European Journal of Medical and Health Sciences
Vol 6 | Issue 1 | February 2024
ISSN 2593-8339

CASE STUDY

Postmeningeal Hydrocephalus in Infants: A Case Report of 39 Patients

Radotina Tony Andrianaivo[1,*], Willy Francis Rakotondraibe[2], Bemora Joseph Synese[1], Willy Ratovondrainy[3], Mamiarisoa Rabarijaona[1], and Clément Andriamamonjy[1]

ABSTRACT

Aim and Objective: **This study aimed to report on the management of post-meningeal hydrocephalus in infants at our centre.**

Methods: **This was an observational, descriptive, cross-sectional study of 39 cases of postmeningeal hydrocephalus operated on in infants.**

Results: **The mean age of the infants was 8.64 months. Clinical signs were dominated by macrocrania in all patients. FET and CT were the most frequently requested morphological examinations for diagnosis, and few patients were able to benefit from CT (41%). In 69% of cases, hydrocephalus occurred within 2 months of the onset of meningitis. Treatment consisted of antibiotic therapy until the CSF was sterilised, followed by the installation of a shunt system. The mortality rate was 8%.**

Conclusion: **This study highlights the need for prevention and appropriate treatment of meningitis, early detection of hydrocephalus and the effectiveness of ventriculoperitoneal shunting in the treatment of hydrocephalus.**

Submitted: January 05, 2024

Published: February 23, 2024

10.24018/ejmed.2024.6.1.2016

[1]Department of Neurosurgery, CHU-JRA, Madagascar.
[2]Department of Neurosurgery, CHU PZaGa Mahajanga, Madagascar.
[3]Department of Neurosurgery, CENH OSOA, Madagascar.

**Corresponding Author:*
e-mail: radotinaandrianaivo@gmail.com

Keywords: CSF derivation, Hydrocephalus, Infant, Meningitis.

1. Introduction

Hydrocephalus is one of the fairly frequent complications of meningitis of all aetiologies, especially in infants [1]. In Africa, the post-infectious aetiology varies from 7 to 60% and remains correlated with the level of health of the country's population. Bacterial meningitis remains the main aetiology of hydrocephalus in developing countries [2].

Hydrocephalus may appear at the onset of the disease or weeks after the diagnosis of meningitis has been made. In Madagascar, hydrocephalus is only discovered at the stage of monstrous macrocrania, reflecting the delay in treatment [3].

The aim of this study is, therefore, to report on the actual management of postmeningeal hydrocephalus in infants at our centre.

2. Materials and Methods

This was an observational, descriptive, cross-sectional study in the Neurosurgery Department of CHU PZaGa Mahajanga Madagascar for a period of 4 years and one month from September 01, 2017, to September 31, 2021. We included in our study all patients less than two years of age without distinction of gender presenting with postmeningeal hydrocephalus, hospitalized and treated surgically, and having a compliant record. Indeed, these were patients for whom the diagnosis of postmeningeal hydrocephalus was evoked given the history of meningitis with clinical and paraclinical signs of hydrocephalus. The diagnosis of hydrocephalus was confirmed either by computed tomography (CT) or transfontanellar ultrasound (FTE).

The sampling method was exhaustive for all patients with postmeningeal hydrocephalus. Data were collected on a survey form based on interviews with relatives, patient records, consultation registers and postoperative reports.

The parameters studied are as follows:

- Frequency, age, gender, vaccination status according to the EPI in Madagascar [4] and parental and perinatal history
- The delay between the onset of hydrocephalus and the onset of meningitis
- The clinical and radiological features of postmeningeal hydrocephalus

- The germ responsible for the meningitis (if identified)
- Therapeutic strategies for each type
- Evolutionary aspects

The data collected was entered into Microsoft Excel 2019® and analysed using R® software version 3.5.2 with an IDE (Integrated Development Environment) RStudio® version 1.1.456.

