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Pediatric Hydrocephalus in Northwest Tanzania: A Descriptive Cross-Sectional Study of Clinical Characteristics and Early Surgical Outcomes from the Bugando Medical Centre

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OBJECTIVES: **In this study, we present data from a neurosurgical training program in Tanzania for the treatment of pediatric hydrocephalus. The objectives of the study were to identify the demographics and clinical characteristics of pediatric patients with hydrocephalus who were admitted to Bugando Medical Centre in Mwanza, Tanzania, as well as to describe their surgical treatment and early clinical outcomes.**

METHODS: **This cross-sectional study included 38 pediatric patients. Physical examinations were conducted pre- and postoperatively, and their mothers completed a questionnaire providing demographic and clinical characteristics.**

RESULTS: **There was a slight preponderance of male sex (21/38; 55.3%) with median age at the time of admission of 98.5 days. The majority of patients were surgically treated (33/38; 86.8%). Among those surgically treated, most received a ventriculoperitoneal shunt (23/33; 69.7%), whereas 7 were treated with an endoscopic third ventriculostomy (7/33; 21.2%). At the time of admission, the majority of patients (86%) had head circumferences that met criteria for macrocephaly. The median time between admission and surgery was 23 days (2-49 days). Overall, 5 patients (13.2%) died, including 2 who did not receive surgical intervention.**

CONCLUSIONS: **We found that in our population, pediatric patients with hydrocephalus often present late for treatment with additional significant delays prior to receiving any surgical intervention. Five patients died, of whom 2 had not undergone surgery. Our study reinforces that targeted investments in clinical services are needed to enable access to care, improve surgical capacity, and alleviate the burden of neurosurgical disease from pediatric hydrocephalus in sub-Saharan Africa.**

INTRODUCTION

Hydrocephalus is one of the most common neurosurgical conditions among children worldwide,[1,2] with significant geographic variation with respect to incidence and etiology. A previously published systematic review

Key words
- Capacity-building
- Neurosurgery
- Pediatric hydrocephalus
- Tanzania

Abbreviations and Acronyms
BMC: Bugando Medical Centre
ETV: Endoscopic third ventriculostomy
HC: Head circumference
PGSSC: Program in Global Surgery and Social Change
SD: Standard deviation
SSA: Sub-Saharan Africa
VP: Ventriculoperitoneal shunt
WHA: World Health Assembly
WHO: World Health Organization

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suggested the pooled estimated incidence of congenital hydrocephalus in Africa to be 145/100,000 births, which is more than double the incidence in the United States and Canada (68/100,000 births).[1] Almost one-half of the estimated 400,000 new global cases of pediatric hydrocephalus annually are expected to occur in Africa,[1] due to greater birth rates, a greater incidence of perinatal and neonatal infections,[1,3,4] as well as a greater incidence of neural tube defects. Although these numbers are staggering in themselves, they probably underestimate the overall pediatric hydrocephalus burden, as many cases, particularly in resource-poor settings, are not registered.

Optimal care for pediatric hydrocephalus often is provided by multi-/interdisciplinary teams that include clinicians trained in the medical specialties of pediatrics, neurology, neurosurgery, and rehabilitation medicine. Unfortunately, in sub-Saharan Africa (SSA), rehabilitation services, neurological,[5] and neurosurgical services are more difficult to find,[6,7] with only 0.51 neurosurgeons/million population in SSA compared with 11.76 neurosurgeons/million population in Europe.[8] As a result, children with hydrocephalus living in SSA often are treated by generalists[9,10] with less neurosurgical operative experience and equipment. In addition, patients with pediatric hydrocephalus often present later and with more advanced clinical symptoms in SSA[11-13] at their first clinical encounter with formal health care services.[12,14,15] This is largely due to the long distances of travel required to seek tertiary medical care, as well as limited pre- and postnatal care that would allow for preventive causes and early correction of hydrocephalus to be addressed. There is a myriad of etiologies for pediatric hydrocephalus, but literature published has shown postinfectious etiology[16] to be the most common in SSA.

