



Original Article

## Outcome in Normal Pressure Hydrocephalus after Ventriculoperitoneal Shunt in Tertiary Care Hospital

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### ABSTRACT

**Objective:** To determine the outcome of the ventriculoperitoneal shunt in normal pressure hydrocephalus.

**Material and Methods:** This study was conducted at Jinnah Postgraduate Medical Centre, a tertiary care hospital in Karachi. Patients with idiopathic normal pressure hydrocephalus (NPH) were included. Gender distribution, presentation of symptoms and post-operative outcome based on the Stein Langfitt Scale were assessed. CSF was sent for microbiological and biochemical analyses. All patients were evaluated preoperatively and compared postoperatively during 6 months duration for improvement and any associated complication.

**Results:** In this study, we had 47 patients, 38 were male and 9 were female. 22 patients presented with dementia, 18 with urinary incontinence, 17 with gait disturbance 17, while 21 had headache based on Stein and Langfitt Scale. The 78.8% patients had an excellent outcome, 17% had a good outcome and 4.2% had poor results.

**Conclusion:** Ventriculoperitoneal (VP) shunt had promising results selected on history and examination of normal pressure hydrocephalus and improved radiological in Evan's ratio CT brain scan.

**Keywords:** Normal Pressure Hydrocephalus (NPH), VP Shunt, Stein and Langfitt Scale.

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### INTRODUCTION

The hydrocephalus having cerebrospinal fluid (CSF) pressure within normal limit and patient becoming symptomatic with a triad of incontinence, dementia and difficulty in gait was first described in 1965, by Hakim and Adams.<sup>1</sup> The complete triad is seen in 60% in normal pressure hydrocephalus (NPH) patients but symptoms differ patient to patient, some present with early or late or nonspecifically, others may include ventricular enlargement associate with old age or

neurodegenerative disorders, having normal cerebrospinal fluid (CSF) pressure.<sup>2</sup> The prevalence rates reported for NPH ranges from 0.51 to 5.9% seen in the elder population that may arise as the age advances. NPH may be seen as underdiagnosed in the world, unfortunate, as it can be managed beneficially by the placement of the ventriculoperitoneal (VP) shunt, this improves symptoms in more than 80% of patients.<sup>3</sup>

The pathophysiological theories are controversial somehow, the prominent suggestion being interference in CSF, affecting its resistance and dynamics, alterations in the brain parenchyma, and vascular abnormalities. Hypothesis by Hakim and Adam regarding NPH state that ventricles enlarge as a compensatory mechanism due to decreased CSF absorption which results in increased intracranial pressure with time a new intracranial pressure steady-state is achieved, its modification with CSF flow is leaner towards the Virchow–Robin spaces into brain parenchyma. These changes in parenchyma occur due to compression of the tissue and ischemia of white matter, authenticated by myelin pallor. While a recent study shows that glucose metabolism may also play some role. Plus decreased strength, brain stiffness and elasticity via magnetic resonance hetero-graphic images are also documented while some suggest the role of cerebral perfusion idiopathic cases or low flow of the blood in the white matter of periventricular area. Besides, venous compliance in NPH is decreased by up to fifty per cent, especially in the sagittal sinus.<sup>4</sup> Although every investigation has its relevant limitations. Spinal tap test has low negative-predictive value. Intracranial pressure (ICP) monitoring is an invasive procedure, while two accessible biomarkers of neuroimaging known to us are callosal angle and Evan's index.<sup>5</sup>

A ventriculoperitoneal shunt is a standardized treatment around the world for normal pressure hydrocephalus, with known complications and modifications.<sup>6</sup> The use of lumboperitoneal shunt

is preferred for normal pressure hydrocephalus in some countries particularly in Japan, while in western countries, ventriculoperitoneal shunt is in demand with better results in their experience.<sup>7</sup> Many known complications of the shunt are similar in children and adults like shunt obstruction, infection, cardiopulmonary events, over drainage, renal dysfunction, pseudocyst and shunt revision.<sup>8</sup> The clinical symptoms of NPH resemble its differentials like neurodegenerative disorders, traumatic insult, vascular dementias, other hydrocephalus conditions, metabolic conditions, Wilson's disease, hepatocerebral degeneration infectious diseases, Parkinson's disease, psychiatric, demyelination or general medical status.<sup>5,9</sup> An early diagnosis with proper assessment can prevent the potentially reversible syndrome of NPH proceeding to ventriculomegaly, improving urinary incontinence, gait apraxia and cognitive impairment.<sup>10</sup>

Our study aims to present the experience of NPH treatment with a VP shunt in the patients who presented to a tertiary care hospital of Sindh. The delayed diagnosis in the elderly population, limited regional study and work-up on proper diagnostic value and shunt outcome in normal pressure hydrocephalus need oriented studies.

