

# Prenatal diagnosis of thrombosis of the dural sinuses with real-time and color Doppler ultrasound

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## ABSTRACT

**Objective** To assess the sonographic findings and clinical implications of fetal thrombosis of dural sinuses.

**Design** Retrospective study of cases with a prenatal diagnosis of thrombosis of the dural sinuses.

**Results** The diagnosis of fetal thrombosis of the dural sinuses was established in three uncomplicated pregnancies at 21, 22 and 28 weeks' gestation by transabdominal and transvaginal sonography, demonstrating a blood clot within the dilated dural sinuses, always in the region of the torcular Herophili. The diagnosis was further confirmed by the color Doppler demonstration of absence of blood flow within the dilated dural sinuses. Upon request of the couples two pregnancies were terminated. One infant was delivered at term by Cesarean section and died during neurosurgery.

**Conclusions** Thrombosis of the cerebral venous circulation can occur antenatally. Accurate diagnosis can be made using fetal real-time and color Doppler ultrasound.

## INTRODUCTION

Thrombosis of the cerebral venous circulation in newborns has been reported and in some cases predisposing factors such as asphyxia, polycythemia, coagulopathy, infection and trauma have been identified<sup>1</sup>. In many cases, however, the condition is idiopathic. We herein report three cases of thrombosis of the dural sinuses that occurred during fetal life in uncomplicated pregnancies and were diagnosed antenatally with ultrasound. To the best of our knowledge, this is the first such report.

## PATIENTS AND METHODS

The archives of our ultrasound laboratories in the period 1995–2000 were searched for cases with a diagnosis of fetal thrombosis of the dural sinuses.

All fetal examinations were performed with ESAOTE (Genoa, Italy) ultrasound equipment (AU4, AU5 EPI, Technos). Abdominal (3.5–5 MHz) and vaginal transducers (5.0–7.5 MHz) were used.

In all cases, a detailed follow up including obstetric and post-natal data was obtained.

## RESULTS

The diagnosis of fetal thrombosis of the dural sinuses was made in three pregnancies. One patient was gravida 2 para 1, the remaining two were primigravidas. Two of them had previously undergone amniocentesis with normal results (male karyotype in one, female karyotype in the other one). The ultrasound examinations were performed for routine studies (mid-trimester anomaly scan in two cases, third-trimester evaluation of fetal growth in the other) at 21, 22 and 28 weeks.

In all cases, the transabdominal scans performed with 3.5–5 MHz transducers revealed a triangular sonolucent area in the occipital region with well-defined regular contours. In the most posterior aspect of the fluid collection a round echogenic mass was seen (Figure 1).

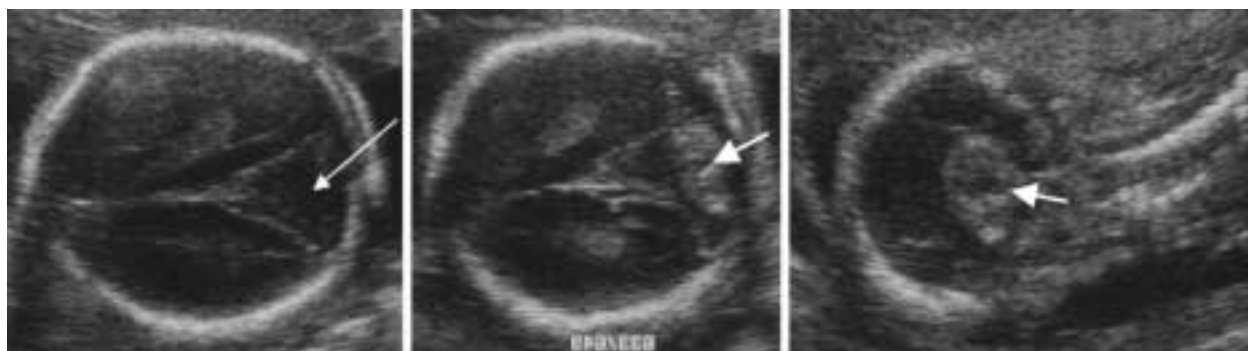
Transvaginal sonography was performed in all cases and identified the posterior fluid filled area as a localized dilatation of the posterior portion of the superior sagittal sinus. Within the dilated sinus, posteriorly to the cerebellum, presumably at the level of the torcular Herophili (confluence of sinuses), the presence of an echogenic homogenous mass with well-defined contours, compatible with a blood clot, was confirmed (Figure 2 and videoclips 1 and 2).

Color Doppler was used to demonstrate blood flow within the superior sagittal sinus, as previously suggested<sup>2</sup>, and showed interruption of the flow at the level of the dilated sinus (Figure 3).

