

Programmable Ventriculo Peritoneal Shunt Outcomes of Normal Pressure Hydrocephalus: A Case Series of 10 Patients

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Abstract: **Background:** Patients with normal pressure hydrocephalus (NPH) may benefit from a programmable Ventriculoperitoneal shunt (VPS) to divert cerebrospinal fluid (CSF). This study aims to examine the results, complication rates, and predictors of Programmable VPS installation in patients with NPH. **Methods:** We retrospectively evaluated 10 patients with NPH (7 males and 3 females) who had Programmable VPS placement between January 2023 and June 2023. These individuals showed objective and/or subjective improvement following a lumbar drain experiment. Clinical improvement following shunting. Complications associated with the VPS operation were documented. **Results:** The study population had a mean age of 69 years (range: 50–80). The average duration of gait disturbance, cognitive impairment, and urine incontinence were 18.4, 15.4, and 13.4 months, respectively. Out of the 10 patients, 9 had a 4-week follow-up; among them, 7 reported improvements in gait, 4 in incontinence, and 1 in cognition. Gait improvement was more significant compared to improvements in incontinence or cognition. A shorter length of gait disruption predicted greater gait improvement following shunting. Patients taking cognitive-enhancing medicines were more likely to report improvement in cognition and/or incontinence following shunting. Complications included misplaced proximal catheters (n-1), asymptomatic catheter tract Infection (n -2), subdural hematomas (n-1), CSF leak (n-0), and post-op mortality (n-1). **Conclusion:** Programmable VPS installation in patients with NPH is well tolerated and linked with better results in the short-term follow-up period (<6 months). A shorter period of gait disturbance and the use of cognition-enhancing medicines are predictors of improved recovery following shunting.

Keywords: normal pressure hydrocephalus (NPH), ventriculoperitoneal shunt (VPS), cerebral spinal fluid (CSF), outcome, complications

1. Introduction

Normal pressure hydrocephalus (NPH) affects a tiny number of older people, ranging from 0.5% to 2.9%^[1]. Patients commonly report symptoms, including gait disturbance, cognitive deterioration, urine incontinence, and ventricular enlargement^[2]. The fundamental etiology of NPH remains unknown, and around 50% of patients have no recognized predisposing factors^[3]. To examine the possible response to cerebrospinal fluid (CSF) diversion, a lumbar tap or short-term lumbar drain (LD) study is often done^[4]. However, the clinical response to these operations is generally transitory. Therefore, a permanent CSF diversion with a ventriculo peritoneal shunt (VPS) is regarded as a therapy option for NPH patients. Shunting has demonstrated clinical relief in 70% to 85% of patients, while complication rates can reach up to 35%^[5]. LD trials are extremely sensitive in predicting shunting responses. Nonetheless, there is no definitive test that may properly predict long-term benefits from shunting, necessitating continued study into developing trustworthy predictors of shunt outcomes. However, the conclusions of such investigations have been contradictory^[6]. This study

aims to evaluate the outcomes, complications, and relationships with predictors following VPS in NPH patients and review the current literature on the issue.

2. Material and Method

From January 2023 to June 2023, our institute's neurosurgery department conducted retrospective observational research. Ten individuals with normal pressure hydrocephalus (NPH) were treated for 6 months. All patients received an MRI Brain, CT Brain (Figure 1), or both to evaluate any related reasons and select the surgical procedure. Clinical examination and neuroimaging were done in the neurosurgery clinic by recognized standards to assess for a probable NPH diagnosis^[7]. Patients with the typical NPH triad and ventriculomegaly disproportionate to brain atrophy were regarded as potential candidates for a lumbar drain (LD) experiment^[7]. The LD study supported the NPH diagnosis and provided insight into the possible response to persistent cerebrospinal fluid (CSF) diversion. Patients who exceeded one-week reliable change markers, indicated improvement by one or more standard deviations on

