Acute Diffusion-weighted Imaging Signaling Severe Periventricular Leukomalacia in Preterm Infants: Case Report and Review of Literature.

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Background and Aim

- Periventricular leukomalacia (PVL) occurs in up to 25% of very preterm infants resulting in adverse neurodevelopmental outcomes.
- In its acute phase, PVL is clinically silent.
- Although cranial ultrasound (CUS) is widely available, its sensitivity in the early detection of PVL is low.
- Few studies have assessed the ability of diffusion weighted imaging (DWI) on magnetic resonance imaging (MRI) for the early identification of PVL.
- We identified a preterm infant with early DWI changes which later evolved to PVL and reviewed all available literature

Case Report

Pregnancy and Delivery Details:

- 30 y/o G2P1, uncomplicated pregnancy with negative serology
- Rupture of membranes at 30 weeks (PPROM 27 hours)

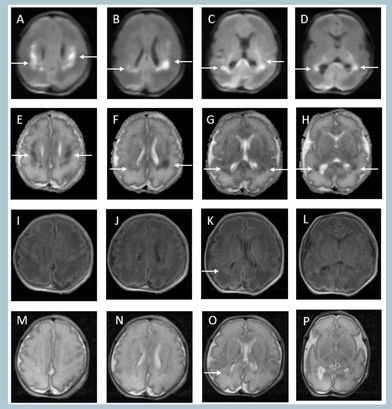
Delivery:

- Male infant born at 30 weeks' by spontaneous vaginal delivery
- Well after birth, required CPAP only
- Apgars 7 [1min], 9 [5mins]

NICU:

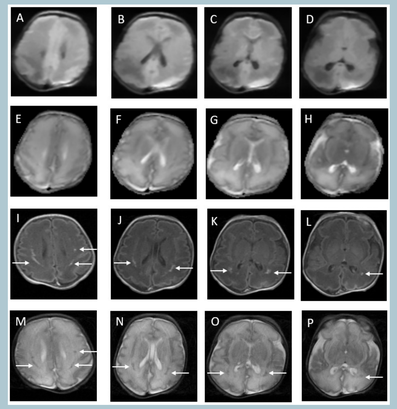
- Physical examination revealed a depressible region on the left parietal skull concerning for a skull fracture.
- CUS could not determine whether depression was pathological or physiological with brain reported as normal.
- MRI (Day 2) confirmed a normal skull but revealed multifocal areas of diffusion abnormality in the periventricular white matter and thalami bilaterally. (Figure 1)
- On repeat MRI 10 days later, reduced diffusivity had resolved with abnormalities more evident on T1 and T2 weighted images.(Figure 2)

Figure 1: MRI Findings on Postnatal Day 2



DWI abnormalities are depicted from A to D. ADC abnormalities are depicted from E to H. White matter abnormalities are in the classic distribution for PVL. Minimal abnormalities seen on conventional axial T1 (I to L) and axial T2 (M to P) weighted images.

Figure 2: MRI Findings on Postnatal Day 12



Previously seen abnormalities on DWI and ADC have resolved (A to H). White matter injury now more evident on axial T1 (I to L) and axial T2 (M to P) images.

Conclusions

- These cases reflect the detection of acute DWI injury preceding moderate-severe PVL occurring in more mature preterm infants, despite many very immature infants having been imaged in the first week of life.
- This may represent a maturational-dependent propensity for PVL and/or the sensitivity of diffusion to detect PVL. The affected infants had minimal clinical illness, highlighting persisting gaps in our understanding of the clinical markers for PVL.
- DWI in the first week of life may be a reliable early marker for PVL injury in preterm infants.

Literature Review

- 31 cases of abnormal DWI reliably heralding severe PVL in the preterm infant have been published in the literature. (Table 1)
- Notable features in these reports and our case include
  a) infants were more mature preterm infants (29-36 weeks gestation);
  b) findings were often serendipitous with benign clinical courses; and
  c) DWI changes were the only abnormal imaging finding in the first week of life with subsequent defined PVL abnormalities seen on conventional MRI or CUS.

Table 1: Studies describing diffusion weighted imaging in infants who later have PVL

	Total No of infants/ inclusion criteria	No of infants with PVL	GA of infants with PVL	Apgar Score at 1minute	Evidence of Infection	Day of 1st MRI	Follow-up Imaging
Inder et al. 1999	1 infant	1	30	8	PPROM for 32 hours. Maternal pyrexia in labor.	5	Normal CUS on day 7. Echolucencies on CUS at 3 weeks. Cystic lesions on MRI at 10 weeks
Bozzao et al. 2003	11 infants, 29-33 weeks	3	29 - 32	4 - 7	Not documented	2 - 4	Cystic lesions on MRI at day 33-53. CUS at 4months: findings compatible with a diagnosis of PVL.
Kidokoro et al. 2008	98 infants, 27-33 weeks	3	29 - 33	4 - 5	Not documented	3 - 6	White matter volume loss, T2 hyperintensity on MRI at TEA. CUS daily for 1st week then 2-3 times per week: periventricular hyperechogenicity.
Fu et al. 2009	148 infants, ≤36 weeks	12	29 - 36	8 - 10	PPROM in 7 infants. 2 infants had positive blood cultures	2 - 7	T1 hyperintensity/T2 hypointensity on MRI at 2wks. Cystic hypointensity at 4-8wks. White matter volume loss at 4-12mths
Martinez-Biarge et al. 2016	82 infants, <36 weeks	47	27-35	3 - 9	NEC, CONS, rotavirus documented in 5 infants	Within 2 weeks of birth (10 infants), within 2 weeks of insult (5 infants)	Cystic lesions on TEA MRI
Current Case	1 infant	1	30	7	PPROM 27 hours	2	T1 hyperintensity/T2 hypointensity on MRI on day 12 and 14

PVL, periventricular leukomalacia; GA, gestational age; PPROM, preterm premature rupture of membranes; MRI, magnetic resonance imaging; US, ultrasound; TEA, term-equivalent age; NEC, Necrotizing Enterocolitis; CONS, Coagulase-negative Staphylococci