



## Research Article

# Assessment of Risk Factors, Features, Treatment Modalities and Prognosis of Posttraumatic Hydrocephalus: A Retrospective Hospital Based Study

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## Abstract

**Background:** Posttraumatic hydrocephalus (PTH) is a frequent and serious complication that follows a traumatic brain injury (TBI). Its incidence varies greatly from study to study, largely based on different criteria for its diagnosis.

**Aims and Objectives:** To find out risk factors, treatment modalities and prognosis of cases with Posttraumatic Hydrocephalus.

**Material and Methods:** This retrospective study was conducted in Department of Neurosurgery at Geetanjali Medical College and Hospital, Udaipur, Rajasthan on the basis of neuro-radiological examination of patients. A total of 500 patients were evaluated for traumatic head Injury in hospital from Jan 2014 – Dec 2017. 40 cases with diagnosis of post traumatic hydrocephalus PTH were identified.

**Result:** Post traumatic Hydrocephalus (PTH) was observed in 40 patients out of total 500 patients over period of time. Thus, incidence of the PTH was found to be 8.0%. Out of 40 patients, 33 (82.5%) were males and 7 (17.5%) were females. Mean age of PTH patients was  $27.96 \pm 12$ . Regarding mode of injury 36 (90.0%) out of 40 injured due to Road Traffic Accidents. Severe HI (GCS  $\leq 8$ ) was present in 31 (77.5%) cases. Findings of CT scan showed that majority 29 (72.5%) cases had predominant contusions. 30 (75.0%) cases of HI treated with DI. Out of 30 cases of DC, 23(76.67%) diagnosed with PTH before cranioplasty. Significant correlation was observed between severe HI, DC and time duration between HI and PTH diagnosis. ( $p = 0.039$ ). Regarding the clinical features at PTH presentation the triad of Memory, Gait and urinary disturbance was observed in 21 (52.5%) cases followed by other features. In majority of cases VP shunt placement was done. Overall mortality was 6 out of 31(19.35%) with the outcome measured by GCS. Out of 25 (80.64%) cases who recovered out of 31, 17 (68.0%) had good recovery according to GCS.

**Conclusion:** PTH could greatly impact morbidity following a severe head injury and could result in increased mortality if it is not recognized and treated.

## Introduction

Posttraumatic Hydrocephalus (PTH) is an active and progressive disorder of cerebrospinal fluid (CSF) accumulation in the ventricular system causing compression of the brain parenchyma.<sup>1</sup>

PTH may result from 1 or a combination of pathophysiologic factors. It can be caused by the overproduction of cerebrospinal fluid (CSF), the blockage of normal CSF flow, or insufficient absorption that results in excessive accumulation

of CSF around the brain. Ultimately, PTH is caused by an imbalance that occurs between CSF production and absorption.<sup>2</sup> PTH is a complication of head injury which can be treated and can be present with many different clinical syndromes such as obtundation, simple failure to improve, memory, gait and urinary disturbance, altered sensorium, loss of consciousness etc. patients developing PTH presents with various types of neurological symptoms with different types of severity.<sup>3</sup> Posttraumatic ventriculomegaly was defined by radiologic evidence of ventricular dilation, as evidenced by an Evans index or ratio of more than 0.3 at follow up of 6 months. The reported incidence of PTH varies from 0.7 – 29%. According to CT findings of abnormal ventriculomegaly alone, the incidence of PTH varies from 30 - 86%.<sup>4</sup> PTH diagnosis generally depends on a combination of clinical, imaging and physiologic data. For the clinical diagnosis of PTH sign and symptoms of secondary brain injuries like edema, infections and hypoxic damage were confounded.<sup>5</sup> Association of Poor prognosis and severe Head injury (HI) complicates the management. Thus this study has been performed to look at various risk factors associated with PTH and the treatment modalities and prognosis.

### Material and Method

This retrospective study was conducted in Department of Neurosurgery at Geetanjali Medical College and Hospital, Udaipur, Rajasthan on the basis of neuro-radiological examination of patients. A total of 500 patients were evaluated for traumatic head Injury in hospital from Jan 2013 - Jan 2018. 40 cases with diagnosis of PTH were identified.

Demographic profile, Glasgow coma scale (GCS) at admission, CT findings of brain, initial surgery performed, clinical features at the time of PTH and various treatment modalities of patients were notes from the admission records. Assessment of Outcome was done using GCS.

