Management outcome in the elderly patient following subarachnoid hemorrhage

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The purpose of this study was to investigate whether the overall management outcome for elderly patients with subarachnoid hemorrhage (SAH), especially for those aged 70 to 79 years, has improved. To this end, the author compared data for the period between 1986 and 1990 (Study Period 2) with those obtained between 1980 and 1985 (Study Period 1). Of 503 patients who were admitted by Day 3 after SAH during the two study periods, 243 (48%) were 59 years of age or younger, 129 (26%) were 60 to 69 years of age, 102 (20%) were 70 to 79 years of age, and 29 (6%) were 80 years of age or older. The percentage of patients aged 70 years or more doubled from 17% during Study Period 1 to 34% during Study Period 2. During Study Period 1, the older patients had a lower operability rate; during Study Period 2, the operability rate for patients aged 70 to 79 years (69%) was similar to that for patients aged 50 to 69 years. At 6 months after SAH for patients aged 70 to 79 years, the overall management and surgical results of good recovery or moderate disability were 18% and 36%, respectively, during Study Period 1, and improved to 41% and 60%, respectively, during Study Period 2. During Study Period 1, the cumulative 5-year survival probabilities for overall management were 59% for patients aged 59 years or less, 53% for those aged 60 to 69 years, and 24% for those aged 70 to 79 years; during Study Period 2, these probabilities improved to 70%, 58%, and 47%, respectively. The 5-year survival rates of surgically treated patients in these three age groups increased from 77%, 68%, and 44% to 88%, 77%, and 69%, respectively.

KEY WORDS • cerebral aneurysm • subarachnoid hemorrhage • geriatrics • management outcome

In recent years, with improvements in surgical and management techniques and with the aging of the population, the number of operations for ruptured intracranial aneurysms have increased in the elderly as well as in younger patients. Recently published series that show improved surgical results are used to justify a more aggressive approach in the surgical treatment in the elderly.1,9,10,14,16,22,29,31,37,39,45 On the other hand, it has frequently been emphasized that, despite the dramatic surgical improvements for patients with ruptured intracranial aneurysms, the ultimate overall management outcome remains unsatisfactory due to primary brain damage and to a variety of serious problems occurring in the acute stage after subarachnoid hemorrhage (SAH), especially in elderly patients.14,16,21,22,24,34,35,41

In 1988, Inagawa, et al.,16 discussed the management of elderly patients with aneurysmal SAH. In the current study, further analyses were made to investigate whether the overall management outcome for elderly patients with aneurysmal SAH, especially for those aged 70 to 79 years, has improved. For this, data for the period between 1986 and 1990 were compared with those obtained between 1980 and 1985.

Clinical Material and Methods

Patient Population

Eligibility criteria for inclusion in this study were: 1) admission on Day 0 to Day 3 following the first aneurysmal SAH (Day 0 was defined as the day of hemorrhage); and 2) no previous history of SAH. During the 11-year period from 1980 to 1990, 602 patients with the diagnosis of aneurysmal SAH were admitted to the Department of Neurosurgery of Shimane Prefectural Central Hospital. Of these, 503 patients were eligible for the study. The clinical condition of the patients was graded according to the scale of Hunt and Hess.9 The patients who were dead on admission were included in Grade V. Of 503 patients, 327 (65%) were surgically treated, 320 by the same surgeon (T.I.). The outcome at 6 months after initial SAH was classified according to the Glasgow Outcome Scale.10 After discharge, patients underwent follow-up review at least once a year using a variety of methods, including personal consultations, telephone interviews, and written correspondence. Only one patient was lost to follow-up monitoring.
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![Figure 1: Bar graph showing the age distribution and operability rate in patients with subarachnoid hemorrhage (SAH) who were admitted by Day 3 after initial SAH. During the period between 1980 and 1985 (Study Period 1), 44% of patients were aged 60 years or more and 17% were aged 70 years or more; these percentages increased to 58% and 34%, respectively, during the period between 1986 and 1990 (Study Period 2). The operability rates were 75% for patients aged 59 years or less, 63% for those aged 60 to 69 years, and 41% for patients aged 70 to 79 years during Study Period 1, and 71%, 68%, and 69%, respectively, during Study Period 2.]

