

# MRI in Neonatal Dural Sinus Thrombosis

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**Dural sinus thrombosis in the newborn period is a rare but underrecognized condition which may cause seizures, macrocephaly, lethargy, and respiratory depression. A 10-day-old term infant with no pre- or perinatal risk factors for thrombosis presented with seizures and was found to have dural sinus thrombosis on computed tomography and magnetic resonance imaging (MRI). One week later, MRI revealed partial resolution and 3 weeks later disclosed a complete resolution of the thrombosis. Clinicians should consider the diagnosis of neonatal dural sinus thrombosis in infants presenting with seizures and/or increased intracranial pressure even in the absence of risk factors or when the cranial computed tomography is normal. MRI is the most sensitive diagnostic tool to establish the diagnosis and permit a noninvasive follow-up, contributing to our understanding of the natural history, associated pathology, and prognosis of this condition.**

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## Introduction

Dural sinus thrombosis (DST) represents a rare but underrecognized cause of seizures in term infants. Before 1980, it was described only in autopsy studies of asphyxiated newborns [1,2]. Literature review revealed only a few recent case reports describing sinus thrombosis in newborns [3-16]. Different diagnostic procedures have been suggested as confirmatory, including carotid angiography, digital subtraction angiography, computed tomog-

raphy (CT), and most recently magnetic resonance imaging (MRI). We report a term newborn with seizures and a subarachnoid hemorrhage due to DST, and review previous reports of neonatal DST and the diagnostic modalities used.

## Case Report

This 10-day-old female infant was the 3,629 gm product of an uncomplicated 42-week gestation to a 38-year-old G6,P3 mother who had 3 prior first trimester spontaneous abortions. There were no immediate postnatal complications. On the eighth day of life, the infant developed loose stools. The next day, 2 brief (<1 min) episodes of right arm twitching were observed. On the day of admission, another brief episode of twitching of the right arm, face, and leg occurred, followed by 20 min of lethargy. Another 1 min episode occurred in the emergency room. There was no history of trauma. The family history was remarkable for a 7½-year-old brother who developed staphylococcal sepsis and necrotizing enterocolitis on the second day of life.

On physical examination, the patient was alert, pink, active, and afebrile. The weight was 3,742 gm and head circumference 36.75 cm (95th percentile). The anterior fontanel was open and flat. She was well hydrated. The funduscopic examination, muscle tone, deep tendon reflexes, and Moro reflex all were normal.

Initial complete blood count, hematocrit, serum electrolytes, serum glucose, bilirubin, calcium, and magnesium all were within normal limits. Lumbar puncture yielded grossly bloody cerebrospinal fluid with 28,000 erythrocytes/mm<sup>3</sup> and 22 leukocytes/mm<sup>3</sup> (53% segmented neutrophils, 47% monocytes); the supernatant was xanthochromic. Serum glucose concentration was 50 mg/dl and total protein 111 mg/dl. No organisms were observed with Gram staining and cultures were negative.

PT, PTT, AT-III, fibrinogen, protein-C, and protein-S levels were within normal limits. EEG was normal. Maternal anticardiolipin antibodies were negative. Unenhanced cranial CT revealed a hyperdense internal cerebral vein, vein of Galen, straight sinus, and superior sagittal sinus without any CT evidence of subarachnoid hemorrhage or venous infarction (Figs 1A,1B). MRI confirmed the CT findings; hyperintense signal appeared in the same venous structures on T<sub>1</sub>-weighted images. These findings were persistent on the coronal T<sub>1</sub>-weighted MRI and T<sub>2</sub>-weighted images. No evidence of any parenchymal pathology existed (Figs 1C,1D). On the eighth day of admission a repeat MRI demonstrated partial resolution of the DST.

By the second day after admission, the patient was active and feeding well. She was discharged in good condition 8 days after admission.

A repeat MRI at 30 days of age was entirely normal (Fig 2). The physical examination, including head circumference, was normal as well. The patient was examined in clinic 1 year later and was neurologically normal and had a normal head circumference.

## Discussion

DST has been described in children as a complication of sinusitis, meningitis, dehydration, hypercoagulable states, neoplasms, intracranial surgery, and homocystinuria [14].

