Prevalence of "Compressed" and Asymmetric Lateral Ventricles in Healthy Full-Term Neonates: Sonographic Study

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AJNR Am J Neuroradiol 1986, 7 (1) 149-153
http://www.ajnr.org/content/7/1/149

Prevalence of "Compressed" and Asymmetric Lateral Ventricles in Healthy Full-Term Neonates: Sonographic Study

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The premature infant brain has been thoroughly studied by sonography, and normal standards for ventricular size have been established. Whether these apply to normal full-term infants is uncertain. Fifty-three healthy full-term infants were electively examined by real-time sonography through the anterior fontanelle on the first to sixth days of life. Nine had asymmetric lateral ventricles; two of these had unexpected evidence of intracranial hemorrhage, while a third had a ventricular cyst. Forty-four infants had symmetric ventricles, but in 36 the ventricles had little or no cerebrospinal fluid. Vaginal delivery had a statistically significant association with these "compressed' lateral ventricles. This study indicates that seemingly healthy infants may have unsuspected intracranial hemorrhage, that asymmetric ventricular size may be normal, and that shortly after birth most healthy infants have "compressed" lateral ventricles that should not be interpreted as cerebral edema.

The normal appearance of the brain and the changes that occur in intracranial hemorrhage have been well described in sonographic studies of the preterm infant. The full-term infant usually has been examined only when anoxic brain damage, cerebral infection, or a malformation have been suspected. Since routine screening by cranial sonography is generally restricted to the premature infant, normal standards for the full-term infant have not been established. To determine the normal appearance of the lateral ventricles, real-time cranial sonography was performed in a group of healthy full-term infants. The suspicion that standards might differ between the full-term and premature infant was based on the observation in our neonatal intensive care unit that some full-term infants suspected of anoxic brain damage had excellent outcomes despite the sonographic finding of "compressed" lateral ventricles.

Subjects and Methods

Fifty-three healthy infants were selected for the study from the well-baby nursery. Each infant was the product of a full-term, uncomplicated gestation and had an Apgar score of 9 or 10 at 1 and 5 min and a normal physical examination. Both parents gave informed consent. Sonography was performed through the anterior fontanelle with the infant supine. Sonograms were obtained in coronal and sagittal planes using a real-time scanner (Diasonics) with a mechanical sector 6 mHz transducer. The infants ranged in age from 1 to 6 days. The sonograms were assessed for ventricular symmetry and size and the presence of intracranial hemorrhage or other abnormal findings. The lateral ventricles were graded as to size on the basis of qualitative assessment of the amount of cerebrospinal fluid (CSF) seen in the ventricles on both sagittal and coronal views. Asymmetry was recorded if the size of the bodies of the lateral ventricles differed in both craniocaudal and transverse dimensions. There was no attempt to assess asymmetry limited to the occipital horns because of possible errors caused by transducer obliquity when scanning in this region. Complete neurologic examination was performed in those infants in whom asymmetry of the ventricles was noted. Follow-up sonograms were obtained in two of the three infants in whom abnormalities were detected.

This article appears in the January/February 1986 issue of *AJNR* and the March 1986 issue of *AJR*.

Received January 8, 1985; accepted after revision May 29, 1985.

Presented at the annual meeting of the Society for Pediatric Radiology, Las Vegas, April 1984.

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***AJNR* 7:149–153, January/February 1986**
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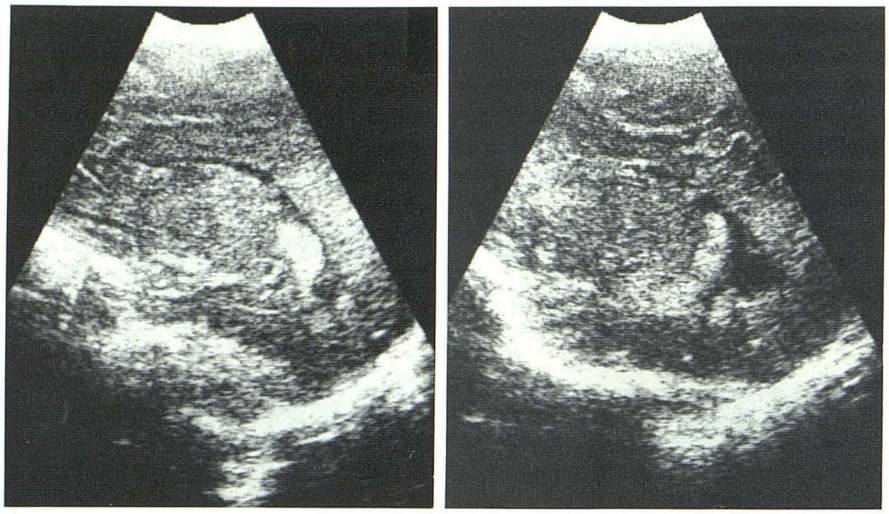