**Study Variables**

In order to investigate the improvement in outcome, the 11-year span from 1980 to 1990 was arbitrarily divided into two periods: the 6-year period from 1980 to 1985 (Study Period 1) and the 5-year period from 1986 to 1990 (Study Period 2). Differences in outcomes between the two study periods were studied with regard to the following four variables: 1) overall management outcome at 6 months after initial SAH; 2) overall surgical outcome at 6 months after initial SAH; 3) surgical outcome in patients operated on within 3 days after SAH; and 4) survival probabilities by age according to a life-table analysis.

**Patient Classification**

The patients were classified by age into four groups. Of the 503 patients included in this study, 243 (48%, 135 men and 108 women) were aged 59 years or less, 129 (26%, 46 men and 83 women) were aged 60 to 69 years, 102 (20%, 16 men and 86 women) were aged 70 to 79 years, and 29 (6%, three men and 26 women) were aged 80 years or more. The mean ages of the four groups were 50 years, 64 years, 74 years, and 84 years, respectively. In this study, the differences in outcome between the two study periods were discussed mainly for the three age groups of 79 years or less with special focus on patients aged 70 to 79 years.

**Change of Treatment**

Over the 11 years of the study, the patients aged 60 to 69 years were surgically treated according to the same criteria as those aged 59 years or less: whenever possible, patients were operated on in the acute stage if they were classified preoperatively as Hunt and Hess Grades I to IV. During Study Period 1, the indication and timing of surgery of patients aged 70 to 79 years were determined case by case after taking into consideration age, neurological grade, computed tomography findings, and other general conditions. However, during Study Period 2, surgical indications for patients in this age group were almost the same as for patients aged 69 years or less. At present, whenever possible, surgery is performed in the acute stage after SAH, even in patients aged 70 to 79 years. The present procedures for therapy and prophylaxis of cerebral vasospasm, which were established between 1985 and 1986, include the removal of subarachnoid blood clots by early operation, sequential use of antihypertensive drugs when blood pressure is lower than 200 mm Hg or of antifibrinolytic drugs or steroids. Neither induced hypervolemia nor dehydrating agents, such as mannitol and glycerol, are administered and intracranial pressure is controlled by ventricular or cisternal drainage.

**Statistical Analysis**

The relationship of clinical grade on admission, site of the ruptured aneurysm, and outcome at 6 months after initial SAH was assessed using the Mann-Whitney U-test and chi-squared test. Survival probabilities of the four groups were determined using the life-table method. A p value of 0.05 or less was considered significant.

**Results**

Figure 1 shows the age distribution and the operability rate for the two treatment periods. For Study Period 1, the age distribution resembles a bell curve, in which patients aged 50 to 59 years were the most numerous and the operability rate decreased as the patients' ages increased. However, for Study Period 2, the pattern shifted: the number of patients aged 50 to 59 years, 60 to 69 years, and 70 to 79 years was almost equal, and there was no significant difference in the operability rate among these three age groups.

Clinical grades on admission in the four age groups are shown in Table 1. Nine patients who were dead on admission, all of whom were admitted in Study Period 2, were included in the Grade V category. While there was no significant difference in clinical grades between the patients aged 59 years or less and those aged 60 to 69 years, patients aged 70 years or more had significantly worse grades than patients aged less than 70 years. However, no significant differences were observed in clinical grades on admission between the two study periods.

The exact location of the ruptured aneurysm was identified by angiography or autopsy in 451 (90%) of the 503 patients. Of these, 151 (33%) were located on the anterior communicating artery, 27 (6%) on the distal anterior cerebral artery, 127 (28%) on the internal carotid artery, 117 (26%) on the middle cerebral artery,
26 (6%) on the vertebrobasilar artery, and three (1%) at other sites. However, no significant relationship could be found between patient age and site of the aneurysm.

