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Case study

MR imaging for accurate prediction of outcome after perinatal arterial ischemic stroke: Sooner not necessarily better

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ABSTRACT

Background: Involvement of the corticospinal tracts after perinatal arterial ischemic stroke (PAIS) is strongly correlated with adverse motor outcome.
Methods: Two full-term infants with PAIS, with two early MRI scans available, are reported.
Results: Diffusion weighted imaging (DWI)-MRI, performed within 24 h following onset of seizures and repeated 48 h later, clearly showed restricted diffusion within the middle cerebral artery territory on both MRIs, but clear patterns of signal intensity changes in the descending corticospinal tracts on the second MRI only.
Conclusion: Since involvement of the corticospinal tracts is essential for prediction of motor outcome, we may need to reconsider optimal timing of MR imaging for prediction of neurodevelopmental outcome after PAIS.

1. Introduction

Perinatal stroke consists of perinatal arterial ischemic stroke (PAIS) and cerebral sinovenous thrombosis (CSVT), and both are associated with unfavorable neurodevelopmental outcome. Adverse sequelae of PAIS include unilateral spastic cerebral palsy (USCP) cognitive dysfunction, epilepsy and speech problems. In 40–75% of infants, PAIS or CSVT lead to abnormal neuromotor and developmental outcome.[1–3] Early MRI is used for diagnostic purposes, and for dating PAIS, but is also increasingly emphasized as an important prognostic value to predict the neurodevelopmental outcome of the infant.[4,5]

PAIS, and especially middle cerebral artery (MCA) infarction, often involves the descending corticospinal tracts (CST).[4–6] MRI and especially diffusion weighted imaging (DWI) offers the advantage of evaluating the posterior limb of the internal capsule (PLIC) and the cerebral peduncles, i.e. the presence of "pre-Wallerian" degeneration. Involvement of

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these structures is strongly correlated with adverse motor outcome.[4–9] CSVT is often associated with neurological co-morbidity, such as hypoxic-ischemic encephalopathy, venous infarction and thalamic hemorrhage.[2,10] The presence of such neurological comorbidity at diagnosis predicts poor outcome in patients with CSVT.[2]

The aim of this short communication is to describe two newborns with PAIS who both had two early MRIs showing delayed onset of "pre-Wallerian" degeneration on sequential MRIs performed within 72 h after onset of symptoms.

2. Case descriptions

2.1. *Case 1*

This boy was born at 40^{+4} weeks of gestation after an uncomplicated pregnancy by secondary caesarean section due to slow dilatation of the cervix and meconium stained amniotic fluid. His birth weight was 3570 g (p15), length 53 cm (p50), head circumference 36 cm (p50). He had good Apgar scores of at 9, 10 and 10 at 1, 5 and 10 min, respectively. He was admitted to the neonatal unit in a level II hospital for observation, where he developed fluctuations in temperature, frequent apneas and lethargy, suspected for seizures. Amplitude integrated EEG (aEEG) showed epileptic activity originating from the left hemisphere. Cranial ultrasound and an early CT-scan showed an area of decreased attenuation in the distribution of the left MCA. He received phenobarbital to control seizure activity, and antibiotics and anti-viral medication until meningitis was ruled out by negative cerebrospinal fluid cultures, and he was transferred to our level III neonatal intensive care unit.

The first MRI was performed on the third day after birth, around 20 h after the onset of apneas (Fig. 1). In the complete left MCA territory, DWI and T2-weighted imaging showed increased signal intensity in the cortex and white matter. The basal ganglia including globus pallidus and putamen were also mildly affected. The left PLIC showed only very mild highlighting on DWI and T2 imaging, while some asymmetry was found laterally in the cerebral left peduncle (Fig. 1C–D). A small cortical lesion was also found in the upper right hemisphere, not affecting the corticospinal tracts. Reduced flow of the left MCA was seen on MR Angiography (MRA). The infant was included in an imaging study and the MRI was repeated on day 5, around 72 h after the onset of clinical seizures and

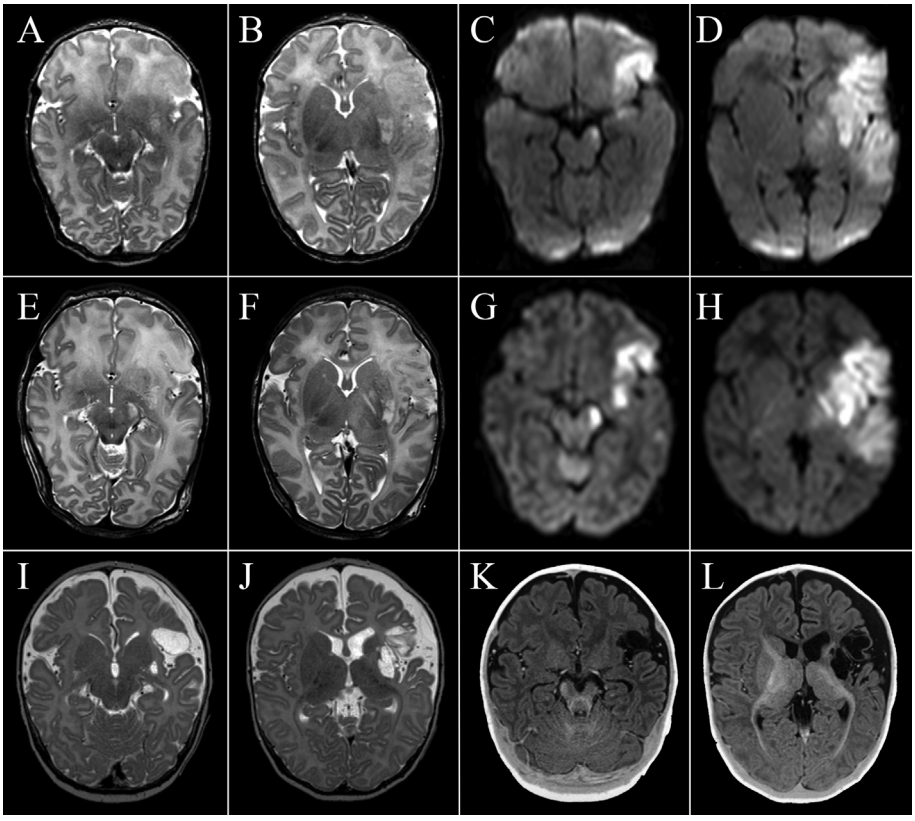

Fig. 1 – MRI of Case 1. MRI of a newborn (case 1) with a left sided MCA PAIS who had three MRIs: the first within 24 h (upper row), the second at 72 h after onset of symptoms (middle row) and the last at three months of age (bottom row). At 72 h there was an increase in signal intensity in the left cerebral peduncle (A versus E) and PLIC (B versus F) on axial T2-weighted imaging compared to the first scan. On early axial DW imaging mild lateral signal changes can be observed in the cerebral peduncle (C), while a profound hyperintense signal was seen at 72 h after onset of seizures (G). Signal changes in the PLIC on DW imaging were very clear after 72 h (H), but not on the first MRI (D). Repeat MRI (bottom row) at the age of three months showed cysts in the left hemisphere, especially in the region of the anterior branch of the MCA (I–J). On Inversion Recovery T1 weighted imaging (axial view) Wallerian degeneration of the left descending CST, involving the cerebral peduncle (K) and PLIC (L) is noted.