A B

Fig. 1.—Asymmetric ventricles, 3100 g boy, low forceps vaginal delivery. Sonogram on day 2. Sagittal sonogram of right (**A**) and left (**B**) lateral ventricles through trigone. Left lateral ventricle is larger than right.

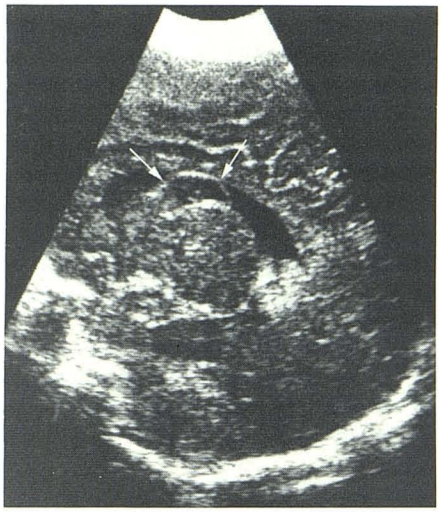

Fig. 2.—Asymmetric ventricles with liquefying subependymal hemorrhage, 4800 g boy delivered by cesarean section to 16-year-old G2, P1 woman. Sonogram on day 3. Sagittal view to left of midline. Anechoic mass (*arrows*) projects into slightly enlarged left lateral ventricle near head of caudate nucleus. Right lateral ventricle was normal.

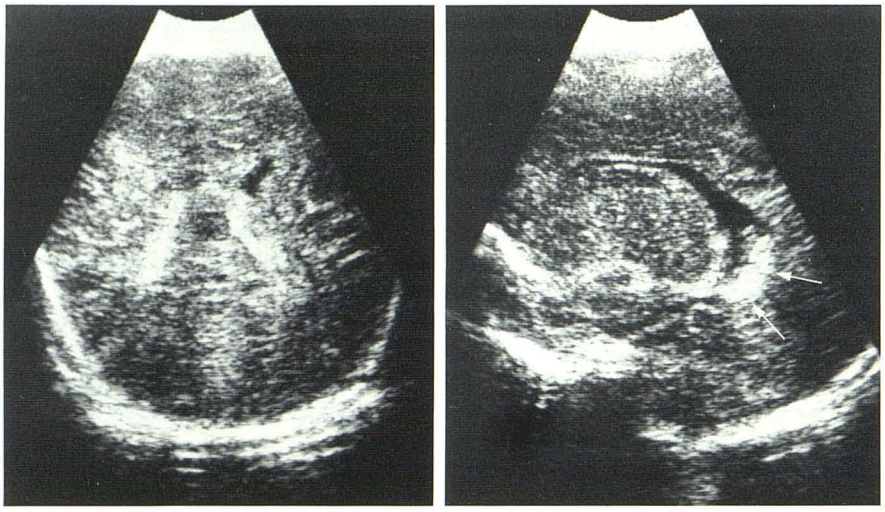

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Fig. 3.—Asymmetric ventricles with intraventricular hemorrhage, 4100 g boy born by vaginal delivery. Sonogram on day 2. **A**, Coronal sonogram through bodies of lateral ventricles. Left ventricle is larger than right. **B**, Sagittal sonogram to left of midline. Echogenic material (*arrows*) extends from choroid plexus into left occipital horn.

Results

Of the 53 intants examined, 27 were boys and 26 were girls. The mean weight was 3600 g (range, 2600–4800). The maternal age varied from 15 to 42 years (mean age, 31 years). Twenty of the infants were first-born, 15 were second-born, 11 were third-born, and seven were higher in birth order. Fifteen sonograms were obtained on the first day of life, 11 on the second, 12 on the third, and 15 on days 4–6.

