Persistent Cognitive Impairment After Transient Ischemic Attack

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Background and Purpose—By definition, the symptoms of a transient ischemic attack (TIA) subside completely within 24 hours. Imaging studies show signs of persistent ischemic tissue damage in a substantial amount of patients with TIA. Cerebral infarction can cause permanent cognitive impairment. Whether permanent cognitive impairment occurs after TIA is unclear, as is its profile.

Methods—Patients with TIA aged 45 to 65 years without prior stroke or dementia underwent comprehensive neuropsychological testing within 3 months. Z scores per cognitive domain were obtained, based on the mean of a control group within the same age range. Cognitive impairment was defined as a domain z score ≤−1.65. Patients underwent either computed tomography or MRI brain imaging.

Results—One hundred seven patients with TIA (63% women, mean age, 56.6 years) were included and compared with 81 controls (56% women, mean age, 52.9 years). Patients performed worse on all cognitive domains except episodic memory. Working memory (25%), attention (22%), and information processing speed (16%) were most frequently impaired and more often than in the control group (age- and sex-adjusted odds ratios, respectively, 22.5 [95% confidence interval, 2.9–174.3], 6.8 [1.9–24.3], 7.1 [1.5–32.5]). More than 35% of patients with TIA had impairment of ≥1 cognitive domain. Presence of silent brain infarcts was related to worse executive functioning but did not explain the whole relationship between TIA and cognitive impairment.

Conclusions—More than a third of patients with TIA have impairment of ≥1 cognitive domain within 3 months after their TIA. The affected domains fit in the vascular cognitive impairment profile. (Stroke. 2014;45:00-00.)

Key Words: cognition ■ ischemic attack, transient
neuropsychological assessment was performed within 3 months after the qualifying event. The number of available slots for these assessments was restricted. However, no selection for neuropsychological assessments was used.

TIA was defined as a sudden onset focal neurological deficit of vascular origin with complete resolution of focal symptoms within 24 hours. Patients with prior stroke or dementia were excluded, whereas those with prior TIA were not. In addition, patients with incident stroke or carotid endarterectomy between TIA and cognitive testing were excluded as were those with a Mini-Mental State Examination score <24 because this was considered indicative for possible pre-existing dementia and would prevent a reliable cognitive assessment. All data were acquired as part of clinical care, and both storage and processing were conducted anonymously in agreement with the local ethical committee rules.

Control Group

Patients' performances on all individual tests were compared with a control group, recruited among spouses, relatives, or social environment of patients attending our outpatient department. All participants were free from TIA, and the same exclusion criteria as for patients were applied. The stroke-free status was verified through a standardized, structured questionnaire. When a possible cerebrovascular event was reported, the general practitioner was contacted for additional information. Only for the California Verbal Learning Test, performance was not compared with the control group but with a normative sample described in the test manual (n=164, age, 45–64 years). None of the subjects in the normative sample had a history of psychiatric or neurological disease.

Clinical Characteristics

Hypertension was considered present when (1) systolic blood pressure was >140 mmHg and diastolic blood pressure was >90 mmHg at both time of presentation and at 90-day follow-up, (2) antihypertensive medication was used, or (3) a previous diagnosis by a physician was recorded. Hypercholesterolemia was considered present when (1) fasting total cholesterol level was >6.5 mmol/L, (2) lipid-lowering drugs were used, or (3) a physician had previously made the diagnosis. Diabetes mellitus was defined as (1) the use of antidiabetic medication or (2) a previous diagnosis by a physician. Smoking status was determined current when a patient smoked or had stopped within the past 6 months and former when smoking was stopped earlier. Any prior myocardial infarction was noted, and the body mass index was calculated.

Brain Imaging

Brain imaging, either computed tomography or MRI, performed within 3 weeks after the qualifying event was evaluated for the presence and severity of age-related white matter changes (ARWMC) using a semiquantitative scale, as well as the presence of silent brain infarct (SBI). SBI was defined as an infarct on computed tomography or MRI at a location that did not correspond with the symptoms of the qualifying or any previous TIA and was classified as lacunar or nonlacunar. Two experienced raters (F.G.v.R. and E.J.v.D.) separately performed assessment of brain imaging. In case of disagreement, a consensus meeting was held.