Before collecting the data, an authorization request was obtained from the hospital directors and heads of the departments concerned. Respect for anonymity, confidentiality and personal and professional secrecy. The forms containing the information collected are kept in a safe place.

2.1. *Limits*

This is a retrospective study and is therefore subject to the effects of confounding factors. The sample size is small.

3. Results

Over 49 months, 2,205 patients were hospitalised in the neurosurgery department for all pathologies combined. 149 cases of hydrocephalus of all aetiologies and ages were hospitalised. We found 137 cases of hydrocephalus in infants, with 49 cases of postmeningeal aetiology (33% of all hydrocephalus). Of the 49 cases, 39 were treated surgically. There were no cases of postmeningeal hydrocephalus in adults or children.

The mean age of our patients was 8.64 +/− 4.36 months, with extremes of 2 and 23 months. There was a clear male predominance, with a sex ratio of 1.44. Vaccination status according to the EPI in Madagascar was complete in 25.64% of cases. Only 36% of the mothers of our patients were able to have a full antenatal check-up during pregnancy, and 38% did not even consult any health personnel (medical or paramedical) during the pregnancy. In terms of maternal history, 77% of mothers presented with a history of fever (46%), leucorrhoea (28%) and toxoplasmosis (3%) (Table I).

The majority of hydrocephalus (69%) had occurred in the acute phase, i.e., within 2+/− 4.54 months of the onset of meningitis, and 8% during the 3rd month. Macrocrania and delayed psychomotor development were found in 100% of cases. Blindness was found in 11.11% of infants. Brain scans were performed in 41.03% and transfontanellar ultrasound in 100% of cases. Hydrocephalus was tetraventricular in 58.97% of cases. Communicating hydrocephalus was found in more than half the cases (56%), while the non-communicating type was present in only 44% of patients. All patients had received medical treatment with acetazolamide before surgery.

TABLE I: Distribution According to Maternal History During Pregnancy

	Frequency (n)	Proportion (%)
No	9	23.08
Leucorrhoea	11	28.21
Fever	18	46.15
Toxoplasmosis/rubella serology not done	1	2.56
Total	**39**	**100**

Sixteen patients (41%) were found to have germs on CSF ECB, with *Haemophilus influenzae* predominating in 18% of cases (n = 7), followed by *streptococcus pneumoniae* (8%) and *gram-negative bacilli* (8%). *Enterobacter* was found in 5% of cases. Ventriculoperitoneal shunt was the technique we used for all our patients and was performed after sterilisation of the CSF and/or normalisation of the proteinorachy and glycorachy. In the meantime, patients received medical treatment with acetazolamide associated with iterative ventricular puncture. The medium pressure valve was used in all cases (Chabbra in 76.92%, Integra in 17.95%, Sohysa polaris in 5.13%). The average hospital stay was 5.41+/− 1.69 days, with a minimum of 3 days and a maximum of 12 days. The outcome was favourable in 75.35% of cases, with a mortality rate of 7.69%. There were 4 cases of infectious complications and 1 case of valve dysfunction during hospitalisation. After 6 months, 52.63% of patients had psycho-intellectual sequelae, 94.73% had motor sequelae, 63.15 had visual sequelae and 15.78% had epilepsy.

4. Discussion

The frequency of postmeningeal hydrocephalus (33%) reported in our practice is similar to that of other African studies, which varies between 32% and 46% [5], [6]. These rates remain low compared with developed countries, due to the quality of their management (early consultation, well-behaved antibiotic therapy) of meningitis, which remains endemic in several tropical regions [7].

