

Research Article

Comparing Lumboperitoneal Shunt and Ventriculoperitoneal Shunt in Normal Pressure Hydrocephalus.

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Abstract

Objectives: Diversion of CSF is the treatment for normal pressure hydrocephalus (NPH). This article aims to assess whether lumboperitoneal (LP) shunt is effective in patients with normal pressure hydrocephalus (NPH) as compared with ventriculoperitoneal (VP) shunt.

Materials and Methods: Case records of 23 patients diagnosed as NPH in the authors' organization for the last 5 years were obtained. 14 of them had undergone LP shunt and 9 had VP shunt. The preoperative, postoperative and follow-up features were noted for comparison.

Statistical analysis: Low mean score was observed for LP shunt in the post-operative period and this was significant ($P=0.007$). Pillai's Trace test indicated that there is a significant difference ($P < 0.001$) between the shunt types. Also estimated means using General Linear Model that LP shunt type can drastically reduce the NPH Grade scores after the surgery.



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Results: Twenty patients had good improvement of their symptoms and two patients died. Three patients in the VP shunt group and three in the LP shunt group had complications that were managed successfully. However, patients who underwent LP shunt had a much better outcome in the long term. These results were statistically significant.

Conclusions: Both VP shunt and LP shunt are equally effective in NPH, but LP shunt has the advantage of avoiding piercing the brain with its potential complications. Also, Long term results seem to be better with LP shunt.

Keywords: normal pressure hydrocephalus, shunt, long term, results.

Introduction

Idiopathic normal pressure hydrocephalus (iNPH) is a neurodegenerative condition described by Hakim (1) and clinically characterized by gait ataxia, urinary incontinence and memory disturbance. It is one of the few treatable neurodegenerative diseases in the elderly. Gait disturbance is a common and early symptom (2). Other symptoms include apathy, oropharyngeal dysphagia, frequent falls, and impulsive aggressive behavior (2). A few patients may present with Other symptoms including features of parkinsonism have also be described (3). Shunt surgery has been accepted as the best treatment modality in NPH. Studies have shown that around 60% of patients do improve after shunt (4). Many types of shunts have been described in the last 60 years with each having its own advantages and disadvantages. Miyake (5) showed that differential pressure valves should be the first line in shunts because of their superior efficacy and also from a medico-economic standpoint. The most important goal in shunt management is to control the intracranial pressure and not the shunt flow.



Traditionally VP shunts have been used for all types of hydrocephalus. Aoki and coworkers (6) proposed that LP shunt has the advantage of being completely extracranial thus minimizing intracranial complications. They studied 207 patents retrospectively in 11 years and concluded that in the case of the communicating hydrocephalus LP shunt is effective and may have much fewer side effects than VP shunts. A similar conclusion was also reached by Yadav and colleagues (7).

Material and methods

This is a retrospective case note study with follow-up done for up to 5 years. There were 28 patients with NPH who underwent shunt procedures in our center from 2013 to 2019 but five patients could not be traced and were lost for follow-up. Out of the rest 23, 14 of them had undergone LP shunt and 9 had VP shunt. There were 14 males and 9 females between 58 and 79 years of age. The patients were diagnosed clinically and radiologically (MRI). LP drainage of CSF (30 ml) was done as is the standard to confirm the diagnosis. Postoperative follow-up was from 14 months to 5 years. All the patients were assessed by the Japanese Health Ministry research grading scale for NPH as described by Mori (8). The same scale was used for assessment at postoperative discharge and during follow-up at about one month (see **table 1**). Modified Rankin scores (mRs) were used to assess patients at longer follow-up visits (**Table 1**). The first author always offered an LP shunt to patients and the second author VP shunt as a routine practice. All the cases were done in the same hospital. Follow-up was only clinical and radiology was added only if new symptoms appeared. The shunt used was Chhabra medium pressure shunt for VP shunt (a differential pressure type) and Chhabra the peritoneal shunt tube. The Chhabra shunts are in use in India for a very long time and are very effective and cheap.

