

Complications of External Ventricular Drainage at CHU-JRA Antananarivo Madagascar

Bemora Joseph Synèse, Ramarokoto Mijoro, Rakotoarivelo Joe Andry,
Barison Mugica, Ratovondrainy Willy, and Rabarijaona Mamiarisoa

ABSTRACT

The external ventricular drainage (EVD) is a device indicated in cases of acute hydrocephalus and in certain cases of intracranial hypertension. The main objective of our study is to determine the frequency of the complication of an EVD at the Centre Hospitalier Universitaire Joseph Ravohangy Andrianavalona (CHU-JRA). This is a retrospective and descriptive study. During the targeted period, 64 patients were operated for EVD, of which 45 had a complication (70.31%). The infectious complication predominated in 43.75% of cases. All patients were operated for ventricular hemorrhage. Antibiotic prophylaxis before surgery was systematic for all patients. The most frequent germ was Coagulase-negative Staphylococcus. The average duration of catheterization was 14.47 days, the average duration of onset of the complication was 7.96 days. Despite systematic insertion of the EVD in the operating room and the existence of a dedicated care protocol, the rate of an EVD-related complication remains high in our center.

Keywords: CHU-JRA, complication, external ventricular drainage, hydrocephalus, infectious.

Published Online: November 26, 2022

ISSN: 2736-5476

DOI: 10.24018/ejclinmed.2022.3.6.190

B. J. Synèse *

Department of Neurosurgery, CHU-JRA,
Antananarivo, Madagascar.

(e-mail: josbemora@yahoo.fr)

R. Mijoro

Department of Neurosurgery, CHU
Anosiala, Antananarivo, Madagascar.

R. J. Andry

Department of Neurosurgery, CHU-JRA,
Antananarivo, Madagascar.

B. Mugica

Department of Neurosurgery, CHU-JRA,
Antananarivo, Madagascar.

R. Willy

Department of Neurosurgery,
CENHOSOA, Antananarivo,
Madagascar.

R. Mamiarisoa

Department of Neurosurgery, CHU
Tambohobe Fianarantsoa, Madagascar.

**Corresponding Author*

I. INTRODUCTION

Hydrocephalus is a progressive or acute distension (cerebrovascular accident) of the ventricular cavities, caused by an anomaly either of the production of cerebrospinal fluid (CSF), or of the circulation or the resorption [1]. The causes can be multiple, which can be vascular, tumoral, infectious or malformative. The placement of an external ventricular drainage (EVD) is a common life-saving gesture in the context of acute hydrocephalus. It is a system allowing transient and controlled external drainage of the CSF using a surgically implanted drain in the lateral ventricle. But despite this therapeutic advance, many complications can occur after the installation of an EVD. These complications are grouped into infectious complications which are by far the most frequent (2% to 27% of cases with an average of 10%) then mechanical complications which are rare and less studied in the literature [2]. These extremely frequent complications pose a problem of care, greatly prolong the hospital stay of patients and considerably increase the cost of treatment, hence the interest of our work.

The main objective of this study is to determine the frequency of the complication of a DVE at the CHU-JRA, the secondary objective are to identify the risk factors for the occurrence of a complication of an EVD, to determine the

time to onset of infection within a DVE as well as identifying the germs frequently responsible.

II. METHODOLOGY

This study was done at the CHU-JRA Antananarivo Madagascar, in the surgical resuscitation department, the neurosurgery department and the medical resuscitation department. This is a retrospective and descriptive study based on the medical records of patients operated for an EVD, for a period of 24 months from January 01, 2019 to December 31, 2020.

We included in this study all the medical files of post-operative patients of an external ventricular drainage, of any age presenting one or more complications related to the EVD during their hospital stays in these services; and were not included patients who died within the first 24 hours of their hospitalization and whose indication for surgery was infectious meningitis. During the study period, 90 patients were operated on for DVE, after which only 64 patients were retained. The parameters studied were the epidemiological, clinical, paraclinical therapeutic and evolutionary parameters. The data was processed by Microsoft Word 2010, Microsoft Excel 2010 and Epi info software.

III. RESULTS

In this study, among the 64 patients who underwent EVD, 45 patients were identified who presented complications with a frequency of 70.31%; infectious complications were 62.22% (28 cases), 28.89% (13 patients) mechanical complications and 8.89% (4 cases) mixed complications. Among the mechanical complications, 11(24.44%) were related to obstruction, one was related to hyperdrainage (2.22%), and one tearing of the EVD (2.22%).

