

Cine Cerebrospinal Fluid Imaging in Multiple Sclerosis. A Case-Control Study

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Objective: To investigate the cerebrospinal fluid (CSF) dynamics in Sylvius aqueduct in multiple sclerosis (MS) patients versus healthy controls (HC) and to define correlates with other specific disease metrics.

Background: CSF velocity and flow dynamics, as measured by MRI in MS patients, may be impaired and associated with higher disease activity.

Methods: Fifty eight (58) consecutive MS patients (41 RR and 17 SP) with mean age 45.3 yrs, mean disease duration 13 yrs and median EDSS 4.0 and 22 age- and sex-matched HC were scanned on a GE 3T scanner. A two-dimensional, phase-contrast gradient-echo MR acquisition using peripheral cardiac gating, with in-plane resolution 0.39x.039mm² and 32 phases, corresponding to a full cardiac cycle, was collected on one 4mm thick slice positioned perpendicular to the Sylvius aqueduct. In addition to CSF

measures, we calculated T2-, T1- and contrast enhancing (CE) lesion volume (LV), global, tissue-specific and central brain atrophy measures.

Results: All CSF flow and velocity measures were significantly altered in the patients with MS, compared to HC. Net CSF flow in the aqueduct, which physiologically is towards 4th ventricle, was significantly lower in MS patients than in HC (3.8 vs. 8.4, $p=0.011$). There were no CSF dynamics differences between RR and SP MS patients. In MS patients, lower net CSF flow was significantly related to a higher number of relapses in the previous year ($r=-0.28$, $p=0.029$) and longer disease duration ($r=-0.25$, $p=0.048$). The lower CSF flow was related to central atrophy, as measured by the enlargement of the lateral ventricle volume and third ventricle width ($r=0.3$, $p<0.02$).

Conclusion: This study shows that CSF flow is significantly altered in MS patients, compared to HC. Altered CSF dynamics may play an important role in the pathophysiology of MS disease process and warrants further investigation.

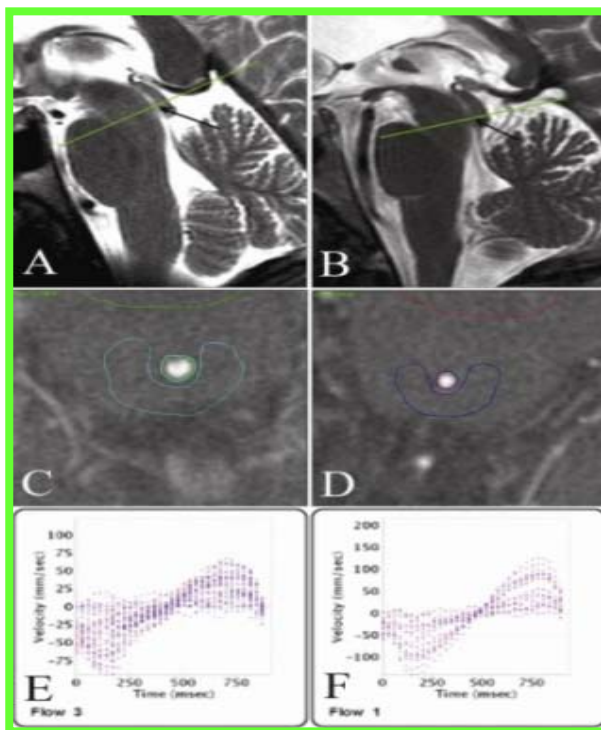


Figure. CSF flow measurement in the aqueduct of Sylvius for HC (left) and MS patient (right).

A-B. Sagittal T2 scans showing positioning for the MRI Cine acquisition. Slice orientation is perpendicular on the aqueduct.

C-D. Aqueduct and background ROIs drawn on the magnitude image.

E-F. CSF velocity distribution within the aqueduct of Sylvius ROIs, for the 32 phases, calculated using the GE ReportCard software