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Article

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Posttraumatic hydrocephalus: Lessons learned from management and evaluation at a tertiary institute with review of literature

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Abstract: *Background*: Post traumatic hydrocephalus (PTH) is a commonest treatable complication of severe traumatic brain injury that's leads to failure of improvement and worsening of the outcome. Incidence of posttraumatic hydrocephalus is 0.7%-29% reported in different literature. We have observed the development of PTH frequently seen in patients with severe head injury and after decompressive craniectomy (DC). Pathophysiology includes inflammatory changes and adhesion of arachnoid granulation, cerebral ischemia and alteration in cerebrospinal fluid (CSF) dynamics. We studied 35 cases of PTH diagnosed and treated at our institute from May 2008 to May 2017. *Material and methods*: This is hospital based retrospective and prospective study conducted in tertiary center on the basis of neuro-radiological examination of the patient. Clinical biodata and radiological profile of the patients was studied at initial presentation with trauma, and when the patient worsened with symptoms of raised intracranial pressure (ICP) in state of established PTH. These cases were treated by medium pressure ventriculoperitoneal shunt (V.P shunt) and outcome was evaluated. *Results*: Incidence of PTH in our study is (2.3%). Out of 35 cases 24 (68.57%) were male and 11(31.4%) were female. Road traffic accident (RTA) was the most common mode of injury (82.85%), acute subdural hematoma (SDH) was the most common finding on C.T scan in 15 cases (42.8 %). Decompressive craniectomy was performed in 77% at time of initial trauma. PTH had favourable outcome with V.P. shunting in 91.42%. *Conclusion*: Patients with traumatic brain injury present with many complications but PTH is most frequent sequeale that can present in form of various neurological symptoms after trauma and decompressive craniectomy. C.T. scan brain is the investigation of choice for diagnosis of PTH. Outcome was favourable after V.P. shunt in PTH.

Key words: Post traumatic hydrocephalus, severe head injury, V.P. shunting

Introduction

Post-traumatic hydrocephalus or Hydrocephalus following traumatic brain injury (TBI) is not just a ventricular enlargement but an active and progressive disorder of cerebrospinal fluid (CSF) accumulation in the ventricular system, causing compression of the brain parenchyma. (1) Posttraumatic hydrocephalus is a treatable complication of head injury and can present with several different clinical syndromes. These include Obtundation, simple failure to improve; a tetrad of psychomotor retardation, memory loss, gait trouble, and incontinence; and unusual symptoms including emotional disorder. (2) Post-hemorrhagic hydrocephalus is the result of extra ventricular obstruction of CSF absorption, hence communicating hydrocephalus. Ventricular enlargement following head injury is a frequent finding but cases that require shunt operation are relatively rare. (3) Patients (pt) developing post traumatic hydrocephalus presents with various types of neurological symptoms with different types of severity. Several different neurological sequeale of Post-traumatic hydrocephalus (PTH) has been recognized since Dandy's report in 1914 and has been recognized as a clinicopathologic entity and the incidence rates of symptomatic PTH in the literature, ranging from 0.7% to 29%. (4) The beneficial effect of DC in reducing ICP has been well-documented in several studies. There is a wide spectrum of post-traumatic sequeale of traumatic brain injury. The awareness of hydrocephalus acquired as a consequence of head injury lags behind these explanations for neurological plateauing or deterioration. Early identification of this condition may lead to early performance of shunting procedures that may dramatically halt or reveres the process. However, failure to identify hydrocephalus is not uncommon and this is especially true when the surgeon has adopted a fatalistic acceptance of an unfortunate outcome.

Aims and objective

To study the various neurological and radiological factor of the patients who were diagnosed with Post traumatic hydrocephalus and their outcome after V.P. shunt.

Material and methods

This retrospective and prospective study conducted at tertiary center in neurosurgery department on the basis of neuro-radiological examination of the patient. A total of 1500 patients were evaluated for traumatic brain injury in our hospital from May 2008 to May 2017. Detailed of the patient at time to presentation at casualty, and when the patient worsened with symptoms of raised ICP were studied. Treatment plan either conservative or surgical at initial trauma were also noted. Medical records of 35 patients, who had undergone VP shunt for posttraumatic hydrocephalus were analyzed. Clinical factors analyzed were the age, sex, mode of injury preoperative C.T. scan, Glasgow coma scale (GCS), and radiographic evidence of ventricular dilatation on Non-contrast CT scan brain with periventricular lucencies was taken as radiological criteria of hydrocephalus. There were twenty four males and eleven female. The youngest patient was a boy aged

15 years, while the eldest was 80 year-old female (Table 1). Twenty nine patients sustained head injury due to RTA, while six patients sustained injury due to other cause like fall on ground, strike with heavy object (Table 2). CT findings at the time of initial injury in these 35 cases were: SDH was most common finding in 15 patients and the least common finding was IVH seen in 2 patients (Table 3).

