Pediatric Hydrocephalus in Ethiopia: Treatment Failures and Infections: A Hospital-Based, Retrospective Study

Tsegazeab Laeke[1], Abenezer Tirsit[1], Hagos Biluts[1], Deeptha Murali[2], Knut Wester[3,4]

OBJECTIVE/BACKGROUND: **Treatment of pediatric hydrocephalus in sub-Saharan countries is associated with significant complication rates. The objective of this study is to analyze the management of hydrocephalus and complication rates of surgical intervention in the Ethiopian setting to improve future quality.**

METHODS: **A retrospective cohort study was conducted in a neurosurgical teaching hospital. Two cohorts separated by 2.5 years were analyzed.**

RESULTS: **A total of 128 (58.6% male and 41.4% female) children with isolated hydrocephalus, meningomyelocele (MMC)-related hydrocephalus, or MMC without hydrocephalus were included. Their age ranged from 1 day to 5 years, for a mean age of 7.2 months (median age 2 months). One hundred thirteen patients had hydrocephalus, of whom 57 (44.5.3%) had isolated hydrocephalus and 56 (43.8%) had hydrocephalus associated with MMC. Seventy-seven (74.7%) patients underwent ventriculoperitoneal (VP) shunting, whereas 24 (23.3%) underwent endoscopic third ventriculostomy (ETV). The incidence of shunt infection was 23.4%. Reoperation was needed in 54 (52.4%) patients, with the most common indication being shunt failure. ETV failed in 14 (58.3%) of the 24 patients undergoing ETV.**

CONCLUSIONS: **VP shunt insertions had unacceptably high infection rate despite the presence of a protocol for the procedure. Intraoperative guidelines should be developed further and followed strictly to reduce infections. Such measures should include restricting the number of surgeons performing the procedure. In our opinion, one should avoid insertion of a VP shunt as the primary treatment. ETV has proved to be a good alternative in other studies and the decreasing pattern of ETV failure in our study also suggest ETV as a better alternative to VP shunt.**

INTRODUCTION

Worldwide, hydrocephalus is the most common pediatric neurosurgical condition. The population incidence of congenital hydrocephalus has been estimated to be 0.2–0.8/1000 live births.[1] Neither qualitatively nor quantitatively are there adequate data to determine the prevalence and incidence of hydrocephalus in the developing world, especially in sub-Saharan Africa, where this condition appears to be much more frequent than in developed countries.[2]

In Ethiopia, the etiology and incidence rates of hydrocephalus can be assumed to correspond to what has been reported from other East African countries, where hydrocephalus has been estimated to have an infectious origin in the majority of cases because of a much greater prevalence of untreated neonatal or even prenatal infections. In these studies, which are based on observations in Uganda, postinfectious hydrocephalus is calculated to account for as much as 60% of the total pediatric hydrocephalus patient population.[2,3]

Several factors probably contribute to this high incidence of central nervous system infections, including malnutrition and consequently a lowered resistance to infections. According to extrapolated estimates,[2] there will be approximately 6000 new cases per year in East Africa and 45,000 new cases of pediatric hydrocephalus in the entire sub-Saharan Africa. If Warf's

Key words
- ETV
- Hydrocephalus
- Management
- Prevalence
- Shunt infection
- VP shunt

Abbreviations and Acronyms
CT: Computed tomography
ETV: Endoscopic third ventriculostomy
HC: Head circumference
MMC: Meningomyelocele
VP: Ventriculoperitoneal

From the [1]Neurosurgery Unit, Addis Ababa University, School of Health Sciences, Addis Ababa, Ethiopia; [2]School of life sciences, Manipal University, Dubai, United Arab Emirates; [3]Department of Clinical Medicine K1, University of Bergen, Bergen; and [4]Department of Neurosurgery, Haukeland University Hospital, Bergen, Norway

To whom correspondence should be addressed: Knut Wester, M.D., Ph.D. [E-mail: kgwe@helse-bergen.no]

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estimates are valid also for Ethiopia, one can expect between 2000 and 4000 new cases of pediatric hydrocephalus per year.

The insertion of ventriculoperitoneal (VP) shunts has been the mainstay of treatment, but over the last few years, endoscopic third ventriculostomy (ETV) with or without choroid plexus cauterization has come into picture. VP shunt insertion is associated with high complication and failure rates. Worldwide, complication rates range widely, from 1% to 40%, with shunt infections probably being the most frequent cause of failure. Studies from so-called developed countries have over the years reported an incidence of shunt infection varying from 0% to 27% per procedure.[4,5] According to a Norwegian study, the shunt infection rate over an 11-year period was 2.7% per procedure.[4] That study also showed that the incidence of infections was significantly correlated with age, type of operation, and etiology of hydrocephalus, with infections being common during the first 6 months of life, after primary shunt insertions rather than revisions, and in children with meningomyelocele (MMC)-related hydrocephalus. Among other possible factors that are related to shunt infections are poor condition of the skin, presence of intercurrent infection at the time of surgery, prolonged operation time, as well as the education and experience of the neurosurgeon.[6-10]

Shunt failure is the most common indication for reoperation and occurs frequently, both in developed countries and low-income countries.[11,12] Proximal shunt obstruction due to ventricular catheter occlusion or misplaced ventricular catheter appears to be the most common cause of shunt failure.[11] In addition to mechanical obstruction or misplacement of shunt elements, shunt infections also may contribute to such obstructions.