To undertake these multifaceted and complex challenges for the care of pediatric hydrocephalus in SSA, long-term global neurosurgical capacity-building programs can provide assistance[17] along with other established global health initiatives. The Weill Cornell Tanzania Neurosurgery Project was established by Roger Härtl in 2008 in collaboration with the Weill Cornell Medicine in New York, the Bugando Medical Centre (BMC) in Mwanza, Tanzania, and the Foundation for International Education in Neurological Surgery.[18] The aim is to provide continuous medical education through teaching and research so that nurses, doctors, and other medical personnel may be trained to create sustainable and optimized patient care.

The philosophy of the Weil Cornell Tanzania Neurosurgery Project echoes current flagship global health initiatives by the World Health Assembly (WHA)[19] and the "Program in Global Surgery and Social Change" (PGSSC) at Harvard Medical School, which has created a consensus, composed by the CHYSPR group entitled "Comprehensive Policy Recommendations for the Management of Spina Bifida and Hydrocephalus in Low-and Middle-income Countries."[20] These 2 joint global commitments are responding to the indisputable and required need to address the high burden of pediatric hydrocephalus, with complex comorbidities and preventable fatalities. However, there is limited research on the burden of pediatric hydrocephalus and its treatment in low-resource settings from which local and global stakeholders can base policy decisions. Therefore, we present data collected as part of the Weill Cornell Neurosurgical Project in Tanzania, focusing on pediatric patients with hydrocephalus, admitted to an urban hospital in Mwanza, Tanzania, in 2013.

Figure 1. Map of study area (Images are adapted from Servier Medical ART. Smart.servier.com).

The objectives of the study were to identify the demographic and clinical characteristics of pediatric patients with hydrocephalus and to describe surgical treatment provided and its early surgical outcome.

METHODS

Study Area/Setting

BMC is a 900-bed government-funded and patient cost-shared tertiary referral center located in Mwanza,[21,22] the second largest city in the northwestern part of Tanzania, serving a catchment area of approximately 13 million people (**Figure 1**). Along with the single other tertiary referral hospital in the country, located in the city of Dar-es-Salaam, BMC provides neurosurgical services to the Lake and Western Zones of Northwest Tanzania.[21]

Pediatric patients with hydrocephalus eligible for surgery were admitted directly from outpatient clinics and at times directly from the Neonatal Unit. Pre- and postoperative patients were admitted

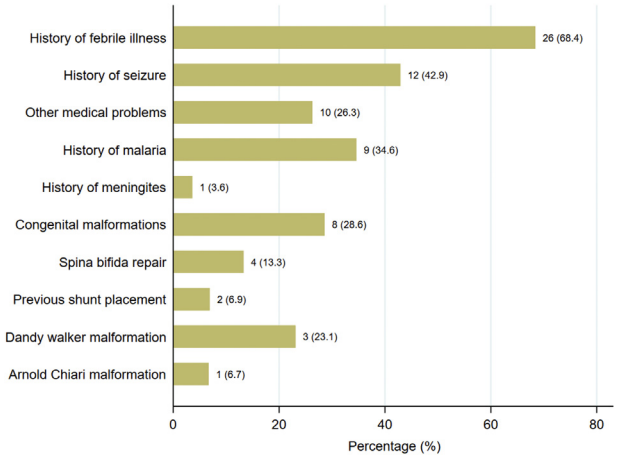

Figure 2. Distribution of medical history.

to a single pediatric surgical ward where all surgical patients, including the pediatric neurosurgical patients, were localized. The neurosurgery department at BMC was formally established in 2015.[21] At the time of the initiation of this study in 2013, there was only one Tanzanian general resident with a special interest in surgery and neurosurgery who performed ventriculoperitoneal (VP) shunt surgeries (using Chhabra Shunts; Surgiwear, Utter Pradesh, India) on pediatric patients with hydrocephalus at BMC. The surgeon performing the operations worked for the surgical department before starting residency. He learned how to perform the neurosurgical procedures by completing an observership and working alongside specialists who were experts in these techniques. In addition, varying global surgical teams would come on occasion to perform endoscopic third ventriculostomies (ETVs).