The average age of our patients was 54.2 years with an extreme of 2 and 77 years. There was a male predominance of 57.78% with a sex ratio of 1.36.

All indications for surgery were a hemorrhagic vascular cause, of which 8 (17.78%) were due to subarachnoid hemorrhage by ruptured aneurysm, and 37 (82.22%) were due to a hemorrhagic stroke of hypertensive origin.

Clinically, 35 patients or 77.78% presented with fever and 10 patients or 22.22% were afebrile. Meningeal syndrome was present in 32 patients (71.11%). According to the Glasgow Score, 33.33% had a score below 8 and 64.44% a score between 8 and 12. Regarding surgery, 7 patients or 15.56% were operated by junior surgeons, 38 patients or 84.44% were operated by senior surgeons. Antibiotic prophylaxis before surgery was systematic for all patients. The average duration of the intervention was 49.92 min with an extreme of 30 and 90 min. The dressings were systematic every two days. Among the patients who had complications, 36 (80.00%) had a clean dressing during hospitalization, 4 (8.89%) had a CSF leak and 5 patients or 11.11% had a sweating dressing.

At the blood count, 39 cases (86.67%) showed hyper leukocytosis. CRP ranged from 10 to 192 with an average of 82.71%. A blood culture was performed in 7 patients, of which 2 results were positive (28.57%).

The direct examination of the CSF was done in 9 cases of patients who an infectious complication or 28.13% had made their examination of the CSF. Among these 9 examinations, 6 results (66.67%) were positive against 3 results (3.33%) which were negative and after Gram staining, 5 or 83.33% Gram Positive Cocci and 1 or 16.67% had a Gram-positive bacillus. All 9 cases showed hypercellularity, hypoglycorachia and hyperproteinorachia. Only one CSF culture came back negative, 3 were positive for Coagulase-negative staphylococcus, 2 were positive for Staphylococcus aureus and 1 result were positive in Pseudomonas aeruginosae (BMR).

Curative antibiotic therapy with third-generation cephalosporin associated with an Imidazole used in 50% of cases. Apart from antibiotic therapy, the other treatments depending on the circumstances were an unblocking in the resuscitation room (17.7%), change of the EVD (2.22%) and remote internalization of the system VP Shunt (2.22%).

In this series, the mean duration of the EVD was 14.47 days with extremes of 3 and 46 days. The average duration of onset of the complication was 7.96 days with an extreme of 3 and 32 days. The average duration of hospitalization of patients with complications was 18.8 days with an extreme of 3 and 60 days. The mortality rate was 77.78%.

IV. DISCUSSION

In the literature, the average age is 52 years [3],[4]; 54.2 years in our study, with a male predominance both in our study and in the literature [3], [5], [6]. But there is no correlation with either the gender or the age of the patients for the occurrence of complications.

Regarding indications for surgery in the literature, there are multiple indications for EVD ranging from traumatic or non-traumatic intracranial hemorrhage, prevention and/or treatment of CSF leaks, a tumor cause, ventricular shunt dysfunction [3], [5], [7]. They were a hemorrhage secondary to a hemorrhagic stroke in our study.

Infectious complication: in the literature, the frequency of these complications varies from 2 to 28% with an average of around 8 to 15 [3]-[5], [7], [8]. In the present study, the frequency of infection related to DVE was 43.75%, which is much higher than in the literature. The definition of a EVD-related infection in the present study was fever associated with a meningeal syndrome from day 5 postoperatively. In the literature, this definition was taken from clinical-biological and microbiological data [3].

Mechanical complication: in the literature, mechanical complications are less frequent than infectious complications, which can be tearing in 0.4% according to [9]; temporary obstruction in 41% and permanent occlusion in 19% [10]. In the present study, 11 cases were related to obstruction, i.e. 24.44%, and tearing of the DVE (2.22%).

The experience of the operator seems to play an important role, but this factor is very little studied. It influences the duration of the intervention and therefore the duration of aerial exposure. According to [3], 93% of the EVD were fitted by a senior operator and 86% were fitted in an emergency context. It is an emergency action that must be performed [11] regardless of the operator. At the CHU-JRA which is a university training center 84.44% of patients were operated on by senior surgeons against 15.56% by junior surgeons.