Nine (17%) of the 53 infants has asymmetrical lateral ventricles. The left lateral ventricle was larger than the right in eight infants. The asymmetry was more marked in the posterior body and occipital horn than in the frontal horn and anterior body (fig. 1). Three of the nine infants with asymmetric ventricles had other findings on the cranial sonogram. A liquefying subependymal hemorrhage was present near the head of the caudate nucleus adjacent to the larger left lateral ventricle in one infant (fig. 2). This infant had been born by cesarean section because of a previous section. Follow-up at 2 months continued to show the anechoic hemorrhage; at 4

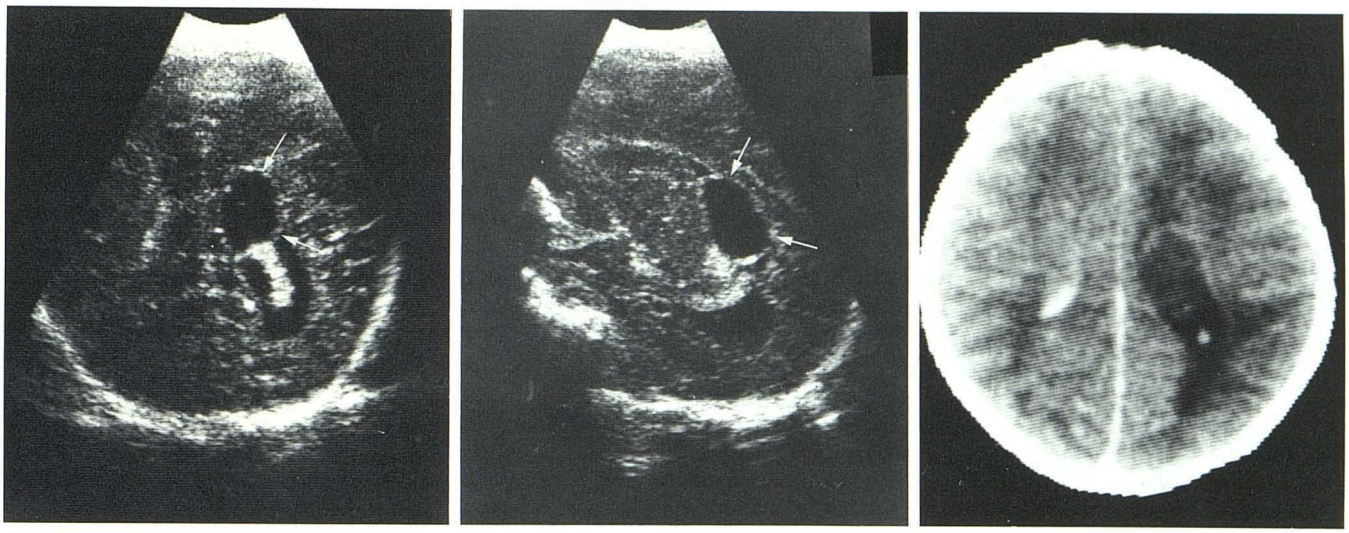

Fig. 4.—Asymmetric ventricles with large cyst in choroid plexus, 3680 g girl born by vaginal delivery. Sonogram on day 2. **A**, Coronal sonogram through bodies of lateral ventricles. Left ventricle is large with its choroid plexus displaced posteriorly. Well defined cystic structure in body of left ventricle (*arrows*). Choroid on right is normal. **B**, Left sagittal sonogram. Frontal horn is normal. Cystic mass measuring 3 × 3 × 2 cm in body of ventricle (*arrows*). Occipital and temporal horns are large. **C**, Postenhancement CT scan. Intraventricular mass does not enhance. It is less dense than brain parenchyma and denser than CSF. Choroid plexus enhancement about mass.

months there was complete resolution. The left lateral ventricle remained larger than the right. Neurologic examination was normal at birth and at 4 and 10 months of age.

Another infant with asymmetric lateral ventricles had irregularity of the margin of the left choroid plexus. Echogenic material extended from the choroid plexus into the left occipital horn (fig. 3). No free blood was noted. The findings suggested intraventricular hemorrhage with clot adherent to the choroid plexus. The study was performed on the first day of life. Birth was by vaginal delivery. Neurologic examination was normal at birth and at 11 months.

In a third infant the body and the occipital and temporal horns of the left lateral ventricles were dilated. A 3 × 3 × 2 cm cystic structure occupied the posterior body of the left lateral ventricle (figs. 4A and 4B). Echogenic strands extended from the choroid plexus to the cyst. The right lateral ventricle and choroid plexus were normal. To rule out the possibility of an intraventricular tumor additional studies were done. A lumbar puncture was normal. Pre- and postenhancement computed tomography (CT) showed a nonenhancing mass in the left lateral ventricle (fig. 4C) corresponding to the cystic lesion demonstrated by sonography. A follow-up sonogram at 2 months of age showed no change in ventricular size or shape or in the appearance of the cyst. The infant's neurologic examination, growth, and development have been normal to 14 months.

