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Original Research Article

Hemorrhagic Stroke: Epidemiological, Clinical, and Prognostic Features in the Emergency Department of Gabriel Touré University Hospital

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Abstract: ***Introduction:*** Hemorrhagic stroke is a major cause of death and disability in low-resource settings. The objective of this study was to describe the epidemiological, clinical, therapeutic, and prognostic features of hemorrhagic stroke patients managed in the Emergency Department (ED). ***Methods:*** We conducted a prospective descriptive and analytical study in the ED of CHU Gabriel Touré over a 12-month period. We included all patients presenting with a focal neurological deficit without head trauma and with CT-confirmed hemorrhagic stroke. Data were collected using a standardized form and analyzed with SPSS version 22. Categorical variables were compared using the chi-square test or Fisher's exact test as appropriate, and relative risks were calculated. Statistical significance was set at $p < 0.05$. ***Results:*** Among 751 stroke cases, 224 hemorrhagic strokes were recorded, accounting for 29.8% of all strokes. The mean age was 53.7 years, with a male predominance (62%). Hypertension was the main risk factor (77.4%). The most frequent reasons for admission were motor deficit (79.3%) and altered level of consciousness (73%), with abrupt onset in 91.1% of cases and admission within 6 hours in 65.2%. CT imaging showed intracerebral (intraparenchymal) hemorrhage in 60.7% of patients. Intensive supportive care was common (intubation 45.5%, oxygen therapy 78.1%), and 18.8% underwent neurosurgical management. The leading complications were aspiration pneumonia (76.9%) and intracranial hypertension (50.8%). In-hospital mortality was 44.6% and was significantly associated with severe prognostic scores (ICH ≥ 3), impaired consciousness, intracranial hypertension, ventilator-associated pneumonia, and malaria. ***Conclusion:*** Hemorrhagic stroke affected predominantly relatively young adults and was associated with high in-hospital mortality. Strengthening hypertension prevention and control, reducing pre-hospital delays, and improving access to intensive and neurovascular care are essential to improve outcomes.

Keywords: hemorrhagic stroke, epidemiological, clinical, therapeutic, prognostic, Emergency Department, Gabriel Touré teaching hospital.

1. INTRODUCTION

Stroke is defined by the World Health Organization (WHO) as the rapid development of clinical signs of cerebral dysfunction of vascular origin lasting more than 24 hours, with no other apparent cause [1]. Strokes result from either ischemia or hemorrhage [2]. The American Heart Association (AHA) and American Stroke Association (ASA) define hemorrhagic stroke as an acute neurological dysfunction caused by a nontraumatic intraparenchymal or intraventricular hemorrhage (3). In industrialized countries, hemorrhagic stroke accounts for 10% to 20% of all strokes—approximately 10 to 20 cases per 100,000 inhabitants with a 30-day mortality rate ranging from 35% to 52% [4, 5].

In Africa, the reported frequency varies from 28% to 60%, with mortality ranging from 19.8% to 57.4% [6, 7]. Several studies have examined prognostic factors in sub-Saharan Africa [8]. In Mali, Sonfo B.

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(2020) reported a hemorrhagic stroke frequency of 22.3% [9]. Effective management of hemorrhagic stroke requires a multidisciplinary approach grounded in rigorous clinical and ancillary (paraclinical) assessment to optimize care and improve outcomes. Despite the magnitude of the problem, few studies specifically address hemorrhagic stroke, underscoring the relevance of the present research.

2. METHODS

The study was conducted in the Emergency Department (ED) of Gabriel Touré University Hospital. It was a descriptive and analytical prospective study carried out over a 12-month period, from March 2024 to February 2025. We included all patients admitted for an acute or progressively developing focal neurological deficit without a history of head trauma, in whom hemorrhagic stroke was confirmed on brain computed tomography (CT). Patients who became symptomatic during their ED hospitalization and had CT confirmation of hemorrhagic stroke were also included.

Data were collected using a standardized form and covered: (i) patient interview (sociodemographic profile, medical history, and symptom onset time), (ii) a complete clinical examination (level of consciousness, focal neurological findings, vital signs, and comorbidities), and (iii) ancillary investigations, including brain CT, electrocardiogram (ECG), transthoracic echocardiography (TTE), transcranial Doppler (TCD), complete blood count (CBC), blood glucose, urea, creatinine, serum electrolytes, prothrombin time (PT), activated partial thromboplastin time (aPTT), and blood typing.

