Cerebral intraparenchymal hemorrhage in neonates: sonographic appearance.

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Cerebral Intraparenchymal Hemorrhage in Neonates:
Sonographic Appearance

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The real time sonographic findings of five neonates with cerebral intraparenchymal hemorrhage are reported. In each case, areas of markedly increased echogenicity corresponded to the site of hemorrhage. Excellent correlation was found between computed tomography (CT) and sonography. Although the sonographic appearance of intraparenchymal hemorrhage is characteristic, it is difficult to separate blood from other contiguous highly reflective structures in the head, including choroid plexus, bone, and the tentorium. It appears that real time sonography may offer an alternative to CT in the diagnosis of cerebroventricular hemorrhage in neonates.

Sonography is rapidly becoming a major diagnostic tool in assessment of the neonatal brain. The accuracy of sonographic evaluation of hydrocephalus is now well established and has been found equal to computed tomography (CT) [1, 2]. Sonography has also been used for identification of intraventricular hemorrhage in low birth weight babies [3]. London et al. [4] used a high resolution transducer system to identify isolated germinal matrix hemorrhage without extension into the ventricles. A single case of intraparenchymal hemorrhage beyond the germinal matrix and diagnosed with sonography was reported by Babcock et al. [1]. To extend observations on intraparenchymal hemorrhage, we describe the real time sonographic findings in five neonates.

Subjects and Methods

All five neonates were examined with Advanced Technology Laboratories Mark III real time sector scanner. A 5 MHz transducer system with a 90° field of vision was used and the anterior fontanelle served as an acoustic window. Scans were obtained in the angled coronal and saggital planes. Complete details of this method are given in a previous article [3]. Four of the five patients had CT scans obtained with a Pfizer 0200 FS scanner of second generation geometry. The scans were obtained within 24 hr after sonographic diagnosis of intraparenchymal cerebral hemorrhage. In two cases confirmatory surgery and autopsy were undertaken within 1 day of the sonographic identification of hemorrhage.

In grading the severity of cerebroventricular hemorrhage the classification of Burstein et al. [5] was used: grade I hemorrhage is confined to the germinal matrix; grade II is hemorrhage into the ventricles; grade III is hemorrhage into the ventricles with dilatation; and grade IV is bleeding into the parenchyma of the brain.

Case Reports

Case 1

An 880 g female infant was delivered by cesarean section after 27 weeks gestation from a 24-year-old primigravida mother. Apgar scores were 2 and 8 at 1 and 5 min, respectively. The infant was intubated in the delivery room and was placed on a ventilator on admission to the nursery. She did very well and was weaned rapidly. There were no episodes of hypo- or hypertension, no drop in hematocrit, or catastrophic events during her course. Sonog-

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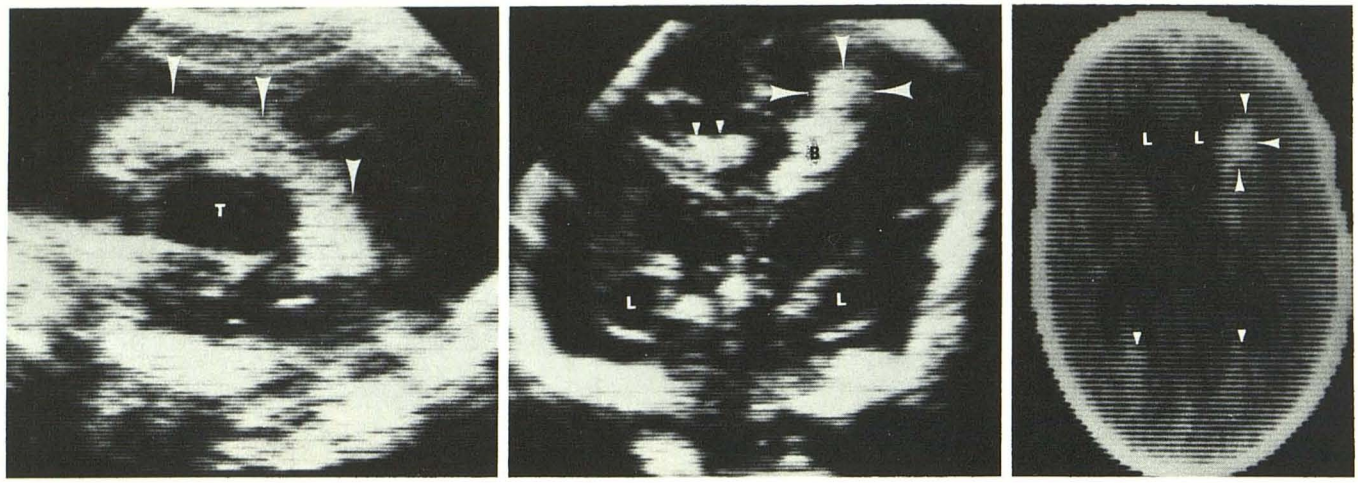

