Correlation of age and haematoma volume in patients with spontaneous lobar intracerebral haemorrhage

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ABSTRACT

Background Lobar intracerebral haemorrhage (LH) is gaining importance in the ageing population, but there are only limited data regarding specific clinical characteristics and risk factors of older patients with LH.

Methods This retrospective analysis of patients with spontaneous supratentorial haemorrhage included 174 consecutive patients (78 LH and 96 deep ICH (DH)). Clinical data including the preadmission status, neuroradiological findings, initial presentation, treatment and outcome were evaluated using institutional databases, patients’ medical charts and mailed questionnaires. Logistic regression analyses were calculated for initial parameters predisposing LH and for treatment and outcome parameters associated with LH.

Results Age-stratified volume analysis revealed increasing haematoma volumes for LH (≤70 years: 26.2 ml; 70–80 years: 37 ml; >80 years: 61.3 ml), whereas DH showed no relation between volume and age (≤70 years: 10.1 ml; 70–80 years: 23.2 ml; >80 years: 12.1 ml). LH patients had significantly higher HbA1c levels. Post-ICH seizures were more frequent after LH. Logistic regression analyses identified the parameters: age, haematoma volume and post-ICH seizures to be associated with LH, whereas intraventricular haemorrhage, extraventricular drainages and elevated HbA1c were related to DH.

Conclusion Haematoma volumes are substantially increasing in LH patients who are older than 70 years. Pathological HbA1c levels are significantly associated and predisposing for DH. These findings further support the ongoing debate of different disease entities for supratentorial ICH (ie, association of cerebral amyloid angiopathy and lobar ICH versus diabetes induced atherosclerosis in deep ICH). Future studies should focus on identifying specific pathological characteristics and risk factors for both bleeding sites to implement specific preventive measures, that is amyloid angiopathy modulating therapies for LH, and to avoid risk factors that are specific for each haemorrhage location.

INTRODUCTION

Spontaneous intracerebral haemorrhage (ICH) is one of the most devastating cerebrovascular diseases with a 30-day mortality up to 35–52%, and poor clinical outcome leaving only 20% of patients functionally independent (modified Rankin scale (mRS)<3) at 6 months.1 2 Generally, the incidence of ICH among first ever strokes is slightly decreasing and ranges from 10 to 15%; however the absolute amount of ICH has increased over the last 10 years, and its rate is expected to double by the year 2050.3–5 However, among ethnic populations, there are differences in incidence as well as haemorrhage location.5 Deep ICH (DH) is the most common location (36–67%), followed by lobar ICH (LH) (15–52%), cerebellar (7–11%) and brainstem haemorrhage (4–9%).5–8 Identified risk factors for all ICH are hypertension, male sex, age, alcohol abuse and other less established risk factors are smoking, diabetes, anaemia, higher fibrinogen levels, lower low-density lipoprotein and triglycerides as well as renal and hepatic insufficiency.5–9

The major consentaneous risk factor for LH is cerebral amyloid angiopathy (CAA).1 12 Incidence rates of CAA are strongly age-dependent, being only 2.3% for patients younger than 75 years of age, but 8% for 75–84-year-old patients and 12.1% for over 85-year-old patients, respectively, while post-mortem examinations of ICH patients revealed incidences as high as 23–54%.12–13 Overall, the 30-day mortality after LH ranges from 11 to 30%, and up to 57% at 1 year, with the best prognosis for patients with smaller haematoma volume and better levels of consciousness on admission.12 14 A superficial location and less intraventricular haemorrhage (IVH) has also been reported to be favourable to outcome, whereas older age of patients is less favourable.15 LH has been shown to be associated with higher rates of recurrent ICH and higher occurrence of poststroke seizures, and an increased incidence of LH in the older population has been proposed.1 4–5 16 Given these specific features and in light of the divergent risk profile, LH has been assumed to reflect a different disease entity.5

The majority of previous studies reported only on small numbers of older patients with supratentorial ICH, thus representing limited data regarding their clinical characteristics and vascular risk factors.11 Considering the growing relevance of LH in ageing populations, we compared a broad spectrum of patient characteristics including preadmission status, past medical and medication history, clinical, neuroradiological and laboratory parameters as well as treatment and functional outcome among both supratentorial haemorrhage sites. Our aim was to further specify characteristics of a lobar location of ICH in elderly patients.

