Temporal characteristics of DWI lesions in the acute and subacute phase of small vessel disease-related intracerebral haemorrhage

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Background

Diffusion weighted imaging (DWI) lesions on magnetic resonance imaging (MRI) are observed in 15-41% of patients with intracerebral haemorrhage (ICH). The presence of DWI lesions is associated with increased risk of poor outcome and recurrent ICH. However, it is unclear whether these lesions are associated with the underlying small vessel disease (SVD), result from secondary injury or the acute treatment.

Aims:
- To determine the prevalence of DWI lesions in patients who underwent MRI on admission compared to those who had MRI during follow-up
- To determine predictors of DWI lesions
- To explore associations with recurrent cerebrovascular events.

Methods
- Setting: Swiss Stroke Registry ICH cohort.
- Population:
  - Patients with SVD-related ICH
  - MRI including DWI lesion present and count within 15 days after ICH
- Neuroimaging assessment on first MRI:
  - DWI lesion presence and count
  - SVD neuroimaging markers
  - CAA

- Primary outcome:
  - Presence of DWI lesions
- Secondary outcomes:
  - SVD and CAA burden scores
  - 3-month functional outcome (mRS)
  - Recurrent cerebrovascular events within 3 months

- Statistical analysis:
  - Association of time to MRI or MRI on admission with outcomes of interest
  - Ordinal logistic and Firth penalized regressions.

Results

- We included 644 patients with MRI ≤ 15 days after the ICH (figure 1).
- DWI lesions were present in 19 (18.4%) patients with hyperacute versus 147 (27.2%) with subacute MRI (table 1).
- Time to MRI (aOR 1.06 per day, 95%-CI 1.00-1.12), but not MRI on admission was independently associated with the presence of DWI lesions (figure 2).
- Patients with DWI lesions had a higher SVD and CAA burden score (figure 3).

Diffusion-weighted imaging (DWI) lesions

Visually hyperintense lesions on DWI with or without corresponding FLAIR-hyperintensity of < 20mm diameter with ≥ 0.5cm distance from the ICH.

Figure 1: Study flowchart.

Table 1: Baseline characteristics comparing patients with hyperacute versus subacute MRI

<table>
<thead>
<tr>
<th>Subacute MRI</th>
<th>Hyperacute MRI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=541</td>
<td>N=150</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td>0.045</td>
</tr>
<tr>
<td>Sex</td>
<td>male</td>
<td>287 (53.1%)</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>253 (46.9%)</td>
</tr>
<tr>
<td>Recent small infarcts</td>
<td>147 (27.2%)</td>
<td>19 (15.4%)</td>
</tr>
<tr>
<td>Time to MRI (days)</td>
<td>2 (IQR 0-0)</td>
<td>&gt;2 (IQR 0-0)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>388 (73.4%)</td>
<td>72 (73.3%)</td>
</tr>
<tr>
<td>Alcohol intake</td>
<td>67 (13.1%)</td>
<td>14 (13.9%)</td>
</tr>
<tr>
<td>Anticoagulation on admission</td>
<td>74 (14.3%)</td>
<td>9 (11.3%)</td>
</tr>
<tr>
<td>Antplatelet on admission</td>
<td>128 (24.9%)</td>
<td>22 (27.5%)</td>
</tr>
<tr>
<td>Systolic blood pressure on admission</td>
<td>160 (140-180)</td>
<td>163 (140-180)</td>
</tr>
<tr>
<td>Diastolic blood pressure on admission</td>
<td>87 (70-100)</td>
<td>87 (71-100)</td>
</tr>
<tr>
<td>NIHSS on admission</td>
<td>5 (2-12)</td>
<td>4 (2-9)</td>
</tr>
<tr>
<td>GCS on admission</td>
<td>15 (14-15)</td>
<td>15 (14-15)</td>
</tr>
</tbody>
</table>

What this study adds

- Time to MRI was associated with the presence of DWI lesions in our study, suggesting an effect of dynamic mechanisms happening in the acute phase after ICH in addition to the chronic SVD.
- DWI lesions are independently associated with a higher SVD and CAA burden score, but not with the underlying SVD.
- Future studies should focus on investigating the longer-term clinical impact of DWI lesions.

Figure 2: Coefficient plots for associations of different covariables with presence of DWI lesions. Model A (left) included time to MRI, while Model B (right) included MRI on admission.

Figure 3: Differences in small vessel disease (left) and CAA burden scores (right) in patients with versus without DWI lesions.