exist.3 Rarely, subdural hematomas have been documented in fetuses by prenatal ultrasonography,4-7 most associated with trauma (e.g., motor vehicle accidents or assaults) and occurring over the cerebral hemispheres. In this report, we document the unusual imaging features in 3 fetuses with subdural hematomas in the posterior fossa, attached to the tentorium cerebelli. Pathologic examination confirmed the findings in 2 cases. In all 3, prenatal ultrasonography raised the pos-
sibility of developmental cysts but showed atypical features that were clues to the final diagnosis.

**Case Reports**

**Case 1**

**Clinical History**

A 19-year-old gravida 1, para 0 woman came in at 20 weeks, 1 week after discovering that she was pregnant. Except for a history of cigarette smoking, she was healthy. There was no history of trauma during the pregnancy. Maternal coagulation function was not investigated. The ultrasonography detected an abnormality, and the woman was referred to our institution for follow-up evaluation and elective termination.

**Imaging**

Repeated ultrasonography showed a single live intrauterine pregnancy, 23 weeks’ gestation by biometric measurement, with a large posterior fossa cyst, 5.5 cm in diameter, containing a fluid-debris level, possibly blood (Fig. 1A). No normal cerebellum was seen. The cyst compressed the lateral ventricles, which were dilated. The findings were thought to be most consistent with a Dandy-Walker cyst, whereas a large arachnoid cyst was considered less likely.

**Pathologic Examination**

At macroscopic evaluation of the brain, the tentorium cerebelli was found to be elevated and to have an adherent 5.4-cm cystlike structure filled with brown fluid and degenerated particulate material along its inferior surface. The cerebellum was markedly compressed inferiorly, with the hemispheres flattened in a leaflike fashion over an obliterated fourth ventricle and flattened brain stem. The inferior temporoo-occipital regions were elevated by the tentorial hematoma but were well formed. The remainder of the brain was developmentally normal and consistent with 22 to 24 weeks' gestation. There was no evidence of subarachnoid hemorrhage or infection. The anatomic characteristics of the cerebral circulation were within normal limits; in particular, no vascular malformations or varices were found.

**Figure 1.** Case 1. A, Sonogram at 23 weeks’ gestation showing a posterior fossa fluid collection (calipers). Note the fluid-debris level (arrows) suggesting blood. B, Histologically, the organizing hematoma contains calcific debris and macrophages (hematoxylin and eosin, original magnification ×100). C, In the medulla, 1 pyramid is hypotrophic (arrow; hematoxylin and eosin, original magnification ×25) secondary to pressure necrosis seen rostrally at the postomesencephalic junction (not shown).
Microscopically, the organizing hematoma in association with the tentorium contained degenerated blood products and macrophages, with focal calcification (Fig. 1B). It was not possible to determine whether the hematoma originated within the leaflets of the dura mater or as a subdural collection. The age of the hematoma was estimated to be at least 1 to several weeks old. Transverse sections of the brain stem revealed foci of resolving necrosis, with macrophages and capillary proliferation, involving the ventral pontomesencephalic junction at 1 lateral edge. The ipsilateral pyramid was hypotrophic (Fig. 1C).

General pathologic examination disclosed a sacral dimple with underlying vertebral arch dysraphism (spina bifida occulta). The placenta was normal.

Case 2

Clinical History
The mother was a 35-year-old gravida 5, para 1, aborta 3 woman who had been delivered of a healthy girl in 1997. She had undergone uterine myomectomy 3 years before the current pregnancy. No history of trauma was given. The mother’s coagulation function was not tested. An elective termination was performed on the basis of imaging studies obtained at 22 weeks.

Imaging
Ultrasonography identified a single intrauterine fetus with a large cyst, measuring 4.8 × 3.7 × 2.6 cm, occupying the posterior fossa (Fig. 2A). The mass effect of the cyst was defined by the tentorium, which appeared elevated, and the cerebellum, which was compressed and deviated anteriorly. There were solid echogenic foci measuring 0.7 and 0.9 cm within the fluid. The differential diagnosis included a posterior fossa arachnoid cyst with hemorrhage or a dermoid cyst. There was no evidence of ventriculomegaly.

A fetal magnetic resonance (MR) scan confirmed the presence of an infratentorial posterior fossa cystic lesion, the edge of which was separated from brain tissue by cerebrospinal fluid, suggesting an origin from the dura mater rather than a lesion intrinsic to the brain. The fluid was of heterogeneous signal intensity; it was of intermediate signal intensity on T2-weighted imaging, with regions of low signal intensity, thought to be consistent with blood (Fig. 2B). Superiorly, along the cerebral hemispheres, were additional small, peripherally arranged foci with low signal intensity on T2-weighted imaging, suggesting subdural hemorrhage (Fig. 2C).

