Cognitive Function Before and After Surgery in Patients With Unruptured Intracranial Aneurysm

Yasunari Otawara, MD; Kuniaki Ogasawara, MD; Akira Ogawa, MD; Keiko Yamadate, BSc

Background and Purpose—This prospective study investigated whether surgery for unruptured intracranial aneurysms (UIAs) affects cognitive function and cerebral blood flow (CBF).

Methods—Cognitive tests using the Wechsler Adult Intelligence Scale-Revised, Wechsler Memory Scale, Rey–Osterrieth Complex Figure test, and CBF measurements using single-photon emission computed tomography were performed before and after surgery for UIAs in 44 patients \( \leq 70 \) years of age.

Results—Group-rate analysis showed the verbal intelligence quotient (IQ), performance IQ, full-scale IQ, and recall trial scores of the Rey–Osterrieth Complex Figure test all increased significantly after surgery, whereas the Wechsler Memory Scale and copy trial scores of the Rey–Osterrieth Complex Figure test were not significantly different. Event-rate analysis demonstrated that no patient showed impaired cognition. There was no significant difference between CBF before and after surgery.

Conclusions—Surgical repair for UIAs does not impair cognition or CBF in patients without postoperative restrictions in lifestyle. (Stroke. 2005;36:142-143.)

Key Words: cognition \( \bullet \) intracranial aneurysm \( \bullet \) surgery

The indications for the treatment of unruptured intracranial aneurysms (UIAs) continue to generate controversy. Most UIAs can be treated with acceptably low morbidity and mortality.1 The International Study of Unruptured Intracranial Aneurysms (ISUIA) suggested that the high surgical morbidity was largely attributable to impaired cognitive status.2 Cerebral blood flow (CBF) measurements have shown that reduction of CBF because of brain retraction is associated with potential cognitive dysfunction after surgical repair for UIAs.3 The present study measured CBF using single-photon emission computed tomography (SPECT) and assessed cognitive function using standard tests after surgical repair of UIAs.

Subjects and Methods

Patient Population
This prospective study was based on a series of patients treated for UIAs at our institution between April 1998 and August 2000. The inclusion criteria for this study were: UIA in the anterior circulation; no informed consent and obvious cognitive impairment (compression of brain by large UIA, previous premorbid psychiatric history, and brain injury caused by surgery for UIAs resulting in a modified Rankin Scale score of \( \geq 1 \)). Ethical approval was granted by the institution.

Surgical Procedures
A standard pterional approach using the operating microscope was performed after widely opening the Sylvian fissure. Self retractors were intermittently used on the frontal and temporal lobes. Cerebral veins were carefully dissected and preserved. All operations were performed or supervised by a senior author (A.O.).

Cognitive Tests and CBF Measurement
The cognitive test battery consisted of the Japanese translation of the Wechsler Adult Intelligence Scale-Revised (WAIS-R),4 the Japanese translation of the Wechsler Memory Scale (WMS),5 and the Rey–Osterrieth Complex Figure test (ROCF).6 Cognitive tests were performed by a single trained neuropsychologist (K.Y.). Regional CBF was determined using \( ^{133} \)Xe inhalation and SPECT. Quantitative CBF maps were reconstructed using the Kanno–Lassen method.7 An investigator unaware of the patient clinical data manually drew an irregular region of interest covering the entire cerebral hemisphere. The CBF was determined in the cerebral hemisphere ipsilateral to the surgical approach. The mean value of the bilateral hemispheres was used if the patient underwent bilateral pterional approaches.

Cognitive tests and CBF measurements were performed 1 month before and 1 month after surgery. If multiple aneurysms required multiple operations, the second examinations were performed after the last surgery.