TABLE 1

Age distribution

Age	Number	%age
10-20	4	11.4%
21-30	8	22.8%
31-40	3	8.5%
41-50	10	28.5%
51-60	3	8.5
61-70	5	14.2%
71-80	2	5.7%

TABLE 2

Mode of injury

Mode of injury	Number of patients	Percentage
RTA	29	82.85
OTHER CAUSE	6	17.15

TABLE 3

NCCT finding after trauma

Finding	No of case	percentage
SDH	15	42.8%
SAH	9	25.7%
ICH	6	17%
CONTUSION	3	8.5%
IVH	2	5.7%

All patients with severe head injury, pt with age group 10 years to 80 years were included in this study while pt with major concurrent medical illness, Substance abuse, psychiatric illness, Concomitant blunt trauma abdomen, chest injury excluded.

Decompressive craniectomy was performed in 77% at time of initial trauma. (3) patients those were diagnosed as a posterior fossa contusion developed hydrocephalus within a span of 5 to 7 days and they were improved after VP shunting. All these cases were treated by medium pressure V.P shunt and post operative outcome was evaluated.

Results

In present study out of 35 cases of PTH, 24 (68.57%) were male and 11(31.4%) were female. The incidence of PTH is 2.3 % in severe head injuries RTA was the most common mode of injury (82.85%), acute subdural hematoma was the most common finding on C.T. scan in 15

cases (42.8 %). Outcome was favourable 91.2% after medium pressure V.P. shunt. In the current study, patients presented with various neurological feature after initial injury. Most common finding at time of worsening was Conscious impairment in 25 (71.4%) cases, followed by vomiting and headache and least common was incidental finding prior to cranioplasty (Table 4). Time interval for built up for hydrocephalus was early within 5 days in 3 patients and late in two patients up to two month, while most of the patients developed HCP at the interval of 1 month.

TABLE 4

Clinical presentation of PTH

Impaired consciousness	25	71.4%
Vomiting	20	57.1%
Headache	20	57.1%
Hemiparesis	10	28.5%
Dysphasia	14	40%%
Urinary incontinence	6	17%
Incidental finding prior to cranioplasty	2	8.5%

TABLE 5

Time interval for PTH

Time interval	Number of patients
5 days	3
1 month	18
1-3 month	12
3 month-6 month	2

Thirty two patients (91.4%) showed improvement in clinical features after ventriculo-peritoneal shunting. Three (11.4%) died. Repeat shunt was done in two patients of decompressive craniectomy, because blockage seen at proximal end of the shunt. Three patients were died and the cause of death in these patients was ventilator associated pneumonia.

Figure 1 - NCCT Brain: Showing acute SDH, FTP convexity left side with mass effect

