Continuous Lumbar Drainage for the Preoperative Management of Patients with Aneurysmal Subarachnoid Hemorrhage

Hidenobu OCHIAI and Yuzo YAMAKAWA

Department of Neurosurgery, Miyazaki Prefectural Hospital, Miyazaki

Abstract

Continuous drainage of lumbar cerebrospinal fluid (CSF) was analyzed for the preoperative management of patients with aneurysmal subarachnoid hemorrhage (SAH) in 50 consecutive cases of surgically treated aneurysmal SAH. Patients were divided into a lumbar drainage group, in whom continuous lumbar CSF drainage was established for preoperative management, and a non-lumbar drainage group. Rebleeding from the aneurysm during the insertion of the lumbar drainage tube and during continuous lumbar drainage, effect on the control of the systolic blood pressure, and effect on the sedation of the patient were examined. Continuous lumbar CSF drainage significantly decreased the systolic blood pressure. Seven of 17 patients in the non-lumbar drainage group had systolic blood pressure uncontrollable to below 150 mmHg even when a large amount of nicardipine was used, whereas only two of 33 patients had the same problem in the lumbar drainage group. Sedation was better in the patients in the lumbar drainage group with a smaller amount of analgesics. The rebleeding rate was 11.7% among patients in the non-lumbar drainage group, and 9.09% among patients in the lumbar drainage group. No rebleeding occurred during insertion of the lumbar drainage catheter. Continuous lumbar CSF drainage improved control of systolic pressure and sedation, and is a useful method of preoperative management for patients with aneurysmal SAH.

Key words: lumbar drainage, subarachnoid hemorrhage, preoperative management

Introduction

Preoperative management in patients with aneurysmal subarachnoid hemorrhage (SAH) is intended to prevent rebleeding of the aneurysm because the prognosis mainly depends on the presence of primary brain damage. Adequate sedation and careful control of the patient’s systolic blood pressure are essential. However, sedation and control of blood pressure are not always easy in patients in the acute stage because of stress, confusion, nausea, and vomiting as a result of intracranial hypertension and meningeal irritation from the SAH. General endotracheal anesthesia may be administered as soon as the diagnosis of SAH is made, but this always troublesome procedure carries the potential risk of maintaining general anesthesia during transport for examination. Continuous lumbar cerebrospinal fluid (CSF) drainage can be performed in the preoperative state, but this procedure raises concerns about the possibility of aneurysm rebleeding, attendant pain, and variations in the CSF pressure induced by the insertion maneuver required for lumbar drainage.

This study investigated the value and risks associated with the use of preoperative continuous lumbar CSF drainage in patients with SAH.

Clinical Materials and Methods

Fifty consecutive patients with aneurysmal SAH, 13 males and 37 females aged from 34 to 88 years (mean 63.8 years), were treated at the Department of Neurosurgery of Miyazaki Prefectural Hospital from April 1, 1995 to March 31, 2000. All diagnoses of SAH were established by computed tomography (CT) and the location of the aneurysm was confirmed by angiography or three-dimensional CT angiography. Clipping of the aneurysm was performed in all patients. The patients were divided into two groups...
groups: the lumbar drainage group in whom continuous lumbar drainage was done for preoperative management from April 1, 1996 to March 31, 2000, excluding patients in whom surgery was started within 3 hours after admission; and non-lumbar drainage group including patients treated mainly from April 1, 1995 to March 31, 1996, and those patients in whom surgery had started within 3 hours after admission. We did not perform lumbar drainage in the preoperative period before March 31, 1996. We performed routine lumbar drainage after April 1, 1996, except for patients with large intracranial hematoma and patients in whom surgery was started within 3 hours after admission. This study included all patients with SAH admitted in this period except for patients with a large amount of intracerebral hematoma, because there was some risk of evoking transtentorial herniation by placing the lumbar drainage in cases of large intracerebral hematoma. Patients treated before March 13, 1995 were not included because the then-current strategy for blood pressure control and sedation of patients was very different.