Fig. 1.—Case 1. **A,** Parasaggital sonogram. Echogenic blood fills enlarged lateral ventricle (*arrowheads*). T = thalamus. **B,** Coronal sonogram 2 days later. Echogenic area in region of left frontal lobe represents intraparenchymal hemorrhage (*large arrowheads*). Body of left lateral ventricle (B) remains full of blood. Temporal horns of lateral ventricles (L) are now dilated but without evidence of clot. Blood/cerebrospinal fluid level in body of right lateral ventricle (*small arrowheads*). **C,** CT scan. Left frontal lobe intraparenchymal hemorrhage (*large arrowheads*). Moderate dilatation of lateral ventricles (L); small amount of blood in occipital horns (*small arrowheads*).

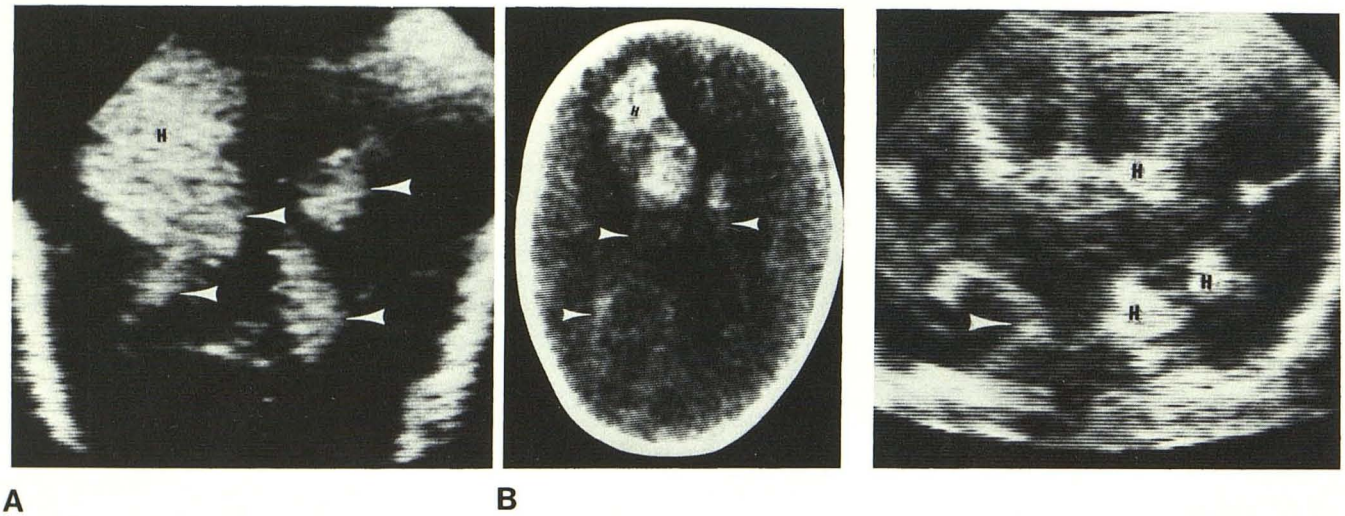

Fig. 2.—Case 2. **A,** Semiaxial sonogram. Large echogenic area involves much of right frontal lobe (H) representing intraparenchymal hemorrhage. Continuity with intraventricular blood (*arrowheads*). **B,** CT scan. Large right frontal lobe hemorrhage (H). Intraventricular blood (*arrowheads*).

Fig. 3.—Case 3. Semicoronal sonogram. Irregular echodense area in left parietooccipital region (H) represents hemorrhage. Normal tentorial echoes on right (*arrowhead*).

raphy on day 1 showed grade I intraventricular hemorrhage. CT confirmed this the next day. Repeat sonography on day 3 showed grade III intraventricular hemorrhage (fig. 1A). Follow-up sonography 2 days later showed blood dissecting into the left frontal lobe and moderate hydrocephalus (fig. 1B). CT the same day confirmed this finding (fig. 1C). Over a 4 week period, a porencephalic cyst developed in the area of the parenchymal hemorrhage, although the infant otherwise progressed normally.

