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Efficacy of Lumbo-Peritoneal Versus Ventriculo-Peritoneal Shunting for Management of Chronic Hydrocephalus Following Aneurysmal Subarachnoid Haemorrhage*

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Summary

Background. The clinical usefulness of lumboperitoneal (LP) shunts in selecting patients with communicating hydrocephalus after aneurysmal subarachnoid haemorrhage (SAH) was compared with that of ventriculoperitoneal (VP) shunts.

Method. Chronic hydrocephalus was defined as clinically and radiographically demonstrated hydrocephalus which lasted 3 weeks or longer after the original haemorrhage and which required shunting. Indications for a CSF shunt were assessed on the basis of neurological symptoms and signs, CT findings, and isotope cisternogram findings. The patients were treated with either LP or VP shunts. A significant response to shunting was defined as an improvement of function to a higher grade. The functioning of the shunt was evaluated by the location of the catheter on x-ray studies, CT features, and isotope cisternograms. The operation groups were checked for comparability of demographic and clinical variables including age, Fisher grade, hypertension, vasospasm, shunt interval, preshunt functional grade, and CT findings. A comparative analysis of the outcome was carried out between the two operation groups.

Findings. Fifty-six patients underwent shunt placements (LP shunts: 22, VP shunts with medium pressure valve: 2, VP shunts with high pressure valve: 32). There was no statistically significant difference in patient demographics and clinical characteristics between the patients with LP shunts and those with VP shunts. A follow-up time of 3 months to 8 years revealed clinical improvement in 11 cases (50.0%) of patients with LP shunts and 31 cases (91.1%) in VP shunts was seen (Fisher's exact test, $P < 0.005$).

Interpretation. These findings suggest that VP shunts are a better choice of treatment than LP shunts in treating chronic hydrocephalus after aneurysmal SAH.

Keywords: Chronic hydrocephalus; shunt; subarachnoid haemorrhage.

Introduction

It has been reported that ventriculoperitoneal (VP) shunts are predominantly utilized as the initial treatment of hydrocephalus. Since the percutaneous silastic lumboperitoneal (LP) shunt has been popularized by Spetzler [16, 17, 19], the LP shunt has found its greatest application in the treatment of communicating hydrocephalus (CH) because of the advantages of the extracranial surgical management and its simplicity when compared with cranial cerebrospinal fluid (CSF) shunts [1, 8, 9]. On the other hand, the choice of either a VP or LP shunt will depend on the CSF fluid flow dynamics and the surgeon's preference.

Clearly, cases of CH secondary to aneurysmal subarachnoid haemorrhage (SAH) can be selected more easily on the basis of clinical and radiological studies and responded more favourably to shunting than cases due to secondary trauma, other cerebrovascular disease, and idiopathic cases in my experiences as well as in the report of others [16, 21]. There was a report focusing on a comparison of the clinical applications and complications of a LP shunt with those of a VP shunt in patients with hydrocepalus after the various underlying pathological conditions including aneurysmal SAH [1]. A major drawback is that the complications of a LP shunt are more difficult to evaluate compared to a VP shunt. Moreover, low complication rates do not always indicate a good outcome due to the possibility of cases who do not have any complications but show poor outcomes such as insufficient drainage despite a patent shunt system.

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The present study was designed to evaluate the clinical outcome between two operation groups, by looking at the results of a single surgeon, in selecting patients with CH after aneurysmal SAH.

Methods and Patients

Of 483 patients treated by clipping of ruptured cerebral aneurysms who were admitted to the Department of Neurosurgery in Wonkwang University Hospital from January 1990 to December 1998, a total of 56 patients were treated with either LP or VP shunts. There were 24 men and 32 women, aged 32 to 72 (mean, 56 years). Patients with symptomatic hydrocephalus lasting 3 weeks or longer after the original haemorrhage were treated by placement of peritoneal shunts. Placement of an LP shunt was usually completed within 30 minutes under general or spinal anaesthesia. The LP shunt system in this series was silastic one piece tube with distal slit-valve (Medtronic Pudenz-Schulte Medical, Co., Goleta, CA). For VP shunting, a catheter with high pressure valve, Accu flo (Codman, Raynham, MA) was used. The entire skin was shaved, and adhesive covering was used over the skin. In all the patients, the ventricular catheter was inserted via an occipital-parietal burr hole. A catheter with a medium pressure valve for VP shunt which was used in initially 2 cases was replaced by a high pressure valve system for the remainder due to the development of 2 cases of subdural fluid collection and low pressure headache after shunting.

Patient selection for a CSF shunt was mainly assessed on the basis of neurological symptoms and signs, and hydrocephalus and periventricular lucency which showed no interval change or more progression at follow-up CT and/or MRI findings. The degree of ventricular dilatation was measured by frontal horn index (the ratio between the maximal width of the frontal horns and the width of the whole brain at the same level). The decision was also made together with radio-isotope findings showing ventricular reflux and delayed clearance of radio-active isotope for 48 hours. The patients were classified by pre-shunt neurological function, based on the Stein and Langfitt grading system [20] as follows:

Grade 0. No neurologic deficit, able to work

Grade I. Minimal deficit, able to function independently at home

Grade II. Some supervision required at home

Grade III. Custodial care required in spite of considerable independent function

Grade IV. No practical capacity for independent function.

