



Hemorrhagic Stroke: Post External Ventricular Drainage Evolution

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DOI: 10.31080/ASNE.2022.05.0551

Received: July 12, 2022

Published: October 10, 2022

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Abstract

Introduction: A hemorrhagic stroke results in a sudden neurological deficit secondary to an eruption of blood in the cerebral parenchyma. External CSF drainage is indicated in cases of intracranial hypertension following acute hydrocephalus due to ventricular flooding.

Objective: Evoke the postoperative prognosis of hemorrhagic stroke treated by external ventricular bypass in the context of Madagascar

Materials and Methods: We conducted a descriptive retrospective study of 61 cases of hemorrhagic stroke treated by external ventricular drainage at the Neurosurgery and Surgical Resuscitation Department of the CHUJRA, between January 2018 and December 2020. The epidemio-clinical, computed tomographic, therapeutic and outcome parameters are described in order to identify the postoperative prognosis using the preoperative ICH score.

Results: The average age of the patients was 55.09 years with a majority in the age groups of 44 to 65 years. There is a slight male predominance. The symptomatology is dominated by the motor deficit syndrome like hemiplegia in 73.77% of the patients, then the syndrome of intracranial hypertension in 34.42%. The main risk factor was high blood pressure (93.44%) followed by alcohol and smoking (50.81%). Brain computed tomography showed ventricular flooding with acute hydrocephalus in 75% of cases. Fifty-one patients (83.61%) had an ICH score between 2 and 3. The used surgical technique was external drainage of CSF with or without hematoma evacuation. Among the postoperative complications (52.45% of cases), CSF infection is the most common (39.34%) followed by mechanical complications (25%). The mortality rate was 52.45%. Mortality factors were associated with severe initial impaired consciousness, a high ICH score greater than or equal to 3 and infections (pleuropulmonary and meningitis).

Conclusion: Morbi-mortality due to hemorrhagic stroke remains high in this study. External drainage of CSF has its place in emergency treatment. Prevention and treatment of CSF infection remains a real challenge.

Keywords: Hemorrhagic Stroke; External Drainage of Cerebrospinal Fluid; Hydrocephalus; Meningitis

Introduction

Stroke is a sudden neurological deficit of presumed vascular origin that may affect motor, sensory, phasic and sensory functions depending on the area of the brain affected [1]. Haemorrhagic stroke is the term used to describe an eruption of blood into the brain parenchyma through rupture of an intracranial vessel [2]. External ventricular shunt is one of the surgical treatments for haemorrhagic stroke. It is indicated as an emergency treatment for intracranial hyper pressure secondary to acute hydrocephalus due to hemorrhagic flooding of the ventricles or in case of CSF infection. It consists of implanting a catheter in one of the lateral ventricles in order to temporarily drain the cerebrospinal fluid [3]. The aim of this study is to identify the postoperative prognosis of haemorrhagic strokes treated by external ventricular shunting.

Materials and Methods

This is a retrospective descriptive study of sixty-one cases of haemorrhagic stroke treated by External Ventricular Diversion hospitalized in the Surgical Resuscitation and Neurosurgery departments of CHUJRA from January 2018 to December 2020, i.e., over a period of 2 years and 11 months. The patients were included according to the following criteria: patient hospitalized in one of these services, during this study period, for a haemorrhagic stroke confirmed by brain scan and treated by an external ventricular drainage. The variables studied were epidemiological (age, gender, risk factors), clinical and CT scan (mode of onset of symptoms, state of consciousness by Glasgow score, neurological signs at the site and extent of the haematoma), surgical treatment (external ventricular drainage alone or associated with other neurosurgical techniques) and finally the patients' evolutionary status.

Data were entered and processed using Microsoft Excel software using statistical tools such as mean and percentage.