The lateral ventricles were symmetric in 44 of the 53 infants examined. Thirty-six of the 44 infants with symmetric ventricles had little or no visible CSF (fig. 5), while in the other eight infants, fluid was easily demonstrable in the bodies and occipital horns of the lateral ventricles (fig. 6). Occasionally the anterior horns were also well seen. No correlation was found between the size of the lateral ventricles and gender of the infant, age or parity of the mother, or the date relative to birth of the sonographic examination. There was, however, a correlation between the type of delivery and the visibility of CSF in the lateral ventricles. Twenty-eight (64%) of the 44 infants with symmetric ventricles were born by vaginal delivery and 16 by cesarean section. Of the eight infants with obvious fluid in symmetric lateral ventricles, six were born by cesarean section. Chi-square and Fisher one-tailed statistical analyses were significant at $p < 0.0189$. The vaginally delivered infants with visible fluid were not examined at an older age than the others. One was studied on day 1 and the other on day 2.

Discussion

In a population of healthy full-term infants selected for normal gestations and Apgar scores of 9 and 10, a 6% incidence of unsuspected abnormalities was noted. All are presumed to be the result of intrauterine intracranial hemorrhage. One hemorrhage occurred in the subependymal region near the head of the caudate nucleus. This hemorrhage showed signs of cystic liquefaction when discovered on the second day of life, suggesting it had occurred during intrauterine life. It resolved in 4 months. Another infant had evidence of intraventricular hemorrhage without apparent involvement of the subependymal germinal matrix. Adherent choroidal clot was present at the trigone extending into the occipital horn on the second day of life. No free ventricular blood was found. The third infant had a large cyst of the left choroid plexus that may have resulted from in utero hemor-

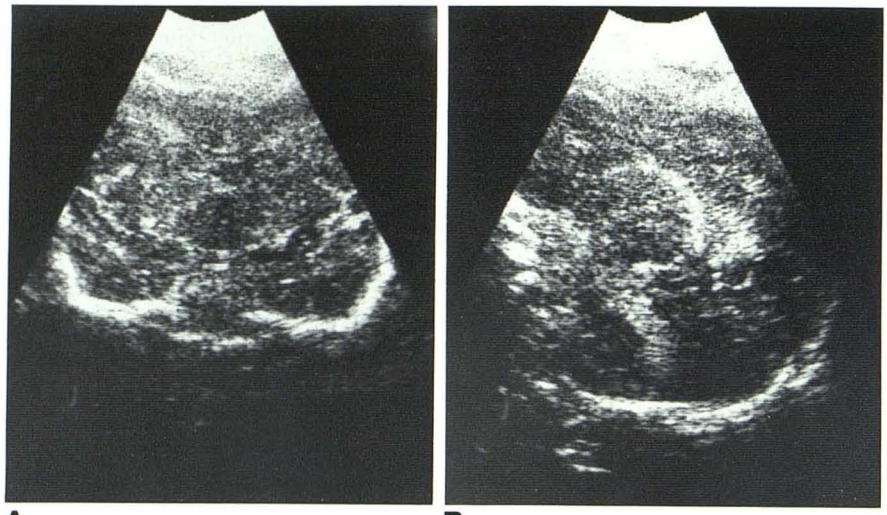

Fig. 5.—Symmetric ventricles with little or no visible CSF, 3060 g boy born by vaginal delivery. Sonogram on day 4. **A**, Coronal sonogram just posterior to foramen of Monro. Little or no visible CSF in lateral ventricles. Brain parenchyma of normal echogenicity. **B**, Sagittal sonogram to right of midline. Normal echogenic choroid plexus in lateral ventricle; no obvious CSF.

