Published in final edited form as:

J Child Neurol. 2011 July ; 26(7): 895–899. doi:10.1177/0883073810393961.

Bilateral In Utero Cerebellar Infarction

Safdar A. Ansari, MD¹, Jill V. Hunter, MD², Lisa M. Nassif, MD³, Gary D. Clark, MD³, and Melissa B. Ramocki, MD, PhD³

¹ Department of Neurology, at Baylor College of Medicine and Texas Children's Hospital, Houston, Texas

² Department of Radiology, Section of Pediatric Neuroradiology, at Baylor College of Medicine and Texas Children's Hospital, Houston, Texas

³ Department of Pediatrics, Section of Pediatric Neurology and Developmental Neuroscience, at Baylor College of Medicine and Texas Children's Hospital, Houston, Texas

Abstract

We report a case of complete bilateral cerebellar infarction diagnosed in utero by routine prenatal ultrasound and magnetic resonance imaging in a 26-week-old fetus. This posterior fossa ischemic stroke with secondary hemorrhage caused transient obstructive hydrocephalus and likely occurred subsequent to vertebrobasilar artery thrombosis. Such posterior fossa ischemic insults diagnosed in utero are rare with scarce clinical reports. The serial imaging characteristics, clinical, and developmental implications of this case are reviewed.

Keywords

fetal; ischemic; stroke; vertebrobasilar; cerebellum; in utero

Ischemic stroke in utero is typically a clinically silent event. Abnormal brain signal detected on routine prenatal ultrasound often prompts fetal magnetic resonance imaging (MRI), hopefully leading to an etiological diagnosis that will facilitate optimal management of the pregnancy. Fetal stroke is most frequently hemorrhagic in nature, and large-vessel ischemic stroke is most common in the left anterior circulation, especially in the middle cerebral artery territory and potentially due to the hemodynamics created by a patent ductus arteriosus.¹ Here, we report a case of bilateral cerebellar infarction diagnosed in utero and demonstrate rarely captured serial imaging characteristics of a posterior circulation thromboembolic stroke in a fetus.

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Corresponding Author: Melissa B. Ramocki, MD, PhD, 6621 Fannin Street CC1250, Houston, Texas 77030, mramocki@bcm.edu.

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Author Contributions

S.A.A. was the neurology resident who performed the in-patient consult, and who wrote the first draft of the manuscript. L.M.E. and G.D.C. are attending pediatric neurologists who provided care for the patient and who assisted with manuscript revision. M.B.R. is the attending pediatric neurologist who cared for the patient at birth, and J.V.H. is the attending neuroradiologist who interpreted the neuroimaging. M.B.R. and J.V.H. oversaw manuscript preparation and revision and therefore are designated as mentors who contributed equally to this work.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

Ethical Approval

This manuscript represents a descriptive, retrospective case report without any intervention, and, therefore, it did not require review or approval by the Institutional Review Board at our hospital.

Case Report

Routine prenatal ultrasound of a 35-year-old G₂P₁A₀ mother at 25 weeks gestation revealed fetal hydrocephalus and a 2-vessel umbilical cord. MRI at 26 weeks gestation revealed obstructive hydrocephalus, abnormal T2-weighted signal in the cerebellum (Figure 1A), and diffuse signal abnormality on gradient echo sequences in the bilateral cerebellar hemispheres extending into the midbrain consistent with hemorrhage (Figure 1B). Diffusion-weighted imaging and apparent diffusion coefficient maps were consistent with completed infarction of the bilateral cerebellar hemispheres (Figure 1C). A repeat MRI at 30 weeks of gestation demonstrated persistent abnormal signal in the cerebellum with decreased mass effect and decreased supratentorial hydrocephalus along with cerebellar volume loss and evolution of the hemorrhagic component (Figure 1D). The family did not endorse known environmental or familial stroke risk factors, and evaluation of maternal predisposition to stroke was unremarkable.

The male infant was delivered by caesarian section at 36 5/7 weeks gestation secondary to intra-uterine growth retardation, reduced movements, and breech presentation. Apgar scores were 5 at 1 minute and 8 at 5 minutes, and mild jitteriness was noted on neurological exam. MRI on postnatal day 2 revealed almost complete absence of the cerebellar hemispheres with increased T1-weighted signal returned from the cerebellar remnants (Figure 1E). There was abnormal T2-weighted, gradient echo signal within the posterior fossa suggestive of abnormal blood products (Figure 1F). Magnetic resonance angiogram demonstrated partial signal loss returned from the left distal vertebral artery at the V3 and V4 levels (Figure 1G and 1H).

