International Journal of
Health, Medicine and Nursing Practice
(IJHMNP)

A Clinical Audit: Ventriculoperitoneal Shunt for Patients with Hydrocephalus

CARI Journals

International Journal of Health, Medicine and Nursing Practice
ISSN 2710-1150 (Online)
Vol.5, Issue No.3, pp 21 – 32, 2023
www.carijournals.org

A Clinical Audit: Ventriculoperitoneal Shunt for Patients with Hydrocephalus

Khawand Saeed Perdawd
MBChB, Trainee at Iraqi Board of Medical Specializations-Neurosurgery
Erbil Teaching Hospital
https://orcid.org/my-orcid?orcid=0009-0003-8553-1627

Accepted: 11th July, 2023 Received in Revised Form: 24th July, 2023 Published: 8th Aug, 2023

Abstract

Purpose: Hydrocephalus, abnormal accumulation of CSF in the ventricles, is one of the most common diseases of the brain. Ventriculoperitoneal shunting is one of the commonest procedures for management of hydrocephalus. Assessment and evaluation of the clinical outcome, following VP shunt, should be carried out to decrease rates of complications of this procedure. Clinical audit plays a vital role in identifying and developing effective methods for improving patient care. This paper sheds light on 37 neurosurgical patients with hydrocephalus who underwent ventriculoperitoneal shunt surgery. Our aim was to identify defects in steps in management of hydrocephalus by VP shunt from time of admission to discharge.

Methodology: In this audit study 37 patients with hydrocephalus were selected between November, 2021 and December, 2022 at West Erbil emergency hospital and Erbil teaching hospital. VP shunt surgery was performed for them. Information was gathered from patient records, diagnostic imaging, and operation notes, and subsequent clinical follow-up evaluations were carefully analyzed and reviewed. The gathered data encompassed demographic details, clinical manifestations, radiological studies, reasons for surgery, operative findings, and complications associated with the shunt.

Findings: The prevalent causes observed were congenital hydrocephalus (45.9%), posterior fossa tumors (13.5%), and post meningitis hydrocephalus (18.9%). A right-sided VP shunt utilizing a medium-pressure valve system emerged as the most prevalent treatment modality. Three patients exhibited symptoms and signs indicative of shunt infection. Additionally, one patient experienced an epidural hematoma at the site of the burr hole.

Unique contribution to theory, practice and policy: Patients with hydrocephalus and undergoing VP shunt surgery should be evaluated carefully and every step from time of admission to discharge is crucial in decreasing the complications which are associated with this surgery.

Keywords: *hydrocephalus, VP shunt*

Introduction:

The treatment of hydrocephalus has developed through advances in various bypassing and shunting operations (2). The first shunt procedure was carried out in 1908 (1). Until now, shunting is the gold standard treatment modality for hydrocephalus.

The shunt procedure involves diverting CSF from the brain ventricles into the peritoneal cavity (ventriculoperitoneal shunt), pleural cavity (ventriculopleural shunt), and right atrium (ventriculoatrial shunt). Of these, ventriculoperitoneal shunt is the most commonly used procedure (3). Endoscopic third ventriculostomy is an alternative to VP shunt in selected situations and patients. In ventriculitis and progressive post-hemorrhagic hydrocephalus cases, external ventricular drain (EVD) is a chosen procedure. Apart from this, EVD can be performed to reduce intracranial pressure during neurosurgical surgeries as a temporary procedure (5, 6).

Success of VP shunt procedure is dependent on many factors. The aim of our clinical audit was to review standards of clinical care of patients undergoing VP shunt surgery in a systematic way. Clinical audit is a quality improvement process which seeks and aids in improving patient care and outcomes against proven and agreed standards. The audit cycle includes assessing clinical management based on the standards of quality care and procedures or interventions followed by re-measurement of the outcome to make further improvements.