Neuropsychological Assessment

A trained examiner administered the neuropsychological tests in a quiet, well-lit room and under standard circumstances. Executive functioning was assessed with a verbal fluency task (naming as many animals as possible within 60 seconds; response generation) and the interference score of the Abbreviated Stroop Color Word Test (response inhibition). Information processing speed was tested with cards I and II of the Abbreviated Stroop Color Word Test and the Symbol-Digit Modalities Test. The Paper and Pencil Memory Scanning Test (4 subtasks) was used to measure working memory, and attention was evaluated by the Verbal Series Attention Test. Finally, verbal episodic memory was tested with the Dutch version of the California Verbal Learning Test, using both the total correct answers of 5 immediate recall trials and the difference between trial 5 and long-term recall (consolidation). For tests requiring both speed and precision, a speed accuracy trade-off score was calculated by dividing the percentage of correct answers by the time taken to complete the test. This applied to the Verbal Series Attention Test, cards I and II of the Stroop Color Word Test, and all subtasks of the Paper and Pencil Memory Scanning Test. The Stroop interference score was computed by dividing the speed accuracy trade-off score of card III by the mean of the speed accuracy trade-off scores of cards I and II.

Subjective Cognitive Failures

In addition, a 15-item semistructured interview based on the Cognitive Failures Questionnaire was administered to identify subjective cognitive failures (SCF) experienced the month before. Responses were added to provide a sum score with a maximum of 25. SCF reported in remembering, word finding, planning, concentration, and slowness in thought were given a higher weight in the sum scores (range 0–3: none, mild, moderate, severe) than the other items (0–1). If ≥1 moderate problem (score ≥2) on an item with a score range of 0 to 3 or a score of 1 on a dichotomous item was reported, SCF was considered present.

Other Measurements

Age, sex, and level of education were recorded. The presence of depressive symptoms was defined as a Hospital Anxiety and Depression Scale depression subscale score ≥8.

Statistical Analysis

All analyses were done with IBM SPSS Statistics version 20.0 (IBM Corp, Armonk, NY). Differences in characteristics between patients and controls were compared using Student t test, Pearson χ², and age- and sex-adjusted ANCOVA when appropriate. Bonferroni correction for multiple testing was applied with α set at 0.01.

Individual z scores were computed for each neuropsychological test using the mean and SD of the control group, and domain z scores were calculated by averaging z scores of individual tests. Per cognitive domain, a z score ≥1.65 of the control group was used as a cutoff to determine domain-specific impairment (ie, corresponding to a performance below the lower fifth percentile). Domain-specific age- and sex-adjusted odds ratios (OR) of cognitive impairment after TIA were obtained by logistic regression. No OR of episodic memory impairment was calculated because California Verbal Learning Test results were not compared with the same control group.

In case of missing neuropsychological test results (maximum 12.2%), the domain score was based on the remaining tests, or if no tests were performed within a cognitive domain, the domain z score was not used in further analyses.

Results

Between September 2004 and December 2010, 246 patients with TIA aged 45 to 65 years were registered, of whom 114 underwent neuropsychological testing within 3 months after the qualifying event (mean [SD], 56 [14.7] days; range, 26–91 days). Patients with and without neuropsychological assessment did not differ on age and sex (Student t test and Pearson χ², P=0.92 and 0.43, respectively). Subsequently, 5 patients were excluded because of a history of stroke and 2 because of a Mini-Mental State Examination score <24. Characteristics of included patients (n=107) are summarized in Table 1. The control group included 81 individuals. No differences were
Table 1. Characteristics of Patients With TIA and Controls