Management of hydrocephalus in the developing world poses the greatest challenge, mainly as a result of the limited resources that are available and the scarcity of trained neurosurgeons. High cost of shunts used to be a major obstacle for management of hydrocephalus until recent years. This problem was tackled in Ethiopia and other African countries by the introduction of the relatively cheap Chhabra shunt.[13] It has been shown that there is no difference in outcome between the Chhabra shunt and the much more expensive shunts commonly used in the Western world.[14]

For all practical purposes, surgical treatment in Ethiopia started in 2006, when a training program in neurosurgery was initiated. Since then, 15 new specialists have been trained in the program, and several hundred hydrocephalic children have undergone operations. It has, however, been our impression over these years that this activity has been hampered by more complications and failures than could be expected. The aim of the present study is therefore to focus on the management of hydrocephalus and complication rates of surgical intervention in the Ethiopian setting, to improve the future quality and results of this neurosurgical activity.

PATIENTS AND METHODS

This retrospective cohort study was performed in one of the neurosurgical teaching hospitals associated with Addis Ababa University, the Myung Sung Christian Medical Center. The collected data included sociodemographics of patients, diagnosis at admission, clinical investigations, etiology of hydrocephalus, details of the performed neurosurgical procedures, antibiotic medication, and postoperative complications. Patient charts were reviewed thoroughly and missing information also was retrieved from the computerized database of the hospital.

The study includes all patients who were admitted to this hospital with a diagnosis of hydrocephalus or MMC during 2 time periods, each extending for 1 year: between July 1, 2010, and June 30, 2011, and between January 1, 2014, and December 31, 2014. Patients who were older than 5 years of age or had had surgical hydrocephalus procedures before the study period started, or who had developed hydrocephalus secondary to a brain tumour or other intracranial conditions, were excluded.

Based on the aforementioned criteria, a total of 128 children with isolated hydrocephalus, MMC-related hydrocephalus, or MMC without hydrocephalus were included in the study during the 2 study periods. Eighty of these were enrolled during the first study period, whereas 48 patients were included during the second period (2014). One hundred thirteen children had hydrocephalus, and 15 had isolated MMC. For further description of these patients, see the Results section.

Preoperative Neuroimaging and Hydrocephalus Classification

The children with hydrocephalus underwent the following neuroimaging investigations: ultrasound only: 33 patients (29.2%), computed tomography (CT) scan only: 53 patients (46.9%), CT and ultrasound: 10 patients (14.7%), and magnetic resonance imaging alone: 3 patients (2.7%). Fourteen patients (12.4%) had no documented imaging modalities. Hydrocephalus was classified as obstructive and communicating depending on the radiographic findings. Obstructive hydrocephalus was tentatively diagnosed if the fourth ventricle was not enlarged according to the readings of the imaging modalities; if all 4 ventricles were enlarged, the hydrocephalus was assumed to be communicating. According to the most likely etiology, hydrocephalus was classified as post-infectious, MMC-related, or congenital hydrocephalus.

Preoperative Preparation

Only 103 patients were operated for their hydrocephalus. The child was allowed to sleep with his or her mother overnight before the procedure. With the exception of 4 patients, all the patients received prophylactic antibiotics (ceftriaxone 50–100 mg/kg): 52 (50.5%) 1–3 hours before surgery, 26 patients (25.2%) less than 1 hour, and 4 patients (3.9%) more than 3 hours before surgery. Nine patients (8.7%) were already on preoperative antibiotics because of a preexisting infection. In 8 patients (7.8%), the exact timing of antibiotics was not known.

In addition to the 9 patients who already were on antibiotics, 94 were given prophylactic antibiotics; they had no known preexisting infection. Fifty-two (55.3%) of these were continued on antibiotics for 3 days or more, 25 (26.6%) patients had antibiotics for 1–3 days after surgery, whereas 11 (11.7%) received antibiotics for only 1 postoperative day. In the remaining 6 cases (6.4%), the exact length of the antibiotic medication could not be specified.

Surgical Technique

Patients were positioned for the appropriate surgical procedure. Hair was clipped over the surgical site. Thorough cleaning of the