Pathology revealed a small for gestational age placenta with remote thrombus of 1 umbilical artery, explaining the 2-vessel cord. The infant's hypercoagulable and metabolic evaluations were unremarkable, and a thorough maternal history, physical examination, and hypercoagulable panel did not reveal any maternal predisposition to thrombosis. Echocardiogram identified a small patent foramen ovale with physiologic shunt. The infant was discharged home at 10 weeks of age with no etiologic diagnosis for his stroke.

Discussion

Fetal stroke (occurring between 14 weeks gestation and labor onset) is usually clinically silent, but now is ascertained more frequently due to aggressive prenatal ultrasound screening. The true incidence and prevalence is unknown, but 91% of fetal strokes are hemorrhagic with an average age at diagnosis of 31 weeks gestation,² and they most commonly occur in the anterior circulation (middle cerebral artery territory).³ Our case provides rare documentation of a posterior circulation, large vessel ischemic stroke in a fetus before 28 weeks gestation. The event was ascertained by detection of hydrocephalus on prenatal ultrasound and was confirmed by fetal MRI (Figure 1A–D). The imaging findings suggest that the cerebellar stroke was ischemic at onset with a secondary hemorrhagic component due to the diffusion restriction returned from the bilateral cerebellar hemispheres (Figure 1C) and the superficial blooming on gradient echo images (Figure 1B). Given the history of umbilical artery thrombosis and bilateral cerebellar infarcts associated with hemorrhage, we considered the possibility of venous infarction; however, the partial signal loss returned from the distal left vertebral artery on magnetic resonance angiogram is highly suggestive of an embolic or thrombotic etiology. Overall, the imaging data suggest that transient thrombosis of the left vertebral and proximal basilar arteries led to occlusion of bilateral posterior inferior cerebellar and anterior inferior cerebellar arteries, and subsequently to bilateral cerebellar infarction. The superficial cerebellar hemorrhage is consistent with reperfusion injury. Involvement of the pontine perforators and the superior

cerebellar arteries would have led to complete posterior fossa infarction that is not compatible with life.

Significant variability in long-term outcomes is reported in perinatal stroke. A meta-analysis revealed that 40% of infants were neurologically normal, 57% were neurologically or cognitively impaired, and 3% had fatal outcomes. There are minimal data describing prenatal posterior fossa ischemic injury, and such cerebellar insults identified postnatally could be confused with congenital malformations such as Dandy-Walker malformation.⁴ Near complete absence of a cerebellum attributed to cerebellar agenesis has been observed incidentally in 2 adults with neurological deficits.⁵ One man lived to age 79 years and had at least slurred speech, a “squint,” and an abnormal gait attributed to near absence of the cerebellum that was identified upon postmortem examination.⁵ The second individual’s near absence of a cerebellum was identified at age 59 years upon MRI examination due to acute hearing loss. This woman had oculomotor abnormalities, ataxic gait, slurred speech, absent conditioned eye blinks, poor fine motor control, and she demonstrated mild to moderate neuropsychological deficits and never learned to read or write.⁵

Our case demonstrates that the vulnerable cerebellum can be injured in utero and documents vertebrobasilar thrombosis and resultant ischemic stroke as one such mechanism of injury. Various etiologies of intrauterine cerebellar damage have been entertained, including hemorrhage, hypoxia, infection, inflammation, glucocorticoid exposure, undernutrition, and remote cerebral lesions.⁶ Deficits predicted by such cerebellar insults include oculomotor, motor, and speech problems, ataxia, and intellectual disabilities as manifested in the adult individuals discussed above.^{5,7} Our patient had a relatively uncomplicated hospital course, but he subsequently returned for gastric-tube placement due to dysphagia and failure-to-thrive, and at 1 year of age he manifests global developmental delays and subtle vision impairment with normal cortical evoked responses.

Cerebellar parenchymal loss is a common finding in premature infants and in infants with motor deficits.⁶ Volumetric magnetic resonance imaging studies have shown that cerebellar volume increases 5-fold from the 24th to 40th week of gestation, which is nearly unparalleled by other brain structures; and which can predispose the cerebellum to vascular ischemic insults.⁶ However, this theory of vascular insufficiency as a cause of cerebellar injury and subsequent motor deficits has not been confirmed. Loss of cerebellar parenchyma and superficial hemosiderin deposition on magnetic resonance imaging has been documented in adult patients with neurological deficits.⁸ Our case illustrates that large vessel ischemic stroke can cause cerebellar parenchymal injury as early as the 25th week of gestation and that such insults can lead to clinically significant neurological compromise.