**Overall Management Outcome**

A comparison of the overall management outcomes in the three age groups between the two study periods showed a trend toward better outcomes in Study Period 2, especially in patients aged 70 to 79 years (Table 2). For Study Period 1, the outcome in patients aged 70 to 79 years was significantly worse than that in patients aged 59 years or less and 60 to 69 years; however, for Study Period 2, the difference between outcome in patients aged 60 to 69 years and those aged 70 to 79 years was not significant. In 29 patients aged 80 years or more, the rate of good recovery or moderate disability was 24% (seven cases) and the mortality rate was 69% (20 cases). The leading cause of death was the direct effect of aneurysmal bleeding, regardless of patient age or study period (Table 3). Of the 503 patients, 176 (35%) were not surgically treated mainly because of their poor condition. The ultimate outcome in nonsurgically treated patients was very poor, regardless of age; 81% died (142 cases).

**Overall Surgical Outcome**

The overall surgical outcomes in the three age groups were better for Study Period 2 than for Study Period 1, especially in patients aged 60 to 69 years and 70 to 79 years. The outcomes in patients aged 60 to 69 years and 70 to 79 years in the latter study period were comparable to those in patients aged 50 years or less and 60 to 69 years in the earlier study period, respectively. For Study Period 2, while the overall surgical outcome in

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**TABLE 1**

Clinical grade on admission in the total 503 patients with SAH by age

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>I and II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 59</td>
<td>117 (48)</td>
<td>59 (24)</td>
<td>26 (11)</td>
<td>41 (17)</td>
<td>243</td>
</tr>
<tr>
<td>60-69</td>
<td>64 (50)</td>
<td>26 (20)</td>
<td>16 (12)</td>
<td>23 (18)</td>
<td>129</td>
</tr>
<tr>
<td>70-79†</td>
<td>29 (28)</td>
<td>27 (26)</td>
<td>23 (23)</td>
<td>23 (23)</td>
<td>102</td>
</tr>
<tr>
<td>≥ 80‡‡</td>
<td>8 (28)</td>
<td>5 (17)</td>
<td>4 (14)</td>
<td>12 (41)</td>
<td>29</td>
</tr>
<tr>
<td>total</td>
<td>218 (43)</td>
<td>117 (23)</td>
<td>69 (14)</td>
<td>59 (20)</td>
<td>503</td>
</tr>
</tbody>
</table>

* Hunt and Hess grading system without modification.
† Significantly different from the grades in patients aged 59 years or less and in those aged 60 to 69 years (p < 0.05).
‡ The number of patients classified as Grade V is significantly higher in this age group, compared to that in the 70- to 79-year group (p < 0.05).

**TABLE 2**

Overall management outcome in 474 patients

<table>
<thead>
<tr>
<th>Study Period</th>
<th>Age (yrs)</th>
<th>Outcome at 6 Months After Initial SAH*</th>
<th>No. (%)</th>
<th>MD</th>
<th>SD</th>
<th>VS</th>
<th>Dead</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–1985†</td>
<td>≤ 59</td>
<td>69 (53)</td>
<td>9 (7)</td>
<td>10 (8)</td>
<td>1 (1)</td>
<td>41 (32)</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>27 (42)</td>
<td>4 (6)</td>
<td>7 (11)</td>
<td>3 (5)</td>
<td>23 (36)</td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-79</td>
<td>4 (12)</td>
<td>2 (6)</td>
<td>3 (9)</td>
<td>5 (15)</td>
<td>20 (59)</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986–1990‡</td>
<td>≤ 59</td>
<td>68 (60)</td>
<td>9 (8)</td>
<td>6 (5)</td>
<td>1 (1)</td>
<td>29 (26)</td>
<td>113</td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>33 (51)</td>
<td>5 (8)</td>
<td>6 (9)</td>
<td>2 (3)</td>
<td>19 (29)</td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70–79</td>
<td>20 (29)</td>
<td>8 (12)</td>
<td>11 (16)</td>
<td>4 (6)</td>
<td>25 (37)</td>
<td>68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* SAH = subarachnoid hemorrhage. Outcome was measured according to the Glasgow Outcome Scale.† GR = good recovery; MD = moderate disability; SD = severe disability; VS = vegetative state.
† Significance: p < 0.01, comparing patients aged 59 years or less to those aged 70 to 79 years, and comparing patients aged 60 to 69 years to those aged 70 to 79 years.
‡ Significance: p < 0.01, comparing patients aged 59 years or less to those aged 70 to 79 years.
§ Significantly different from the outcome during 1980 to 1985 (p < 0.01). The number of patients classified as GR or MD is significantly higher (p < 0.05) and the mortality rate is significantly lower (p < 0.05) compared to those treated during 1980 to 1985.

