

Acute and Sub-acute MRI Feature Reflects Neurological Prognosis for Patients with Cervical Spinal Cord Injury

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Abstract

Aim: We investigated the relationship between the acute (within 3 days after injury) and sub-acute (1 month after injury) MRI features and neurological prognosis.

Method: The acute MRI (within 3 days after injury): We evaluated the relationship between the vertical diameter of T2 high-intensity changed area in MR images and neurological outcome. The sub-acute MRI (1 month after injury): We evaluated the relationship between the antero-posterior diameter of T1 low-intensity changed area in MR images and neurological outcome.

Conclusion: At the acute MRI, 2-3 days after injury, a significant relationship was observed between the vertical diameter of T2 high-intensity area and the neurological prognosis at discharge. 0-1 days after injury, a relationship between the vertical diameter of T2 high-intensity area and the neurological prognosis at discharge was weak. Neurological prognosis is more correlation with MRI after 2-3 days after the injury. If the vertical diameter of T2 high-intensity area was <45 mm, the patients were able to walk with or without a cane at discharge. At sub-acute MRI, There was a significant relationship between the antero-posterior diameter ratio of the T1-weighted low-intensity area on MRI at the sub-acute stage and the ASIA motor score. The patients with <50% T1-weighted low-intensity area recovered to walk with or without a cane at discharge.

Keywords: Acute MRI; Sub-acute MRI; T2 high-intensity changed area; T1 low-intensity changed area; Neurological prognosis; Walking ability

Commentary

Several prognostic studies looked for the relationship between the MRI and neurologic outcome. But, it was not clearly demonstrated whether the MRI at any time is to correlate with neurological prognosis. We investigated the relationship between the acute (within 3 days after injury) and sub-acute (1 month after injury) MRI features and neurological prognosis. The acute MRI (within 3 days after injury): We evaluated the relationship between the vertical diameter of T2 high-intensity changed area in MR images and neurological outcome (Figure 1). We divided the patients into two groups: those admitted 0-1 day after injury group and those admitted 2-3 days after injury group.

We investigated the correlation between the vertical diameter of T2 high-intensity changed area and neurological evaluations in both groups. At 0-1 day after injury group, there was a relationship between the vertical diameter of T2 high-intensity area in MR image and ASIA motor score at admission and at discharge, but correlation coefficient was low (Figure 2). On the other hands, at 2-3 days after injury group, there was a significant relationship between the vertical diameter of T2 high-intensity area in MR image and ASIA motor score at admission and at discharge, and correlation coefficient was very high (Figure 3).



Figure 1: T2-weighted image. White arrow (a): cranio-caudal diameter (mm) of intramedullary intensity changed area (increased signal intensities ISI).

About this 2-3days group, Receiver operator characteristic (ROC) curve analysis demonstrated that the optimal vertical diameter of T2 high-intensity area cut-off value for patients who were able to walk at discharge was 45.8 mm. If the vertical diameter of T2 high-intensity area cut-off value was 45 mm, there was a significant positive correlation with being able to walk at discharge ($P < 0.0001$) [1].

The sub-acute MRI (1 month after injury): We evaluated the relationship between the antero-posterior diameter of T1 low-intensity changed area in MR images and neurological outcome (Figure 4). There was a significant relationship between the antero-posterior diameter ratio of the T1-weighted low-intensity area on MRI at the sub-acute stage and the ASIA motor score at discharge (Figure 5). The optimal threshold of the T1-weighted low-intensity diameter ratio for predicting the patient's ability to walk with or without assistance at discharge was determined to be 46%. Moreover, 96.8% of the patients with $< 50\%$ T1-weighted low-intensity area recovered to walk with or without a cane at discharge [2].

