

Fetal magnetic resonance imaging in the prenatal diagnosis of cerebellar hemorrhage

G. GORINCOUR*, F. RYPENS*, C. LAPIERRE*, T. COSTA†, F. AUDIBERT‡ and Y. ROBITAILLE§

*Department of Medical Imaging, †Department of Genetics, ‡Department of Obstetrics and Gynecology and §Department of Pathology, Sainte Justine Hospital, Montreal, Quebec, Canada

KEYWORDS: cerebellum; hemorrhage; MRI; prenatal diagnosis; ultrasound

ABSTRACT

We report the case of a fetus with a sonographic mid-gestation diagnosis of hyperechogenic cerebellum suspected to be of hemorrhagic origin on fetal brain magnetic resonance imaging (MRI). No etiological factors for fetal hemorrhage were found other than a maternal heterozygosity for factor V Leiden. Following termination of the pregnancy, autopsy confirmed the prenatal diagnosis of massive cerebellar hemorrhage without underlying vascular anomaly. As an additional tool to ultrasonography, fetal brain MRI can affirm the hemorrhagic origin of hyperechogenic cerebellar lesions, especially by showing a high signal on T1-weighted images. Copyright © 2005 ISUOG. Published by John Wiley & Sons, Ltd.

CASE REPORT

A 32-year-old woman, gravida 2 para 1, was referred to our institution for a second-trimester ultrasound scan at 18 weeks' gestation. Her previous pregnancy resulted in the unexplained death of a baby who suffered from severe convulsions at birth. In the current pregnancy, first-trimester scans demonstrated nuchal translucency above the 95th centile (2.7 mm for a 65 mm crown–rump length). Ultrasound examination at 18 weeks' gestation showed isolated cerebellar hyperechogenicity with a small cisterna magna and fourth ventricle (Figure 1). Only the central part of the cerebellum maintained its normal echogenicity. The transverse cerebellar diameter was normal (19.5 mm). The rest of the sonographic survey was normal and biometry was normal for gestational age. Karyotyping following amniocentesis was normal.

Follow-up ultrasound scans performed at 20 weeks' gestation demonstrated disappearance of the cerebellar

hyperechogenicity, with the transverse cerebellar diameter remaining constant at 19 mm and cerebellar curvature resembling a 'banana sign'. The cisterna magna was not clearly visible (Figure 2). Fetal brain magnetic resonance imaging (MRI) performed on the same day proved inconclusive owing to artifacts generated by fetal motion. TRUE-FISP, T2-HASTE and T1-gradient echo sequences were initially considered normal. There were neither hydrocephaly nor supratentorial signs of hemorrhage.

Ultrasound examinations were repeated after 2 weeks and demonstrated a non-growing hypoechogenic cerebellum (transverse diameter 20 mm). MRI was repeated at 24 weeks' gestation and showed areas of hypersignal within the cerebellum on T1-weighted imaging, suggestive of hemorrhage. No other anomaly was detected.

On a retrospective review of the initial coronal T1-weighted MR images, hyperintensity was detected on both cerebellar hemispheres (Figure 3a), with the vermis appearing slightly hypointense on the sagittal T2-HASTE scan (Figure 3b). Etiological factors for fetal hemorrhage were considered. However, the only relevant one found was maternal heterozygosity for factor V Leiden.

Given the poor prognosis, the parents eventually elected to terminate the pregnancy at 26 weeks' gestation. Autopsy confirmed the prenatal diagnosis of massive old cerebellar hemorrhage (Figure 4) without underlying vascular anomaly.

