ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF GRADUATE STUDIES

BRAIN IMAGING EVALUATION OF VENTRICULOPERITONEAL SHUNTING AND COMPLICATION AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA

BY: AKREM DURI ((MD, RADIOLOGY RESIDENT)

A research Thesis preparation of senior paper to be submitted to radiology department, college of health science, Addis Ababa University in preparation for partial fulfillment of the requirements for the specialty certificate in radiology.

Oct, 2021

ADDIS ABEBA, ETHIOPIA

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ADVISORS: Dr. AMAL S (MD, Ass. Prof. Of radiology, Neuroradiologist, Department of Radiology, School of Medicine, College of Health Sciences, Addis Ababa University and Dr. TESFAYEA G (MD, Neuroradiology fellow Department of Radiology, School of Medicine, College of Health Sciences, Addis Ababa University)

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Approval sheet

The Undersigned declare that I have submitted my original work on a title

Brain imaging evaluation of ventriculoperitoneal shunting and complication at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia

Submitted by Akrem Duri Ahmed signature_____

This thesis work has been submitted for examination with my approval as an adviser.

Approved by

Dr Amal S signature _____ Date _____

Dr Tesfaye G signature _____ Date _____

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First and foremost, I would like to thank almighty Allah for his immense blessings and help provided to me throughout my life. Without Him, I would not have had the wisdom or the physical ability to do so.

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Abbreviations and Acronyms

CT scan- computer tomography

CSF – cerebrospinal fluid

EVD- External ventricular drain

ETV –Endoscopic third ventricular dilatation

INPH-Idiopathic normal pressure hydrocephalus

TASH- Tikur Anbessa specialized hospital

MRI-Magnetic resonance imaging

SS- shunt series

SPSS -Statistical Package for the Social Sciences

VP shunt- Ventriculoperitoneal shunt

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Abstract

Background: Hydrocephalus is an abnormal accumulation of CSF in the central nervous system by different pathologic causes. Abnormal CSF accumulation causes a rise of intracranial pressure and results in catastrophic complications unless treated. The management focused on reliving raised intracranial pressure using different methods and one of the commonly used methods is a ventriculoperitoneal shunt. Our study direction was to assess brain image evaluation of ventriculoperitoneal shunt using different imaging.

Methods: A retrospective cross-sectional study was conducted, on all patients who had a ventriculoperitoneal shunt, and brain imaging was reviewed from **15 Jun 2017 to 2 Mar 2021** G.C. Data Review of medical records and all the images in the study population during the study period was carried out. Information on socio-demographic characters, indication for shunting, imaging finding, and related complication were reviewed, using data collected by using structured questionnaires and image analysis. Data were compiled and analyzed using SPSS 23.0 computer software and presented using tables, graphs, and figures.

Result: In 60 patients we study the age of the participants ranges from 1 month to 55 years, with a mean of 20.8, and a median of 19. The sex distribution showed 22(36.1%) females and 38(63.9%) were males. Post-op CT images done in the study period were 45(75%), and shunt tip grading analysis showed grade two shunt tip of 28(46.7%) and grade one in 19(31.6%). Fifty-four (90%) causes of Hydrocephalus were neoplasm, three (5%) congenital, and one (1.6%) meningitis. Complications we identified in our study were 12(20%) intracranial hemorrhage, four (6.7%) ventriculitis, and five (8.3%) pneumocephalus.

Conclusion: Our study showed, most patients had no imaging evaluation after VPS procedure, and common imaging used where pre-contrast CT. A common indication for VPS insertion was neoplasm. Complications related to VPS in our study are commonly caused by intracranial hemorrhage.

Keywords: CT, Complication, Hydrocephalus, MRI, ventriculoperitoneal shunt

1. BACKGROUND

1.1. Introduction

Hydrocephalus is an excessive accumulation of cerebrospinal fluid(CSF) in the head caused by a disturbance of CSF formation, flow, or absorption. If normal CSF flow is impeded by a blockage within the ventricular system, CSF production continues and the ventricles enlarge. In the classic model, hydrocephalus can also result from an imbalance between CSF production and absorption. When CSF absorption through the arachnoid granulations is compromised, the ventricles enlarge, and hydrocephalus results. Absorption can be blocked at any level within the subarachnoid cisterns. Hydrocephalus is a neurosurgical disorder, commonly occurred in pediatric patients which require neurosurgical intervention. (1)

Abnormally enlarged cerebral ventricles can be observed by clinical parameters or imaging. The diagnostic value of imaging is to identify the cause and for evaluation of shunt function by comparing consequent images. And also using clinical parameters we can Indirectly assess enlarged ventricles using head circumference, enlarged or bulged fontanel in the neonate, and also another parameter.

In the pediatric age group, a majority of cases are caused by congenital defects of the CSF pathway, but in adult-onset hydrocephalus is usually secondary to different pathologies that encompass a heterogeneous group of disorders. The most common is intracranial hemorrhage (45%, most often caused by aneurysmal subarachnoid hemorrhage) followed by neoplasm (30%) and head injury or infection (5% each). Normal-pressure hydrocephalus (11%) and idiopathic intracranial hypotension (4%) together account for 15% of cases. (1)

The diagnosis of hydrocephalus is reasonably straightforward in most patients. Patients with acute hydrocephalus experience classic symptoms (headaches, vomiting, and mental status changes) and signs (up-gaze palsy, declining mental status, and bradycardia) of elevated intracranial pressure. (2)

Management of high pressure due to CSF accumulation is reliving the pressure by decompression through different neurosurgical procedures. Depending on the patient and the clinical scenario we can use different ways of treatment like external ventricular drainage, Ventriculoperitoneal drainage, video-assisted ventricular drainage, third ventriculostomy, and remove the obstructive mass. One of the treatments for hydrocephalus is VP shunting, which is done using putting a catheter system into the peritoneal cavity. (3)