Lumbar drainage was established by sedating the patient with modified neuroleptic anesthesia using an intravenous injection of 5 mg diazepam and 15 mg pentazocine. After the sedation, the patient was placed in the left lateral position. The puncture was made at the L4-5 or L3-4 intervertebral level. Local infiltrative anesthesia using a 1% lidocaine solution was induced from the skin to the interspinous ligament level. A small skin incision about 2 mm in length was then made, and the lumbar tap was performed. After inserting the needle into the lumbar canal, the lumbar drainage tube was inserted quickly to prevent rapid exit of the CSF. After the lumbar drainage tube was established, continuous lumbar drainage was started at a pressure of 15 cmH₂O.

Continuous intravenous injection of nicardipine was started at 1 mg/hr in patients with systolic blood pressure over 160 mmHg on admission. The patient's systolic blood pressure was then measured every 20 minutes, and the amount of nicardipine was changed to maintain the systolic blood pressure under 150 mmHg. In this study, mean systolic pressure is the mean of all values for systolic blood pressure measured every hour from admission to operation.

The effects of sedation were divided into good, fair, and poor sedation. In good sedation, the patient was sleeping but opened his/her eyes on a verbal command, otherwise the patient continued to sleep (corresponding to Ramsey’s score 211). In fair sedation, the patient was awake even when analgesics were administered (corresponding to Ramsey’s score 111). In poor sedation, the patient was awake even when analgesics were administered (corresponding to Ramsey’s score 011). In this investigation, the worst score for each patient was used. Sedation of a patient was started as soon as possible after neurological examination, using 5 mg diazepam and 15 mg pentazocine by bolus intravenous injection. After this procedure, continuous intravenous injection of 1 mg diazepam per hour and 1.5 mg pentazocine per hour was started and increased until the patient reached good sedation. The mean dosage of each drug per hour required to reach good sedation was analyzed.

The groups were compared for rebleeding from the aneurysm during the insertion of the lumbar drainage tube and during the continuous lumbar CSF drainage, the effect on the control of the systolic blood pressure, and the effects of sedation on the patient. Data are expressed as mean ± standard deviation. The two groups and the clinical features were compared with the Mann-Whitney U-test. The level of statistical significance was p < 0.05. Correlations within groups were tested using Pearson’s test. Data were analyzed with commercially available software (StatView 5.0 J; Abacus Concepts, Berkeley, Calif., U.S.A.).

Results

The clinical characteristics of each group are shown in Table 1. There were no significant differences in the age or sex distributions of patients in these groups. Table 2 shows the clinical grade according to the Hunt and Kosnik scale4) and amount of SAH according to Fisher group5) at admission for the patients in each group. These were no significant differences in the clinical grade or amount of SAH.

The mean time from the onset of SAH to completing the lumbar drainage procedure was 352.5 ± 321.6 minutes. Lumbar drainage was placed within 360 minutes (6 hours) from the onset in 21 patients and above 360 minutes in 12 patients.

I. Changes in preoperative systolic blood pressure

The mean systolic pressure on admission was 143.0 ± 32 mmHg in the lumbar drainage group, and 129.1 ± 16.7 mmHg in non-lumbar drainage group (p = 0.06). The mean systolic blood pressure was 143.0 ± 32 mmHg before drainage and 132 ± 19 mmHg after drainage, showing a significant decrease (p = 0.0226) (Fig. 1). Seven of 17 patients in the non-lumbar drainage group had uncontrollable preoperative systolic blood pressure even when a large amount of nicardipine was used. In contrast,
Table 1 Clinical characteristics of the lumbar drainage and non-lumbar drainage groups

<table>
<thead>
<tr>
<th></th>
<th>Lumbar drainage group</th>
<th>Non-lumbar drainage group</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>34–88 (64.9)</td>
<td>47–76 (61.82)</td>
<td>ns</td>
</tr>
<tr>
<td>Sex (male:female)</td>
<td>8:25</td>
<td>5:12</td>
<td>ns</td>
</tr>
<tr>
<td>Location of aneurysm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACoA</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>distal ACA</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MCA</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ICA</td>
<td>9</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BA tip</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BA-SCA</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>VA</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>others</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>


Table 2 Clinical grade and amount of subarachnoid hemorrhage (SAH) at admission

<table>
<thead>
<tr>
<th></th>
<th>Lumbar drainage group</th>
<th>Non-lumbar drainage group</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunt and Kosnik grade</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Ia</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>11</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Amount of SAH (Fisher group)</td>
<td>1</td>
<td>1</td>
<td>ns</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

ns: not significant.

only two of 33 patients in the lumbar drainage group had uncontrollable preoperative systolic blood pressure, showing a significant difference (p = 0.025).