Results

Out of the 23 patients, 14 undergone LP shunt and 9 had VP shunt. As mentioned earlier the first author always offered an LP shunt to patients and the second author VP shunt. Most of the patients improved in the INPH grade in both groups. There were nine females and 14 males in this study. In the LP shunt group patients were from 58 years to 79 years (Mean 67.67). In the VP shunt group, the youngest patient was 60 and the oldest 78 (Mean 70.11). The INPH scores at admission, at the time of discharge and during the follow up which is at the time of our data collection are given in **Table 1**.

**Table 1 Clinical Details**

no	age	sex	shunt	NPH Grade		adverse effects	Follow up 1 month	long term Rankin	cause of deterioration
				Preop	Discharge				
1	64	M	LP	G4D3V3 = 10	G2V2D2 = 6	Subdural collection	G2V2D2 = 6	4	
2	71	M	LP	G4D3V4 = 11	G4V2D3 = 9	Subdural collection	G0V1D1 = 2	1	
3	79	M	LP	G4D4V4 = 12	G2V3D4 = 9	myocardial infarct	G0V0D0 = 0	6	Myocardial Infarct
4	58	F	LP	G3D3V2 = 8	G1D1V1 = 3	Subdural collection	G0V0D1 = 1	1	
5	64	F	LP	G2D2V4 = 8	G0V0D0 = 0	No adverse effects	G0V0D0 = 0	0	
6	63	M	LP	G4V4D3 = 11	G1D2V1 = 4	No adverse effects	G0V0D0 = 0	0	
7	60	F	LP	G3V3D4 = 10	G0V3D2 = 5	Shunt block	G4V3D1 = 8	3	
8	75	M	LP	G4V3D3 = 10	G0V0D0 = 0	No adverse effects	G0V0D0 = 0	1	
9	68	F	LP	G1D2V4 - 7	G1D1V1 = 3	No adverse effects	G1D1V1 = 3	1	
10	75	M	LP	G2V2D4 = 8	G0V0D0 = 0	No adverse effects	G0V0D0 = 0	0	
11	71	M	LP	G3D3V4 = 10	G2D3V2 = 7	No adverse effects	G1V1D3 = 5	3	
12	66	M	LP	G4D4V4 = 12	G2D1V2 = 5	Shunt block	G2V3D3 = 7	4	
13	62	F	LP	G3V4D3 = 10	G0V1D1 = 2	No adverse effects	G0V1D1 = 2	0	
14	70	F	LP	G4V4D3 = 11	G2V2D3 = 7	No adverse effects	G3V1D1 = 5	3	Hemiplegia
15	67	M	VP	G4V3D4 = 11	G4V2D2 = 8	CSF leak & infection	G2V1D1 = 4	2	
16	60	F	VP	G4D4V4 = 12	G4D4V4 = 12	No improvement	G4D4V4 = 12	5	
17	74	M	VP	G3V2D3 = 8	G2V1D3 = 6	CSF leak from burr	G2V1D3 = 6	4	herniation
18	73	M	VP	G3V4D3 = 10	G2V3D3 = 8	Shunt block	G1V1D3 = 6	3	
19	78	F	VP	G2V2D3 = 7	G1V1D2 = 4	Subdural collection	G0V0D0 = 0	0	
20	69	M	VP	G4V4D4 = 12	G3V3D3 = 9	No improvement	G4D4V4 = 12	5	hyponatremia
21	77	M	VP	G3V4D2 = 9	G2V3D2 = 7	Subdural collection	G4V1D2 = 7	4	Hemiplegia
22	61	F	VP	G4V3D3 = 10	G4V4D4 = 12	No improvement	G4D4V4 = 12	6	status epilepticus
23	72	M	VP	G4V2D3 = 9	G2V2D3 = 7	shunt block	G1V2D3 = 6	2	

Table 1: Clinical details of the patients.