Results

Epidemiological parameters

Sixty-one cases of haemorrhagic stroke treated by DVE were collected during the 2 years and 11 months, i.e., an incidence of 20.9 cases per year. The mean age was 55.098 years with extremes of 36 and 81 years. The dominant age group was 44 to 65 years, representing 67.21% of patients (Table 1). The sex ratio was 1.17 with 54.10% men and 45.90% women. The study of risk factors for haemorrhagic stroke (Figure 1) showed that 59/61 patients (96.72%) had cardiovascular risk factors, including

| Age | Number 61 | Pourcentage 100% |
|-------------------|-----------|------------------|
| 0-21 | 0 | 0% |
| 22-43 | 5 | 8,19% |
| 44-65 | 41 | 67,21% |
| 66 years and more | 15 | 24,59% |

Table 1: Distribution of patients by age group.

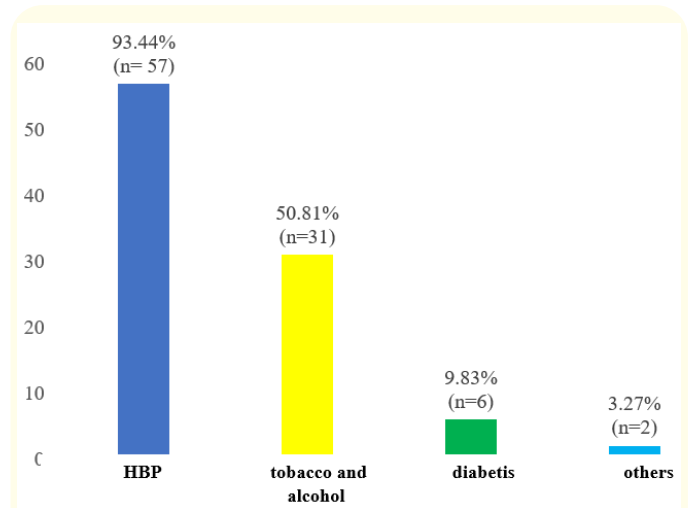


Figure 1: Distribution of patients by observed risk factors.

- 57 hypertensive patients (93.44% of cases)
- 51 patients with hypertension (93.44% of cases)
- 31 patients with alcoholism (hypertension or not) (50.81%)
- 6 patients with diabetes (9.83%)
- 2 patients with other associated cardiovascular risk factors (3.27%)

Clinical parameters

Mode of onset

Of the 61 patients, 55 had an abrupt onset of symptoms compared to 6 patients with a progressive onset.

Temperature

In 93.44% of cases (49 patients), the body temperature was between 36°C and 38°C. 04 patients (6.56%) had hyperthermia above 38°C and 08 patients (13.11%) had hypothermia below 36°C.

State of consciousness on admission

On admission

- 32 patients (53%) were comatose with a Glasgow score less than or equal to 08/15
- 24 cases (39%) had a moderately altered state of consciousness with a Glasgow score between 09 and 13.
- 8 patients (8%) had normal or slightly altered consciousness with a GCS score of 14 and 15.

Systolic blood pressure on admission

Of our 61 patients, at admission, we observed

- 15 patients (24.6%) with a systolic blood pressure less than or equal to 140 mmHg,
- 20 patients (37.78%) with a systolic blood pressure between 150 and 180 mmHg,
- 26 patients (42.62%) had a systolic blood pressure above 180 mmHg.

Observed neurological syndromes (Figure 2)

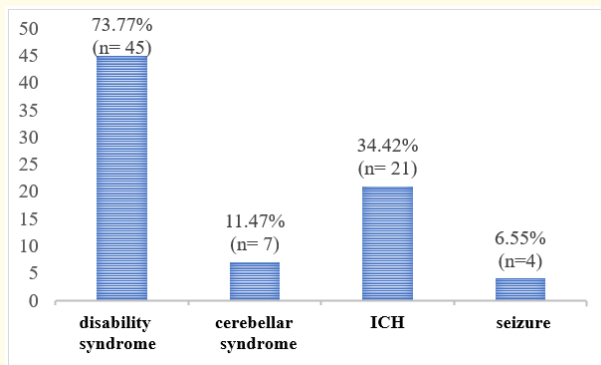


Figure 2: Distribution of patients according to the neurological syndromes observed.

