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CHILDREN**

## THE CHALLENGES OF THE MANAGEMENT OF HYDROCEPHALUS IN NIGERIAN CHILDREN

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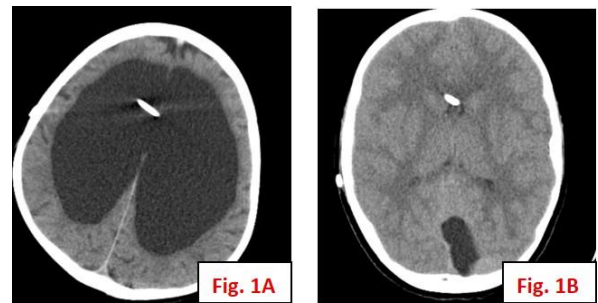
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### INTRODUCTION

Hydrocephalus in children is defined as the presence of an increase in size of the brain ventricles with elevated intracranial pressure. The two images in figure 1 represent those of 2 different 11-year-old boys being followed up in my clinic. Both were diagnosed with hydrocephalus in infancy, and both had the same treatment with a ventriculoperitoneal shunt. Figure 1A represents an 11-year-old with comprehensive health insurance who presented late in his disease in Nigeria with markedly dilated ventricles and 10 years after surgery there is incomplete recovery of the brain mantle and the child is severely disabled with generalized spasticity, lack of speech and unable to ambulate. Figure 1B shows that of a Canadian boy who presented early and was able to recover his full brain mantle [thickness] and has met all his developmental milestones and cannot be differentiated from his peers both physically and intellectually.

Hydrocephalus is of public health concern in Nigeria. The true incidence is unknown but based on an incidence of 1 per 1000 births in developed countries, one would expect the incidence to be similar, with the reported higher incidence of post infectious hydrocephalus in Nigeria compensating for the high incidence of post hemorrhagic hydrocephalus in developed countries. The incidence of hydrocephalus secondary to Chiari II malformations is also expected to be higher because of lower uptake of preconception folate supplementation in

Nigeria. This is not the first time this issue has been highlighted; Anele, Komolafe and co-workers have recently described management challenges of hydrocephalus in a low-income country<sup>1</sup>



### DISCUSSION

Drs Obanife, Shehu and coworkers, have described their experience of managing 410 patients in Sokoto<sup>2</sup>. In this landmark paper, the challenges of managing children with hydrocephalus in our environment come to light.

1. Delayed presentation. This leads to increased complications of treatment. The heads of the patients are often huge with stretching and thinning of the scalp and a thin brain mantle. This most likely accounted for the high incidence of post operative wound cerebrospinal fluid leaks reported. The recovery of neurological function could also be incomplete with high incidence of physical and intellectual disability. Sadly the 15% mortality

rate in the series can also be attributed to delayed presentation as 61 patients in the cohort died before treatment could be instituted.

2. High cost of treatment. The attrition rate before treatment was high. 14% did not come back for surgery while 36% defaulted from follow up within 1 year. Most patients were also imaged by ultrasound. Of note, no patient had endoscopic treatment either because of the unavailability of the equipment or cost of imaging necessary to assess the feasibility of the patient for endoscopic treatment. The cost of hardware and surgery are not affordable for most families.
3. The burden of infection<sup>5</sup>. The most frequent etiology seen in the cohort was infection, accounting for 46% while infection also accounted for 54% of the post operative complications seen. Co-morbidities that need to be treated also play a role.
4. The “Cash and Carry” health care financing model in an environment of widespread poverty. The disadvantages of this model have been well documented; people who can’t pay for care won’t be treated leading to irreversible consequences, in the case of hydrocephalus, death and disability.
5. Lack of education, social taboos, and low socioeconomic status also play a role and intersects many of the recognized challenges.

The availability of neurosurgeons in Nigeria has increased significantly over the past 30 years with less than 5 neurosurgeons practicing locally 30 years ago to over 160 neurosurgeons in 2024. Importantly, the geographical spread of neurosurgeons is wide with coverage available in all geographical zones in the country.

How can we overcome or at least mitigate these challenges?

My ideas will aim to address each of the identified challenges.

1. Most patients would be diagnosed within the first year of life. [77.5% in the Sokoto series]. Efforts to secure early diagnosis should therefore be targeted mainly at this demographic. In Canada, newborns are frequently examined within the first year of life by their Family Physician or Pediatrician with regular head circumference charting. This is not feasible for majority of the Nigerian Population. While there are studies documenting the mean head circumference of the Nigerian newborn at term, a country specific head circumference nomogram for the first year of life could not be found in the literature. Research can be conducted to document this tool. The sex specific WHO chart can be utilized prior to the outcome of such study. Health care workers should be trained to measure head circumference, and every child should have a head circumference measured and charted at birth and at every visit for immunization. Figures above the 97<sup>th</sup> percentile or figures crossing multiple percentiles should be referred to an appropriate medical practitioner for further evaluation of the fontanels, cranial sutures, scalp veins and other features of hydrocephalus. If concerns arise, then a trans-fontanel ultrasound should be obtained. If abnormally dilated ventricles are seen, then the infant should have further neuroimaging with an MRI or low dose CT scan of the brain if affordable, otherwise treatment can be



instituted. A common differential diagnosis is benign macrocephaly. In this entity, there is increased fluid in the sulcal subarachnoid spaces and only a mild ventricular enlargement. The father's head circumference can also be measured to be large. No treatment is required for benign macrocephaly. Inability to obtain a brain MRI or CT scan has its pitfalls, the etiology of the hydrocephalus may not be able to be defined, including some cases of posterior fossa tumors especially if the resolution of the ultrasound is low. Ultrasound does not image the posterior fossa as well as it does the supratentorial compartment. Emphasis should also be placed on hydrocephalus in the nursing school and medical school curriculum so that nurses and doctors can readily identify the clinical features of hydrocephalus.