METHODS

Patient selection

This retrospective study included consecutive patients with supratentorial ICH who were admitted to the neurocritical care or stroke unit of...
the Department of Neurology, University of Erlangen, from January 2007 to February 2009. The analysis was based on our institutional database into which all relevant clinical and neuroradiological data of ICH patients were included. From 236 patients with the diagnosis of ICH, we excluded posterior fossa haematomas (n=48) and, by definition, did not include patients with secondary ICH, that is ICH related to oral anticoagulant therapy, trauma, tumour, arteriovenous malformations, cerebral venous thrombosis, subarachnoid haemorrhage, or with acute thrombolyis or coagulopathy with platelet counts below 50 000/μl. Moreover, we excluded those patients who were lost to follow-up (n=14). Hence, 174 patients (78 LH and 96 DH) of central European descent remained for analysis.

Parameter acquisition
Clinical presentation
All in-hospital parameters (Glasgow Coma Scale, National Institutes of Health Stroke Scale, ICH score, body temperature and mean arterial blood pressure) were obtained by reviewing the patient’s medical charts, emergency protocols and institutional databases.

Laboratory parameters
Data were obtained by reviewing the patient’s medical charts and institutional databases. Data are presented as continuous variables. Initial on-admission data are presented.

Preadmission status and past medical history
Data of patients prior to admission were obtained by a mailed standardised questionnaire. Whenever this questionnaire was not returned within 6 weeks, a semiquantitative phone interview was conducted with patients, or their closest relatives, respectively. Telephone interviews were performed by four physicians (JJK, RS, ICK, DS) who were trained and certified for data collection on disability and quality of life. Written or oral consent was obtained from all patients or their relatives. The preadmission data consisted of: body mass index, history of cardiac event (myocardial infarction or peripheral arterial disease), history of cerebrovascular disease (stroke, transient ischemic attack), history of diabetes mellitus, alcohol abuse (defined as >80 g ethanol/day), intake of statines, diagnosis of hypercholesterolaemia, diagnosis of arterial hypertension according to established criteria, and diagnosis of diabetes mellitus.

In-hospital treatment
Parameters were obtained by reviewing the patient’s medical charts. Treatment data were: need for ventilation (in days), hospital length of stay (in days), requirement of external ventilatory drainage (EVD; for occlusive hydrocephalus), or lumbar drainages (for posthaemorrhagic communicating hydrocephalus), intraventricular fibrinolysis using rt-PA, diagnosis of pneumonia and sepsis according to established criteria.

Outcome findings
Mortality and functional outcome data were obtained by mailed questionnaires and structured phone interviews, as appropriate, as described above for predmission data. The functional outcome was assessed after 3 months and 1 year (75% by filled in questionnaires and 27% by telephone interviews) and was evaluated using the mRS. Favourable outcome was defined as mRS 0–2. Mortality was evaluated at 3 months and 12 months after ICH. Post-ICH seizures were scored if patients developed focal or generalised seizures (≥2) within 1 year after stroke.

Imaging
Diagnosis of ICH was made immediately after hospital admission by either CT (SIEMENS Somatom Volume Zoom, Erlangen, Germany) or MRI (SIEMENS Sonata, 1.5 Tesla). Two neuroradiologists (HL and SK) who were blinded to all clinical data reviewed the scans independently in randomised order. For all cases in which there was discrepancy regarding neuroradiological parameters, a second consensus analysis was made. The time from symptom onset to initial imaging was between 0 and 6 h, 86.9% of patients had initial CT, and 13.1% patients had MRI scans. All patients received follow-up imaging within 48 h. Location of haemorrhage was defined as lobar versus deep (latter including thalamic haematomas). Haematoma volume was calculated according to the formula of ellipsoids (ABC/2), IVH or subdural extensions were not taken into account for volume measurement. IVH was documented and scored using the Graeb score summation. Haematoma growth was defined as an increase in intraparenchymal haemorrhage volume >53% as measured by image analysis on follow-up CT or MRI. Midline shift was measured on initial imaging at the site of maximal deflection in millimetres.

