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Mortality of Severe Trauma Adults Patients in Polyvalent Intensive Care Unit at University Hospital of Brazzaville, Republic of Congo

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Abstract: *Aim*: To describe the profile of severe trauma adults who died in polyvalent intensive care unit at University Hospital of Brazzaville. *Materials and methods*: It was a retrospective, cross-sectional study carried out in polyvalent intensive care unit of University Hospital of Brazzaville, during 30 months period. We included all severe trauma who died, aged 18 years or over patients regardless of age or sex and treated for at least one hour in intensive care. Epidemiological, clinical and therapeutic parameters were recorded and analyzed with Excel 2016 for Windows. *Results*: During the study period, 35 deaths out of 90 severe trauma patients were recorded, i.e. a lethality rate of 38.8%. The mean age was 42.4±18.6 years (sex ratio=7.5). Admissions were primary in 58.8%. Road traffic collisions (RTC, 73.5%) were the most common mechanism of injury involved. In intensive care, 82.4% of patients presented with severe trauma brain injury (TBI), of which 50.0% was isolated. Respiratory (47.1%) and hemodynamic (17.6%) distress were observed. Pickup and transport of trauma victims were not medical. Oxygen therapy (91.2%), blood transfusion (23.5%), use of vasopressor amines (47.1%) and osmotherapy (23.5%) were necessary. The patients were intubated and ventilated then sedated in 64.7%. Surgical management concerned 20.6% and was dominated by neurosurgical indications. Neurological distress (61.8%) was the main cause of death. *Conclusion*: The lethality rate of severe trauma patients was high, affecting young males, victims of both RTC and severe TBI. This confirms the need to promote collaboration and communication between hospital structures, to set up pre-hospital care structures, to improve the technical platform and to train staff involved in their care.

Keywords: Mortality, Severe Trauma, Polyvalent Intensive Care Unit, Brazzaville

1. Introduction

Severe or major trauma or polytrauma (TG), whatever the cause, is a major public health problem in modern society. They occupy the 6th cause of global mortality across the world. According to the World Health Organization (WHO), trauma resulting from traffic collisions, drowning, poisoning, falls or burns and violence from assault, self-inflicted violence or acts of war, kill more than five million people worldwide annually and cause harm to millions more. They account for 9% of global mortality and 1.7 times the number of deaths caused by HIV/AIDS, tuberculosis and malaria, and are a threat to health in every country of the world [1-4]. Severe trauma or polytrauma is a patient submitted to high-energy trauma regardless apparent injuries. Standardized by the Vittel's algorithm during the Congress of Emergency Medical Assistance Services in 2002, this definition makes it possible to avoid delays in treatment and orientation errors which could hamper the patient's future development. He is therefore a fragile and unstable patient [5, 6]. Their care represents a health and economic issue. Time is an important factor in the prognosis and imaging is essential in deciding the referral of these patients [7].

In industrialized countries, severe trauma are the leading cause of death for people under 40 years of age and the fourth leading cause of death for the whole population. Although delicate, their management is well codified and multidisciplinary comprising first a pre-hospital phase subject to regulation by the Emergency Medical Assistance Services (SAMU) then a hospital phase carried out in "trauma centers". Numerous advances, particularly in intensive care, have made it possible to increase the survival rate of these patients with multiple lesions [4-6].

In low and middle-income countries in general, severe trauma are responsible for high morbidity and mortality due to insufficient care, unsuitable technical facilities and untrained staff and equipped in the care of these fragile patients. According to the various studies carried out in sub-Saharan Africa, the global mortality of severe trauma would reach 72% of cases and road traffic collisions (RTC) represent the leading cause of death [8, 9].

In Republic of Congo, the frequency of severe trauma was 5.7% for all admissions in polyvalent intensive care unit (ICU) at the University Hospital of Brazzaville (UHB or CHU-B) with a mortality of 42.7% [10]. However, no study has looked at the mortality of severe trauma in ICU. It is in this context that our study proposes to study this mortality in order to define the axes of prevention, care and readjust health policies aimed at reducing their mortality, both pre-hospital and hospital.

The aim of this study is to describe the profile of severe trauma adults who died in polyvalent ICU at UHB.