In our study

- 45 patients (73.77%) had deficit syndromes dominated by hemicorporal deficits with inferior facial involvement followed by language and higher function disorders,
- 21 patients (34.42%) had an intracranial hypertension syndrome,

- 07 patients (11.47%) had a cerebellar syndrome,
- and 04 patients (6.55%) had experienced seizures

CT parameters

Spontaneous intraparenchymal haematoma

Location of haematomas

Spontaneous intraparenchymal haematomas are mainly located in the basal ganglia (thalamic, capsulothalamic, capsulolenticulothalamic) in 56% of cases, followed by lobar location in 21% of cases, then posterior cerebral fossa in 15% of cases and finally both supratentorial and subtentorial location in 8% of cases (Figure 3).

Volume of haematomas

In our series, 40 cases of haematoma (65.57%) were less than or equal to 30mm and 21 cases of haematoma (34.43%) greater than 30mm.

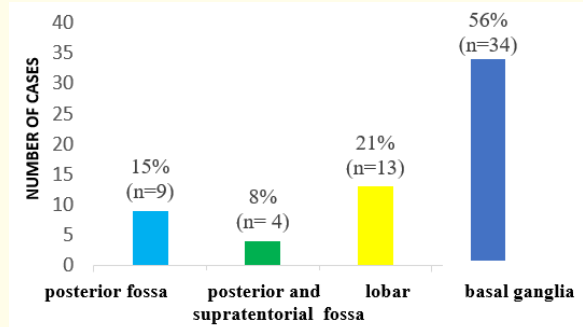


Figure 3: Distribution of intra-parenchymal haematomas by location.

ICH score (Table 2)

| ICH Score | Number 61 | Pourcentage 100% |
|-----------|-----------|------------------|
| 5 ou 6 | 0 | 0% |
| 4 | 5 | 8,19% |
| 3 | 16 | 26,22% |
| 2 | 35 | 57,4% |
| 1 | 5 | 8,19% |
| 0 | 0 | 0% |

Table 2: ICH score of patients at admission.

In our study, out of 61 cases

- 35 patients had an ICH score of 2
- 16 cases or 26.22% of cases with an ICH score of 3
- Only 4 cases or 6.55 had an ICH score of 4

Cerebral involvement

We counted 19 cases (31%) of cerebral involvement against 42 cases (82%) of absence of cerebral involvement on the brain scan.

Ventricular flooding and acute hydrocephalus

Cerebral CT revealed 93.44% cases (57 patients) of ventricular flooding. Only 4 cases (6.56%) had no hematic contamination of the cerebral ventricles identifiable on brain CT. Out of 61 patients, 46 cases (75%) presented with acute hydrocephalus against 15 patients without hydrocephalus (25%).

Therapeutic parameters

Surgical treatment

Among all our patients

- 85.24% of cases (52 patients) received an external ventricular shunt alone
- 14.76% of the cases (9 patients) received an external ventricular shunt associated with an evacuation of Intraparenchymental haematoma.

Time to management (Figure 4)

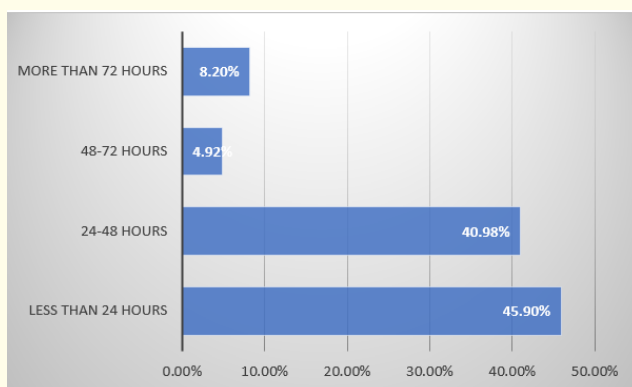


Figure 4: Distribution of haemorrhagic stroke cases by time to management.

From admission to neurosurgical intervention

- 28 patients (45.90%) were managed within 24 hours,
- 25 patients (40.98%) had a delay between 24 and 48 hours,
- 3 patients (4.92%) were treated after a delay of 48 to 72 hours
- and 5 patients (8.2%) had a delay of more than 72 hours.

