Original article

Retrospective Observational Study of Clinical Profile of Hydrocephalus Presenting to Tertiary Care Teaching Government Hospital in Maharashtra

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BACKGROUND: Hydrocephalus is known as a condition in which excess cerebrospinal fluid (CSF) builds up within ventricles or fluid containing cavities of brain.

OBJECTIVE: This study was done to analyze the presentation and post procedure outcome of patients after ventriculoperitoneal shunt.

PATIENTS AND METHODS: The study is a retrospective observational study and included all the patients who underwent ventriculoperitoneal shunt in our hospital from December 2016 to December 2021.

RESULTS: This study included 250 patients who were admitted in our hospital from December 2016 to December 2021 and underwent ventriculoperitoneal shunt procedure. All patients presented with headache was the commonest symptom in adults, while increase in head circumference was the commonest presentation in infants. The most common tumor associated with hydrocephalus was cerebellopontine angle tumors. The commonest cause of shunt obstruction was mechanical failure. There were no anesthesia related complications associated with our procedures.

CONCLUSION: Ventriculoperitoneal shunt(V-P shunt) is the procedure of choice in patients with hydrocephalus with very low complication rates.

KEYWORDS: Hydrocephalus, Keen's point, Ventriculoperitoneal shunt.

INTRODUCTION

Hydrocephalus literally means water head and has traditionally been regarded as an abnormality in the formation, flow or absorbtion of cerebrospinal fluid (CSF). If CSF flow is obstructed by a blockage within the ventricular system, CSF production continues through the choroid plexus and the ventricular system enlarges. Also, it can be due to imbalance between CSF production and its absorption anywhere in the brain. If CSF absorption is hampered by the arachnoid granulation for any reason it might result in enlargement of ventricles and hydrocephalus. CSF absorption can be blocked at any level within the subarachnoid cisterns, for example within the cisterna magna, at the basilar cistern or along the cerebral convexities. The latest attempt to understand hydrocephalus development, aquaporin mediated brain water homeostasis and clearance of both CSF and ISF into the perivascular space and blood are compromised.^{1,2}

Hydrocephalus is the commonest condition leading to neurosurgical intervention in children. A rigorous definition of hydrocephalus is surprisingly difficult; however, hydrocephalus can be subclassified into intra-ventricular obstructive hydrocephalus or extra-ventricular obstructive hydrocephalus. Both shall be distinguished from each other

Correspondence: Agraj Mishra Department of Neurosurgery, B.J. Medical College and Sassoon Hospital Email: drneuromishra@gmail.com as treatment differs for each of them and includes CSF diversion and membrane fenestration respectively.³

In the pediatric age, majority of cases are due to defects in CSF pathway which are usually congenital. However, adult - onset hydrocephalus is secondary to heterogenous pathologies like intracranial hemorrhage due to aneurysmal subarachnoid hemorrhage (43%) and tumor (32%) or trauma to head or infectious disease (6% each). Idiopathic intracranial hypertension accounts for 16% of cases.³

Various modalities of treatment are present in hydrocephalus like ventricular access device, ventricular subgaleae shunt, ventriculoarterial shunt, ventriculoperitoneal shunt (VP), endoscopic third ventriculostomy and external ventricular drainage.⁴⁻⁶

VP shunt is a communication between the cerebrospinal fluid flow in the ventricle and peritoneum of abdominal cavity where a proximal ventricular catheter is introduced in the ventricles and through the chamber and pipe system it is connected with distal end of peritoneum through which it drains the CSF.^{6.7}

Ventricular access for CSF shunts may be obtained by either a frontal or parietal or occipitoparietal approach. In the frontal approach, a linear or curvilinear incision is made and a burr hole is created at Kocher's point, found 1 cm anterior to coronal suture and 2-3 cm off midline; the catheter is guided perpendicular to the skull axis from the burr hole targeting the ipsilateral medial canthus and external auditory meatus in coronal and sagittal plane respectively. In parietal approach a curvilinear incision is made at Keen's point 3 cm above and behind the pinna and burr hole is done and the lateral ventricles approached. In the occipitoparietal approach, bur is created along the parietal boss in infants or at Frazier's point in adult.

Naturally, one of the risks associated with ventricular cannulation is bleeding. This may present as a hematoma along catheter tract or as intraventricular hemorrhage. There has been report of intra-tumoral hemorrhage following VP shunt insertions, either from direct injury or as result of ventricular decompression causing distortion of intracranial structures.