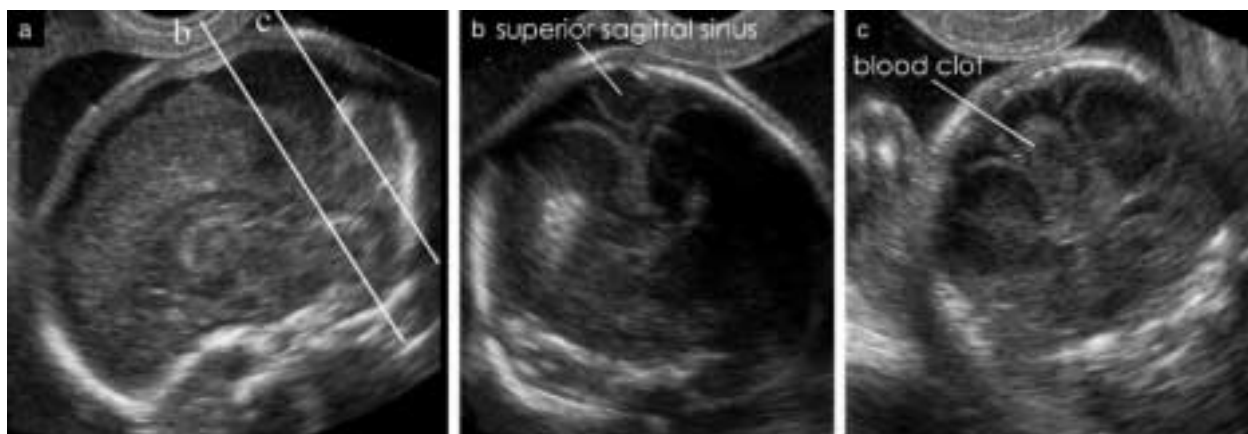
No fetal abnormalities were detected in all three cases apart from borderline ventriculomegaly (the transverse diameter of the atrium in the axial plane measured 13 mm) in the fetus diagnosed at 28 weeks' gestation. The two fetuses seen in the mid-trimester had normal cerebral ventricles.

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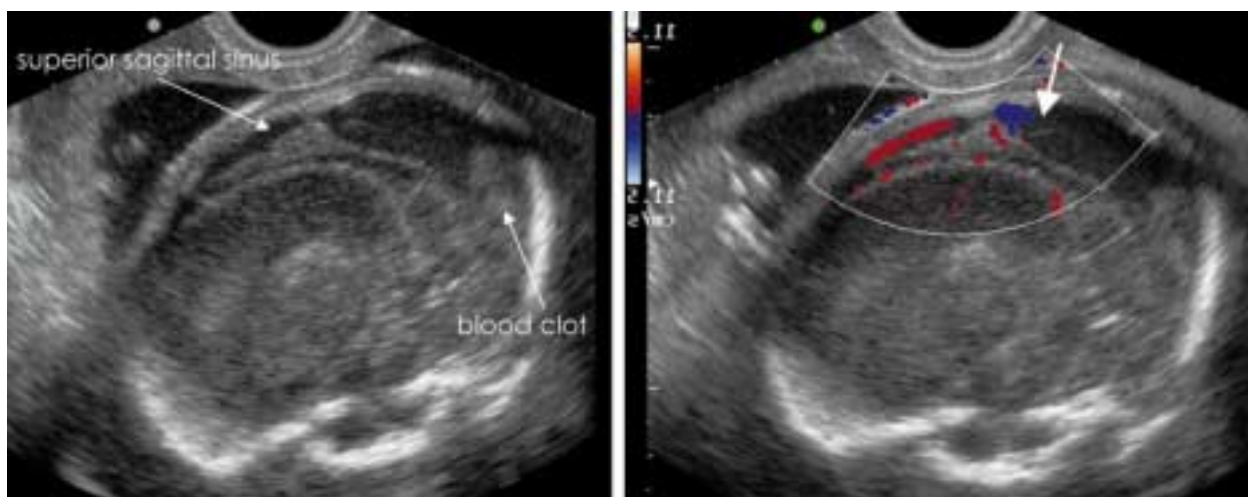
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**Figure 1** Transabdominal scan of the head of a 22-week fetus with thrombosis of the dural sinuses. A large fluid collection is seen posteriorly to the brain (long arrow). Within such fluid collection an echogenic mass is demonstrated (short arrow).



**Figure 2** Transvaginal multiplanar neurosonography in the same fetus as in Figure 1. (a) A midline sagittal scan demonstrating a fluid collection posterior to the brain, with an echogenic mass above the cerebellum, presumably at the level of the torcular Herophili. Lines b and c indicate the scanning planes along which images b and c were obtained. (b) A coronal scan identifies the fluid collection as an enlargement of the sagittal sinus. (c) A posterior coronal scan passing presumably through the torcular demonstrates the overall enlargement of the posterior dural sinuses within which the echogenic mass suggestive of a blood clot is seen. (See videoclips.)