Patients were scored using the ICH score and the WFNS classification to stratify prognosis and assess their association with mortality. Data entry was performed in Microsoft Word, and statistical analyses were conducted using SPSS version 2022. Qualitative variables were compared using the chi-square test or Fisher's exact test as appropriate, with statistical significance set at $p < 0.05$. Relative risk (RR) was calculated to quantify associations between variables of interest and mortality. Ethical requirements were met, including informed consent and confidentiality of individual data through anonymization of the data collection forms.

3. RESULTS

Among 19,911 patients admitted during the study period, 751 were diagnosed with stroke, including 224 hemorrhagic strokes (30%). The mean age was 53.74 ± 14.77 years, with a male predominance (62%), corresponding to a sex ratio of 1.6. Most patients lived in urban areas (66.1%). Transportation to the hospital was most commonly by taxi (44.6%), and the first point of care was most often a district referral health center (44.1%) before admission to the Emergency Department (ED). The mean time from symptom onset to ED admission was 18.21 ± 16.21 hours.

Hypertension was the most frequent pre-existing risk factor (77.4%). The main presenting complaints were motor deficit (79.3%), followed by altered level of consciousness (73.0%). On admission, elevated blood pressure was common, with systolic hypertension in 80% and diastolic hypertension in 68%. A Glasgow Coma Scale (GCS) score in the 9–12 range was most frequent (50%). The most common associated symptoms were headache (64%) and paresthesia (62%).

Brain computed tomography (CT) showed a predominance of intraparenchymal hemorrhage (60.7%), most frequently located in the parietal region (36.8%). Transcranial Doppler (TCD), performed in 78% of patients, identified intracranial hypertension (ICHtn) in 38% of cases. Clinical features suggestive of intracranial hypertension were dominated by severe headache, anisocoria, and projectile vomiting, sometimes accompanied by altered consciousness.

Regarding prognostic stratification, most patients (95.5%) had an ICH score between 0 and 2, while WFNS grades I and II accounted for 39.3% of cases. The most frequent complications were aspiration pneumonia (77%) and intracranial hypertension (50.8%). A neurosurgical consultation was obtained for 89% of patients. All patients received medical management (100%), including rehydration, nutritional support, analgesics, and antihypertensive therapy. Surgical intervention was required in 18.8% of cases. Transfers were primarily to the Neurology Department (50%) and the Intensive Care Unit (10%). The mean length of stay was 4.09 ± 4.0 days.

Overall mortality was 44.6%. Statistical analyses showed a significant association between mortality and the presence of headache at presentation ($p = 0.042$; RR = 1.3 [0.9–1.9]), as well as with certain in-hospital complications, including ventilator-associated pneumonia (VAP) ($p < 0.001$; RR = 1.96 [1.73–2.22]), intracranial hypertension ($p < 0.001$; RR = 1.67 [1.44–1.94]), and malaria ($p < 0.001$; RR = 0.93 [0.70–1.23]). In addition, a clear relationship was observed between mortality and prognostic scores. Mortality increased significantly with higher ICH scores ($p = 0.001$), rising from 38% among patients with low scores (0–1) to 100% among those with scores ≥ 3 (RR = 2.63 [1.99–3.48]). Similarly, based on WFNS classification, mortality increased from 22.7% in grades I–II to 63.5% in grades IV–V ($p < 0.001$; RR = 2.80 [1.97–3.99]).

Table I: Age group, place of residence, and reason for hospitalization (n = 224)

Age group (years)	**n**	**%**
< 20	4	1,8
21 – 40	40	17,9
41 – 60	**112**	**50,0**
61 – 80	64	28,6
≥ 81	4	1,8
Residence		
Rural	76	33,9
Urban	148	66,1
Reason for hospitalization		
Motor deficit	**176**	**79,3**
Altered level of consciousness	162	73,0
Language disturbance	132	59,5
Sensory disturbances	96	43,2
Sensory deficits	62	27,9
Headache	36	16,2
Cranial nerve involvement	30	13,5
Seizures	8	3,6

Note: Reasons for hospitalization were not mutually exclusive (a patient could present with more than one symptom); therefore, percentages may exceed 100%.

