

## OUTCOME ANALYSIS OF VP SHUNT SURGERY IN POST TRAUMATIC HYDROCEPHALUS AFTER DECOMPRESSIVE CRANIECTOMY

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Article Received:25-02-2025

Article Accepted:06-04-2025

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### ABSTRACT

**Objective** – Post traumatic hydrocephalus is one of significant complication post DC.PTH has significant morbidity and mortality.In this study we study prognostic and etiologic factors of PTH with outcome analysis.

**Ethical Clearance** – This study conducted at UPUMS SAIFAI between august 2022 to November 2022 after clearance from institutional ethics committee.

**Material And Methods** - This prospective study includes 103 patients who underwent DC after TBI between august 22 and November 22 2022 at UPUMS Saifai Hospital and were still alive at 6-month follow-up. It was prospective cohort study. Various etiologic factors and demographic factors correlated with outcome.

**Results** – IN this study total 103 patients studied among them 21 developed PTH who undergone vp shunt. Low Glasgow Coma Scale (GCS) score, post DC meningitis, and intraventricular hemorrhage (IVH)and SAH were significant predictors for the development of PTH after DC. PTH patients showed impeded recovery or low-pressure hydrocephalus symptoms, of whom 9 experienced subjective clinical improvement after shunt treatment. TWO DC patients received a shunt due to subdural hygromas of whom one improved following treatment. Four patients were vegetative with concurrent ventriculomegaly and these patients did not have any positive shunt response. Altogether, 11 PTH patients improved after shunt surgery.

**Conclusion:** Post-traumatic ventriculomegaly was common, but few developed symptomatic PTH and received a VP-shunt. Patients with low-pressure hydrocephalus symptoms had the best shunt response, whereas patients with suspected vegetative state exhibited a minimal shunt response.

**Key Words:** decompressive craniectomy; posttraumatic hydrocephalus, risk factor, traumatic brain injury.

### INTRODUCTION

Traumatic head injury leading and preventable cause of mortality in our society.TBI also major cause of mortality in young population. Decompressive craniectomy is life saving procedure in TBI with severe head injury. Decompressive craniectomy associated with many complications which can acute and chronic. Posttraumatic hydrocephalus is one of subacute to chronic complication post DC . PTH alters brain metabolism which can impede brain recovery and alter metabolism .Posttraumatic hydrocephalus (PTH), symptomatic dilatation of ventricles one of common complication post decompressive craniectomy . Incidence of PTH is 7.9%-54% in patients with TBI after DC<sup>3-6</sup>.

PTH causes progressive ventricular enlargement and further clinical deterioration.The onset of PTH may vary from weeks to months or even a year after TBI and can be associated with poor outcomes but mostly occurs in 15 days to 3-6 month duration Post dc PTH .Early diagnosis and mangment is crucial for patient recovery<sup>4</sup>. Several factors increase the risk of developing PTH including age, lower Glasgow Coma Scale (GCS) scores,subarachnoid or intraventricular hemorrhage (IVH), distance of craniectomy from midline, subdural hygroma (SDG),delayed time to craniotomy, and repeated operation<sup>7</sup>. IN this study we try to formulate prognostic model for post dc PTH based on the risk factors to predict the development of PTH.

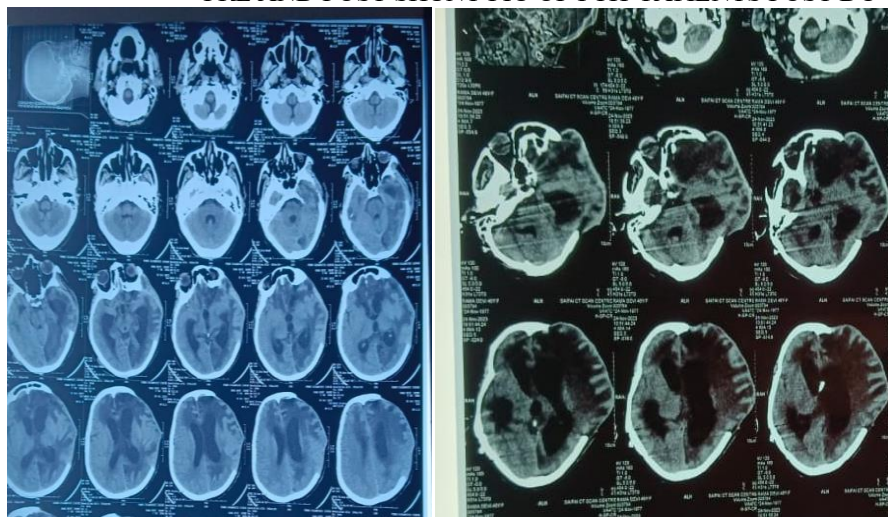
## MATERIAL AND METHODS

This is prospective study included 103 patients who underwent DC for TBI between august 22 to november 22 at upums medical Hospital and will be followed up for 6months for PTH. DC was performed at admission or at a delayed time point due to the presence of midline shift, contusions, cerebral edema, or intractable intracranial pressure. The inclusion criteria were as follows: (1) patients survived more than 6 months, follow-up observations were possible, and (2) all available serial computed tomography (CT) scans or magnetic resonance imaging (MRI) images from admission to discharge, after discharge up to 6 months screened for PTH. To avoid interfering factors, we excluded (1) patients with a history of neurological disease or intracranial pathological changes before their injury, and (2) patients with acute hydrocephalus before DC.

