Early False-Negative Diffusion-Weighted Imaging in Pontine Medial Longitudinal Fasciculus Infarction

Ashkan Mowla1*, Haris Kamal1, S. Ali Nabavizadeh2 and Peyman Shirani1
1Stroke Program, Department of Neurology, State University of New York at Buffalo, USA
2Department of Radiology, Hospital of the University of Pennsylvania, USA

Abstract

A 61-year-old man with multiple cardiovascular risk factors presented to the emergency department with true vertigo, binocular horizontal diplopia and ataxic gate 5 hours after onset of symptoms. He was alert and his general and neurological exam was unremarkable except for his ocular motility and gait. On left lateral gaze, he had limited adduction in right eye, but left eye was fully abducting with jerky nystagmus. Convergence was preserved and upward and downward gaze were intact bilaterally. His gait was ataxic with wide base. An enhanced head computed tomography (CT) scan performed and was unremarkable for any acute abnormality. His initial brain MRI which included Diffusion-Weighted Imaging (DWI) and fluid-attenuated inversion recovery (FLAIR) sequences done 10 hour after admission did not show any area of diffusion restriction on DWI or any focal hyperintensity in the clinically relevant brain regions. Brain MRI was performed on a GE Signa CVi, 1.5T MR unit (GE Medical Systems, Milwaukee, WI) and DWI sequence had contiguous slices with slice thickness of 5mm. Since he remained symptomatic, a second brain MRI was obtained on day three of admission which was positive for an area of restricted diffusion in the right paramedian upper pontine tegmentum involving medial longitudinal fasciculus (MLF). The apparent diffusion coefficient (ADC) map showed decreased ADC correlating with the area of diffusion restriction confirming acute pontine infarction (Figure A,B). Concomitant FLAIR images shows a focal intense signal matching with location of diffusion restriction on DWI. Both MRIs were done with the same scanner and a board-certified neuroradiologist interpreted the Brain MRIs.

INTRODUCTION

“False-negative DWI stroke” has been reported in various locations in both anterior and posterior circulation territories, more commonly in posterior circulation. This entity has been frequently reported in lateral medulla, anterolateral pons and cerebellum [1-4] and with lower frequency in other areas [5]. However, to the best of our knowledge, it has been rarely reported in MLF infarcts. Our patient presented with prominent unilateral internuclear ophthalmoplegia (INO) syndrome and showed delayed signal on DWI in upper pontine tegmentum involving only MLF.

Although MLF syndrome or partial oculomotor nerve palsy were initially thought as the cause of the limitation of adduction in the right eye in our patient, the presence of convergence was in favor of diagnosis of MLF syndrome rather than medial rectus palsy. Chuang et al. have studied 8 patients with suspected MLF syndrome and they all were found to have abnormal high signal lesions close to the floor of the fourth ventricle on the dorsal side of the pons on their DWI images; however, the timing between the onset of symptom and brain MRI was not reported. In a case series of 30 patients who presented with isolated or predominant INO, Kim has shown that all of them had a small dorsal brainstem lesion on their brain MRI, much more common in pons and isthmus rather than midbrain. One of the patients in the Kim’s report is a 57 year old lady who presented with diplopia, vertigo, nausea and right INO on neurological examination. She had a negative DWI but a high signal lesion on T2-weighted MRI in right isthmus. The timing of the brain MRI from the onset of symptom was not reported in this patient. Thus far, to the best of our knowledge, Kim’s patient was the only reported patient who had a prominent INO on presentation and was found to have a
negative DWI with a high signal on FLAIR in the literature. No follow up imaging was reported for this patient.

In recent years, there have been more frequent reports of early false-negative imaging as DWI has been used as a routine sequence in brain imaging. Several reports have proposed that the rate of false-negative DWI results depend on multiple factors including size of the infarct, location and MRI timing from the time of symptom onset [2,5,8]. The majority of the false-negative DWI cases underwent DWI MRI within the 24 hours of symptom onset; however, such cases have also been reported in those imaged after 24 hours of symptom onset. In addition, patients presenting with very small size posterior circulation infarcts were more likely to have negative DWI particularly if imaged early after the onset of symptoms. Possible explanations include lesions too small for the resolution of the DWI echo-planar sequence, insufficient signal-to-noise ratio in the first few hours after symptom onset and also magnetic susceptibility artifacts occurring in echo-planar imaging causing brain stem distortion that hinder image analysis [1], although improvement in imaging techniques with routine use of parallel imaging in recent years lead to better quality images of the brainstem with less image distortion.

We used parallel imaging in MR acquisition and our DWI images did not show any image distortion in the brainstem. There is also a recent study which proposed that the degree of hypoperfusion in the early phase of ischemia may remain below the threshold required to form an image with DWI as the reason for the false negativity [10].

In conclusion, isolated or predominant INO is a unique clinical syndrome usually caused by small dorsal brainstem lesion and acute infarct should not be excluded based on the early negative DWI. A follow up DWI study might be beneficial after 24 hours of symptom onset in patients presenting with initial negative DWI and symptoms suggestive of MLF syndrome.

REFERENCES