**Figure 3** Transvaginal scan in the same fetus as in Figures 1 and 2. Color Doppler ultrasound demonstrates interruption of blood flow (arrow) within the enlarged portion of the superior sagittal sinus.

In the patient in which the diagnosis was made at 28 weeks, serial scans did not demonstrate further evolution of the lesion originally seen. Although no previous information was available to discuss the preferable mode of delivery

with the couple, it was our feeling that Cesarean section may be beneficial by avoiding a potential cerebral trauma or changes in the intracranial pressure. The couple concurred with our recommendation and the delivery was by planned Cesarean

section at 38 weeks' gestation. The newborn, a male, had no abnormalities on initial physical examination. His weight was 3580 g (73rd centile according to the Italian standards)<sup>3</sup>, with the Apgar scores being 9 and 10 at 1 and 5 min, respectively. There was no evidence of polycythemia and the basic coagulation tests (prothrombin time, partial thromboplastin time) were normal. Magnetic resonance imaging (MRI) confirmed the presence of thrombosis of the torcular Herophili, and also suggested the presence of a posterior fossa hematoma. Surgery was performed on the third day of life, but was complicated by a massive intraoperative hemorrhage that resulted in the death of the neonate. At pathology, the presence of thrombosis of the dural sinuses with a 3.5-cm clot occupying the torcular Herophili and extending into the straight sinus was confirmed (Figure 4a).

No specific data existed to counsel the other two patients who still had a right, according to Italian law, to selective abortion. Experience with cases diagnosed postnatally to have thrombosis of the dural sinuses revealed a spectrum of possible outcomes, ranging between a completely asymptomatic condition to brain damage and possibly death. Both patients requested pregnancy termination that was performed by administration of prostaglandin suppositories. The antenatal findings were confirmed in both cases (Figure 4b). Prior to the termination one of the patients underwent fetal blood sampling that revealed a normal karyotype.

## DISCUSSION

Dural sinus thrombosis in infancy was first described by Bailly and Hass in 1931<sup>4</sup>. Before 1980, there were no reports of neonatal dural sinus thrombosis, other than in postmortem examination studies of asphyxiated newborns<sup>5</sup>. Early reports emphasized an association with trauma and underlying systemic conditions such as sepsis, meningitis and dehydration<sup>1,6</sup>. More

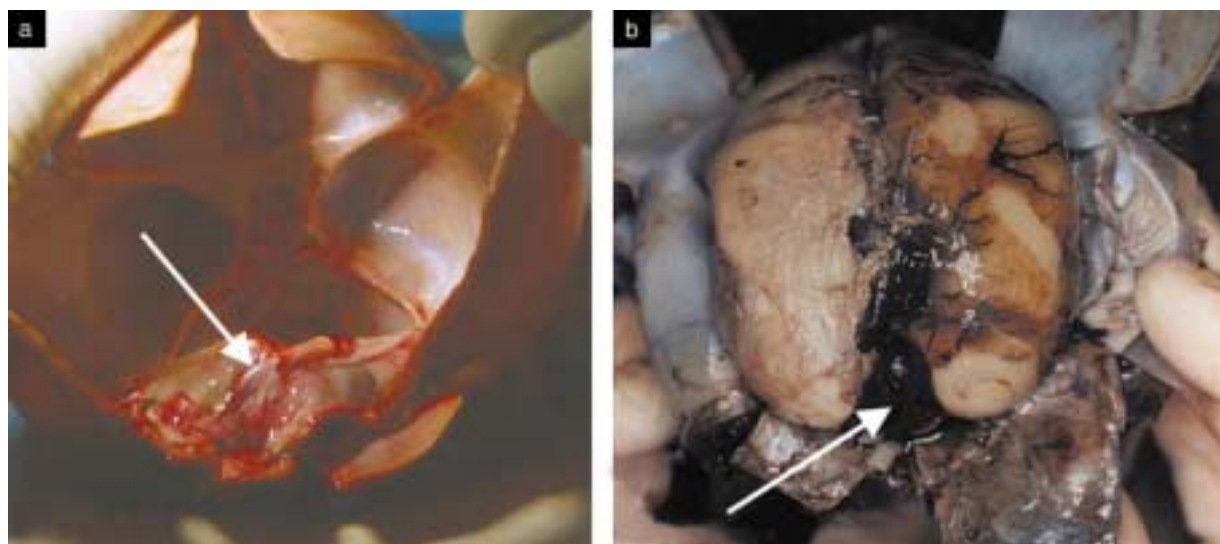
recent studies have also focused upon hypercoagulopathy caused by polycythemia<sup>7,8</sup> or deficiency of physiological anticoagulants (antithrombin, protein C or protein S, factor V Leiden mutation)<sup>9,10</sup>. Prematurity and perinatal asphyxia are considered predisposing factors<sup>1,10,11</sup>. A possible role of maternal pre-eclampsia has also been suggested<sup>1</sup>. However, in up to 40% of cases the condition is idiopathic<sup>12,13</sup>. As the puerperium is a risk factor for maternal dural sinus thrombosis<sup>13,14</sup> the possibility of transplacental transfer of as yet unidentified circulating factors has also been suggested.

