Erbbral vasospasm remains a leading cause of illness and death in patients who survive SAH. It has been well documented that the amount of subarachnoid clot is closely related to the incidence and severity of vasospasm. Experimental studies in which a primate model was used showed that clot removal within 48 hours of SAH prevented vasospasm. Attempts have been made to remove cisternal clots at the time of early clip occlusion to prevent vasospasm, but the clinical results have not been satisfactory because it is very difficult to remove the clot completely. Recent clinical and experimental studies have shown that intrathecal administration of thrombolytic agents such as urokinase or recombinant tPA facilitated rapid dissolution of subarachnoid clots, decreased the incidence of vasospasm, and conferred a better prognosis.

The head-shaking method was first described by Suzuki and colleagues in 1991 as a means to accelerate removal of the clot from the basal and distal sylvian cistern. The idea that shaking the patient's head not only helps to dissolve the residual clot, but also expedites the drainage of the residual hemolysate by inducing local CSF flow was simple and intuitively recognizable. The head-shaking device became commercially available in 1994 and has been adopted as an option for preventing vasospasm after aneurysmal SAH. Nevertheless, clinical evidence regarding this treatment has been scarce because no controlled study has been conducted yet.

The device for the head-shaking method, the Neuroshaker (Mizuho, Tokyo, Japan), was introduced at Showa General Hospital in 1994. Because only one machine was available and it required a maintenance period of 1 month, 114 patients underwent irrigation combined with the head-shaking method (head-shaking group), whereas the remaining 116 patients received cisternal irrigation alone (control group). There were no significant differences in sex, age, site of aneurysm, or preoperative grade between the two groups.

The incidence of symptomatic vasospasm with or without infarction, cerebral infarction on CT scans, and permanent ischemic neurological deficit was 25.7, 17.7, and 8.8%, respectively, in the control group and 15.2, 4.5, and 2.7% in the head-shaking group. The difference was statistically significant for symptomatic vasospasm, cerebral infarction, and permanent ischemic neurological deficit (p \(<\) 0.05). In a multivariate backward stepwise logistic regression analysis, absence of head shaking was the only variable that was predictive of permanent ischemic neurological deficit (p = 0.061). The outcomes evaluated using the modified Rankin Scale were better in the head-shaking group (p = 0.051).

Conclusions. The head-shaking method significantly reduced the incidence of symptomatic vasospasm, cerebral infarction, and permanent ischemic neurological deficit and improved the clinical outcomes in patients who underwent cisternal irrigation therapy after aneurysmal SAH.
every other month, only half of our patients were treated with the head-shaking method. Although the study was not randomized, this situation allowed us to compare the treatment results among relatively homogeneous groups and to investigate the efficacy of the head-shaking method in preventing vasospasm in patients who underwent cisternal irrigation therapy after acute-stage surgery.

Clinical Material and Methods

Patient Population and Study Design

During the 8-year period between September 1994 and August 2002, 505 patients underwent surgery for clip occlusion of ruptured cerebral aneurysms at our institution. Two hundred thirty who met the following criteria were eligible for the study: 1) patient age between 18 and 79 years; 2) Fisher Grade 3 SAH on preoperative CT scans; 3) SAH from a single ruptured saccular aneurysm in the anterior half of the circle of Willis or at the bifurcation of the MCA; 4) aneurysm secured by clip occlusion of its neck within 48 hours of onset; 5) patient had no neurological deficit and ability to obey commands promptly (that is, best motor points 6 on the GCS62 ) and to respond verbally with good orientation (that is, best verbal points 5 on the GCS) within 24 hours after surgery; and 6) informed consent was obtained either from the patient or family members before the treatment. Cisternal irrigation therapy with urokinase31 was performed after surgery in all patients. Of the 230 patients enrolled in this study, 116 received cisternal irrigation therapy only (control group) and the other 114 underwent the head-shaking protocol in addition to cisternal irrigation. There were 83 men and 147 women, and their ages ranged from 22 to 79 years (mean 56.1 years).