**TABLE 3**

Cause of death within 6 months after initial SAH in the 503 patients in this series*

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Total Causes</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 59</td>
<td>32 (3)</td>
<td>23 (2)</td>
</tr>
<tr>
<td>60-69</td>
<td>21 (2)</td>
<td>8 (1)</td>
</tr>
<tr>
<td>70-79</td>
<td>12 (8)</td>
<td>7 (3)</td>
</tr>
<tr>
<td>≥ 80‡‡</td>
<td>2 (1)</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

* SAH = subarachnoid hemorrhage. Numbers in parentheses indicate numbers of patients who were surgically treated.

**TABLE 4**

Overall surgical outcome in 322 patients

<table>
<thead>
<tr>
<th>Study Period</th>
<th>Age (yrs)</th>
<th>Outcome at 6 Months After Initial SAH*</th>
<th>No. (%)</th>
<th>MD</th>
<th>SD</th>
<th>VS</th>
<th>Dead</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–1985†</td>
<td>≤ 59</td>
<td>65 (57)</td>
<td>9 (9)</td>
<td>10 (10)</td>
<td>1 (1)</td>
<td>12 (12)</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>20 (50)</td>
<td>4 (10)</td>
<td>7 (18)</td>
<td>2 (5)</td>
<td>7 (18)</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-79</td>
<td>3 (21)</td>
<td>2 (14)</td>
<td>3 (21)</td>
<td>2 (21)</td>
<td>3 (21)</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986–1990‡</td>
<td>≤ 59</td>
<td>60 (75)</td>
<td>9 (11)</td>
<td>6 (8)</td>
<td>1 (1)</td>
<td>4 (5)</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>60-69‡‡</td>
<td>30 (68)</td>
<td>4 (9)</td>
<td>6 (14)</td>
<td>2 (5)</td>
<td>2 (5)</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70–79‡‡</td>
<td>20 (43)</td>
<td>8 (17)</td>
<td>11 (23)</td>
<td>2 (4)</td>
<td>6 (13)</td>
<td>47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* SAH = subarachnoid hemorrhage. Outcome was measured according to the Glasgow Outcome Scale.† GR = good recovery; MD = moderate disability; SD = severe disability; VS = vegetative state.
‡ Significance: p < 0.01, comparing patients aged 59 years or less to those aged 70 to 79 years; p < 0.05, comparing patients aged 59 years or less to those aged 60 to 69 years, and comparing patients aged 60 to 69 years to those aged 70 to 79 years.
‡‡ Significance: p < 0.01, comparing patients aged 59 years or less to those aged 70 to 79 years, and comparing patients aged 60 to 69 years to those aged 70 to 79 years.
§ Significantly different from the outcome during 1980 to 1985 in each age group (p < 0.05).