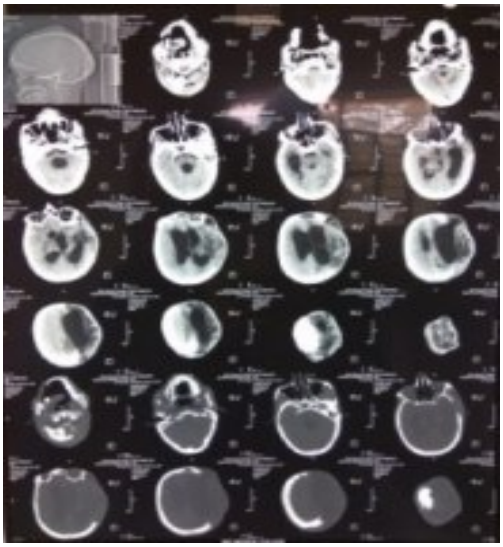

Figure 2 - CT scan of same patient after 4 weeks interval showing hydrocephalus

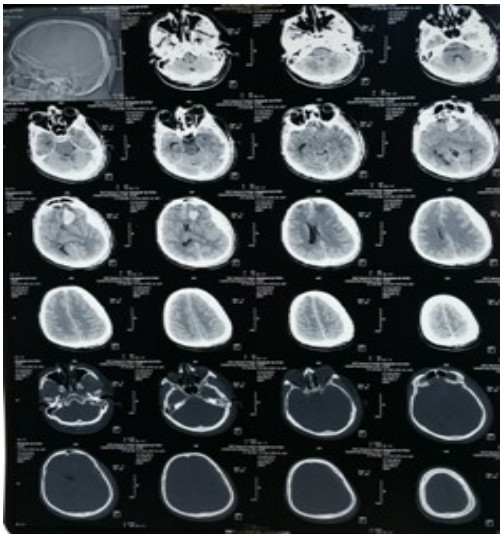

Figure 4 - NCCT Brain: Acute SDH FTP convexity left side with mass effect

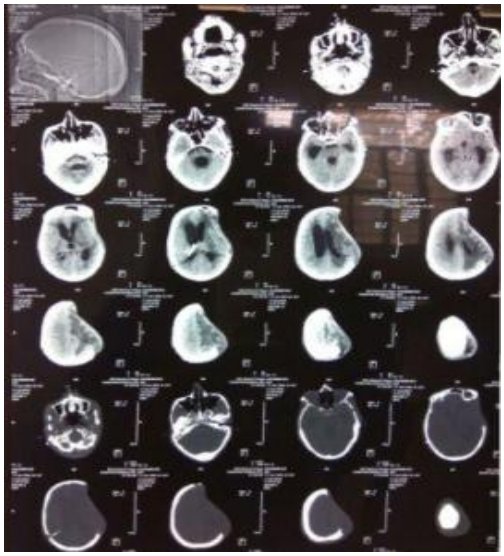

Figure 3 - Resolved hydrocephalus of VP shunt

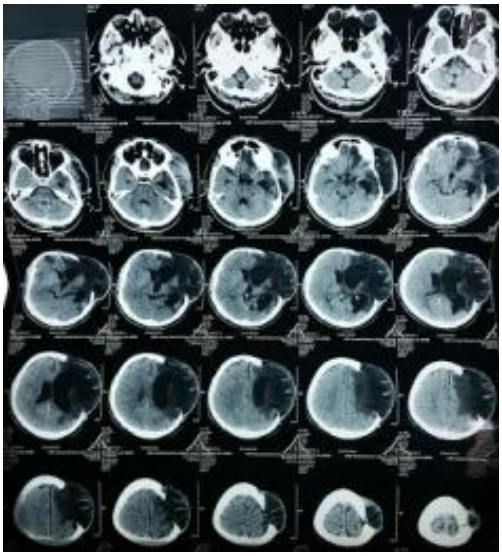

Figure 5 - Post op scan after decompressive craniectomy

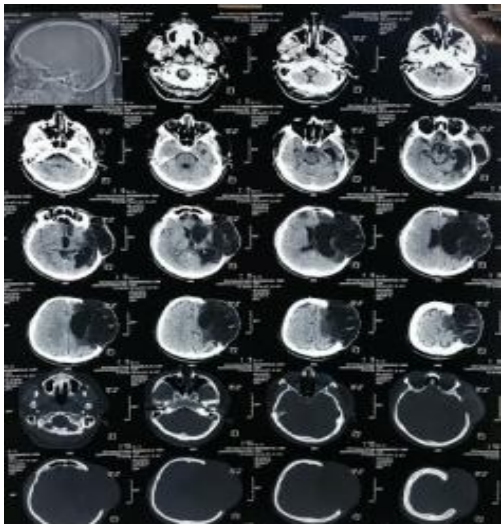

Figure 6 - NCCT Brain: Day 90 incidentally diagnosed PTH and gliosis

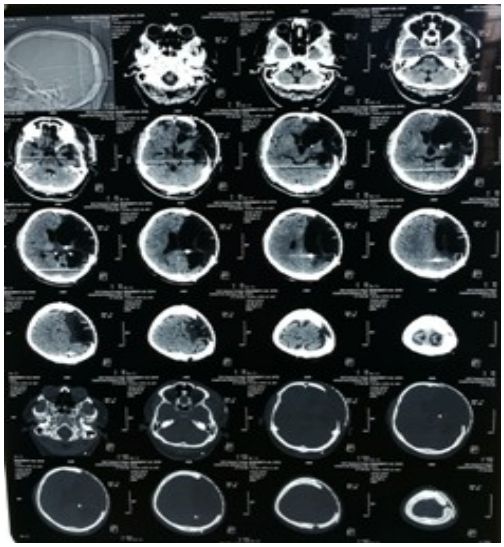

Figure 7 - Scan revealing VP shunt and mesh cranioplasty with resolve HCP

Discussion

Criteria given by Kishore et al. (5) were used to diagnose hydrocephalus were used in this study: 1) a distended appearance of the anterior horns of the lateral ventricles; 2) enlargement of the temporal horns and the 3rd ventricle; 3) normal or absent sulci; 4) if present enlargement of the basal cisterns and the 4th ventricle; and 5) periventricular decreased density. Tian et al, found that traumatic SAH is a risk factor for the development of hydrocephalus in head injury patients. (6) Risk factors for PTH are not yet fully identified but data suggested severity of injury, age, duration of coma, and DC increased the risk. (7) Jiao et al. reported that advanced age, subarachnoid hemorrhage (SAH), and hygromas (subdural, or interhemispheric) are correlated with the development of hydrocephalus. (8) Some authors found that the distance of craniectomy to the midline was a factor associated with hydrocephalus after decompressive craniectomy. They considered that when the skull was removed too close to the midline, the external force compressing the temporal and parietal bridging veins was reduced, and that this might cause an increase in venous blood flow and extracellular fluid absorption and a decrease in brain parenchyma volume, causing a consequent increase in ventricular volume, which resulted in post-operation hydrocephalus. (9) Distance from the midline is the only factor associated with hydrocephalus after TBI was reported by De Bonis et al. (9) Some studies reported that patients with DC whose superior limit was <25 mm from midline had a significant risk factor for development of hydrocephalus (9, 10, 11). Waziri et al found no relationship between DC and hydrocephalus through retrospectively analyzing a cohort of consecutive patients.

(12) Gudeman et al. reported the incidence of ventricular enlargement after TBI between 1.5% to 29%, when evaluated by CT. (13) Cardoso et al. suggested that, Post traumatic hydrocephalus may present with various clinical syndromes including altered sensorium, failure to improve, psychomotor retardation, memory loss, gait ataxia and incontinence (14). These cases were treated by V.P shunting and outcome was evaluated. PTH commonly occurs in first year post trauma and has been reported as early as within 7 hours of injury. (15) In our study 3 patients were diagnosed on 5th post-trauma day and one as late as 90th post operative day which was accidentally diagnosed during follow up period. Higher incidence of PTH has been found with extended DC hence; early cranioplasty should lead to restoration of normal intracranial pressure dynamics and spontaneous resolution of hydrocephalus. It has been found that SAH is most important pathology leading to the development of PTH. (13, 16) While in our study most common finding was SDH in 15 (42.8%) patients and SAH in 9 (25.9.