2. Materials and Methods

This was a cross-sectional and retrospective study carried out in polyvalent ICU at UHB over a thirty months period from January 1, 2016 to June 30, 2018. Located in the department of Brazzaville, UHB is a level III public heath institution of the Republic of Congo and serves as teaching, training and biomedical research for the Faculty of Health Sciences, Marien N'GOUABI University and other paramedical institutions. Within his organization, it does not have "trauma centers", essential in management of severe trauma. With 876 beds, it divided into several services including 11 in polyvalent ICU, led by an anesthesiologist-intensivist. This service supports all patients regardless of pathology (traumatic or not, medical or surgical) requiring the use of specific means of care not available in other services such as mechanical ventilatory, vasoactive drug, continuous electronic monitoring. Most patients are from other hospitalization services, while others come from peripheral hospitals.

In Republic of Congo, there is no pre-hospital care system that justifies the fact that pre-hospital assistance is not medical. This system would allow adequate regulation for a better organization in the management of these fragile patients. The pick-up and transport of severe trauma patients to the care structures were done by the witnesses of the trauma in private vehicles or public transport thus exposing the severe trauma patients to the risk of secondary injuries; rarely, this transport was provided by the fire brigade.

Our general study population was drawn from of severe trauma ou polytrauma with a least one of Vittel criteria. Vittel's algorithm includes five evaluation criteria, namely physiological variables, kinetic elements, anatomical injuries observed, pre-hospital care and the patient's condition before the trauma. Were included in the study, all deceased severe trauma aged at least 18 years and treated in polyvalent ICU for at least one hour. The exclusion criteria were: patients whose medical data records were insufficient, admission and / or death times were not specified. The data collection was based on the admissions register and medical records established by the medical team in the department and the operating room register. The data were then recorded on a survey sheet developed for this study. Epidemiological data for mortality rate, age, gender, origin or admission procedures, trauma mechanism were recorded. The following clinical data were collected: Glasgow coma score (GCS), pupils' examination, vital signs upon arrival, severity scores and injured body areas. The following therapeutic data were analyzed: pre-hospital rescue, intensive care and surgical management.

Data analysis was performed using Excel 2016 software and epi-info 7. The quantitative variables were expressed as an average±standard deviation or median (interquartile range) and the qualitative variables were expressed as numbers and percentages.

Upon arrival at the emergencies department, severe trauma patients underwent a clinical, biological and radiological assessment based on the injuries allowing for a lesion assessment. This evaluation is carried out by the on-call team which is provided by students in Specialized Studies Diplomas (DES) in general surgery under the guise of a

surgical specialty (visceral surgery, neurosurgery, thoracic and cardiovascular surgery, orthopedics and traumatology surgery and pediatric surgery). In severe trauma, the indication of the scanner is urgent to facilitate and guide management; however, the examination will only be carried out after the examination fees have been settled. The initial management consisted of conditioning the patient with the installation of a peripheral venous line of good caliber, the installation of a cervical collar, a bladder probing in the absence of trauma to the pelvis, the realization sutures and compressive dressings for hemostatic purposes and immobilization of fractures. Depending on the severity of the injuries and after a specialist opinion, severe trauma patients were admitted in polyvalent ICU either directly from the emergency room or via the operating room.

During the study period, four anesthetist-intensivist (AI) and three general practitioners (GP) provided medical care for hospitalized patients. The paramedical team consisted of two nurses, a technical health worker, a hospital service worker and coordinated by two supervisors on duty. There were seven functional beds out of 11, including three scopes and four functional respirators out of eight, a mobile X-ray machine and an ultrasound machine allowing bedside examinations to be carried out. However, there was no transport respirator, transport oxygen cylinder, or intracranial pressure (ICP) monitoring system. The oxygenation of hospitalized patients was done through wall outlets supplied by oxygen tanks. Hospital care was provided 24 hours a day, seven days a week by the AI / GP couple throughout 2016, then the GP under the direction of an on-call AI from January 1, 2017. In polyvalent ICU, the management included the treatment of vital distress and the carrying out of emergency actions. Physiological saline was administered for the first 48 hours in cases of severe trauma brain injury (TBI). Analgesic treatment (combination paracetamol and nefopam and / or tramadol or morphine), prevention of stress ulcer with proton pump inhibitors and thromboembolic disease with low molecular weight heparins (24 hours after admission in the absence of bleeding lesions or other contraindications) were also administered to all patients.

