A RARE CASE OF ACUTE QUADRIPARESIS IN YOUNG ADULT – ROLE OF DIFFUSION-WEIGHTED MR IMAGING

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Abstract

We present a case of a young adult without any comorbidities who presented with acute quadriparesis. There was a diagnostic dilemma of the case whereby the primary team had difficulties to come up with a diagnosis due to lack of supportive information from the clinical history and limited laboratory investigation results prior to neuroimaging. Purely based on the clinical signs and symptoms, the patient was initially treated for transverse myelitis. Initial imaging performed includes computed tomography (CT) of the brain which did not show any abnormalities. Subsequent magnetic resonance imaging (MRI) of the brain showed no supratentorial abnormalities however there was restricted diffusion at medulla noted in the diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) map. MRI of the cervical spine showed high signal intensity on T2-weighted images in the anterior part of the spinal cord on standard MRI spine sequences. The restricted diffusion detected on DWI and ADC map aids in the diagnosis of spinal cord infarction (SCI) in this patient. However, it is to be noted that the DWI sequence of the MRI spine study is not routinely performed. This case report illustrates the role of DWI in diagnosing SCI in a young adult with quadriparesis.

Keywords**:** Diffusion-weighted Imaging (DWI), Magnetic Resonance Imaging (MRI), Spinal Cord Infarction (SCI).

Introduction

It is rare to encounter cases of spinal cord infarction (SCI) worldwide. The rich anastomotic arterial network of the spinal cord largely contributes to its rarity and hence lack of its epidemiological data. Etiologies of SCI are heterogeneous and may vary depending on the age, with atherosclerosis being one of the commonest causes in the adult population. In cases where there are no obvious risk factors identified and clinical history is unhelpful, diagnosis can be extremely challenging. Apart from thorough physical evaluation, neuroimaging thus plays a very significant role in diagnosis of SCI. While magnetic resonance imaging is imperative as part of diagnostic tools in the evaluation of acute spinal cord syndromes, most findings are not specific for SCI which can include cord swelling and T2-weighted hyperintense signals of the involved cord. 'Owl-eyes or snake-eyes' appearance is another helpful finding however this is also non-specific as it can be present in other conditions. In a case of infarction, we expect to see restricted diffusion at the affected region, and this can be demonstrated with diffusion-weighted imaging. The purpose of this case report is to highlight the role of diffusion-weighted imaging (DWI) in the diagnosis of SCI.

Case presentation

This is a case of a 20-year-old gentleman with no known medical illness. His presentation was a sudden onset of quadriparesis which developed over several hours and progressively worsened. Prior to developing the symptoms, he was merely resting and there was no precipitating event or trauma. Patient denied similar presentation previously nor other symptoms including fever, neck stiffness or photophobia.

Upon neurological examination, the patient elicited complete motor paralysis, hypotonia and areflexia involving both his upper and lower limbs. There was loss of pain sensation below the level of C3/C4 with preserved proprioception. His baseline basic blood parameters were all normal. No growth in blood and urine culture. Initial computed tomography (CT) of the brain was unremarkable.

Magnetic resonance imaging (MRI) brain together with cervical spine were performed on day 2 of admission. On MRI of the cervical spine, sagittal T2-weighted images showed mild cord edema with long-segment intramedullary high signal intensities at the level of medulla till visualized upper thoracic level at T3-T4 (Figure 1A). Corresponding images post gadolinium showed patchy enhancement of the affected cord. Axial T2-weighted images at the level of C5-C6 showed bilateral symmetrical high signal intensities involving the anterior horns of grey matter giving the appearance of owl-eyes or snake-eyes signs (Figure 1B). Compressive causes were excluded. There was evidence of abnormal restricted diffusion at the medulla noted in the MRI brain which showed high signal intensity on diffusion-weighted imaging (DWI) with corresponding low signal intensity on apparent diffusion coefficient (ADC) maps (Figure 2C & D), raising the possibility of acute infarction. It is to be noted that the DWI sequence for MRI spine is not routinely performed at the center.