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assessment measures, or reported subjective improvement as observed by patients or family members were considered "responders" in the LD study [7]. The results of the LD experiment were reviewed with the patients and their families, and the responders were given a programmable ventriculoperitoneal shunt (VPS) Surgery (Figure no. 6). Nonresponders were sent to Neuromedicine for a more thorough assessment of their functional deterioration. A Codman programmable valve Shunt (Johnson and Johnson, MA, USA)(Figure 2) was used in the majority of instances [7]. In the case of shunt infection, intravenous antibiotics were given to cover both gram-positive and gram-negative pathogens. Wound healing was aided by local cleansing and the administration of topical antibiotic cream. The follow-up was performed as an outpatient procedure. A phone conversation with the parents was employed in the event of a delayed visit to the outpatient department. Patients were called every month for the first six months, or sooner if there was any sign of symptom alleviation.



Figure 3: Device with Notch pointer under fluoroscopy



Figure 1: Preop C.T Brain of NPH

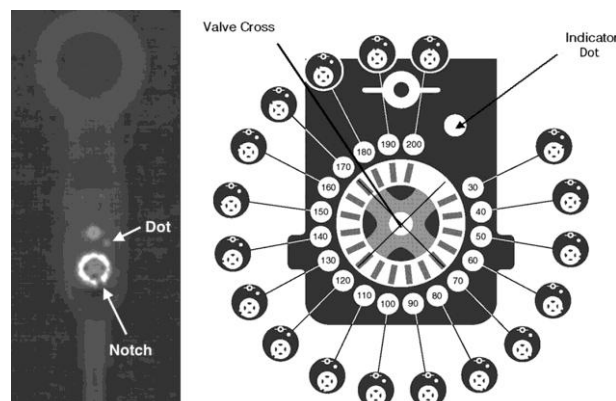


Figure 4: Reference Graph for Shunt Device

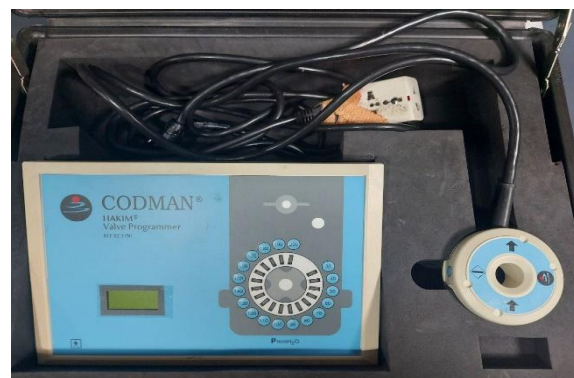


Figure 5: Valve programmer of shunt



Figure 2: Codman programmable valve Shunt



Figure 6: Shunt Device Insertion Intraoperatively

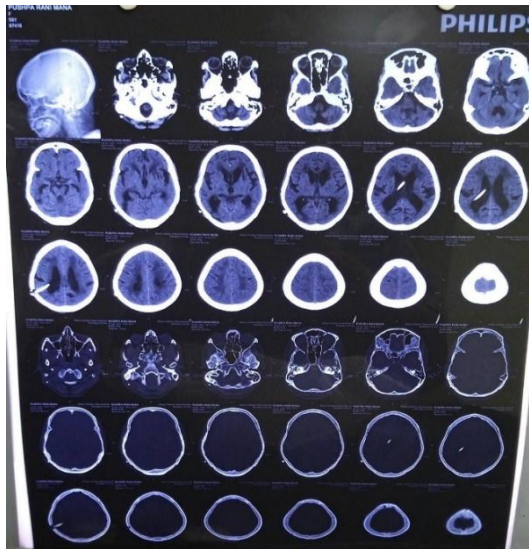


Figure 7: Post-op C.T scan of Programmable Shunt

3. Outcome Assessment

Age, gender, medical co-morbidities, the use of cognition-enhancing medications (such as anti-Alzheimer's and anti-Parkinson agents), and the duration of preoperative gait disturbance, cognitive dysfunction, and urinary incontinence were all recorded as potential clinical predictors of VPS outcomes [8]. Prior spine surgery causes, such as cervical or lumbar stenosis, were mentioned [8]. Preoperative brain MRIs were used to gather radiographic parameters such as the callosal angle, temporal horn size, and the presence or absence of disproportionate subarachnoid spaces [8]. The