Because the device introduced at our institution was a prototype of the commercial Neuroshaker, bimonthly maintenance was necessary, and each period of maintenance work took an entire month. Throughout the study period, the head-shaking method combined with cisternal irrigation therapy was performed for 1 month (head-shaking group), followed by another month in which the machine was not available because of its maintenance requirements and the patients underwent cisternal irrigation therapy only (control group). Consequently, patients were allocated to one of the groups every other month alternately. In total, 116 patients received cisternal irrigation therapy only and the other 114 patients underwent cisternal irrigation plus the head-shaking method. The age, sex, site of the aneurysm, and preoperative WFNS grade5 in both groups are summarized in Table 1.

Surgical Procedures

The surgical procedures were the same for both groups. Removal of the subarachnoid clot around the ICA and the M1 segment of the MCA was performed. The prepontine clot was also removed after opening of the Liliequist membrane. A ventricular catheter was placed in the anterior horn of the lateral ventricle to be used as the inlet for the irrigation fluid, and a cisternal catheter was placed in the prechiasmatic or prepontine cistern as the outlet. All operations were performed or supervised by one of the senior authors (S.K. or K.N.).

Neuroshaker Apparatus

Figure 1 shows a photograph of the commercially available Neuroshaker apparatus. The patient’s head is placed on a pillow on the sliding table (a), which makes a reciprocal motion and swings the patient’s head. The frequency and amplitude of the movement is adjusted using a separate control box (b).

Protocol for the Head-Shaking Method

Our method for cisternal irrigation therapy (Fig. 2) was similar to that described by Kodama, et al.31 Immediately after surgery, infusion of lactated Ringer solution with tobramycin (0.12 mg/ml) was started at the rate of 20 ml/hour through the ventricular catheter. The inflow pressure was set at 15 cm H2O to avoid excessive infusion and raised ICP. Twelve hours postsurgery, when a CT scan was

---

**TABLE 1**

Priorities of 230 patients with SAH

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Head-Shaking</th>
<th>Control</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>sex (M:F)</td>
<td>42:72</td>
<td>41:75</td>
<td>0.813*</td>
</tr>
<tr>
<td>age (yrs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>22–78</td>
<td>23–79</td>
<td>0.607†</td>
</tr>
<tr>
<td>mean</td>
<td>55.8</td>
<td>56.5</td>
<td></td>
</tr>
<tr>
<td>aneurysm location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACoA</td>
<td>40</td>
<td>43</td>
<td>0.867*</td>
</tr>
<tr>
<td>ICA</td>
<td>42</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>MCA</td>
<td>32</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>preop WFNS grade</td>
<td></td>
<td></td>
<td>0.995*</td>
</tr>
<tr>
<td>I</td>
<td>28</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>62</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>24</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

* According to the Pearson chi-square test.
† According to the t-test.
H2 O to avoid excessive infusion and raised ICP. The outflow pressure was used to control the flow rate. The inflow pressure was set at 15 cm H2 O.

In the head-shaking group, the patient’s head was placed on the Neuroshaker and swung at a frequency of 1 cycle per second with an amplitude of 4 cm. In the head-shaking group, the patient’s head was placed on the Neuroshaker and swung at a frequency of 1 cycle per second with an amplitude of 4 cm. For bloody CSF and as the ICP control system. The cisternal catheter was removed between Days 11 and 14. The cisternal catheter was used both as an outlet for normal CSF, and a microdrop system was used to control the flow rate. The volume of drained fluid was measured hourly to avoid excessive infusion. The ICP was controlled by setting the drainage pressure control system at a height of 10 cm H2 O.

In the head-shaking group, the patient’s head was placed on the Neuroshaker and swung at a frequency of 1 cycle per second with an amplitude of 4 cm. Each session consisted of 15 minutes of head shaking followed by a 45-minute break. Forty-eight sessions were prescribed for each patient; therefore, the head-shaking treatment was continued for 48 hours and then terminated.

In both groups, the ventriculocisternal irrigation was continued for 72 hours, including the initial 12 hours without urokinase and the subsequent 60 hours with it. After the completion of irrigation, the ventricular catheter was removed and the cisternal catheter was used both as an outlet for bloody CSF and as the ICP control system. The cisternal catheter was removed between Days 11 and 14.

