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Research Article

Management of patients with external ventricular drainage at the Yalgado Ouedraogo University Hospital Center (CHU-YO)

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Abstract

Introduction: External ventricular Drainage (EVD) is a system for transiently evacuating cerebrospinal fluid (CSF) to the exterior, using a drain surgically implanted in the ventricles. The aim of this first work about external ventricular drainage in our country (Burkina Faso), was to study the management of patients undergoing EVD at the Yalgado Ouedraogo University Hospital (CHU-YO).

Patients and methods: This was a retrospective study of 97 cases of EVD over a nine-year period (January 1st, 2015 to December 31th, 2023) in the neurosurgery department of CHU-YO.

Results: The mean annual frequency of EVD was 10.77 cases. The mean age was 34.95 ± 23.8 years, ranging from 4 months to 88 years. Males accounted for 54.64%, giving a sex ratio of 1.2. Clinically, 69 patients (71.13%) had altered consciousness. Indications were hydrocephalus due to cerebral hemorrhage with ventricular flooding in 54 cases (55.67%) and hydrocephalus due to infection in 32 cases (32.98%). EVD was performed via the frontal horn of the right lateral ventricle in 82.47% of cases. After monitoring for 8 days, the outcome was favorable in 50 cases (51.54%), and marked by infectious complications in 25 cases (25.77%), with a mortality rate of 36.08%.

Conclusion: EVD is a simple, rapid and effective emergency surgical procedure for the treatment of fluid-induced intracranial hypertension (ICH). It requires correct monitoring. However, the patient's vital and functional prognosis depends on the etiology of the ICH.

Keywords: Acute hydrocephalus, External Ventricular Drainage, Infections

Introduction

External ventricular drainage (EVD) is a system that allows cerebrospinal fluid (CSF) to be diverted temporarily through a drain surgically implanted in the ventricles. This technique, described since 1744 by Claude Nicholas Le Cat [1], has become standard practice in neurosurgery throughout the world. Its indications, initially focused on pathologies and conditions accompanied by acute hydrocephalus, have been progressively updated. Today, the indications for EVD include acute hydrocephalus, subarachnoid hemorrhage due to rupture of an aneurysm or arteriovenous malformation with ventricular flooding, post-traumatic cerebral hemorrhage with intraventricular flooding, meningitis and ventriculitis. Complications may arise after insertion of an EVD, the most dreaded of which is infection. This is an easy emergency procedure, but it is difficult to monitor effectively, which makes it an unusual procedure, especially in centers without highly trained neuro-resuscitation departments.

The aim of this first work about external ventricular drainage in our country (Burkina Faso), was to study the management of patients undergoing EVD at the Yalgado Ouedraogo University Hospital (CHU-YO).

Patients and methods

This was a descriptive cross-sectional study with retrospective data collection that included all patients who underwent EVD from 1 January 2015 to 31 December 2023. The chosen technique consisted of implanting a catheter into the ventricle without radiological guidance. The catheter is connected to a collection bag via tubing with a system for regulating the drainage level.

Results

Epidemiology

In nine years, 97 patients underwent EVD, representing an annual average of 10.77 cases. This population comprised 53 men (54.64%) and 44 women (45.36%), giving a sex ratio of 1.20. The mean age was 34.95 years, ranging from 4 months to 88 years, and 44 patients (45.35%) were between 30 and 60 years of age.

Clinical signs

Thirteen (13.40%) patients consulted in a traumatic context and 84 patients (86.60%) in a non-traumatic context. Of the traumatic brain injury

cases, 12 consulted for impaired vigilance (12.37%) and one for post-traumatic neck pain (1.03%).

Among admissions in a non-traumatic context, 55 patients (56.67%) consulted for a disorder of consciousness, 25 of which were preceded by headaches associated with vomiting (25.77%). Table 1 shows the frequency of reasons for consultation.

Table 1: Reasons for consultation

	Traumatic	Non traumatic	Total	
	context	Context	Number	Frequency
	(n)	(n)	(N=97)	(%)
Consciousness disorder	12	55	67	69.07
Headaches	0	41	41	42.27
Vomiting	0	25	25	25.77
Convulsions	0	10	10	10.31
Gait disorders	0	9	9	9.28
Hemibody motor deficit	0	9	9	9.28
Cervicalgia + cervical stiffness	1	6	7	7.22
Visual disorders	0	6	6	6.19
Behavioral disorders	0	3	3	3.09
Macrocrania	0	2	2	2.06
Refusal of feed	0	1	1	1.03

The neurological examination revealed disorders of consciousness in 69 cases (71.13%), focal neurological deficits in 25 cases (25.77%) and was normal in three cases (3.10%). The distribution according to the depth of the altered state of consciousness is summarised in Table 2.