<table>
<thead>
<tr>
<th></th>
<th>Patients With TIA (n=107)</th>
<th>Controls (n=81)</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>67 (62.6)</td>
<td>45 (55.6)</td>
<td>0.41</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>56.6 (6.3)</td>
<td>52.9 (6.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Low level of education</td>
<td>28 (26.2)</td>
<td>17 (21.0)</td>
<td>0.52</td>
</tr>
<tr>
<td>HADS-D, mean (SD)</td>
<td>3.2 (3.9)</td>
<td>2.6 (2.7)</td>
<td>0.22</td>
</tr>
<tr>
<td>HADS-D score ≥8</td>
<td>13 (12.1)</td>
<td>6 (7.4)</td>
<td>0.35</td>
</tr>
<tr>
<td>Body mass index, mean (SD)</td>
<td>26.8 (4.0)</td>
<td>27.4 (4.9)</td>
<td>0.36</td>
</tr>
<tr>
<td>Hypertension</td>
<td>52 (48.6)</td>
<td>27 (33.3)</td>
<td>0.05</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>31 (29.0)</td>
<td>15 (18.5)</td>
<td>0.14</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>5 (4.7)</td>
<td>1 (1.2)</td>
<td>0.36</td>
</tr>
<tr>
<td>Prior myocardial infarction</td>
<td>8 (7.5)</td>
<td>1 (1.2)</td>
<td>0.10</td>
</tr>
<tr>
<td>Smoking status</td>
<td>Current 19 (17.8)</td>
<td>22 (27.2)</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>Former 53 (49.5)</td>
<td>35 (43.2)</td>
<td></td>
</tr>
<tr>
<td>ARWMC score, median (IQR)</td>
<td>1 (3)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Silent brain infarct</td>
<td>18 (18.2)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>17 (15.9)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Lacunar</td>
<td>14 (13.1)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>DWI lesion (only MRI)</td>
<td>16 (27.1)</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

Numbers are n (%) unless stated otherwise. ARWMC indicates age-related white matter changes; DWI, diffusion-weighted imaging; HADS-D, Hospital Anxiety and Depression Scale; IQR, interquartile range; N/A, not applicable; and TIA, transient ischemic attack.

*Difference using Student t test and Pearson χ² (continuity correction) when appropriate.

Table 2. Mean Difference in Z Scores per Cognitive Domain and Cognitive Test Between Patients With TIA (n=107) and Controls (n=81)

<table>
<thead>
<tr>
<th>Cognitive Test and Domain</th>
<th>Difference in Z Score, Mean</th>
<th>P Value*</th>
<th>% Impaired†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive function</td>
<td>−0.59</td>
<td>&lt;0.001</td>
<td>10.3</td>
</tr>
<tr>
<td>Verbal fluency</td>
<td>−0.69</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Stroop interference task</td>
<td>−0.48</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Information processing speed</td>
<td>−0.66</td>
<td>&lt;0.001</td>
<td>16.1</td>
</tr>
<tr>
<td>Stroop task 1</td>
<td>−0.64</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Stroop task 2</td>
<td>−0.74</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>SDMT</td>
<td>−0.55</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Working memory</td>
<td>−0.87</td>
<td>&lt;0.001</td>
<td>24.5</td>
</tr>
<tr>
<td>PPMST %</td>
<td>−1.47</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>PPMST 1 letter</td>
<td>−0.80</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>PPMST 2 letters</td>
<td>−0.68</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>PPMST 3 letters</td>
<td>−0.55</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Attention</td>
<td>−0.51</td>
<td>0.01</td>
<td>21.7</td>
</tr>
<tr>
<td>VSAT</td>
<td>−0.51</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Episodic memory</td>
<td>0.01†</td>
<td>0.96</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Percentage of patients with domain-specific cognitive impairment. CVLT indicates California Verbal Learning Test; PPMST, Paper and Pencil Memory Scanning Test; SDMT, Symbol-Digit Modalities Test; TIA, transient ischemic attack; and VSAT, Verbal Series Attention Test.

All Patients With TIA performed worse than controls on each individual cognitive test and all cognitive domains, except episodic memory (Table 2). The highest impairment rates were present in the domains of working memory and attention, whereas episodic memory was relatively preserved. Age- and sex-adjusted ORs for domain-specific cognitive impairment after TIA ranged from 3.5 (executive function, 95% confidence interval, 0.7–16.7) to 22.5 (working memory, 95% confidence interval, 2.9–174.3). Impairment ≥1 cognitive domain (excluding episodic memory) was present in 38.3% of patients with TIA, with an associated age- and sex-adjusted OR of 5.9 (95% confidence interval, 2.4–14.5; Table 3).

Brain imaging was performed within 3 weeks after the qualifying event in 99 patients with TIA (59% MRI). Within the patient group, SBI, but not ARWMC, was associated with worse executive functioning (Table 1 in the online-only Data Supplement). SBI were almost exclusively single lacunar infarcts (4 nonlacunar infarcts, 3 of which were subcortical). Patients with TIA with signs of cytotoxic edema on diffusion-weighted imaging were not more frequently impaired (age- and sex-adjusted OR for any domain-specific cognitive impairment 0.7 [95% confidence interval, 0.3–2.0]). After excluding patients with SBI, TIA was still associated with impairment of cognition within 3 months (Table 3).