Diagnosis and Treatment of Vasospasm

Postoperatively, all patients were maintained in a normo- to mildly hypervolemic, normo- to mildly hypertensive state with intravenous administration of albumin. Medical treatments, including systemic administration of calcium channel blockers, antiplatelet, and/or other agents, or direct mechanical arterial dilation by angioplasty, were not routinely used. Transcranial Doppler ultrasonography studies were not performed routinely. Follow-up CT scans were obtained 12 hours after surgery and on Days 4, 7, and 14 after the initial SAH to detect cerebral infarction caused by vasospasm or other possible sources of neurological deterioration, including hydrocephalus and cerebral edema.

The diagnosis of symptomatic vasospasm was made when the patient experienced a focal neurological speech or motor deficit or decreased level of consciousness (best eye points 3 or less, and/or best motor points 5 or less on the GCS) more than 96 hours post-SAH. Once the diagnosis of symptomatic vasospasm was made, a hypervolemic, hypertensive state was induced in the patient by intravenous administration of dobutamine and an additional dose of albumin, and angiography was performed as soon as possible to confirm the diagnosis. Superselective intraarterial administration of urokinase was performed if the involved arteries were appropriate to the patient's neurological deficit.

Low-density lesions on CT scans were diagnosed as cerebral infarction caused by vasospasm if the lesions were absent on Day 4 and newly detected on Days 7 or 14. The diagnosis of cerebral infarction was based on reports made by independent radiologists who reviewed the films. Patients were referred to independent neurologists and to a neuropsychologist for neurological and neuropsychological evaluation. Permanent ischemic neurological deficit caused by vasospasm was evaluated 6 months after the onset of SAH. The final outcome of the patient was evaluated at the same time by using the mRS.

Statistical Analysis

The incidence of symptomatic vasospasm, cerebral infarction on CT scans and permanent neurological deficit caused by vasospasm was compared between the two groups (head-shaking compared with control) by using the Pearson chi-square or the Fisher exact test. The Mann-Whitney rank-sum test was used to evaluate the difference in the mRS scores between the two groups. A probability value of 0.05 or less was considered to be significant. Multivariate logistic regression was performed for the incidence of permanent ischemic neurological deficit to assess the independent effect of clinical and treatment variables including age, sex, site of aneurysm, preoperative grade, and presence or absence of head-shaking therapy, as well as to assess interactions between variables. Unreported probability values were not significant at the 0.1 level. All tests were performed using commercially available software (SPSS version 11.5 for Windows; SPSS, Inc., Chicago, IL).

Results

Eighty-three patients (36.1%) had an ACoA aneurysm, 86 (37.4%) had an ICA aneurysm, and 61 (26.5%) had an MCA aneurysm. On admission, 56 patients (24.3%) were Grade I according to the WFNS scoring system, 125 (54.3%) were Grade II, and 49 (21.3%) were Grade IV. The differences in age, sex, site of the aneurysm, and preoperative WFNS grade between the head-shaking and control groups were not statistically significant (Table 1).
Head-shaking method for prevention of vasospasm

TABLE 2
Incidence of symptomatic vasospasm, cerebral infarction, and permanent neurological deficits in 225 patients with SAH*

<table>
<thead>
<tr>
<th>Group (%)</th>
<th>Head-Shaking</th>
<th>Control</th>
<th>Total (%)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of patients</td>
<td>112</td>
<td>113</td>
<td>225</td>
<td>0.033†</td>
</tr>
<tr>
<td>symptomatic vasospasm</td>
<td>16 (14.3)</td>
<td>29 (25.7)</td>
<td>45 (20.0)</td>
<td>0.033†</td>
</tr>
<tr>
<td>days btwn SAH &amp; vasospasm</td>
<td>6–12</td>
<td>5–13</td>
<td>5–13</td>
<td>0.033†</td>
</tr>
<tr>
<td>aphasia</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>0.004‡</td>
</tr>
<tr>
<td>hemiparesis</td>
<td>4</td>
<td>13</td>
<td>17</td>
<td>0.043§</td>
</tr>
<tr>
<td>DOC</td>
<td>8</td>
<td>12</td>
<td>20</td>
<td>0.043§</td>
</tr>
<tr>
<td>cerebral infarction</td>
<td>5 (4.5)</td>
<td>20 (17.7)</td>
<td>25 (11.1)</td>
<td>0.004‡</td>
</tr>
<tr>
<td>permanent neuro def</td>
<td>3 (2.7)</td>
<td>10 (8.8)‡</td>
<td>13 (5.8)</td>
<td>0.043§</td>
</tr>
<tr>
<td>aphasia</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0.1</td>
</tr>
<tr>
<td>hemiparesis</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>0.051</td>
</tr>
<tr>
<td>DOC</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>0.051</td>
</tr>
</tbody>
</table>