Table 2: Distribution of patients according to their state of consciousness (Glasgow Coma Scale)

	Number	Percentage (%)
14-15	28	28.86
8-13	60	61.85
3-7	9	9.27
Total	97	100

Hemiplegia and hemiparesis were noted in 15 cases (15.46%) and 8 cases (8.24%) respectively.

The distribution of the various focal neurological deficits is described in Table 3 below.

Table 3: Distribution of neurological signs

	Traumatic context	Non traumatic context	Total	
	(n)	(n)	Number (N=97)	Frequency (%)
Mydriasis	4	1	5	5.15
Hemiplegia	4	11	15	15.46
Hemiparesis	1	7	8	8.24
Paraparesis	1	0	1	1.03
Flaccid tetraplegia	1	0	1	1.03
Meningeal syndrom	0	1	1	1.03
Facial paralysis	1	0	1	1.03

In addition to neurological signs, the examination revealed 10 cases of macrocrania (10.31%) in children.

Paraclinical signs

A computed tomography (CT) scan was performed in all patients (100%) and a cytobacteriological study of the CSF was also performed intraoperatively in all patients (100%).

The CT scan and cytobacteriological study of the CSF led to the conclusion of hydrocephalus due to cerebral haemorrhage with ventricular flooding in 54 cases (55.67%), hydrocephalus due to infection in 32 cases (32.99%) and hydrocephalus due to a tumor of the posterior cerebral fossa in 11 cases (11.34% of cases).

Figure 1 is a CT scan illustrating a case of spontaneous cerebral haemorrhage in one of our patients, aged 44, admitted for altered consciousness with no contributing factors.

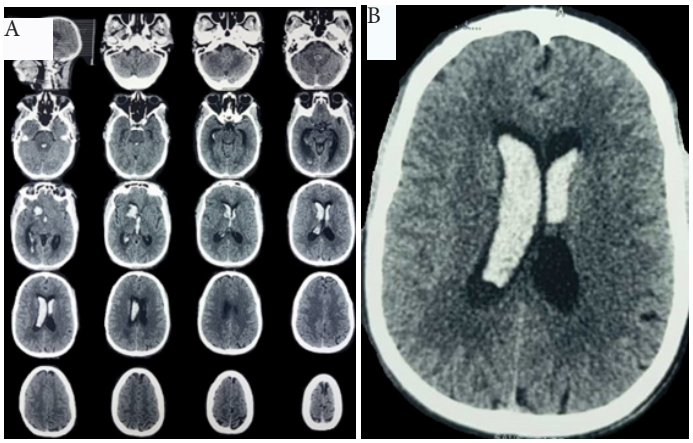

Figure 1. Cranioencephalic computed tomography showing on the series of axial sections in the parenchymal window (A) a right lenticulocaudal hemorrhage with tetraventricular flooding accompanied by hydrocephalus and the extent of flooding of the lateral ventricles on the enlarged axial section (B).

CSF analysis in non-infectious cases was normal in all cases. In cases of hydrocephalus due to meningitis, the biochemistry was in favour of meningitis (decreased glycorrachia and increased proteinorrachia), but no germs were isolated on cyto-bacteriological examination.

The presumptive cause of cerebral hemorrhage was found in 18 cases (18.55%), including 13 cases of trauma (13.40%) and 5 cases of aneurysmal rupture (5.15%). Among the 36 other cases (37.1&%), arterial hypertension was found in 13 cases (13.40%), but no etiology was identified.

Placement and management of the external ventricular drain

The EVD was placed with a right frontal trepan hole in 80 cases (82.47%); in the remaining 17 cases (17.53%) the trepan hole was left frontal. All EVD were inserted in the operating room. The average operating time was 42 minutes, ranging from16 minutes to 90 minutes. The mean duration of drain maintenance was eight (8) days ± 2.1 days ranging from (1) day to 25 days.

During anesthetic induction, all patients received antibiotic prophylaxis, which was continued after surgery for 10 days in cases of non-infectious EVD and for more than 10 days in infectious cases. CSF analyses were systematically performed on all patients and 59 of them (60.82%) also benefited from a cytobacteriological study of the CSF just before weaning, without isolation of any germs.

Evolution

In the in-patient setting, the outcome was favorable in 33 patients, i.e. 34.02% of cases. Complications occurred in 52 patients (53.60%), nine of whom (9.27%) were transferred to the intensive care unit. Of these 52 cases of complication, 35 deaths were recorded, bringing the mortality rate to 36.08%. Table 4 illustrates the different modes of evolution in the in-patient setting.