Statistical analysis
Statistical analysis was performed with the SPSS 17.0 (SPSS, Chicago, Illinois) software package (http://www.spss.com) and Statview (SAS Institute, Cary, North Carolina) version 5.0 (http://www.jmp.com). The significance level was set at p<0.05. Statistical tests were two-sided. Data distribution was assessed with the Kolmogorov–Smirnov test. Normally distributed data are presented as mean±SD and were compared using the Student t test. Other data are presented as the median and IQR (25th–75th percentile). For all tests, p<0.05 was considered significant. Where appropriate, the Fisher exact test was used to analyse frequency distributions of categorised variables between LH and DH. The correlation of age and haematoma volume with haemorrhage location was shown graphically using the Whisker Box plot and locally weighted scatter plot smoothing with a span of 0.25–0.5 and a tension of 0.66. Regarding the parameter age, we decided a priori to dichotomise the patients into those younger than 70 years, those between 70 and 80 years and those older than 80 years. One univariate logistic regression analysis was calculated to determine parameters that were associated with LH. Two stepwise forward inclusion multivariable logistic regression models were calculated for parameters that were significant or showed a trend in the univariate analysis (p<0.1) with lobar ICH as the dependent variable. The first multivariate model was calculated with parameters that were predisposing for LH. A second multivariate regression model was calculated to identify those parameters arising not until the course of treatment that were independently related to LH.

RESULTS
The demographic, preadmission and neuroradiological characteristics of all patients are shown in table 1. The time to hospital arrival as well as the chosen imaging modality did not differ between patients with lobar and deep ICH. The clinical and laboratory findings on admission are given in table 2.

The mean age was 70.2 years (range=35–98 years). The comparison of age between lobar and deep haemorrhage revealed significant overall differences (73.8 vs 67.6 years), even more when focusing on age-stratified patients (1) ≤70 years, (2) >70 years and (3) >80 years, respectively (table 1). LH was significantly more frequent among the older age group (ie,
Table 1  Demographic, past medical history and neuroradiological characteristics

<table>
<thead>
<tr>
<th>Total lobar intracerebral haemorrhage (n = 174)</th>
<th>Lobar intracerebral haemorrhage (n = 78)</th>
<th>Deep lobar intracerebral haemorrhage (n = 96)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean±SD)</td>
<td>73.8±10.7</td>
<td>67.6±11.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age&lt;70</td>
<td>26 (33.3%)</td>
<td>57 (59.4%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Age&gt;70</td>
<td>52 (66.7%)</td>
<td>39 (40.6%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age&gt;80</td>
<td>22 (28.2%)</td>
<td>12 (12.5%)</td>
<td>0.012</td>
</tr>
<tr>
<td>Female</td>
<td>37 (47.4%)</td>
<td>48 (50.0%)</td>
<td>0.762</td>
</tr>
<tr>
<td>Prior admission status and past medical history</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (mean±SD)</td>
<td>26.1±5.1</td>
<td>27.4±5.7</td>
<td>0.132</td>
</tr>
<tr>
<td>HTN</td>
<td>54 (65.4%)</td>
<td>72 (75.0%)</td>
<td>0.396</td>
</tr>
<tr>
<td>Hypercholesterolaemia</td>
<td>29 (37.1%)</td>
<td>26 (27.1%)</td>
<td>0.190</td>
</tr>
<tr>
<td>Diabetes</td>
<td>14 (17.9%)</td>
<td>16 (16.6%)</td>
<td>0.574</td>
</tr>
<tr>
<td>Haemorrhagic stroke</td>
<td>18 (23.1%)</td>
<td>13 (13.5%)</td>
<td>0.076</td>
</tr>
<tr>
<td>Haemorrhagic stroke</td>
<td>17 (22.1%)</td>
<td>2 (2.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cardiac event</td>
<td>8 (10.3%)</td>
<td>7 (7.3%)</td>
<td>0.335</td>
</tr>
<tr>
<td>Aspirin use</td>
<td>31 (39.7%)</td>
<td>32 (33.3%)</td>
<td>0.380</td>
</tr>
<tr>
<td>Statine use</td>
<td>21 (26.9%)</td>
<td>19 (19.8%)</td>
<td>0.265</td>
</tr>
<tr>
<td>Alcohol abuse</td>
<td>26 (33.3%)</td>
<td>36 (37.5%)</td>
<td>0.566</td>
</tr>
<tr>
<td>Smoking</td>
<td>30 (38.5%)</td>
<td>39 (38.9%)</td>
<td>0.887</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>4 (5.1%)</td>
<td>1 (1.2%)</td>
<td>0.207</td>
</tr>
</tbody>
</table>