Study Design, Study Sample, and Data Collection

We conducted a descriptive cross-sectional, hospital-based study that consecutively enrolled pediatric patients with hydrocephalus that were admitted to BMC between April and September 2013. All pediatric patients with hydrocephalus were eligible.

Mothers of admitted pediatric patients with hydrocephalus were approached to participate in the study, with study objectives discussed in Swahili (the official national language in Tanzania) through the assistance of a local medical student. Written informed consent was obtained in Swahili. We used a questionnaire to collect demographic and clinical characteristics, including prenatal history, birth history, medical history, as well as history of hydrocephalus symptoms and signs (**Supplementary Table 1**). A physical examination was performed pre- and postoperatively, with emphasis on head circumference (HC) measurements, characterization of the fontanelle (depressed/flat or tense/bulging), presence or absence of prominent skull veins and sunsetting eyes, and whether there were any signs of increased lethargy in the patient.

Ethics Statement

Ethical approval was obtained from the BMC and the Catholic University of Health and Allied Sciences, Mwanza, Tanzania, combined ethical committees (research clearance certificate number CREC/040/2013) as well as the institutional review board of Weill Cornell Medical College in New York, New York, USA (protocol number: 1304013806).

Analysis

Data were collected on paper questionnaires and entered into a spreadsheet database. Numerical data were assessed for normality using the Shapiro–Wilk test, and variables that were found to deviate from the normal distribution were described using medians and range (minimum, maximum), whereas normally distributed data were summarized using the means and standard deviations (SD). Frequencies with percentages were used to describe categorical variables. We used the independent t test and Mann–Whitney U test to compare mean and median differences between boys and girls, respectively, whereas the Fisher exact test was used to investigate the associations between categorical variables. The level of significance was set at $P < 0.05$. All statistical analyses were performed in SPSS, version 27 (IBM Corp, Armonk, New York, USA) and the graphs were produced in StataSE 17 (StataCorp, College Station, Texas, USA: StataCorp LLC).

RESULTS

Demographics

A total of 38 pediatric patients with hydrocephalus were included in the study; there was a slight preponderance of the male sex (21/38; 55.3%). Within this group of 38 patients with hydrocephalus, 36 patients had a registered date of hospital admission, with median age at time of admission to be 98.5 days (range 15–998 days).

Clinical Characteristics from Maternal Retrospective Reporting

We present our results as the number of positive responses against the total number of available responses due to incomplete data and partial follow-up as is often a challenge in resource-limited settings. Seventeen children were delivered at a health care facility in the presence of a trained health worker (17/24; 70.8%); 7 children were born at home (7/24; 29.2%). Of the 24 known deliveries, 23 patients were delivered vaginally, one via caesarian delivery. Almost all the mothers had registered for prenatal care (36/38; 94.7%), which involved a visit to a nearby health clinic for women and children or to a hospital with obstetric services. Nearly one-half of the mothers (17/36; 47.2%) reported to have experienced fevers during their pregnancy.

With respect to medical history, 8 mothers (8/35; 22.9%) reported that their child had experienced other medical problems: 5 patients with a history of gastrointestinal symptoms (vomiting/diarrhea), 1 with umbilical cord bleeding, 1 with medical problems of unknown cause, and 1 with papules of unknown origin. In addition, 1 patient was admitted with severe malnutrition (marasmus type) and another patient of older age had multiple other diagnoses (**Figure 2**). With respect to congenital abnormalities, 8 patients (8/28; 28.6%) had spina bifida (one diagnostically with myelomeningocele).