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T. Inagawa
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**TABLE 5**

<table>
<thead>
<tr>
<th>Study Period</th>
<th>Age (yrs)</th>
<th>Outcome at 6 Months After Initial SAH</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>(%)</td>
</tr>
<tr>
<td>1980-1985†</td>
<td>≤ 59</td>
<td>65 (78)</td>
<td>6 (7)</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>20 (61)</td>
<td>5 (15)</td>
</tr>
<tr>
<td></td>
<td>70-79</td>
<td>2 (25)</td>
<td>1 (13)</td>
</tr>
<tr>
<td>1986-1990‡</td>
<td>≤ 59</td>
<td>56 (80)</td>
<td>5 (7)</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>29 (74)</td>
<td>4 (10)</td>
</tr>
<tr>
<td></td>
<td>70-79</td>
<td>18 (51)</td>
<td>6 (17)</td>
</tr>
</tbody>
</table>

* SAH = subarachnoid hemorrhage. Outcome was measured according to the Glasgow Outcome Scale. *GR = good recovery; MD = moderate disability; SD = severe disability; VS = vegetative state. Clinical grades were determined by the Hunt and Hess grading system, without modification.† Significance: p < 0.01, comparing patients aged 59 years or less to those aged 60 to 69 years and to those aged 70 to 79 years; p < 0.05, comparing patients aged 60 to 69 years to those aged 70 to 79 years.‡ Significance: p < 0.01, comparing patients aged 59 years or less to those aged 70 to 79 years; p < 0.05, comparing patients aged 60 to 69 years to those aged 60 to 79 years.§ Significantly different from the outcome during 1980 to 1985 (p < 0.05).

Patients aged 70 to 79 years was still significantly worse than that both in patients aged 59 years or less and in those aged 60 to 69 years, the difference between the outcomes in patients aged 59 years or less and 60 to 69 years was not statistically significant (Table 4). In good-risk patients, classified preoperatively in clinical Grades I to III, the surgical results of those aged 70 to 79 years improved markedly; however, there was little change in those aged 59 years or less (Table 5).

**Early Operation**

Of 327 surgical patients, 81% (266 cases) were operated on by Day 3 after initial SAH; 79% (121 of 153 cases) during Study Period 1 and 83% (145 of 174 cases) during Study Period 2. In Study Period 2, the percentages of early operations to total number of patients operated on were 83% (66 of 80 cases) for patients aged 59 years or less, 82% (36 of 44 cases) for those aged 60 to 69 years, 85% (40 of 47 cases) for those aged 70 to 79 years, and 100% (three cases) for patients aged 80 years or more. During Study Period 2, surgery was delayed beyond Day 3 in 29 patients because of the inability to detect a ruptured aneurysm on initial angiograms in 13 cases, clinical Grade V on admission in three, vertebralbasilar artery aneurysms in three, operation on Day 4 in three, severe medical complications in two, and other reasons in five. The surgical outcomes in patients classified preoperatively in clinical Grades I to IV who underwent early operation were basically similar to the overall surgical outcomes (Table 6). For Study Period 1, the difference in surgical outcome in patients aged 59 years or less and in those aged 60 to 69 years was statistically significant, but became statistically insignificant during Study Period 2. In the 254 patients with preoperative Grades I to IV who underwent early operation, death from vasospasm decreased significantly from 11% (12 of 112 cases) during Study Period 1 to 4% (five of 142 cases) during Study Period 2 (p < 0.05). Of five patients aged 80 years or more with early operation, four achieved a good recovery and one died of cerebral vasospasm.

**Life-Table Analysis**

Figure 2 illustrates the survival curves of the overall management. While the survival rate decreased in each of the successive age groups, the survival curves of patients admitted during Study Period 2 were superior to those during Study Period 1. This was especially significant in patients 70 to 79 years of age; the cumulative 5-year survival rate in this group increased from 24% for Study Period 1 to 47% for Study Period 2. The survival curves of patients 60 to 69 years of age and 70 to 79 years of age in the later study period were comparable to those of patients aged 59 years or less and those 60 to 69 years of age in the earlier period, respectively. In good-risk patients classified at admission in Grades I to III during Study Period 2, the survival curve of patients aged 60 to 69 years approximated that of patients aged 59 years or less for about 2 years after SAH, after which the survival rate decreased to about 10% lower than that for patients aged 59 years or less, mainly because of other unrelated diseases (Fig. 3). The survival curves of patients who underwent surgery had a similar pattern to those for the overall management in good-risk patients (Fig. 4). The cumulative 5-year survival rate in surgically treated patients aged 70 to 79 years increased from 44% for Study Period 1 to 69% for Study Period 2.