The clinical details are described in **table 1**. There were two deaths one in each group. One 79-year-old man who underwent LP shunt was a known ischaemic heart disease patient who developed a massive myocardial infarction on the fourth day and could not be saved. The other patient had status epilepticus about 40 days after VP shunt and did not survive. Two other patients after VP shunt did not improve after surgery. One was brought in altered sensorium five days after a trial which was positive. So an impression of raised intracranial pressure was suspected and a shunt was done. However, he did not improve and after 15 months of follow up continued to be in a vegetative state. The other patient developed hyponatremia and went into a coma. The sodium levels were corrected but the patient did not improve. Subdural collection happened in three patients after LP shunt and in two patients after VP shunt. Initially, the abdominal incision in the LP shunt was being placed at a lower level compared to the lumbar incision and possibly because of gravity excessive drainage was happening. So later the abdominal incision was planned slightly above and this problem was avoided. One patient after VP shunt had hemiplegia about 2 years after the shunt; MRI showed a large subdural hematoma. The hematoma



was drained but the weakness did not improve. Shunt block happened in two cases each and was revised appropriately. In the patient with VP shunt, it was revised twice. Two patients developed a CSF leak after VP shunt and one patient, a diabetic showed evidence of infection with fever and high blood counts. Both were treated with antibiotics and both patients settled down.

Patients were discharged from the fourth to the seventh day and the INPH score was done at discharge. The details of the scores are given in **table 2**. The Modified Rankin score (mRs) was put for 21 patients at follow-up (**Table 3**). From this, it can be seen that the short term, as well as the long term results of LP shunt, was much better than VP shunting. Moreover, complications were seen in more patients in the V P shunt group.

	L P Shunt Group		V P Shunt Group	
	Post Op	Followup	Post Op	Followup
<u>Gait</u>				
Improved	11	9	5	5
same	2	2	4	3
Deteriorated	0	2	0	0
<u>Dementia</u>				
Improved	10	4	3	2
same	3	8	6	5
Deteriorated	0	1	0	1
<u>Incontinence</u>				
Improved	11	5	6	4
same	2	7	3	3
Deteriorated	0	1	0	1

Table 2: Comparing the clinical features in the two groups after surgery and during follow up



L P Shunt Group		V P Shunt Group	
mRs Score	No of patients	mRs Score	No of patients
0	4	0	1
1	4	1	0
2	0	2	2
3	3	3	1
4	2	4	2
5	0	5	2
6	1	6	1

Table 3: Modified Rankin Scale at follow up

An analysis was done for the adverse effect and shunt type by age and NPH grade scores. It was found that the average PH-score is least for no adverse effect category and it was significant ($P= 0.007$). Similarly, a significant difference was observed ($P= 0.010$) after a one-month follow-up (**table 4**). The NPH scores were compared between the shunt types. A low mean score was observed for LP shunt in the post-operative period and this was significant ($P=0.007$). Similar significance (0.010) was also noted after a one-month follow-up (**table 5**). Rank score compared using Mann-Whitney U test showed no real significance. Pillai's Trace test indicated that there is a significant difference ($P < 0.001$) between the shunt types over the three-time points. The Post-hoc test did not show much significant difference between the shunt types in the postoperative period and after one-month follow-up. It can be clearly inferred that the observed difference is due to the post-operative value of NPH Grade scores for LP shunt. It is further supported by the estimated means (**Figure 1**) using General Linear Model that LP shunt type can drastically reduce the NPH Grade scores after the surgery.



	Adverse Effect Mean (SD)				Shunt Type Mean (SD)		
	No Adverse effect (n=8) Mean (SD)	Subdural collection (n=5) Mean (SD)	Other Effect (n=10) Mean (SD)	P Value	LP (n=14) Mean (SD)	VP (n=9) Mean (SD)	P Value
Age	68.5 (5.15)	69.6 (8.56)	68.1 (6.51)	NS	67.6 (6.20)	70.1 (6.45)	NS
PreOp- NPH- Grade scores	9.4 (1.51)	8.8 (1.64)	10.6 (1.43)	NS	9.9 (1.56)	9.7 (1.80)	NS
Post-Op NPH- Grade scores	2.6 (2.62)	6.8 (1.92)	7.4 (3.50)	0.007	4.1 (0.32)	8.0* (2.65)	0.007
NPH-Grade scores (after one month) follow- up	1.9 (2.23)	3.8 (3.49)	7.2 (3.94)	0.010	3.0 (3.06)	7.1* (4.17)	0.013
Rank	1.0 (1.31)	2.0 (1.87)	4.0 (1.49)	NS	1.9 (1.90)	3.4 (1.88)	NS