Materials and methods:

We undertook this clinical audit study in neurosurgery units at West Erbil Emergency hospital and Erbil Teaching hospital in Erbil, Iraq which are the only two public hospitals in Erbil governorate with neurosurgical units. Thirty seven patients with hydrocephalus were selected for this study by the non-probability opportunity sampling. These patients underwent VP shunt surgery between November, 2021 and December, 2022

Data was collected from medical records, imaging studies, and operation notes and clinical follow-up evaluations were analyzed and reviewed. Then, demographic detail, clinical manifestation, radiological studies, indications for intervention, operative findings and complications relating to shunt were analyzed and assessed. It is essential to define standards to compare and identify any deviation from the standard protocol for the surgical management of hydrocephalus patients. In this study, sixteen standards were established for such a comparison, aiming to ensure adherence to the recommended protocol and improve patient outcomes. The standards were according to the local guidelines (Figure 1).

Results:

In this study, data was gathered and examined using MS excel. The statistical output was presented in the form of percentages and frequencies. Tables were used to summarize the frequency and percentage of diagnoses, surgical procedures, and findings related to the neurosurgical patients

who underwent VP shunt surgery for the management of hydrocephalus. Additionally, the study allowed for re-audit within a 10-month period, providing an opportunity to review and assess any changes or improvements made based on the initial audit results.

Description of the standards:

Guideline and protocol for the treatment of hydrocephalus patients include taking full history and examination on admission, confirmation of the condition by radiological investigations. There are various treatment choices including conservative management and the options are according to the definitive diagnosis of the patient. Surgeries for hydrocephalus include VP shunting, endoscopic third ventriculostomy, and external ventricular drain. After deciding and planning surgical treatment, the neuroanesthetist should carry out pre-anesthetic checkup (PAC). All members of the surgical team, neuroanesthetist, OT nurse, and other OT staff should have prior information of surgery. An informed consent is obtained from the patient and relative. Pre-operative instructions are written down in the case record file, preoperative checklist should verify the instructions and the patient is transferred to the OT. Routinely, a 3rd generation cephalosporin is injected intravenously to the patient at the time of induction of anesthesia. Vital signs, temperature, ECG, bispectral index monitor, intra-arterial or noninvasive blood pressure, and central venous pressure are monitored intraoperatively. In the case report file, details of OT notes and instructions and neurological assessment postoperatively will be recorded. We have acquired knowledge from this study that necessitates 16 parameters from comprehensive and evidence-supported patient care. These parameters have been categorized into 3 groups:

Standards of Preoperative work up, standards at the time of surgery, and postoperative standards.

Table 1: Details of Standards and Expected Targets

Serial Number	Standard	Target	Exception
1	Comprehensive history, Physical & neurological examination & diagnosis	100	No
2	Information to patients	100	No
3	Written consent	100	No

4	Was the surgery was performed by trained neurosurgeon	100	No
5	Imaging studies done	100	No
6	Pre-anesthetic care before procedure	100	No
7	Pre-op antibiotic prophylaxis administered	100	No
8	Nursing staff signed check-list	100	No
9	Anesthesia consent form signed	100	No
10	Patient monitoring during procedure documented by anesthetist	100	No
11	Neurosurgical team operative notes	100	No
12	Neurosurgical team mentioned post-op instructions	100	No
13	Complication recorded	100	No
	Following surgery antibiotic given		

14		100	No
15	Discharged summary given to patients	100	Death
16	Instructions given to patients to contact team in case of emergency	100	Death

Standards of pre-operative work up

1) Full history, general and neurological examination and diagnosis:
All the patients underwent comprehensive clinical assessment. Which included detailed medical history, through physical examination conducted by a neurosurgeon, and diagnostic investigations. The systematic investigations involved various diagnostic tests, including complete blood count for the blood profile. Additionally, CSF examination covered an extensive range of biochemistry assessments (proteins, sugar), cytology, and gram stain. This criterion was met in 31 cases, while in 6 cases, it was unclear whether the record completion had been achieved.

2) Information to the patient:

Information regarding the procedure was provided to all patients. However, in 5 out of 37 cases, the case record file lacked evidence that the patients had received detailed information about the surgical procedure and its potential outcomes.

3) Consent obtaining:

Before the surgery, an informed written consent was obtained from all the patients. Therefore, the standard that determines whether the procedure was performed by a trained neurosurgeon or not was met in our cases, as a qualified neurosurgeon performed the surgeries.

4) Imaging studies done:
All patients underwent radiological investigations, such as brain CT scan or MRI, for diagnosis.

Standards at the time of surgery

1) PAC (pre-anesthesia care prior to surgery):
A comprehensive preanesthetic check-up was performed on all cases prior to surgery.