Pathologic Examination
At gross examination, the tentorium was slightly elevated and had a 0.6-cm ovoid blood clot attached to the left transverse sinus (Fig. 2D), along with fluid and free clots in the posterior fossa. Because the fluid escaped at the time of brain dissection, and because no cyst wall was preserved, the exact size of the lesion could not be determined. The vermis was intact. The leptomeninges were markedly congested, and punctate hemorrhages were present over the right parasagittal and sylvian regions (Fig. 2E).

Microscopically, the clots from the posterior fossa showed degenerated blood products and macrophages, with calcifications, virtually identical to those seen in case 1 (Fig. 1B). Cross sections of the brain stem revealed flattening of the cerebral peduncle and rarefaction of the anterior aspect of the basis pontis. Multifocal mineralization, capillary proliferation, and prominent microglia in the deep white matter were evidence of subacute hypoxic-ischemic white matter damage.

The general autopsy revealed no other abnormalities. The placenta was normal.

Case 3

Clinical History
The mother was a 35-year-old gravida 3, para 2 woman with a history of mild von Willebrand disease but no history of spontaneous bleeding. Ultrasonography at 19 weeks showed a fetus without abnormalities. However, because only limited views of the heart were obtained, ultrasonography was repeated at 22 weeks, and additional studies were obtained at 31 and 33 weeks. Because of the imaging findings, cesarean delivery was performed at term. The neonate had Apgar scores of 8 and 9 at 1 and 5 minutes. Follow-up images were obtained up
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Figure 2. Case 2. A, Sonogram at 22 weeks’ gestation showing a fluid collection occupying the posterior fossa and containing an echogenic nodule (arrow), suggesting focal calcification. A mass effect is shown as the slightly flattened appearance of the cerebellar hemispheres. B, Sagittal midline T2-weighted half-Fourier single-shot turbo spin-echo (HASTE) MR image showing the posterior fossa collection adjacent to bone and tentorium, with a mass effect on the cerebellum (large arrow). Areas of low signal intensity (small arrows) are consistent with old blood. C, Sagittal view lateral to B showing other small areas of subdural hemorrhage (arrows). D, At autopsy, examination of the base of the skull with the brain removed revealed a blood clot, 0.6 cm, adherent to the left transverse sinus (arrow), with free clots in the posterior fossa; smaller hematomas in the anterior and middle fossae are also visible. E, The lateral aspect of the right hemisphere has punctate subarachnoid hemorrhage.
to 1 year of age. At 2 years of age, the toddler was developing normally; hematologic workup showed mild von Willebrand disease.

**Imaging**

At 22 weeks, a 1.7-cm posterior fossa extra-axial collection with debris (Fig. 3, A and B) was a new finding compared with the normal scan at 19 weeks. The collection had an echogenic rim, suggesting a hematoma.

T2-weighted fetal MR imaging at 22 weeks further showed a collection of intermediate signal intensity adjacent to the falx with a centrally located ringlike area of high and low signal intensity consistent with blood in varying stages of evolution (Fig. 3C). On T1-weighted imaging, this region was of high signal intensity (Fig. 3D). The collection extended between the leaves of the falx and the dural venous sinuses. At 24 weeks, the echogenic mass on ultrasonography decreased to 1.4 cm (Fig. 3E). By 31 weeks, the hematoma was barely visible on ultrasonography. Magnetic resonance imaging at that time showed a small residual hematoma (Fig. 3F).

Six weeks after an uneventful cesarean delivery at term, the infant underwent head ultrasonography, revealing a normal posterior fossa but a subarachnoid hematoma in the right parietal region. Computed tomography at 7 months showed small calcifications along the left medial orbital gyrus and the lateral right sylvian fissure and at the confluence of sinuses superior to the torcular Herophili. Magnetic resonance imaging at 11 months of age showed no abnormalities (Fig. 3G).

**Discussion**

Posterior fossa hematomas in neonates are rare but well described. They are thought to reflect stress on the tentorium cerebelli as the fetal head undergoes deformation during vaginal delivery, and, in fact, tentorial tears can sometimes be shown at autopsy. Uncommonly, posterior fossa subdural hematomas arise spontaneously in utero and in neonates born by cesarean delivery, suggesting an alternative cause in some instances. Factors associated with prenatal or neonatal subdural hemorrhage at any intracranial site include abdominal trauma and maternal coagulopathy. Some dural hemorrhages are thought to reflect intratwterine hypoxia-ischemia of unknown cause. Only 1 of our 3 cases had a history of maternal coagulopathy, and, interestingly, the infant in that case had another apparently asymptomatic episode of bleeding, detected on follow-up imaging at 6 postnatal weeks of age. The other 2 cases had pathologic evidence of subacute hypoxic-ischemic damage in other brain sites. However, whether these changes preceded, occurred synchronously with, or followed the tentorial hematoma is unclear.