Neuroradiological data

<table>
<thead>
<tr>
<th>Total lobar intracerebral haemorrhage (n = 174)</th>
<th>Lobar intracerebral haemorrhage (n = 78)</th>
<th>Deep lobar intracerebral haemorrhage (n = 96)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesion volume (cm³) (median, IQR)</td>
<td>42.7 (16.1 to 72.1)</td>
<td>11.9 (3.1 to 37.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Volume for age&lt;70 years (cm³) (median, IQR)</td>
<td>26.2 (9.1 to 58.6)</td>
<td>10.1 (3.1 to 26.9)</td>
<td>0.028</td>
</tr>
<tr>
<td>Volume for age&gt;70 years (cm³) (median, IQR)</td>
<td>37.0 (17.6 to 86.7)</td>
<td>23.2 (4.7 to 49.6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Volume for age&gt;80 years (cm³) (median, IQR)</td>
<td>61.3 (30.1 to 106.3)</td>
<td>12.1 (2.9 to 30.1)</td>
<td>0.008</td>
</tr>
<tr>
<td>Left hemisphere</td>
<td>46 (59.0%)</td>
<td>49 (51.1%)</td>
<td>0.296</td>
</tr>
<tr>
<td>Intraventricular haemorrhage</td>
<td>26 (30.9%)</td>
<td>58 (69.0%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Graeb score (median, IQR)</td>
<td>0 (0 to 2)</td>
<td>3 (0 to 10)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Haematoma growth</td>
<td>8 (10.3%)</td>
<td>10 (10.4%)</td>
<td>0.999</td>
</tr>
<tr>
<td>Midline shift (mm) (median, IQR)</td>
<td>0 (0 to 6.8)</td>
<td>2 (0 to 7.3)</td>
<td>0.288</td>
</tr>
</tbody>
</table>

Significant parameters are shown in bold.

>70 years, LH (n=52), DH (n=39); p<0.001. Lesion volume was significantly higher in LH than in DH (42.7 vs 11.9 ml). The correlation of age, volume and lesion site is shown in figure 1 and displays a substantial volume increase for LH patients with a take-off at >70 years. In contrast, DH patients showed no correlation of volume and age. A history of prior haemorrhagic stroke was significantly more often with LH. IVH, as well as the Graeb score, was significantly higher and more frequent in DH (p<0.001).

Significant laboratory findings in LH patients were higher high-density lipoprotein values (p=0.045) as well as lower HbA1c levels (p=0.042). Given the significance of HbA1c, a dichotomised analysis revealed significantly fewer patients with a pathologically elevated HbA1c (ie, >6.5%; LH (9/78), versus DH (31/96), p<0.01).

Treatment procedures and outcome findings are given in table 3. LH patients required neurocritical care for a significantly shorter period of time (p=0.046) and were less frequently mechanically ventilated (p=0.015). As shown in table 1, patients with LH suffered less often from IVH and thus rarely required placement of an EVD (p<0.001). In this regard, DH patients required intraventricular fibrinolysis more often (p<0.001) as well as lumbar drainage placement (p<0.001). Moreover, complications such as pneumonia and sepsis were more commonly appreciated with DH (p=0.049 and p=0.024). Mortalities and functional outcome measures revealed no significant differences among both groups. The only outcome difference for LH was the development of post-ICH seizures (p=0.026).

The univariate associations of significant parameters or those showing a trend with LH are listed in table 4. The multivariate logistic regression models are shown in table 5. With respect to preadmission status and initial presentation, the parameters (1) age and (2) haematoma volume were independently predisposing for LH, whereas (3) presence of IVH and (4) elevated HbA1c levels were inversely correlated (table 5A). Regarding the regression analysis for treatment and outcome, the incidence of post-ICH seizures was independently related to LH, whereas requirement of an EVD was inversely associated (table 5B).