**TABLE 6**

<table>
<thead>
<tr>
<th>Study Period</th>
<th>Age (yrs)</th>
<th>Outcome at 6 Months After Initial SAH</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>(%)</td>
</tr>
<tr>
<td>1980-1985‡</td>
<td>≤ 59</td>
<td>51 (71)</td>
<td>9 (13)</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>13 (44)</td>
<td>5 (18)</td>
</tr>
<tr>
<td></td>
<td>70-79</td>
<td>2 (20)</td>
<td>2 (20)</td>
</tr>
<tr>
<td>1986-1990§</td>
<td>≤ 59</td>
<td>52 (83)</td>
<td>4 (6)</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>25 (69)</td>
<td>6 (17)</td>
</tr>
<tr>
<td></td>
<td>70-79</td>
<td>16 (40)</td>
<td>9 (23)</td>
</tr>
</tbody>
</table>

* SAH = subarachnoid hemorrhage. Outcome was measured according to the Glasgow Outcome Scale: *GR = good recovery; MD = moderate disability; SD = severe disability; VS = vegetative state. Included are the patients with preoperative Grades I to IV during the Study Period 3 after SAH.† Significance: p < 0.01, comparing patients aged 59 years or less to those aged 60 to 69 years and to those aged 70 to 79 years.‡ Significance: p < 0.01, comparing patients aged 59 years or less to those aged 70 to 79 years, and comparing patients aged 60 to 69 years to those aged 70 to 79 years.§ Significantly different from the outcome for the period from 1980 to 1985 in each group (p < 0.05). The mortality rate in patients aged 60 to 69 years is significantly lower than that for the period from 1980 to 1985 (p < 0.05).

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FIG. 2. Graphs showing the survival curves for overall management in patients with aneurysmal subarachnoid hemorrhage (SAH) who were admitted by Day 3 after initial SAH. The cumulative 5-year survival rates for patients aged 59 years or less, 60 to 69 years, and 70 to 79 years were 59%, 53%, and 24%, respectively, during the period between 1980 and 1985 (left), and 70%, 58%, and 47%, respectively, during the period from 1986 to 1990 (right).

Of 325 patients who were alive at 6 months after SAH, 56 (37 during Study Period 1 and 19 during Study Period 2) subsequently died and one was lost to follow-up monitoring. Only four patients died due to diseases related to operation for aneurysms and/or SAH: brain abscess (one case), status epilepticus (one case), and rebleeding (two cases). Six patients died of cerebrovascular diseases other than SAH, and the other 46 patients died of unrelated diseases.

Discussion

Literature Review

In order to analyze the overall management outcome in patients with aneurysmal SAH, it is necessary to include all patients, whether treated medically or surgically, good-risk or poor-risk, young or old. According to epidemiological studies that included not only hospitalized patients but also patients who died before being hospitalized or receiving medical attention, 42% to 61% of aneurysmal SAH patients die within the 1st month. On the other hand, neurosurgical series that included a sufficient number of operative cases report an overall mortality rate for aneurysmal SAH patients of between 30% and 52%. The range of differences in outcome of these neurosurgical studies is partly due to the proportion of nonsurgically treated patients, because the mortality rates for those patients are very high, regardless of age. In this study, the mortality rate for non-