Developmental parameters

Post-operative complications (Figure 5)

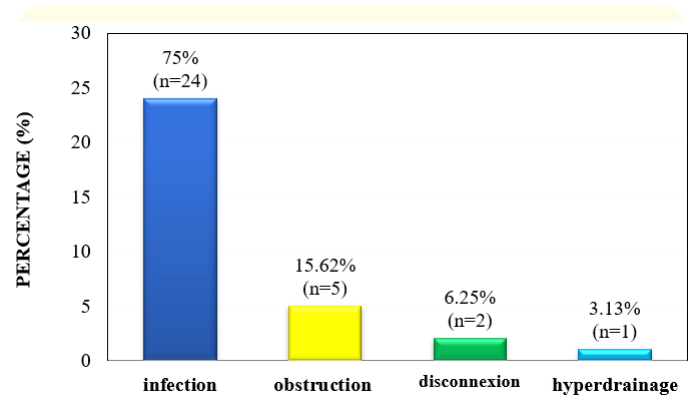


Figure 5: Distribution of cases according to post-operative complications.

Of the 61 patients, 32 cases (52.45%) had complicated post-operative outcomes.

Of the 32 cases of EVG complications

- 24 patients (75%) presented with infectious complications of the external ventricular shunt.
- Eight patients presented mechanical valve complications, including five cases (15.62%) of valve obstruction, two cases (6.25%) of EVG valve disconnection and one case (3.13%) of hyper-drainage.

Final outcome (Table 3)

During this study, we noted 32 cases (52.45%) of death with an average age of 56.31. The extreme age of the deceased patients was between 36 and 81 years.

Twenty-nine patients (47.55%) were discharged alive.

| Discharge | Number 61 | Pourcentage 100% |
|-----------|-----------|------------------|
| Deceased | 32 | 52,45% |
| Alive | 29 | 47,55% |

Table 3: Final outcome of patients.

In the 32 cases of death,

according to their state of consciousness on admission, we identified

- 23 comatose subjects with a Glasgow score less than or equal to 8/15.
- 8 patients had a Glasgow score between 9 and 13.
- 1 patient had a mild disorder of consciousness with a GCS score between 13 and 15.
- According to their ICH score at entry, we noted that (Table 4)
- the 05 patients who had an ICH score of 4 all died (100% of the subjects with an ICH score of 4 and 15.52% of the cases of death),
- 10 of the 16 patients with an ICH score of 3 died (62.5% of subjects with an ICH score of 3, and 31.26% of deaths),
- 16 of the 35 patients who had an ICH score of 2 died (45.71% of individuals with an ICH score of 2 on admission and 50% of cases of death),
- Only one of the 5 patients with an ICH score of 1 died (20% of those with an ICH score of 1 on admission and 3.22% of deaths).

Discussion

Epidemiological aspects

Age

According to Milan C., *et al.* [4], the average age of onset of haemorrhagic stroke in Western countries is between 50 and 60 years. Patients under 55 years of age represent only 5-6% of cases. According to Serardu M and Rosa A [5], 75% of haemorrhagic strokes occur after 65 years of age.

In our study the average age of patients with haemorrhagic stroke was 55.098 years. The age group most concerned is 44 to 65 years, which represents 67.21% of the patients, and more than half (54% of the cases) are under 55 years. The average age corresponds to that of the literature, although there are more patients

| ICH Score On admission | Number on admission 61 | Deceased 32 | Pourcentage 100% (n = 32) |
|------------------------|------------------------|-------------|---------------------------|
| 5 ou 6 | 0 | 0 | 0% |
| 4 | 5 | 5 | 15,52% |
| 3 | 16 | 10 | 31,26% |
| 2 | 35 | 16 | 50% |
| 1 | 5 | 2 | 3,22% |
| 0 | 0 | 0 | 0% |

Table 4: Distribution of deaths by ICH score on admission.

under 55 than in Western countries. Indeed, young people and children are spared from haemorrhagic stroke because the two main causes of haemorrhagic stroke are chronic hypertension and amyloid angiopathy, which mainly affect adults.