angle formed by the lateral ventricles on a coronal incision at the level of the posterior commissure was designated as the callosal angle [8]. The maximal dilation of both temporal horns averaged together in millimeters (mm) was referred to as temporal horn size [8]. The unequal growth of supratentorial CSF spaces was described as disproportionate subarachnoid space [8]. Patients were scheduled for a two-week follow-up clinic appointment to monitor wound healing, remove sutures, and evaluate symptoms. Following follow-up appointments were scheduled based on the degree of recovery, the existence of problems, and the necessity for valve pressure adjustments. Patients were evaluated for clinical and functional improvement in their NPH symptoms at each visit. Basic cognitive and gait examinations were used to determine clinical progress, with gait assessed visually for fluidity, speed, and balance. The patient's capacity to do daily activities and general quality of life was assessed to measure functional improvement. The attending surgeon recorded NPH symptom outcomes as "better," "same," or "worse." Symptoms were considered "better" if there was a persistent improvement over baseline symptoms reported by the patient and/or family members, as well as objective improvement in cognitive and gait tests at follow-up visits [8]. Gait and cognitive results were regularly recorded, although urine incontinence was sometimes withheld if it was thought to be multifactorial. A CT brain scan was conducted if complications were suspected. During follow-up visits, VPS settings (Figure no. 3,4,5) were modified based on symptomatic response or the emergence of problems (valve pressures were lowered in the absence of significant symptomatic improvement or raised in cases of hygromas or low-pressure headaches) [8].

sr. no.	age	sex	comorbidity	NPH Symptoms (months)			Radio S/o HCP	Resp. to LD trial	prog. shunt done	Post op NPH Symp			Complication	Follow up
				Gait	urinay Incont	Dementia				same	better	worse		
1	68	M	parkinsonism	17	12	6	yes	yes	yes	same			shunt infec	stable
2	76	F	Diabetes	27	9	10	yes	yes	yes		better			stable
3	72	M	Diabetes	19	20	15	yes	yes	yes		better		prox. mig.	stable
4	65	M	parkinsonism	22	16	10	yes	yes	yes		better			stable
5	83	M	Alzheimers	24	15	26	yes	yes	yes	same				stable
6	78	M	Hypertensive	15	9	8	yes	yes	yes		better			stable
7	58	F	Hypertensive	22	26	12	yes	yes	yes		better		sdh	died
8	70	M		14	17	13	yes	yes	yes		better			stable
9	68	M	Diabetes	24	13	6	yes	yes	yes		better			stable
10	52	F	Hypertensive	26	17	10	yes	yes	yes		better			stable

NPH- Normal pressure hydrocephalus, incont- incontinence, Radio- Radiology, HCP- Hydrocephalus, Resp.- Response, Prog. - Programmable, Sym- symptoms, prox. -proximal, Mig. – Migration

population. The average age is 69, while the standard deviation is about 8.68.

4. Result

Table 1

Gender	Total Number	Percentage
Male	7	70%
Female	3	30%
Total	10	100%

This research (Table No. 1) included 7 males (representing 70% of the participants) and 3 females (30% of the participants). The table also includes a row for the total number of participants, which is ten, as well as a percentage column that totals 100% to reflect the whole research

Table 2

Symptom	Average Months
Gait	18.4
Urinary Incontinence	15.4
Dementia	13.4

This chart's "Symptom" column lists the symptoms of interest, which are gait, urinary incontinence, and dementia. The "Average Months" column (Table no. 2) represents each symptom's average duration (in months) based on the data provided. The average length of gait symptoms is 18.4 months, 15.4 months for urinary incontinence symptoms, and 13.4 months for dementia symptoms, according to data.

