



# Pediatric Hydrocephalus in the Developing World: Etiology and Treatment

## Citation

Marano, Paul. 2016. Pediatric Hydrocephalus in the Developing World: Etiology and Treatment. Doctoral dissertation, Harvard Medical School.

## Link

<http://nrs.harvard.edu/urn-3:HUL.InstRepos:40620232>

## Terms of use

This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material (LAA), as set forth at

<https://harvardwiki.atlassian.net/wiki/external/NGY5NDE4ZjgzNTc5NDQzMGIzZWZhMGFIOWI2M2EwYTg>

## Accessibility

<https://accessibility.huit.harvard.edu/digital-accessibility-policy>

## Share Your Story

The Harvard community has made this article openly available.  
Please share how this access benefits you. [Submit a story](#)

**Scholarly Report submitted in partial fulfillment of the MD Degree at Harvard Medical School**

**Date:** 28 February 2016

**Student Name:** Paul Marano

**Scholarly Report Title:** Pediatric hydrocephalus in the developing world: etiology and treatment

**Mentor Name and Affiliations:** Benjamin Warf, MD, Director, Neonatal and Congenital Anomaly Neurosurgery, Associate in Neurosurgery, Associate Professor of Neurosurgery, Harvard Medical School

**Collaborators, with Affiliations:**

Scellig S. D. Stone, MD, PhD (Harvard Medical school, Department of Neurosurgery Boston Children's Hospital)<sup>1</sup>

John Mugamba, MD (CURE Children's Hospital of Uganda)<sup>1</sup>

Peter Ssenyonga, MD (CURE Children's Hospital of Uganda)<sup>1</sup>

Ezra B. Warf, Wheaton College

Oumar Diallo, MD (Hospital of Mali)<sup>2</sup>

Kachinga Sichizya, MD (Beit CURE Hospital)<sup>2</sup>

<sup>1</sup>Collaborators for published work

<sup>2</sup>Collaborators for unpublished work

## **Published Work**

### **Abstract**

**TITLE:** Reopening of an obstructed third ventriculostomy: long-term success and factors affecting outcome in 215 infants

Paul J. Marano, BA, Scellig S. D. Stone, MD, PhD, John Mugamba, MD2, Peter Ssenyonga, MD, Ezra B. Warf, and Benjamin C. Warf, MD

### **OBJECT:**

The role of reopening an obstructed endoscopic third ventriculostomy (ETV) as treatment for ETV failure is not well defined. The authors studied 215 children with ETV closure who underwent successful repeat ETV to determine the indications, long-term success, and factors affecting outcome.

### **METHODS:**

The authors retrospectively reviewed the CURE Children's Hospital of Uganda database from August 2001 through December 2012, identifying 215 children with failed ETV (with or without prior choroid plexus cauterization [CPC]) who underwent reopening of an obstructed ETV stoma. Treatment survival according to sex, age at first and second operation, time to failure of first operation, etiology of hydrocephalus, prior CPC, and mode of ETV obstruction (simple stoma closure, second membrane, or cisternal obstruction from arachnoid scarring) were assessed using the Kaplan-Meier survival method. Survival differences among groups were assessed using log-rank and Wilcoxon methods and a Cox proportional hazards model.

### **RESULTS:**

There were 125 boys and 90 girls with mean and median ages of 229 and 92 days, respectively, at the initial ETV. Mean and median ages at repeat ETV were 347 and 180 days, respectively. Postinfectious hydrocephalus (PIH) was the etiology in 126 patients, and nonpostinfectious hydrocephalus (NPIH) in 89. Overall estimated 7-year success for repeat ETV was 51%. Sex ( $p = 0.46$ , log-rank test;  $p = 0.54$ , Wilcoxon test), age (< vs > 6 months) at initial or repeat ETV ( $p = 0.08$  initial,  $p = 0.13$  repeat; log-rank test), and type of ETV obstruction ( $p = 0.61$ , log-rank test) did not affect outcome for repeat ETV ( $p$  values  $\geq 0.05$ , Cox regression). Those with a longer time to failure of initial ETV (> 6 months 91%, 3-6 months 60%, < 3 months 42%,  $p < 0.01$ ; log-rank test), postinfectious etiology (PIH 58% vs NPIH 42%,  $p =$

0.02; log-rank and Wilcoxon tests) and prior CPC (p = 0.03, log-rank and Wilcoxon tests) had significantly better outcome.

**CONCLUSIONS:**

Repeat ETV was successful in half of the patients overall, and was more successful in association with later failures, prior CPC, and PIH. Obstruction of the original ETV by secondary arachnoid scarring was not a negative prognostic factor, and should not discourage the surgeon from proceeding. Repeat ETV may be a more durable solution to failed ETV/CPC than shunt placement in this context, especially for failures at more than 3 months after the initial ETV. Some ETV closures may result from an inflammatory response that is less robust at the second operation.

**Student Contribution:**

I began working with Dr. Warf on projects studying hydrocephalus in sub-Saharan Africa and its treatment during my first year of medical school. This paper published in Journal of Neurosurgery Pediatrics is a retrospective analysis of outcomes in patients that were treated with repeat endoscopic third ventriculostomy in Uganda by Dr. Warf and his colleagues Dr. Mugamba and Dr. Ssyenyonga at the CURE Uganda Hospital from 2001 and 2012. The data was collected by the surgeons and entered into a database developed by the non-profit organization CURE international. I met with the team at CURE that designed the software in order to develop an understanding of the data and methodologies for aggregating and analyzing the data. I conducted a literature review on the use of endoscopic treatments in hydrocephalus and the role of repeat endoscopic intervention. Dr. Warf conceived the study of outcomes on patients who had undergone repeat endoscopic treatment; there had been no large published series of these patients to guide clinicians. I worked with Dr. Warf to design subgroup analyses that would be helpful for clinicians seeking to determine the patient population for which repeat endoscopic treatment was most likely to be successful. I reviewed the charts of all of the patients that had multiple endoscopies at CURE Uganda during this time period, and identified 215 children who had an ETV that failed and subsequently underwent a technically successful repeat endoscopic operation, as opposed to the traditional treatment of shunting for patients with

failed ETV. I conducted the statistical analysis of the data, using the Kaplan–Meier method to model time to failure of the repeat operations, and further assessing survival differences between groups. After working independently on the statistical analysis, I worked with Dr. Stone to refine and add to the statistical methods. After the analysis was complete, I created the figures for the paper and drafted the results and discussion sections, and subsequently took part in the editing and submission process along with my co-authors. I also am presently working on a separate study investigating the etiology of hydrocephalus in Mali, Zambia and Tanzania. For this study, I am working with Dr. Warf, collaborating with surgeons in these countries to develop a system for data collection and analysis to consistently determine the etiology of hydrocephalus in patients. This work is currently in the drafting stage for future publication.

**Link to Publication:**

<http://www.ncbi.nlm.nih.gov.ezp-prod1.hul.harvard.edu/pubmed/25658247>

Marano PJ, Stone SS, Mugamba J, Ssenyonga P, Warf EB, Warf BC. “Reopening of an obstructed third ventriculostomy: long-term success and factors affecting outcome in 215 infants.” *Journal of Neurosurgery Pediatrics*, 2015 Apr;15(4):399-405. doi: 10.3171/2014.10.PEDS14250. Epub 2015 Feb 6.