2) Giving pre-op prophylactic antibiotic:

In 11 cases, the documentation regarding the administration of prophylactic antibiotic was not evident. The main reason for this discrepancy was the omission of prophylactic antibiotics from the printed proformas used by the neurosurgeon and anesthetist.

3) Signing the preoperative check-list by nursing staff:
In 2 cases, the check-list was not signed by the nursing staff.

4) Neuroanesthesia consent form:
In one case, the neuroanesthetist had not signed the anesthesia consent form.

5) Record of the patient monitoring during surgery by anesthetist:
In 2 cases, the intraoperative monitoring was not documented on the anesthesia case sheet.

6) Operative notes by the neurosurgical team:
In 7 cases, the neurosurgical team did not document the operative procedures comprehensively.

Post-operative standards

1) Post-operative instructions mentioned by the neurosurgical team:
In one case, the post-operative instructions were absent from the case record file.

2) Record of any complications:
In all cases, the chronological record of the clinical status, including post-operative complications, was documenteds.

3) Antibiotic following surgery according to antibiotic policy:
All patients in our study received antibiotics following the Institute"s antibiotic policy.

4) Comprehensive Discharge summary:
A detailed discharge summary with instructions for follow-uo was provided to all the patients.

5) In case of emergency, Instruction given to patients to contact doctor:
After neurosurgical intervention, the patients underwent radiological and clinical follow-up assessments. However, in 7 cases, the instructions regarding the person to be contacted in case of an emergency were not clearly mentioned.

6) The results indicate deficiencies in documentation that can be significantly improved across all standards with the introduction of the standardized proforma.

Discussion:

Our study included a total of 37 patients, ranging in age from 2 months to 75 years. Among them, there were 20 were male and 17 female patients. All patients underwent detailed clinical assessment, preanesthetic checkup, chest X-ray and hematological investigations. Cranial imaging

modalities included CT scan and MRI with or without contrast. The common etiologies observed were congenital hydrocephalus (45.9%), posterior fossa tumors (13.5%), and post meningitis hydrocephalus (18.9%), NPH (6%), post traumatic (6%), supratentorial tumors (6%). Other causes include arachnoid cyst and idiopathic aqueduct stenosis (Table 1). In infants with congenital hydrocephalus, preoperative ventricular tapping was performed to exclude infection for which external ventricular drain needs to be performed. The most common modality of treatment was a right-sided ventriculoperitoneal shunt with a medium-pressure valve system. Cytology and

Biochemistry samples, were collected for all patients. The two patients with normal pressure hydrocephalus were treated using a low-pressure right VP shunt.

One patient died during follow up due to primary malignancy in the chest. Three patients developed symptoms and signs of shunt infection. Epidural hematoma at the site of the burr hole developed in one patient. Because of malpositioning of the ventricular catheter, one patient needed shunt revision.

To diagnose hydrocephalus, clinical and radiological features and, sometimes, intracranial pressure recordings are required. CT and MRI of brain are the most commonly used techniques for detecting space occupying lesions and revealing the etiology of hydrocephalus. In general, the incidence of hydrocephalus is equal in males and females. However, there is slight male predominance in cases of NPH. Hydrocephalus incidence has a bimodal age curve. One peak occurs in infancy, which is associated with other congenital anomalies. Second peak occurs in adulthood, primarily attributed to NPH. Adult hydrocephalus accounts for about 40% of all cases (4). In our study, congenital hydrocephalus was the commonest type (45.9%), followed by post meningitis hydrocephalus (18.9%)

The management of hydroceohalus presents significant challenges (3). If left untreated, hydrocephalus can lead to death due to tonsillar herniation caused by increased intracranial pressure leading to brainstem compression and subsequent respiratory arrest. Additionally, untreated hydrocephalus can result in poor cognitive development in infants and children or cognitive decline in adults. Visual loss is another possible complication of untreated hydrocephalus, which may persist even after treatment (4).