Case 2

A 1,040 g female infant was delivered precipitously in the emergency room of a rural hospital at 30 weeks gestation. Apgar scores were 2 and 5 at 1 and 5 min, respectively. She was stabilized and transferred to a neonatal center and subsequently did very well, except for apnea and bradycardia requiring aminophylline. Sonography on the fifth day of life revealed grade IV cerebroventricular hemorrhage with a large component extending into the right frontal lobe (fig. 2A). CT later the same day confirmed these findings (fig. 2B). During the next 5 weeks, a large porencephalic cyst developed in the right frontal lobe. Otherwise, this infant progressed normally.

Case 3

A 920 g male infant was delivered by cesarean section from a 34-year-old mother after 28 weeks gestation. Apgar scores were 1

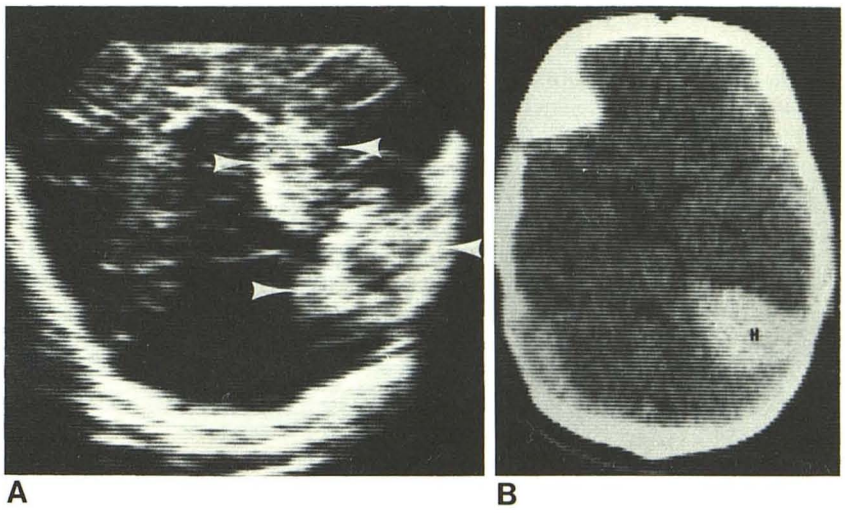

Fig. 4.—Case 4. **A,** Semiaxial sonogram. Large echodense area corresponds to temporoparietal hematoma (*arrowheads*). **B,** CT scan. High density area in similar location (H) correlates well with sonogram.

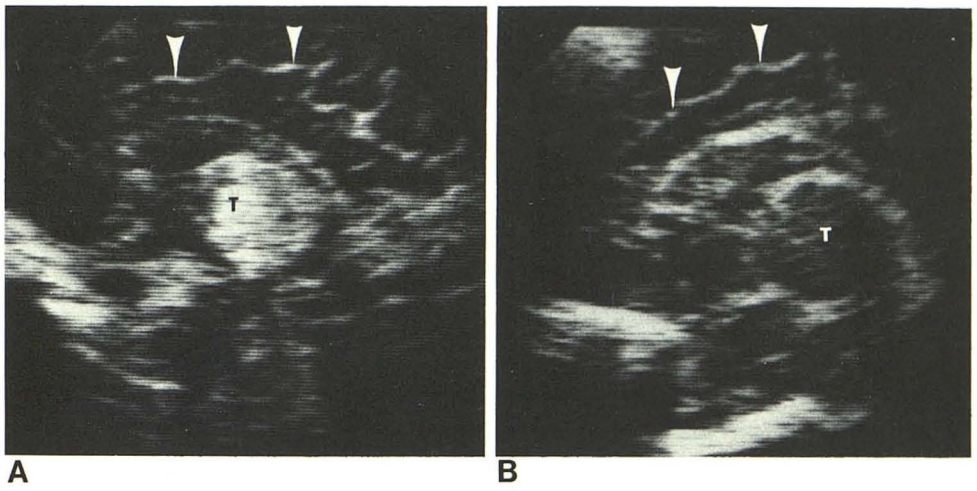

Fig. 5.—Case 5. **A,** Parasaggital sonogram. Intensely echogenic area in right thalamus (T). Anterior cerebral artery and branches (*arrowheads*). **B,** Parasaggital sonogram. Normal low level echogenicity exhibited by corresponding left thalamus (T) in somewhat more angled section. Part of anterior cerebral artery group (*arrowheads*).

and 5, and the infant was appropriately resuscitated in the delivery room and transferred to the intensive care nursery. He was immediately placed on a ventilator, but remained hypotensive, hypotonic, and markedly cyanotic with poor response to supportive therapy. He had several malformations compatible with trisomy 18 syndrome, which was later confirmed by chromosome analysis. Sonography on day 2 showed cerebroventricular hemorrhage with a parenchymal component extending into the left parietooccipital region (fig. 3). This was confirmed the next day at autopsy.