II. Effects of preoperative sedation

The sedation effect was significantly better in the lumbar drainage group than in the non-lumbar drainage group (p = 0.002) (Fig. 2). The mean dosage of diazepam was 1.13 ± 0.9 mg, and the mean dose of pentazocine was 1.75 ± 1.8 mg per hour in the lumbar drainage group, and 3.2 ± 2.7 mg and 6.87 ± 7.7 mg per hour, respectively, in the non-lumbar drainage group, showing significant differences for diazepam (p = 0.01) and pentazocine

Fig. 1 Changes in the preoperative systolic blood pressure before and after lumbar drainage.

Fig. 2 Effects of preoperative sedation on Ramsey score.

(p = 0.009) (Figs. 3 and 4).

III. Preoperative aneurysmal rebleeding

Rebleeding was observed in two of 17 patients in the non-lumbar drainage group. Early operation within 3 days of onset was planned for these patients, but rebleeding occurred 3 hours after onset in one and 2 hours after onset in the other. Rebleeding was observed in three of 33 patients in the lumbar drainage group. Rebleeding occurred 4 days after onset in one and 5 days after onset in the other. Delayed operation (2 weeks after onset) was planned because of poor Hunt and Kosnik grade on admission (grade V) and advanced age (88 years) in these patients. Early operation was planned in the other patient, but rebleeding occurred 7 hours after onset. In patients in whom early operation was planned, rebleeding occurred in one of 31 patients in the lumbar drainage group, and in two of 17 patients in the non-lumbar drainage group. No rebleeding occurred when the catheter for lumbar drainage was inserted.

Neurol Med Chir (Tokyo) 41, December, 2001
Continuous lumbar CSF drainage started as soon as the diagnosis of SAH was made to decrease the intracranial pressure and meningeal irritation and to ease the process of preoperative sedation and management of blood pressure. As a result, the patient's headaches diminished, and control of blood pressure and sedation were easier with smaller amounts of antihypertensive agent and analgesics. Furthermore, the operation was more easily performed because an improved operative field was obtained with minimal retraction of the brain. Continuous lumbar CSF drainage for the management of SAH has previously been used after a clipping operation to prevent cerebrovasospasm and hydrocephalus.6–9)

Preoperative use of lumbar CSF drainage may have several risks. Firstly, rebleeding of the aneurysm may occur during the insertion procedure and the attendant pain from the puncture and insertion of a catheter. However, this risk may be easily overcome by adequately sedating the patient during the procedure, by providing an adequate local infiltrative anesthesia, and by rapidly inserting the catheter to prevent any excess leakage of CSF. In fact, we did not experience any rebleeding from aneurysms during the insertion of lumbar drainage catheters. No deterioration occurred in patients with SAH during lumbar puncture except for those with large intracerebral hematoma.3,10) Another possible risk is rebleeding of the aneurysm caused by a decrease in the CSF pressure resulting from drainage. Rebleeding evoked by a decrease in CSF pressure is commonly caused by the shear force at the aneurysmal tip that adheres to the surrounding brain tissue rather than a decrease in the packing pressure of the aneurysm. In other words, brain tissue is moved to some extent to decrease CSF pressure, resulting in disruption of the thrombus that attaches the ruptured aneurysmal dome tip to the surrounding tissue. However, lumbar CSF drainage causes the brain to shrink uniformly, so detachment of the aneurysmal tip would not occur. Therefore, rebleeding would not occur unless the ruptured aneurysmal dome had adhered to the dura matter (for example, a middle cerebral artery aneurysm).