Table 1. Demographic Characteristics of the Mother–Child Pairs in the 33 Children Who Were Surgically Treated

Covariates	Total	Sex		*P* Value
		Female (n = 15)	Male (n = 18)	
Maternal factors				
Parity: median (min, max)	2.0 (1.0, 10.0)	2.0 (1.0, 10.0)	3.0 (1.0, 8.0)	0.80
Prenatal visits: median (min, max)	3.0 (1.0, 6.0)	3.0 (1.0, 4.0)	3.0 (1.0, 6.0)	0.08
Fever during pregnancy, *n* (%)	15 (100.0)	7 (46.7)	8 (53.3)	1.00
Patient characteristics: *n* (%)				
Malaria	7 (100.0)	4 (57.1)	3 (42.9)	1.00
Febrile illness	22 (100.0)	11 (50.0)	11 (50.0)	0.71
Seizure	11 (100.0)	6 (54.5)	5 (45.5)	0.49
Other medical problem	5 (100.0)	2 (40.0)	3 (60.0)	1.00
Congenital abnormalities	7 (100.0)	4 (57.1)	3 (42.9)	0.67
Surgery performed	33 (100.0)	15 (45.5)	18 (54.5)	1.00
Type of surgery				0.53
Shunt VP	23 (100.0)	10 (43.5)	13 (56.5)	
ETV	7 (100.0)	4 (57.1)	3 (42.9)	
Median age at admission, days (min, max)	105.5 (15, 998)	147.0 (15, 998)	103.5 (24, 477)	0.33
Median age at surgery, days (min, max)	135.0 (35.0, 1024.0)	163.0 (35, 1024.0)	132.0 (58.0, 484.0)	1.00
Median days between admission and surgery, (min, max)	23.0 (2.0, 49.0)	20.0 (2.0, 32.0)	24.5 (7.0, 49.0)	0.18
Median days between surgery and discharge, (min, max)	6.0 (2.0, 43.0)	5.0 (3.0, 43.0)	6.0 (2.0, 10.0)	0.96
Head circumference preoperatively, mean ± SD	52.2 ± 7.9	50.0 ± 8.2	54.3 ± 6.9	0.04
Head circumference postoperatively, mean ± SD	51.4 ± 7.1	49.3 ± 7.0	54.2 ± 6.5	0.05
Survival status after surgery, *n* (%)				1.00
Survived	30 (100.0)	14 (46.7)	16 (53.3)	
Deceased	3 (100.0)	1 (33.3)	2 (66.7)	

VP, ventriculoperitoneal; ETV, endoscopic third ventriculostomy; SD, standard deviation.

Concerning childhood illness that might have contributed to etiology of hydrocephalus at the time of presentation to BMC, 26 mothers (26/38; 68.4%) reported that their child had experienced at least 1 episode of febrile illness. Malaria was reported in 9 of 26 patients (34.6%), 12 of 28 (42.9%) with a seizure, and 1 of 28 patients (3.6%) with a history of meningitis.

The first clinical sign of hydrocephalus was observed by mothers to be increased HC (15/23; 65.2%), delayed milestones (4/23; 17.4%), poor feeding (2/23; 8.7%), reduced growth (2/23; 8.7%), and the observation of a bulging fontanelle (2/23; 8.7%) (2 mothers reported on 2 characteristics).

Clinical Characteristics from Examination at Presentation

Among the 38 patients, 33 received surgery (Table 1). Twenty-three patients had VP shunts, 7 ETVs, and 3 were of unknown procedure. Mean HC was 52.2 cm (SD = 7.9) measured preoperatively in 31 patients at the time of presentation to BMC. Postoperatively the HC was measured in 28 children, with a mean of 51.4 cm (SD = 7.1). When plotted on the World Health Organization's (WHO) HC chart for age and sex, 86% of the patients had macrocephaly that was at least 2 SD greater than normative values. Of the 33 patients who received surgery, clinical signs registered included description of the fontanelle, the presence or absence of the prominent skull veins and sun-setting eyes, as well as increased lethargy of the child (Figure 3).

