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Ventriculoperitoneal shunt surgery in a Nigerian city. A single institutional experience

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ventriculoperitoneal shunt, hydrocephalus, paediatric hydrocephalus

ABSTRACT

Introduction. Improvements in surgical techniques and advancements in antibiotic management have significantly reduced the complications associated with Ventriculoperitoneal Shunting which is still the most common procedure for the treatment of hydrocephalus. These complications are believed to be highest in Low and middle-income countries due to delayed presentation to care facilities. The authors report our experience of managing paediatric hydrocephalus in an institution with evolving Neurosurgical practice in North Central Nigeria.

Material and methods. We retrospectively reviewed all cases of VP shunting from 2011 to 2018 taking into consideration the demographics, aetiologies of hydrocephalus, length of hospital stay, postoperative morbidity and mortality, and overall outcome. Complications sought included, Surgical Site infections, shunt exposure, obstruction or any other cause of shunt malfunction. The minimum follow-up period was 24 months

Results. There were 27 VPS procedures done in 25 patients of whom 15 were males and 10 females (M:F ratio of 1.5:1). The age range was 8 days to 9 years with a median age of 5 months. Of the 25 cases, 24 (96%) were non-tumoral in origin comprising 17 congenital and 7 acquired hydrocephalus. At 2 years post shunt insertion, 21 (84%) of the 25 initial cases were still functional. The total complication rate was 28%, comprising Surgical Site infection, shunt exposure, shunt obstruction, seizure, and one death, There were 3 (12%) shunt failures from shunt obstruction (2) and shunt exposure (1).

Conclusion

With meticulous control of the surgical environment and improved experience in ventriculoperitoneal shunting, the complication rate can be significantly reduced. There is a need to increase the awareness of the population to the availability of care for seemingly hopeless conditions. The burden of the cost of care on individuals should be lightened through better health insurance coverage.

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Introduction

Hydrocephalus is one of the most common clinical conditions affecting children in Neurological surgery. Ventriculoperitoneal (VP) shunt placement is the mainstay of treatment for hydrocephalus in both adult and paediatric patients.(1, 2) Hydrocephalus accounts for over 69,000 hospital admissions and over 30,000 procedures performed every year in the United States.(3-7) with failure rates of 30–40% at 1 year and approximately 50% at 2 years in pediatric patients.(8) Some recent studies report a relatively lower rate of shunt failure.(1, 9, 10) It is believed that VP shunting complications are highest in Africa and other developing countries.(11) This is not unconnected with delayed presentation to care facilities as a result of poverty, ignorance and other socio-cultural factors.

Hereby, we report our experience of managing pediatric hydrocephalus in an institution with evolving Neurosurgical practice in North Central Nigeria.

Materials and method

The authors present a three-year-old female patient who accidentally sustained a PHI with a screwdriver through the right orbit (Figure 1). The patient did not lose consciousness or vomit after the injury. She was previously examined by an ophthalmologist and a pediatric surgeon at the local hospital. During the neurosurgical examination, on admission, the patient was conscious, oriented to time, space and person (Glasgow Coma Scale score of 15), cardiopulmonary stable, without any recorded gross neurological deficits.

Results

Demographics

There were 27 VPS procedures done in 25 patients of whom 15 were males and 10 females with a male-female ratio of 1.5:1. The age range was 8 days to 9 years with a mean age of 1.2 years and a median of 5 months. All patients had clinical features of hydrocephalus and confirmation was made with diagnostic Scan. The Occipito-Frontal circumference ranged betwwn 39cm to 65cm. All patients were treated with CChabra Slit and Spring Shunt. Length of post-operative hospital stay was 3 days to 16 days with a mean duration of 9.2 days.

Aetiology of hydrocephalus

Of the 25 cases of hydrocephalus, 24 (96%) were non-tumoral in origin with only one case (4%) caused by posterior fossa tumour in a 9 year-old child, who coincidentally is the oldest patient in this series.

Seventeen (68%) of the 25 cases were congenital in origin, comprising of Aqueductal stenosis (11), Arnold-Chiari Malformation (4) and Dandy-Walker malformation (2). The major cause of Acquired hydrocephalus was post-meningitic (5 of 8). There were 2 cases of Aqueductal stenosis with no history of infection. (Table 1b)

Table 1. Demographic profile of hydrocephalus

Variables (Total Number N=25)	Frequency (%)
A)	
Males	15 (60)
Females	10 (40)
B)	
Congenital	**17 (68)**
a) Aqueductal stenosis	11 (44)
b) Arnorld-Chiari Malformation	4 (16)
c) Dandy-Walker malformation	2 (8)
Acquired	**8 (32)**
a) Post-infective	5 (20)
b) Aqueductal Stenosis	2 (8)
c) Post fossa Tumor	1 (4)
C) Diagnostic Imaging	
MRI	6 (24)
CT Scan	17 (68)
TFUS	2 (8)

Diagnostic Imaging

Diagnosis was made in 17 cases (68%) with Computerized Tomographic (CT) scan. Magnetic Resonance Imaging (MRI) was deployed in 6 (24%) while Trans-fontanel Ultrasonographic Scan (TFUSS) was used in 2 (8%) patients (Table 1c)

Outcome

At 2-year post shunt insertion, 21 (84%) of the 25 initial cases were still functional. There were 3 (12%) shunt failures from shunt obstruction (2) and shunt exposure (1). Two of the shunt failures were revised. There was one post-operative death (4%).

