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Etiology, Prediction, and Frequency of Hemorrhagic Shock in the Intensive Care Unit

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Abstract

Introduction: Acute hemorrhage remains a major cause of mortality, particularly in trauma, postpartum, anesthesia, and intensive care. In Africa, data are limited, especially outside the obstetric context. The absence of a national algorithm justifies this study, which aims to evaluate the prevalence, etiology, and prognosis of hemorrhagic shock at the Angré University Hospital. **Methodology:** This is a cross-sectional analytical study conducted from January 2020 to December 2021 at Angré University Hospital, including all patients admitted to intensive care for hemorrhagic shock. **Results:** Of the 457 patients admitted to intensive care during the study period, 100 had hemorrhage, including 72 cases of hemorrhagic shock. The mean age was 34.31 ± 14.5 years. The male-to-female ratio was 0.18. The majority of patients came from the operating room (79.2%) and 15.3% had sickle cell disease. Hemodynamic instability, particularly hypotension (72.2%), was the main reason for admission. Surgical conditions accounted for 94.4%, and approximately 75% were transferred from another department. The mean systolic blood pressure was 80.37 ± 16.01 mmHg, and the mean diastolic blood pressure was 47.87 ± 11.44 mmHg. The mean heart rate was 118.83 ± 27.04 bpm, with a mean shock index of 1.4. A Glasgow score ≤ 8 (35%) was noted. Biological abnormalities included hyperlactatemia (69.4%), low PT (40.6%), acidosis (38.8%), and hemoglobin < 9 g/dL (84.7%). Mortality was 47.2%, associated with several significant clinical and biological parameters ($p < 0.05$). **Conclusion:** Hemorrhagic shock, which is common in intensive care, affects a young, predominantly female population with high mortality, requiring early and multidisciplinary standardization of care.

Keywords

Hemorrhagic Shock, Intensive Care, Etiology

1. Introduction

Acute hemorrhage remains a major cause of mortality in medicine, whether in trauma, during the postpartum period, in anesthesia, or in intensive care [1]. It leads to impaired tissue perfusion and a lack of oxygen supply to cells due to hypovolemia associated with a significant loss of red blood cells [2] [3]. Hemorrhagic shock accounts for 5% - 10% of hospitalizations in intensive care [4]. The causes of hemorrhage leading to shock vary considerably and include gastrointestinal bleeding, trauma, gynecological and obstetric hemorrhage, respiratory diseases, ruptured aneurysms, coagulopathies, and anticoagulant overdose [5] [6]. In Africa, the available data on mortality related to hemorrhagic shock have focused mainly on obstetric hemorrhagic shock, with mortality rates varying by region [2] [7] [8]. Mortality related to hemorrhagic shock is high in the first 24 hours and is mainly due to the inability to control bleeding [9]. Early treatment is therefore a fundamental prognostic factor.

In our context, few studies have focused on hemorrhagic shock in intensive care, regardless of etiology, and there is also a lack of a standard national algorithm for the management of hemorrhagic shock. These are the reasons behind our decision to conduct this study, the overall objective of which is to assess the prevalence, etiology, and prognosis of hemorrhagic shock in our intensive care unit at the Angré University Hospital.

2. Methodology

This is a cross-sectional analytical study conducted over a two-year period, from January 2020 to December 2021, in the anesthesia and intensive care unit at Angré University Hospital. The study focused on patients admitted to intensive care for the management of hemorrhagic shock. Our study included patients of all ages and genders admitted to intensive care for bleeding complicated by hemorrhagic shock during the study period. Patients admitted to intensive care for shock in a non-hemorrhagic context and those with incomplete and/or unusable records were excluded.

We used a non-probabilistic exhaustive sampling method, incorporating all available information. Data were collected from medical records, referral forms, intensive care unit admission records, surgical logs, and operating room records. The parameters studied included sociodemographic data (gender, age, occupation, ethnicity, medical history, referring department), anamnestic and clinical data (circumstances, mechanism, initial assessment, general condition, vital signs, etiologies, and diagnoses), as well as biological and paraclinical data (blood tests, imaging). Treatment strategies, outcomes, and discharge arrangements were also ana-

lyzed. Data collection was carried out, after approval by the ethics committee, using a pre-established survey form. The data were entered into Microsoft Word and Excel, then analyzed using Epi Info 3.5.4. Qualitative variables were expressed as proportions. Fisher's exact test was used, with significance set at $p \leq 0.05$. Confidentiality was guaranteed under medical supervision.

3. Results

Of a total of 457 patients admitted to intensive care during the study period, 100 patients were admitted for hemorrhage, of whom 72 were in shock.