2. The high cost of treatment not only includes hospital care, but also the cost of transportation, medications, hardware and loss of income for caregivers. This challenge would require investment from the government and charitable organizations.

The government can ensure the availability of neuro-endoscopic equipment at all neurosurgical centers. I am aware that this equipment can be provided at a 66% discount for developing countries by the major manufacturers. Purchase of such equipment is straightforward directly from the manufacturers. Purchase through contractors is completely unnecessary and wasteful. Subsidies towards the cost of shunt hardware would also be necessary as most families in Nigeria cannot afford to purchase one on their own. The

Chhabra shunt hardware may be the cheapest shunt system available, but it has been validated to be at least as effective as the other more expensive regular shunt hardware. Improvement of transportation networks and security and safety of travel also fall within the purview of the government. Diagnostic neuroimaging is available in Nigeria at a cost beyond the reach of a vast majority of Nigerians. It is the responsibility of the government to provide these facilities and its associated supporting structures at public hospitals. Direct purchase from manufacturers would make the cost implications more affordable to the government. The government would benefit from the benefits of a healthy, nondependent and economically productive cohort of hydrocephalus patients.

Advocacy and charitable efforts of nongovernmental organizations are also helpful. The Spina Bifida and Hydrocephalus Association of Nigeria are well placed to contribute to this effort. However, better organization, transparency and more information on who they are and what they do would be helpful. A governing board of individuals who have a track record of integrity would be helpful in attracting funding for hydrocephalus patients. Public hospitals can set up foundations with minimal staffing. The aim of such foundations will be to seek out charitable funding from the public. It is important that the work of those foundations be accountable and transparent.

3. The burden of infection is mainly tied to the overall health status of the children, with early diagnosis and treatment being important. Preoperative or temporizing ventricular taps should be avoided;

they only provide very temporary relief and can predispose to infections. Established protocols for shunt infection prevention should be adhered to. A technical note is that during VP shunt insertion procedures in an environment with high rates of infection, the burr hole should be completed, ventricle tapped with a brain needle and the CSF should be seen to be clear and colorless before the abdominal incision is made and before the shunt hardware sterile container is opened. If the CSF is cloudy or turbid, the procedure should be abandoned and an external ventricular drain inserted, and serial CSF samples sent for culture. Appropriate antibiotics are commenced, and shunting can be undertaken when serial csf cultures are negative and preferably in consultation with an infectious diseases specialist when one is available.

I would argue against the blanket use of endoscopic third ventriculostomy (ETV) for all patients as the first line of therapy. There are studies to show that the success rates in the African population is above 50%<sup>3,4,6</sup> but follow up data are often lacking. I believe patient management should be individualized, with management decisions based on the validated ETV success score. When appropriate imaging is not available to obtain an accurate success score, perhaps shunting should be undertaken. Failure of ETV often manifests as CSF fluid leakage in the early post operative period and this is a risk factor for infectious complications, especially in patients with large heads and thin scalps.

4. The health system in Nigeria at the present time is ill equipped to care expeditiously for the emergently or urgently ill individual. While it is recognized that Nigeria is a low-income country with a limited budget, I think it is morally and humanely necessary that a system be put in place to care for these patients without first asking for payment. The bills can be sent to the families after treatment and payment plans instituted for the families to settle the bills in instalments.
5. Public awareness campaigns directed specifically at educating the community about hydrocephalus would be useful. Parents need to know that with appropriate care, most patients will live a normal life. Education should include the fact that no traditional or alternative medical care remedy exists for hydrocephalus. Education of parents should stress the importance of follow up care. Neurosurgical units should ideally arrange a system of virtual follow up to minimize travelling by patients who frequently live in rural communities. The estimated mobile phone penetration in Nigeria is estimated at 40% and patients should endeavour to provide a cell phone contact for ease of communication, education and follow up. A helpline connected to a suitably trained healthcare professional to respond to patient concerns would also be ideal. Overall improvement in the literary status of the community is also a goal

## CONCLUSION

Improvements in the care of patients with Hydrocephalus in Nigeria should not have to wait until Nigeria achieves a high-income status. There are many examples of low- and medium-income countries that have been able to achieve care standards that mirror those of high-income countries. The research and innovation infrastructure and funding should be prioritized so that Nigerians can utilize their talents locally as well as develop and commercialize novel products to improve healthcare of patients with hydrocephalus. We currently import our shunt hardware and a significant amount of medications from India, a fellow lower- middle- income country according to the World Bank. The model described is also translatable to other capital-intensive interventions in the Nigerian Health System. Perhaps one of the ways of improving Nigeria's economy is to improve the health of its citizens if one believes in the saying "health is wealth" and considers health a fundamental human right. Of note Nigeria continues to spend less than the WHO recommended 5% of GDP on healthcare.

This article has limitations, one of which is that it relies on published data rather than recent actual local Nigerian clinical experience of the author.

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