Sex

According to Aboderin I and Venables G [6], the frequency of haemorrhagic stroke is higher in men than in women, but this figure tends to equalise in the very young (under 30 years) and the very old (over 85 years). In some studies, there is a slight male predominance, such as the STICH (surgical trial in intracerebral haemorrhage) which included 1053 patients, 57% were male [7], this rate increases to 60% in China [8] and to 58.61% in Japan [9].

This observation is confirmed in our study which found a male predominance of 54.10%. This male predominance is explained by the fact that the male gender is a cardiovascular risk factor.

Risk factors or etiological factors

Jean de Recondo [10], Rolak L., *et al.* [11] state that hypertension is the main risk factor for haemorrhagic stroke, accounting for 70 to 80% of cases. In our observation we had 93.44% of hypertensive patients.

Alcohol and tobacco are the two most observed factors after hypertension. They represent 50.81% of cases in our study. It could be concluded that alcohol and tobacco could be significant risk factors in Madagascar.

Most of the patients included in our study have at least 2 risk factors. The accumulation of risk factors seems to increase the risk of Haemorrhagic stroke [12].

Clinical aspects

Blood pressure on admission

In an American study of 563,704 stroke patients, 75% of patients with stroke had a PAS greater than 140 mm Hg on admission, of which 33.1% were greater than 160 mm Hg [13]. This result is in good agreement with our study where 75.41% of patients (46 out of 61 patients) have high blood pressure figures on admission with a systolic pressure greater than or equal to 14mmHg. Several mechanisms could be at the origin of this rise in blood pressure during the acute phase: the existence of chronic hypertension, systemic neuroendocrine activation which increases blood pressure in order to raise cerebral perfusion pressure and the stress due to hospitalisation which has also been mentioned [13,14].

Arterial hypotension during Haemorrhagic stroke is rare and should suggest the coexistence of cardiac disease, dehydration or sepsis which should be corrected rapidly as they interfere with cerebral perfusion [15].

Mananjo D., *et al.* in a study of 30 cases, found 2 patients with hypotension, i.e., 6.66% of cases [16]. In our observation we had only one case (1.63%) of arterial hypotension with PAS at 80mmHg.

Glasgow score assessment

Impaired alertness is frequently encountered in haemorrhagic stroke. It may be due to compression of the ARFF (Activating Reticular Formation), which is responsible for our state of alertness, by a posterior fossa haematoma or ICHT [17].

In the STICH study [7] of 503 patients, 20% had a Glasgow score of 8 or less and 40% between 9 and 12. For their part, Jean de Recondo [10], *et al.* state that coma in haemorrhagic stroke is generally deep, and Bogousslavsky J and Bousser M. [18] state that 50% of haemorrhagic strokes always present with consciousness disorders that are life threatening.

The result of this study corresponds to that of our observation because we counted 53% of comatose patients with a Glasgow score less than or equal to 08 and 39% between 9 and 14 and 8% of cases had a normal or slightly altered state of consciousness with a Glasgow score of 14 or 15.

This high rate of severe alteration of consciousness in our study could be explained by the selection of our patients who are ex-

clusively operated on and mainly hospitalised in intensive care. Indeed, the main neurosurgical indication during Haemorrhagic stroke is the presence of altered consciousness.

Observed neurological syndromes

In a Jordanian study [19], 80% of the study population also had hemiplegia, whereas in the STICH study [7], 60% had it. In our study, it was observed in 73.77% with or without lower facial involvement and with or without phasic disorder. The type of neurological deficit depends mainly on the location of the haemorrhage. Thus, following HBP, the most frequent location is the basal ganglia, manifested by a total and proportional hemiplegia.

However, other situations are not negligible, such as posterior fossa and lobar Haemorrhagic stroke which are much rarer.

Temperature at entry

Mananjo D., *et al.* in a study with 30 patients, 02 patients had hyperthermia on admission and 08 patients had hyperthermia at 24 hours. One of the 2 patients with hyperthermia on admission and 5 of the patients with hyperthermia at 24 hours had a fatal outcome [16]. Hyperthermia is a factor in systemic brain injury. An increase in temperature from 37 to 38°C increases cerebral metabolism by three times [20]. In 93.44% of our patients, a temperature between 36°C and 38°C was observed. 12 patients had an abnormal temperature, of which 04 patients (06.56%) had a temperature above 38°C.