* Five patients were excluded for various reasons (see Results). Abbreviations: DOC = deterioration of consciousness level; neuro def = neurological deficit.
† According to the Pearson chi-square test.
‡ Three patients in the control group suffered deficits in more than one category; therefore, the sum of patients with aphasia, hemiparesis, or deterioration of consciousness level is greater than 10.
§ According to the Fisher exact test.

Among the 230 patients, a malfunction of the cisternal catheter developed in five (2.2%; two in the head-shaking group). For those patients, the inlet and the outlet were exchanged using the mRS 6 months after the onset of SAH*

<table>
<thead>
<tr>
<th>Group (Grades)</th>
<th>Head-Shaking</th>
<th>Control</th>
<th>Total</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>109</td>
<td>103</td>
<td>212</td>
<td>0.051</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

| p = 0.051 according to the Mann–Whitney rank-sum test.

Seven patients in the head-shaking group and 13 in the control group underwent superselective intraarterial administration of fasudil hydrochloride,58 which led to clinical remission of vasospasm in five patients in the head-shaking and seven in the control group.

In 25 patients (11.1%) cerebral infarction due to vasospasm developed; this was demonstrated on CT scans. The incidence of cerebral infarction was 4.5% (five patients) in the head-shaking group and 17.7% (20 patients) in the control group (Table 2). The difference was statistically significant (p = 0.004, Pearson chi-square test).

In 13 patients (5.8%) permanent neurological deficit due to vasospasm developed. The incidence of permanent ischemic neurological deficit was 2.7% (three patients) in the head-shaking group and 8.8% (10 patients) in the control group (Table 2). The difference was statistically significant (p = 0.043, Fisher exact test).

In a multivariate logistic regression analysis performed for variables including age (≤ 65 or > 65 years of age); sex; site of aneurysm (ACoA, ICA, or MCA); preoperative WFNS score (Grade I, II, or IV); and treatment (head-shaking or control), the treatment category (control: p = 0.061) was the only factor that was associated with a higher incidence of permanent ischemic neurological deficit.

As shown in Table 3, the outcome of the patients evaluated using the mRS 6 months after the onset of SAH was Grade 0 in 212 patients (94.2%), Grade 1 in two (0.9%), Grade 2 in four (1.8%), Grade 3 in four (1.8%), Grade 4 in one (0.4%), and Grade 5 in two (0.9%). The clinical outcome was better in the head-shaking than in the control group, although the statistical difference was not significant (p = 0.051, Mann–Whitney rank-sum test).

Complications and Outcomes

Hemorrhagic complications occurred in four (1.7%) of the 230 patients. One patient in the control group suffered a second SAH from the aneurysm on Day 9 due to slippage of the clip and was excluded from the analysis. Another patient in the control group, in whom a left ICA aneurysm was diagnosed, suffered a small intracerebral hemorrhage in the right thalamus on Day 7; this lesion caused transient mild hemiparesis but did not affect the patient’s final outcome. In one patient in the control and one in the head-shaking group an acute epidural hematoma developed on Days 5 and 2, respectively. Both patients were treated con-
servatively and the hematomas did not affect their ultimate course.

Eight patients (3.5%, four each from the control and head-shaking groups) suffered from bacterial meningitis. The diagnostic criteria for this disease included the following: 1) glucose level in the CSF 34 mg/dl or less; and 2) white blood cell count in the CSF 2000/mm3 or more. In all eight patients, meningitis was well controlled by antibiotic agents and did not affect their outcomes.

In one patient in the head-shaking group (0.9%) discomfort similar to ear sickness developed 12 hours after initiation of the protocol. Head shaking was discontinued immediately and the symptom resolved soon after cessation of the therapy.