The following definitions were used:

1) Primary admissions: these correspond to all severe trauma patients admitted to UHB directly from the site of the trauma.
2) Secondary admissions: these are patients admitted after receiving first aid in another hospital center before their referral or evacuation to UHB.
3) Revised Trauma Score (RTS): this is a physiological score defined by the SAMU for the pre-hospital triage of trauma patients. Three clinical variables (GCS, respiratory rate or RR and systolic blood pressure or SBP) allow its calculation using the following formula: RTS=0.9368 (CGS points) + 0.7326 (SBP points) + 0.2908 (RR points). The RTS values are between 0 and 7.8408 11.
4) MGAP score: this is a composite score developed by Sartorius et al to predict the mortality of trauma patients. Its calculation is easy and requires several variables: CGS, SBP, type of blunt trauma and age. It allows the risk of mortality to be graded high (score <18), intermediate (score between 18 and 22) and low (score > 23) from the pre-hospital phase 11.
5) TRISS (Trauma Related Injury Severity Score): it is the reference method for predicting mortality after trauma developed in the late 1980s. This score is used to calculate a probability of survival, based on the variables physiological RTS, anatomical lesions of the Injury Severity Score (ISS) and patient age. However, this score does not apply to a single patient, but to a group of patients. It is used by comparing the probability of overall survival to observed survival. Thus, the variables used must be measured on arrival of the patient 11.
6) Shock: it is defined by a SBP <90 mmHg or a decrease of 30% of the usual SBP or of 40 mmHg of SBP not responding to a well-conducted vascular filling and requiring the use of vasopressor amines.

3. Results

During the study period, we collected a total 90 severe trauma adults patients admitted to the polyvalent ICU at UHB. Among them, 35 had died, for a case fatality rate of 38.8%. After applying the inclusion and exclusion criteria of our study, 34 patients were eligible and therefore retained for our study. The average age of severe trauma patients was 42.4±18.6 years with extremes ranging from 18 to 77 years. The age group under 45 was the most represented with 58.8% of cases. The sex ratio was 7.5 in favor of men. Admission procedures were primary in 58.8% of cases. Road Traffic Collisions (RTC) were the most common mechanism of injury involved with 73.5% of cases, of which 11 patients (44%) were pedestrians. The admission delay of severe trauma patients to the emergencies department of UHB was specified in 88.2% of cases; 32.4% of patients were admitted within two hours of trauma while 20.6% were between seven and 24 hours after trauma. Once in the emergency room, the admission delay to the polyvalent ICU was more than seven hours in 50% of cases (table 1).

Clinically, the average GCS of severe trauma patients was 7±3 (3 to 15). On admission to ICU, 82.4% of the deceased patients presented with severe trauma brain injury (TBI), of which 50.0% was isolated; 23.5% presented with anisocoria. Respiratory and hemodynamic distress were found in 47.1% and 17.6% of cases respectively. The head (97.1%), the thoracic limbs (23.5%) and the thorax (20.6%) were the most commonly injured body areas. The mean RTS was 5.7±1.3 (range: 2.5 to 7.8). The MGAP calculation found 14.7% of severe trauma in the group of patients at high risk of mortality. The mean TRISS was 28.2 (range: 1.3 to 96.8). Table 2 illustrates the clinical characteristics and severity scores of our patients.

No patient received medical pickup and transport from the

site of the trauma to treatment centers. Oxygen therapy was administered in 91.2% of patients. Blood transfusion (23.5%), use of vasopressor amines (47.1%) and osmotherapy (23.5%) were necessary. Patients were intubated and sedated and then ventilated in 64.7% of cases. Surgical management concerned 20.6% of patients and was dominated by neurosurgical indications. Central nervous system (CNS) injury (61.8%) was the main cause for death. The median length of hospital stay in ICU was 4 days (quartiles: 2 - 6.5 days). Table 3 shows the distribution of patients according to the criteria for tracheal intubation, surgical indications and cause for death.