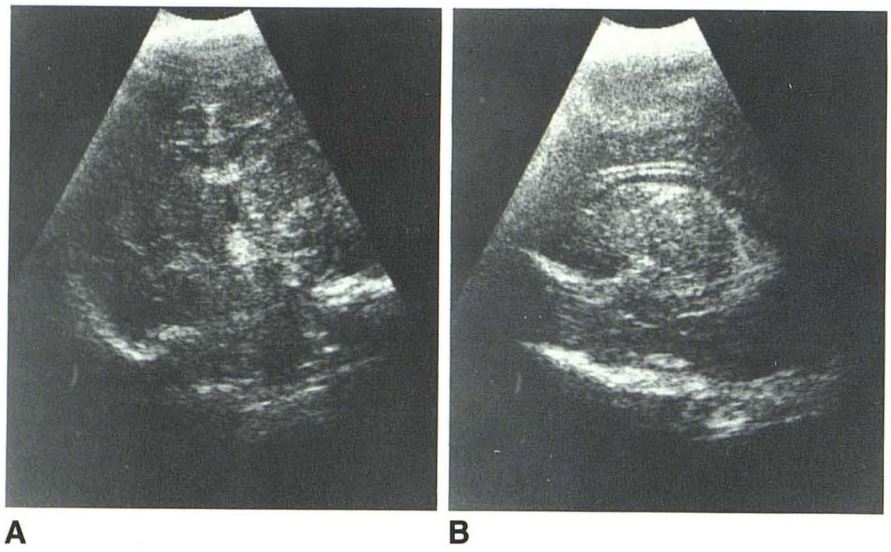

Fig. 6.—Symmetric ventricles with easily seen CSF, 3620 g boy delivered by cesarean section. Sonogram on day 2. **A**, Coronal sonogram through third ventricle. Fluid is easily seen in bodies of lateral ventricles and in third ventricle. **B**, Sagittal sonogram to left of midline. CSF in frontal horn and body of lateral ventricle.

rhage of the choroid plexus. It was unchanged at a 2 month follow-up. Our incidence of intracranial abnormality is similar to the 4.6% incidence found in a large series of full-term infants reported from the University of Texas, Galveston [1]. Subependymal hemorrhage was the only type of intracranial bleeding reported by this group.

Asymmetry of the lateral ventricles has been noted frequently with pneumoencephalography in adults [2] and in older children [3] without abnormalities in the brain. In a recent study of preterm infants with otherwise normal cranial sonograms, Hobar et al. [4] noted that the left lateral ventricle was larger than the right in 32% and that the right lateral ventricle was larger in 6%. Our lower incidence of asymmetry (17%) may reflect the fact that all the infants were studied during the first 6 days of life, a time when the ventricles usually appear "compressed," and subtle differences in size are not apparent. It is interesting that an obvious abnormality was present on the side of the larger ventricle in three of the nine infants with asymmetry. This raises the possibility that intrauterine intracranial hemorrhage may lead to ventricular asymmetry in some cases.

The very small amount of CSF visible in the lateral ventricles of most normal full-term infants indicates that the isolated appearance of "compressed" lateral ventricles is not a reliable sign of cerebral edema in the first few days of life. While the ventricles appear "compressed" in infants with cerebral edema secondary to hypoxia, additional findings such as loss of definition of the interhemispheric fissure and increase in parenchymal echogenicity are necessary for the sonographic diagnosis of cerebral edema [5]. No difference in the overall size of the ventricles was noted in those infants examined on day 1 ($n = 15$) as compared with those studied on days 4–6 ($n = 15$). Sonography was not repeated in this normal population because it did not seem justified to recall healthy infants for sonograms after discharge from the nursery in order to determine the age at which CSF becomes visible in the

ventricles.

The high incidence of "compressed" lateral ventricles in healthy infants delivered vaginally invites comparison with the occurrence of retinal hemorrhages in healthy infants. In a study of the fundi of normal newborn infants on the first day of life, Schenker and Gombos [6] found no retinal hemorrhage in infants born by cesarean section and a 19.2% incidence of retinal hemorrhage in those born vaginally. The authors concluded that prolonged labor and various obstetric complications were the main causes of eyeground hemorrhages. In our series, the delivery records of the 16 infants born by cesarean section who had symmetric ventricles (10 "compressed," six "noncompressed") were reviewed to determine whether a trial of labor, the type of anesthesia, or the amount of intravenous fluid the mother received during labor influenced the size of the lateral ventricles. No association was found between these factors and the amount of visible CSF.

We conclude that "compressed" lateral ventricles are the rule not the exception in healthy full-term babies. This appearance of the ventricles cannot be diagnosed as cerebral edema without abnormal periventricular white matter, indistinct sulci and fissures, or decreased cerebral pulsations. Asymptomatic antenatal hemorrhage may be as frequent as 6% in full-term infants. Lateral ventricular asymmetry is usually a normal finding, but if present, a careful search for a resolving or resolved intrauterine intracranial hemorrhage is indicated.

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