Outcome at the follow-up period 3 months to 8 years after shunting varied a little according to pre-shunt neurological grade, and thus a response to shunting was assessed by the change of Stein and Langfitt grade [20]. The outcome was categorized as excellent (improvement of function of two or more grades), good (improvement of function of one grade), or poor (not improved). The functioning of both shunts were judged by neurological findings, CT features, radio-isotope scan, the location of the catheter on abdominal x-ray studies, and shuntogram.

The patients were divided into two groups; patients with LP shunts and patients with VP shunts. Two groups were checked for comparability of demographic and clinical variables including age, Fisher grade, hypertension, vasospasm, shunt interval, pre-shunt functional grade, and pre-shunt CT findings (frontal horn index, periventricular lucency) at entry by a t-test or Fisher's exact tests for categories. In the final analysis of the outcome at the last follow-up period, the significance of observed differences in the outcome between the groups were assessed by Fisher's exact test. A p value 0.05 or less was considered significant.

Table 1. *Characteristics of the Operation Groups*

Characteristics	LP shunt	VP shunt
No. of cases	22	34
Age (mean)	57	54
Sex (M : F)	8 : 14	16 : 18
Hypertension	12	13
Vasospasm	7	9
Fisher grade		
1	1	2
2	1	4
3	13	16
4	7	12
Shunt interval (mo)		
<1	8	6
1–3	13	22
4–6	0	4
>6	1	2

LP Lumboperitoneal; *VP* ventriculoperitoneal; *mo* month.

Results

The frequency of acute hydrocephalus occurring within 3 days after SAH was 117 (24.2%). In the present series, of 56 (11.6%) patients who required placement of a shunt, 22 patients had a LP shunt and 34 patients underwent VP shunting during the same period. Therefore, of the 117 patients with acute hydrocephalus, 56 (47.9%) underwent shunt surgery.

A comparison of clinical characteristics in the two patient groups is shown in Table 1. The number of patients who were treated by either LP or VP shunts was approximately the same for clinical factors. Functional grade received according to Stein and Langfitt grade [20] just before shunting was mainly III or IV, and it was well balanced among the two groups without any significant differences. Almost all of the patients revealed periventricular lucency (Table 2). The outcome of thirty-one patients (22: excellent, 9: good) with a VP shunt (91.1%) was improved, however, only half of the patients (3: excellent, 8: good) with a LP shunt (50.0%) were improved (Table 3). This difference was statistically significant (Fisher's exact test, $p < 0.005$).

In follow-up studies of patients who showed clinical improvement, all of the enlarged ventricles on CT or MRI reduced to nearly normal size. In contrast, there was a slight decrease or no gross interval change of preshunt hydrocepalus on CT scans of LP shunt non-responders. Follow-up radio-isotope scans also revealed ventricular reflux and delayed clearance of radioactive isotope. Catheters, which proved to be patent on peritoneal exposure, of LP shunt non-

Table 2. *Functional Grading and Computed Tomographic Findings Before Shunting*

Factor		No. of patients	
		LP shunt	VP shunt
Preshunt functional grade[a]	I	0	0
	II	3	1
	III	6	11
	IV	13	22
Frontal horn index (%)			
	30–39	9	10
	40–46	12	16
	>46	1	8
Periventricular lucency-	yes	20	31
	no	2	3

LP Lumboperitoneal; *VP* ventriculoperitoneal.
[a] Measured by Stein and Langfitt grade [20].

Table 3. *Outcome According to Two Shunt Methods*

Outcome[a]	No. of patients	
	VP shunt	LP shunt
Excellent	22	3
Good	9	8
Not improved	3	11
Total	34	22

VP Ventriculoperitoneal; *LP* lumboperitoneal.
[a] Defined by the change of Stein and Langfitt grade (excellent: improvement by two to a higher grade, good: improvement to one higher grade) [20]. $p < 0.005$ (Fisher's exact test, excellent or good vs not improved).

responders were revised electively under local anaesthesia, however patients were not improved. Only two patients were converted to VP shunts, and were subsequently improved; however, unfortunately the remainder refused shunt revision to VP shunt. Although ventricle size was nearly normal in two patients after VP shunts, they were still not improved. A 71-years-old woman who did not show ventricular shrinkage after a VP shunt with a high pressure valve system received revision to medium pressure, however she did not improve. There were no shunt-related infections; however there had been one case of obstruction in a VP shunt and two obstructions after LP shunts (1; peritoneal end, 1; migration of spinal catheter). The obstructed or migrated shunt was revised and the patients were improved. Two subdural fluid collections were encountered in the patients who were to improve neurologically following the shunt placement. These collections spontaneously resorbed on their own.