From the first pathologic study by Baily and Hass in 1931 [15] through the early 1980s, there were no clinical

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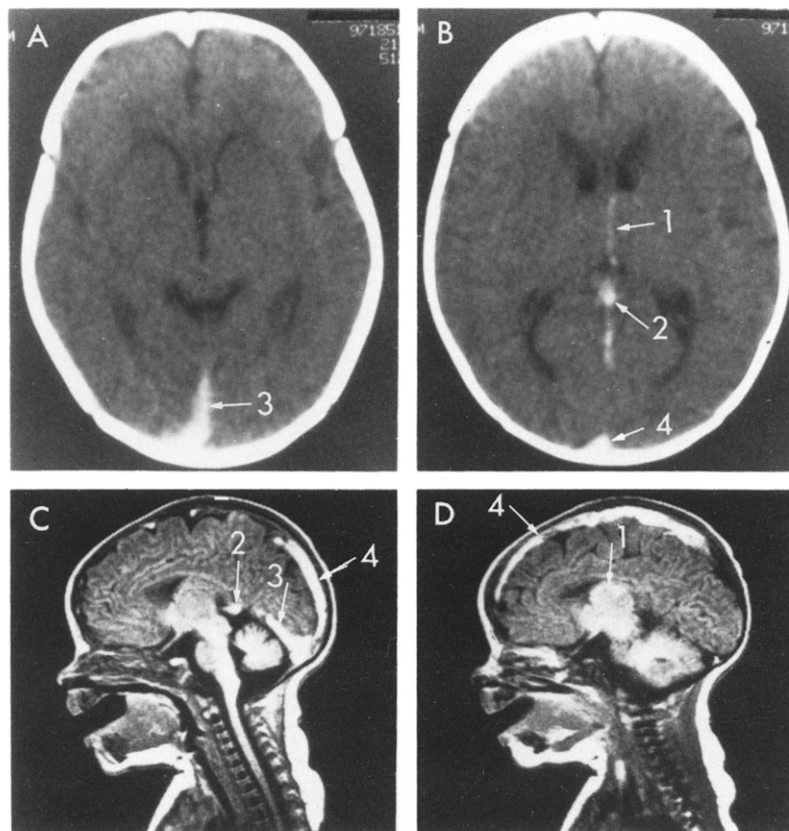


Figure 1. (A,B) Unenhanced axial CT scans. (C,D) Midline sagittal T<sub>1</sub>-weighted MRI scans without gadolinium. Demonstrating hyperdense (1) internal cerebral vein, (2) vein of Galen, (3) straight sinus, and (4) superior sagittal sinus on CT and hyperintensity of the same venous structures on MRI due to extensive midline dural venous sinus and deep venous thrombosis.

reports of neonatal DST, in spite of its frequent occurrence (about 40%) in some autopsy studies of asphyxiated newborns [1,2].

In the last 4 years more than 30 patients with neonatal DST have been reported, presenting with a variety of signs, including macrocrania, bulging anterior fontanel, irritability, and respiratory depression. Most of these patients had a very good outcome, correlating mainly with

the Apgar score at birth, and the severity of the underlying disorders.

All reported patients with neonatal DST in all languages, are summarized in Table 1, describing the clinical presentation and modalities used to make the diagnosis.

Shevell and Silver reviewed the largest series – 17 patients [3]. These patients were identified by a retrospective review of unenhanced CT scans, which revealed a

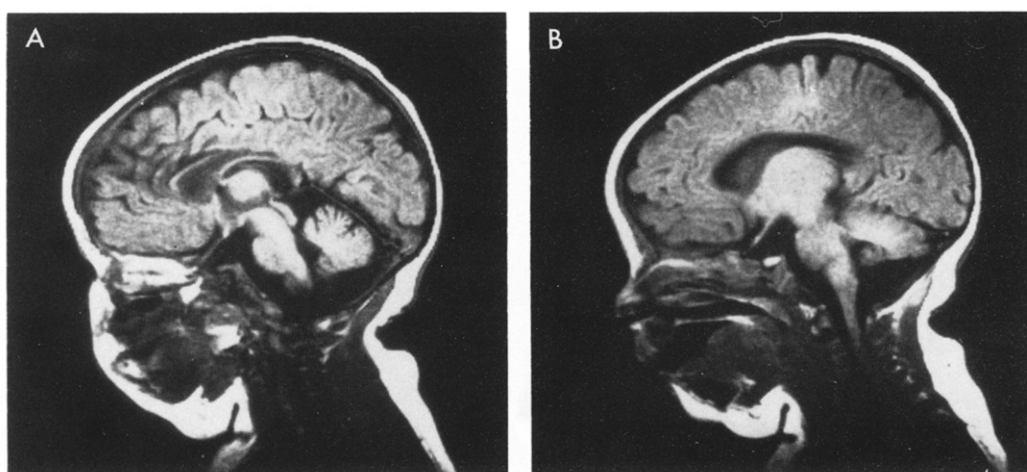


Figure 2. (A,B) Midline sagittal T<sub>1</sub>-weighted MRI scans (30 days of life). Complete resolution of venous sinus and deep venous thrombosis.

