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Management of Shock in the Pediatric Emergency Unit of the National Teaching Hospital HKM (CNHU-HKM) in Cotonou

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Abstract

Introduction: The mortality of severely ill children presenting with life-threatening emergencies remains high in emerging countries. The objective of this study was to evaluate the management of shock in the pediatric emergency department of the CNHU in accordance with WHO guidelines.

Methods: The cross-sectional study covered the period from 1 November 2019 to 31 October 2020. All records of children aged 1 month to 18 years, who presented with shock, were analysed after implementation of life-saving measures.

Results: The hospital incidence of shock was 2.6%, and its diagnosis was made on admission in 81.2% of cases. The median age of the children was 29.50 months. Septic shock occurred in 50% of cases. Mortality was 50%, related to the presence of fever on admission. The triage and sequence of management was correct. However, the median time to care was 30 minutes, the use of the intraosseous access was non-existent, and traceability should be improved.

Conclusion: The introduction of an intraosseous kit is essential in order to reduce management delays. The priority remains the fight against infectious pathologies.

Introduction

Shock is a life-threatening emergency whose prognosis depends above all on the speed of diagnosis and the quality of its initial management [1]. It is an acute systemic circulatory failure with insufficient tissue perfusion, the consequences of which worsen over time. Shock may be «quantitative» with reduced cardiac output, secondary to hypovolaemia, cardiac pump failure, ejection obstruction or cardiac filling [2,3]. It can be «qualitative» or distributive with arteriolar and venular vasodilation, altered microcirculatory reactivity and peripheral oxygen extraction. This mechanism is observed in sepsis, anaphylaxis, spinal cord injury, etc. [2,3]. The World Health Organization (WHO), in its guide to pediatric hospital care, defines shock as the simultaneous presence of the following three elements: cold extremities, skin recolouration time (SRT) > 3 seconds, small thready pulse [4]. Conditions that cause shock in emerging countries include severe malaria, sepsis, diarrhoeal diseases, dengue fever, etc [4]. The main steps in management include rapid recognition of shock, vascular filling, etiological

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treatment, use of vasopressor, ventilatory support, monitoring and continuous surveillance of the patient [4]. In Benin, few studies have evaluated the management of shock in a pediatric hospital setting. This study is part of this framework, in order to determine the clinical, therapeutic and evolutionary aspects.

Methods

The study was cross-sectional from November 1, 2019 to October 31, 2020, in the emergency pediatric unit of the National Teaching Hospital (CNHU-HKM) of Cotonou. The study population consisted of all children aged between 1 month and 18 years, hospitalized in the said unit, who presented a state of shock regardless of the time of occurrence during the stay. Reception and triage on the ward was carried out by pediatricians and physicians specialising in pediatrics. For this normative assessment, the definition of shock was consistent with that of the WHO [4]. The nutritional status of the children was assessed using the different WHO curves according to the child's sex and age [5]. Lactate and blood gas measurements were not available in the hospital. All records of children who presented with shock were analysed consecutively, using a survey grid, after the implementation of life-saving measures. The variables collected were related to socio-demographic (age, sex, origin), clinical (moment of diagnostic of shock, etiological diagnosis), therapeutic and evolutionary characteristics. The time at which the diagnosis of shock was made and recorded in the file was considered as time zero (T0). The time of the start of filling was assessed in relation to T0. Analysis was performed using SPSS 21 software. The uncorrected Pearson's Chi-2 test and Fisher's exact test were used for comparison of proportions. The significance level was 5%.

Results

Frequency of shock and socio-demographic characteristics of children

During the study period, 2411 children were admitted, 64 of whom experienced shock, representing a hospital incidence of 2.6%. The median age of the children was 29.50 months interquartile range [14; 76.50]. Males accounted for 59.4% of cases. They were referred from a peripheral health centre in 59.4% of cases.

Clinical characteristics

The main symptom for admission was fever (32.8%). The median time to onset of symptoms before admission was 3 days interquartile range [1,4], with extremes of 3 hours and 60 days. Figure 1 summarises the distribution of children by reason for admission. Shock was present on admission in 81.2% of cases. Blood pressure (BP) was not mentioned in 59.4% of cases. It was normal in 7.8% of cases, low or impregnable in 32.8% of cases. Seven children had severe acute undernutrition.

Etiology of shock

The two main pathologies found were severe sepsis in 53.1% of cases and severe malaria without comorbidity in 26.5%. Table 1 summarises the diseases present in the children, and the outcome according to the diagnoses. Germs were isolated in three cases: E. coli and Citrobacter sp (producers of extended spectrum beta lactamases), and Stenotrophomonas maltophilia.

Therapeutics

A nasogastric tube was used to start vascular filling in 2 cases, prior to venous access. The median time to start filling was 30 minutes interquartile range (30; 60), with extremes of 15 minutes and 240 minutes. A Darrow solution was used in children with severe acute undernutrition (n=7). Table 2 summarises the different treatments administered.

Evolution

The time for reassessment was not systematically recorded. Hourly diuresis was mentioned in 11 children. Mortality was 50% (n=32). Almost all deaths occurred within six hours of the diagnosis of shock. Factors associated with mortality were fever on admission (p=0.0000016 OR=8.70 [3.23 - 23.41]), and severe malaria (p=0.000052 OR=0.12 [0.04 - 0.37]).