## **MATERIAL AND METHODS**

### **Study Setting and Design**

A cohort study was conducted at the department of neurosurgery, Jinnah Postgraduate Medical Centre, Karachi from February 2015 to February 2020.

### **Inclusion Criteria**

We included patients with normal pressure hydrocephalus who reported an Evans index > 0.3 on MRI Brain or CT scan brain, improvement of clinical symptoms with tapping trial, having any two of following; cognitive difficulties, urinary

incontinence or gait disturbance. Patients with preoperative Stein Langfitt Scale score of more than 2 were included.

### Exclusion Criteria

Previously operated cases, diagnosed secondary cause of normal of hydrocephalus or intracranial pathology, history of infections, diagnosed cases with other neurodegenerative diseases and patients with symptoms of raised intracranial pressure and papilledema were excluded.

### Patients and Data Collection

The following study was conducted after an approval from the medical ethical board of the hospital and informed consents were taken from all the patients.

### Surgical Procedure

In our hospital, all the patients who presented with normal pressure hydrocephalus underwent ventriculoperitoneal shunt procedure with medium pressure shunt. MRI brain and CT scan brain were done to exclude other possibilities, based on the diagnostic criteria of Evan's ratio > 0.3 and improvement of symptoms after tapping of 30 ml of CSF for confirmation of diagnosis.

### Cerebrospinal Fluid (CSF) and Neurological Examination

CSF was also sent for microbiological and biochemical analyses. Complete history and neurological examination were performed, fundoscopy was done routinely to rule out papilledema. All patients were evaluated preoperatively and compared postoperatively during 6 months duration for improvement and any associated complication. Patients were admitted for 2 days post-surgery and kept on antibiotic ceftriaxone and gentamicin.

### Stein-Langfitt Scale

Clinical outcome was assessed on Stein-Langfitt scale, improvement by score of 2 or above was considered as an excellent outcome, improvement by score of 1 as good outcome but if no change it was poor outcome. Improvement was also assessed on imaging with Evan's ratio < 0.3 on CT scan brain with follow-up of 3 to 6 months.

### Data Analysis

The data was analyzed by descriptive statistics by applying mean ± standard deviation for quantitative data and frequencies were calculated for qualitative data in the statistical program SPSS version 23. This was non-probability consecutive sampling. Sample size calculation was based on WHO, OPENEPI Calculation. Forty seven patients with CI 95%.

## RESULTS

### Gender Distribution

We had 47 patients, 38 (80.8%) male and 9 (19.2%) female, and ratio 4:1.

### Age Distribution

The age distribution of patients is mentioned in **Table 1**.

**Table 1:** Age Distribution.

Age in years	n	Percentage
55 to 60	6	12.7%
61 to 65	10	21.2%
66 to 70	14	29.7%
71 to 80	17	36.1%

### Clinical Presentation

The dementia was in 22 (46.8%) patients, gait disturbance in 17 (36.1%) patients, urinary

**Table 2:** Symptomatology improvement.

So. No.	Symptoms	n (Total Patients)	No. of Patients with Improved Symptoms	Percentage
1.	Dementia	25	18	72%
2.	Urinary Incontinence	24	19	79.16%
3.	Gait disturbance	28	23	82%
4.	Headache	21	18	85.5%

incontinence in 18 (38.2%) patients and headache in 21 (44.6%) patients, detail mentioned in **Table 2**.

patient (50%) patients, who presented in the first three months.

**Table 3:** Stein and Langfitt Scale Outcome.

Characteristics	n	Percentage
Excellent outcome	37	78.7%
Good outcome	8	17%
Poor outcome	2	4.2%

### Outcome

Shunt revision was done in 4 (6.3%) patients, among them, the infection was seen in two. Follow-up was done at 3 months and 6 months. **Table 3** explained results based on Stein and Langfitt Scale outcome.