DISCUSSION

In the present study, we compared clinical, neuroradiological and laboratory parameters of patients with supratentorial haemorrhage to identify specific parameters that were independently related to LH. The key findings of LH were: (1) increasing age resulted in an increase in haematoma volume, and (2) pathologically elevated levels of HbA1c were less common. Moreover, (3) the frequency of IVH with consecutive need of EVD was lower, and (4) the rate of post-ICH seizures was higher in patients with LH. The following aspects emerged from the data.

The present study discovered a previously unnoticed age—volume correlation in LH. Each parameter, older age and greater haematoma volume, has been separately described to be...
independently associated with LH. However, there were only limited data on the exact correlation of these factors with various patient characteristics, radiological features and outcome. With respect to increasing haematoma volumes in older LH patients, one has to refer to CAA, as the strongest age-dependent risk factor for LH. CAA is defined by the deposition of β-amyloid protein in the media and adventitia of vessels of the cortex and leptomeninges. Therefore, the finding of larger haematoma volumes in older patients with LH could be based on greater vascular fragility because of a higher prevalence of severe angiopathy with fibrinoid necrosis. In addition, a more pronounced parenchymal atrophy of the cerebral lobes, with less consecutive tamponade effect of the haematoma itself and hence greater volumes, might also be attributable in elderly patients. We could not find any significant differences for other factors influencing volume, such as the use of aggregation inhibition, hepatic dysfunction, coagulation parameters or prevalence of hypertension among DH and LH. With respect to hypertension as the strongest independent risk factor for ICH, we were not able to elucidate any relationship with LH, neither a different prevalence, nor greater haematoma volumes, nor more frequent haematoma growth on control scans. Therefore, the findings presented here may support the idea of previous studies that arterial hypertension should be considered as a secondary side finding in older LH patients, and not as a primary causative factor for LH. If correct, in line with the hypothesis of different disease entities as the primary cause for DH and LH, this can be prospectively tested in the future.

This aspect of different disease entities seems also to be supported by the finding of significantly elevated HbA1c levels in DH patients. Evaluation of other previously noted cerebrovascular risk factors did not reveal any differences among our patient cohort. Special attention should be given to HbA1c as a diagnostic and surveillance marker. As glycosylated haemoglobin can be considered a widely accepted parameter for the assessment of an atherosclerotic risk profile, its
These studies, LH was strongly associated with the occurrence of seizures. However, haematoma volume was not associated with an increased frequency of seizures in our series (data not shown). Interestingly, patients who received EVD placement did not reveal an increased rate of seizures as compared with patients without EVD, irrespective of haematoma site. Although based elevation may also be relevant as a driving cofactor for DH. Given the difficulty in assessing the prior history of longstanding diabetes and compliant drug-taking behaviour, and in light of diabetes as an already proposed weak risk factor for ICH in general, patients with elevated HbA1c levels should be screened for further atherosclerotic progression and risk factors that are predisposing for DH to optimise primary prevention of ICH.

IVH in supratentorial haemorrhage occurs more frequently with larger haematoma volumes and is influenced by haemorrhage location, as the basal ganglia and thalamus are located more closely to the ventricular system. In line with these studies, IVH was also less frequently associated with LH in our series, thus resulting in fewer placements of EVD, LD and use of intraventricular fibrinolyis. IVH has previously been shown to be related to a higher mortality and poorer functional outcome; however, given the finding in LH with fewer IVH, we could not show any significant outcome differences between patients with DH and LH. This may be based on the older mean age of LH patients and potentially more comorbidities and larger haematoma volumes in LH. Hence, it appears plausible that those two predictors (IVH and volume) were counterbalancing functional outcome of LH versus DH. Additionally, patients with IVH received an aggressive treatment regimen including EVD, intraventricular fibrinolyis and lumbar drainages, which also could have contributed to an equivalent mortality and functional outcome after supratentorial haemorrhage. Regarding the development of seizures after spontaneous ICH, the reported incidences range between 2.8 and 18.7%, and predictors for their development are cortical involvement, subdural haematoma and haematoma volume. In line with these studies, LH was strongly associated with the occurrence of seizures. However, haematoma volume was not associated with an increased frequency of seizures in our series (data not shown). Interestingly, patients who received EVD placement did not reveal an increased rate of seizures as compared with patients without EVD, irrespective of haematoma site. Although based elevation may also be relevant as a driving cofactor for DH. Given the difficulty in assessing the prior history of longstanding diabetes and compliant drug-taking behaviour, and in light of diabetes as an already proposed weak risk factor for ICH in general, patients with elevated HbA1c levels should be screened for further atherosclerotic progression and risk factors that are predisposing for DH to optimise primary prevention of ICH.