We found no difference between patients and controls with respect to mean Cognitive Failures Questionnaire sum score. SCF were reported by 59% of patients with TIA, which did not differ from the control group. SCF were associated with lower z scores in all cognitive domains for patients with TIA (age- and sex-adjusted ANCOVA; P<0.01).

Table 3. Odds Ratios for Cognitive Impairment Within 3 Months After TIA Compared With Controls Without TIA (n=81)

<table>
<thead>
<tr>
<th>Cognitive Domain</th>
<th>All Patients With TIA (n=107)</th>
<th>Patients With TIA Without SBI Only (n=89)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Impairment, OR (95% CI)*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cognitive impairment defined as domain z score <−1.65. CI indicates confidence interval; OR, odds ratio; SBI, silent brain infarct; and TIA, transient ischemic attack.

*Age- and sex-adjusted logistic regression; †P<0.01; ‡P<0.001.
Discussion

The main findings of our study are that (1) more than a third of patients aged 45 to 65 years who had a TIA in the previous 3 months has impairment of function in ≥1 cognitive domain, (2) working memory, attention, and information processing speed are the most affected cognitive domains, whereas global memory functions remain relatively intact, (3) this cognitive impairment is only partly related to cerebrovascular damage on conventional neuroimaging, and (4) subjective cognitive complaints are not more frequently reported by patients with TIA than by healthy individuals.

This study was not without limitations. Given the cross-sectional design of the study without information on cognitive performance before the qualifying event, neither definite causal relations between cognitive function and TIA nor its time course could be established. Not all patients with TIA seen during the study period underwent cognitive assessment because of restricted availability of slots. To prevent selection bias, patients were assigned to cognitive assessment irrespective of clinical data. Furthermore, California Verbal Learning Test was not performed in the control group, and patients’ results for this test were compared with normative data derived from a different age-adjusted reference group published in the test manual. Although this prevented calculation of ORs for overall cognitive impairment, the composition of the cognitive profile of patients with TIA separately could be described. In addition, not all patients completed the neuropsychological test battery. By computing a domain-specific compound z score based on less than all associated tests when necessary and by not using missing values in further analyses, we might have reduced statistical power of our results. Despite swift analysis after referral, patient delay caused initial brain imaging to take place ≤3 weeks after the qualifying event, which could have influenced diffusion-weighted imaging lesion prevalence.25 Also, controls were on average slightly younger than the patients. However, they were all from the same relatively narrow age range, and although statistically significant, the mean difference was small and analyses were adjusted for differences in age. Therefore, we think that this potential factor has been adequately accounted for and cannot entirely explain our findings. Finally, to reduce the influence of concomitant cognitive disorders, we excluded older patients and those with low Mini-Mental State Examination performance. This limits the generalizability of our results to the whole TIA population and might have excluded representatives of the more severe spectrum of cognitive impairment after TIA.

Previous data on cognitive function after TIA are scarce and heterogeneous.7,11,26 Patient characteristics, definition of cognitive impairment, and delay from TIA to assessment of cognition differ widely between studies. Furthermore, cognitive assessment is mostly limited to screening tools such as Mini-Mental State Examination and Montreal Cognitive Assessment, which are not sensitive to mild cognitive deficits after stroke and do not assess specific cognitive domains.27,28 Previously reported prevalence of cognitive impairment after TIA varies from 30% to 57%.7,9,10 Compared with our study, these studies included substantially older patients, performed cognitive assessment much later after TIA, and did not exclude patients with previous stroke. In contrast, we aimed to minimize the effect of possible concomitant causes of cognitive impairment by performing cognitive testing within 3 months after the qualifying event in patients aged <65 years and excluding those with a history of stroke. Despite our rigorous measures to minimize the effects of neurodegenerative or previous vascular cognitive disorders, we found a prevalence of 38% of cognitive impairment in a relative young cohort of patients with a recent TIA.