They were divided into PTH group and non-PTH group according to the presence of PTH. Quantitative data were expressed in mean or median depending on normally distribution difference between two comparable groups . Assessment of post vp shunt response according to various causal factor of PTH like low and high pressure hydrocephalus, impeded neurological recovery, subdural hygromas, vegetative state.

PTH diagnosis -PTH diagnosis required both radiological and clinical evidence. Radiological criteria includes progressive ventricular dilatation (Evans index  $>0.3$ ) accompanied by transependymal edema<sup>8</sup>. PTH patient clinical have both acute and chronic presentation. Acute presentation patient have headache, vomiting, low gcs, presence of papilloedema. Chronic presentation patient have gait, memory and urinary disturbances. Usually there is clinical improvement on csf drainage. Most cases of PTH occur between duration of 15 days to 6 months .

PRE AND POST SHUNT PIC OF PTH PATIENTS POST DC



Characteristics of patients treated with ventriculoperitoneal-shunt -All patients treated with a VP-shunt had ventriculomegaly (Evans' index  $>0.30$  or mFHI  $>0.33$ ), but the symptoms that led to surgery differed among the patients. 7 patients received a VP-shunt due to impeded neurological recovery (after initial improvement), 6 patients because of development of gait disturbance, urinary incontinence, or cognitive decline, 2 patients deteriorated in consciousness due to PTH, two patients had symptomatic subdural hygromas, and four patients who were vegetative with some concurrent ventriculomegaly.

### Outcomes after TBI

Recovery was assessed with the Glasgow Outcome Scale Extended (GOSE), which measures functional outcome on an eight-point scale : 8=complete recovery, 7=suboptimal recovery, 6=upper moderate disability, 5=lower moderate disability, 4=upper severe disability, 3=lower severe disability, 2=vegetative state, and 1=death

## RESULTS

This prospective study done in UPUMS saifai from august 2022 to November 2022. A total of 103 patients with TBI who underwent DC met the inclusion criteria. These patients further divided based on baseline demographic, clinical, imaging data and outcome analysis. patient divided according to various age group ,among them maximum patient were in 40yrs and above age group. Among them, 64 were males and 39 females. Among admitted patient maximum were in low gcs 50 in number .There is also high incidence of PTH in low gcs patients. These patients followed up for 6-months period, with interval scan according to clinical status. Among total 21 patients develop clinicoradiological evidences of

hydrocephalus and underwent placement of a ventriculoperitoneal shunt. The average time of PTH occurrence after injury was 55 days with maximum patient were in 15 days to 3months duration . PTH group showed a significant difference in radiological presentation based on IVH,SAH,SDH,TBI.SAH responsible for maximum no of PTH in our study. Post dc patients develop various complications like meningitis, subdural hygroma, PTH, chest complications, DVT, SSI. Furthermore, we analyze various factors like age, sex, subdural hygroma, postop meningitis, gcs on admission,delayed time of craniotomy, IVH or SAH in prospective manner where each variable was used individually to predict PTH development after DC. Among these 3 factors gcs on admission, post op meningitis, sah ,ivh,ich were significant causal factor for PTH. P value indicated that a final predictive model composed of 3 factors was significantly better than each single model . Post vp shunt patients analysed according to various causal factors for PTH. All 21 patients undergone VP shunt procedure, low or medium pressure chabra shunt according to csf pressure on taping the ventricle. Among total six patients develop post vp shunt complication as post op meningitis in 2, malfunction in 3 and ssi in one patient. Patients with impeding recovery and various pressure hydrocephalus show better response (9 among 12) then patient with vegetative state and subdural hygromas (1 among 5).

DEMOGRAPHIC TABLES OF STUDY PATIENTS

AGE	No of patients undergone Decompressive craniectomy	post dc PTH	POST DC normal	Pvalue
0-20	19	2	17	0.4079
20-40	22	6	16	
40- and above	62	13	49	

SEX	No of patients undergone Decompressive craniectomy	post dc PTH	POST DC normal	Pvalue
MALE	64	15	49	0.1705
FEMALE	39	6	33	

GLASGOW COMA SCALE

GCS	No of patients undergone Decompressive craniectomy	post dc PTH	POST normal DC	Pvalue
3-8	50	15	34	0.04651
9-12	40	4	36	
13-15	13	2	12	

CT FINDINGS OF STUDY PATIENTS

CT Brain findings	No of patients undergone Decompressive craniectomy	post dc PTH	POST normal DC	P value
ICH/SAH/IVH	41	13	27	0.043984
SDH/EDH	28	4	24	
TBI	34	4	30	