The average age of the patients was 34.31 ± 14.5 years, with the majority in the 18 - 30 age group. The average weight was 68.15 kg. The population was predominantly female (sex ratio M/F = 0.18). The majority came from the operating room (79.2%) and 15.3% had sickle cell disease. Antiplatelet agents were the most commonly used drugs. The data are presented in Table 1.

Table 1. Distribution according to sociodemographic data.

	Number	Percentage
Age (n = 72)		
≤17 years	3	4.16
]17 - 30 years old]	31	43.05
]30 - 45 years old]	24	33.33
]45 - 60 years old]	8	11
>60 years old	6	8.33
e (n = 72)		
Male	11	15
Female	61	85
Origin (n = 72)		
CHU operating room	57	79.2
University Hospital Emergency Department	2	2.8
Surgical emergencies at university hospitals	5	6.9
Hospitalization at university hospitals	3	4.2
Gynecological emergencies	1	1.4
Pediatric emergencies	1	1.4
Other Abidjan Hospital	3	4.2
Medical history (n = 72)		
Coagulopathy	2	2.8
Hypertension*	7	9.7
Cancer	2	2.8

Continued

Sickle cell disease	11	15.3
Diabetes	4	5.6
Asthma	1	1.4
Concept of atopy	2	2.8
UGD*	3	4.2
No history	40	55.6
Type of medication (n = 20)		
Anticoagulants	3	15
Antiplatelet agents	7	3
Other*	10	50

HTA*: High blood pressure; UGD*: Peptic ulcer; *CHU: University Hospital Center; *Other Abidjan hospitals: Port Bouet Hospital; PISAM, Allepé Hospital; *Other types of medication: antihypertensives, antidiabetics (oral, insulin), alpha-blockers, chemotherapy.

Hemodynamic instability, mainly hypotension, was the main reason for admission (72.2%). The majority of patients (94.4%) had a surgical condition, and approximately 75% were transferred from another department. The mean diastolic blood pressure was 47.87 ± 11.44 mmHg, with 56.9% of patients below 50 mmHg. The mean systolic blood pressure was 80.37 ± 16.01 mmHg, with 59.7% of patients having a SBP ≤ 80 mmHg. The mean heart rate was 118.83 ± 27.04 bpm; 66.6% of patients had tachycardia > 100 bpm. The mean shock index was 1.4. Tachypnea (25.29 bpm), mean saturation of 92%, mean temperature of 35.9˚C, anuria in 55.6%, and a Glasgow score ≤ 8 in 35% were noted. Biologically, hyperlactatemia (69.4%), low PT (40.6%), acidosis (38.8%), and hemoglobin < 9 g/dL (84.7%) were observed. The data are presented in Table 2.

Table 2. Distribution according to admission and stay data.

	Number	Percentage (%)
Reason for admission (n = 72)		
Obvious bleeding	5	7
Disturbance of consciousness	8	11.1
Respiratory distress	7	9.7
Hemodynamic instability	52	72.2
Type of condition (n = 72)		
Medical	4	6
Surgical	68	94
Admission mode (n = 72)		
Primary (direct)	18	25

Continued

Secondary	54	75
Diastolic blood pressure DBP (mmHg) (n = 72)		
≤50	41	56.9
>51	31	43.1
Systolic blood pressure SBP (mmHg) (n = 72)		
<80	29	40.3
≥80	43	59.7
Heart rate (beats per minute = bpm) (n = 72)		
<100	10	13.9
>100	24	33.3
>120	24	33.3
>140	14	19.4
Shock index (n = 72)		
≥0.9	67	93.1
<0.9	5	6.9
Respiratory rate (Cycles Per Minute = CPM) (n = 72)		
≤ 20	18	25.0
21 - 29	35	48.6
30 - 39	13	18.1
≥40	6	8.3
Diuresis (n = 72)		
Anuria	40	55.6
Preserved	11	15.3
Oliguria	21	29.2
Neurological status (Glasgow score) (n = 72)		
3 - 8	27	37.5
9 - 14	18	25.0
15	27	37.5

The majority of conditions were postoperative complications (21, or 29,2%). Retroplacental hematoma was the most common obstetric pathology (19, or 45.2%). Critically ill patients accounted for 33.3% of cases. The data are presented in Table 3.

Vascular filling was performed in all patients, mainly with crystalloids (SSI and Ringer's Lactate) in 83.3% of cases, for an average volume of 1883 ml. Mechanical ventilation was required in 42% of cases. Red blood cell transfusions were performed in more than 90% of cases, with an average volume of 511 ml. Vasopressor

amines, particularly norepinephrine (88.9%), were used in 90% of cases, and hemostatics in 69.4%. The data are presented in Table 4.