Table II: Distribution of patients by time to admission

Time to admission	**n**	**%**
< 6 h	**146**	**65,2**
6 – 12 h	10	4,5
> 12h	68	30,4
Total	**224**	**100,0**

Table III: Distribution of patients by risk factors (n=212)

Risk factor	**n**	**%**
Hypertension	**164**	**77,4**
Dyslipidemia	24	11,3
Diabetes mellitus	12	5,7
Oral contraceptive use	8	3,8
Alcohol use	8	3,8
Prior stroke history	8	3,8
Cocaine use	8	3,8
Heart disease	4	1,9

Table IV: Distribution of patients by associated symptoms (m=188)

Associated symptom	**n**	**%**
Headache	**120**	**63,8**
Paresthesia	116	61,7
Visual disturbances	76	40,4
Dizziness/vertigo	32	17,0
Seizures	14	7,4
Vomiting	14	7,4
Tinnitus	8	4,3
Neck pain	4	2,1

Table V: Affected brain region (n=136)

Affected region	**n**	**%**
Parietal	50	36,8%
Temporal	42	30,9%
Frontal	36	26,5%
Deep (basal ganglia/thalamus)	34	25,0%
Lobar	22	16,2%
Occipital	10	7,4%
Infratentorial	2	1,5%

Table VI : Stroke etiology

Etiology	**n**	**%**
Hypertension-related	162	**72,3**
Undetermined	50	22,3
Anticoagulant-associated	8	3,6
Arteriovenous malformation (AVM)	4	1,8
Total	**224**	**100**

Table V : Paraclinical test results

Type d´examen réalisé	**n**	**%**
Brain CT (n = 224)		
Intraparenchymal hemorrhage	136	60.7
Cerebro-meningeal hemorrhage	82	36.6
Meningeal hemorrhage	6	2.7
Transcranial Doppler (TCD) (n = 174)		
Intracranial hypertension	66	37.9
Normal	58	33.3
Vasospasm	50	28.8
Chest CT (n = 110)		
Associated pneumonia	80	72.7
Normal	30	18.2
ECG (n=70)		
Conduction abnormalities	30	42.9
Repolarization abnormalities	24	34.3
Normal	10	14.3
Rhythm disturbances	6	8.5
Chest X-ray (n = 40)		
Alveolar opacities	15	37.5
Normal	25	62.5
Transthoracic echocardiography (TTE) (n = 2)		
Heart failure	2	100,0

Table VI: Distribution by ICH score

ICH score	**n**	**%**
0	84	37.5
1	100	44,6
2	30	13,4
3	10	4,5
Total	224	100,0

Table VII: Distribution by complications (n=130)

Complications	**n**	**%**
Aspiration pneumonia	100	76.9
Intracranial hypertension	66	50.8
Malaria	60	46.2
Vasospasm	50	38.5
Seizures	22	16.9
Ventilator-associated pneumonia (VAP)	16	12.3

Table VIII: Risk factors and complications by mortality status

Variable	**Death**		**Total**		
	Yes	**No**		**p**	**RR (95% CI)**
Risk factor					
Headache	30	52	82	0,042	1,3 [0,9-1,9]
Complications					
Aspiration pneumonia	78	12	100	0,062	1,1 [0,96 – 1,20]
Intracranial hypertension	52	14	66	0,000	1,67 [1,44 – 1,94]
Malaria	28	32	60	0,000	0,93 [0,70 – 1,23]
Ventilator-associated pneumonia (VAP)	15	1	16	0,000	1,96 [1,73-2,22]
Vasospasm	26	24	50	0,181	1,04 [0,79 – 1,37]
Seizures	10	12	22	0,136	0,91 [0,57 – 1,44]

Table IX: Prognostic scores and mortality

Variable	Death		Total		
	Oui	Non		p	RR (95% CI)
ICH Score					
0–1	70	114	184	0,001	1,00 (réf.)
2	20	10	30	0,001	1,75 [1,22–2,51]
≥ 3	10	0	10	0,001	2,63 [1,99–3,48]

4. COMMENTS AND DISCUSSION

In our cohort, hemorrhagic strokes accounted for 30% of all strokes admitted, with a mean age of 53.7 ± 14.8 years and a male predominance (62%; sex ratio 1.6). This distribution supports the substantial burden of stroke in middle-aged adults and the greater male exposure to cardiovascular risk factors, particularly in African settings. Our findings are consistent with those reported by Gnazegbo *et al*., in 2018 (61% men; mean age 54 years) and with the pan-African meta-analysis by Okekunle *et al*., in 2023, which placed the proportion of hemorrhagic stroke between 20% and 40% [6, 7].