Infection is the most common cause of hydrocephalus in children in most African countries, including Madagascar [3]. Hydrocephalus may be the consequence of a prenatal or postnatal infection, as reported in the studies by Vertinsky and Barnes [8]. The source of infection could be during delivery, as Warf observed in Uganda [6], or as a result of inadequate care of the newborn or even the use of worn utensils. Most mothers in developing countries still give birth at home, to a matron out of belief, knowledge or lack of financial means to go to a hospital, from which the care of the newborn would not be adequate and neonatal infection would be favoured. Moreover, vaccination is often incomplete or absent after birth as reported in our study, a hypothesis that could be explained by the parents' lack of knowledge or by the inaccessibilitý of the health centre. We would also emphasise, the delay in diagnosis and management, or even more seriously inadequate management of infections in children which would aggravate the onset of hydrocephalus.

According to the literature, postmeningeal hydrocephalus predominates in infants [9], [10]. In our study, this could be explained by the fact that infants are vulnerable in terms of immune defence and that vaccination protection is not always complete or even absent, especially in developing countries such as Madagascar (in our series, 26% had no vaccination coverage), hence, hydrocephalus in infants, especially of infectious origin, is more frequently observed at this age [3]. In developed countries, on the other hand,

screening and diagnostic investigations for meningitis and hydrocephalus are more accessible and early, and care is provided at an early stage. In addition, infections are better controlled in these countries.

Parents' lack of knowledge about vaccines, their refusal out of fear of contracting other diseases, traditional beliefs, the inaccessibility of health centres (which are too far away) or the absence of vaccines (stock shortages) may explain the low vaccination coverage rate. Fortunately, the Malagasy state, with the Expanded Programme on Immunisation (EPI), is tending to increase the immunisation coverage rate of infants (over 80% in Antananarivo) to prevent infections and combat the occurrence of meningitis, including the Haemophilus influenza meningitis vaccine that has been introduced [4].

The risk factors for meningitis in infants are dominated by maternal infection, immunosuppressive treatment of the mother, vaginal cerclage, premature rupture of membranes, stained or fetid amniotic fluid, unexplained prematurity, etc. [11]. The mother's state of health during pregnancy and the course of the pregnancy therefore plays a decisive role in the onset of meningitis [8], [11].

The delay between the onset of hydrocephalus and the onset of meningitis is variable and depends on the mechanism of the hydrocephalus. However, in the majority of cases, hydrocephalus occurs during the acute phase of meningitis [12]. This was confirmed in our series. Indeed, in our practice, 69% of hydrocephalus developed during the acute phase of meningitis and 8% during the 3rd month. This result is close to that found by Ba MC [7].

All our patients are seen in consultation for advanced macrocrania, and more than 70% of our patients arrive in consultation with monstrous macrocrania (more than 3 DS). This may be due to a delay in diagnosis, often linked to socio-economic problems or a lack of awareness of the existence of suitable treatments for this disease. Regular monitoring of PC by the GP, noted in the health records would certainly be the best way of detecting macrocrania. In addition to measuring the cranial perimeter, its regular assessment and its evolution kinetics especially in infants with meningitis.

Transfontanellar ultrasound (FUS) is a first-line examination for newborns and infants with a permeable anterior fontanel, due to its safety and ease of use. ETF, because of its simplicity, accessibility and low cost, retains a major place in the exploration and follow-up of hydrocephalus in neonates and infants. Thus, we have requested it systematically from all our patients. ETF remains very limited as regards the exact description of the third and fourth ventricles as well as the exploration of the posterior fossa but also because it is user-dependent hence, the need for other investigations such as CT and MRI [13].

Accessibility of the latter is still difficult in Madagascar because of the high cost, which explains the low rate of performance of these examinations in our series.

Meningitis causing hydrocephalus has several possible mechanisms, such as blockage of CSF flow due to leptomeningeal inflammation or obliteration of the subarachnoid spaces and the foramen of Luschka and Magendie due to meningeal exudate. The flow of CSF may be blocked in the third or fourth ventricle (non-communicating hydrocephalus) or in the arachnoid villi (communicating hydrocephalus) [2], [12]. In our practice, communicating hydrocephalus was found in more than half the cases (56%), whereas the non-communicating type was present in only 44% of patients.