The cognitive profile after TIA showed prominent impairment in the domains of working memory, attention, and information processing speed, whereas global memory functions remained within normal ranges. This nonamnestic cognitive impairment is compatible with the vascular cognitive impairment profile and mainly driven by subcortical brain damage disrupting subcortical–frontal connections.29 Only a few studies have previously described the cognitive profile of patients with TIA and found prominent deficits in executive functioning, visuoconstruction, and attention.7,9,10 However, one of these studies included only patients with internal carotid artery occlusion and did not exclude patients with prior stroke, whereas the others performed Montreal Cognitive Assessment instead of a more comprehensive neuropsychological evaluation.

Presence of SBI was related only to worse executive functioning, whereas ARWMC were not related to any cognitive impairment after TIA. Because of limited numbers, we were unable to assess the relationship of different types of SBI with cognitive function. The prevalence of SBI and the severity of ARWMC were low compared with population based studies, probably related to our relatively young study population.15,30 Both SBI and ARWMC are markers for cerebral small vessel disease, indicating that in our study population the role of small vessel disease in cognitive impairment after TIA seems limited. This is further strengthened by the robust association of TIA with cognitive impairment after excluding patients with SBI. The influence of concomitant neurodegeneration on cognitive function was minimized through a rigorous age restriction. This suggests a role for TIA itself in cognitive impairment afterward, the mechanism of which remains to be elucidated. Transient ischemia might lead to microstructural damage and loss of white matter structural integrity, giving rise to subcortical–frontal disconnection in a similar fashion as the vascular cognitive impairment construct. Verification of this potential pathway was not possible in our study because imaging modalities assessing the structural integrity of white matter were not performed.

In contrast to the high prevalence of objective cognitive dysfunction, patients with TIA did not report more SCF than controls. The prevalence of SCF among patients with TIA is remarkably lower than in elderly persons with white matter lesions and is comparable to the one study that previously reported cognitive complaints in patients with TIA.31,32 However, those results were not separately reported for TIA and minor stroke patients, and assessment of SCF was limited. The discrepancy between prevalence of objective and subjective cognitive dysfunction in TIA might mean that only relatively minor difficulties in everyday life are perceived. Still,
because patients with TIA in our study were relatively young, a large proportion would still be working and be socially active. Even minor cognitive decline might, therefore, have impact.

The causes of cognitive impairment after TIA remain unknown. Future studies should include advanced brain imaging techniques to identify microstructural and functional cerebrovascular damage and perform longitudinal assessment of cognitive function after TIA to observe whether cognitive impairment is transient, stationary, or progresses over time. Nevertheless, our results show the extent of cognitive impairment after TIA in relatively young adults and warrant the need for more clinical awareness of this condition.

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Disclosures
None.

References
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SUPPLEMENTAL MATERIAL

Persistent cognitive impairment after transient ischemic attack

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Short title: Persistent cognitive impairment after TIA

Key words: Transient ischemic attack, cognition, vascular cognitive impairment

Supplementary Table I. Associations of silent brain infarct and age-related white matter changes with cognitive impairment within three months after TIA.

<table>
<thead>
<tr>
<th>Cognitive domain</th>
<th>SBI (yes/no)</th>
<th>ARWMC (per 1 point increase)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive function</td>
<td>10.7 (2.5-44.8)†</td>
<td>1.0 (0.8-1.3)</td>
</tr>
<tr>
<td>Information processing speed</td>
<td>4.8 (1.3-17.5)</td>
<td>0.7 (0.5-1.0)</td>
</tr>
<tr>
<td>Working memory</td>
<td>3.5 (1.0-11.9)</td>
<td>0.7 (0.5-1.0)</td>
</tr>
<tr>
<td>Attention</td>
<td>3.4 (1.0-11.4)</td>
<td>0.8 (0.6-1.0)</td>
</tr>
<tr>
<td>≥1 cognitive domain</td>
<td>2.4 (0.8-7.2)</td>
<td>0.8 (0.7-1.0)</td>
</tr>
</tbody>
</table>

Cognitive impairment defined as z-score < -1.65.

*age- and sex-adjusted logistic regression; †p-value < 0.01.

OR Indicates odds ratio; CI, confidence interval; SBI, silent brain infarct; ARWMC, age-related white matter changes.