Table 4: In-hospital evolution

	Number (N=97)	Frequency (%)
Clinical improvement	33	34.02
Stationary	12	12.37
Complications	52	53.60
Deaths	35	36.08

Complications arising during hospitalization included infection in 25 cases, i.e. 25.77% of cases in the series, and drainage system dysfunction in 7 cases (7.21%). Table 5 shows the different types of complications observed.

Table 5: Types of hospital complications

	Number	Frequency (%)
EVD Complications		
Infection	25	25.77
Drain malfunction	7	7.21
Accidental removal	5	5.15
Other complications		
Malignant hypertension	10	10.31
Lung embolism	3	3.09
Pressure ulcers	2	2.06

In terms of management of complications, 12 cases (12.37%) underwent drain revision, including seven (7.21%) for drain dysfunction and five (5.15%) for accidental removal of the drain.

After monitoring for 8 days, the outcome was considered favorable in 62 cases (63.91%), marked by significant clinical improvement and regression of ventricular dilatation on the follow-up CT scan.

In the outpatient setting, after three (3) months from discharge, a favorable outcome was noted in 51.54% of cases, as shown in table 6.

Table 6: Distribution of patients according to out-of-hospital outcome three (3) months after discharge

	Number	Percentage (%)
Favorable evolution	50	51.54
Stationary	5	5.15
Complications	4	4.12
Patients lost to follow-up	3	3.09
Deaths	35	36.08
Total	97	100

The complications were recurrent bleeding.

Discussion

Since its introduction in 1744 [1], EVD has always been a neurosurgical procedure whose main indication remains acute hydrocephalus, whether caused by hemorrhage (subarachnoid hemorrhage, intracerebral hemorrhage with or without ventricular flooding), infection or often tumour. In severe cranioencephalic trauma, EVD has been recognised as an effective therapeutic method and a device for monitoring intracranial pressure [2,3]. The frequency with which it is used is proportionally linked to the epidemiology of the pathologies that may lead to its use.

The number of EVD implantations was relatively low over the nine (9) years, with an annual average of 10.77 cases.

Epidemiological aspects

The age of patients undergoing EVD depends on the underlying pathology. The average age varies from 38.09 to 58.2 years [4-7]. The average age of our patients was 34.95 years. The relatively young age of our patients may be related to the youth of the Burkinabe population in general, which has an average age of 21.7 years according to the latest general population census carried out in 2022 [8].

We noted a predominance of males, in accordance with the literature, which shows a predominance of males ranging from 52.7% to 58% [5,7,9,10] . This trend may be explained by the fact that males are more exposed to pathologies that cause acute hydrocephalus and trauma, which are the main indications for the procedure.

Diagnostic aspects

The clinical profile for the indication of EVD corresponds to severe cerebrovascular patients with intracranial hypertension syndrome and consciousness disorders who are newly admitted or in the neuro-resuscitation unit, intensive care unit or neurosurgery department [2,11,12]. However, depending on the indications, patients in a less serious clinical state may also benefit from EVD treatment [13,14]. In our study, 71.72% of the patients in the series had consciousness disorders and were all initially hospitalized in the neurosurgery department at the time the procedure was performed. However, 9.27% of patients were transferred to the general intensive care unit postoperatively. This low rate of admission of patients to the intensive care unit could be attributed to infrastructural difficulties (insufficient intensive care beds) and financial difficulties (linked to the

financial conditions for admission to the intensive care unit) in a context of poverty.

Cranioencephalic computed tomography (CT) was the principal imaging used to identify brain lesions in our patients. In several studies [5,15,16], CT has been shown to make a significant contribution to diagnosis, partly because it is available at lower cost in emergency situations, and partly because it is effective in detecting the acute intracranial pathologies involved.

The main causes of acute hydrocephalus for which EVD is performed are generally neurovascular (in particular subarachnoid hemorrhage with or without ventricular flooding), infectious or traumatic [2,4,17]. In some cases, EVD follows low drainage or infection of an ventriculoperitoneal shunt[18] . In our context, the main indications were cerebral hemorrhage with ventricular flooding (55.67%) and infection (32.99%). Apart from cases of traumatic cerebral hemorrhage, diagnosis of the cause of the hemorrhage remains difficult in our context due to the serious inadequacy of diagnostic methods, in particular arteriography.

Placement and management of external ventricular drain related aspects

In our context, all EVD were performed using the classic frontal entry technique. As we do not have an intraoperative guidance system, its contribution cannot be assessed.