Haemophilus influenzae and *streptococcus pneumoniae* are the germs most frequently observed in many African series [14]. Our results are in line with those reported in the literature. This is not surprising, given that meningitis is often caused by self-medication, probabilistic antibiotic therapy and, above all, the non-negligible proportion of viral meningitis, since in the majority of cases aetiological research is limited to bacteriology.

Virological diagnosis of meningitis is not routine in many developing countries such as Madagascar.

Postmeningeal hydrocephalus must be operated on cold after the infectious process has been cured and the inflammatory phenomena have cooled, as assessed by a study of the CSF (sterile fluid, normal cytology, albuminorachy not exceeding 1 to 1.5 g/l, and also after any extrameningeal infectious involvement has been cured), for fear of contaminating the shunt material. Care must be taken to ensure that the hydrocephalus is progressive both clinically and through further investigations to look for changes in the lateral ventricles or transependymal resorption. It should be noted that any hydrocephalus treated during the first three months will have minor sequelae [9].

In our practice, as in the literature, ventriculoperitoneal shunting has been the preferred technique because the length of its catheter avoids the repeated lengthening operations required by growth. All our patients have benefited from a ventriculoperitoneal shunt without exception. More recent studies have shown that ventriculocisternostomy can be used for the treatment of postmeningeal hydrocephalus [15], [16]. Indeed, endoscopic ventriculocisternostomy (VCS) is a technique that is simple, and safe with excellent results. Despite the difference in the aetiological profile of hydrocephalus between rich and poor countries, this technique should be promoted and made available in developing countries, taking into account its advantages in terms of quality of life and morbidity compared with other internal shunting techniques (shunt valves). Although expensive, the argument most often put forward in developing countries for its acquisition, its economic and social return is superior in the long term to that of bypass valves. In our practice, no child has ever benefited from ventriculocisternostomy. Unfortunately, this is the only technique that can be performed, due to the lack of the necessary infrastructure to perform a VCS in our centre. As for the capital Antananarivo, this technique should be possible given the presence of an endoscopy on site.

For our patients, the CHABBRA type valve was used most frequently, in 77% of cases (30 patients). This is a one-piece, non-adjustable, medium-pressure valve. Other types of valves were used, such as the INTEGRA valve in 7 patients (18%) and, exceptionally, the SOPHYSA POLARIS valve in two patients (5%). The CHABBRA valve is the most widely available in Madagascar, although

most families cannot afford it. According to Venkataramana [17], the CHABBRA type valve, manufactured in India, has been evaluated and compared with western valves, demonstrating the same efficacy. The author specifies that the CHABBRA valve is economical and effective, but as we have pointed out, in our country the cost is not yet within everyone's reach.

5. Conclusion

Hydrocephalus occurs in most cases during the acute phase of meningitis.

Haemophilus influenzae and *Streptococcus pneumoniae* are the germs most frequently found, but the germ remains unidentified in the majority of cases.

The diagnosis of postmeningeal hydrocephalus is clinically evoked by macrocrania with a history of meningitis. The other clinical signs are visual and neurological, which merely complete an already obvious picture. Hydrocephalus is confirmed by neuroimaging, in particular transfontanellar ultrasound, cerebral tomography and magnetic resonance imaging, which are the tests of first choice.

Therapeutic management is based on antibiotic therapy adapted to the antibiogram until the cerebrospinal fluid is sterilised, followed by placement of a ventriculoperitoneal shunt. This procedure has been used in all our patients without exception.

The short-term outcome is almost always favourable; unfortunately, long-term follow-up is difficult to achieve, as most patients are lost to follow-up after the first check-up.

Surgery is a symptomatic treatment aimed at lowering intracranial pressure. Prevention of meningitis and early detection of hydrocephalus by vaccination against the most common germs, regular measurement of head circumference, systematic transfontanellar ultrasound and lumbar puncture to diagnose and monitor meningitis should be the rule.

Conflicts of Interest

Authors declare that they do not have any conflict of interest.