Statistical Analysis
Neuropsychological performance was evaluated by group-rate analysis and by event-rate analysis. Group-rate analysis used the paired \( \bar{r} \) test to analyze the neuropsychological scores. Event-rate analysis calculated the SD for each test from all preoperative scores, and a cognitive deficit was defined as a fall of \( \bar{1} \) SD in the postoperative score compared with the preoperative score for individual patients.8 A patient with deficits in \( \geq 2 \) test scores was considered to have...
TABLE 1. Group-Rate Analysis of Cognitive Tests

<table>
<thead>
<tr>
<th></th>
<th>Preoperative Mean (SD)</th>
<th>Postoperative Mean (SD)</th>
<th>Paired t Test</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAIS-R (verbal IQ)</td>
<td>88.5 (12.2)</td>
<td>90.9 (13.1)</td>
<td></td>
<td>0.0038</td>
</tr>
<tr>
<td>WAIS-R (performance IQ)</td>
<td>95.1 (10.8)</td>
<td>100.2 (13.0)</td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>WAIS-R (full-scale IQ)</td>
<td>91.2 (11.4)</td>
<td>94.9 (13.4)</td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>WMS</td>
<td>102.1 (16.4)</td>
<td>105.1 (17.5)</td>
<td></td>
<td>0.0611</td>
</tr>
<tr>
<td>ROCF (copy)</td>
<td>35.1 (1.4)</td>
<td>34.7 (2.4)</td>
<td></td>
<td>0.232</td>
</tr>
<tr>
<td>ROCF (recall)</td>
<td>17.4 (7.8)</td>
<td>19.9 (7.9)</td>
<td></td>
<td>0.0110</td>
</tr>
</tbody>
</table>

postoperative cognitive impairment. The change in CBF before and after surgery was analyzed using the paired t test. Statistical significance was set at the P<0.05 level.

Results

Surgical complications occurred in 2 patients (parent artery occlusion and brain contusion), resulting in modified Rankin Scale scores of 2 and 5. Forty-four patients were entered in this study during the study period: 17 men and 27 women aged 32 to 70 years (mean age 56.8 years). The UIAs were found incidentally in 30 patients, and the remaining cases were found by other reasons (manifested as visual impairment in 2 patients and cerebral stroke in 12 patients). The mean interval between the onset of stroke and surgery for UIAs was 232±56 days.

Group-rate analysis of the neuropsychological tests is summarized in Table 1. The verbal intelligence quotient (IQ), performance IQ, full-scale IQ, and recall trial scores of the ROCF increased significantly after surgery. The WMS and copy trial scores of the ROCF showed no statistical difference before and after surgery. Event-rate analysis showed no patient developed postoperative cognitive impairment. There was no significant difference between CBF before and after surgery (Table 2).

Discussion

The present study demonstrated that surgical treatment of UIAs does not impair cognitive function or CBF in patients without postoperative restrictions in lifestyle.

Previous studies of cognition after surgery for UIAs have involved various study designs. The ISUIA lacks data of cognitive change before and after surgery.2 Another study defined impaired cognition as a decrease in postoperative test scores by ≥1 points, which may overestimate postoperative cognitive impairment compared with our study.3 Other previous cognitive study confirmed safe surgery for UIAs, although no CBF study was done.9 Our results confirmed that neither cognitive function nor CBF decreased after surgery. Previous research showed that surgical repair of UIAs does not affect CBF if the surgery can be completed with fine surgical manipulation.10 Thus, we believe that fine surgical manipulation preserves cognitive function.

Group-rate analysis found that the scores of the WAIS-R and ROCF improved after surgery. Improvement with practice can occur if patients are reassessed within 3 months.11 Other potential causes of the improved cognitive scores after surgery include a different cognitive test battery than those used in previous studies, the high preoperative level of anxiety affecting cognitive function,12 the inclusion of patients recovering from stroke, and the neuropsychologist being unaware of the clinical information. In conclusion, the present study demonstrated that surgical repair for UIAs does not impair cognitive function in patients without postoperative restrictions in lifestyle.

Acknowledgments

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References

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