%). PTH most commonly developed in patients those underwent decompressive craniectomy for acute subdural hematoma SDH. The reason is that out of total head injuries maximum number of patients had SDH at our centre. Hematoma may leads to Inflammatory changes and adhesion to arachnoid granulation that causes impaired CSF circulation and eventually responsible for development of hydrocephalus. Shunt surgery was performed in most of the patient within 6 month after trauma. In this study, showed no correlation between interval time and postoperative improvement in those patient who developed PTH after decompressive craniectomy while it was a very good results noted following early shunt surgery in patient having posterior fossa hematoma whoever managed conservatively. However, Sheffler et al.16 presented a case of PTH that improved with a shunting procedure after having clinical symptoms of PTH for 11 months after a closed head injury. Wood et. al. (17) Insisted that patients with clinical symptoms of hydrocephalus for less than 6 months had a better prognosis. Decompressive craniectomy that has been found to be associated with development of PTH by various mechanism like altering CSF flow dynamics, mechanical blockage around convexities, inflammation of arachnoid granulation by post surgical debris. (12, 18)

Conclusion

In present study we have found that PTH is commonest sequeale of severe head injury and in those who underwent decompressive craniectomy. However, several other late complications of DC have been reported, including sinking flap syndrome, extra-axial fluid collection and hydrocephalus. Hydrocephalus was developed early in patient with posterior fossa SAH or contusion in comparison to decompressive craniectomy. CSF absorption is meanly dependent on Arachnoid granulation function and pressure difference between the subarachnoid space and draining venous supply. Hence, decompressive craniectomy results in decreased CSF outflow as well its absorption; thus, leading to hydrocephalus. NCCT brain

should perform not only to diagnose PTH but also to rule out other causes of delayed deterioration or when patient fails to improve after initial trauma. Early diagnosis and performance of shunting procedures may significantly stop or reveres the sequence of worsening. This study showed that most patients with PTH were improved after shunt surgery. Following the shunt surgery, there was rapid improvement noted in conscious level, headaches and in cognitive functions and outcome of our study was favourable in 92.7% cases. All the cases of PTH should be treated by medium pressure V.P. shunt.