Table 3

Comorbidity	Count	Percentage
Parkinsonism	2	20%
Diabetes	4	40%
Alzheimer's	1	10%
Hypertensive	3	30%
Total	10	100%

Two persons had Parkinsonism, accounting for 20% of the total number of participants, according to the statistics. Diabetes was discovered in four people, accounting for 40% of the total. One person, representing 10% of the total, had Alzheimer's disease, while three others had hypertensive comorbidity (**Table No. 3**).

Table 4

Sr. No.	Post-op NPH Symptoms	Percentage Relief
1	Same	20%
2	Better	80%

Seven of the ten patients (70%) reported improvement in post-operative NPH symptoms (**Table no. 4**). Two (20%) patients exhibited the same post-operative NPH symptoms. One patient Died.

5. Discussion

Normal Pressure Hydrocephalus (NPH) is a neurological disorder characterized by an abnormal buildup of cerebrospinal fluid in the brain, which causes gradual cognitive deterioration, gait difficulties, and urine incontinence. Shunting, a surgical treatment that diverts excess fluid, is routinely used to relieve symptoms^[14]. Based on a review and prior studies, this essay will explore the results and determinants of shunting in NPH patients.

Improvement Rates and Symptom Response: In NPH patients who had to shunt, the evaluation predicted an overall improvement rate of 70% at three months and 80% at 6 months. In contrast to dementia or incontinence, gait was shown to be more likely to improve. Consistent with previous research, cognitive impairment was rated as the symptom least likely to improve following shunting. These data emphasize the variable sensitivity of various NPH symptoms to surgical intervention^[14].

Sustained Improvement and Factors Influencing Outcomes: Previous studies found long-term improvement in gait, with some reporting persistent improvement for five to seven years. However, at future follow-up visits, a fraction of patients saw a reduction in postoperative gait improvement. Age was investigated as a prognostic factor, with conflicting findings. While our study did not identify a significant relationship between age and prognosis, more research is needed to provide solid proof. Gender also seems to have a factor, with male patients being more prone to NPH than females, however, bigger studies are needed to prove this^[14,16].

Comorbidities and Duration of Symptom Onset: A shorter duration of symptoms was related to better results following shunting. However, the best period for full recovery is yet unknown. Furthermore, the prevalence of comorbidities,

particularly vascular disorders, was linked to worse outcomes. In our findings, diabetes, hypertension, etc. did not have a clear link with shunt outcomes. These findings highlight the necessity of taking into account the length of symptoms as well as the kind of comorbidities when determining the prognosis of NPH patients after shunting^[14,15].

Complications and Management: Our study found complications such as subdural hematoma (SDH) and shunt infection after shunting operations, which is consistent with earlier studies. Notably, the initial shunt setting played a role in the development of over-drainage issues. Beginning with increased drainage pressures proved to be well-tolerated, which may help lower the risk of problems. However, further research is needed to find the best shunt settings and minimize unwanted occurrences^[14,17].

Shunting has proven to have favorable improvement rates in NPH patients, notably in gait problems. The least likely to improve were cognitive impairment and urine incontinence. Age, gender, length of symptom onset, and comorbidities were found as possible predictors of outcomes, but further study is required to reach clear results. Understanding these variables can help influence treatment options and improve patient care. Complication treatment, including SDH and shunt infection, is still a key issue for doctors. Future research with bigger sample numbers and standardized techniques will offer a better knowledge of shunting results in NPH and help to enhance surgical approaches^[14,15,18].

6. Conclusion

Shunting has shown encouraging results in terms of symptom relief in individuals with Normal Pressure Hydrocephalus (NPH), notably in gait abnormalities^[12,19]. Cognitive impairment and urine incontinence, on the other hand, were shown to be less sensitive to shunting^[19]. Although additional study is needed to establish clear connections, factors like age, gender, length of symptom onset, and comorbidities may impact the prognosis of NPH patients following shunting^[13,19]. Complication management, such as subdural hematoma and shunt infection, is still an important aspect of patient care^[20]. Larger sample numbers and standardized methods are required in future research to fully understand shunting outcomes in NPH and modify surgical approaches to optimize patient outcomes^[14,15,16,17].

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