VP shunting consists of a silicone ventricular catheter that is inserted through a single burr hole, using either image guidance or anatomical landmarks to locate the ventricle. The catheter is sometimes rifampicin and clindamycin or silver-impregnated. It is connected to a valve that is usually placed in the subgaleal space. The valve can be pressure or flow-regulated and may contain an anti-siphon device. This is connected to a length of distal tubing that is tunneled subcutaneously from the valve site to the level of the abdomen, or chest, where it is inserted through the abdominal wall into the peritoneal cavity, in pleural space or atrium where the distal catheter tip sits. (4)

A functioning VPS provides a permanent pathway for ventricular CSF outflow and allows for normalization of CSF pressure in hydrocephalus. Common complications following successful

VPS include bleeding, shunt infection, ventriculitis, damage to normal brain tissue, and need for future operation. Proximal catheter occlusion or migration, shunt fracture, over drainage, and distal catheter occlusion. (4)

The major risks of the procedure are bleeding, infection, damage to normal brain tissue, and need for future operation. The risk of bleeding is immediate and will be detected while the patient is still in the hospital. If there is excessive bleeding, a larger surgery may be required to prevent brain damage. When the shunt is placed, the catheter must pass through normal brain tissue to reach the ventricle. The shunt is usually placed in a part of the brain that can tolerate this manipulation, but rarely patients can develop weakness, sensory or visual changes, and speech difficulty. The risk of infection and obstruction is the most common problem with VPS. The shunt tubing is a foreign object in the body which can make it impossible for the body to kill the bacteria growing on the tubing. If a shunt becomes infected, it needs to be removed and replaced with an entirely new system. If an obstruction occurs, only the part of the shunt system that does not work needs to be replaced. Depending on the clinical situation, patients can go home 2-7 days after surgery. The success rates depend on the age of the patient and indication. Generally, there is around a 50% failure rate for ventriculoperitoneal shunts. The shunt tubing can become infected or obstructed requiring surgical revision. Endoscopic third ventriculostomy (ETV) is an alternative treatment that has a higher success rate but is only available for select patients. (5).

Shunt malfunction and other complications need a rapid diagnosis to prevent mortality and significant morbidity. We can evaluate clinically for the shunt malfunction with a clinical history of vomiting drowsiness, and irritability but these symptoms are not specific so clinicians need to have a noninvasive investigation like CT or MRI and radiographic shunt series to identify a malfunction and its cause. (6)

1.2. Statement of the problem and significance of the study

Hydrocephalus is one of the most common brain disorders, yet the global burden is lacking. Due to the combination of sparse population data, competing definitions, failed to report, miss diagnosis, and low access to radiographic technology. Hydrocephalus incident shows geographic inconsistency. In sub-Saharan Africa, the estimated annual incidence was more than 225,000 new cases of infant hydrocephalus, neonate, or childhood and CNS infection was the major cause. This would project approximately 750 new cases per 100,000 live births. In contrast, a cohort study in Europe shows a calculated incidence of 110 cases of infantile hydrocephalus per 100,000 live births. in resource-poor settings. Recognizing the complications of shunting can in the management of patients. Identifying the scope of the problem is essential for public health policymakers. This is particularly true in many low-income countries where children are at a higher risk for developing hydrocephalus. (7)

In Africa, largely because of limited resources and other pressing public health problems, including communicable diseases such as Acquired Immune Deficiency Syndrome (AIDS)/Human Immunodeficiency Virus (HIV) infection, malaria, and tuberculosis. New advanced medical fields and technology-dependent medical disciplines are very young that need a lot of effort to reach to another developed country**.** (8)

Ethiopia is one of the developing countries that has resource limitations in radiological services, and also compromised health services due to inadequate, poorly maintained infrastructure and scarcity of health professionals. A radiological service is a resource-intensive unit. In most developing countries radiological service is expected to be poor or may not be available at all. A study done in 2011 shows, 18% CT scan coverage and no MRI in all public hospitals in Addis Ababa which was found to be the least available **(9).**

Currently, there is no study to show a dynamic change in radiologic resources in Addis Ababa and Ethiopia.

Despite the abundance of hydrocephalus cases and VP shunting procedures, especially in Addis Ababa and the increasing number s of neurosurgeons. This study will help to create awareness and identify the importance of imaging to identify hydrocephalus and imaging of VP shunting and shunt-related complications. There are also not that many studies were done.

May help as footstep for further studies, and provide information regarding image finding of VP shunt, indication, shunt related complication and also helps as first step in drafting guideline in Tikur Anbessa specialized hospital. The results of this study may give an insight for administrators about functional CT or MRI imaging in the management of the patient.

2. LITERATURE REVIEW

2.1 Introduction

Radiology is a department that uses advanced technology like x-ray, ultrasound, CT, and MRI. To diagnosis disease, for follow-up, assess complications, body surveillance, and treatment response. Neuroradiology is a subspecialty of radiology focusing on the diagnosis and characterization of abnormalities of the central and peripheral nervous system, spine, and head and neck using neuroimaging techniques.