For antibiotic prophylaxis; in the literature it is controversial, not systematic according to some authors, 38.89% according to [12]. For other authors 30% type amoxicillin-clavulanic acid and CEFZOLINE [3], [6]. It is systematic according to [9]. Some authors advocate the use of antibiotics throughout the life of the DVE [4], [5]. But the use of antibiotic prophylaxis does not seem to reduce this risk of infection, but the introduction of antibiotic prophylaxis remains reasonable since it is a surgical procedure.

The definition of an infectious complication (meningitis) is clinico-biological, but according to a study by [3], all patients with infection linked to EVD were febrile and had positive CSF cultures. But the diagnosis of meningitis can be made on the sole parameter of the rise in temperature [7]. In our study, the diagnosis of a complication was made with a rise in temperature with meningeal syndrome and absence of other infectious focus. Thus, any unexplained fever associated with altered consciousness in a patient with a EVD should alert physicians to carry out paraclinical investigations, including emergency CSF sampling, in order to detect these complications early [9]. With regard to the follow-up of the care protocol, the literature provides quite a few studies having demonstrated the interest of the implementation of a protocol for the prevention of EVD infections, with a

significant reduction in meningitis [4], [13]. Regarding the dressing, it was carried out systematically every 48 hours after placement of the EVD. Any oozing EVD and one that had an CSF leak were prone to infectious complications [14].

Cytochemical examination of the CSF alone does not make it possible to make the diagnosis of meningitis, thus an increase in glucorachia, proteinorachia and cytology have no predictive value for infection linked to EVD [3]. These examinations remain an indirect sign of the existence of meningitis; these elements were present in our study on all positive cultures. Another examination such as the measurement of a cellularity index (or cell-index) can be done. It is the cellularity ratio in CSF and blood that is similar, in the literature a threshold of 2.9 was indicative of an infection [3].

The bacteriological examination of CSF remains the reference examination to make the diagnosis of an infection linked to EVD. The most encountered germs responsible for this infection both in our study and in the literature are Gram-positive Cocci and 67.6% by Gram-negative bacilli, especially coagulase-negative Staphylococci [3], [5], [6], [14]-[16]. The majority of coagulase-negative staphylococci are opportunistic bacteria responsible for nosocomial infection. In order to prevent these infections, it is necessary to handle them in a sterile manner, strictly respecting aseptic gestures.

Antibiotic therapy is always based on the antibiogram, but in the context where the culture is negative or awaiting the result, a probabilistic antibiotic is used, especially third-generation cephalosporins associated with VANCOMYCIN [8], [10], [17]. The duration of treatment was 7 days in the case of weakly virulent pathogens such as coagulase-negative staphylococci and Cutibacterium spp; 14 days in the case of Staphylococci aureus, Streptococcus spp, Enterococcus spp and culture-negative infections, and 21 days if Gram-negative bacilli are isolated [10].

In our study, given the absence of bacteriological proof and the frequency of negative culture, we used third-generation cephalosporin associated with imidazoles.

In the literature, the median duration of the EVD maintenance is variable, around 10 days with a range of 2 to 40 days [3], [4], [9], [18]. In our study, this average duration was 13.5 days. It is clearly affirmed in the literature that the prolonged duration of catheterization for more than 5 days is a risk factor for the occurrence of infections [4], [10]. Therefore, as a precaution, some authors make a systematic change of the EVD on day 5 postoperative, but this is open to criticism, exposing the patient to a new surgical intervention increases the risk of occurrence of infections. For [10], it is not recommended, but in case of high grade infection (S. aureus, Gram-negative bacilli or Candida spp.), or inadequate response to treatment, the catheter should be changed, if necessary.

The time to appearance of an infection on EVD is variable in the literature: it is on average 6 days for Hagel [5], 12 days for [18], 13 days for [14] and 15, 72 days for [8]. According to [4], the infection rate increases from the start of catheterization, but this reaches a plateau after the fourth day. In our study, the median duration of onset of the infection is 7.96 days with an extreme of 3 and 32 days.

V. CONCLUSION

The frequency of complications related to EVD in our center remains high despite the implementation of various preventive measures in the department concerned. Infectious complications predominated in 43.75% of cases; the most common mechanical complication was obstruction. Acute hydrocephalus due to ventricular flooding following a hemorrhagic stroke was the main indication for surgery. Meningitis on a EVD is to be suspected in all fevers with altered consciousness more than 5 days after surgery. An examination of the CSF confirms this, the treatment is generally an association of 3rd generation cephalosporin associated with a Vancomycin, and the duration depends on the type of germ and the clinico-biological parameters.