Table 3. Distribution according to etiological data.

	Number	Percentage
Type of condition (n = 72)		
Postoperative complication	21	29.2
Obstetric pathology	42	58.3
Traumatology	4	5.6
Hematological disease	2	2.8
Infectious diseases	3	4.2
Gynecological and obstetric disorders (n = 42)		
Uterine rupture	13	31
Placenta previa	3	7.1
HRP* grade III	19	45.2
Postpartum hemorrhage	3	7.1
HELLP* syndrome	2	4.8
Uterine atony	2	4.8
Severity of shock (n = 72)		
Fairly serious	18	25
Critical	24	33
Serious	2	3
Severe	28	39

Table 4. Distribution of patient care data.

	Number	Percentage
Filling solutions (n = 72)		
SSI*	7	9.7
RL*	3	4.2
SSI, RL	60	83.3
Gelofusine, SSI, RL	2	2.8
Intubation on admission (n = 72)		
Yes	30	42
No	42	58
Red blood cell transfusion (n = 72)		
No	7	9.7
Yes	65	90.3

Continued

Use of vasopressin amines (n = 72)		
No	7	10
Yes	65	90
Type of vasopressin amine used (n = 65)		
Adrenaline	1	1.4
Noradrenaline	64	88.9
Use of cardiac tonics (n = 72)		
Yes	5	7
No	67	93
Type of cardiac stimulant used (n = 5)		
Dobutamine	4	5.6
Ephedrine	1	1.4
Use of hemostatics (n = 72)		
No	22	30.6
Yes	50	69.4
Use of hemostatic surgery (n = 72)		
No	64	88.9
Yes	8	11.1

Complications were present in 68% of cases. Neurological failure was the most common complication, accounting for 22.2% of cases. Nearly half of the patients were transferred to the university hospital after discharge. Thirty-four patients, or 47.2%, died. The average length of stay in intensive care was 3.72 ± 4.45 days [0 - 26]. Twenty-three cases, or 31.9%, had a stay of less than or equal to 1 day. The data are presented in Table 5.

Table 5. Distribution according to patient progression.

	Number	Percentage
Complications (n = 72)		
No	24	33
Yes	48	67
Type of complications that occurred (n = 72)		
Pressure sores	3	4.2
Septic shock	11	15.3
Embolic disorders	4	5.6
Malnutrition	2	2.8
IRA*	11	15.3

Continued

Neurological failure	16	22.2
Liver failure	1	1.4
No complications	24	33.3
Discharge status (n = 72)		
Home	1	1.4
Transfer to hospital	37	51.4
Death	34	47.2
Length of stay in intensive care (days) (n = 72)		
≤1	23	31.9
≥2	49	68.1

The following parameters were significantly associated with mortality ($p < 0.05$): intubation and ventilation on admission, systolic blood pressure ≤ 80 mmHg, impaired consciousness, obvious bleeding, acidosis, use of mechanical ventilation, use of hemostatics, and a stay in intensive care ≤ 24 hours. The data are presented in Table 6.

Table 6. Relationship between the various parameters studied and patient mortality.

Parameters	Deceased	Survivors	p value	Odd Ratio	Confidence Interval
Arrived intubated and ventilated	20	10	0.005	0.25	[0.607 - 5.224]
NOT ≤ 80 mmHg	18	11	0.038	2.761	[1.045 - 7.300]
Shock index ≥ 0.9	30	37	0.128	0.203	[0.022 - 1.911]
Consciousness disorder	26	29	0.021	3.250	[1.177 - 8.977]
Obvious bleeding	17	7	0.005	0.226	[0.078 - 0.652]
Acidosis	21	7	0.000	0.140	[0.048 - 0.409]
Low TP	20	10	0.005	0.250	[0.093 - 0.675]
Mechanical ventilation	30	9	0.000	0.041	[0.011 - 0.149]
Use of amines	32	33	0.298	0.413	[0.075 - 2.282]
Use of cardiac tonics	4	1	0.128	0.203	[0.022 - 1.911]
Use of hemostatics	28	22	0.025	0.295	[0.099 - 0.878]
Stay of 24 hours or less	21	2	0.000	29.077	[5.971 - 141.950]

The following parameters were significantly associated with mortality ($p < 0.05$): intubation and ventilation on admission, systolic blood pressure ≤ 80 mmHg, impaired consciousness, obvious bleeding, acidosis, use of mechanical ventilation, use of hemostatics, and a stay in intensive care ≤ 24 hours. The data are presented

in Table 6.