Statistical analysis was done using SPSS software version 20.0. Mean and SD were calculated and t-test used for test of significant difference and correlation for finding the relationship between variables.

### Results and Observation

Out of 500 patients with Head Injury (HI) over period of time, Post traumatic Hydrocephalus (PTH) was observed in 40 patients. Thus, incidence of the PTH was found to be 8.0%. Out of 40 patients, 33 (82.5%) were males and 7 (17.5%) were females. Mean age of patients was  $27.96 \pm 12$  years and the range was 18 – 50 years. Regarding mode of injury out of 40 cases of PTH, 36 (90.0%) injured due to Road Traffic Accidents (RTA) and 4 (10.0%) injured due to falling from height. During initial presentation severe HI (GCS  $\leq 8$ ) was present in 31 (77.5%) cases out of 40 total cases. Table 1

Findings of CT scan showed that out of 40 cases, 29 (72.5%) cases had predominant contusions, 12 (30.0%) had subdural Hematoma (SDH) alone or contusion and SDH, 5 (12.5%) had Extradural Hematoma and 8 (20.0%) cases had depressed and skullbase fracture. Table 2

30 (75.0%) cases of HI treated with Decompressive craniectomy (DI) followed by 4 (10.0%) with Anterior cranial focca defect repair to stop cerebrospinal fluid (CSF) fluid and 3 (7.5%) cases were treated with depressed fracture elevation and 3 (7.5%) with conservative management. Table 3

Out of 30 cases of Decompressive craniectomy (DC), 23 (76.67%) diagnosed with PTH before cranioplasty. Among cases with Decompressive craniectomy (DC), the mean duration between diagnosis of PTH and HI was  $11.12 \pm 0.61$  months and mean duration was  $16.89 \pm 1.12$  months in cases who underwent elective cranioplasty. Thus, significant correlation was observed between severe HI, Decompressive craniectomy and time duration between HI and PTH diagnosis. ( $p = 0.039$ )

Also, the mean interval observed between emergency Decompressive craniectomy and elective cranioplasty was  $6.03 \pm 13$  months.

Regarding the clinical features at PTH presentation the triad of Memory, Gait and urinary disturbance was observed in 21 (52.5%) cases followed by 10 (25.0%) cases with Altered Sensorium, 6 (15.0%) cases with difficulty in walking, papaparesis and Hemiparsis and 3 (7.5%) case was found with loss of consciousness.

Table 4

In majority of cases i.e. 23 (57.5%) Ventriculoperitoneal (VP) shunt placement was done followed by 12 (30.0%) treated with Thecoperitoneal (TP) shunt placement and 5 (12.5%) treated with Lumber drain placement in pre operative period. Table 5

Among all 40 cases, 3 (7.5%) cases VP shunt infection at the abdominal end, TP shunt complication was observed in the form of blockade requiring revision in 4 (10.0%) cases and 24 (60.0%) cases showed improvement in Glasgow Coma Outcome scale (GCS) post shunt.

Out of total 40 cases, 13 (77.5%) cases followed up over period of time and average period of follow up was 5 years with range of 2 months to 11 years. Among 31 (77.5%) patients who followed up over period of time, 5 (16.13%) died during follow up due to poor functional status and 1 (3.23%) expired during the treatment in the hospital due to septicemia. Thus overall mortality was 19.35% with the outcome measured by GCS.

Out of 25 (80.64%) cases who recovered out of 31, 17 (68.0%) had good recovery, moderate recovery was found in 6 (24.0%) cases and 2 (8.0%) case observed with lower recovery according to GCS.

Mean age among 31 cases who underwent DC was  $28.9 \pm 8.9$  years and  $24.89 \pm 6.79$  years among 7 cases with non – DC. Thus insignificant difference regarding age was observed between them. ( $p > 0.05$ )

**Table1:** Distribution of features of Head Injury (HI)

Features	Number of patients N= 40	Percentage
Severe HI (GCS $\leq$ 8)	31	77.50
HI due to road traffic accidents	36	90.00
HI due to fall from height	4	10.00

**Table 2:** Radiologic feature according to findings of CT scan

Features	Number of patients N = 40	Percentage
Contusions	29	72.50
Subdural hematoma(SDH) + Contusions or SDH alone	12	30.00
Extradural Hematoma	5	12.50
Depressed and skullbase fracture	8	20.00

