ASymmetry of white matter hyperintensity burden and potential differential relationships with cognition

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BACKGROUND

White matter hyperintensities (WMH) are a prominent feature in normal aging, dementia and Alzheimer’s disease [1]. WMH are thought to be a downstream effect of small vessel disease and reflect pathological changes that may affect cognitive functioning [2].

Generally speaking, WMH tend to form symmetrically over time in the human brain. However, in certain individuals, there appears to be substantial asymmetry of WMH burden.

PURPOSE & HYPOTHESIS

The aim of this study was to examine differential cognitive deficits seen with highly asymmetrical WMH burden.

We hypothesized that asymmetrical WMH lesions would result in greater cognitive deficits in function relating to the affected hemisphere.

METHODS

Fifty-five subjects from the Sunnybrook Dementia study have been included from a variety of neurodegenerative vascular disease states.

- 19 subjects with Left (L) > Right (R) WMH burden (mean volume difference = 6.36cc)
- 9 subjects with R>L WMH burden (mean volume difference = 8.45cc)
- 27 subjects with symmetric WMH burden (L/R volumes did not differ by more than +/- 1cc, mean volume difference = 0.27cc)

Neuropsychological Testing [3]:

Visuospatial: (predominantly right lateralized function) Benton Judgement of Line Orientation (BJLO) test

Language: (predominantly left lateralized function) Boston Naming (BN) test

Non-verbal abstract reasoning: (predominantly non-lateralized function) Ravens Progressive Matrices (RPM) test

MRI-derived volumetrics: WMH burden and regional volumetrics were obtained using the previously validated pipelines Semi-Automatic Brain Region Extraction (SABRE) [4] and Lesion Explorer [5].

RESULTS

There was no significant difference between groups for years of education, sex or STIC.

L>R group was significantly older (p<0.05).

Table 1. Demographics: L>R, R>L and symmetric groups

<table>
<thead>
<tr>
<th>Demographics</th>
<th>L&gt;R (n=19)</th>
<th>R&gt;L (n=9)</th>
<th>Symmetric (n=27)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>80.0±6.0</td>
<td>76.1±9.5</td>
<td>74.2±7.3</td>
<td>*</td>
</tr>
<tr>
<td>Education (years)</td>
<td>13.8±3.9</td>
<td>13.2±2.2</td>
<td>13.7±3.4</td>
<td>ns</td>
</tr>
</tbody>
</table>

The R>L group had more frontal lobe WMH than the R>L group (p=0.000), while the R>L group had significantly larger WMH asymmetry (p=0.000).

Table 2. Volumetrics and neuropsychological testing scores: L>R, R>L and symmetric groups

<table>
<thead>
<tr>
<th>Volumetrics</th>
<th>L&gt;R (n=19)</th>
<th>R&gt;L (n=9)</th>
<th>Symmetric (n=27)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVT (cc)</td>
<td>1292.0±111.5</td>
<td>1238.4±156.2</td>
<td>1290.5±124.6</td>
<td>ns</td>
</tr>
<tr>
<td>WMH (cc)</td>
<td>32.1±6.5</td>
<td>33.5±3.0</td>
<td>10.1±1.1</td>
<td>***</td>
</tr>
<tr>
<td>WMH asymmetry (cc)</td>
<td>22.3±9.0</td>
<td>12.5±6.6</td>
<td>15.5±5.6</td>
<td>***</td>
</tr>
<tr>
<td>Frontal WMH (cc)</td>
<td>13.9±9.6</td>
<td>21.0±6.5</td>
<td>9.0±5.6</td>
<td>ns</td>
</tr>
<tr>
<td>WMH asymmetry (cc)</td>
<td>14.1±6.8</td>
<td>11.9±7.0</td>
<td>8.0±5.5</td>
<td>***</td>
</tr>
</tbody>
</table>

The relationship between the L>R group and RPM may be explained by the overall greater WMH burden when compared to the R>L group. The L>R group has more frontal lobe WMH than the R>L group (ns), which may contribute to the poor RPM performance.

It is possible that with a larger sample size the relationship between other cognitive functions and lateralized WMH may become significant.

DISCUSSION

Asymmetric WMH burden does not appear to selectively impact language and spatial cognition in this preliminary sample.

Those with greater left hemisphere WMH burden had a more significant correlation with overall cognition, but this could potentially relate to their overall greater global WMH burden.

ACKNOWLEDGEMENTS

We gratefully acknowledge financial support from the Canadian Institute of Health Research (MTN13129), Alzheimer Society of Canada, Alzheimers Association (USA), The L. C. Campbell Foundation and The Heart and Stroke Foundation Centre for Stroke Recovery.

REFERENCES


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