In some cases of hydrocephalus, the patients may undergo conservative management with short term medical treatment, including carbonic anhydrase inhibitors, osmotic agents, loop diuretics, and fibrinolytic therapy. Acetazolamide, either alone or combined with furosemide, appears to be the most suitable drugs. In instances of post-hemorrhagic hydrocephalus, fibrinolytic therapy can be administered directly into the ventricular system (7). Other measures to treat hydrocephalus include ventricular tapping, repeated lumbar punctures, and the use of subcutaneous reservoirs. However, surgical treatment remains the preferred therapeutic option (4). Commonly used surgical procedures for hydrocephalus include ventriculoperitoneal shunt, external ventricular drain, and

endoscopic third ventriculostomy. The choice of shunt procedure for a patient depends on clinical and radiological features. Right-sided shunt surgery is commonly performed, while in some cases, a left-side VP shunt may be inserted depending on the diagnosis. For instances, if a patient has a right-sided cerebellopontine angle tumor and a right-sided retro sigmoid craniotomy is planned for tumor resection, a left VP shunt is done to treat hydrocephalus.

Similarly, in a patient with obstructive hydrocephalus presenting left-sided lateral ventricular enlargement, a left VP shunt is performed. Usually, when patients have hydrocephalus due to meningitis, a ventricular tap is conducted to send CSF for cytology, biochemistry, and other investigations based on the provisional diagnosis. If infection is present, an EVD is inserted. If the sample was clear, VP shunt is performed. The type of pressure setting for the shunt valve is determined based on the CSF pressure during the ventricular tap. Low-pressure VP shunt should be avoided in children with obstructive hydrocephalus due to aqueductal stenosis to prevent over-drainage and subdural hematoma. For these patients with congenital hydrocephalus, a medium-pressure right VP shunt is most appropriate. In patients with NPH, a low-pressure VP shunt is used.

Shunt complications can be minimized by implementing simple measures such as preoperative preparation, draping, limiting movement of personnel in the OT, prophylactic antibiotic administration, secure assembly of the shunt components, selecting an appropriate shunt type, careful collection of CSF during surgery, changing gloves before shunt handling, minimizing handling of the shunt assembly, and administering antibiotic therapy after shunt insertion. Giving due importance to every stage of shunt surgery can help reduce the frequency of shunt revisions. In suspected failure cases, the patient should undergo a thorough investigation before any further operation. As long as the ventricular tip remains inside the ventricle, it is highly unlikely that the shunt is not functioning. Shunt revision should not be performed if the ventricular end has crossed to the opposite side lateral ventricle, piercing the septum pellucidum.

The audit cycle involves taking action to align practice with these standards to enhance the quality of care and health outcomes. By adhering to the cycle, any clinician or team can identify areas or steps in their practice that can be improved. This continuous process helps in achieving better healthcare practices and patient outcomes.

Table 2: Etiology of hydrocephalus in our 37 cases

Diagnosis	No. of cases	Percentage
Congenital Htdrocephalus	17	45.9%
Post meningitis	7	18.9%

Posterior fossa tumor	5	13.5%
Post traumatic	2	6%
Supra tentorial tumor	2	6%
NPH	2	6%
Idiopathic	1	2.7%
Arachnoid cyst	1	2.7%

Table 3: Type of VP shunt according to pressure

Type of shunt	No. of cases	Percentage
Medium Pressure Right-side VP shunt	35	94.59%
Low pressure Right side VP shunt	2	5.4%