Case 4

This infant was the product of a term, vaginal, low forceps delivery from a primigravida mother. Apgar scores were both 9. The infant developed seizures, and lumbar puncture showed bloody cerebrospinal fluid. Sonography revealed a large echogenic region in the left temporoparietal area, contiguous with the bone (fig. 4A). CT showed an area of high density in a similar location to that seen with sonography (fig. 4B). At surgery the next day, an intracerebral hemorrhage was found that had ruptured into the surrounding subdural space. The infant had an uneventful recovery from surgery and continued to do well.

Case 5

A 3,900 g term male infant was delivered by normal spontaneous vaginal delivery from a healthy 30-year-old primigravida mother. Generalized seizures occurred on days 1 and 4 of life. Lumbar puncture revealed bloody cerebrospinal fluid. Sonography on day 5 showed marked increase in echogenicity of the right thalamus, which appeared to indent the surrounding right lateral ventricle slightly (fig. 5). The rest of the scan was normal and without blood in the lateral ventricles. CT the same day confirmed right intrathalamic hemorrhage. Follow-up sonography and CT at 1 and 3 months of age showed no abnormality and the child progressed normally.

Discussion

Intracerebral hemorrhage in the neonate may take a number of forms depending on the clinical setting. In low birth weight babies, Burstein et al. [5] found cerebroventricular hemorrhage to be present in 44% of patients by CT scanning. The same authors devised a grading system based on CT appearance of cerebroventricular hemorrhage. They showed that isolated germinal matrix (grade I) and uncom-

plicated intraventricular hemorrhage (grade II) resulted in no future sequelae after short periods of follow-up. The finding of intraventricular hemorrhage with ventricular dilatation (grade III) led to progressive hydrocephalus in 89%. The appearance of hemorrhage beyond the germinal matrix into the brain itself (grade IV) carried the worst prognosis, with death occurring in seven of 10 patients, with the surviving three infants progressing to porencephaly. Few long term studies have been done to follow these children, but McCullough and Wells [6] and Krishnamoorthy et al. [7] also report a poor prognosis in association with extension of hemorrhage beyond the germinal matrix into the parenchyma of the brain.

In term babies, intracerebral hemorrhage has classically been believed to occur in association with birth trauma or hypoxia and to be quite rare. Recent reports indicate that cerebroventricular hemorrhage may be more common in term babies than previously suspected [8, 9]. It appears that seizures and bloody spinal tap should be investigated closely in term infants and underlying intracranial hemorrhage suspected more frequently as the cause. The increasing use of the CT scanner is most likely responsible for more of these hemorrhages being recognized in term infants.

The sonographic appearance of intraparenchymal hemorrhage was quite similar in all five of our neonates. Highly echogenic regions representing intraparenchymal blood were easily identified and contrasted with the low level echo pattern of the normal brain. Few structures in the neonatal head are as echogenic as hemorrhage. Among them are specular reflectors such as the tentorium and sylvian fissures. The choroid plexus and cerebellum are also quite echogenic, possibly due to their surface characteristics.

It has been our experience that intraventricular hemorrhage is also very echogenic [3]. The echogenicity of intraventricular hemorrhage is similar to that of choroid plexus and will blend with it, forming a single echogenic complex. Likewise, when intraparenchymal hemorrhage occurred adjacent to a blood filled ventricle (cases 1 and 2) a large continuous echogenic complex comprised of choroid plexus, intraventricular blood clot, and intraparenchymal hemorrhage was observed. A similar situation existed in the other patients. Tentorial echoes could not be distinguished from those arising in adjacent intraparenchymal hemorrhage (cases 3 and 4).

Although CT is still considered the primary method for identifying intracranial hemorrhage in neonates, real time sonography is emerging as a viable alternative and offers a number of advantages. Foremost among them is that the examination may be repeated as frequently as desired because of lack of ionizing radiation and the ease of performing the scans at the bedside. In our five patients, sonography was able to identify intraparenchymal hemorrhage prior to CT examination. It has been demonstrated that sonography is able to identify all grades of cerebroventricular hemorrhage [3, 4] and will undoubtedly play an increasingly important role in the evaluation of intracranial pathology in the future in both premature and term neonates.

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