DISCUSSION

Intracerebellar hemorrhage is uncommon in the neonate and the neurological outcome is very poor¹. Few cases of fetal cerebellar hemorrhage diagnosed *in utero* have been reported^{2–10}. The usefulness of fetal MRI is still controversial⁹. We report a case of fetal cerebellar hemorrhage detected by ultrasonography and confirmed

Correspondence to: Dr G. Gorincour, Department of Medical Imaging, 3175 Sainte Catherine Road, Montreal, Quebec H3T 1C5, Canada (e-mail: guillaume.gorincour@ap-hm.fr)

Accepted: 22 June 2005

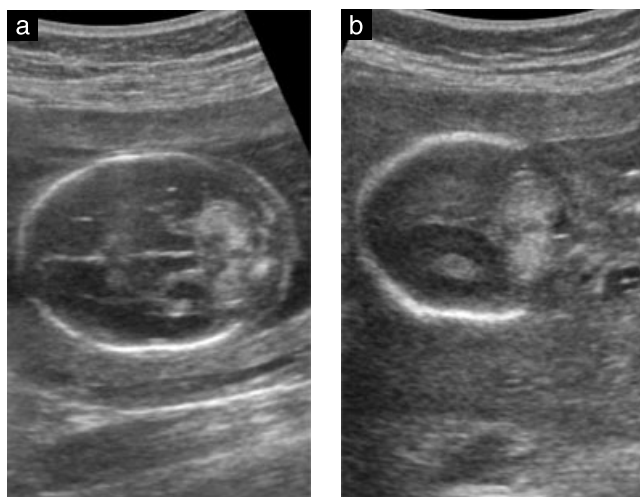


Figure 1 Axial (a) and coronal (b) ultrasound scans of the fetal head at 18 weeks' gestation, showing diffuse hyperechogenicity of the cerebellum, with only a small central part showing normal echogenicity. The cisterna magna is very small.



Figure 2 Axial ultrasound scan at 20 weeks' gestation, demonstrating a small cerebellum with a 'pseudo-banana configuration' (arrows) and no visible cisterna magna.

by MRI. To our knowledge, this is the third case of fetal hyperechogenic cerebellum further investigated by MRI^{9,10}.

Cerebellar hemorrhage is a rare pathological event in the pediatric population¹, occurring for the most part in preterm newborns. A prospective sonographic study reported a rate of 2% in premature newborns of less than 28 weeks' gestation, most of which suffered an adverse outcome¹¹. The majority of prenatally-diagnosed intracranial hemorrhages are supratentorial, although the cause of this remains mostly obscure¹². Predisposing maternal factors include infection, pre-eclampsia, seizures, thrombocytopenia, coagulation disorders (including factor VII and X deficiencies), drug exposure, trauma, cocaine, pancreatitis, placental abruption and fetal vascular anomaly. Such brain injuries may also occur prenatally in fetuses with extreme anemia due to red blood cell alloimmunization¹³.

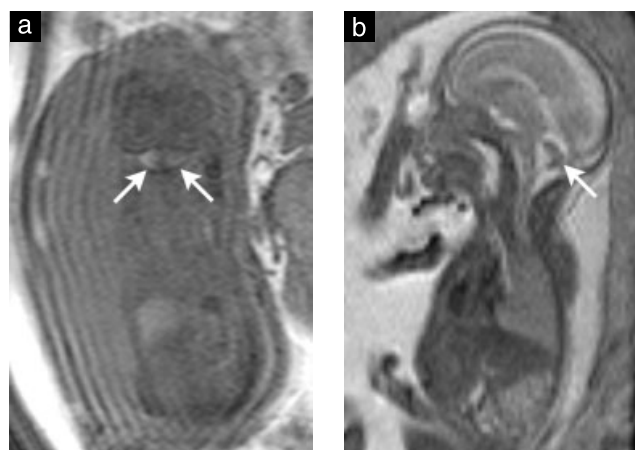


Figure 3 Coronal (a) and sagittal (b) gradient-echo T1-weighted images at 20 weeks' gestation, showing definite hyperintensity of both cerebellar hemispheres (arrows).

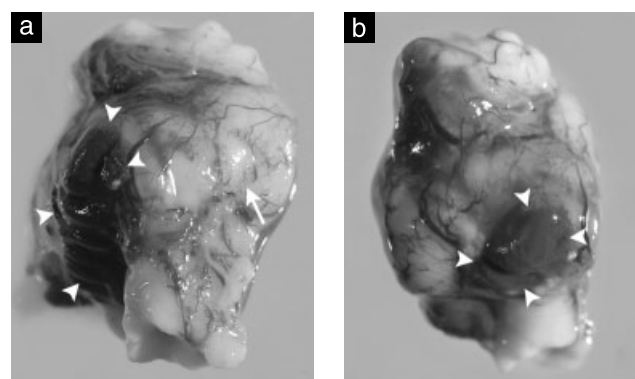


Figure 4 Macroscopic external anterior (a) and posterior (b) views of the posterior fossa showing the normal pons curvature (arrow) and a blood clot corresponding to hemorrhagic necrosis of the cerebellum (arrowheads), mainly affecting the hemispheres.