FIG. 3. Graphs showing the survival curves for patients with aneurysmal subarachnoid hemorrhage (SAH) who were admitted by Day 3 after initial SAH and whose Hunt and Hess grades on admission were between I and III. The cumulative 5-year survival rates for patients aged 59 years or less, 60 to 69 years, and 70 to 79 years were 73%, 64%, and 39%, respectively, during the period between 1980 and 1985 (left) and 87%, 73%, and 57%, respectively, during the period from 1986 to 1990 (right).
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Fig. 4. Graphs showing the survival curves for overall surgical outcome in patients with aneurysmal subarachnoid hemorrhage (SAH) who were admitted by Day 3 after initial SAH. The cumulative 5-year survival rates for patients aged 59 years or less, 60 to 69 years, and 70 to 79 years were 77%, 68%, and 44%, respectively, during the period from 1980 to 1985 (left) and 88%, 77%, and 69%, respectively, during the period between 1986 and 1990 (right).

surgically treated patients was 81%. However, in previous neurosurgical studies, even in those that have attempted to include all patients regardless of age or condition,8,24 it is very difficult to know precisely the overall management outcome in elderly patients because the percentage of elderly patients has been very small, especially for those aged 70 years or more.

Published studies have gradually changed both the upper age limit for patients eligible for surgery and the definition of “the elderly.” In studies published in the 1950's and 1960's, the demarcation line for the mortality rate was approximately age 50 years.6,27,53,40 The upper age limit for surgical treatment of ruptured intracranial aneurysms was set at 60 years of age in 19706 and at the end of the patient’s seventh decade in 1973.7 In 1978, it was argued that neurosurgical beds and neuroradiological facilities should not be occupied by patients aged 60 years or more.26 From the 1970's to the mid 1980's, patients with ruptured intracranial aneurysms were usually defined as “the elderly” if they were over age 60 years,1,4,7,26,30,31,39 and the surgical mortality rate for these patients was 9% to 34%.2,2,3,6,9,19,26,30,31,39 From the late 1980's to the early 1990's, patients aged 65 years or more were defined as “the elderly”29,31,37 and the surgical mortality rate for these patients was 12% to 25%.29,32,37 In the few studies that have concentrated on patients aged 70 years or more,10,14,16,63 the surgical mortality rate varied from 19% to 40%.10,16,19,22,43 In addition to the obvious factor of the patient's age, the wide difference in these surgical results also depends on factors such as timing of admission and operation, time of outcome evaluation, and whether poor-risk patients were included in the study.

Patient Population and Operability Rate

In the present series, the percentage of patients aged 60 years or more increased from 44% for Study Period 1 to 58% for Study Period 2, and the percentage of those 70 years of age or older doubled from 17% to 34%. In the latter study period, although the number of the general population decreases with age, the numbers of patients aged 50 to 59 years, 60 to 69 years, and 70 to 79 years were almost equal. Therefore, when calculating the incidence of patients with aneurysmal SAH by age, the rate for each age group increases up to the eighth decade; that is, the age distribution for Study Period 2 is closer to the pattern found in the epidemiological studies,12,17,23,34,40 rather than to the pattern found in other neurosurgical studies.12,24 This trend shows that the proportion of elderly patients, particularly very old patients, with aneurysmal SAH is increasing and/or their condition is being diagnosed more frequently.12,16

In this series, the operability rate for patients aged 70 to 79 years was very high compared with those in previous studies.1,19,22,43 Although the operability rate for patients aged 50 to 59 years seems to have leveled off during Study Period 1, it increased for those aged 60 to 69 years and 70 to 79 years during Study Period 2. Since the operability rate for patients aged 70 to 79 years during Study Period 2 reached 69% (a rate similar to that for patients aged 50 to 59 years and 60 to 69 years), the surgical indication for patients aged 70 to 79 years seems to have reached a plateau for now, similar to that for those aged between 50 and 69 years.