Surgical Treatment and Outcomes

The median age at the time of admission for the group of children who were surgically treated was 105.5 days (range 15–998 days). Median age at time of surgery was 135 days (range 35–1024 days). The age at the time of surgery was not statistically significant between the VP shunt operated group and the ETV group (P = 0.23). The number of days between admission and

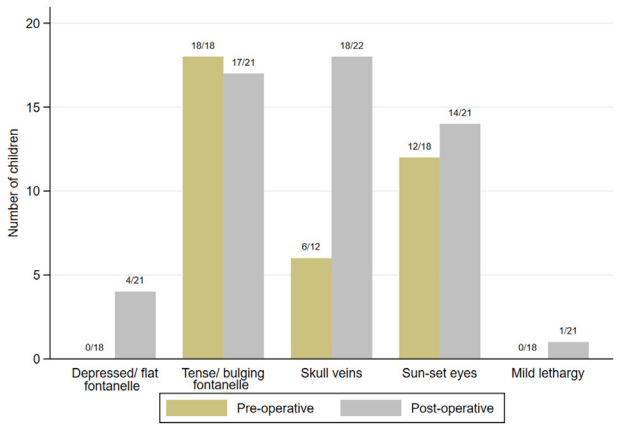

Figure 3. Pre- and postoperative clinical signs. The apparent increase in the presence of skulls veins postoperatively may be because we only have a preoperative assessment of this variable in 12 patients; hence, the number of patients with prominent skull veins before surgery is possibly larger. In addition, we attribute this seemingly increase in the number of patients with prominent skull veins to the fact that we have applied the date of clinical assessment furthest away from the surgical date. In some of the patients, the presence of prominent skull veins did in fact temporarily resolve, only to reappear on later physical examinations. Lastly, characterization of fontanelles, presence or absence of prominent skull veins, and sun-setting eyes as well as lethargy are all indirect clinical measures of hydrocephalus, and we do not expect much change immediately after surgery.

surgery was registered in 32 patients, with a median of 23 days (range 2–49 days).

Previous Neurosurgical Treatment

Six patients had a previous history of neurosurgical procedure; 4 patients with spina bifida repair (4/30; 13.3%) and 2 patients with a previous shunt placement (2/29; 6.9%). Shunt blockage was reported in the 2 patients with previous shunt placements (2/28; 7.1%).

Diagnostics

Ultrasound scanning was performed in 16 patients (16/31; 51.6%); in 5 cases within the VP shunt–treated group and in all children within the ETV group. Dandy–Walker malformation was observed on ultrasound scans in 3 patients (3/13; 23.1%) and Arnold Chiari type 2 malformation in 1 patient (1/15; 6.7%). In addition, 1 of these 16 patients underwent a computed tomography scan of the head as well as a radiograph of the head.

Complications

One pediatric patient (1/31; 3.2%) who had undergone ETV developed seizures within the 24-hour postoperative period. One patient who received a VP shunt developed diarrhea within the 24-hour postoperative period. Postoperative complications after the 24-hour period included 2 patients who developed fevers, 1 with obstipation, and 1 with vomiting. The eldest patient in the group (close to 3 years old) was transferred to the pediatric intensive care unit on the first postoperative day and developed tonic–clonic seizures 7 days postoperatively. This patient was given phenobarbitone for seizure control, was transitioned to valproate on day 8 postoperatively, and was discharged on day 13.

Mortality

In total, 5 patients died during hospitalization. Two of these 5 did not undergo surgery. One of these patients was reported to have hydranencephaly and died 29 days after admission. The other patient died 36 days after admission of unknown etiology. Three patients (3/23; 13%) died following receiving a VP shunt. Of these 3 patients, 1 patient died within 24 hours after surgery (time period from admission to time of surgery was 37 days) of unknown etiology. Another patient had been discharged 8 days postoperatively, then was readmitted at postoperatively day 16 due to vomiting, oral thrush, anuria, and fevers; the patient passed 31 days postoperatively. The third patient passed away 21 days postoperatively of unknown etiology.