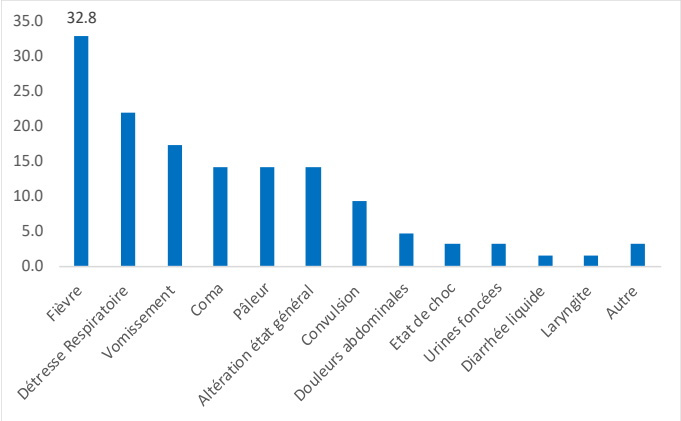

Figure 1: Distribution according to the reason for admission of 64 children who presented with shock during the period from November 1, 2019 to October 31, 2020 in the pediatric emergency unit of the CNHU.

Table 1: Etiological diagnosis and outcome in the 64 children who presented with shock during the period from November 1, 2019 to October 31, 2020 in the pediatric emergency unit of the CNHU.

Diagnosis	Patients (n=64)	Death number
Severe sepsis	27	15
Severe malaria	20	10
Severe malaria in SS sickle cell disease	1	1
Severe malaria and bacterial complications*	10	3
Meningoencephalitis	1	1
Inhalation lung disease by force-feeding	2	0
Pyelonephritis	1	0
Heart disease	2	2

*Bacterial complications found: pneumonia (n=3), meningitis (n=1), digestive infection (n=1), unidentified focus (n=5).

Table 2: Treatment modalities in 64 children who presented with shock during the period from November 1, 2019 to October 31, 2020 in the pediatric emergency unit of the CNHU.

Treatment	Patients (n=64)	Percentage
Oxygen therapy	54	84,4
Filling path		
Peripheral vein	61	95,3
Nasogastric tube	2	
Intraosseuse	0	
None	3	
Fluids used for filling		
Saline	34	
Lactate ringer	18	
Darrow's* solution	7	
Inotropes		
Dobutamine	1	
Adrenalin	1	
Nomber of vascular filling		
1	15	37,5
2	12	45,3
3	5	15,6
Antibiotic therapy(n=37)**		
C3G	34	53,1
Quinolones	11	17,1
Aminosides	7	11
Métronidazoles	6	9,3
Pénicillin A	3	4,7
Others	3	4,7
Artesunate IV	31	46,9

*It is a solution with halth of Ringer lactate or saline serum and 5% glucose.

** A child could receive a double or triple antibiotic.

Discussion

According to the WHO, the majority of deaths related to emergencies can be prevented by early recognition of severely ill children and immediate management [4]. However, resource-limited countries struggle to meet the requirements for the infrastructure, equipment and trained health workers needed for adequate management of these emergencies [6,7]. In this study, the hospital frequency of shock was low at 2.6%. The majority of children who had been ill for at least 72 hours were referred from peripheral health care facilities. As the majority of these children presented with shock within one hour of admission, the question of late referral to care remains [8]. The identification of severely ill children is rapid in the pediatric emergency unit of the CNHU, as the doctors at the reception desk are trained in the ABCD method of assessment. The absence of systematic Blood Pressure (BP) measurement could be explained by the fact that it is not part of the WHO diagnostic criteria and that, in general, its drop in states of shock in children is delayed [2,9]. For some authors, BP measurement is necessary because it allows classification into compensated shock when it is normal, and into decompensated shock when hypotension is present [10]. The main mechanism reported in the present study was distributive shock, related to severe sepsis presumed to be of bacterial origin. Sepsis is defined as an infection with dysregulation of the body's immune response and organ dysfunction [11]. In addition to bacteria, viruses (influenzae virus, respiratory syncitial virus, coronavirus, dengue, etc), parasites (plasmodium), fungi (candida) can also be sources of true sepsis [7,12]. It is estimated that approximately 11 million people died from sepsis worldwide in 2017 [13]. Mortality is estimated to be higher in resource-limited countries such as those in sub-Saharan Africa [14]. Dembélé and al in Mali, in a study of bacterial sepsis, reported a mortality of 44.18% [15]. The management of septic shock and severe sepsis has been the subject of the Surviving Sepsis Campaign International. The aim was to provide guidelines that could be applied by clinicians everywhere [16]. The mechanism of shock in severe malaria is complex, especially as bacterial co-infections are common in children [17]. In the present study, compliance with the different stages of shock management is in line with WHO recommendations [4]. However, there are shortcomings in the actual implementation of care. The median time for vascular filling is 30 minutes with a minimum of 15 minutes. Although it did not influence mortality in this study, this delay is long compared to the proposed algorithms, in which management after recognition of shock should begin within five minutes [18]. Several factors may explain this delay: difficulties with venous lines, the absence of intraosseous lines. The usefulness of the intraosseous line was reassessed by El-Nawawy et al in 2018, showing a reduction in mortality [19]. The nature of the fluids and the quantities infused are in line with WHO and Pediatric Life support recommendations [4,20]. This is despite the controversy caused by the results of the FEAST study, which established a link between mortality and rapid vascular filling [21,22,23]. The hourly diuresis, an important criterion testifying to good tissue perfusion, was only recorded in 17% of cases. The monitoring and traceability of the various procedures should therefore be improved. The very high mortality rate confirms the diagnostic and therapeutic urgency of a state of shock. Hence the importance of the WHO's call for worldwide action against septic state [23].

Conclusion

The implementation of a kit for the intraosseous approach is essential to reduce management delays. The traceability of procedures needs to be improved. The prevention of infectious diseases remains a priority, focusing on improving hygiene in the communities, the extended vaccination programme and the fight against malaria.

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