Aneurysmal Subarachnoid Hemorrhage in Izumo City and Shimane Prefecture of Japan

Outcome

Tetsuji Inagawa, MD, Masaru Takahashi, MD, Hidenobu Aoki, MD, Susumu Ishikawa, MD, and Hisanori Yoshimoto, MD

The overall outcome of patients with aneurysmal subarachnoid hemorrhage was investigated in Izumo City and Shimane Prefecture. Of the patients from Izumo City, the clinical grade on admission was Grade I or II in 41% and Grade IV or V in 31%. Of those from Shimane Prefecture, 49% were graded as Grade I or II and 24% as Grade IV or V. The overall mortality rates 1 year after subarachnoid hemorrhage were 46% for Izumo City and 35% for Shimane Prefecture, while the surgical mortality rates were 18% and 15%, respectively. The mortality rates were particularly high among the elderly over the age of 70 years and among unoperated cases. The leading cause of death in these cases was the effect of aneurysm rupture itself, followed by rebleeding and vasospasm. The 5-year survival probabilities according to life table analysis were 50% for Izumo City and 59% for Shimane Prefecture, and a significant difference was observed in survival curves between Izumo City and Shimane Prefecture. It is concluded that the smaller the community studied, the less favorable the overall outcome, mainly because of poorer clinical conditions on admission. (Stroke 1987;19:176-180)

Subjects and Methods

Figure 1 shows the interval from onset of subarachnoid hemorrhage (SAH) to hospital admission. Using the date of initial SAH as Day 0, 58 (69.9%) of the 83 Izumo City patients were admitted on Day 0, whereas 295 (53.8%) of the 548 patients from Shimane Prefecture as a whole were so admitted. The clinical condition of the patients was graded on admission according to the Hunt and Hess grade without modification. Of the patients from Izumo City, 34 (41%) were Grade I or II, 23 (28%) Grade III, 10 (12%) Grade IV, and 16 (19%) Grade V. Of those from Shimane Prefecture, 270 (49%) were Grade I or II, 144 (26%) Grade III, 77 (14%) Grade IV, and 57 (10%) Grade V; four patients who were dead on admission were Grade V.

Ultimately, 51 patients (61.4%) from Izumo City and 352 patients (64.2%) from Shimane Prefecture underwent surgery, and of those, 43 patients (84.3%) from Izumo City and 260 (73.9%) from Shimane Prefecture did so by Day 14. Figure 2 shows the interval from initial SAH to surgery for patients from Izumo City and Shimane Prefecture. Of the 51 surgical patients from Izumo City, 29 (57%) were preoperative Grade I or II, 15 (29%) Grade III, 3 (6%) Grade IV, and 4 (8%) Grade V. Of the 352 surgical patients from Shimane Prefecture, 205 (58%) were preoperative Grade I or II, 89 (25%) Grade III, 47 (13%) Grade IV, and 11 (3%) Grade V.

The second part of our study focused on two particular points. First, the overall outcomes of patients from Izumo City and Shimane Prefecture 1 year after initial SAH were analyzed separately according to clinical grade on admission, incidence of surgery, and age. Statistical analyses were made by chi-squared test. Second, the patients were followed up for 2.5-7.5 years, and a life table analysis was performed. The survival probabilities for the two groups were determined using the Kaplan-Meier method, and differences among the distributions were tested using the generalized Wilcoxon test for the two curves.

Results

The overall outcome 1 year after the initial SAH in relation to clinical grade on admission was evaluated in the 83 patients from Izumo City and in 539 of the 548 patients from Shimane Prefecture using the Glasgow Outcome Scale (GOS). The five categories described in GOS, good recovery, moderate disability (disabled but independent), severe disability (conscious but disabled), persistent vegetative state, and death, were recorded as GR, MD, SD, VS, and D, respectively.