Hospital Stay and Follow-Up

Follow up data regarding postoperative period and discharge were available on 26 patients. Median days between surgery and discharge was 6 days (range 2–43 days). Median time to last clinical assessment was 28 days postoperatively.

DISCUSSION

In this study, we present data from the Weill Cornell Tanzania Neurosurgery Project, a neurosurgical capacity-building project. The study sample consists of a cohort of 38 pediatric patients with hydrocephalus, where the majority ($n = 23$) received a VP shunt and 7 had an ETV. The sex distribution in the study sample consisted of more male subjects (55.3%) than female subjects, which is consistent with other studies across the world[15,21,23-27] and was also reported in a recent systematic review.[28] The median age on admission (within the entire patient population of 38 children) of 98.5 days is also comparable with other studies from Tanzania,[21] Uganda,[29] and Malawi.[25] The advanced clinical presentation with near-refractory pediatric hydrocephalus has been described in the hydrocephalus literature from both the SSA region in general[11-15,30-32] and Tanzania[33-35] in particular.

Previous research from Uganda suggests that the most common cause of pediatric hydrocephalus is postinfectious in SSA.[1] Our data show that almost 70% of the children in our study had a history of febrile illness, which could suggest a similar etiology. The impediments of course, of making this assumption include, but are not limited to, poor prenatal care and history, restricted diagnostic imaging before surgery along with sparse intraoperative tools and use of endoscope.

Consistent with previous data, macrocephaly was the first clinical sign of hydrocephalus observed by the mothers,[25,32,36] with the great majority of pediatric patients presenting with HC greater than 2 SD from normative values as per age/sex. One may postulate that macrocephaly is a proxy for a progressed hydrocephalus condition, and therefore that the patients in our study presented late. In addition, not only did these patients present late with clinical presentations of pediatric hydrocephalus, there was often delay in treatment after presentation. Our pediatric patients waited on average 23 days

from admission to surgery. We attribute this delay to the lack of a dedicated neurosurgical department, as neurosurgical services fell under the general surgical department. This is consistent with other studies, suggesting that not only late presentation, but also delayed treatment, is a considerable challenge in many resource-limited settings.[37,38] A study from Zambia found that hospital-related factors, such as limited operating room time, rather than individual patient-related factors, contributed to delay access to needed surgical treatment.[37] Another study, concerned with pediatric surgical capacity in Africa, found that median waiting time for elective surgical procedures was 40 days, while for emergency surgeries it was 7 days.[38]

The treatment of pediatric hydrocephalus, even in well-resourced settings, has high risks of postoperative complications, including but not limited to failure of treatment, risk of infection, developmental delay, and other comorbidities that reduce quality of life.[39] In our study, 2 patients developed complications within 24 hours postoperatively whereas 4 children had complications greater than 24 hours after surgery. The follow-up period in our study was limited due to families being unable to come back to the outpatient clinic postoperatively. One could anticipate, if consistent and longer follow-up occurred, that there would be increased number of postoperative complications contributing to morbidity and mortality. The short and inconsistent follow-up period in our study limits comparison to previous studies. Nevertheless, in a study by Santos et al.[21] from the same setting, at least one surgical complication was found in 33% of the children at first follow-up assessment (median follow-up time of 70 days) and an overall mortality rate of 14.5%. In our cohort of 38 patients, 5 died (5/38; 13.2%), which is comparable to the mortality rate of Santos et al. In addition to follow-up duration, a systematic review showed that WHO region also affects surgical incidence and mortality.[1]

