Decrease in size of secondary neck vessels and cerebral aqueduct enlargement in multiple sclerosis: A 5-year longitudinal MRI study

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Background

Studies have previously shown changes within the cerebrospinal fluid (CSF) dynamics, extracranial vascular arterial, and venous vessels in persons with multiple sclerosis (PwMS) when compared to healthy controls (HCs).[1-3]

Objectives

To determine the change in CSF dynamics and in number and size of secondary neck vessels in PwMS and HCs over 5-year follow-up period.

Methods

Both at baseline and follow-up, 83 PwMS and 25 HCs underwent magnetic resonance angiography (MRA) imaging whereas, a subset of 40 PwMS and 20 HCs underwent also longitudinal phase contrast cine imaging. The number and cross-sectional area (CSA) of all secondary neck vessels (excluding the common/internal carotid, vertebral artery, and internal jugular vein) measured at levels from C2-T1 were determined by semi-automated edge detection/contouring software. Measures of CSF Aqueduct of Sylvius (AoS) velocity, average AoS CSA, and systolic and diastolic peaks of velocity and flow rate were determined using Segment version 2.0 (Medvisio, Lund, Sweden, http://segment.heiberg.se). The longitudinal change in CSF and vascular measures was analyzed by non-parametric Wilcoxon repeated measure. For each substudy, Benjamini-Hochberg procedure adjusted for false discovery rate (FDR).

Results

Over 5 years, PwMS demonstrated consistent longitudinal decrease in both the number of secondary neck vessels (Z-change between –3.3 and –5.4, q=0.001) and their CSA (Z-change between –2.9 and –5.2, q=0.004). On the contrary, the HCs did not demonstrate significant longitudinal change in secondary neck vessels over the follow-up period. The subset of PwMS had average AoS CSA increase from 3.1 mm^2 to 3.7 mm^2, q=0.001, and increase in diastolic peak flow rate from 7.8 mL/min to 9.3 mL/min, P=0.023. When compared to HCs, PwMS had greater average AoS CSA (2.6 mm^2 *vs* 3.6 mm^2, P=0.045). The increase in AoS CSA was driven by the progressive MS phenotype (2.6 mm^2 *v* 3.3 mm^2 *v* 3.9 mm^2; for HCs, relapsing-remitting MS, and progressive MS, respectively). The change in AoS CSA was not associated with the change in secondary vessels, but with global ventricular CSF expansion rate (r_s=0.457, P=0.025).

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Conclusions

PwMS demonstrate significant mid-term decrease in the number and the size of the secondary neck vessels. The significant AoS CSA enlargement may reflect local atrophy of the surrounding brain structures. The clinical relevance of these findings and its effect on intracranial fluid dynamics are currently unknown.

References

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