Of those patients who were Grade I or II, 74% were categorized as GR or MD, both for Izumo City and Shimane Prefecture, and their overall mortality rates were 15% for Izumo City and 16% for Shimane Prefecture. The mortality rates of Grade III patients

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Received April 16, 1987; accepted September 14, 1987.
were 48% for Izumo City and 36% for Shimane Prefecture, while those of Grade IV patients were 70% for Izumo City and 58% for Shimane Prefecture. The rates of both were therefore higher for Izumo City. The mortality rates of Grade V patients were similar at 94 and 93%, respectively. In the total series, for Izumo City, 8 patients (10%) died on Day 0, 27 (33%) by Day 7, 33 (40%) within 1 month, and 38 (46%) after 1 year, while for Shimane Prefecture 11 (2%) died on Day 0, 83 (15%) by Day 7, 152 (28%) within 1 month, and 189 (35%) after 1 year (Table 1). The surgical outcome in relation to preoperative grade is shown in Table 2. In both Izumo City and Shimane Prefecture, surgical mortality was closely related to preoperative grade (p<0.01). The surgical results 1 year after the initial SAH in patients in preoperative Grade I or II were not significantly different between Izumo City and Shimane Prefecture; for Izumo City 79% were categorized GR, 76% for Shimane Prefecture. Mortality was 3 and 5%, respectively. All in all, 18% of the surgical patients from Izumo City died, compared with 15% for Shimane Prefecture. The outcome of unoperated or inoperable patients 1 year after initial SAH is shown in Table 3. The ultimate outcome of these unoperated or inoperable patients 1 year after initial SAH was very poor, with only 3% of the patients from Izumo City categorized as GR and 19% of those from Shimane Prefecture categorized as GR. Of the 32 patients from Izumo City 29 (91%) died, and of the 187 patients from Shimane Prefecture 136 (73%) died.

The relation between age of the patients and overall outcome was analyzed with age grouped as <59, 60-69, and ≥70 years (Table 4). Mortality rates by age group were 41% in Izumo City and 32% in Shimane Prefecture for the ≤59 years age group, 40 and 29% for the 60-69 years age group, and 71 and 56% for the ≥70 years age group, respectively. The overall outcome in both Izumo City and Shimane Prefecture was not significantly different for the ≤59 years age group or the 60-69 years age group, but the overall outcome of the ≥70 years age group was significantly poorer than that of the ≤69 years age group (p<0.05 for Izumo City, p<0.01 for Shimane Prefecture).

The causes of death within 1 year after the initial SAH in the present series are shown in Table 5. The leading cause of death was the aneurysm rupture itself, followed by rebleeding and vasospasm, in that order. These three causes accounted for the death of 33 patients (87%) from Izumo City and 155 patients (82%) from Shimane Prefecture.

The survival curves for patients from Izumo City and Shimane Prefecture are shown in Figure 3. The 5-year survival probabilities were 50% for Izumo City and 59% for Shimane Prefecture, and the 7-year probabilities were 50 and 58%, respectively. There was a significant difference in survival curves between Izumo City and Shimane Prefecture (Z=2.6082, p<0.01).

Discussion

How many patients with aneurysmal SAH survive in this era of contemporary microsurgical techniques and pharmacologic management? Despite the dramatic improvement in surgical results for ruptured intracranial aneurysm, several reports have pointed out that overall mortality still remains high.5-10 Phillips et al10 in their study in Rochester, Minnesota, reported no significant difference in survival between 1945-1969 and 1970-1974.

Reports on the overall outcome in aneurysmal SAH can be broadly classified into reports from epidemiologic studies and reports from referral centers or large-scale cooperative studies. Epidemiologic studies have reported that 30-43% of spontaneous SAH patients die within the first week6,11,12 and that 47-58%
Izumo City and Shimane Prefecture are closely related to grade on admission (p<0.01), but there is no significant difference between the two. GR, good recovery; MD, moderate disability; SD, severe disability; VS, persistent vegetative state; D, dead.