Conclusion

In summary, this case demonstrates serial imaging of a posterior circulation thromboembolic stroke that resulted in complete cerebellar infarction before 25 weeks of gestation. Without prospective data, it is impossible to predict long-term outcomes in infants with severe bilateral in utero cerebellar ischemic injury; however, neurologic disabilities are expected. The emerging field of fetal MRI will lead to increased ascertainment of fetal stroke and will facilitate prospective studies. It is imperative that subspecialist teams collaborate to better define the etiology, risk factors, imaging characteristics, and management of fetal stroke with the ultimate goal of prevention.

Acknowledgments

The content is solely the responsibility of the authors and does not necessarily represent the official views of NINDS or the National Institutes of Health. The authors thank Dr. Jennifer C. Lee for helpful discussions.

Financial Disclosure/Funding

The authors disclosed receipt of the following financial support for the research and/or authorship of this article: M.B.R. acknowledges the support of NIH/NINDS grant 5K08NS062711-03. L.M.N. acknowledges the support of the NIH Child Health Research Career Development Award K12 HD41648. L.M.N. and G.D.C. acknowledge the support of the Anderson Foundation for the development of the Pediatric Stroke Program at Texas Children's Hospital.

References

1. Sreenan C, Bhargava R, Robertson CM. Cerebral infarction in the term newborn: clinical presentation and long-term outcome. *J Pediatr*. 2000; 137:351–355. [PubMed: 10969259]
2. Ozduman K, Poer BR, Barnes P. Fetal stroke. *Pediatr Neurol*. 2004; 30:151–162. [PubMed: 15033196]
3. Lee J, Croen LA, Backstrand KH, et al. Maternal and infant characteristics associated with perinatal arterial stroke in the newborn. *JAMA*. 2005; 293:723–729. [PubMed: 15701914]
4. Limperopoulos C, Folkerth R, Barnewolt CE, et al. Post hemorrhagic cerebellar disruption mimicking Dandy-Walker malformation: fetal imaging and neuropathology findings. *Semin Pediatr Neurol*. 2010; 17:75–81. [PubMed: 20434704]
5. Lemon RN, Edgley SA. Life without a cerebellum. *Brain*. 2010; 133(Pt 3):652–654. [PubMed: 20305277]
6. Volpe JJ. Cerebellum of the premature infant: rapidly developing, vulnerable, clinically important. *J Child Neurol*. 2009; 24:1085–1104. [PubMed: 19745085]
7. Steinlin M. Cerebellar disorders in childhood: cognitive problems. *Cerebellum*. 2008; 7:607–610. [PubMed: 19057977]
8. Koeppen AH, Michael SC, Li D, et al. The pathology of superficial siderosis of the central nervous system. *Acta Neuropathol*. 2008; 116:371–382. [PubMed: 18696091]

Figure 1.

Serial magnetic resonance imaging (MRI) features of an evolving in utero cerebellar infarct. Fetal MRI at 26 weeks: A, Sagittal T2-weighted half-Fourier acquisition single-shot turbo spin echo image demonstrates decreased T2 signal returned from the posterior cerebellum. B, Axial gradient echo image demonstrates evidence of blooming consistent with hemorrhagic infarction. C, Axial diffusion-weighted imaging and apparent diffusion coefficient maps demonstrate restricted diffusion abnormality returned from both cerebellar hemispheres consistent with completed infarction. Fetal MRI at 30 weeks: D, Axial gradient echo image demonstrates evolution of the previous hemorrhage along with new evidence of volume loss with increased extra-axial cerebrospinal fluid space surrounding both cerebellar hemispheres. Postnatal MRI: E, Sagittal T1-weighted image demonstrates increased T1-weighted signal consistent with methemoglobin and/or calcification in the atrophic appearing posterior fossa contents. F, Axial T2-weighted gradient echo image demonstrates evidence of altered blood and blood products within the posterior fossa. Postnatal magnetic resonance angiogram: Axial (G) and coronal (H) collapsed maximum intensity projections demonstrate the absence of flow within the left vertebral artery.