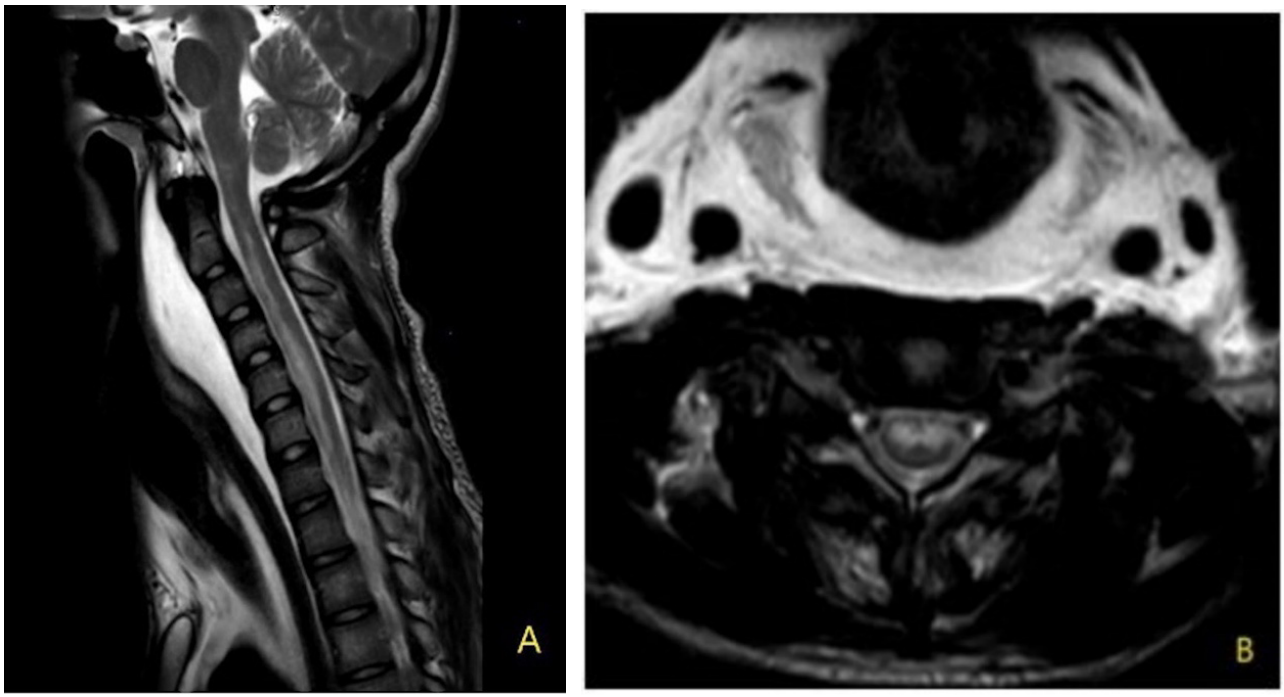

Figure 1: **(A)** Sagittal T2 weighted image showed long segment of hyperintensity from medulla till visualized upper thoracic level; **(B)** Selected axial T2 weighted image at the level of C5 vertebra showed characteristic 'owl-eyes' or 'snake-eyes' appearance.

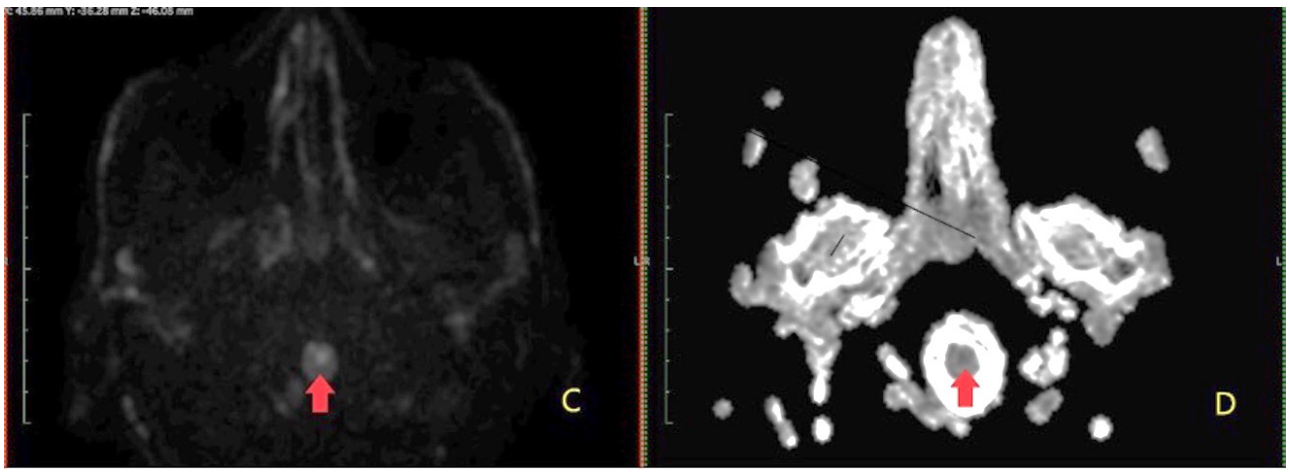

Figure 2: **(C)** Hyperintense signal on DWI and **(D)** hypointense signal on ADC (red arrow) at visualized medulla in keeping with abnormal restricted diffusion suggestive of an area of acute infarct.

Given his young age and clinical presentation, the initial concern was more towards transverse myelitis and the patient was initially started on intravenous corticosteroid. After reviewing the MRI, despite unclear etiology, a decision was made that the possible cause for his clinical presentation is spinal cord infarction. Antiplatelet therapy was immediately commenced, and corticosteroid was withheld. Further history from the family member revealed that the patient was a chronic methamphetamine abuser and it was then postulated that there might be a causal link between methamphetamine and SCI.