2.2 Imaging of VP shunt, associated factors, and shunt-related complications.

In a study done in Brigham and Women's Hospital, Harvard medical school, out of 263 cases 174 patients performed shunt series and head CT. The median age was 48, Nine shunt series were interpreted as abnormal (fluid collection around shunt tube), three (kinking), five (discontinuity, and two(migration).
A total of 71 (27%) cases of head CTs showed evidence of obstruction: 37 patients shows increased hydrocephalus and 34 patients showed hydrocephalus with no prior CT for comparison. (10)

A total of 192 head CTs were not otherwise suggestive of new or worsening obstruction: 9 cases are normal; 159 cases have no change from the prior exam; in 24 cases have decreased hydrocephalus. Contemporaneous shunt revision took place in a total of 46/263 (17%) cases. CT provided the sole imaging basis for revision in 21/46 cases (46%) and SS provides only 2/46 cases, such that overall, among those with a normal or unchanged CT, SS provided the sole imaging basis for revision in 1% of cases (2/192). (10).

In another study done in Paediatric Surgery, Gandhi Medical College and Associated, Kamla Nehru and Hamidia Hospitals Bhopal, Madhya Pradesh, India. Single institute prospective study analysis for five years, hundred and thirty-six VP shunt operations were performed for hydrocephalus in children below 12 years of age. The average number of VP shunt operations done per year was 47.2 shunts from 2006 to 2010. Forty (16.94%), 28 (70%) boys, and 12 (30%) girls, of 236 VP shunts developed shunt complications in the follow-up period and needed 48 shunt revisions. Four-fifth (n=38, 79.16%) shunt complications occurred within 6 months of previous surgery; of these, 28 (58.33%) were reported within 3 months of previous shunting. Shunt complications that occurred after 6 months to one year of previous VP shunt were 4 (8.33%) and after one year of shunting were 6 (12.5%). The average interval between VP shunt operation and shunt complications/revision was 5.11 months, ranging from one month to 4 years. However, we also encountered a shunt complication after 11 years of VP shunt (not included in the study. (11)

A study done in Myungsung Christian Medical Centre in Ethiopia shows that the commonest causes of hydrocephalus were spina bifida (42.3%) and post-infectious causes (20.2%). Early complications following surgery were seen in 65(58%) patients. The commonest complication was mechanical failure in 54(48.2%) patients, under shunting constituted 83.3% of the mechanical failure, shunt infection being 7% follow up was available in 75.4% of children with a mean follow-up period of 68+-7.7 month (range 1-36). (12)

In another institution-based retrospective medical review for a patient with INPH in Mayo Clinic School of Medicine and Departments of Neurosurgery, Radiology, Bioengineering, and Orthopedics, Mayo Clinic, Rochester, Minnesota, USA, The Study included 348 patients for analysis. The mean age of the cohort was 73.2 _ 8.3 years, most patients had their shunt placed via a frontal approach (n ¼ 266, 76.4%), with a relative minority of patients receiving parietal shunts (n ¼ 82, 23.6%) The frequency of grade 1, 2, and 3 catheter accuracy was 26.1% (n ¼ 81), 69.4% (n ¼ 215), and 4.5% (n ¼ 14). There were no statistically significant differences in catheter accuracy when placed via a frontal versus parietal approach cohort was 73.2 _ 8.3 years, The catheter accuracy was graded according to the methodology by Hayhurst et al, grade 1 was defined as the catheter tip being completely surrounded by CSF without contact with ependymal lining. Grade 2 was defined as the catheter tip touching the ependymal lining of the ventricle. Grade 3 was assigned when there was complete misplacement of the catheter outside of the ventricle or if a portion of the catheter was intraparenchymal (13).

3. OBJECTIVES OF THE STUDY

3.1. Objective

3.1.1. General objectives

To assess brain CT and MRI image evaluation of VP shunt, indication and complications at the department of radiology, Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia 2021 from **15 Jun 2017 to 2 Mar 2021** G.C

3.1.1. Specific objectives

To assess brain CT and MRI finding of VP shunt at the department of radiology Tikur Anbessa specialized, Addis Ababa, Ethiopia 2021 from **15 Jun 2017 to 2 Mar 2021** G.C.

To assess the indications for VP shunt placement at the department of radiology Tikur Anbessa specialized, Addis Ababa, Ethiopia 2021 from **15 Jun 2017 to 2 Mar 2021** G.C

To assess VP shunt response at the department of radiology Tikur Anbessa specialized, Addis Ababa, Ethiopia 2021 from **15 Jun 2017 to 2 Mar 2021** G.C.

To evaluate VPS-related Intra-cranial complications at the department of radiology Tikur Anbessa specialized, Addis Ababa, Ethiopia 2021 from **15 Jun 2017 to 2 Mar 2021** G.C.

4. METHODS AND MATERIALS

4.1 Study area and period

The study was conducted in TASH, College of health science, Addis Ababa University Addis Ababa Ethiopia. located in Addis Ababa capital city of Ethiopia, TASH is the largest referral hospital in Ethiopia as well as a medical college which has established in 1978 G.C. It provides a tertiary level referral treatment. TASH has 200 doctors, 379 nurses, and 115 other health professionals dedicated to providing health care services. The various departments, faculties, and residents under specialty training in the School of Medicine provide patient care in the hospital. The hospital also has 950 permanent and contract administration staff to support the hospital activities. In addition, almost all regional and federal hospitals in Addis Ababa are affiliated with the School of Medicine as clinical services and training sites.

The Department of radiology is one of the departments of the college of health sciences. The department serves both clinical activities and teaching for medical students, residents, and fellow radiologists. The modalities currently available in the department include x-ray, ultrasound, CT (computed tomography) scan. The study was conducted in the neuroradiology and neurosurgery department in TASH, both have money training residents and fellows. The hospital has four neuroradiologists and two fellow neuroradiologists and 12 neurosurgeons in TASH.

The study was conducted from **15 Jun 2017 to 2 Mar 2021** G.C

4.2 Study design

An institution-based retrospective cross-sectional study design was employed.

4.3. Populations

4.3.1. Source population

All patients in the neurosurgery department TASH hospital in the study period.

