Predicting clinical course of Relapsing Remitting Multiple Sclerosis using Magnetic Resonance Support Vector Machine of Cervical Spinal Cord

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Objectives

Relapsing Remitting Multiple Sclerosis (RRMS) is an inflammatory, demyelinating and degenerative disease of the central nervous system. The degree of severity varies widely across patients, and it is often difficult to predict the clinical course in the early stages of this disease. It is known that spinal cord involvement is a bad prognostic factor of MS-related disability. In this study we aimed to identify biomarkers of physical disability by using magnetic resonance imaging (MRI) of the spinal cord in two groups of RRMS patients, divided into stable (S) and worsening (W) based on their clinical course during a follow-up period of at least 6 years.

Materials and methods

Table 1. Characteristics of 24 Relapsing Remitting Multiple Sclerosis patients, divided into 13 stable (S) and 11 worsening (w) based on their clinical course.

	Stable (N°13)	Worsening (N°11)
Age at onset (mean±SD)	27,3±3,9	29±5,2
EDSS at scan (mean±SD)	2±1,1	3±1,2
Sex (M/F)	5/8	3/8
Patients with motor/cerebellar onset (n°)	4	8
Cervical cord lesion count (mean±SD)	1,9±2,3	2,4±1,6

In this retrospective study we included **24 RRMS patients**, **13 S and 11 W**. Baseline characteristics of all patients were similar (kind of onset, disease duration, age at onset). Their classification in S or W was based on EDSS progression and/or prophylaxis treatment failure during a clinical follow-up of at least 6 years. We analysed **MRI sagittal T2-weighted scans of cervical spinal cord**, obtained with a **1,5 Tesla MRI scanner**.

Images were processed with the open-source software Spinal CordToolBox.
By means of registration to a common template, we segmented the cervical spinal cord into seven regions (from C1 to C7) and from each one we extracted volume, mean T2 intensity and standard deviation. Lesion count for each segment was also assessed.
Afterwards, we used **Support Vector Machines (SVM)** to automatically classify patients in the two subgroups, thus testing the predictive power of spinal cord metrics. We used ten-fold validation to estimate accuracy of the algorithm.

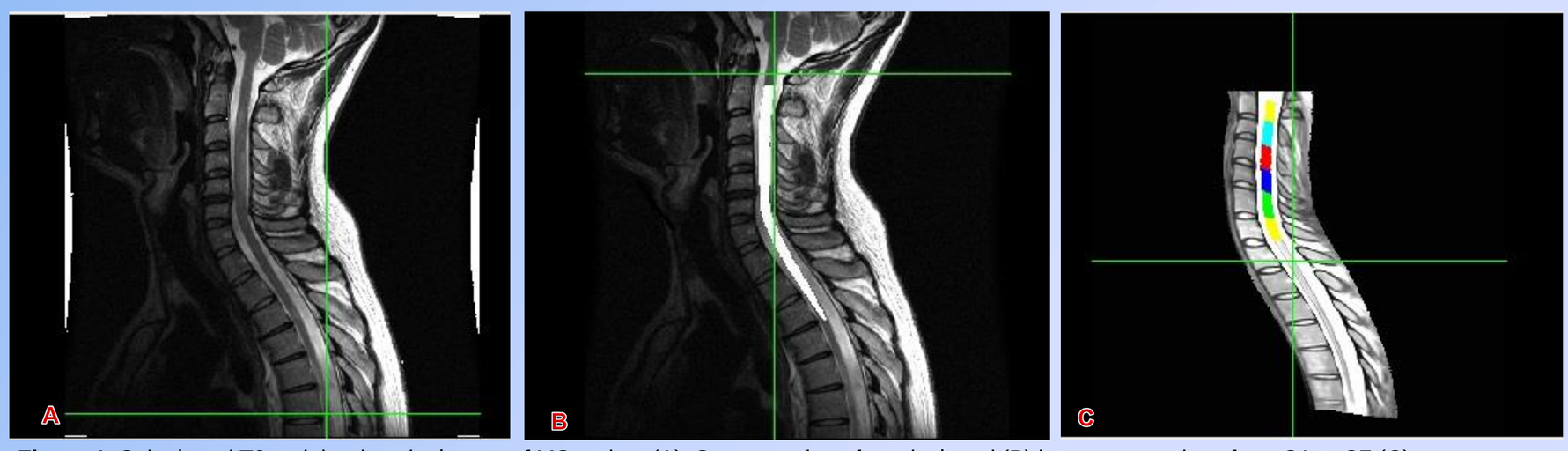


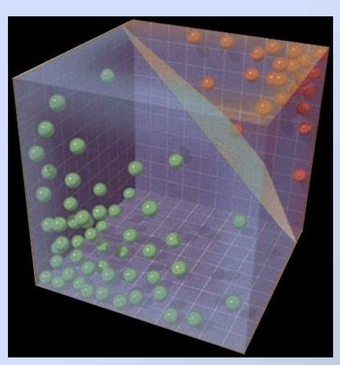
Figure 1. Spinal cord T2-weighted sagittal scan of MS patient (A). Segmentation of cervical cord (B) into seven regions from C1 to C7 (C).

Results

There were no significant differences of the studied biomarkers between the two groups, although some trends existed. There was no correlation between lesion count and spinal cord metrics. Instead, **SVM** was able to distinguish patients with an **accuracy of 83%** using a combination of the three biomarkers extracted from each cervical spinal cord segment, leading to a feature vector of **21 elements.**

Conclusions

This work, despite the small number of enrolled patients, highlighted the potential of SVM in predicting clinical course of RRMS based on spinal cord measures, instead of brain-extracted metrics. This might be explained by the fact that the selected biomarkers provide complementary information from lesion count.



Bibliography

1-Cherubini A, Morelli M, Nisticó R, Salsone M, Arabia G, Vasta R, Augimeri A, Caligiuri ME, Quattrone A. Magnetic resonance support vector machine discriminates between Parkinson disease and progressive supranuclear palsy. Mov Disord. 2013 Dec 3.
2-Cherubini A, Nisticò R, Novellino F, Salsone M, Nigro S, Donzuso G, Quattrone A. MR Support Vector Machine discriminates Essential Tremor with rest tremor from tremor dominant PD. Mov Disord. 2014, in press.
3-Wottschel V, Alexander DC, Kwok PP, Chard DT, Stromillo ML, De Stefano N, Thompson AJ, Miller DH, Ciccarelli O. Predicting outcome in clinically isolated syndrome using machine learning Neuroimage Clin. 2014 Dec 4;7:281-7. doi: 10.1016/j.nicl.2014.11.021. eCollection 2015.

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