Table 4: Comparing adverse effects

	Shunt Type	Mean	SD	N
Pre operation value	LP	9.86	1.56	14
	VP	9.67	1.80	9
Post operation value	LP	4.07	3.32	14
	VP	8.00	2.65	9
After one month follow-up	LP	3.00	3.06	14
	VP	7.11	4.17	9

Table 5: Mean NPH-Grade scores By Shunt type for three Time points

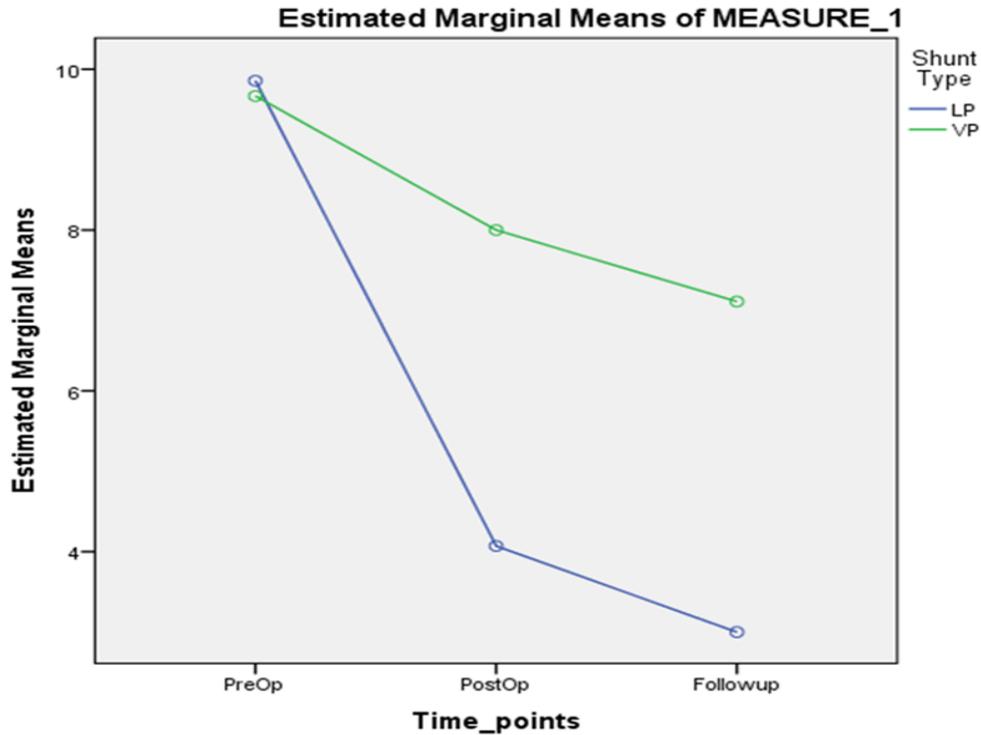


Figure 1 Estimated marginal Means of the two groups

Discussion

In this retrospective study with a long-term follow-up, both VP, as well as LP shunts, was effective in reducing symptoms but the results of LP shunts were better. One of the earliest studies on lumboperitoneal shunt was by Philippon and coworkers (9). They treated forty-six patients of NPH with LP shunt. Postoperative results were good and complications of LP shunts were mild and did not compromise the outcome. So they recommended the use of an LP shunt in the treatment of NPH. There have been further studies comparing LP shunt and VP shunt in hydrocephalus of various aetiology. Aoki (6) did a retrospective study of 207 patients who underwent LP shunt and compared this with 120 patients who underwent VP shunt. There was a revision rate of 14% and an infection rate of 1% and two patients had a subdural hematoma. They concluded that the incidence of infection and malfunction with LP shunt was much lower compared to VP shunt. Also, LP shunt avoided intracranial complications. Yadav and coworkers (10) conducted a prospective study in 409 patients with communicating hydrocephalus. A majority of them were tuberculous meningitis patients. They also concluded that LP shunt was effective in communicating hydrocephalus.