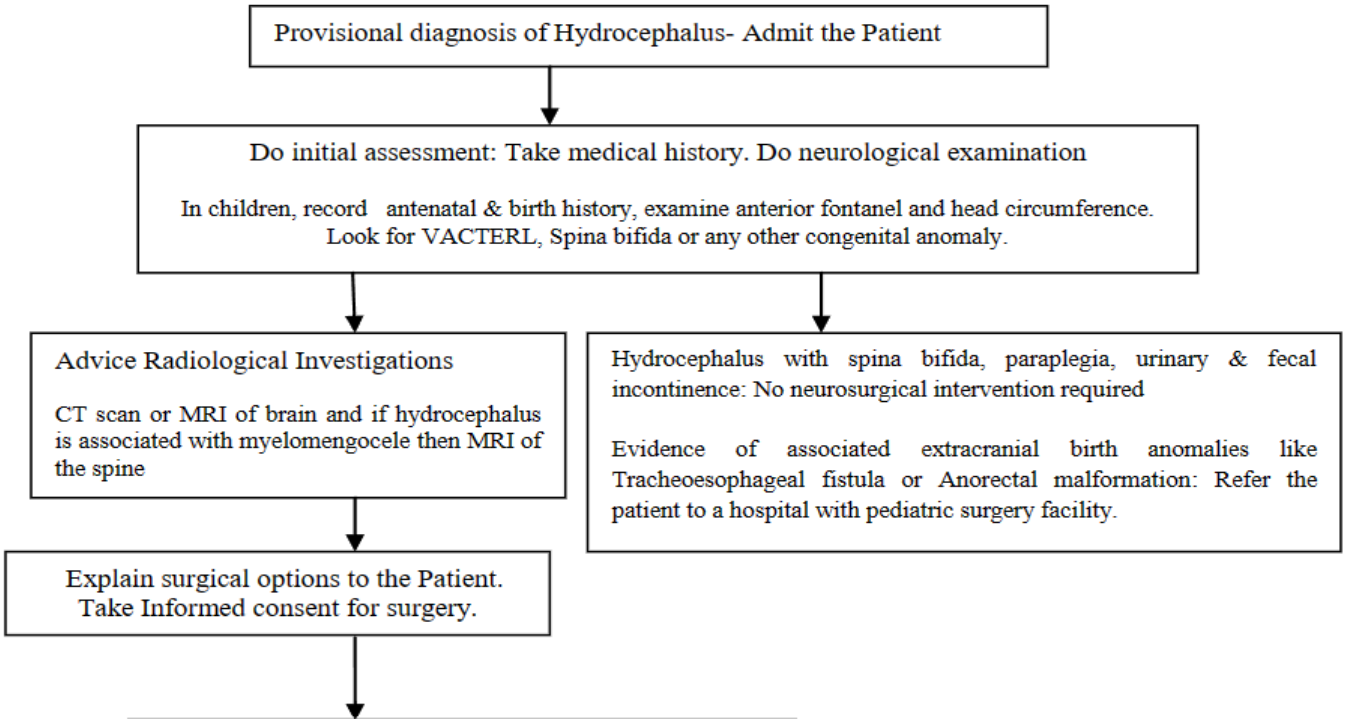
Conclusion:

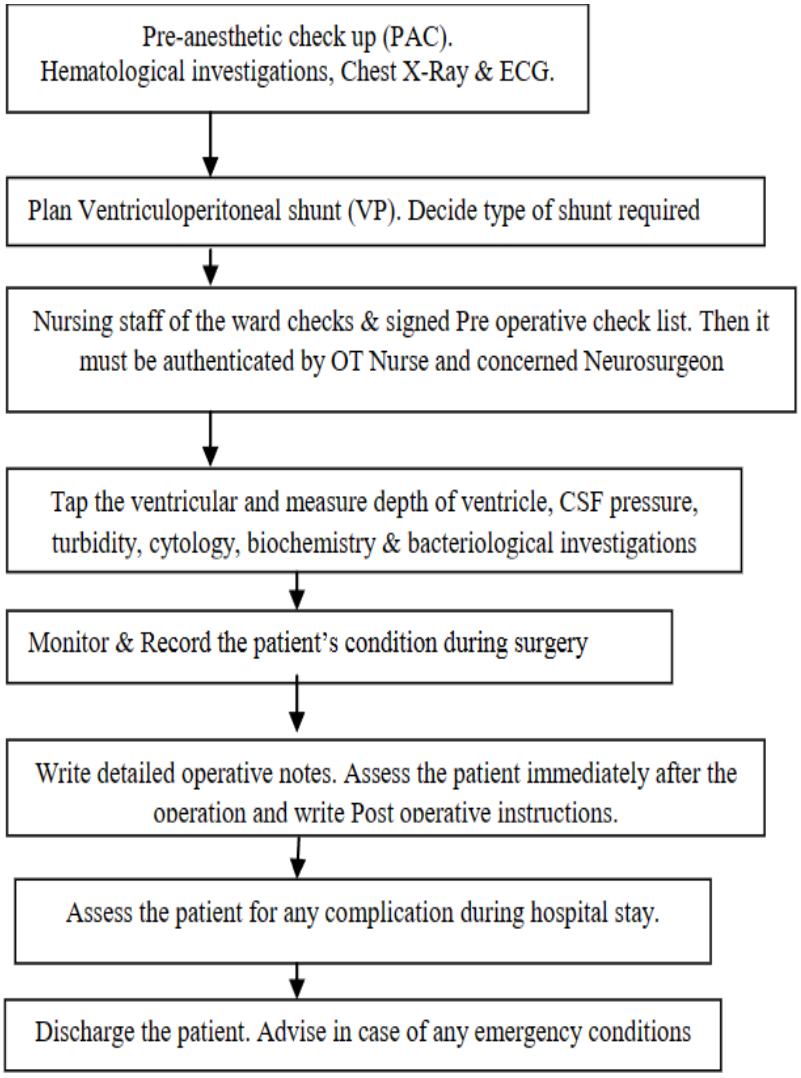
VP shunting is the most commonly used neurosurgical procedure for managing hydrocephalus. To treat non-communicating hydrocephalus, another alternative is endoscopic third ventriculostomy. Meticulous clinical work up, choosing appropriate shunt type, CSF study, prophylactic antibiotic usage, and precautions at the time of the procedure can minimize the high incidence of shunt failure and complications. Shunt surgery is often performed by neurosurgical trainees and younger neurosurgeons.