Our experience suggests that thrombosis of the dural sinuses can occur antenatally as early as the second trimester, in uncomplicated pregnancies. Trauma is a well-recognized cause of dural sinus thrombosis, and it is of note that two of our patients had undergone mid-trimester amniocentesis. However, a careful postnatal examination of the fetuses failed to reveal needle scars. Furthermore, the technique had been performed in both cases under continuous ultrasound guidance, which renders fetal puncture unlikely<sup>15</sup>.

The clinical presentation of thrombosis of the dural sinuses in newborn infants is variable. Symptoms include seizures, unexplained irritability, macrocephaly, or a bulging fontanel<sup>1,7,10</sup>.

Postnatally, MRI is the technique of choice for the diagnosis<sup>16</sup>. In particular, magnetic resonance angiography has the capability to demonstrate absence or reduction of blood flow within the occluded sinuses<sup>1</sup>. Color Doppler ultrasound has been suggested recently for the evaluation and follow-up of high-risk infants<sup>17</sup>.

The venous dural system, particularly the posterior portion, can be well demonstrated with both real-time ultrasound and color Doppler<sup>2</sup>. The clear identification of the sagittal sinus in our cases was the key leading to the diagnosis of thrombosis. Color Doppler was also helpful in demonstrating interruption of blood flow in the dilated sinuses.



**Figure 4** (a) In the case of death during surgery, pathology reveals a large blood clot (arrow) at the level of the torcular Herophili, extending into the superior sagittal, transverse and straight sinuses; (b) pathology in one of the abortion specimens (same case as Figures 1, 2 and 3) demonstrating, after removal of a part of the dura mater, a blood clot (arrow) within the superior sagittal sinus down to the torcular with marked stasis and dilatation of collateral venous vessels.

One limitation of our study is the lack of data with regard to the possible association of fetal cerebral thrombosis and trombophilia. Termination of pregnancy in two cases and the early death of the remaining neonate prevented detailed coagulation studies. Theoretically, such investigations could be performed antenatally on a sample of fetal blood. Some trombophilias are familial, and evaluation of the parents should be considered, as the recognition of one of these conditions may have clinical implications.

There are no clear-cut data to counsel couples after the prenatal diagnosis of thrombosis of the dural sinuses. Postnatal studies reveal that in general thrombosis of the cerebral venous circulation is an important and under-recognized cause of seizures in term infants<sup>9,13</sup>. The natural history is variable. In the absence of perinatal asphyxia, normal neurodevelopmental outcome is likely and the risk of seizure recurrence is low<sup>1</sup>. A poor outcome should be expected especially in preterm neonates, and in cases of secondary cerebral sinus thrombosis. Associated imaging signs such as infarction or ventricular hemorrhage are correlated with poor prognosis. Sequelae may also depend on the location of the thrombus. In a recent study<sup>12</sup>, all patients with permanent neurological disability had thrombosis of the deep veins with an associated deep cerebral infarction; in contrast, all patients with thrombosis without infarction or with superficial cortical venous infarction had uniformly a good outcome.

The optimal obstetric management of continuing pregnancies remains uncertain. In our case that was delivered, a Cesarean section was performed with the intention of avoiding further compromise to the cerebral circulation of the fetus, although there is no direct evidence in this regard.

Postnatally, conservative general medical and neurological supportive care is the mainstay of treatment<sup>18</sup>. Our experience confirms that a surgical approach is associated with significant operative risks and should always be considered with caution.

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## SUPPLEMENTARY MATERIAL ON THE INTERNET

The following material is available from <http://www.blackwell-science.com/products/journals/suppmat/UOG/UOG372/UOG372sm.htm>

Video clips: Transvaginal sonography of the 22-week fetus with thrombosis of the dural sinuses shown in Figures 1–3. (a) Midline sagittal scan demonstrating a fluid collection posterior to the brain, with an echogenic mass above the cerebellum, presumably at the level of the torcular Herophili. (b) Posterior coronal scan demonstrating an echogenic mass suggestive of a blood clot within the dilated posterior dural sinuses.