**Table 1. Literature review of infants with neonatal DST**

Reference	No. of Patients	Presentation	Imaging Study Diagnostic for DST			
			CT	MRI	Angio-gram	Sono-gram
Patronas and Duda [5]	2	1 with vomiting, diarrhea, seizures; 1 with fever, vomiting, diarrhea, lethargy	+			
Schubiger and Schubiger [9]	1	Seizures	+			
Marciniac and Wilson [7]	2	Seizures, protein c deficiency	+			
Hanigan and Rossi [11]	1	Seizures	-	+		
Wong and LeMesurier [6]	2	Seizures	+		+	
Konishi and Kuriama [4]	3	Seizures	+ 2 - 1		+ 1	
Edwards and Kuharik [13]	2	Meconium aspiration, respiratory distress, hypotonia, hypotension	+			+
Shevell and Silver [3]	17	15 with seizures, 2 with bulging fontanel and macrocrania	+			
Baram and Butler [10]	1	Irritability	-	+		
Hanigan and Tracy [12]	4	27 weeks gestation with RDS and other complications, multiple trauma during delivery and hydrocephalus, grade III, IVH, traumatic subarachnoid hemorrhage and jitteriness		+		+
Davies and Slavotivsek [8]	1	Respiratory depression	+*			
Rivkin and Anderson [16]	7	Seizures x3 Lethargy x4	+ 6 - 1	+ 7		
Present patient	1	Seizures	+**			
<b>Totals:</b>	44	29 presented with seizures; 15 with different presentations	5 with normal or non-diagnostic CT scans			

\* Autopsy revealed a much more extensive lesion.  
 \*\* MRI revealed a much more extensive lesion.

Abbreviations:  
 IVH = Intraventricular hemorrhage  
 RDS = Respiratory distress syndrome

dense sagittal sinus with concomitant small ventricles. Two were confirmed by angiography and nuclear flow scan. No etiology was apparent in 14 patients and 14 of the 17 infants recovered fully. MRI was not used. Other authors have reported cases in which the CT findings of DST were confirmed angiographically [4,6] or at autopsy [8].

Only 4 reports of MRI in the diagnosis of neonatal DST have been published. Hanigan and Tracy reported 5 infants with neonatal DST [12], 1 of whom had been

reported previously [11]. The others presented with a very complicated neonatal course. All were diagnosed by MRI, following head sonograms revealing various abnormalities, including ventricular dilatation, "enlarged choroid plexus," cystic lesions, or periventricular leukomalacia. In 1 patient, cranial CT demonstrated a small midline hemorrhage. All of these patients had follow-up MRI scans within 6 months disclosing resolution of the thrombotic process. Baram and Butler described an asphyxiated newborn with maternal fever and meconium aspiration who

presented with irritability and jitteriness, but without true seizures [10]; cranial CT was normal, but MRI demonstrated a thrombosis of the right transverse sinus. Rivkin and Anderson reported 7 neonates presenting with focal seizures or lethargy [16]. In one of them, cranial CT was nondiagnostic and in all the others, MRI demonstrated the pathology much more extensively.

Literature review and our patient demonstrated an important role for MRI in the diagnosis and follow-up of newborns with DST. Our patient is the first in whom the diagnosis and complete resolution of DST over 3 weeks was demonstrated by MRI. MRI clearly visualizes the DST in patients in whom cranial CT is normal, nondiagnostic, or does not demonstrate the full extent of the lesion. MRI avoids the risks of carotid angiography and documents associated cerebral pathology as well.

DST should be considered much more frequently in neonates with seizures, unexplained irritability, macrocephaly, or bulging fontanel, especially when cranial CT demonstrates subarachnoid bleeding.

The fact that 31 of 44 reported infants with neonatal DST have been reported in the last 4 years indicates that clinicians are more aware of this diagnosis and more sensitive diagnostic modalities are available. DST in an otherwise well child has an excellent prognosis [3,6,11, 16]. This diagnosis, therefore, is important for reassurance of parents and exclusion of other conditions causing neonatal seizures.

We believe that more frequent use of MRI in patients with undiagnosed neonatal seizures, macrocrania, and bulging fontanel or abnormal cranial sonograms [12] will reveal a much larger infant population with the diagnosis of DST.

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