The rebleeding rate in the group undergoing lumbar CSF drainage was 9.09%, which compares favorably with others reported preoperative rebleeding rates of 11%13) and 19%.5,12) This result suggests that continuous lumbar CSF drainage is a useful strategy for the preoperative management of patients with ruptured aneurysm in whom early operation is planned. However, the efficacy of continuous lumbar CSF drainage before delayed operation is still unclear, because rebleeding occurred in two of two such cases in the lumbar drainage group.

Continuous lumbar CSF drainage for the preoperative management of patients with ruptured aneurysmal SAH improved intracranial hypertension and meningeal irritation, and sedation and blood pressure control were easier to achieve. The risk of rebleeding was not increased, but apparently actually decreased compared to patients without lumbar CSF drainage. Preoperative lumbar continuous CSF drainage is a useful and safe tool for the preoperative management of patients with aneurysmal SAH in whom early operation is planned.

References


Address reprint requests to: H. Ochiai, M.D., Department of Neurosurgery, Miyazaki Medical College, 5200 Kihara, Kiyotake-cho, Miyazaki-gun, Miyazaki 889–1692, Japan.

Commentary on this paper appears on the next page.
**Commentary**

This is a very interesting study of potentially considerable importance, showing that after aneurysm hemorrhage, with preoperative lumbar drainage there was no increased risk of rebleeding, blood pressure was easier to control, and the amount of preoperative sedation needed was considerably reduced. CSF drainage has always been a concern in case the reduced pressure makes recurrent hemorrhage more likely, and this has been shown with ventricular drainage. The argument presented of a more uniform brain shrinkage with lumbar drainage may well be valid.

I presume the drainage removes irritating blood products and reduces intracranial pressure, thus lessening headache and the need for sedation. It would be interesting to know what the opening pressures were on LP, and also the volumes needing to be drained. I doubt if there would be universal agreement that a “good” level of sedation involves the patient sleeping all the time, but this does not change the principle.

The numbers who did not have drainage were small, and they were historical controls. It would be very worthwhile to do a more formal, randomized study on a much larger group, say 100 or more. It could not of course be even single-blind, but final outcome could be gauged by a blinded assessor. The impressive differences seen here would then be even more valid if reproduced; furthermore, the incidence of delayed ischemia could also be assessed in each group, to see if the removal of bloodstained CSF alone made a difference.

**Nicholas Dorsch, M.D., F.R.C.S., F.R.A.C.S.**
Department of Surgery
Westmead Hospital
Sydney, Australia

This paper points out the usefulness of preoperative lumbar drainage in the management of aneurysmal subarachnoid hemorrhage. The authors report that sedation and blood pressure were well controlled after drainage of the cerebrospinal fluid. Interestingly, lumbar cerebrospinal fluid drainage might reduce the risk of rebleeding. However, the rebleeding rate should be statistically evaluated with a larger number of the patients. I am wondering how intracranial pressure changes just after insertion of the drain tube. I look forward to seeing further clinical investigations from the authors.

**Shigeaki Kobayashi, M.D.**
Department of Neurosurgery
Shinshu University School of Medicine
Matsumoto, Nagano, Japan

The authors report on the use of lumbar CSF drainage for the control of systolic blood pressure and of the effects of sedation in SAH patients. Their criteria are not clear as many patients in Hunt and Hess grades IV and V were included in the study. Diffuse brain swelling is usually present in such patients and the risks of herniation are greater. If early surgical intervention is planned, the risks of CSF drainage in the pre-operative period should not be underestimated. In our practice, the control of these patients in the acute stage is performed in the intensive care unit maintaining the mean arterial pressure at 125 mmHg. Enalapril and nitroprussiate are used as antihypertensive drugs. Paracetamol is used for analgesic control, and opioid drugs (codeine and morfin) and dexamethasone are used when necessary. The sedation is performed using midazolam by bolus or continuous infusion. Early aneurysmatic clipping rather than continuous lumbar CSF drainage, which can lead to several complications like aneurysm rebleeding, herniated brain changes (even without intracranial hematomas), and CNS infection, is preferred.

**Feres Chaddad Neto, M.D.**
Helder Tedeschi, M.D.
and Evandro de Oliveira, M.D.
Instituto de Ciências Neurológicas
São Paulo, Brazil

neurol med chir (tokyo) 41, december, 2001