Amit and Vajpeyi (11) compared LP shunt and VP shunt in post meningitic communicating hydrocephalus in children. Only children with post meningitis communicating hydrocephalus who underwent either LP or VP with a minimum follow-up period of 36 months were included in the study. Medium pressure Chhabra shunt with slit valves was used in all cases of VP and LP shunt. LP shunt was performed in 37 while VP shunt in 53 cases. The complication rate in the LP and VP shunt was 15% and 29% respectively. Non Obstructive complications were higher in the VP shunt group when compared to the LP shunt group. The obstructive complication rate was similar in both groups. So the study concluded that LP shunt can be an alternative to VP shunt in cases of communicating hydrocephalus in children. Zhan Peng and colleagues (12) compared the retrospective efficacy of LP and VP shunt and their associated complications in 158 patients. They found that the efficacy of both LP shunt and VP shunt was the same but the complication rate of LP shunt was much lower. The conclusion was that in moderate and severe post hemorrhagic communicating hydrocephalus, LP shunt surgery is equally effective as VP shunt surgery and is associated with fewer complications. Tsung-Hsi Yang (13) and others described a two-stage technique for LP shunt surgery and compared the results and complications with VP shunt. Revision rate and shunt infection was 1% each in the LP shunt group whereas it was 13.5% and 5.7% in the VP shunt group. So they opined that recent improvements in the quality of the LP shunt device and the proficiency of the procedure have made the LP shunt a safer procedure than the VP shunt. With the two-stage procedure, an LP shunt can be used to decrease the complications and revision rates.

Miyajima, Kazui, Mori and Ishikawa (14) looked at the one-year outcome in patients with INPH and compared 83 patients who underwent LP shunt with historic VP shunt patients in a prospective multicenter study. The outcome was compared in both the groups at 1 year by both Modified Rankin score and iNPHGS score. The proportion of patients experiencing serious adverse events (SAEs) and non-SAEs did not differ significantly between the groups 1 year after surgery. But more shunt revisions happened in the LP shunt group. So the authors concluded that the efficacy and safety rates for LP Shunt are comparable to those for VP shunts in patients with iNPH. Despite the relatively high shunt failure rate, LP shunt can be the treatment of choice because of its minimal invasiveness and avoidance of brain injury. Bayar et al (15) looked at the efficacy of LP shunt in 65 patients with NPH. There was very good improvement in the clinical picture with very few complications at one year. So they concluded that LP shunt surgery is associated with a lower rate of complication in comparison to VP shunt surgery and is an effective procedure in the treatment of NPH. Recently Liu and Su (16) investigated retrospectively whether the efficacy of LP shunt in 42 patients was sustained over time. They found that most measured parameters improved over time but by three years the parameters start declining. They suggested that the LP shunt was efficient in the short term. However, the neurological degeneration was



still progressive. In our study also noted that in some patients the improvement was not sustained and a few of them had actually deteriorated over time.

This is a retrospective case note study with all its disadvantages. So to prove this point we plan to do a randomized controlled study soon.

Conclusion

Lumboperitoneal shunt could be a better alternative in normal pressure hydrocephalus with good results and with much less side effect profile especially because the brain need not be punctured. Also, long-term results seem to be better with LP shunt.

This is a retrospective case note study done in New Hope Hospital. There was no funding received for this study. Also, there is no conflict of interest in this study. Informed consent was obtained from the patient before his details and X-rays were used for this article.

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