Regarding perioperative complications, placement of the distal catheter of a VP shunt is more difficult in context of previous abdominal surgery (including multiple shunt revisions), obesity or prior intra-abdominal infection. Over time, the distal catheter may erode through virtually any of the abdominal viscera into one of many different locations. Reports have been published of the peritoneal catheter migrating into gall bladder, oral cavity, anus, scrotum, umbilicus, heart, thorax, pulmonary artery and bladder among other sites. Other abdominal complications are abdominal CSF pseudocyst, volvulus, CSF ascites, inguinal hernia and hydrocele.⁸⁻¹⁰

The failure rates of V-P shunt is around 20% in the first year of surgery, and revisions are needed more in pediatric age group than adults. A study conducted of 64 patients who were followed up for 15 years, found that 15% of the study group didn't need any revision and 17% required more than 2 revisions. Overall, the commonest causes of shunt failure is mechanical shunt failure followed by infection, and infectious causes lead to early shunt failure post operatively and occlusion counts for late presentation. Through multivariate analysis the strongest independent risk for failure is with congenital or obstructive type. Perhaps the greatest pitfall of ventricular shunting is relatively poor durability of this treatment. In the shunt design trial, 60% of population were free of any failure at 1 year while 45% of population were free of any failure within 2 years. Most cases of shunt failure are related to mechanical failure 60% (occlusion, fracture of tubing, disconnection of components, migration of shunt), infection 12%, and over-drainage 5%.11-14

This study was done to analyze the presentation and post procedure outcome of patiens after venreiuloperitineal shunt.

PATIENTS AND METHODS

Retrospective analysis of case records were reviewed from both adult and pediatric age groups between December 2016 until December 2021 at the neurosurgery department of B.J. Medical college and Sassoon hospital, Pune; a tertiary care hospital.

Study objective was to analyze the clinical profile and postoperative complications of VP shunt surgery in our

tertiary center and also to study factors influencing the shunt complication and the prognosis of patient after shunt surgery. Patients who died in 6 month follow up were excluded from this study.

Consent of the patients with institutional approval has been taken before study Institutional ethical committee (IEC) number 0222022-022.

Inclusion criteria

All age groups & genders who were diagnosed as hydrocephalic on pre-operative computerized tomography (CT) and magnetic reasonace imaging (MRI) brain were included in the study group and underwent ventriculoperitoneal shunt.

Exclusion criteria

Patients were excluded from the study if they pre operatively presented with features of bacterial meningitis, with intracranial hemorrhages or presented with Glasgow coma scale (GCS) of less than 8.

Clinical data

We studied the retrospective observational study data from medical records of our tertiary centre; and detailed history and neurological examination were retrieved from patient files including presenting symptoms, age group, investigations being performed while in the hospital, treatment and its response and outcome of treatment.

Two hundred and fifty patients were studied of which 30 patients were less than 1 year (infants) and 220 patients were between 1 and 80 years old. Only patients who underwent ventriculoperitoneal shunt were included in our study.

The patients were categorized according to presenting symptoms. In adults the symptoms were headache, nausea and vomiting, ocular symptoms, cognitive impairment, sixth nerve palsy, gait instability, urinary difficulties. In pediatric age group the symptoms were increase in head circumference, improper feeding, tense frontaelle, development delay and sun setting phenomenon.

All patients of all age groups were included in the study. Chhabra medium pressure ventriculoperitoneal shunt were used in patients and Keen's point was used as ventricular end entry point in all the patients. All patients who underwent surgery were evaluated with post operative CT scan or MRI and close neurological monitoring was done.

Procedure

Complete aseptic precautions were taken, and under general anesthesia, the patient was placed in supine position on the operating table. The head was slightly elevated and sandbags placed beneath the shoulder of the patient. Keen's point was marked and was located 3 cm behind and up from the ear pinna and a transverse incision was made in the abdomen, which was 2 cm upwards and lateral to umbilicus and on the same vertical line from the cranial incision. We used a Chhabra medium pressure shunt in our procedure. The skin from the cranium to the abdomen was scrubbed with betadine solution and had been cleansed with betadine solution and draped properly. An umbrella shaped incision was taken on the cranial part and through perforator and a burr hole was done and dura was cauterized (Fig. 1). Through a transverse abdominal incision, peritoneum was opened and through a shunt introducer, the subcutaneous space was created from the abdominal to cranial end. Chhabra abdominal end was passed from the cranial to peritoneal end via shunt introducer and a space behind the pinna at the mastoid level was created for the shunt chamber. The ventricular end was passed 3-4 cm till ventricles were hit and inserted till the 8 cm mark and secured via silk 4-0. CSF flow was checked and attached to the abdominal end and the abdominal end was buried in the peritoneum and layer closure done. The cranial end was closed in two layers with Vicryl 2-0 RB for galea subgalea and Ethilon 2-0 CB for skin.