POST OP COMPLICATIONS IN STUDY PATIENTS

POST DC MENINGITIS	post dc PTH	Post dc normal	pvalue
Present = 6	3	3	0.03179
Absent=97	18	79	

POST DC TIMING IN POST TRAUMATIC HYDROCEPHALUS DEVELOPMENT

Timing of development of PTH	post dc PTH	Post dc normal
0 – 15 days	2	101

15- 3months	11	90
3-6 monts	8	82

#### FACTORS FOR POST DC PTH DEVELOPMENT

Distance decompressive craniectomy from midline	post dc PTH	Post dc normal	Pvalue
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Outcome analysis according to various etiology of PTH	Total no of patients	Improved outcome	Worsened or non improved staus
Low pressure hydrocephalus	5	3	2
High pressure hydrocephalus	1	1	0
Impeded neurological recovery	7	5	2
Vegetative state	4	1	3
Subdural hygroma	2	1	1
Altered level of consciousness	2	0	2
< 2 cm	11	39	0.3508
>2 cm	10	43	

#### ETIOLOGY AND OUTCOME OF POST DC PTH PATIENTS

#### DISCUSSION

PTH is one of the frequent and devastating complications after TBI in patients who underwent DC. PTH early detection and intervention is of clinical importance in preventing further neurological compromising effects in patients.<sup>9</sup>The underlying mechanisms for PTH involve altered CSF reabsorption e.g., due to fibrosis of the arachnoid granulations, but also obstruction of the CSF circulation in the ventricles and/ or the subarachnoid space. Guangfu Di et AL.<sup>3</sup> in their study found that PTH incidence was 19.01% in patients with TBI who underwent DC, and patients with PTH suffered worse neurological outcomes than patients who did not develop PTH at 6 months follow-up after DC, in our study also PTH group has poor outcome then non PTH group which was consistent with previous studies.<sup>11, 13</sup> Studies indicated that disruption of cerebrospinal fluid (CSF) drainage due to mechanical blockage or inflammation of arachnoid granulations by postsurgical debris, loss of pulsatile intracranial CSF dynamics and impaired venous drainage into the sagittal sinus are causative factors.<sup>16, 19</sup>. Guangfu Di et AL<sup>3</sup> found low gcs, ivh and bilateral DC as major determinant factor in formation of PTH. Teodor Svedung et AL<sup>1</sup> article on PTH has incidence rate of 3.4%.Poor neurological status at NIC admission, greater amount of tSAH, EVD monitoring, meningitis, DC surgery, and ventriculomegaly at NIC discharge were factors related to PTH/ VP-shunt operation in there study. .Meningeal fibrosis increases with age and older patients may be more susceptible to symptomatic CSF outflow obstructions following acute brain injury<sup>2</sup> Higher age has also been associated with increased risk of PTH and VP-shunt treatment in some studies<sup>10</sup>. Lower GCS has been associated with higher risk of VPshunt treatment due to more severe structural brain injury with a corresponding development of disturbances in the CSF circulation. lower GCS might also reflect a more severe brain injury with more pronounced Wallerian degeneration with secondary ventriculomegaly.<sup>12</sup> It has been hypothesized that tSAH and IVH induce scarring in the ventricular system and arachnoid granulations that precipitate for hydrocephalus, similar to the risk of post-hemorrhagic hydrocephalus following aneurysmal SAH. we found association between higher CT Fisher grade and having a VP-shunt due to PTH. Poca et al. suggested that SAH is a relatively common post-traumatic finding and it may be difficult to grade the amount of SAH after TBI. Meningitis may lead to scarring in the subarachnoid space with a corresponding reduction in CSF outflow. we found that meningitis with positive CSF culture was associated with having a VPshunt due to PTH. Relevant studies suggest that infammation and fever are related to hydrocephalus<sup>14-15</sup>. A large

accumulation of various proteins in the cerebrospinal fluid will change osmotic pressure and cause hydrocephalus, which has been verified in animal models<sup>16-17</sup> and the CSF-TP of hydrocephalus patients is higher than that of the normal group<sup>18</sup>

In our study outcome of vp shunt in PTH patient assessed according to various etiological factors. Patients with various pressure hydrocephalus and impeded neurological recovery have good response post PTH. Teodor Svedung et al<sup>1</sup> reported in his study, patient with symptoms reminding of low-pressure hydrocephalus had the best shunt response and patients in a poor neurological condition with suspected vegetative state exhibited a minimal shunt response.

Conclusion: Post-traumatic ventriculomegaly was common, but few developed symptomatic PTH and received a VP-shunt. Patients with low-pressure hydrocephalus symptoms had the best shunt response, whereas patients with suspected vegetative state exhibited a minimal shunt response.

### Limitations

There is no gold standard diagnostics for PTH. There is a chance of selection bias probably led to some “false negatives”, patients who will be missed to diagnose post-traumatic hydrocephalus. There could also be some “false positives”, i.e., patients treated with a shunt despite a low probability of PTH.

### CONFLICT OF INTEREST

There is no conflict of interest in this study and no funding involved in this study

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