4.3.2. Study population

All patients which had VP shunt procedure and imaging in TASH.

4.4. Sampling technique and sample size determination.

Non-probability sampling technique was used and all patients which had VP shunt and had image were included during the study period.

4.5. Inclusion and exclusion criteria

4.5.1. Inclusion criteria

All patients who had VPS procedures in the neurosurgery department and had image were included.

4.5.2. Exclusion criteria:

Patients which had incomplete data, incomplete imaging, patients with no imaging in our hospital, and patients who didn't have post-op imaging but had a pre-op image.

4.6. Data collection technique and management

A well-structured questionnaire was constructed from reviewed literature. Data were collected from the source population and PACS in the study area. Then the questioner filled and prepared for data analysis.

4.7. Data analysis

Data entering, coding, and clearing for the quantitative data, and analyzed using tables, figures and edited using computer software SPSS23.0 calculators and excel.

4.8. Variables

4.8.1. Independent variable

Age, sex and Residency

4.8.2. Dependent variable

CT Imaging finding VP shunt, Indication and shunt related complication

4.9. Limitations

Hospital CT was failed for almost 4 months and a patient who had no post-shunt image in our hospital, incomplete patient data, and patients who don't have post-op imaging.

4.10. Operational definition

- Increased hydrocephalus - increment in size of ventricular dilatation compared to previous image
- Decreased hydrocephalus - decrement in size of ventricular dilatation compared to the previous image.
- No change - No change in size of hydrocephalus compared to previous image

- Measurement level- maximum bifrontal distance of the lateral ventricle at the same place as the previous image.
- Over shunting - After VPS, slit or collapsed ventricle.
- Pre-op image - CT/MRI image taken before VPS surgical procedure.
- Post-op Image - CT/MRI done after VPS surgery was done.
- Grading of VPS on imaging we use the Hayhurst et al method.

4.11. Ethical considerations

Ethical approval was obtained from Addis Ababa University College of health sciences department of IRB and then the research and ethical clearance committee. All data obtained in the course of the study was kept confidential and used solely for the study.

4.12. Dissemination plan

After completion of the study, the result will be submitted and presented to the radiology department of Addis Ababa University College of Health Science and attempts will be made to publish in peer-reviewed journals.

5: Result

5.1. SOCIO-DEMOGRAPHIC CHARACTERISTICS

We reviewed 109 medical records of which 60 fulfilled the inclusion criteria, the age range of participants ranges from 1 month to 55 years with a mean of 20.8, median of 19, mode of 6, and standard deviation of 1.58+ 1. Age less than 20 years was 56%, above 20 years was 43%, and age less than 18 years account for 50 %. Twenty-two (36.1%) were female and 38(63.9%) are male to female ratio is 1.7:1. (Table 1, Fig1).

Table 1, Sex distribution of total patient who had VP shunting in neurosurgery department and had an image in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C.

Sex	**Frequency**	**Percentage**
Female	22	36.7
Male	38	63.3
Total	6o	100

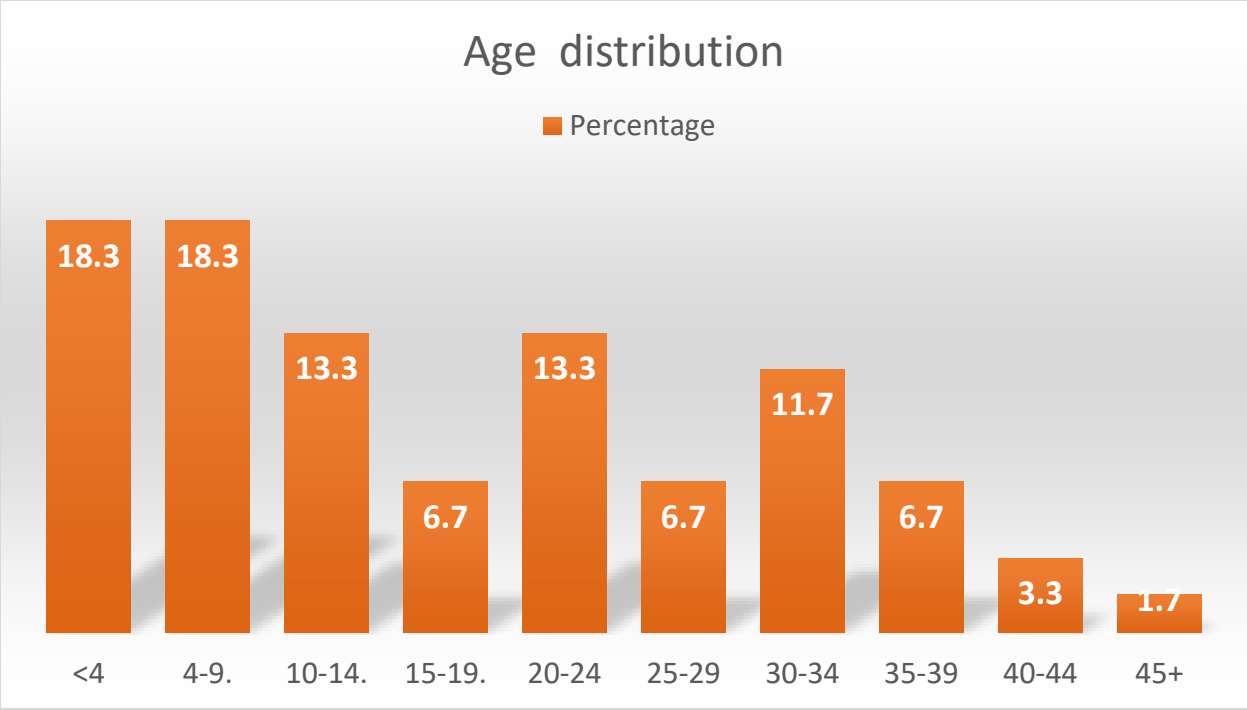

Figure 1, the Age distribution of patients who had VPS in the neurosurgery department and had an image in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C

