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Transverse Sinus Thrombosis in Newborns: Clinical and Magnetic Resonance Imaging Findings

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Neonatal transverse sinus thrombosis (TST) is considered a rare and severe sequela of birth injury. Clinical descriptions of this entity are few since most published series are postmortem studies. The advent of magnetic resonance imaging (MRI) allows recognition of TST ante mortem. We describe 4 full-term infants with distinct clinical and neuroradiological features indicative of TST, which we suggest may be relatively common, with a wide spectrum of severity, including favorable outcome.

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Transverse sinus thrombosis (TST) in infants has been associated with conditions causing significant morbidity, such as sepsis, dehydration, and shock [1]. The majority of reported cases are in postmortem series [1, 2]. Magnetic resonance imaging (MRI) allows the detection of intracranial blood collections in neonates, and in particular, the visualization of dural sinus thrombosis [3, 4]. Neonates with a perinatal central nervous system insult present with a variety of clinical syndromes, including stupor, hypotonia or hyperalertness, jitteriness, and seizures [5]. Clinicopathological correlates of these distinct presentations were difficult to obtain before computed tomography (CT) or MRI of the neonatal brain was available.

We present a series of full-term infants with similar clinical, electrophysiological, and cerebrospinal fluid (CSF) characteristics, all of whom had transverse sinus thrombosis on MRI.

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Patients and Methods

Infants were evaluated neurologically when seizures were suspected or hyperirritability and an abnormal electroencephalogram (EEG) were noted. Magnetic resonance images were performed on a General Electric 1.5 Tesla Signa system (General Electric, Milwaukee, WI). Slice thickness was 5 mm with a 1-mm gap. Unless other parameters are indicated in the text, T1-weighted spin echo (SE) sequences consisted of TR 600 ms and TE 20 ms, and T2-weighted SE sequences consisted of TR 2,500 ms and TE 160 ms. All images were obtained from 10 to 21 days after birth. EEGs were performed according to the recommendations of the American Electroencephalography Society for studies in infants [6].

Results

The clinical characteristics of the 4 patients as well as the results of CSF analysis (in 3 cases) and the salient features of their EEGs are depicted in the Table. A sample history of the first evaluated infant follows.

Baby S was a term product of a pregnancy complicated by maternal fever. The patient was meconium stained at birth; Apgar scores were 4 and 6 at 1 and 5 minutes, respectively. Irritability and jitteriness were noted in the nursery but the infant experienced no true seizures. An evaluation for sepsis revealed xanthochromic CSF. Neurological examination confirmed the irritability and, in conjunction with the CSF findings, prompted neuroradiological evaluation. A CT scan was normal; however, the torcula, distal straight sinus, and transverse sinus were considered thrombosed by MRI criteria. EEG showed a normal background activity with excessive central and right temporal spikes and sharp waves. The child's irritability resolved gradually over 2 to 3 weeks. Neurological follow-up examination was normal.

Figures 1 and 2 demonstrate the appearance of dural sinuses involved in the thrombotic process. The dominant right transverse sinus appears hyperintense on T1-weighted images in all cases. Additionally, nonflowing blood is seen in the torcula in Figure 2, which also demonstrates extravasated blood in the posterior fossa, probably in the subdural space.