Table 1. *Epidemiological characteristics of deceased severe trauma in ICU at UHB.*

	Effective	Percentage
Age group		
< 45 years	20	58.8%
45-64 years	10	29.4%
>64 years	4	11.8%
Genre		
Male	30	88.2%
Admission procedures		
Primary	20	58.8%
Secondary	14	41.2%
Trauma mechanism		
Road Traffic collisions	25	73.5%
Pedestrian	*11*	
Driver or passage of vehicules	*8*	
Motocyclist	*6*	
Assault	5	14.7%
Falls	4	11.8%
Admission delay to emergencies department of UHB		
< 2 hours	11	32.4%
2 to 6 hours	6	17.6%
7 to 24 hours	7	20.6%
>24 hours	6	17.6%
Unspecified	4	11.8%
Admission delay to polyvalent ICU of UHB		
< 2 hours	4	11.8%
2 to 6 hours	8	23.5%
7 to 24 hours	12	35.3%
>24 hours	5	14.7%
Unspecified	5	14.7%
Total	34	100%

Table 2. *Clinical characteristics and severity scores of deceased severe trauma in ICU at UHB.*

	Effective	Percentage
Glasgow Coma Score		
Average	7	
3 to 8	28	82.3%
09 to 12	2	5.9%
13 to 15	4	11.8%
Pupils examination		
Normal	19	55.9%
Anisocoria	8	23.5%
Vital distres		
Respiratory	16	47.1%
Shock	6	17.6%
MGAP score		
< 18	14	41.2%
18 to 22	15	44.1%
23 to 29	5	14.7%
Injured body areas		
Head	33	97.1%
Pelvic limbs	8	23.5%
Thorax	7	20.6%
Thoracic limbs	6	17.6%
Abdomen	2	5.9%
Basin	1	2.9%
Injured body areas'number		
One	19	55.9%
Two	9	26.5%
Three or more	6	17.6%

Table 3. *Criteria for tracheal intubation, surgical indications and cause for death of severe trauma in ICU at UHB.*

	Effective	Percentage
Criteria for intubation (22)		
Neurological	16	72.7%
Hemodynamic	1	4.5%%
Respiratory	0	0%
Neurological and respiratory	5	22.6%
Surgical indications (7)		
Neurosurgical	4	57.1%
Laparotomy	2	28.6%
Osteosynthesis	1	14.3%
Cause of death (34)		
Central nervous system injury	21	61.7%
Brain involvement	14	
Brain death	7	
Hemodynamic failure	11	32.4%
Shock	8	
Hypoxia	3	
Unspecified	2	5.9%

4. Discussion

For a better analysis and interpretation of our results, certain limitations must be taken into account. Indeed, the retrospective nature did not allow us to have a larger workforce due to poorly kept or lost medical records. The monocentric nature and small size of our study population do not allow us to extrapolate these results to the national level. The non-inclusion of medical records with missing data such as the type of transport means for severe trauma patients to the treatment centers and the qualification of staff initially having these severe trauma on arrival as well as the delay in admission to polyvalent ICU or in the operating room limitations were also limitations in our study. However, these results provide a basis on which to build a future multicenter study with a much larger workforce.

In our study, we recorded 35 deaths in 30 months out of 90 patients admitted for severe trauma in polyvalent ICU, for a mortality rate of 38.8%. The most affected age group was under 45 years, with a predominance of men. Our mortality rate is comparable to those reported by Tchaou et al (38.1%) and Essola et al (37.5%) in their studies relating respectively to polytrauma victims and the causes and factors of mortality in intensive care [12, 13]. Diemer et al reported a mortality of 39.4% in their study [4]. Some authors have found lower rates varying between 14.3 and 32.7% [14-17]. Other authors have found higher rates