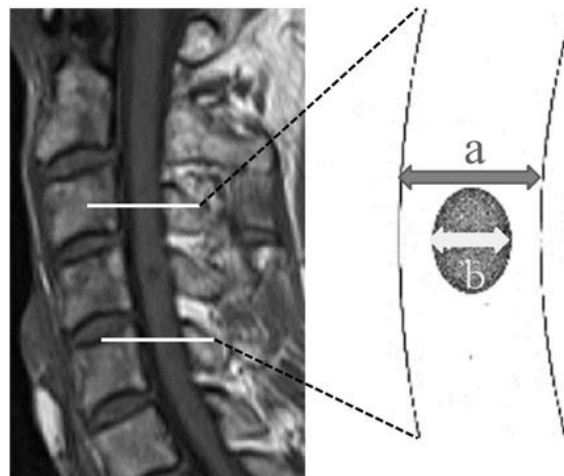


Figure 4: T1-weighted image. Black arrow (a): Cervical spinal cord transverse diameter. White arrow (b): T1 low transverse diameter. T1-low diameter ratio was b/a (%).

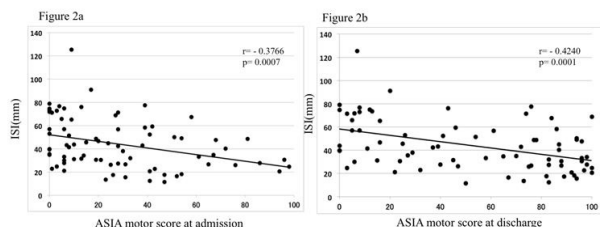


Figure 2: At 0-1 day group A. The relationship between the ISI and the ASIA motor score at admission (a) and at discharge (b). There was a relationship between ISI and ASIA motor score at admission and at discharge ($P < 0.05$), but correlation coefficient was low. ASIA: American Spinal Injury Association. ISI: Increased Signal Intensities.

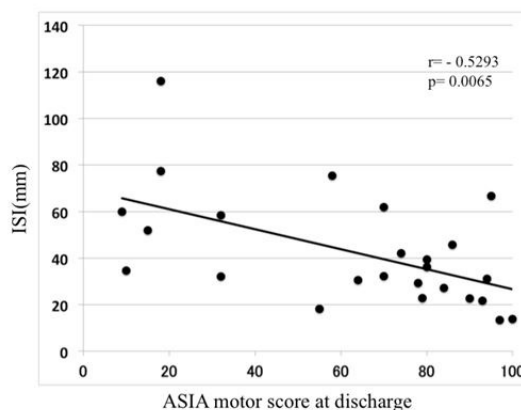


Figure 5: The relationship between the ASIA motor score at discharge and the T1-LCAR. There was a significant negative relationship between the 2 parameters, indicating that a larger T1-LCAR was associated with more severe paralysis. ASIA: American Spinal Injury Association. T1-LCAR: T1 low-intensity area ratio.

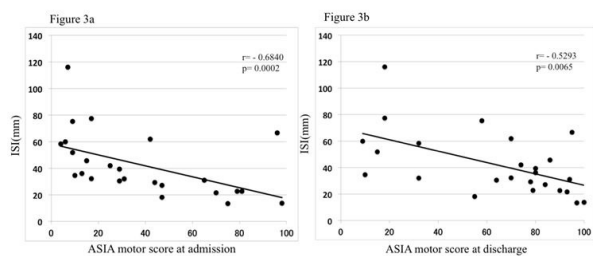


Figure 3: At 2-3 days Group. The relationship between the ISI and ASIA motor score at admission (a) and at discharge (b). There was a significant relationship between the ISI and ASIA motor score at admission and at discharge ($P < 0.05$), and correlation coefficient was very high. ASIA: American Spinal Injury Association. ISI: Increased Signal Intensities.

Conclusion

At the acute MRI, 2-3 days after injury, a significant relationship was observed between the vertical diameter of T2 high-intensity area and the neurological prognosis at discharge. 0-1 days after injury, a relationship between the vertical diameter of T2 high-intensity area and the neurological prognosis at discharge was weak. Neurological prognosis is more correlation with MRI after 2-3 days after the injury. If the vertical diameter of T2 high-intensity area was < 45 mm, the patients were able to walk with or without a cane at discharge.

At subacute MRI, There was a significant relationship between the antero-posterior diameter ratio of the T1-weighted low-intensity area on MRI at the sub-acute stage and the ASIA motor score. The patients

with <50% T1-weighted low-intensity area recovered to walk with or without a cane at discharge.

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