Nine patients were lost to follow-up in Shimane Prefecture. Outcome measured by Glasgow Outcome Scale. Surgical outcomes in both Izumo City and Shimane Prefecture are closely related to grade on admission (p<0.01), but there is no significant difference between the two. GR, good recovery; MD, moderate disability; SD, severe disability; VS, persistent vegetative state; D, dead.

### Table 2. Surgical Outcome 1 Year After Initial Subarachnoid Hemorrhage for All Patients in Izumo City and Shimane Prefecture of Japan by Preoperative Grade

<table>
<thead>
<tr>
<th>Grade</th>
<th>Outcome</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
<th>Total</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Izumo City</td>
<td>I, II</td>
<td>23</td>
<td>79</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>29</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>8</td>
<td>53</td>
<td>2</td>
<td>13</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>27</td>
<td>15</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>33</td>
<td>1</td>
<td>33</td>
<td>1</td>
<td>33</td>
<td>3</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>75</td>
<td>4</td>
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</tr>
<tr>
<td></td>
<td>Total</td>
<td>31</td>
<td>61</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>2</td>
<td>4</td>
<td>9</td>
<td>18</td>
<td>51</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Shimane Prefecture</td>
<td>I, II</td>
<td>155</td>
<td>76</td>
<td>19</td>
<td>9</td>
<td>15</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>11</td>
<td>5</td>
<td>205</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>38</td>
<td>43</td>
<td>18</td>
<td>20</td>
<td>17</td>
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<td>0</td>
<td>16</td>
<td>18</td>
<td>89</td>
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<tr>
<td></td>
<td>IV</td>
<td>4</td>
<td>9</td>
<td>9</td>
<td>19</td>
<td>10</td>
<td>21</td>
<td>6</td>
<td>13</td>
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<td>38</td>
<td>47</td>
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<td></td>
<td>V</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>2</td>
<td>18</td>
<td>8</td>
<td>73</td>
<td>11</td>
<td>100</td>
<td></td>
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<tr>
<td></td>
<td>Total</td>
<td>197</td>
<td>56</td>
<td>46</td>
<td>13</td>
<td>43</td>
<td>12</td>
<td>13</td>
<td>4</td>
<td>53</td>
<td>15</td>
<td>352</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Outcome measured by Glasgow Outcome Scale. Surgical outcomes in both Izumo City and Shimane Prefecture are closely related to grade on admission (p<0.01), but there is no significant difference between the two. GR, good recovery; MD, moderate disability; SD, severe disability; VS, persistent vegetative state; D, dead.
those found dead or those who were dead on arrival at that in south Sweden, with a population of 1.46 overall mortality rates 1 year after SAH were higher that of patients from Shimane Prefecture (Grade I or II in 41%, Grade IV or V in 31%) was poorer than admission of the patients from Izumo City (Grade I in the clinical grade on admission or overall outcome 6 months or more from the time of initial SAH.

In our study no significant difference could be found between Izumo City and Shimane Prefecture in the clinical grade on admission or overall outcome 1 year thereafter. However, the clinical grade on admission of the patients from Izumo City (Grade I or II in 41%, Grade IV or V in 31%) was poorer than that of patients from Shimane Prefecture (Grade I or II in 49%, Grade IV or V in 24%). Furthermore, the overall mortality rates 1 year after SAH were higher in Izumo City (46%) than in Shimane Prefecture (35%). Life table analysis showed that the 5-year survival probabilities were 50% in Izumo City and 59% in Shimane Prefecture, and a significantly higher mortality rate was demonstrated for the patients from Izumo City. The surgical mortality rates after 1 year were 18% in Izumo City and 15% in Shimane Prefecture, but when confined to patients who were Grade I or II, the mortality rates were only 3 and 5%, respectively. There was also no difference in the surgical outcome per se between Izumo City and Shimane Prefecture; mortality rates of unoperated patients were 91 and 73%, respectively, especially high in Izumo City because most of these were elderly patients in very poor condition, patients in whom surgery was infeasible. When examined by age, overall mortality rates of patients older than the age of 70 years were 71% in Izumo City and 56% in Shimane Prefecture; both rates were significantly higher than those in the age group younger than 70 years. Of the total deaths, 50% in Izumo City and 40% in Shimane Prefecture were attributed to the aneurysmal rupture itself. These findings suggest that many elderly patients die as a result of the initial insult and do not become available for treatment following aneurysmal SAH, especially in Izumo City. It appears that the smaller the community studied, the poorer the overall outcome, mainly because of poor clinical grade on admission.