References

[1] Zabsonre DS, Ouattara O, Dao I, Sanou A, Yameogo WSPA, Kabré A. Etiologies of hydrocephalus among children at the Yalgado Ouedraogo University hospital (YO-CHU) of Burkina Faso. *AJNS*. 2021;40(1):264–7.

[2] Idrissi SR, Aqqad A, Sami A, Hilmani S, Ibahioin K, Naja A, *et al.* L'hydrocéphalie Post-méningitique Du Nourrisson Et De L'enfant à Propos De 47 Cas [Post-meningitic hydrocephalus in infants and children in 47 cases]. *J Neurosurg*. 2008;4(2):7–11.

[3] Andrianaivo RT, Rakotoarivelo JA, Ramarokoto M, Ratovondrainy W, Rabarijaona M, Andriamamonjy C. Epidemiological, therapeutic and evolution aspects of hydrocephalus in children in Madagascar. *Paripex*. 2022;11(5): 48–50.

[4] MCSP. Madagascar-technical summary, reaching every child with immunisation services in Madagascar. 2018. Available from: www.mcsprogram.org.

[5] Kumar R, Singh V, Kumar MVK. Shunt revision in hydrocephalus. *Indian J Pediatr*. 2005;72:843–7.

[6] Warf BC. Hydrocephalus in Uganda: the predominance of infectious origin and primary management with endoscopic third ventriculostomy. *J Neurosurg: Pediatr*. 2005;102:1–15.

[7] Ba MC, Kpelao S, Thioub M, Kouara M, Thiam AB, Ndoye N, *et al.* Post-meningitic hydrocephalus of infants in Dakar. *African J Neurol Sci*. 2012;31:8–6.

[8] Vertinsky AT, Barnes PD. Macrocephaly, increased intracranial pressure, and hydrocephalus in the infant and young child. *Top Magn Reson Imag*. 2007;18:31–51.

[9] Huo L, Fan Y, Jiang C, Gao J, Yin M, Wang H, *et al.* Clinical features of and risk factors for hydrocephalus in childhood bacterial meningitis. *J Child Neurol*. 2019;34:11–6.

[10] Lovera D, Arbo A. Risk factors for mortality in Paraguayan children with pneumococcal bacterial meningitis: mortality risk factors in Paraguayan children with meningitis. *Trop Med Int Health*. 2005;10:1235–41.

[11] Beer R, Lackner P, Pfausler B, Schmutzhard E. Nosocomial ventriculitis and meningitis in neurocritical care patients. *J Neurol*. 2008;255:1617–24.

[12] Lin JJ, Wu CT, Hsia SH, Lin KL, Chiu CH. Community-acquired Pseudomonas meningitis causes acute obstructive hydrocephalus. *Childs Nerv Syst*. 2009;25:723–5.

[13] Dinçer A, Özek MM. Radiologic evaluation of pediatric hydrocephalus. *Childs Nerv Syst*. 2011;27:1543–62.

[14] Orega M, Plo KJ, Ouattara AL, Niangue-Beugre M, Cisse L, Migan Y, *et al.* Purulent meningitis in children in Abidjan (a propos de 521 cas). *Médecine d'Afrique Noire*. 1997;44(4):216–2.

[15] Salem-Memou S, Chavey S, Elmoustapha H, Mamoune A, Moctar A, Salihy S, *et al.* Hydrocephalus of the newborn and infant at the centre hospitalier national de Nouakchott. *Pan Afr Med J [Internet]*. 2020;36:1–9. cited 20 Jul 2023. Available from: https://www.panafrican-med-journal.com/content/article/36/184/full.

[16] Furlanetti LL, Santos MV, De Oliveira RS. The success of endoscopic third ventriculostomy in children: analysis of prognostic factors. *Pediatr Neurosurg*. 2012;48:352–9.

[17] Venkataramana NK. Hydrocephalus Indian scenario—A review. *J Pediatr Neurosci*. 2011;6:S11–22.