4. Discussion

This study aimed to evaluate the prevalence, etiologies, and prognosis of hemorrhagic shock in intensive care at the Angré University Hospital. Of the 457 patients admitted, 72 had hemorrhagic shock, representing a frequency of 15.7%. This rate is similar to that found by RAMAROLAHY [7] in Madagascar (17.20%); however, it is higher than that found in Gabon by MATSANGA [2] (9.90%). The high frequency of hemorrhagic shock observed can be explained in particular by insufficient monitoring of pregnancies, late detection of complications, and delayed transfer to the referral hospital. This study had no age limit; the average age was 34 years, with extremes ranging from 11 to 75 years. This is similar to that found in France by VERSPYCK [10] (34 years). This frequency could be explained by the inclusion, without age restriction, of various medical specialties, in particular gynecology, traumatology, and digestive surgery, which were strongly represented in our study population. The female predominance found in our study is similar to that found by VERSPYCK in his study, which focused solely on pregnant women [10]. This could be explained by the fact that the majority of our patients came from gynecology. Studies on hemorrhagic shock outside of pregnancy have found a male predominance [2] [8] [11]. In terms of comorbidities, sickle cell disease was the most common, followed by hypertension. Twenty patients were found to be taking drugs that affect coagulation (mainly antiplatelet agents and anticoagulants). In his study, DIAKITE [8] found that NSAIDs were the most commonly used drugs. The majority of patients in our study came from the operating room (79.2%) or the emergency department, a finding also reported by MATSANGA [2]. This is probably due to the continuation of postoperative resuscitation and the lack of space in the post-operative care unit. In our study, the clinical signs of hemorrhagic shock were dominated by arterial hypotension, found in 72.2% of patients on admission, making it the main reason for transfer to intensive care. This high frequency can be explained by the fact that the majority of patients came from the operating room for continued postoperative resuscitation. DIAKITÉ [8] found hypotension in 65.1% of cases. In our series, the mean systolic blood pressure was 80.37 mmHg and the mean diastolic blood pressure was 47.87 mmHg. An SBP < 80 mmHg was significantly associated with mortality ($p = 0.038$), in line with the SFAR recommendations [12], which advocate a target SBP of 80 - 90 mmHg as long as bleeding persists. Similar studies have found a relationship between low blood pressure and mortality [13] [14]. In our study, the majority of our patients presented with tachypnea, observed in 75% of cases with an average respiratory rate of 25 bpm, and tachycardia in 86.1% of cases with an average heart rate of 118 bpm. With regard to visceral distress, renal failure was noted in 84.8% of cases (oliguria 29.2% and anuria 55.6%). MBOGNING [13] reported 90% pallor and 93.3% tachycardia. RANDRIANIRINA [14] observed acute renal failure in 61% of cases. The Shock Index (SI), defined as the

ratio between heart rate (bpm) and systolic blood pressure (mmHg), becomes pathological when it exceeds 1 [15]. During the initial assessment of shock, European guidelines [9] recommend the use of the Shock Index (SI) and/or Pulse Pressure (PP) to estimate the severity of hypovolemic shock (grade 1C). In our study, the mean SI was 1.4, with no significant link to mortality, unlike other studies [16]. Initial pulse oxygen saturation was good at 92%. The mean initial temperature was 35.9˚C, with extremes ranging from hypothermia at 33˚C to 38.3˚C. Hypothermia is an independent predictor of survival in patients with hemorrhagic shock, and it is recommended that core temperature be maintained above 36˚C [12].

In our series, 27 patients had a GS between 3 and 8. This was a factor associated with mortality. MATSANGA A. [2] found that 8 of his patients, or 22%, also had a Glasgow score of 8 or less.

Several etiologies are cited in the literature as causes of hemorrhagic shock in emergency medicine or perioperative medicine, such as gastrointestinal bleeding, obstetric hemorrhage, multiple trauma, and iatrogenic causes [5].

In our study, hemorrhage due to gynecological and obstetric conditions was the most common (58.3%), dominated by retroplacental hematoma (45.2%). This result has been found by many other authors [7] [10] [13]. This is consistent with data in the literature showing that obstetric hemorrhage is one of the leading causes of maternal mortality, accounting for one-third of maternal deaths in Africa [17].