<table>
<thead>
<tr>
<th>Table 3. Outcome in Unoperated Patients 1 Year After Initial Subarachnoid Hemorrhage for All Patients in Izumo City and 187 Patients in Shimane Prefecture of Japan by Clinical Grade on Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 4. Overall Outcome 1 Year After Initial Subarachnoid Hemorrhage for All Patients in Izumo City and 539 Patients in Shimane Prefecture of Japan by Age</strong></td>
</tr>
</tbody>
</table>

| Nine patients were lost to follow-up in Shimane Prefecture. Outcome measured by Glasgow Outcome Scale. | 4 Overall outcome of ≥70 years age group is significantly poorer than that of 60–69 years age group (p<0.05 for Izumo City, p<0.01 for Shimane Prefecture), but there is no significant difference between the two. GR, good recovery; MD, moderate disability; SD, severe disability; VS, persistent vegetative state; D, dead. |
In Izumo City, 51 (61%) of the 83 patients with aneurysmal SAH underwent surgery. Thus, the annual surgery rate in Izumo City was 12.9 per 100,000 population, the highest among the rates reported in the literature, which are 1.5-3.6 per 100,000. This may be due in part to the practice in Izumo City of early surgery, but it also may be predominantly attributable to the high annual incidence of aneurysmal SAH, 21.0 per 100,000 population for all ages.

To date, most surgeons have reported their surgical results without being concerned with the whole picture, including all patients with aneurysmal SAH, especially poor-risk or elderly patients. On the contrary, most epidemiologists have examined the overall outcome in all patients, but their studies rarely include patients who have undergone current surgical and medical treatment. It was not the primary purpose of this study to compare our overall or surgical results with those of other published studies but merely to present the annual incidences of aneurysmal SAH and the overall and surgical results for Izumo City and Shimane Prefecture. Rather than a large-scale cooperative study, it may be advisable in the future to conduct a cooperative study among small communities such as Izumo City to answer the question of how many patients would survive in the era of contemporary microsurgical techniques and pharmacologic management.

### References


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**Key Words**: subarachnoid hemorrhage • Japan • cerebral aneurysm • epidemiology

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**TABLE 5. Causes of Death Within 1 Year After Initial Subarachnoid Hemorrhage**

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Izumo City No.</th>
<th>%</th>
<th>Shimane Prefecture No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct effect</td>
<td>19</td>
<td>50</td>
<td>76</td>
<td>40</td>
</tr>
<tr>
<td>Rebleeding</td>
<td>11</td>
<td>29</td>
<td>48</td>
<td>25</td>
</tr>
<tr>
<td>Vasospasm</td>
<td>3</td>
<td>8</td>
<td>31</td>
<td>16</td>
</tr>
<tr>
<td>Medical complications</td>
<td>5</td>
<td>13</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Surgical complications</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Brain abscess</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Meningitis</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Unrelated illnesses</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>100</td>
<td>189</td>
<td>100</td>
</tr>
</tbody>
</table>

---

**FIGURE 3. Cumulative survival rates for patients with aneurysmal subarachnoid hemorrhage (SAH) in Izumo City and Shimane Prefecture.**
Aneurysmal subarachnoid hemorrhage in Izumo City and Shimane Prefecture of Japan. Outcome.

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Stroke. 1988;19:176-180
doi: 10.1161/01.STR.19.2.176

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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