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References

1.Choi I, Park HK, Chang JC, Cho SJ, Choi SK, Byun BJ. Clinical factors for the development of posttraumatic hydrocephalus after decompressive craniectomy. J Korean Neurosurgery Soc. 2008;43:227–231
2. Beyerl B, Black PM. Posttraumatic hydrocephalus. Neurosurgery.1984;15:257–261.
3. Bret P, Hor F, Huppert J, Lapras C, Fischer G. Treatment of cerebrospinal fluid rhinorrhea by percutaneous lumboperitoneal shunting: review of 15 cases. Neurosurgery. 1985;16:44–47.
4. Dandy WE, Blackfan KD. Internal hydrocephalus. An experimental, clinical and pathological study. J Neurosurg. 1964;21:588–635.
5.Kishor PRS, Lipper MH, Miller JD, Girevendulis AK, Becker DP, Vines FS. Post-traumatic hydrocephalus in patients with severe head injury. Neuroradiology 1978; 16:261-5.
6. Tian HL, Xu T, Hu J, Cui YH, Chen H, Zhou LF. Risk factors related to hydrocephalus after traumatic subarachnoid hemorrhage. Surg Neurology2008; 69: 241-246; discussion 246.
7. Chuang K, Stroud NL, Zafonte R. Rehabilitation of patients with traumatic brain injury. In: Winn HR, editor. Youmans neurological surgery. Ed 6.Phildelphia, PA: Elsevier Saunders; 2011. pp. 3516–3534.pp. e3511–e3513.
8. Jiao QF, Liu Z, Li S, Zhou LX, Li SZ, Tian W, et al. Influencing factors for posttraumatic hydrocephalus in patients suffering from severe traumatic brain injuries. Chin J Traumatol 2007; 10: 159-162.
9. De Bonis P, Sturiale CL, Anile C, Gaudino S, Mangiola A, Martucci M, et al. Decompressive craniectomy, interhemispheric hygroma and hydrocephalus: a timeline of events? Clinical Neurology Neurosurg 2013; 115: 1308-1312.
10. Takeuchi S, Takasato Y, Masaoka H, Hayakawa T, Yatsushige H, Nagatani K, et al. Hydrocephalus after decompressive craniectomy for hemispheric cerebral infarction. J Clin Neuroscience 2013; 20: 377-382.
11. Wang LP, Wu CG, Yao J. Risk factors of post-traumatic hydrocephalus after decompressive craniectomy for patients with craniocerebral trauma. Chin J Trauma. 2014;30:307–310.
12. Waziri A, Fusco D, Mayer SA, McKhann GM, 2nd, Connolly ES., Jr Postoperative hydrocephalus in patients undergoing decompressive hemicraniectomy for ischemic or hemorrhagic stroke. Neurosurgery.2007;61:489–493.
13. Gudeman SK, Kishore PR, Becker DP, Lipper MH, Girevendulis AK, Jeffries BF, et al. Computed tomography in the evaluation of incidence and significance of post-traumatic hydrocephalus. Radiology.1981;141:397–402.
14. Cardoso ER, Galbraith S. Posttraumatic hydrocephalus — A retrospective review. Surg Neurol 1985; 23:261-4.
15.Takagi H, Tamaki Y, Morii S, Ohwada T. Rapid enlargement of ventricles within seven hours after head injury. Surg Neurol 1981; 16:103-5.
16. Sheffler LR, Ito VY, Philip PA, Sahgal V. Shunting in chronic post-traumatic hydrocephalus: demonstration of neurophysiologic improvement. Arch Phys Med Rehabil. 1994;75:338–341.
17. Wood JH, Bartlet D, James AE, Jr, Udvarhelyi GB. Normal-pressure hydrocephalus: diagnosis and patient selection for shunt surgery. Neurology. 1974;24:517–526.
18. Foroglou G, Zander E. Post-traumatic hydrocephalus and measurement of cerebrospinal fluid pressure. Acta Radiol Diagn (Stockh) 1972; 13:524-30.