**Figure 1:** MRI brain showing gross hydrocephalus in an adult patient with NPH.

### Complications

Shunt revision was done in 4 (6.3%) patients, among them, the infection was seen in two

### DISCUSSION

Although the recent advancement in the diagnostic investigation and criteria at international level has evolved but in our region of developing state, we more or less rely on our history, examination, imaging and spinal tapping in elderly populations. In a study at our centre, we monitored neurobehavioral and cognitive issues and our diagnosis was based on spinal tapping and imaging as well as history and excluded the secondary causes while the study by Mathew et al<sup>11</sup> stated that neurobehavioral and cognitive issues are commonly seen in patients having advanced normal pressure hydrocephalus. The severity is less compared to other neurodegenerative diseases e.g. Alzheimer’s disease. We mainly relied on conventional methods and imaging due to easy availability and cost-effectiveness having excellent results in 76% and good results in 17% while in a study by Sharma AK et al<sup>12</sup> mention that contrast MR imaging, that is done pre and post cerebrospinal fluid drainage, can be a sensitive method to help in diagnosis, proving beneficial for selection of

patients with NPH likely to get benefit from ventriculoperitoneal shunt surgery. While in the study by Chang CC<sup>13</sup> showed that both cerebral blood flow and cerebral vascular regulation decline as normal pressure hydrocephalus starts to develop which is suggestive of a hemodynamical cause of ischemia that may be responsible for the symptoms. So it states that impaired cerebral vascular regulation and decreased cerebral blood flow can be associated with the presence of symptoms that can be proposed as NPH diagnostic criteria.

Our study had a limited number of patient and short follow-up of about 6-month with 47 patients 38 male and 9 female patients, ventriculoperitoneal shunt performed at our centre did not had any major complications, while the study by Isik et al<sup>14</sup> came with the concept that the authentication of the disease is difficulty in gait, which may show improvement and halt in cognitive decline, can be done with recurrent drainage if the shunt is not performed in normal pressure hydrocephalus patients. Although we had patients related to NPH, no patient with Parkinsonism was included, all patient had Evans ratio > 0.3 in our study but Liew et al<sup>15</sup> showed in their study that diagnosis of normal pressure hydrocephalus should be considered based on clinical and radiological finding plus the marked significance of CSF tapping as prime a diagnostic test to assess the clinical improvements post tapping. While the patient may have associated diseases such as vascular and white matter diseases, Alzheimer's disease or Parkinsonism which may affect the accurate response of VP shunt. Another study by Ahmad et al<sup>16</sup> highly supports the fact that VP shunt results in effective improvement but depends on clinical history plus supported by imaging findings having Evan's ratio  $\geq 0.30$ .

At our centre, during the study, we used medium pressure shunts under aseptic measure and limited staff in operation theatre so no patients developed complication of subdural

dural hematoma and only two patients developed infections, we had excellent results in 78.7% while good results in 17% and 4.2% had poor outcome while Assoumane et al<sup>17</sup> in their study stated that complication of subdural hematoma was observed during hydrocephalus treatment and this can prove to be a significant complication. This study has also supported a post-surgery CT brain to exclude such complications.

At our centre, post-shunt improvement in patient condition was seen within a month, dementia, headache, urinary symptoms and gait while further improvement was observed in symptoms with ratios mentioned in results at a follow-up of six months. Improved cognitive state was also observed in a prospective study of 52 patients by McGovern RA<sup>18</sup> with one-year follow-up. Patients in this study underwent neuropsychological testing at pre-shunt (baseline) and post shunt and they found that the Rey Auditory Verbal Learning Test (RAVLT) can be used as a preoperative predictor of postoperative cognitive improvement, and RAVLT can be used to evaluate the cognitive function of NPH patients.

### Limitations

The limitations of our study are that it included a single centre data, the sampling method was non-probability consecutive sampling and included only a limited number of patients. We need larger study groups with involvement of multiple centers and longer follow-up.

### CONCLUSION

The ventriculoperitoneal shunt had promising results for normal pressure hydrocephalus symptomatically and improved radiology in Evan's ratio on CT scan brain with reasonably low rate of complications.

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### Additional Information

**Disclosures:** Authors report no conflict of interest.

**Ethical Review Board Approval:** The study was conformed to the ethical review board requirements.

**Human Subjects:** Consent was obtained by all patients/participants in this study.

**Conflicts of Interest:**

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

**Financial Relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

**Other Relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

### AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Abdul Samad Panezai	1. Study design and methodology.
2.	Aurangzeb Kalhoro	2. Paper writing, referencing, and data calculations.
3.	Sher Hassan	3. Data collection and calculations Analysis of data.
4.	Farrukh Javeed	4. Analysis of data and interpretation of results etc.
5.	Lal Rehman	5. Literature review and manuscript writing quality insurer.