Hypertension, present in 77.4% of our patients, was the leading risk factor, confirming its major etiopathogenic role in intracerebral hemorrhage, as previously highlighted by Walker *et al*., in 2011 and Owolabi *et al*., in 2022 in African cohorts [8-10]. The predominance of patients from urban areas (66.1%) likely reflects both increased exposure to cardiovascular risk factors associated with urban lifestyles (physical inactivity, diet, stress) and better access to CT imaging, which is often unavailable in rural settings.

The mean time to admission was 18.2 ± 16.2 hours, indicating delayed access to specialized care compared with international recommendations that advocate management within 6 hours of symptom onset. However, this delay remained shorter than that reported in some African series, notably in Dakar, where Fall *et al*., in 2007 reported a mean delay of 28 hours [12]. Altered level of consciousness (73%) and motor deficit (79.3%) were the main reasons for admission, reflecting substantial neurological severity at presentation. Severe headache (64%) and paresthesia (62%), frequently observed, correspond to classic warning symptoms of intracerebral hemorrhage.

Brain CT confirmed a predominance of intraparenchymal hemorrhages (60.7%), most commonly located in the parietal region (36.8%), in line with findings reported by Sonfo *et al*., in Mopti in 2020 [9]. Transcranial Doppler, performed in 78% of patients, identified elevated intracranial pressure in 38% of cases, clinically reflected by severe headache and projectile vomiting, sometimes accompanied by impaired consciousness—features classically described in the literature.

In our cohort, most patients (95.5%) had an ICH score between 0 and 2, suggesting low-to-moderate initial severity. This pattern is consistent with relatively limited hemorrhage volumes, although it does not preclude a high risk of death when complications occur. According to the WFNS classification, grades I and II represented 39.3% of cases, indicating preserved neurological status in about one third of patients, whereas the substantial proportion of advanced grades reflects the severity of admitted cases and their unfavorable prognostic impact.

The main complications observed were aspiration pneumonia (77%) and elevated intracranial pressure (50.8%), reflecting the severity of the initial neurological insult, as well as concomitant malaria (46.2%), which is characteristic of the Malian tropical context. Prognostic analysis showed an overall mortality of 44.6%, significantly associated with several clinical and in-hospital factors. Headache at presentation was associated with death ($p = 0.042$; RR = 1.3 [0.9–1.9]). Among complications, three factors emerged as key determinants: ventilator-associated pneumonia (VAP) ($p < 0.001$; RR = 1.96 [1.73–2.22]), elevated intracranial pressure ($p < 0.001$; RR = 1.67 [1.44–1.94]), and concomitant malaria ($p < 0.001$; RR = 0.93 [0.70–1.23]). These findings emphasize the major prognostic role of neurological, respiratory, and infectious complications in unfavorable outcomes after hemorrhagic stroke.

Mortality also increased significantly with higher prognostic scores at admission. It rose from 38% in patients with low ICH scores (0–1) to 100% in those with scores ≥ 3 ($p = 0.001$; RR = 2.63 [1.99–3.48]). This trend is consistent with Delcourt *et al*., (2017), who reported that each additional point on the ICH score significantly increased the risk of death (13). These results confirm the ICH score as a simple, reproducible, and predictive indicator of intracerebral hemorrhage severity. Together with findings from Rajaonarison *et al*., in 2025—where neurological severity (GCS ≤ 8; $p < 0.001$) and metabolic disturbances (hyperglycemia, hyperthermia) were associated with mortality—our data illustrate the combined impact of baseline severity and secondary complications [14]. The combination of a high prognostic score, persistent elevated intracranial pressure, and intercurrent infection appears to constitute the most unfavorable predictive triad.

Overall, these observations highlight the need for earlier detection and control of hypertension, faster access to acute stroke care, and strengthened technical capacity in emergency and critical care services in Mali to reduce hemorrhagic stroke–related mortality.

5. CONCLUSION

Hemorrhagic stroke primarily affects middle-aged adults with hypertension. Prognostic factors are largely driven by initial neurological severity and early complications. Improving outcomes requires strengthening hypertension screening and control, shortening time to hospital presentation, ensuring rapid access to brain imaging, and implementing early, standardized management to reduce mortality and long-term disability.

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