RESULTS

Between December 2016 to December 2021; 250 patients were studied and included in the study. All patients were diagnosed with hydrocephalus on preoperative CT/ MRI imaging. 62 patients were females (24.8%) and 188 patients were males (76.2%). Graph 1: In adults, raised intracranial tension (ICT) features were present in 178 patients, headache was present in 64 patients, nausea and vomiting in 29 patients, and ocular signs in 140 patients. Abducens nerve palsy was present in 78 patients, cognitive impairment, urinary difficulties and gait instability where present in 44 patients. In infants the presenting features were increase in frontaloccipital circumference seen in 21 patients, while 6 patients presented with non-specific sign. Graph 2: Hydrocephalus due to tumors like cerebellopontine angle tumor, colloid cyst of third ventricle, suprasellar mass, hypothalamic glioma, medulloblastoma was one of the major causes of shunt surgery in 105 cases (48%), of which cerebellopontine angle tumor constituted 51 cases (48.5%), followed by nonobstructive hydrocephalus due to tubercular meningitis(TBM) in 71 cases (32.2%). As much as 18% of cases were normal pressure hydrocephalus (NPH) and 1.8% had head injury. Graph 3: The most common cause of hydrocephalus in infants was posterior fossa medulloblastoma in 12 patients (40%), followed by commeunication hydrocephalus in 10 patients. In 8 (26.6%) cases, biventricular shunting was performed, which were suprasellar tumors causing foramen of Monroe blockage. Graph 4: Of all the cases, 11.6% (29) were re-do cases, 20 cases of which were due to mechanical shunt obstruction and 9 patients due to infection. Shunts were inserted through the parietal entry point (Keen's point) either left or right side depending were the tumors were localized, or in redo cases where the one side shunt was infected or obstructed. CSF routine analysis was done in all the cases intraoperatively and 48 cases had elevated CSF protein. In all the recorded cases, no anesthetic complications were observed. **Graph 5:** Shunt complications occurred in 34 cases and we had to perform revision surgery in all the cases. Mechanical failure was the commonest cause followed by infection and pseudocyst of abdomen. In 3 of the cases, the medium pressure shunt was changed to high pressure due to over drainage.



Fig 1: Intraoperative image of burr hole at the site of ventricular end of cranium.



Graph 1: Showing male and female ratio in presented group.





Graph 3: Showing causes of Hydrocephalus in adult group.







DISCUSSION

Ventriculoperitoneal shunting is routinely performed for various indications and has variable outcomes and complications. Out of 250 cases, 220 cases were adults and 30 cases were children, and the commonest causes were tumors. In a study conducted by Issacs et al, there was an 8 time decline in prevalence from pediatric to adult age group and 17 times increase in elderly making it a U shaped continuum.¹⁵ In our study, the adult group between 30-45 was the most common representing 50% of all cases.

There is higher chance of tumor occurrence in posterior fossa in pediatric age group leading to increase incidence of hydrocephalus in children presenting with posterior fossa tumor. The Canadian preoperative prediction rule for posterior fossa neoplasms identifies patients at high risk of developing postresection hydrocephalus. These patients might selectively be exposed to the risks of preresection CSF diversion to improve outcome.16

Among infants, 12 cases were reported to have medulloblastoma. In our study, all the congenital cases had communicating hydrocephalus which occurred in 10 patients.

According to Ramos et al, hydrocephalus generally has a congenital or acquired etiology. Congenital causes include Dandy Walker syndrome, cerebral aqueduct stenosis, Chiari malformations, meningomyelocele, infection, intraventricular hemorrhage, genetic defects, trauma and teratogens. In acquired etiologies, development of hydrocephalus after a hemorrhagic process in subarachnoid space or intraventricular hemorrhage is less common than central nervous system CNS tumors, infections and low-pressure hydrocephalus.¹⁷ In all the observed cases in our adult population, the most common cause were tumors (48%) in which cerebellopontine angle tumor constitutes 42%. Tubercular meningitis is the

second most comon cause and constitutes of 32.2% cases. However, in elderly the normal pressure hydrocephalus (18.1%) was the most common.

Postoperatively shunt surgeries are evaluated for any signs of complications. Symptoms associated with shunt complications are headache, vomiting, seizure, double vision, sixth nerve palsy, poor feeding, increase in head circumference and signs of meningismus. If complications arise, the ventricular and peritoneal end need to be assessed in cases of shunt surgery for function or any signs of redness or swelling. According to Merkler et al., in all adult patients of total 17,035 who underwent VP shunt surgery, CNS infection occurred in 6.1% and VP shunt revision was needed in 22%.¹⁸ In our study, revision occurred in 13.6% cases and most common cause was mechanical shunt obstruction.

CONCLUSION

Hydrocephalus is a life-threatening condition and if not addressed immediately, death can occur. The most common cause observed are tumors associated with hydrocephalus and immediate shunting is necessary. The complication rate of shunt surgery is high and the most common is obstruction.

We have observed that males have a higher tendency for hydrocephalus compared to females with the commonest presentation being headache then vomiting and papilledema. Tumors were the commonest cause of hydrocephalus followed by tuberculous meningitis in adults and posterior fossa tumors were the commoest cause in pediatrics. The commonest cause of shunt revision is obstruction or blockage of the catheter.

List of Abbreviations

CNS: Central nervous system. CSF: Cerebrospinal fluid. CT: Computerized tomography. GCS: Glasgow coma scale. IEC: Institutional ethical committee. ICT: Intra cranial tension. MRI: Magnetic resonance imaging. NPH: Normal pressure hydrocephalus. TBM: Tubercular meningitis. V-P shunt: Ventriculoperitoneal shunt.

Disclosure

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