This procedure is associated with high failure rates despite being a simple surgery. The clinical team should revise the clinical outcome to modify and rectify the clinical care steps and to improve the documentation.

Re-auditing after enhancing the quality and content of documentation and implementing standard operating procedures is an effective approach to identify areas needing improvement in clinical management and enhance clinical outcomes.

Figure 1: Hydrocephalus Management Steps


Provisional diagnosis of Hydrocephalus- Admit the Patient
Do initial assessment: Take medical history. Do neurological examination
In children, record antenatal & birth history, examine anterior fontanel and head circumference. Look for VACTERL, Spina bifida or any other congenital anomaly.
Advice Radiological Investigations
CT scan or MRI of brain and if hydrocephalus is associated with myelomengocele then MRI of the spine
Hydrocephalus with spina bifida, paraplegia, urinary & fecal incontinence: No neurosurgical intervention required
Evidence of associated extracranial birth anomalies like Tracheoesophageal fistula or Anorectal malformation: Refer the patient to a hospital with pediatric surgery facility.
Explain surgical options to the Patient. Take Informed consent for surgery.



References:

1) Kausch W. Die behandlung des hydrocephalus der kleinen kinder. Arch Klin Chir 1908;87:709-96

2)Robertson J.S., Maraqa M.I., Jennett Bryan: Ventriculopperitoneal shunting for hydrocephalus. *British Medical Journal*, 1973,2, 289- 292.

3)Low D, Drake JM, Seow WT, Ng WH. Management of ventriculo- peritoneal shunts in the paediatric population.*Asian J Neurosurg.* 2010 Jan; 5(1):7-14.

4)Jha R, Khadka N, Kumar P. Management of Hydrocephalus – Our Experience.*PMJN*, Vol 10, Number 2, Jul-Dec 2010, 68-70.

5)Ali M, Usman M, Khan Z, Khan K.M.,Hussain R,and Khanzada K: Endoscopic third ventriculostomy for obstructive hydrocephalus. *Journal of the College of Physicians and Surgeons, Pakistan* 2013, Vol. 23(5): 338-341.

6)Weninger M, Salzer HR, Pollak A, Rosenkranz M, Vorkapic P, Korn A, Lesigang C. External ventricular drainage for treatment of rapidly progressive posthemorrhagic hydrocephalus. *Neurosurgery.* 1992 Jul; 31(1):52-7; discussion 57-8.

7)Poca MA, Sahuquillo J. Short-term medical management of hydro- cephalus. *Expert Opin Pharmacother.* 2005 Aug; 6(9):1525-38.

8)Hamilton MG. Treatment of hydrocephalus in adults. *Semin Pediatr Neurol*. Mar 2009; 16(1):34-41.

9)Rehman AU, Rehman TU, Bashir HH, Gupta V. A simple method to reduce infection of ventriculoperitoneal shunts. *J Neurosurg Pediatr.* 2010 Jun;5(6):569-72

10)VINOD K S Gautam, Ravinder Singh, Sarbjeet Khurana. Hydrocephalus treated with VP shunt surgery: a clinical audit. Internation J. Of health, 2014 Jul: 2 (2) 26-29