It is thought that cerebellar subependymal germinal plate hemorrhage is a response to circumstances similar to those encountered by blood vessels within the germinal plate located along the lateral ventricles¹⁴. Maternal factor V Leiden heterozygosity was the only etiological factor retained in our case, which has not been previously reported.

Our literature search could find only nine cases of cerebellar hemorrhage diagnosed *in utero*^{2–10}. The sonographic size and appearance of the normal fetal cerebellum are now well documented¹⁵. The sonographic presentation of fetal cerebellar hemorrhage is variable, but it is mainly described as a hyperechogenic cerebellar hemisphere or as a hyperechogenic mass within the cerebellum. In our case, the cerebellum was diffusely hyperechogenic and subsequently hypoechogenic and non-growing.

Interestingly (as can be observed in the normal posterior fossa very early in pregnancy) the progressive sonographic appearance of the posterior fossa associated with cerebellar hemorrhage can be quite similar to that of the Dandy–Walker malformation⁶, namely absence of

the vermis and an enlarged fourth ventricle. However, careful sonographic examination would show that these features were actually caused by a porencephalic cystic lesion.

It is noteworthy that in our case the cerebellum was initially diffusely hyperechogenic and enlarged, with an almost absent cisterna magna and pseudofused cerebellar hemispheres. These findings resembled those of the well-known 'banana sign'; however, in our case, the specific echogenicity, the absence of spina bifida and the progression of the previously listed symptoms helped to differentiate cerebellar hemorrhage from this sign. Fetal hyperechogenic cerebellum is associated with several important differential diagnoses. A case of cavernous hemangioma of the cerebellum has been reported, presenting as a hyperechogenic lesion of a cerebellar hemisphere, with a small central hypoechogenic area¹⁶. Three cases of capillary telangiectasia have been described as focal lesions of the cerebellum without any mass effect¹⁷. These cases are of interest since MR T1-weighted images showed no focal hyperintensity that might suggest focal hemorrhage. As it stands, the possibility of a vascular malformation causing the cerebellar hemorrhage cannot be excluded prenatally.

Since the first case series and with the technical improvements of ultrasound and MRI techniques and devices¹⁸, intracranial hemorrhage has been detected *in utero* through the use of both dedicated sonography and fetal brain MRI, although some authors challenge the claim that MRI brings additional information to ultrasonography⁹. Although, because of its frequency, hemorrhage is the most likely diagnosis, we question how sonography alone can ascertain the hemorrhagic nature of such lesions.

In our case, an early fetal brain MRI at 20 weeks' gestation was initially inconclusive. The subsequent examination at 24 weeks' gestation was demonstrative of parenchymal posterior fossa hemorrhage due to the hyperintense cerebellar signal seen on T1-weighted images. Indeed, even if the first MRI is retrospectively interpreted as pathological, we recommend repeating this investigation if initially inconclusive (particularly if performed early during pregnancy), given fetal motion artifacts and the changing MR properties of extravascular blood with time.

Advanced neuroimaging techniques enable the diagnosis of fetal cerebellar hemorrhage. However, the literature has little to say on this topic and the timing, topography and pathogenesis may be associated with variable outcomes. This case further strengthens the argument for the use of fetal MRI in conjunction with ultrasound examination in the prenatal diagnosis and prognosis of intracranial hemorrhage, especially of the cerebellum.