5.2. Imaging finding of VPS

5.2.1. VPS procedure based on urgency, imaging time, and Time of imaging after VP shunting procedure

Out of 60 patients VPS surgery procedure as an emergency has done (acute hydrocephalus) for 56(93.4%) and as an elective procedure in four (6.7%) patients. Fifty-two (86.7%) of patients have CT images, five (8.3%) patients had both CT and MRI, and three (5%) patients had MRI images. The patients with post-op CT images were 45(75%), pre-and post-op CT images were seven (11.5%). Our study shows 41(68.3%) patients had imaging after VPS procedure in more than three days, 10(16.6%) in more than 1 day's post-operation, seven (11.7%) within three days, and two (3.3% patients in two days post-operation.(Fig 2, Table 2)

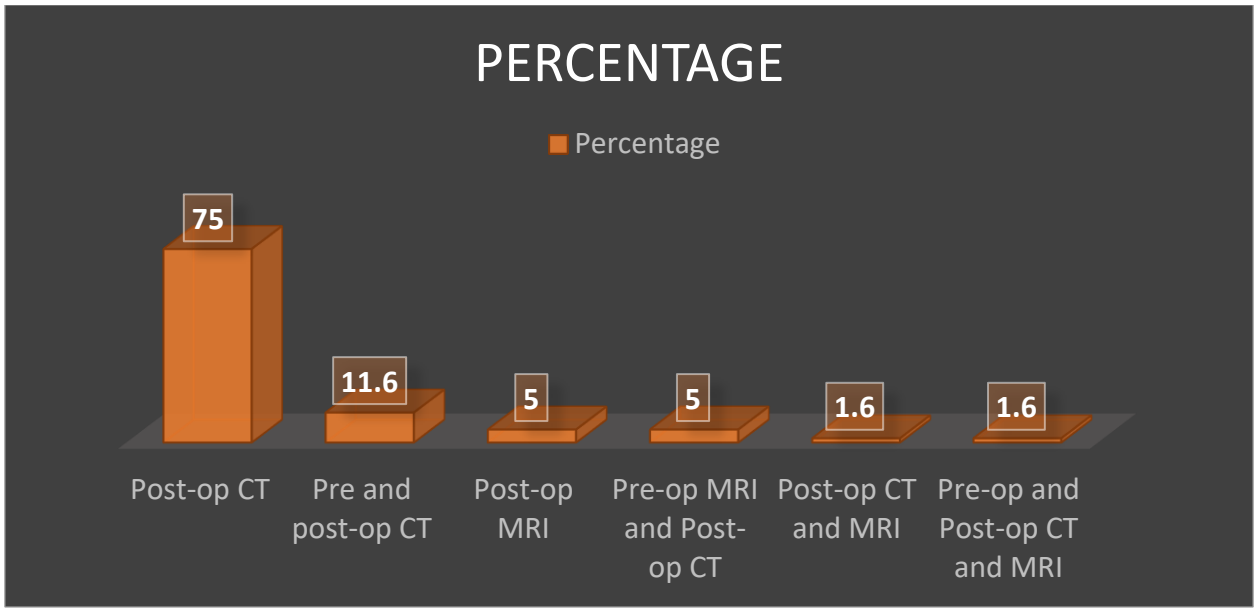

Figure 2, Distribution of image type based on timing in patients who had VPS in neurosurgery department and had an image in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C.

Table 2, Time of imaging after VPS placement in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C.

Time of image post-insertion of VPS	**Frequency**	**Percentage**
Within 1 day	10	16.6
1-2 day	2	3.3
2-3 days	7	11.7
More than 3 days	41	68.3
Total	60	100

5.2.2. Imaging technique and image types based

Out of 60 patients, 52(85%) patients had pre-contrast images, five (8.1%) patients had pre-and post-contrast CT images, and figure 3. shows others the remaining types of images.