Complications unrelated to head shaking and/or the cisternal irrigation method included CSF otorrhea in one patient, which required surgical repair but did not influence the outcome. Also, cerebral infarction was identified in one patient with a left MCA aneurysm in whom left hemiparesis developed 33 days after the onset of the initial SAH. This patient suffered from a permanent left hemiparesis and was excluded from the analysis.

Chronic hydrocephalus that required a CSF diversion procedure occurred in 25 patients (10.9%). Ventriculoperitoneal shunt placement was necessary in 16 patients in the control group and in nine patients in the head-shaking group. The difference was not statistically significant (p = 0.151, Pearson chi-square test).

Discussion

In this study, patients were not randomly allocated to either of the groups (head-shaking and control). The only condition that dictated the allocation of the patients was the availability of the Neuroshaker apparatus, and there was no occasion for an arbitrary decision as to which patient would undergo the head-shaking method. Furthermore, the duration of each period for head-shaking and control treatment was 1 month for each throughout the entire period of the study. As a result, the clinical characteristics of the eligible patients were essentially identical between the head-shaking and control groups and the differences were not statistically significant (Table 1). Therefore, the results obtained should reflect the difference in the treatment almost exclusively and the reliability will be fairly comparable to a randomized controlled trial.

Cerebral Vasospasm After SAH

Cerebral ischemia remains the leading cause of illness and death after aneurysmal SAH. Angiographically detectable vasospasm may occur in as many as 70 to 90% of patients. Ischemic neurological deficits from clinically evident vasospasm occur in approximately half of patients whose angiograms demonstrate vasospasm. Severe symptomatic vasospasm occurs in approximately 25 to 37% of patients and causes permanent ischemic neurological deficit or death in 7 to 17%. The incidence and severity of cerebral vasospasm has been shown to correlate with the amount and location of blood in the basal cisterns.

The molecular mechanism of cerebral vasospasm remains to be elucidated, but it is now generally accepted that factors in the subarachnoid clot induce the muscular contraction and damage to the vessel wall. Several attempts have been made using different methods to remove these potential vasospasmogenic agents from the CSF space to prevent vasospasm. Extensive removal of the subarachnoid clot during aneurysm surgery has been advocated by some neurosurgeons, but clot removal in the acute stage after SAH is often difficult and may even be hazardous. Continuous cisternal drainage after aneurysm surgery has been reported to be effective in preventing vasospasm in several nonprospective studies. More recently, many studies on intrathecal fibrinolytic therapy have demonstrated the efficacy of tPA in preventing vasospasm.

Effectiveness of the Head-Shaking Method

Our study showed that the head-shaking method significantly reduced the incidence of symptomatic vasospasm and permanent ischemic neurological deficit in patients who underwent cisternal irrigation therapy with urokinase after aneurysmal SAH. Symptomatic vasospasm developed in 16 patients (14.3%) in the head-shaking group, compared with 29 patients (25.7%) in the control group. Three patients (2.7%) in the head-shaking group had permanent ischemic sequelae, compared with 10 (8.8%) in the control group. The figures in the control group are comparable to those of previous reports on intrathecal thrombolytic therapy. Because the patient population in this study is reasonably homogeneous due to the strict inclusion criteria, the difference between the head-shaking and control group is significant and should be interpreted to reflect the treatment effect of the head-shaking method.

The difference in the outcomes between groups, which was evaluated with the mRS, did not reach statistical significance (p = 0.051). This is attributed to the small number of patients who suffered permanent neurological deficits. A larger, controlled study is required to confirm the role of the head-shaking method in improving the clinical outcome of patients after aneurysmal SAH.

