Diffusion-weighted MRI of middle cerebral artery stroke in a newborn

Abstract  Diffusion-weighted MRI of the brain is becoming clinically available as a tool to investigate cerebral ischaemia. We report a newborn girl presenting with seizures in whom diffusion-weighted MRI showed a large hyperintensity in the area perfused by the left middle cerebral artery. Short-term neurological follow-up before discharge was uneventful and the patient was discharged without sequelae. On follow-up clinical examination, right-sided spastic signs were noted which disappeared with time.

Introduction

Major cerebral artery stroke is rare in neonates and sometimes difficult to diagnose [1]. While conventional methods such as cranial US and CT have shown themselves to be of use, MRI is becoming the method of choice for imaging of neonates and children in general [2]. Diffusion-weighted MRI (DWI) has established itself as a sensitive method for the detection of ischaemia, both in adults and children [3–6]. In this technique, a pair of diffusion-sensitising pulses is placed in a spin-echo sequence: the imaging sequence is rendered sensitive to motion. In cerebral ischaemia, the diminished molecular motion associated with dysfunction of the membrane-bound Na’K’ATPase leads to intracellular accumulation of water and cytotoxic oedema. This is seen as a decrease in the apparent diffusion coefficient and as increased signal on diffusion-weighted images acquired at a high b value. We report a newborn presenting with seizures in who MRI of the brain with DWI was performed.

Case report

This girl was born to a 42-year-old mother by caesarean section indicated by oligohydramnios and fetal intrauterine position, after an uneventful pregnancy. At birth the general and neurological examinations were normal and the patient was initially transferred to the post-natal unit. After the first myoclonic seizure of the arms, neck and mouth, deviation of gaze and nystagmus towards the right and hypersalivation on the second day of life, she was transferred to the neonatal intensive care unit. There she suffered a further seizure. Injection of vitamin B1 was ineffective, but the seizures were stopped with phenobarbital. Blood electrolytes, haemoglobin and
urine and plasma amino acids were normal. Ultrasound of the brain was normal, as was the EEG. On the following night, seizures re-
curred and were again stopped with phenobarbital. The next.morn-
ing, decreased consciousness and generalized hypotonia were noted. MRI was performed on the morning of the 3rd day of life.

MRI was performed on a 1.5-T system (Siemens Vision) equipped with a head coil and capable of echo-planar imaging. T2-weighted (T2-W) (TR 3,500 ms; TE 98 ms) and isotropic diffusion-weighted MR sequences with b values of 0 and 972 s/mm² (TR 4,000 ms; TE 136 ms; 4 acquisitions) were performed, followed by MR angiography (MRA) done with a time-of-flight sequence. The DWI sets showed the presence of a large area of high signal on the images at the high b value in the frontal area perfused by the left middle cerebral artery (MCA) (Fig. 1). The ischaemic region seemed to encompass the posterior part of the insula, part of the in-
ferior frontal gyrus and the postcentral gyrus. Apparent diffusion coefficient (ADC) values were subsequently calculated from pixel-
by-pixel ADC maps generated by the MR console software. The slices with b values of 0 and 972 s/mm² were matched and ADC maps were obtained for each slice. ADC values were calculated ac-
cording to the Stejskal and Tanner equation. Areas of disturbed dif-
fusion on the high b value images, seen as hyperintensities, cor-
responding to low signal on the ADC maps, were then measured on the corresponding ADC maps. Regions of interest were deter-
mined using the console software as circles in the small areas of dis-
turbed signal on the ADC maps. ADC values were also measured in the contralateral region. The relative ADC (rADC) was then ob-
tained by dividing the value in the ischaemic area by a measure in the contralateral non-affected region. ADC values varied between 638 and 840 mm²/s in the ischaemic region, and 1170 to 1300 mm²/s in the contralateral normal-appearing region. Relative ADCs in the lesion thus varied between 0.49 and 0.61.

T2-W MRI showed slight effacement of the cortical sulci in the corresponding area (Fig. 2). MRA did not show any occlusion of the appropriate vessel (Fig. 3).

Although CMV and herpetic encephalitis were not the cause, she was initially treated with aciclovir. Repeated lumbar punctures were normal. Phenobarbital treatment was discontinued and there was no recurrence of seizures. Neurological progress was normal: consciousness was full and there were no detectable neurological deficits, feeding was normal with progressive weight gain and the patient was discharged after 2 weeks with a normal neurological examination.

Further neurological examinations were undertaken at 4 and 8 months after birth. At 4 months, movements were asymmetrical with less movement of the right side of the body. Muscular tone was higher on the right side and there was hyperreflexia of the right peripheral tendon reflexes. However, at 8 months these find-
ings had almost completely disappeared and both hands manipu-