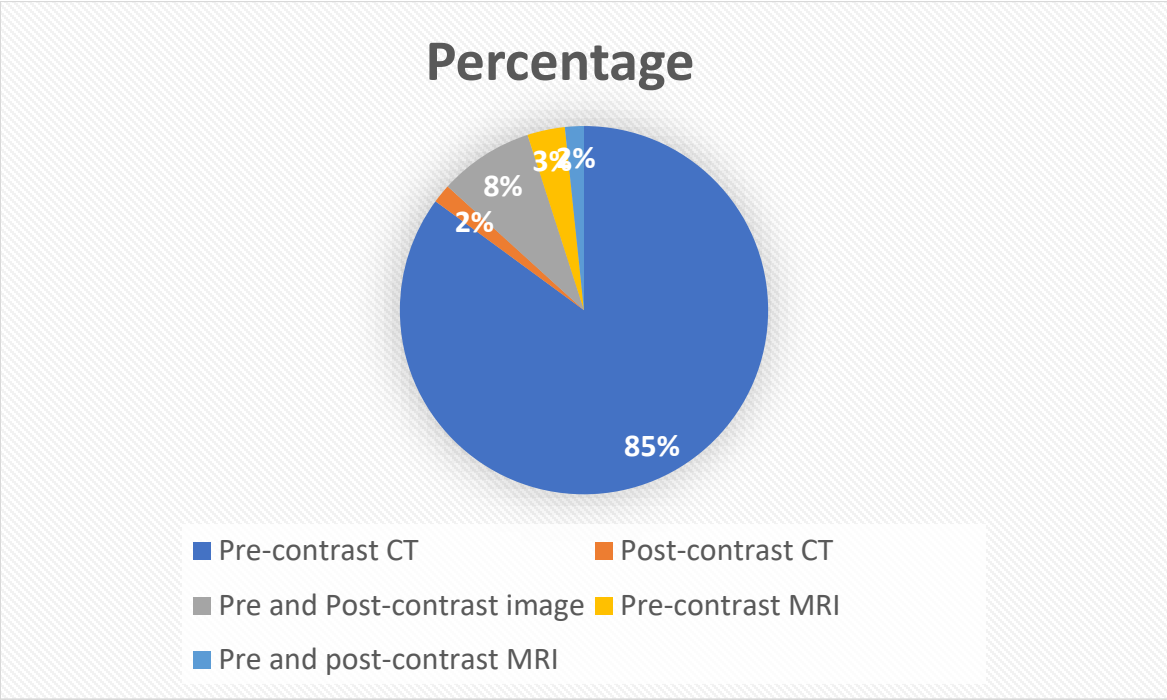

Figure 3, Imaging technique and types of images in TASH, Addis Ababa, Ethiopia, from **15 Jun 2017 to 2 Mar 2021** G.C.

5.2.3. VP shunt grading

Twenty-eight patients (46.7%) had Grade two shunt and 19(31.6%) had grade I. (Table 3)

The site of surgical bone defect which passes the VPS tube: 29(48.3%) patients had right parietal eight (13.3%) right frontal, and eight (13.3%) patients had left parietal the remaining described on (fig 4).

Table 3, Shunt tip grading in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C.

Image based VPS Grading	Grade I	Grade II	Grade III	Grade I/III	Grade II/III	Total
Frequency	19	28	10	2	1	60
Percentage	31.6	46.7	16.67	3.3	1.6	100

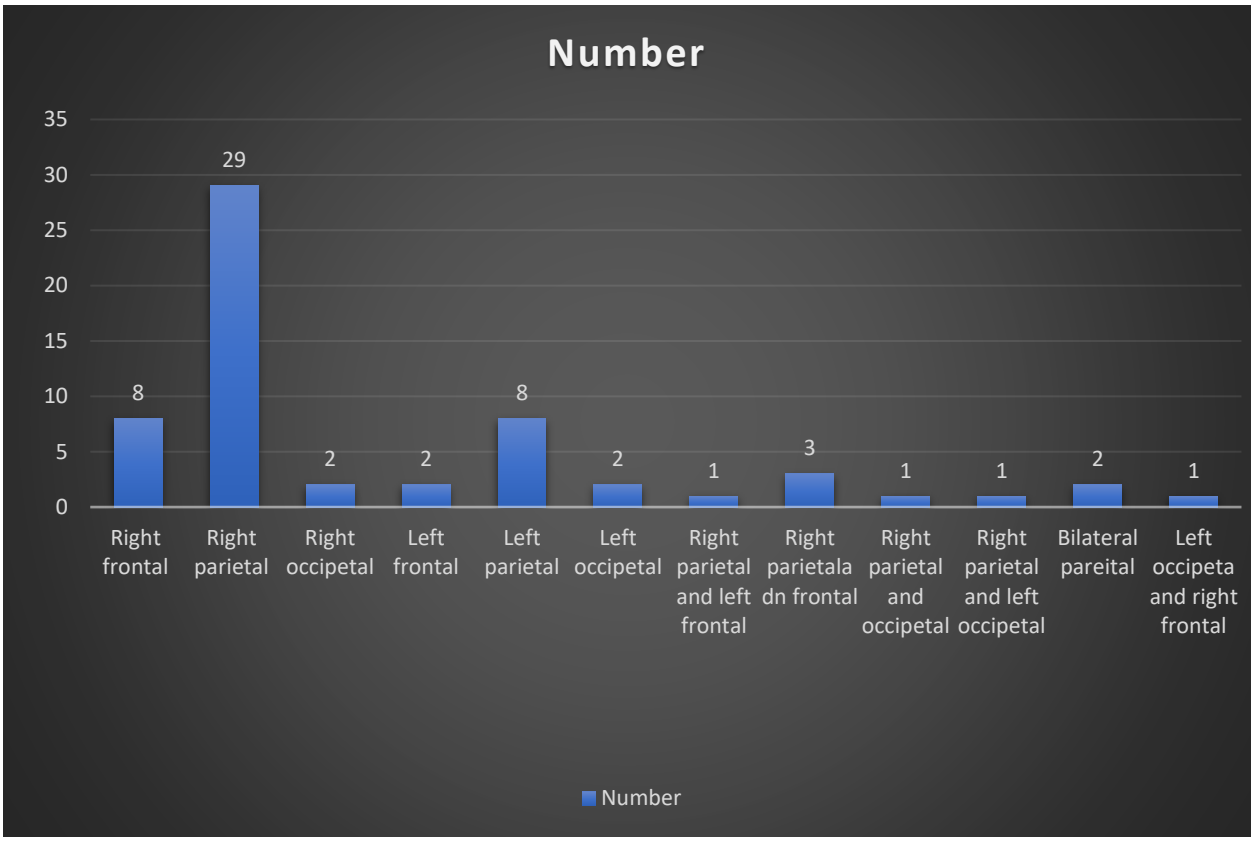

Figure 4, Surgical bone defect in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C.

5.3 Cause of hydrocephalus

Fifty-four (90%) were neoplasm as the cause of hydrocephalus, predominate causes were posterior fossa mass accounts for 34(56%), three (5%) congenital causes specifically (chair I and Chair II), one (1.6%) post-meningitis and two (3.3%) Posterior fossa hemorrhagic stroke.