Discussion

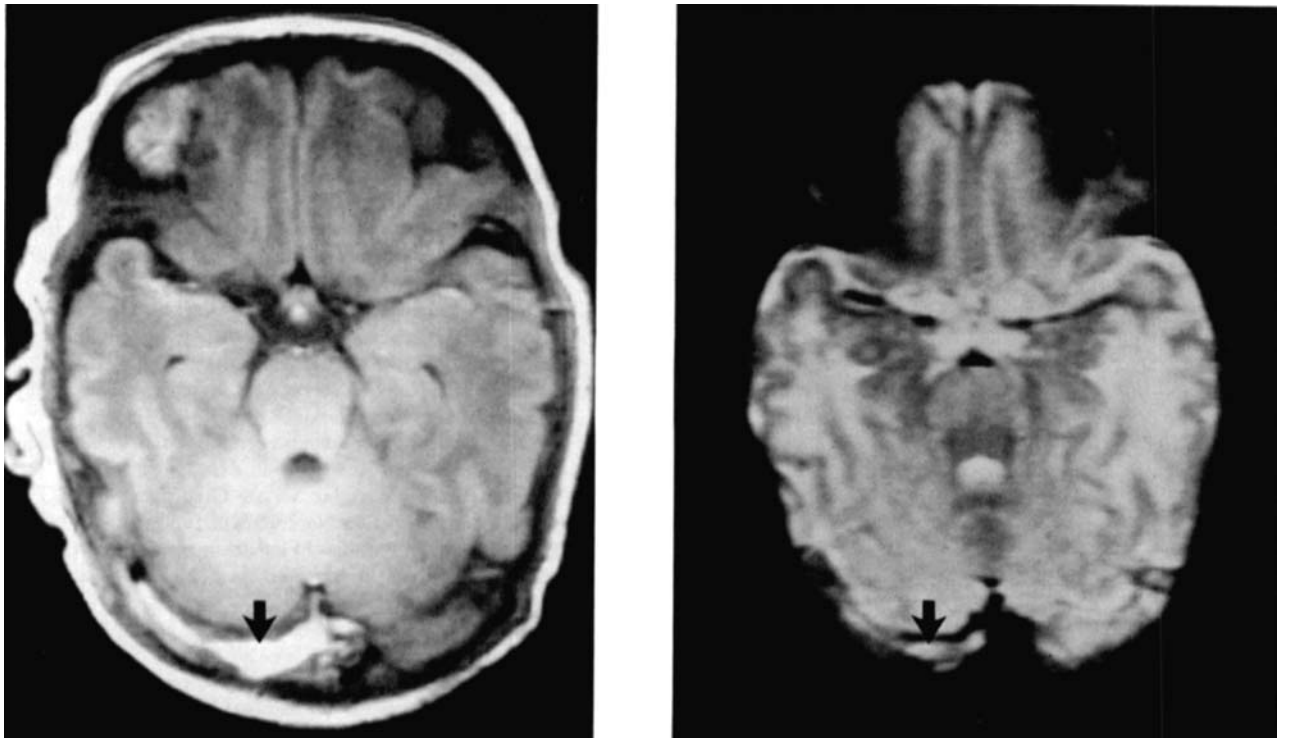
In this report we describe a small group of newborns with TST and a benign outcome. This is at variance with most reported series of sinus thrombosis in infancy [1, 2, 5]. Few clinical descriptions of the course of newborns with TST are available [7]. Published clinical reports usually describe a catastrophic, rapidly fatal brainstem compression by an associated infratentorial hematoma [5]. A slower course, with a prodromal "normal" phase followed by signs of increased intracranial pressure, brainstem compression, and death has also been described [7]. Recently, benign variants of neonatal superior sagittal sinus thrombosis presenting with seizures have been reported [8, 9].

Sinus thrombosis, including TST, in newborns most

Characteristics of Infants with Transverse Sinus Thrombosis

Patient No.	Sex/Weight (gm)	Initial Neurological Examination	Seizures/EEG	Cerebrospinal Fluid	Follow-up Neurological Examination
1	F/2,185	Jittery, irritable	None/temporal sw	RBC xantho	Normal
2	F/3,900	Jittery, mild hypertonia	None/excessive right temporal sw	Not done	Not available
3	M/2,575	Irritable	One/temporal and central sw	100,000 RBC	Normal
4	F/4,540	Irritable, mild hypertonia	Not done	Hemorrhagic	Not available

sw = sharp waves; RBCs = red blood cells; xantho = xanthochromic.



A B

Fig 1. Axial spin echo magnetic resonance images of Patient 3. (A) T1-weighted image (TR 800 ms, TE 20 ms) demonstrates a hyperintense signal (thrombosis) in the right transverse sinus (arrow). *(B) T2-weighted image (TR 2,500 ms, TE 20 ms) at the same level shows a less intense signal within the transverse sinus* (arrow). *The normal black signal void of flowing blood is absent.*

commonly is associated with intracranial hemorrhage complicating birth trauma [1, 5]. Volpe [5] recognizes several major varieties of traumatic subdural hematomas involving specific dural sinuses. Tentorial laceration causes infratentorial accumulation of blood, with severe involvement of the transverse sinus as well as the straight sinus and the vein of Galen. In the infants presented, a mild variant of tentorial laceration resulting in both subdural and subarachnoid hemorrhage and secondary thrombosis of the transverse sinus is the most likely sequence.