**Table 3:** Distribution of treatment of Head Injury

Features	Number of patients	Percentage
Decompressive craniectomy (DC)	30	75.50
Non – DC	Anterior cranial focca defect repair	4 10.00
	Conservative management	3 7.50
	Depressed fracture elevation	3 7.50
<b>Total</b>	<b>40</b>	<b>100.0</b>

**Table 4:** Distribution of clinical features at PTH presentation

Features	Number of patients	Percentage
Memory, Gait and Urinary disturbance	21	52.50
Altered Sensorium	10	25.00
Difficulty in walking, Papaparesis and Hemiparesis	6	15.00
Unconsciousness	3	7.50
<b>Total</b>	<b>40</b>	<b>100.0</b>

**Table 5:** Distribution of treatment at PTH presentation

Features	Number of patients	Percentage
VP shunt placement	23	57.50
VP shunt placement	12	30.00
Lumber drain placement	5	12.50
<b>Total</b>	<b>40</b>	<b>100.0</b>

**Discussion**

Posttraumatic Hydrocephalus was recognized first by Dandy and Blackfan in 1914 in which they recognized the case of child who developed with hydrocephalus after fall from height.<sup>6</sup> In this study

the incidence of PTH is 8.0% which shows that it is not rare and variable incidence arising from diagnostic criteria worldwide.<sup>6-10</sup> To diagnose PTH combination of clinical and radiological findings were used. Consideration of management strategy and the fact that over a period of time DC results in ventriculomegaly is more appropriate as it may not always be symptomatic.<sup>11,12</sup>

Kishore et al in his study reveals that more than 93% of cases presented with ventriculomegaly within period of 2 weeks of traumatic HI<sup>13</sup> and Marmarou et al also suggested that most cases presented with ventriculomegaly within period of 1 month of post injury<sup>14</sup>. In this study it was observed that PTH was diagnosed in range of 2 weeks to 15 months in case of HI and early in case of post DC. Before development of Hydrocephalus, in some studies convexity subdural CSF collection after DC has been described.

In most of the studies, continuous headache, morning vomiting, dementia, inconsistency, difficulty in walking, papilledema, altered sensorium, failure to improve and psychomotor retardation were the clinical features of presentation of PTH.<sup>15</sup> In this study triad of memory, gait and urinary disturbance was the most common feature of presentation of PTH followed by other features similar to other studies. In this study significant correlation was observed in DC and Development of PTH which is similar to other studies and literature. In literature various factors such as debris which causes block in arachnoid granulations and change in CSF flow disturbances.<sup>8,9,11,12</sup>

In this study significant relationship was found between time of cranioplasty and development of PTH thus we can say that delay in cranioplasty increases the chance of development of PTH due to CSF flow disturbances. It was revealed from this study that DC accelerates the development of PTH.

Chang et al, Chun and Yi and Schuss et al reported in their study that early cranioplasty is significantly associated higher rates of infection

and delay in cranioplasty may result in delay of progression of neurologic outcome due to various factors whereas this study did not find out PTH presentation as a cause of poor neurologic outcome.<sup>16-18</sup>

Treatment of PTH with lumbar drain placement in pre-operative period of cranioplasty in selected 4 cases has been done. In this study medium-pressure shunt was used so as to reduce the risk of extradural hematoma (EDH), subdural hematoma (SDH) and slit ventricle.

Regarding the treatment for PTH, VP shunt placement was given more preference as compared to TP shunt placement. De Bonis et al in their review of some published cases of use of VP shunt placement for treatment of PTH, concluded that this procedure has a high success rate.<sup>19</sup> The mortality rate is high in patients developing PTH which is also evident from this study as 6 out of 31 expired that is about 15% patients with PTH expired. This may be due to reason that most of the patients developed PTH due to severe HI and were declining at the time of diagnosis of PTH. Thus it can be well said that patients which are in better pre operative clinical condition results in to have better outcomes.

### Conclusion

In the present study, the etiology of PTH is multi factorial and its incidence is low. High chances of development of PTH are associated with delay in cranioplasty, Decompressive craniectomy and severe Head Injury. Memory, Gait and urinary disturbances are main clinical features at PTH presentation and VP shunt placement is most considered treatment followed by TP shunt and Temporary Lumbar Drain placement. PTH could greatly impact morbidity following a severe head injury and could result in increased mortality if it is not recognized and treated.

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