Despite positive efforts to strengthen access to neurosurgery in SSA, such as the neurosurgical training program that this study was part of, there continues to be no straightforward solution to the ongoing challenges associated with pediatric hydrocephalus care and treatment. Two recent and highly relevant global policy actions need to be mentioned in this context. The WHA, which is the decision-making organ of WHO, has formally decided to identify neurology as a priority disease through the WHA resolution 73.10.[19,40] This represents a historic milestone within global neurology and neurosurgery for multiple reasons; we will outline 4 of them here. First, the resolution encouraged the development of a 10-year Global Intersectoral Action Plan on Epilepsy and Other Neurological Disorders to ensure a coordinated public health effort within the fields of neurology and neurosurgery. Second, it emphasizes the importance of acknowledging neurologic and neurosurgical disorders as the most common causes of disability and the second most common causes of mortality globally,[40,41] including hydrocephalus. Third, the resolution aims to attain health equity through health-system strengthening, particularly in low-resource settings, such as Tanzania. Lastly, the WHO encourages member states to support a life course approach, which not only includes the need for (surgical) treatment, but also measures of prevention, surveillance, diagnosis, and rehabilitation. This is particularly crucial for pediatric patients with hydrocephalus, as they are dependent on lifelong clinical care and close follow-up.

Correspondingly, the document "Comprehensive Policy Recommendations for the Management of Spina Bifida and Hydrocephalus in Low-and Middle-income Countries"[20] from PGSSC at Harvard Medical School has been crafted to aid policy and decision makers to develop national strategies to reduce the burden of pediatric hydrocephalus. Encouraging the same life course approach, these recommendations span the areas from surveillance and screening, surgical treatment, and rehabilitation.

The clinical data from our study is consistent with the global investments mentioned previously as well as more recent research from the same setting[21] that argues the imperative need to increase and improve neurosurgical capacity building in Tanzania and SSA. Multidisciplinary and specialist care needs to be reinforced throughout the entire clinical chain of care for pediatric patients with hydrocephalus to optimize care from diagnosis to treatment. In this regard, there is an implied need for continuous scaled up neurosurgical services, trained multispecialty medical personnel, encouragement of early detection and strengthened follow-up for this patient group in SSA.

Since 2016, the Weill Cornell Neurosurgery Project has redirected its efforts toward Muhimbili Orthopedic and Neurosurgery Institute in the city of Dar-es-Salaam. Currently, there are 3 neurosurgeons at BMC along with 2 trainees from Tanzania. Annually, about 300 shunt surgeries (including about 5% revisions) are now performed at BMC. In addition, for diagnostic workup, there are 2 computed tomography scanners as well as a magnetic resonance imaging machine.

Strengths and Limitations

Even though there was no formally trained neurosurgeon at BMC at the time of the study, we were still able to capture 38 pediatric patients with hydrocephalus with their clinical histories and the majority of them received surgical treatment.

Data collection was challenging, given the resource-limited setting with sparse and inconsistent pre- and postoperative data and follow-up. This includes, but is not limited to clinical history, limited diagnostic imaging, and poor surgical and clinical follow up. Through the help of a local medical student who was fluent in both Swahili and English, we were able to obtain data from the patients' mothers, but unfortunately recall bias cannot be excluded.

CONCLUDING REMARKS

Our study supplements data to the under-researched field of management of pediatric hydrocephalus in low- and middle-income countries where treatment of affected patients is met with challenges. Although performed under challenging conditions, studies like ours are essential as they contribute to strengthening the scientific evidence required to support the current efforts reflected by the WHO "Intersectoral Action Plan on Epilepsy and Other Neurological Disorders" and the policy recommendations on spina bifida and hydrocephalus from the PGSSC. Both endeavors may be seen as stimuli for increased focus

and investment in pediatric neurologic and neurosurgical diseases for both research and ongoing health policy development.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Camilla G. Aukrust: Writing — original draft, Validation, Formal analysis, Visualization, Conceptualization. **Karishma Parikh:** Investigation, Conceptualization, Writing — review & editing. **Luke R. Smart:** Conceptualization, Writing — review & editing. **Ibrahimu Mdala:** Formal analysis, Visualization. **Heidi E. Fjeld:** Writing — review & editing. **James Lubuulwa:** Writing — review & editing. **Antonia Msafiri Makene:** Investigation. **Roger Härtl:** Conceptualization, Writing — review & editing, Funding acquisition. **Andrea Sylvia Winkler:** Conceptualization, Writing — review & editing, Supervision.

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