Comparison of Outcomes

A comparison between the two study periods of the management and surgical outcomes in patients aged 59 years or less, 60 to 69 years, and 70 to 79 years is briefly summarized and discussed. In each of the three age groups, while both the overall management and surgical outcomes improved, the statistical results were different. In patients aged 59 years or less, the improvements in both outcomes were statistically insignificant. In this
age group, the surgical results between the two study periods in patients who were classified in preoperative clinical Grades I to III were almost the same. Therefore, there may be less opportunity for major improvements, even by surgery, in this group, especially in good-risk patients. In patients aged 60 to 69 years, the only statistically significant difference was found in the surgical outcome. The outcome of these patients seems to have improved to the rate for those aged 59 years or less, at least in surgical cases. In fact, in surgically treated patients, the survival curve in patients aged 60 to 69 years was almost equal to that in patients aged 59 years or less, at least for the 2-year period after SAH. In patients aged 70 to 79 years, improvements in both the management and surgical outcomes were significant. However, these results are still unsatisfactory when compared with those in patients aged 69 years or less.

For the two study periods, the cumulative 5-year survival rates based on the overall management increased 11% for patients aged 59 years or less, 5% for those aged 60 to 69 years, and 23% for those aged 70 to 79 years. On the other hand, in patients who were surgically treated, the rates increased 11%, 9%, and 26%, respectively. Therefore, in all three age groups, the increase in the 5-year survival probabilities achieved by the overall management was almost the same as that achieved by surgery. Considering that the outcome in nonsurgically treated patients was very poor regardless of age, improvement in the overall management outcome seems to be the result of improvement in the surgical outcome, owing to improvement in both perioperative management of patients and surgical techniques.\(^6,11,13,15,16\)

**Analysis of Current Outcomes**

Recent studies that discussed the overall management and/or surgical outcome in patients with aneurysmal SAH have been restricted to patients admitted in the acute stage after SAH (that is, within 72 hours or by Day 3)\(^9,10,11,12,22\) because the outcome is often dependent on the elapsed time from SAH to admission.\(^1,4,6,10,20,22\) However, few of these studies included elderly patients.\(^1,6\) In the International Cooperative Study on the Timing of Aneurysm Surgery published in 1990,\(^22\) which was also restricted to patients admitted before Day 3 and whose outcomes were assessed at 6 months after SAH, the percentage of patients aged 70 years or more was only 6%. However, since the International Cooperative Study has the same criteria as this study, it is possible to compare the results of the two studies with reasonable accuracy. In the International Cooperative Study, the overall management and surgical outcomes in patients aged 70 years or more showed that the rates of good recovery or moderate disable were 36% and 45%, and the mortality rates were 48% and 34%, respectively. For Study Period 2 in the present series, the respective rates for patients aged 70 to 79 years were 41% and 60%, and 37% and 13%. Therefore, although there was little difference in the overall management outcome between the two studies, the surgical outcome in this series was definitely better than that in the International Cooperative Study. The principal rea-

son why the overall management outcome in this series was less than outstanding when compared with the surgical outcome is because it includes many poor-risk patients who were not eligible for surgery.

**Early Operation**

While early surgery is usually attempted to prevent rebleeding, it may have the additional benefit of alleviating vasospasm.\(^6,11,13,15,28,42\) In elderly patients, the surgical mortality rate after early operation has been reported to be 17% to 30% for those aged 60 years or more.\(^9,10,30\) 31% to 50% for those aged 65 years or more,\(^29,37,43\) and 25% for those aged 70 years or more.\(^10\) However, the literature contains little information focused on the results of early surgery for aneurysm in patients past the age of 70 years.

In the present study, about 80% of the patients were operated on by Day 3 after SAH regardless of age, and the surgical mortality rate for Study Period 2 was 13% for those aged 70 to 79 years. Therefore, at present, the surgical outcome of patients aged 70 to 79 years is not necessarily poor, even with early operation. It is true that elderly patients require a higher degree of caution in early surgery, even when their neurological status is good; however, if their neurological and physical condition does not become aggravated after surgery, it becomes much easier to manage these patients after the aneurysms have been clipped. At present, while patients aged 70 years or more with aneurysmal SAH may be defined as "elderly," 70 years of age should no longer be regarded as a firm demarcation line when considering surgery for ruptured intracranial aneurysms.

**References**

Management of SAH in elderly patients


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