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IVH in supratentorial haemorrhage occurs more frequently with larger haematoma volumes and is influenced by haemorrhage location, as the basal ganglia and thalamus are located more closely to the ventricular system. In line with these studies, IVH was also less frequently associated with LH in our series, thus resulting in fewer placements of EVD, LD and use of intraventricular fibrinolyis. IVH has previously been shown to be related to a higher mortality and poorer functional outcome; however, given the finding in LH with fewer IVH, we could not show any significant outcome differences between patients with DH and LH. This may be based on the older mean age of LH patients and potentially more comorbidities and larger haematoma volumes in LH. Hence, it appears plausible that those two predictors (IVH and volume) were counterbalancing functional outcome of LH versus DH. Additionally, patients with IVH received an aggressive treatment regimen including EVD, intraventricular fibrinolyis and lumbar drainages, which also could have contributed to an equivalent mortality and functional outcome after supratentorial haemorrhage. Regarding the development of seizures after spontaneous ICH, the reported incidences range between 2.8 and 18.7%, and predictors for their development are cortical involvement, subdural haematoma and haematoma volume. In line with these studies, LH was strongly associated with the occurrence of seizures. However, haematoma volume was not associated with an increased frequency of seizures in our series (data not shown). Interestingly, patients who received EVD placement did not reveal an increased rate of seizures as compared with patients without EVD, irrespective of haematoma site. Although based elevation may also be relevant as a driving cofactor for DH. Given the difficulty in assessing the prior history of longstanding diabetes and compliant drug-taking behaviour, and in light of diabetes as an already proposed weak risk factor for ICH in general, patients with elevated HbA1c levels should be screened for further atherosclerotic progression and risk factors that are predisposing for DH to optimise primary prevention of ICH.
on a small number of patients who received an EVD (n=45), this finding could indicate that cortical trauma caused by an EVD may not lead to a decreased seizure threshold. Furthermore, we did not detect outcome differences among patients with and without post-ICH seizures.4 30 37

Our study has certain limitations. First, due to the nature of this retrospective, single-centre investigation, the patient number of n=174 appears rather small to draw definite conclusions on patient characteristics. Second, no ‘gold standard’ test for CAA such as autopsy was applied to all subjects. Third, confirmation of the duration of diabetes, arterial hypertension and the extent of subsequent atherosclerosis in brain and whole body was not evaluated. Fourth, the impact of exclusion of both posterior fossa bleedings and ICH related to oral anticoagulants on the findings is unknown. Fifth, the mailed questionnaire was filled out by patients, their relatives or legal attorneys, and may have been answered wrongly with respect to the time point of follow-up and the validity of mRS estimation.36 Sixth, as we did not focus on first ever ICH only, but included patients with recurrent ICH, this selection bias might have impacted haematoam volume at presentation as well as functional outcome. Seventh, the results may have been biased by 14 patients who were lost to follow-up.

Concluding the findings of our study, we identified a highly significant age—volume correlation in an older patient with LH only, whereas pathologically elevated HbA1c levels were attributable to basal ganglia and thalamus bleedings. In light of the tremendous disease burden of ICH and its growing relevance in the ageing population, future studies should focus on (1) establishing novel CAA-modulating treatment strategies and (2) further attempts to definitively classify LH (as amyloid-angiopathic disease) and DH (as atherosclerotic disease). If this classification proves correct, then treating these two supratentorial haemorrhage locations more specifically with respect to different risk factors and patient characteristics could be very important.

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