MRI Features of the Inflamed Spine: A Comprehensive Comparison of Spinal Lesions in Acute Transverse Myelitis and Multiple Sclerosis in Children

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Background: The contribution of MRI to the diagnosis of Multiple Sclerosis (MS) rests largely on the delineation of lesion dissemination in space and time within the brain. The MRI features of MS lesions in the brain in children differ from those in adults, and to date, no studies have reported on the characteristics of spinal lesions in pediatric MS. MRI plays a pivotal role in the exclusion of diseases that have clinical similarity to MS. In adult MS patients, spinal cord lesions are typically small and detected at multiple independent spinal levels. In contrast, spinal lesions in monophasic, post-infectious or idiopathic acute transverse myelitis, lesions are typically solitary but span multiple spinal segments in length. It is unknown whether these distinctions are also true in the context of the inflamed spinal cord in children.

Objective: To compare the MRI characteristics of spinal cord lesions in children with clinically-definite MS to children with monophasic acute transverse myelitis (ATM)

Methods: MR images of the spine were acquired on a 1.5 Tesla scanner at onset in children with monophasic ATM, and at the time of spinal cord relapse in children with relapsing-remitting MS (RRMS). All MR scans with sagittal images, and axial images when available, were scored. T1w pre- and post-gadolinium and T2w FSE images were scored using a pre-determined standardized scoring tool by two independent pediatric neuroradiologists, who were blinded to both clinical and outcome data. Variables of interest included total lesion count as well as lesion location, horizontal extent, and number of vertebral segments spanned for each lesion. Children meeting diagnostic criteria for MS and ATM were confirmed from clinical databases in the Demyelinating Disease Program at the Hospital for Sick Children.

Results: Thirty-three children diagnosed with ATM (mean age at onset 10.6 yrs; M:F = 1:1.5) and 38 MS patients with spinal involvement (mean age at onset: 10.1 yrs; M:F = 1:3.2) were enrolled. Chi-square analysis of lesion 4 features revealed significant differences between the two groups ($p<0.001$): with only 5 (16%) of MS and 21 (67%) of ATM patients having lesions extending >3 vertebral bodies, 8 (26%) MS and only 2 (6%) ATM patients having cervical lesions, 9 (29%) MS and 4 (13%) ATM patients having thoracic lesions; and 9 (29%) MS and 5 (16%) ATM patients had lesions in multiple regions (Figure 1). Horizontal extent of lesions was significantly different between children with MS and ATM (Chi-square analysis $p<0.01$): anterior cord: MS=0 (0%), ATM=2 (6%); anterior horn cells: MS=0 (0%), ATM=2 (6%); central grey matter: MS=8 (30%), ATM=22 (69%); posterior cord: MS=2 (7%), ATM=0 (0%); complete cord: MS= 7 (26%), ATM= 5 (16%); more than one horizontal region involved: MS=10 (37%), ATM=1 (3%) (Figure 2). Despite no overall difference in total lesion count, ATM patients had significantly longer lesions than children with MS ($t(62)=4.68$, $p<0.01$). Evidence of acute lesional hemorrhage was detected in 3/38 children with ATM, and in none of the children with MS.

Conclusion: Children with ATM were more likely than MS patients to have longer lesions, extending more than 3 vertebral segments, with a higher propensity for lesions to be located in anterior and central spinal cord regions. Children with MS were more likely to have lesions in the posterior cord with an affinity for the cervical and thoracic regions. Although longitudinal lesions occurred less often in children with MS, it is noteworthy that 16% of MS spinal lesions would be considered longitudinally extensive.

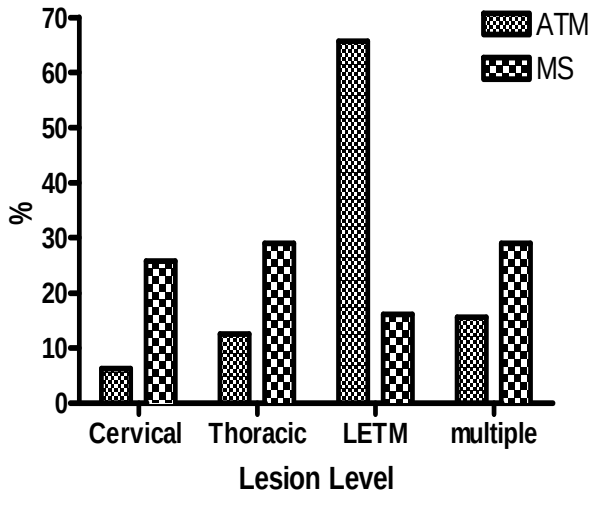

Figure 1. Lesion level in MS and ATM ($p<0.001$)

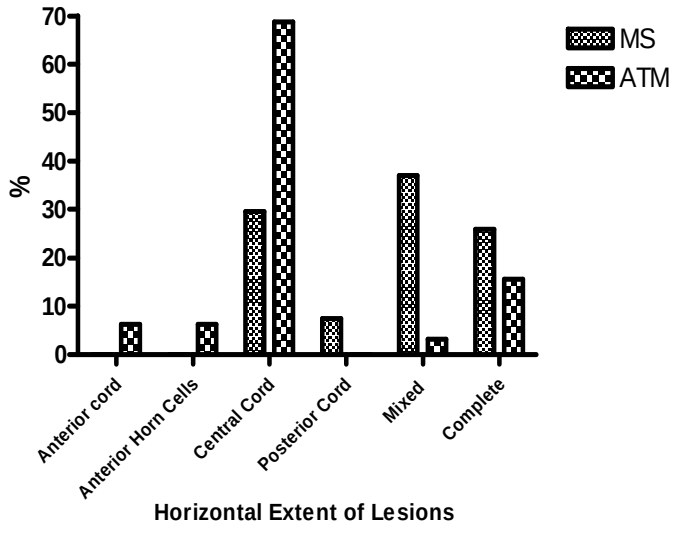

Figure 2. Horizontal extent of lesion in MS and ATM ($p=0.001$)