Table 4, Causes of hydrocephalus as an indication for VPS placement in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C.

Cause of hydrocephalus	Frequency	Percentage
Neoplastic	54	90
Congenital	3	5
Post-meningitis	1	1.6
Posterior fossa hemorrhagic stroke	2	3.3
Total	60	100

5.4 Response of hydrocephalus after VPS placement

In 20(33.3%) patients had no image for comparison in our hospital and 11(18.3%) showed no change after VPS placement with a gap between imaging was one month in five patients (45.5%), more than 7 days gap in three (27.3%) patients and one day's gap in two (18%) patients, 11(18.3%) showed an increment in the size of hydrocephalus, nine (15%) showed over shunting after placement of VPS, and nine (15%) showed improvement after VPS placement.

Table 5, Response of Hydrocephalus after VPS placement compared with the previous image, in TASH, Addis Ababa, Ethiopia, from 15 Jun 2017 to 2 Mar 2021 G.C.

Hydrocephalus	**frequency**	**Percentage**
No change	11	18.3
Increase	11	18.3
Decrease	9	15
Over shunt	9	15
No image for comparison	20	33.3
Total	60	100

5.5 Imaging finding of VPS complication

Out of 60 patients in this study no intracranial VPS tube break, 12(20%) patients had intracranial hemorrhage specifically described in (fig 4), our (6.7%) patients had imaging evidence of ventriculitis, and five (8.3%) patients had pneumocephalus.

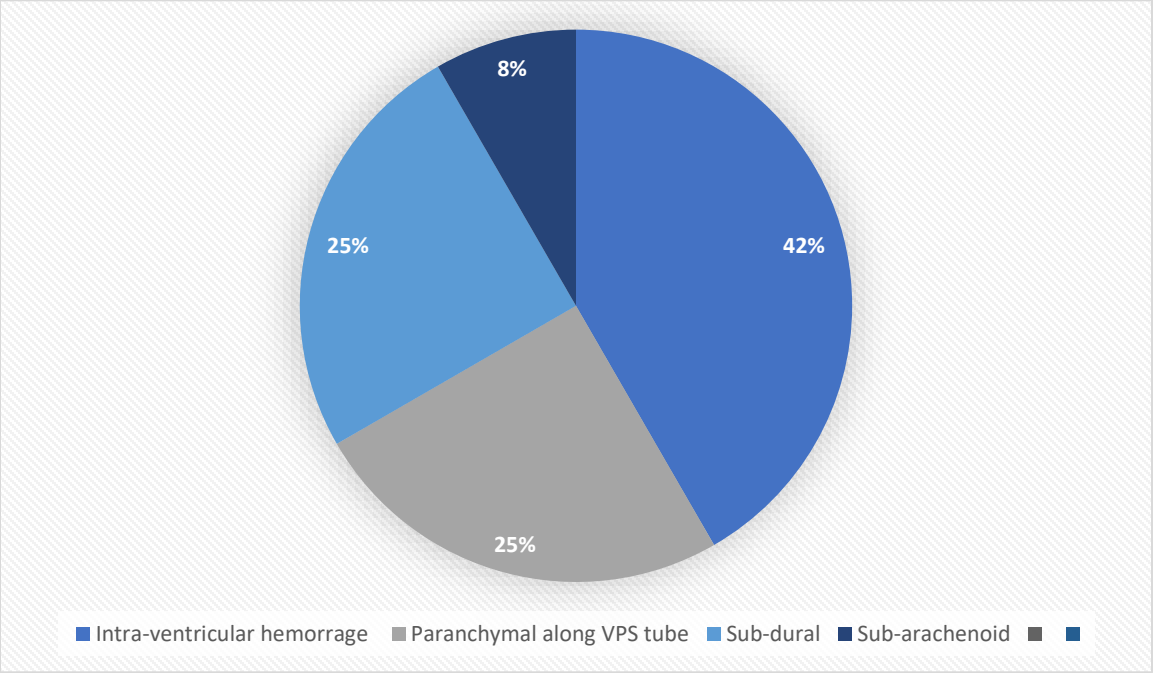

Figure 5, Types of Intra-cranial hemorrhage in TASH, Addis Ababa, Ethiopia, 15 Jun 2017 to 2 Mar 2021 G.C.

6. Discussion

In our study age of participants ranged from 1 month to 55 years with a mean age of 20.8, age less than 20 was 56 %, above 20 was 43%, and 50% less than 18 years of age, most patients are male 38(63.9%) patient compared to the female 22(36.1%), and most of the image were taken after 72hr, but a study done in USA California 66.1 % of patients were more than 18 years of age and 52% patients were male and 48% were female. The age distribution was not in line with the study done in USA California this might be due to the small sample size of our study, but in this study males were predominant. (14)

VPS surgery procedure was predominantly done as an emergency surgery in 56(93.4%) and as an elective procedure in four (6.7%) patients. In our study 52(86.7%) of patients had CT images, five (8.3%) patients had both CT and MRI and three (5%) patients had MRI images. About 45(75%) patients had post-op CT images, and seven (11.5%) had pre-and post-op CT images out of these patients 52(85%) had pre-contrast images, five (8.1%) had pre-and post-contrast images. Our study shows 41(68.3%) patients had to imagine more than three days post-operation, 10(16.6%) patients had to imagine more than 1 day's post-operation, seven (11.7%) to imagine within three days, and two (3.3% patient with two days post-operation.