CT aspects

Location of the haematoma

Only cerebral imaging, in particular a CT scan, can confirm the diagnosis of haemorrhagic stroke, even if the existence of altered consciousness and the abruptness of the onset of symptoms are suggestive of an intracerebral haemorrhage.

Regarding the location of Haemorrhagic stroke in general, Adeoye and Brodwich [21] reported that 5% of cases were in the brainstem. Auer, *et al.* [22] noted 53% of haematomas in the UCS, 28% in the lobar, 9% in the cerebellum and 10% in the brainstem. Zhu XL [23] showed that the location in the basal ganglia predominates. This is proven by our study which found spontaneous intraparenchymal haematomas in the basal ganglia (thalamic, capsulo-thalamic, capsulo-lenticulo-thalamic) in 56% of cases, followed by

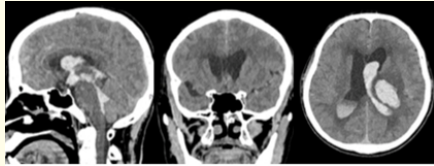


Figure 6: Brain CT scan of a case of capsular haemorrhagic stroke with quadriventricular flooding causing acute hydrocephalus.



Figure 7: Cerebral CT on day 10 after placement of an external ventricular drainage, regression of hydrocephalus permeability of the ventricles.

lobar location in 21% of cases and then in the posterior cerebral fossa in 15% of cases. This distribution can be explained by the preferential location of haematomas due to chronic hypertension in the basal ganglia.

Shiomi, *et al.* reported only 11 cases out of 1069 (1%) of spontaneous intracerebral haematoma that occurred in two different locations simultaneously [24]. We had 4 cases (8%) of multiple locations of both supratentorial and subtentorial intracerebral haematoma.

Hematoma volume and mass effect

In our case, we had 65.57% of cases of hematoma less than or equal to 30mm and 34.43% of cases of compressive hematoma greater than 30mm.

In the work of Hemphil, *et al.*, 78.63% of patients had a midline deviation greater than 5mm [25]. In our study, 31% of patients had subfalcular involvement and 82% had no cerebral involvement. This difference in results could be related to the indication for external ventricular drainage, which is not based on the existence of subfalcular involvement but on the existence of ventricular flooding and/or acute hydrocephalus. Cerebral involvement is mainly due to a large haematoma but also to perilesional oedema exerting a mass effect on adjacent structures.

Intraventricular haemorrhage and acute hydrocephalus

The results of our study show much more ventricular flooding, observed in 93% of patients, contrary to those of Bilbao B, *et al.* [26] who found 45% and Mahoungnou G., *et al.*, 48.6% [27]. This difference in results is always due to the method of selection of our patients in whom External ventricular shunt was indicated. Ventricular flooding is one of the elements that dictate the indication of an external ventricular shunt. It is also important to know that the presence of ventricular flooding is associated with a poor prognosis and rapid neurological deterioration [26].

Like ventricular flooding, our result regarding hydrocephalus is totally different from the literature for the same reason, because while Goldstein J., *et al.* observed 26.13% hydrocephalus in their series [28], we found 75%.

Therapeutic aspects

Time to surgical management

Stroke is an extreme diagnostic and therapeutic emergency. In our series, we recorded

- 45.90% of patients were treated within 24 hours,
- 40.98% of patients were treated between 24 and 48 hours
- 4.92% of patients treated after 48 to 72 hours
- 8.2% of patients with a delay of more than 72 hours

In total, a delay in surgical management of more than 24 hours can be observed in more than half of the patients (54%). This could be due to the absence of an efficient system of collection, transport and pre-hospital care, a lack of material and human resources and access to care, as well as the low density of specialised health centres making the journey long, without forgetting the financial problem caused by poverty.

External ventricular shunt

Of all our patients, 85.24% benefited from an external ventricular shunt alone and 14.76% benefited from an external ventricular shunt associated with an evacuation of the ICH. The External ventricular shunt approach is made at the frontal level contralateral to the haematoma and aims at the ventricular crossroads, whereas a decompressive craniectomy with secondary evacuation of a spontaneous intra-parenchymal haematoma is indicated only if the lat-

ter is compressive, accessible and life-threatening in a young patient. Figure [6,7].