The clinical features of our patients, exemplified by the case report and summarized in the Table, are remarkably homogeneous: an irritable baby evaluated for suspected seizures with a hemorrhagic CSF and an abnormal EEG. The presence of excessive temporal sharp waves on the EEGs of these infants is intriguing. Recently, Novotny and associates [10] have linked central sharp waves in neonatal EEGs to paramedian white-matter lesions. The lateralization of the temporal sharp waves to the right, the side of the dominant transverse sinus, suggests at least a temporary functional compromise of neuronal activity in areas underlying the thrombosed sinus.

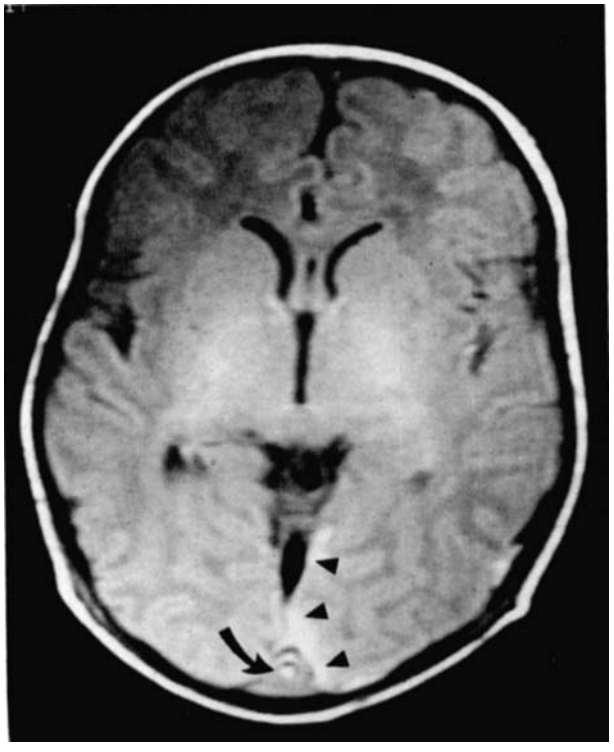


Fig 2. Axial spin echo T1-weighted image of Patient 4, showing the ring appearance of partial thrombosis within the torcular herophili (curved arrow) *and subdural hematoma along the medial aspect of the left occipital lobe* (arrowheads).

The diagnosis of dural sinus thrombosis has undergone significant evolution since 1978, when Blank and associates [7] pointed out the scarcity of antemortem diagnoses of this entity in newborns. Angiography has been the accepted standard for diagnosis in adults and older children [11]. Ultrasonic detection of a large subdural hematoma has been reported [12], but during the last decade, CT scanning has been the neurodiagnostic modality of choice [13, 14]. Small amounts of blood in the posterior fossa, however, may be poorly visualized by CT scanning. Moreover, this modality does not differentiate flowing from acutely clotted blood. Two of our patients underwent CT scanning before MRI and in both cases the study was unrevealing.

In the past year, the criteria for the diagnosis of dural sinus thrombosis by MRI have been defined [3]. During the first few days after thrombosis, T1-weighted images display the absence of normal flow void within the sinuses [3, 4] and the thrombus appears hyperintense on both T1- and T2-weighted images [3]. Partial thrombosis can be seen as a ring pattern of central hyperintense signal, which represents the thrombus, surrounded by a peripheral halo of a signal void, which corresponds to flowing blood (see Fig 2). McArdle and associates [15] described the MRI appearance of 6 venography-proven cases of transverse/sigmoid sinus thrombosis, and distinguished thrombus from the increased signal caused by turbulent slow flow by the difference in signal intensity from the first to the second echo. The change in signal intensity for thrombus was quantitatively less than that observed with slow flow. Bauer and colleagues [4] also described the typical subacute hyperintense appearance of sinus thrombosis on both T1- and T2-weighted images. The MRI scans of our patients, obtained 10 to 21 days after birth, reveal the hyperintense signal of sinus thromboses, as demonstrated in both T1- and T2-weighted images (see Figs 1 and 2). The associated subdural and subarachnoid hemorrhages are also seen (see Fig 2).

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