varying between 46.0% and 73.3% in their respective studies [9, 18-20]. These differences could be explained by the absence of a pre-hospital care system by the SAMU in developing countries in general, in Republic of Congo in particular, resulting in the unmedical pick-up and transport of the severe trauma from the site of the trauma to a referral center and / or intra-hospital. Other justifications could be mentioned, namely the seriousness of the clinical symptomatology on admission dominated by severe trauma brain injury (TBI), the delay in the management of patients with a long delay in admission to ICU, the unavailability of medication for urgency to start resuscitation care, a lack of technical facilities preventing effective and optimal monitoring of patients. All of these factors contribute to worsening the prognosis of severe trauma patients. In our study, half of the deceased patients were admitted to the emergency room within six hours of the trauma, of which 32.4% within two hours. However, 50% were admitted to polyvalent ICU beyond the seven hours following their admission to the emergency room. Recently, a study in Greece indicated that the average time to admission of a patient to intensive care was around three hours [21]. Richardson et al, for their part, found that patients admitted to ICU within six hours of their trauma were in the emergency room for about three hours [22]. This difference could be explained by waiting for an initial lesion assessment, which is decisive for the orientation and optimal management of polytrauma. Insufficient personnel and the appropriate technical platform could also contribute to the increase in this delay and therefore in the hospital mortality of polytrauma patients because their prognosis is strongly correlated with early diagnosis and multidisciplinary management. However, it is recommended that the admission delay be no longer than 60 minutes [23].

Central nervous system distress (61.7%) associating cerebral engagement and / or cerebral death was the main cause of death found in our study, followed by hemodynamic distress (32.4%). These results corroborate those of Charpentier et al as well as Pfeifer et al who found brain death followed by uncontrolled bleeding as the main causes of death in their respective studies [24, 25]. This observation was made by Hunga et al who reported that the cranio-encephalic component was involved in 74% of deaths [9]. However, Assounewé et al, for their part, found shock as the leading cause of death followed by cerebral death [15]. In fact, hemorrhagic shock remains the leading cause of preventable death in severe trauma patients. Its management is the most difficult and demanding situation for multidisciplinary teams because it requires seamless coordination between the various stakeholders so that the time to obtain hemostasis remains as short as possible. An emergency procedure integrating transfusion management makes it possible to structure and accelerate the management of these patients [26]. Three to 5% of polytrauma victims require a massive transfusion (> 10 red blood cell concentrates or RBCs) and consume at them alone approximately 75% of the blood products of a level 1 urban trauma center. European recommendations suggest the blood transfusion of concentrated RBCs with a hemoglobin objective of between 7 and 9 g / dL except in the case of severe TBI potentiating this rate to 10 g / dL [27, 28]. In industrialized countries, the management of post-traumatic hemorrhagic shock is well codified and the availability of labile blood products (LBP) is immediate and sustained because it is now well established that the implementation of massive transfusion protocol improves the prognosis of patients and especially mortality [27]. In Spain, Servià et al noted a blood transfusion frequency of 36% while Yeguiayan et al reported 40.0% of patients who received blood transfusion in France [29, 30]. However, in developing countries in general and in Congo-Brazzaville in particular, the management of severe trauma patients is hampered by difficulties in the availability and accessibility of labile blood products. In our study, 23.5% of deceased severe trauma had received an emergency RBCs transfusion. Indeed, the UHB has a blood bank within it, the functioning of which is autonomous and 24 hours a day. The delivery of a unit of labile blood products is conditioned by the payment of fees and the contribution of four donors by the entourage or the family of the victim or sometimes the deposit of an identity document of the latter: this which contributes to delaying the management of these patients and therefore to increasing the mortality associated with this condition.

The predominance of the young active population, of the male sex and that of the RTC found in our study are in accordance with the data of the literature [4, 9, 31, 32]. In fact, trauma is the leading cause of death for adults under 45 years of age [1, 32]. In our study, pedestrians were the main victims of RTC. Diermer et al for their part reported that the main circumstance of occurrence of accidents in their series was RTC involving mototaxis [4]. Evans et al, for their part, noted RTC by vehicle as the main cause of death in 72% of cases [32].

On admission to polyvalent ICU, 82.4% of deceased patients presented with severe TBI, of which 50.0% was isolated. Mortality linked to trauma brain injury was 90% at the Libreville hospital center [33]. Several data from the literature confirm the predominance of TBI in severe trauma [14, 18, 34, 35]. Chalya et al reported 59% TBI in non-survivors in their severe trauma mortality study [14]. This high frequency of severe TBI could be explained by the direct or indirect cranio-encephalic impact, the failure to wear protective helmets for motorcyclists or seat belts by drivers and passengers of vehicles.