REFERENCES

- Volpe JJ. Intracranial hemorrhage: subdural, primary subarachnoid, intracerebellar, intraventricular (term infants) and miscellaneous. In *Neurology of the Newborn*, Volpe JJ (ed). W. B. Saunders: Philadelphia, PA, 1981; 374.
- Jennet RJ, Daily WJR, Tarby TL, Manwaring KH. Prenatal diagnosis of intracerebellar hemorrhage: case report. *Am J Obstet Gynecol* 1990; **162**: 1472–1475.
- Hadi HA, Finley J, Mallette JQ, Strickland D. Prenatal diagnosis of cerebellar hemorrhage: medicolegal implications. *Am J Obstet Gynecol* 1994; **170**: 1392–1395.
- Vergani P, Strobelt N, Locatelli A, Paterlini G, Tagliabue P, Parravicini E, Ghidini A. Clinical significance of fetal intracranial hemorrhage. *Am J Obstet Gynecol* 1996; **175**: 536–543.
- Ranzini AC, Shen-Schwarz S, Guzman ER, Fischer AJ, White M, Vintzileos AM. Prenatal sonographic appearance of hemorrhagic cerebellar infarction. *J Ultrasound Med* 1998; **17**: 725–727.
- Yuksel A, Batukan C. Fetal cerebellar hemorrhage in a severely growth-restricted fetus: natural history and differential diagnosis from Dandy–Walker malformation. *Ultrasound Obstet Gynecol* 2003; **22**: 178–181.
- Hiller L 4th, McGahan JP, Bijan B, Melendres G, Towner D. Sonographic detection of *in utero* isolated cerebellar hemorrhage. *J Ultrasound Med* 2003; **22**: 649–652.
- Ortiz JU, Ostermayer E, Fischer T, Kuschel B, Rudelius M, Schneider KTM. Severe fetal cytomegalovirus infection associated with cerebellar hemorrhage. *Ultrasound Obstet Gynecol* 2004; **23**: 402–406.
- Malinger G, Ben-Sira L, Lev D, Ben-Aroya Z, Kidron D, Lerman-Sagie T. Fetal brain imaging: a comparison between magnetic resonance imaging and dedicated neurosonography. *Ultrasound Obstet Gynecol* 2004; **23**: 333–340.
- Guibaud L. Practical approach to prenatal posterior fossa abnormalities using MRI. *Pediatr Radiol* 2004; **34**: 700–711.
- Claris O, Besnier S, Lapillonne A, Picaud JC, Salle BL. Incidence of ischemic-hemorrhagic cerebral lesions in premature infants of gestational age below 28 weeks: a prospective ultrasound study. *Biol Neonate* 1996; **70**: 29–34.
- Sherer DM, Anyaegbunam A, Onyeije C. Antepartum fetal intracranial hemorrhage, predisposing factors and prenatal sonography: a review. *Am J Perinatol* 1998; **15**: 431–441.
- Ghi T, Brondelli L, Simonazzi G, Valeri B, Santini D, Sandri F, Ancora G, Pilu G. Sonographic demonstration of brain injury in fetuses with severe red blood cell alloimmunization undergoing intrauterine transfusions. *Ultrasound Obstet Gynecol* 2004; **23**: 428–431.
- Merrill JD, Piccuch RE, Fell SC, Barkovich AJ, Goldstein RB. A new pattern of cerebellar hemorrhage in preterm infants. *Pediatrics* 1998; **102**: E62.
- Hashimoto K, Shimizu T, Shimoya K, Kanzaki T, Clapp JF, Murata Y. Fetal cerebellum: US appearance with advancing gestational age. *Radiology* 2001; **221**: 70–74.
- Sharon R, Kidron D, Aviram R, Beyth Y, Tepper R. Prenatal diagnosis of fetal cerebellar lesions: a case report and review of the literature. *Prenatal Diagn* 1999; **19**: 1077–1080.
- Guibaud L, Garel C, Buenerd A, Gaucherand P, Varlet F, Vavasseur C, Oury JF, Pracros JP. Prenatal diagnosis of capillary telangiectasia of the cerebellum: ultrasound and MRI features. *Prenatal Diagn* 2003; **23**: 791–796.
- Sonigo PC, Rypens FF, Carteret M, Delezoide AL, Brunelle FO. MR imaging of fetal cerebral anomalies. *Pediatr Radiol* 1998; **28**: 212–222.