Evolutionary aspects

Complications

Complications related to External ventricular shunt

Roitberg and colleagues, in Chicago USA, report 103 cases of acute post-SAH hydrocephalus treated by External ventricular shunt. The patients were hospitalised in a neurosurgical intensive care unit and 04 patients (3.88%) presented complications: 01 valve infection, 01 intra-parenchymal haematoma and 02 accidental valve disconnections [29]. In our series, we found complications in 32 cases/61 patients (52.45%), distributed as follows: 24 patients with infectious complications of the external ventricular shunt, 8 patients with mechanical valve complications (5 cases of valve obstruction and 02 cases of valve disconnection from the External ventricular shunt) and one (01) case of hyper-drainage. The incidence of External ventricular shunt infection is therefore still very high in our country and could be explained by the lack of human and material resources to provide quality patient care.

Complications not related to External ventricular shunt

Ido F., *et al.* in their series of 128 stroke cases, observed 45.31% of cases of infectious complication dominated by bronchopulmonary infection (29.68%) and urinary infection (14.06%) [30]. In our study, 31.14% cases of respiratory infection and 14.75% cases of urinary tract infection were found, results close to those in the literature.

However, other complications such as bedsores and cardiac complications should not be overlooked as these are also considered to be poor prognostic factors.

Final evolution of patients

Hasan D., *et al.* report 31 cases of acute post-ASH hydrocephalus treated with external CSF shunting: 25 cases (78%) had an improvement in initial consciousness. Total neurological recovery was found in 08 patients, partial recovery in 06 patients and 17 patients (54.8%) died, of which 07 cases due to rebleeding, 05 cases due to recurrence of hydrocephalus, 03 cases due to cerebral infarction [31]. Kusske and colleagues report 11 cases of acute hydrocephalus secondary to SAH treated by External ventricular shunt. Improvements were observed in 08 patients (72.7%) immediately

after surgery [32]. In our study, we noted 44 patients (72%) with improved consciousness in the immediate postoperative period, 32 cases (52.45%) with death and 29 patients (47.55%) discharged alive. In relation to the state of consciousness on admission, 23/32 deaths (71.87%) had a Glasgow score of 8 or less out of 15.

According to the ICH score on admission, 100% of patients with an ICH score of 4, 62.2% of patients with an ICH score of 3, 45.71% of patients with an ICH score of 2 and 20% of subjects with an ICH score of 1 died.

The severe disorder of consciousness and a high ICH score of 3 or more at entry is therefore strongly associated with a high mortality rate.

Conclusion

Haemorrhagic stroke is a serious pathology associated with a significant morbi-mortality. The management is multidisciplinary, involving the indication of an External ventricular shunt in case of ICH following ventricular flooding and acute hydrocephalus. This retrospective study of 61 cases of haemorrhagic stroke treated by external ventricular bypass shows the frequency of this pathology in elderly male subjects with hypertension as the main risk factor, followed by alcohol and tobacco use. The clinical picture is dominated by an abrupt onset of a deficit syndrome with hemiplegia and aphasia. The key examination for the diagnosis is the brain scan. External ventricular shunt improved consciousness in 72% of patients in the immediate postoperative period. The evolution was marked by a high mortality rate of 52.45%. Severe disorder of consciousness and a high ICH score of 3 or more at entry is strongly associated with a high mortality rate. The complication rate is much higher than in developed countries, at 52.45%. Shunt infection is the main complication followed by mechanical complications. Other complications not related to the external ventricular bypass are not negligible and also contribute to the increase in postoperative mortality. The difficulties in the management of this condition in the developing world are obvious. Thus, we propose to emphasize the importance of prevention by eliminating modifiable risk factors, the improvement of the technical platforms in particular the access to the tomographic examination and the creation of the neurovascular units for a fast and effective assumption of responsibility as of the moment of the accident and the endowment of material and human means for a assumption of responsibility of quality thus reducing the rate of infection of valve.

Conflict of Interest

None.

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