References:

TIA 后持续性认知功能障碍
 Persistent Cognitive Impairment After Transient Ischemic Attack

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方法

目的

为减轻老年化认知缺损的偏移影响，研究对象限制在 45 到 65 岁之间。导致的相关认知缺损混淆。另外，短暂性脑缺血引起的认知障碍特征可能是由于 TIA 导致的潜在的认知功能损害。我们研究了短暂性脑缺血发作的临床特征以及其与认知功能障碍的关系。

结果

结果表明，超过 30% 的短暂性缺血发作患者仍不能完全解释 TIA 与认知功能障碍的关系。

结论:

通过弥散加权成像技术，研究发现细胞毒性脑水肿的影像学征象症状超出 30% 的短暂性脑缺血发作组。而脑白质改变症状较多，但仍然与认知障碍相关。

数据处理

所有数据都通过 IBM SPSS 数据 20.0 版处理 (IBM 公司, 阿蒙克, 纽约)。TIA 组和对照组比较采用单因素方差分析，当 p 值<0.05 时认为具有统计学意义；当年龄和性别校正 AGE 值进行比较。运用 Bonferroni 多重测验校正 p 值；RI 计算为中等，95% CI,1.9–24.3；RI 计算为大，95% CI,7.1–32.5。≥ 1 个认知领域(不包括情境记忆)损伤的短暂性脑缺血发作患者有 38.3% 的认知功能损伤，年龄和性别校正后的 OR 值为 5.9 (95% CI, 2.4–14.5)。表 3, 90 天短暂性脑缺血发作患者在短期和长期中没有显著不同。所有认知领域中，认知功能障碍和短暂性脑缺血发作在 3 周内仍然与认知功能障碍相关。

我们发现 TIA 患者对测试问题的反应时间较短，脑功能受损的严重程度与短暂性脑缺血发作的关系仍然与认知功能障碍和短暂性脑缺血发作在 3 周内仍然与认知功能障碍相关。

结论

在短暂性脑缺血发作后，TIA 患者的认知功能障碍显著降低。执行功能、注意力、信息处理速度、工作记忆力和言语流畅性领域影响发展。

表 1 TIA 组及对照组的临床特征

<table>
<thead>
<tr>
<th>临床特征</th>
<th>TIA 组</th>
<th>对照组</th>
</tr>
</thead>
<tbody>
<tr>
<td>年龄 (n=107)</td>
<td>56.6 (3.2)</td>
<td>60.6 (3.3)</td>
</tr>
<tr>
<td>性别</td>
<td>女性</td>
<td>50 (47.2)</td>
</tr>
<tr>
<td>数量</td>
<td>50 (47.2)</td>
<td>51 (47.7)</td>
</tr>
<tr>
<td>平均</td>
<td>56.6 (3.2)</td>
<td>60.6 (3.3)</td>
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**Blood Pressure Variability on Antihypertensive Therapy in Acute Intracerebral Hemorrhage**

**The Stroke Acute Management With Urgent Risk-Factor Assessment and Improvement-Intracerebral Hemorrhage Study**

**Background:**
- Previous studies have shown that blood pressure (BP) variability during the acute phase of intracerebral hemorrhage (ICH) can be a predictor of clinical outcomes, including blood volume expansion and 3-month poor outcome.

**Objective:**
To evaluate BP variability and its clinical outcomes in patients with ICH.

**Methods:**
- A total of 238 patients with ICH were enrolled from 21 tertiary hospitals in China.
- The primary endpoint was 3-month clinical outcome, which was defined using The modified Rankin Scale.
- BP variability was assessed as systolic blood pressure (SBP) and diastolic blood pressure (DBP) variability over 24 hours, defined as the standard deviation (SD) of SBP and DBP.

**Results:**
- The mean age of the study population was 62 years, with a male-to-female ratio of 1.6:1.
- The mean blood pressure (BP) at admission was 152/95 mmHg.
- The mean SD of SBP and DBP was 15.6 mmHg and 13.2 mmHg, respectively.
- The primary endpoint was achieved in 15% of patients.
- The mean SD of SBP and DBP was significantly higher in patients with a poorer clinical outcome compared to those with a better clinical outcome.

**Conclusions:**
- BP variability is a significant predictor of clinical outcomes in patients with ICH.
- Future studies are needed to further investigate the mechanisms underlying BP variability in ICH patients.

**Keywords:**
- Intracerebral hemorrhage
- Blood pressure variability
- Clinical outcomes

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