There were 3 (12%) cases of surgical site infection (SSI) at the scalp region noted in the first week post-operative period, all of which grew Staphylococcus

aureus that was treated with Amikacin and Rifampicin. One of the cases of SSI led to shunt exposure which was promptly removed but the parents declined revision surgery and requested discharge from the facility. The child was lost to follow-up. One patient (4%) died on the third post-operative day accounting for the shortest period of hospital stay. Permission for autopsy was not granted by the parents. One patient developed seizure disorder post op.

Whereas shunt complication was seen in 28% of all patients, only 12% required shunt revision (Table 2). The other 2 cases of shunt failure were marked by increasing head circumference and reduced activities. These occurred within 6 months of the surgery. Shunt was promptly revised and the cause of failure was determined in both cases to be obstruction of the ventricular catheter by debris. These two patients have remained clinically stable.

Table 2. Outcome and complications of Ventriculoperitoneal Shunting
(*one case of SSI led to shunt exposure)

a) Summary of Outcome (n=25)	**Frequency (%)**	**Comments**
Favourable outcome Poor outcome	21 (84) 4 (16)	satisfactory 3 failed, 1 died
a. Complications (7 of 25)	**Frequency (%)**	**Comments**
Surgical Site Infection (SSI)* Shunt Exposure* Shunt Obstruction Seizure Death	3 (12) 1 (4) 2 (8) 1 (4) 1 (4)	Antibiotics Declined Treatment Revised Anticonvulsant Post-op day 3

Discussion

Ventriculoperitoneal shunting remains the mainstay for treatment of hydrocephalus despite recent advances in neurological surgery practice. (1-3)

In this study the age range was between 8 days to 9years with a median of 5 months. Ninety two percent of the patients were below the age of 1 year and it is mainly caused by congenital anomalies. Hydrocephalus is predominantly a disease of infants and this is a common finding in Sub-Saharan Africa. (6, 11-15)

The male to female ratio of 1.5:1 is in keeping with the male preponderance noted in many studies. (6, 12-14, 16)

The occiptofrontal circumference (OFC) ranged from 39cm to 65cm. Increase in the OFC is the commonest sign of hydrocephalus seen in infants.(17) Grotesque head enlargement is common in underdeveloped countries due to late presentation and head circumference greater than 60cm is associated with higher rates of shunt failure.(11)

About 70% of the cases of hydrocephalus were congenital with Acqueductal stenosis being the commonest cause. (Table 1b) This is at variance with some of the studies cited (11, 12, 14-16, 18) and the reason may be partly related to volume of the study population. The other reasons may be geographical in nature. Many mothers who had infection during pregnancy in rural areas may not have been adequately looked after, thereby increasing the risk of maternal-to-fetal transmission. Neural tube defects (Arnold-Chiari Malformations with Spina bifida, and congenital posterior fossa anomalies) are still a challenge in low-income communities where adherence to Folic acid supplementation is sub-optimal.(15, 19)

The preferred imaging modality is MRI but this was used in only 24% of patients (Table 1c). CT scan was the most commonly used imaging modality in this study because of affordability. Transfontanel Ultrasonography has been used very frequently is our region for the similar reasons.(20, 21)

The overall complication rate in this series was 28%. (Table 2) The commonly reported incidence of complication is between 20 to 40%(10) though there are reported failures as high as 85%.(6) The incidence has reduced in more recent publications. The infection rate was 12% in this study. This is similar to the rate recorded by Yusuf et al(13) in an earlier study though they had a relatively higher volume in their series. The weighted average shunt infection rate across multiple studies is about 5.1% but could be as high as 39% in some studies.(18, 22-28) Staphylococcus aureus is one of the most implicated bacterial organisms in shunt infections.(29) Shunt infection has been reduced with advent of newer techniques including double gloving, prophylactic antibiotics and antibiotic-impregnated shunts (commonly with Rifampicin and Clindamycin)(30) Most of the shunts used in developing countries are fixed-pressure types of shunt; antibiotic-impregnated shunts are not affordable to most patients in underdeveloped countries where the

citizens are not adequately covered by health insurance and health care is paid on out-of-pocket basis.(20, 21) Other established factors that influence the shunt infection rate are the age of the patients, aetiology of the hydrocephalus, operating room settings to prevent infection, total operating time and experience of the surgeon.(26) Sharing the experience of the senior author in center with large volume has helped to cut down shunt failure rates in the country.

There were 3 (12%) failed shunts though 2 (8%) shunt revision surgeries were done in this study. One was caused by infection, while the other two were caused by shunt obstruction. The incidence of shunt failure is commonly seen in children younger than 6 months and often noticed within the first month of shunt placement.(18, 31)

Seizure was seen in one patient in our series, accounting for 4% and this was controlled with anticonvulsant. Seizure is a known complication of VP shunting accounting for 48%. It is believed that seizure is not due to direct placement of the VP shunt but to the underlying neurologic disorder.(32)

One patient (4%) died in the first week following VP shunt placement. The cause of death could not be determined because the parents declined postmortem. The shunt-related mortality has been reported to be 3.4% to 13.7%.(13, 33).

Though Endoscopic third Ventriculostomy is available in the country as shown in many studies, (13, 14, 16) this facility is not available in our center at the time of this study. It is expected that the face of hydrocephalus treatment will improve as soon as this is done.

Conclusion

With meticulous control of the surgical environment and improved experience in ventriculoperitoneal shunting, the complication rate can be significantly reduced. There is need to increase the awareness of the population to the availability of care for seeming hopeless conditions. The burden of the cost of care on individuals should be lightened through better health insurance coverage.

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