Subdural hematomas in fetuses and infants may be fatal or may resolve completely without sequelae, as in our case 3. Surgical evacuation is required in some infants. Occasionally, shunt placement is necessary for relief of hydrocephalus because of either compression on the aqueduct by the hematoma or the presence of intraventricular blood inciting aqueductal stenosis. Despite timely treatment, many surviving children have developmental delays and spasticity (cerebral palsy). Although subdural hematomas have been detected prenatally, they have not, to our knowledge, been confused initially with developmental malformations such as Dandy-Walker, retrocerebellar arachnoid, or dermoid cysts, as happened in our cases. This may be because the composition of an organizing hematoma may more closely resemble a cyst, whereas an acute hematoma would be recognizable as such. Also, most ultrasonographically detected subdural hematomas are over the convexities, which is not a common location for developmental cysts.

Properly identifying organizing hematomas is important so that a prenatal diagnosis of a “malformation,” which may engender concern about genetic or syndromic disorders, is not made. Dandy-Walker cysts, for example, very frequently coexist with other malformations and may be familial in a small percentage of cases. Hemorrhage is rarely seen in association with arachnoid cysts but is not a feature of either Dandy-Walker or dermoid cysts. Thus, we emphasize that the ultrasonographic findings of echogenic debris within the cyst, an echogenic rim, or the new appearance of a fluid collection after previously normal findings may be clues to the correct diagnosis of organizing hematoma. Fetal MR imaging is helpful in confirming the presence of blood products, because an evolving
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Figure 3. Case 3. A, Transabdominal axial view of the fetal head at 22 weeks' gestation showing a normal-appearing cerebellum. B, Transvaginal view of the fetal head, slightly lower than in A, showing a 1.7-cm mass with an echogenic rim (calipers). The cisterna magna appears enlarged around this mass. C, Sagittal T2-weighted HASTE MR image showing an intermediate signal intensity collection adjacent to bone. Because of a mass effect, the cerebellum is displaced anteriorly (arrow). Regions of low signal intensity within the mass suggest old blood and correspond to the echogenic rim in B. D, Axial T1-weighted image showing increased signal intensity, thought to be due to blood products. E, Transabdominal axial view of the fetal head, 2 weeks after A–D were obtained, showing a decrease in the size of the mass to 1.4 cm. F (opposite page), Sagittal T2-weighted HASTE MR image at 33 weeks' gestation showing a further marked decrease in size of the mass. No new hemorrhages are shown. G (opposite page), Postnatal MR image at 11 months of age showing no abnormalities.
hemorrhage on MR imaging has a distinct appearance. Oxyhemoglobin is dark on T1- and bright on T2-weighted imaging; extracellular hemoglobin is bright on both T1- and T2-weighted imaging; and hemosiderin is isointense on T1- and dark on T2-weighted imaging. Magnetic resonance imaging is also helpful in identifying smaller blood collections in other sites, such as over the hemispheres, and in localizing the collection more precisely to the tentorium (by showing high-signal cerebrospinal fluid between the cerebellum and the collection).

Making the correct diagnosis of hematoma may also prompt the maternal coagulation function to be assessed. If abnormal, cesarean delivery to avoid fetal head trauma can be planned if the pregnancy proceeds to term, as was done in our case 3.

Whether spontaneous resolution of the posterior fossa subdural hematomas would have occurred in our cases 1 and 2 is impossible to know. However, the microscopic findings of brain stem changes in both and white matter changes in one suggest the possibility of potentially serious neurologic sequelae should these pregnancies have continued to term. In particular, the white matter changes are similar to those seen in asphyxiated infants and are thought to be the substrate for the eventual development of cerebral palsy. It is noteworthy that the size of the hematomas was much greater in these 2 cases, suggesting that compression of adjacent brain and blood vessels could have been significant.

In summary, when a posterior fossa cyst with atypical features is seen on ultrasonography, MR imaging adds important information regarding the presence of blood products, the location of the cyst or hematoma, and associated intracerebral lesions. Pathologic correlation in unusual cases such as this is a source of valuable educational feedback for the sonographer as well as important pregnancy-planning information for the parents, obstetrician, and genetic counselor.

References