In emergency situations, EVD is generally performed at the patient's bedside (neuro-resuscitation unit, intensive care unit) rather than in the operating room[2]. However, it should be noted that the choice of location for the procedure depends on the equipment available and the infrastructure, both of which are crucial to the safety of the procedure and the patient. For this reason, several teams, including our own, perform the EVD mainly in the operating theatre [14,19]. The equipment used varies from country to country, but retains the same components, including a ventricular catheter, a connector, tubing, a graduated device for regulating the drainage level, and a collection bag.

The most feared complication is infection [10,11,20,21], which occurs in 0% to 25.8% of cases [22,23,24,25]. In addition to infection, other mechanical and functional complications may arise, such as catheter hematoma, drain collapse and obstruction [14,23,26]. The factors favoring infection are many and varied: duration of EVD longer than 10 days [27], lack of prophylaxis [22], inadequate nursing, poor asepsis management. Our high rate of infectious complications (25.77%) could be explained by inadequate regular disinfection of the department's equipment, inadequate nursing, and inadequate local care of the EVD device.

As part of infection prevention, some authors recommend the use of antibiotic-soaked catheters [5,10]. Similarly, other authors recommend antibiotic prophylaxis [20,22,28]. In our study, antibiotic prophylaxis was systematically applied preoperatively (at the time of anesthetic induction) and continued postoperatively for 10 days for non-septic EVD, or longer in the case of EVD indicated for acute hydrocephalus of infectious cause.

In our study, the average duration of the operation was 42 minutes, ranging from 16 minutes to 90 minutes. In the literature, this average duration varies from 35 minutes to 80 minutes depending on the study [22,29,30]. All these authors recognised that the duration of the procedure depends on several factors including the technical platform, experience and technical skills of the neurosurgeon.

The length of time the external ventricular drain is maintained varies according to the indications, whether the objectives set for drainage have been achieved, and the occurrence of complications. Authors report a duration of 1.5 days to 44 days [23,31]. Due to the diversity of indications for EVD (infectious, hemorrhagic, tumor-related causes, intracranial pressure monitoring) there is no clear consensus on how long the external ventricular drain should be maintained, but it has been clearly established that the risk of infection increases proportionally with the duration of the drainage [23,31]. The weaning process consists of a progressive increase in the height of the drainage (+ 5cm/day until reaching 20 to 25 cm before clamping). The procedure is completed with removal of the drain when there is clinical tolerance for 48 to 72 hours [32]. In our context, the average duration of drain maintenance was 8 days, ranging from one day to 25 days. This duration of drain maintenance was linked to infectious complications, doubts about the sterilisation of the CSF and the persistence of the hematic tingling of the cerebrospinal fluid. The germs usually implicated in EVD infections are staphylococci and enterococci [21,24]. In no case in our series was a germ isolated on cytobacteriological examination of the CSF; this could be linked to the heavy use of antibiotic therapy without bacteriological proof of infection or an antibiogram.

Evolution aspects

General mortality varies from 22% to 28.6% [10,28]; in our series we recorded a high mortality of 36.08%, which would be linked to the initial severity of the pathologies involved and the inadequacy of intensive care. According to current recommendations, severe cerebrovascular patients should be managed in a neuro-intensive care unit or a well-equipped intensive care unit with experienced, qualified human resources [2,12,32]. In our context, we have a multi-purpose intensive care unit which accepts all patients with a severe clinical condition, whatever their origin. As a result, it does not have enough places to meet demand. In addition, our patients' access to the intensive care unit is conditional on a commitment to pay the costs of a stay in intensive cares, which are not always within the reach of low-income families, all of which justifies the low rate of admission of our patients to intensive care (9.27%).

The outcome of surviving patients generally depends on the pathologies involved. In general, despite treatment, a mortality rate of 25.2% to 46% can be observed, with 48% to 49% of favorable outcomes and 34% to 51% of unfavorable outcomes in survivors [5,10,33]. In our case, there were 65.92% survivors, 51.54% of whom had a favorable outcome after 3 months of out-of-hospital follow-up.

Conclusion

Our study shows that EVD is a simple and rapid surgical technique whose indications have increased over the years. It is indicated for several pathologies responsible for acute hydrocephalus. Acute hydrocephalus due to cerebral hemorrhage with ventricular flooding represented the majority of diagnoses that led to the placement of an EVD. After EVD insertion, multiple complications can arise, the most dreaded of which is infection. These complications can reduce the effectiveness of the shunt and, together with the underlying pathology, contribute to high mortality. A subsequent analytical study in our hospital could help to clarify the origin of complications so that they can be better prevented.

Conflicts of interest

We declare no conflict of interest in the preparation of this document.

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