Study Design and Characteristics

Our study was designed with very strict inclusion criteria to make the patient population as homogeneous as possible. Only patients with severe SAH as defined by classification in Fisher CT Grade 3, who were considered to be at high risk of suffering vasospasm, were selected. Patients were included in this trial only if they were free from focal neurological deficit and able to obey commands promptly and respond verbally with good orientation within 24 hours after surgery. Patients in preoperative WFNS Grade III did not fulfill our criteria and were not enrolled in this study because they presented with major focal deficits (aphasia, hemiparesis, or hemiplegia) by definition, and these deficits persisted for several days after surgery. In general, 5 to 20% of patients undergoing aneurysm surgery awake with new neurological deficits because of surgical complications, including major vessel occlusion, which lead to or induce cerebral infarction and disabling stroke, cerebral contusion, and intracerebral hematoma. Once any of these complications arises, it can affect the analysis results by obscuring the true incidence of symptoms associated with vasospasm. The criteria we used...
Head-shaking method for prevention of vasospasm

were an attempt to exclude these disturbing factors and enable precise detection of symptomatic vasospasm. Any laterality in motor function, impairment in speech function and/or deterioration in consciousness level that occurred 4 days or more after the onset of SAH was diagnosed as vasospasm, provided that other conditions such as hydrocephalus, cerebral edema, or disturbed electrolyte balance that could lead to such deterioration were ruled out.

This series included a total of 49 patients who were classified in WFNS Grade IV on admission. Despite the fact that these “poor-grade” patients comprised 21.3% of the total, 94.2% ended up with an excellent result (mRS Grade 0) 6 months after SAH. The reason for such an extraordinary result seems to be our inclusion criteria. First, because only patients who were alert and without focal deficit 24 hours after surgery were included, only a very small fraction of the entire group of Grade IV patients treated at our institution during the same period were included. It is well known that quite a few patients with SAH who arrive at the hospital in poor neurological condition spontaneously improve within the next several hours, and the poor grade assigned on admission does not necessarily reflect the overall and ultimate clinical picture. Second, the definition of WFNS Grade IV covers a wide range of patients, whose GCS scores range from 7 to 12. Most of the Grade IV patients enrolled in this study had a GCS score of 12 (E2V4M6) and were able to obey verbal commands. For these reasons, the WFNS Grade IV patients enrolled in this study represent a rather exceptional subset of patients who had a much better chance of recovery than their average counterparts.

Complications With Neuroshaker Therapy

We chose a swinging frequency for the Neuroshaker of 1 cycle per second; the duration of each session was 15 minutes in all the cases. This setting was arbitrary; fortunately, only one patient experienced motion sickness and we encountered no other complication. Aoki reported two hemorrhagic complications and two cases of acute brain swelling in patients treated with the head-shaking method. This author operated the Neuroshaker at a frequency of 1.5 cycles per second for 48 to 72 hours. The continuous operation at a relatively high swinging frequency might have been the cause of the patients’ adverse effects. Intermittent operation at a frequency of 1 cycle per second is safe and not associated with serious complications.

Hemorrhagic complications developed in four patients in our series. These hemorrhages were considered to be related to urokinase, not to head shaking, because the incidence was identical between the two groups. In other studies of intrathecal tPA hemorrhagic complications have been reported with an incidence up to 70%. The risk of hemorrhage should always be kept in mind during irrigation therapy with fibrinolytic agents.

Bacterial meningitis developed in eight patients. The incidence of this infectious complication was identical between the head-shaking and control groups and was considered to be related to the long-term continuous cisternal irrigation; therefore, great care should be taken to keep this open system sterile.

Chronic hydrocephalus that required CSF diversion procedures developed in 16 patients in the control group, compared with nine in the head-shaking group. It is postulated that the incidence of CSF malabsorption is reduced when the subarachnoid clot is removed sooner, but the difference was not statistically significant and no definitive conclusion can be drawn from our result.

Conclusions

The efficacy of the head-shaking method in reducing the incidence of vasospasm and improving clinical outcomes in patients suffering from SAH was demonstrated. This method requires no more tasks than cisternal irrigation therapy with urokinase, in which great care is demanded of the residents and nursing staff to keep the open system sterile. The head-shaking method itself is simple, and it helps lower the risk of cerebral vasospasm by facilitating the removal of the clot from the subarachnoid space when combined with cisternal irrigation therapy with urokinase. To our knowledge, the effect of head shaking in preventing vasospasm is the most definite compared with any existing treatment protocol.

References

Head-shaking method for prevention of vasospasm


Address reprint requests to: Shunsuke Kawamoto, M.D., Ph.D., Department of Neurosurgery, Dokkyo University School of Medicine, 880 Mibu, Tochigi 321-0293, Japan. email: s-kawamot@dokkyomed.ac.jp.