The patient, however, deteriorated after almost one week of admission due to respiratory distress requiring mechanical ventilation and autonomic dysfunction. Maximum resuscitation was given, however he unfortunately passed away following cardiac arrhythmia and subsequently asystole.

Discussion

SCI is a rare disease and previously reported to account for only ~1% of all strokes (1). Its sequelae is debilitating and may result in permanent functional impairment and even high mortality rate (2). It is therefore important to establish an accurate diagnosis to direct management plans.

The mainstay diagnosis of SCI is primarily clinical however it is not always straightforward (3). Clinical features largely depend on location and extent of infarct. One has to bear in mind that severity of clinical presentation can vary from minor weakness to paraparesis, giving rise to a list of differential diagnoses, among which are transverse myelitis, multiple sclerosis and cord compression (4, 5).

Additionally, it is challenging to discriminate between vascular and inflammatory causes (3). There are even studies that revealed a certain percentage of patients with presumptive diagnosis of transverse myelitis had alternative specific myelopathy diagnoses, one of which was proven to be ischemia/stroke related (6, 7). The same goes for our case where diagnostic dilemma arises when we consider the young age and the lack of risk factors for spinal cord infarction making the diagnosis inclined more towards transverse myelitis.

Certain clinical measures or investigations e.g. cerebrospinal fluid (CSF) analysis are important for definite diagnoses and also part of work out in acute spinal syndrome. However, CSF analysis was not performed in our case as consent was not given by family member. MRI was hence the investigation of choice to aid with the diagnosis. In acute phase i.e. within 24 hours of symptom onset, MRI findings may be normal in SCI. The expected abnormalities generally develop after 1-2 days which include cord swelling and T2-weighted hyperintensities (8). These abnormal findings are however non-specific as inflammatory etiology can show similar characteristics although they usually develop more acutely compared to SCI (3).

The appearance of 'owl-eyes or snake-eyes' on axial T2-weighted images which primarily suggests involvement of the anterior part of the grey matter (known to have the highest vulnerability to ischemia) helped to support the impression of SCI (9). However, owl-eyes or snake-eyes sign per se is not specific for SCI and can be present in other diseases such as in cervical spondylotic myelopathy (10). The key to diagnosing SCI in this patient was essentially the presence of abnormal restricted diffusion on DWI and ADC maps.

Previous established studies have shown that hyperintense signal on DWI with low ADC values have high sensitivity for spinal infarction, similar to acute cerebral ischemia (3, 11). Hence, although only incidentally detected on MRI brain at the visualized medulla, this finding has therefore helped to differentiate it from initial diagnosis of transverse myelitis.

The main principle behind DWI is that it involves the measurement of diffusion coefficient i.e. the amount of microscopic random movement of molecules, specifically water. Acute infarction results in cytotoxic edema hence decrease in diffusion rate of water molecules within an affected tissue. In DWI, a spin echo sequence is used and two large gradients are applied at either side of the 180° pulse. The first gradient dephases the spin and the second gradient rephases the spin so that only the molecules that are stationary will return signal. Hence, tissue with restricted diffusion will appear bright in DWI and vice versa (12, 13). It is also important to note that DWI images have T2 weighting so tissues with inherent high T2-weighted signal will also appear bright, which is known as T2 shine through. This is where the ADC map comes in useful as it removes the T2 dependence and so can be used to distinguish true restricted diffusion from T2 shine through where tissue with restricted diffusion will appear dark (13).

From this discussion, it is obvious that DWI can be an extremely useful sequence in MRI spine especially in cases where spinal cord infarction is suspected. However, DWI of the spinal cord is rarely performed due to technical challenges associated in obtaining the sequence, such as motion artifacts from the spinal cord and its surrounding structures' physiological movement (e.g: CSF pulsation), susceptibility artifacts from the presence of bone and cerebrospinal fluid interfaces, and low signal-to-noise ratio due to the small pixel sizes needed for accurate spinal cord visualization (14). Studies are still being carried out to make it feasible for an adequate DWI of the spinal cord, one which demonstrated that apart from single-shot echo-planar diffusion imaging, a sufficient DWI of the spinal cord is possible using alternative, albeit slower, diffusion imaging methods like navigated pulsed-gradient multishot spin-echo imaging, navigated segmented echo-planar diffusion imaging, or line scan diffusion imaging (14).

Conclusion

SCI is a potentially disabling disorder particularly in cases with poor initial neurological deficit, hence an early detection is imperative for prompt management and possible better neurological outcome. Conventional MRI sequence can play a role in acute spinal syndrome, however

is limited especially in the early course of the disease. DWI has the potential to be a very useful sequence in the diagnosis of SCI and may be feasible with improvised technique.

Acknowledgement

None.

Ethical Clearance

Institutional Review Board approval is not required at the authors' institution for the presentation of a single case report.

Competing interest

The authors declare that they have no competing interests.

Informed consent

Verbal consent was granted from the patient's family member for the publication of this case report and the accompanying images.

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