Not all of our patients had undergone paraclinical testing at the time of diagnosis of hemorrhagic shock for financial reasons and/or due to the urgency of the situation. The mean hemoglobin level was below 9 g/dL in 61 patients. Although precise data are lacking in the literature, the latest RFE [9] [12] recommends a hemoglobin target of between 7 and 9 g/dL (GRADE 2+). The platelet count was below 100×10^3 cells/mm^3 in only 20 patients, whereas the tolerable threshold in cases of acute hemorrhage is generally set at 50×10^3 cells/mm^3 [12]. MBOGNING [13] and MATSANGA [2] reported hemoglobin levels below 7 g/dL and 6 g/dL, respectively, as their studies were conducted in emergency departments. Arterial blood gas analysis showed elevated lactate levels in 50 patients, who are recommended for follow-up to assess tissue hypoperfusion (GRADE 1+).

Prehospital and hospital management of hemorrhagic shock is based on clearly defined therapeutic and organizational strategies, summarized in the Formalized Expert Recommendations (FER) [12], aimed at rapidly controlling bleeding and preventing organ dysfunction. In our study, all patients received volume expansion, mainly with crystalloids (0.9% saline and Ringer's lactate), in accordance with SFAR recommendations, which advocate their use as first-line treatment (GRADE 1+). Many other authors have used crystalloids as first-line treatment [2] [8] [13]. The average volume of fluid administered was 1880 ml, with a maximum of 3500 ml. The SFAR recommendations [12] and European guidelines recommend limiting fluid replacement to the strict maintenance of blood pressure

targets, sometimes favoring permissive hypotension, as long as bleeding persists (GRADE 1+). After vascular filling, the administration of vasopressors, mainly norepinephrine, is recommended in cases of persistent hypotension (SBP < 80 mmHg) (GRADE 2+) [12]. In our study, 90% of patients received a transfusion, mainly packed red blood cells with an average volume of 511 ml. Contrary to the recommendations [12] advocating a PFC/CGR ratio between 1/2 and 1/1, our practice remains limited by the availability of labile blood products. Tranexamic acid was administered to 50 of our patients, or 69.4%. This rate is significantly higher than those reported by RAMAROLAHY [7] (9%) and MATSANGA [2] (16.6%), probably due to the government coverage of obstetric surgeries in our context. During our study, eight patients underwent hemostasis surgery, including secondary sutures, trimming, or hysterectomies. In the study by MATSANGA [2], 69.4% of patients underwent surgery in the operating room. This difference can be explained by the fact that, in our series, surgery was often performed before transfer. In our study, approximately 30 patients, or 42%, arrived intubated and ventilated, and this situation was significantly associated with mortality. This could be explained by the deleterious effects of positive-pressure mechanical ventilation on venous return and cardiac preload, as well as by the inhibition of sympathetic tone and vasoplegia induced by intravenous sedation [5]. RAMAROLAHY [7] reported a mechanical ventilation rate of 59%, compared to 8% for MATSANGA [2], reflecting different levels of severity. Severe hemorrhagic shock can lead to respiratory failure requiring mechanical ventilation. However, MACRE [18] observed no difference in mortality between pre-hospital and in-hospital intubations.

In our study, the complication rate was 68%, dominated by neurological failure (22.28%), septic shock, and acute renal failure (15.3% each). MATSANGA A. [2] also found renal failure and DIC to be the main complications, both associated with mortality. The mortality rate in our series was 47.2%, confirming the severity of hemorrhagic shock, which is responsible for 40% - 50% of deaths according to the literature [11]. MATSANGA A. [2] reported a 16% mortality rate, with a 70% lethality rate ($p = 0.02$) for an SBP < 70 mmHg. Similarly, in our study, a SBP < 80 mmHg ($p = 0.038$) and low PT ($p = 0.005$) were associated with mortality. With regard to therapeutic, our study revealed a highly significant correlation between mortality and the use of mechanical ventilation, including in patients who were already intubated on admission ($p = 0.000$). Given the respiratory impact of hemorrhagic shock, early airway management is recommended, particularly in cases of associated head trauma [14]. In addition, an unfavorable outcome was observed in patients who died within 24 hours ($p = 0.000$) [2] [19].

5. Conclusion

Hemorrhagic shock remains a major medical and surgical emergency, associated with high mortality in the absence of rapid and appropriate treatment. Our study, conducted in the general intensive care unit at Angré University Hospital over a

two-year period, reveals a significant prevalence (15.7%) of this condition, mainly affecting young women. The etiologies were mainly postoperative, and comorbidities, particularly sickle cell disease, impacted the prognosis. Several clinical and biological factors of severity were identified, including severe hemodynamic instability, altered consciousness, thrombocytopenia, acidosis, and low PT. The high mortality rate (47.2%) highlights the need for improved practices, particularly in terms of transfusion strategy, vascular filling, and mechanical ventilation. Standardization of care through multidisciplinary protocols, starting in the prehospital phase, appears essential to improve the prognosis of patients in hemorrhagic shock.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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