Twenty-eight patients (46.7%) had grade two,19(31.5%) had grade one, and 10(16.67%) had grade three shunt tip, but in a study done in the USA, mayo clinic showed patients with grade two shunt tips were 69.7% and grade one was 26.7%. Our study was not in line with this study, this may be due to the small sample size and also might suggest a low rate of shunt malfunction in our study.

The surgical bone defect for passage of VPS tube in right parietal bone was in 29(48.3%), eight (13.3%) was in right frontal, and eight (13.3%) patients were in left parietal, but study in the USA in mayo clinic shows the predominate surgical bone defect was frontal than the parietal (13). This difference may be, the small sample size in our study, and insertion of VP shunt is preferred at parietooccipital area because the frontal lobe has much lower seizure threshold than the occipital or parietal lobe and hence may lead to post-operative seizures. The distance between parietooccipital area and peritoneal cavity is also shorter which avoids the need of an additional incision (22).

Causes of hydrocephalus in our study were mostly by neoplasm 54(90%) out of this predominate causes was posterior fossa mass, congenital cause like chair malformation accounts for five percent, infection 1.6%, and cerebrovascular disease 3.3%. This is in line with the study done in the USA at the University of California, but a study done in Ethiopia Myungsung Christian Medical Centre shows spina bifida accounts for about 42.3% and post-infectious cause about 20.2%. This is due to our study was done in the whole age group, not in the pediatric age group only, and also most pediatric patients were excluded due to lack of imaging (12,14).
In our study about 33.3% had no prior image for assessing the response of VPS placement, Increased hydrocephalus in 18.3%, about 15% shows over shunting, The remaining were not otherwise suggestive of worsening; No change from prior exam 18.3 %; decrease hydrocephalus 15% but Study done in the USA, shows increased in 14%, decreased in 9%, no change 60.4%, and no image for comparison in 12%. This shows that a large number of patients had no prior image for comparison in our institution (10).

Overall there was no intra-cranial VPS tube break but we didn't evaluate extra-cranial shunt status using shunt series, 12(20%) patients had an intracranial hemorrhage, (9)15% over shunt, four (6.7%) patients had ventriculitis, and five (8.3%) patients had pneumocephalus, but a study done in the USA Louisiana State University Health science center, shunt complications include infection (3.6%), over drainage (7.6%), obstruction (4.8%), proximal shunt complication (7.6%), distal shunt complication (3.6%), old shunt dysfunction (6.8%), valve malfunction (10.0%), externalization (3.6%), and shunt complication (12.0%). It was not in line with our study this may be due to the small sample size of our study and lack of shunt series in our study (20)

7. Strength and limitation of the study

This study tries to assess imaging findings of patients with VPS shunting and related factors like types of images, timing, and surgical bone defects.

This study also tries to assess complications related to the VPS procedure on the image.

- The Limitations of the was Hospital CT was failed for almost 4 months, MRI was non-functional for over a year, Patients who had no post-shunt image, Incomplete patient data, and patients who don't have post-op imaging.

8. Conclusion

This study has shown that most incomplete imaging for response assessment. Most patients have pre-contrast CT images only. CNS Neoplasm was the predominant cause of hydrocephalus and predominantly by posterior fossa mass. A common complication in our study was intracranial hemorrhage.

9. Recommendation.

- The recommendation of this study is to create awareness of the importance of imaging in early detecting VPS malfunction and complication as well as response of hydrocephalus on follow-up and also to start doing shunt series here in our hospital for early detection of shunt failure. To develop shunt protocol for follow-up (simple MRI sequence/ low dose CT combined with shunt series. A prospective study as the sample size was limited and could have impacted the result.

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ANNEX I: QUESTIONNAIRE

Date: _____
Name: _____
MRN: _____
Phone number: _____

A. Demography:

1. Age: ____

2. Sex: ____

B. Imaging finding of VP shunt and indication.

1. Patient with VP shunt has post op CT image 1. Yes 2. No

2. Has follow-up CT image 1. Yes 2. No

3. What is indication for VP shunting ……

4. Follow up image done with in ……

5. Time of CT image done after operation 1. With 24 hour (immediate post op) 2. 72 hour 3. More than 3 day.

6. Type of CT image 1. Pre-contrast only 2. Post-contrast image only 3. Pre and post contrast image.

7. CT report 1. Normal 2. Hydrocephalus without prior CT for comparison 3. Increased hydrocephalus compared to prior image Unchanged compared to prior image 5. Decreases hydrocephalus.

8. Tip of shunt tube 1. Grade 1 2. Grade2 3. Grade 3

9. Cause of Hydrocephalus. 1. Congenital 2. Infectious cause 3. Neoplastic 4. Post-traumatic 5. Inflammatory

10. Specific cause of hydrocephalus ……

11. Surgical bone defect is in 1. Frontal 2. Parietal , 3 occipital 4. Other

C. Imaging finding of Shunt related complication

1. Hydrocephalus shows 1. Increased in size 2. Decreased in size 3. Over shunting
2. Shunt tube shows breakage or shunt tube is dislodged 1. Yes 2. No
3. Intra-cranial hemorrhage/hematoma related to the Shunt present 1. Yes 2. No
4. Specific type hematoma if the above answer is yes 1. Epidural 2. Sub-Dural 3. Sub-arachnoid 4. Intra-ventricular 5. Brain parenchymal.
5. Brain parenchymal hemorrhage 1. On the path of the shunt tube 2. Other site
6. CT image has evidence of ventriculitis 1. Yes 2. NO
7. CT image has evidence of Post-VP shunt meningitis 1. Yes 2. No
8. Post-VP shunt associated infectious complication 1. Brain abscess 2. Meningitis 3. Ventriculitis 4. Scalp surgical site infection 5. Epidural/sub-Dural Abscess
9. Time at which complication happened ……..