In general, optimal management of severe trauma requires control of the upper airway through tracheal intubation and mechanical ventilation. The control and maintenance of good oxygenation and a level of cerebral capnia and the prevention of the occurrence of secondary cerebral attacks of systemic origin (ACSOS) in severe TBI are the essential points on which the management is focused in order to maintain sufficient and adequate cerebral blood flow. These measures help prevent the onset and or worsening of cerebral ischemia

and life-threatening intracranial hypertension (ICH). The use of mechanical ventilation was achieved in 64.7% of severe trauma patients in our study. In Tanzania, 88% of deceased patients had received mechanical ventilation [14]. Tracheal intubation and ventilation, from the pre-hospital phase, have demonstrated their prognostic impact [36]. The indications for intubation - mechanical ventilation were dominated by neurological criteria (72.7%).

In our study, 20.6% of patients required emergency surgery with 57.1% of neurosurgical indications. These involved evacuations of subdural and extradural hematomas performed in the operating room under general anesthesia by rapid sequence induction with orotracheal intubation. These neurosurgical injuries must be managed early because the evacuation of an extradural or subdural hematoma should not be delayed by more than 90 minutes or four hours, respectively [14].

The pre-hospital care of these severe trauma patients by the SAMU consists, on the one hand, in immobilizing the patient to avoid the aggravation of unstable lesions, in carrying out the first assessment of potential or proven lesions and in stabilizing the main vital failures and, on the other hand, to transfer the patient to the more appropriate trauma center [5, 11]. During our study, no patient benefited from a medical pick-up and / or transport from the site of the trauma to the treatment centers. This bitter observation was also reported by Tchaou et al in Benin [12]. A low medicalization of the transport of severe trauma patients varying between 1.6 and 22.6% was found by several African authors in their studies [15, 18, 31, 37, 38]. In developing countries in general, the lack or poor medicalization of the transport of severe trauma patients is justified by the absence of an organization system for pre-hospital care of severe pathologies, by the insufficiency of means of transport medicalized in health facilities, the lack of a universal health insurance system in most developing countries and in the Republic of Congo in particular. This could explain the worsening of the primary lesions and the severity of the symptoms upon admission of severe trauma patients to ICU. On the other hand, much higher rates of medicalization of severe trauma were found in developed countries. Yeguiayan et al, in their study on the first assessment of the "French Intensive care Recorded in Severe Trauma" study noted that approximately 7% of severe trauma patients were not pre-hospitalized in France [29]. Gomez de Sergura Nieva et al, for their part, found a frequency of 75.5% and 90.4% of medical transport respectively in Spain and France [39].

5. Conclusion

Severe trauma is a frequent reason for admission in ICU. Our study showed that the lethality rate of severe trauma patients was high, affecting young adults who were victims of RTC and severe TBI. Their management, although codified, remains insufficient because of the high mortality which is attributable to them. This retrospective study confirms the need to promote collaboration and communication between hospital structures, to set up pre-hospital care structures, to improve the technical platform and to train nursing staff in the specific management of severe trauma.

Abbreviations

ACSOS, secondary cerebral attacks of systemic origin; AI, anesthetist-intensivist; AIDS, acquired immunodeficiency syndrome; CNS, central nervous system; DES, Specialized Studies Diplomas; GCS, Glasgow Coma Scale; GP, general practitioners; HR, heart rate; ICH, intracranial hypertension; ICP, intracranial pressure; ICU, intensive care unit; IQR, interquartile range; ISS, Injury Severity Score; LBP, labile blood products; LOS, length of stay; RBCs, red blood cell concentrates;; RR, respiratory rate; RTC, road traffic collisions; RTS, Revised Trauma Score; SBP, systolic blood pressure; TBI, trauma brain injury; TG, severe trauma; TRISS, Trauma Related Injury Severity Score; UHB or CHU-B, University Hospital of Brazzaville; HIV, Human immunodeficiency virus; WHO, Word Health Organization.

Authors' Contributions

All authors contributed to review concept, design and acquisition, analysis and interpretation of the literature. Finally, all authors read and approved the submitted manuscript.

Competing Interests

The authors declare that they have no competing interests.

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