Discussion

Pathophysiology of neurological deterioration with ventricular dilation may be associated with a multifactorial process due to complex CSF flow dynamics. Although indications for shunting in chronic hydrocephalus after aneurysmal SAH are not well defined because of this complexity, a shunt will usually be beneficial in patients with a dilated ventricle who have plateaued in their neurological recovery or deteriorated several weeks after the haemorrhage.

The choice of either a VP or a LP shunt remains subjective, however, when hydrocephalus appears to be communicating, use of the LP shunt has recently increased because of its simplicity. LP shunts have been used with the aim of decreasing the number of complications due to cranial shunts [1, 7, 16, 17, 19]. Aoki [1] compared 207 patients with LP shunt placement to 120 patients undergoing placement of a VP shunt during the same period. He concluded that LP shunting should be given greater consideration for patients with communicating hydrocephalus, especially after aneurysmal SAH, because the incidence of complications with a LP shunt was significantly lower than that with a VP shunt. He only compared complication rates between two methods as that of others [10], however, it is not certain whether or not they assessed for insufficient drainage. We can expect a good outcome after revision in the cases of shunt occlusion but not in overdrainage or underdrainage because of difficulties in determining the exact flow pattern. Additionally, the occlusion of a LP shunt is more difficult to evaluate when compared with a VP shunt. Therefore, the present study was directed to compare the outcome rather than the comparison of complication rates between two shunt methods with each comparable clinical variables.

There was one obstruction in a VP shunt and two obstructions in LP shunts, but no infections at the last follow-up period in this series. In contrast, there was no shrinkage of the ventricles showing insufficient drainage in half of the patients after LP shunting. The present results were different from previous reports where LP shunts were the first choice in the treatment of communicating hydrocephalus [1, 16, 19]. The reported complications in shunt surgery vary considerably [2, 5, 6, 12, 14, 15, 18, 20]. A possible explanation for these various results is that different selection criteria between departments and many unknown variables may influence the results of shunt surgery. It is my impression that initial shunt failure such as overdrainage or underdrainage can usually be decided by the postoperative clinical course within a couple of months, however, complications such as chronic subdural haematoma, back pain, obstruction, migration, and fracture should be followed much longer. Lund-Johansen *et al.* [11] observed at a follow-up time of 1 to 9 years that shunt malfunction rates were lower in patients treated with VP shunts after an intracranial haemorrhage, than other groups. They emphasized that this rare occurrence of shunt malfunction resulted from a gradual normalization of resorption of CSF by a clearing of subarachnoid blood from the CSF, as Borgmann also suggested [3]. Accordingly, they indicated that given sufficient time after haemorrhage, many of these patients might no longer be shunt dependent. Indeed, it may be clinically difficult to differentiate between improvements at the long-term follow-up; can they be ascribed to shunting itself or spontaneous improvement.

There are several types of shunt systems in VP or LP shunts. Thus, the selection of a shunt system in each method is different according to the surgeon's preference because all shunts have their own advantages and disadvantages. For instance, Chumas *et al.* [4] emphasized that the T-type LP shunt fared significantly better than the percutaneous type in the paediatric population, and the overall survival characteristics for the T-tube shunt approximated those seen for VP shunts. Recently Ausman mentioned that a shunt device which exactly meets the requirements for CSF drainage has not been constructed, and concluded that the best shunt for a surgeon's practice is the one with which the surgeon feels the most comfortable. This was based on several commentators' responses that most shunts are compatible with each other, and many times even the simplest devices work as well as the more complicated ones [13]. In the present study, the author used the simplest shunt system in both methods, which had a rather low frequency of complication in my hands.

In summary, there was no significant difference in demographic and clinical variables between the two shunt groups in patients with CH after aneurysmal SAH. The surgical success rate was much higher in the VP shunt group than the LP group. These results suggest that VP shunts, if patients' conditions are not too risky for general anasthesia, are a better choice of treatment than LP shunts in the management of CH following aneurysmal SAH. Even though the series is relatively small to prove this conclusively, I believe that this will still hold true, considering that our latest results, which are not included in this series, follow the same trend.

Acknowledgments

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Comments

The study compares the effect on acquired hydrocephalus of ventriculoperitoneal and lumbo-peritoneal CSF shunting.

The result is very clear and convincing: Ventriculoperitoneal shunts are far more effective than lumboperitoneal shunts.

The patient material seems sufficient and the statistic analysis is adequate. It takes into account possible differences between the two groups regarding demographic and clinical variables.

S. Børgesen

The two possible types of shunt, lumbo-peritoneal or ventriculo-peritoneal, are usually used depending on the surgeon preferences. However the lumbo-peritoneal shunts are gaining recently more and more advocates. Thus the study comparing statistically the clinical results after both shunting procedures is highly desirable. The authors finding–clearly better results following ventriculo-peritoneal shunting, is very interesting. Although the author does not try to give us a credible explanation.

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