CONFLICT OF INTEREST

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

REFERENCES

- [1] Sakka L. Anatomy and physiology of cerebrospinal fluid. *Annales françaises d'oto-rhino-laryngologie et de pathologie cervico-faciale*. (JOURNAL NAME). 2011;128: 359-66.
- [2] Beer R, Lackner P, Fausler BP, Schmutzhard E. Nosocomial ventriculitis and meningitis in neurocritical care patient. *J Neurol*. 2008; 255(11):1617-24.
- [3] Rogier P, Schade, Janke S, Freek W, Roelandse, Ronald B, Lack of value of routine analysis of cerebrospinal fluid for prediction and diagnosis of external drainage-related bacterial meningitis. *J. Neurosurg*. 2006;104(1): 101-8.
- [4] Dasic D, Hanna J, Bojanic S, Kerr C. External ventricular drain infection: the effect of a strict protocol on infection rates and a review of the literature. *British Journal of Neurosurgery*. 2006; 20(5): 296-300.
- [5] Hagel S, Bruns T, Pletz M, Engel C, Kalff R, Ewald C et al. External Ventricular Drain Infections: Risk Factors and outcome. *Hindawi Publishing. Corporation*. 2014: 325-30.
- [6] Lozier P, Robert R, Romagnoli F, Sander E, Connolly Jr. Ventriculostomy-related infections: a critical review of the literature. *Neurosurgery*. 2002; 51(1):170-182.
- [7] Stephen R, Sally A, Arlo U, Sally R. Clinical parameters do not predict infection in patients with external ventricular drains: A retrospective observational study of daily cerebrospinal fluid analysis. *Journal of Medical Microbiology*. 2008; 57(2): 207-209.
- [8] Joseph C. Thesis. Complication and management of external ventricular leads. Québec University; 2016.
- [9] Velásquez C, Rivero-Garvía M, Mayorga-Buiza MJ, Cañizares-Méndez MLA, Jiménez-Mejías ME, Márquez-Rivas J. Avoiding Pullout Complications in External Ventricular Drains: Technical Note. *J Neurosurg* 2017;126(3):1003-5.
- [10] Aten Q, Killeffer J, Seaver C, Reier L. Causes, Complications, and Costs Associated with External Ventricular Drainage Catheter Obstruction. *World Neurosurgery*. 2020;134:501-6.
- [11] Dey M, Jaffe J, Stadnik A, Awad IA. External Ventricular Drainage for Intraventricular Hemorrhage. *Current Neurology and Neuroscience Reports*. 2012; 12: 24-33.
- [12] Sari F, Opprecht N, Mirek S, Nadji A, Aho-Glele S, Girard C, et al. Survey: Management of infectious complications on ventricular bypass. *SFAR*. 2016.
- [13] Bertrand B. Hydrocephalus, valves and shunts. 2017.
- [14] Chloé A. Thèse. Infections on the external ventricular leads in neurosurgical intensive care: clinical audit after implementation of a prevention protocol. *Medicine Humaine*. France; 2017.
- [15] Blomstedt G. Post-operative aseptic meningitis. *Acta Neurochir (Wien)*. 1987; 89(3-4):112-6.
- [16] Ross D, Rosegay H, Pons V. Differentiation of aseptic and bacterial meningitis in postoperative neurosurgical patients. *J Neurosurg*. 1988; 69(5):669-74.

- [17] Filiz S. Thesis. National survey on the management of infectious complications on external ventricular bypass in intensive care. Dijon University; 2016.
- [18] Jason Y, Selbi W, Muquit S, Berei T. Complication rates of external ventricular drain insertion by surgeons of different experience. *Ann R Coll Surg Engl*. 2018; 100(3): 221-5.



J. S. Bemora was born on December 20, 1987 in Maroantsetra, he is the second son of a family of three children. He began his medical studies in 2006 after having obtained the baccalaureate with honors. He was admitted to the competitive examination to be a specialist in 2012 and continued his studies in France then became a specialist in Neurosurgery in 2018. He was admitted to the clinical examination in 2019 and currently, he is head of clinic in Neurosurgery at the Faculty of Antananarivo medicine at CHU JRA Madagascar. He has participated in various national and international research and publications. He has work in a many hospital abroad.