

Ionic Disorders Observed in Infants with Severe Wasting at the Yalgado Ouedraogo Teaching Hospital and the Charles de Gaulle Pediatric Teaching Hospital in Ouagadougou, Burkina Faso

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Abstract

Introduction: A higher risk of death is associated with wasting in children if it is not treated properly. The objective of this study was to investigate the ionic disorders observed in infants suffering from severe wasting at Yalgado Ouedraogo Teaching Hospital (YO-TH) and at Charles de Gaulle Pediatric Teaching Hospital (CDG-PTH) in Ouagadougou (Burkina Faso). **Methods:** This was a retrospective study with a descriptive and analytical aim over the period from January 1, 2016 to December 31, 2020. **Results:** It concerned infants aged 6 to 24 months hospitalized at YO-TH and at CDG-PTH from Ouagadougou. We included 271 infants. The mean age of the infants was 14.48 ± 5.44 months with 42.07% which was in the age range of [12 - 18] months. On admission to the hospital, the children had an average weight, height and BMI of 6.22 ± 1.32 kg, 0.73 ± 0.07 m and 11.67 ± 1.53 kg/m². In urban areas 56.46% of children and the main reasons for consultation were fever (88.19%), vomiting (52.80%) and diarrhea (50.20%). Electrolyte disturbances in emaciated infants affected all 8 parameters of the blood ionogram. However, the major disorders were 65.68% hyponatremia, 55.35% hypobicarbonatemia, 41.33% hypoprotidemia and 32.47% hypokalemia in infants aged 6 to 24 months. We found an association between diarrhea and resi-



dence with hypokalemia ($p = 0.0000$) and hypochloremia ($p = 0.010$), respectively. **Conclusion:** Severe acute wasting in infants 6 to 24 months of age remains a concern in the hospital setting. The frequency of biochemical disturbances is also high.

Keywords

Severe Wasting, Emaciation, Infants over 6 - 24 Months, Blood Ionogram, Burkina Faso

1. Introduction

Emaciation is defined as a low weight/height ratio. It is a major public health problem. A higher risk of death is associated with wasting in children if it is not treated properly. It is the result of chronic or recurrent undernutrition, usually associated with poverty, poor maternal health and nutrition, frequent illness and/or inadequate nutrition and care early in life [1].

In Burkina Faso, according to the final report of the SMART 2020 survey, the prevalence of acute malnutrition, chronic malnutrition and severe wasting at the national level were respectively 9.1% (including 1.0% in severe form), 24.9% and 17.6% [2].

Severe physio-pathological disorders (hydroelectrolytic disorders) are associated with emaciation. They are the subject of a medical emergency and require rapid and effective treatment. In Burkina Faso, these troubles are poorly studied. Thus, through this study, we propose to evaluate the factors associated with ionic disorders occurring in wasting in infants aged 6 to 24 months hospitalized at the Yalgado Ouedraogo Teaching Hospital (YO-TH) and at the Charles De Gaulle Pediatric Teaching Hospital (CDG PTH). These centers have a Center for Recovery and Nutritional Education (CRNE).

2. Patients and Methods

2.1. Type and Study Site

This was a cross-sectional study with a descriptive and analytical aim; the retrospective collection of which took place from January 1, 2016 to December 31, 2020. The study concerned all infants aged 6 to 24 months hospitalized in Teaching Hospitals Charles De Gaulle and Yalgado Ouedraogo suffering from severe emaciation (low weight/height ratio) and having carried out an extensive complete blood ionogram during hospitalization.

2.2. Data Analysis and Processing

The sociodemographic variables were age, sex, anthropometric data, place of residence and motive for consultation. The biological variables explored were sodium, potassium, chloride, calcium, magnesium, phosphorus, bicarbonate and

total protein ions.

Data collected on a questionnaire were entered from Microsoft Office Excel 2013 software and analyzed with Epi-Info™ 7 software in version 7.2.0. Bivariate regression analyses were performed to establish a statistical relationship between the variables. For bivariate analysis, measures of association such as Odds Ratio and p-value were performed. The significance level was $p < 0.05$. Before the beginning of the study, authorization to collect data was obtained from the management of CDG-PTH and YO-TH. Data confidentiality was maintained throughout the study.

3. Results

3.1. Socio-Demographic Characteristics

Our study included 125 at YO-TH and 146 at CDG-PTH (Figure 1).

In total, we included 271 infants aged 6 to 24 months in the study. The characteristics of the study population are presented in Table 1. The mean age of

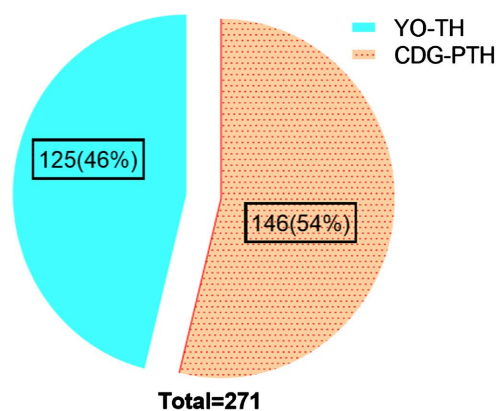


Figure 1. Distribution of infants with severe acute wasting by hospital center.

Table 1. General characteristics of the study population.

Characteristics		Values (N = 271)
Ages (months)	6 to 11	93 (34.32%)
	12 to 18	114 (42.07%)
	19 to 24	64 (23.62%)
Sex	Male	158 (58.3%)
	Female	113 (41.7%)
Residence	Urban area	158 (56.46%)
	Rural area	118 (43.54%)
Reasons for consultation	Fever	239 (88.19%)
	Vomiting	143 (52.80%)
	Diarrhea	136 (50.20%)
	Cough	102 (37.60%)

the infants were 14.48 ± 5.44 months with 42.07% of them in the age range of [12 - 18] months. On admission to the hospital, the children had a mean weight of 6.22 ± 1.32 kg and a height of 0.73 ± 0.07 m. Children were from urban settings 56.46% and the main motives for consultation were fever (88.19%), vomiting (52.80%) and diarrhea (50.20%).

3.2. Ionic Disorders in Wasted Children

The mean values of blood ionogram parameters of severely malnourished children are presented in **Table 2**.

Electrolyte disturbances in severely emaciated children affected all 8 parameters of the blood ionogram (**Figure 2**). The major disorders were hyponatremia (65.68%), hypobicarbonataemia (55.35%), hypoprotidemia (41.33%) and hypokalaemia (32.47%) in infants aged 6 to 24 months.

Table 2. Mean values of blood ionogram parameters in severely malnourished children.

Characteristics	Values (m ± SD)
Natremia (mmol/L)	131.84 ± 8.55
Kalemia (mmol/L)	3.95 ± 1.11
Chloremia (mmol/L)	98.68 ± 12.65
Calcemia (mmol/L)	2.27 ± 0.40
Magnesiumemia (mmol/L)	0.90 ± 0.27
Phosphoremia (mmol/L)	1.87 ± 5.53
Bicarbonatemia (mmol/L)	17.05 ± 5.28
Protidemia (g/L)	64.67 ± 12.00

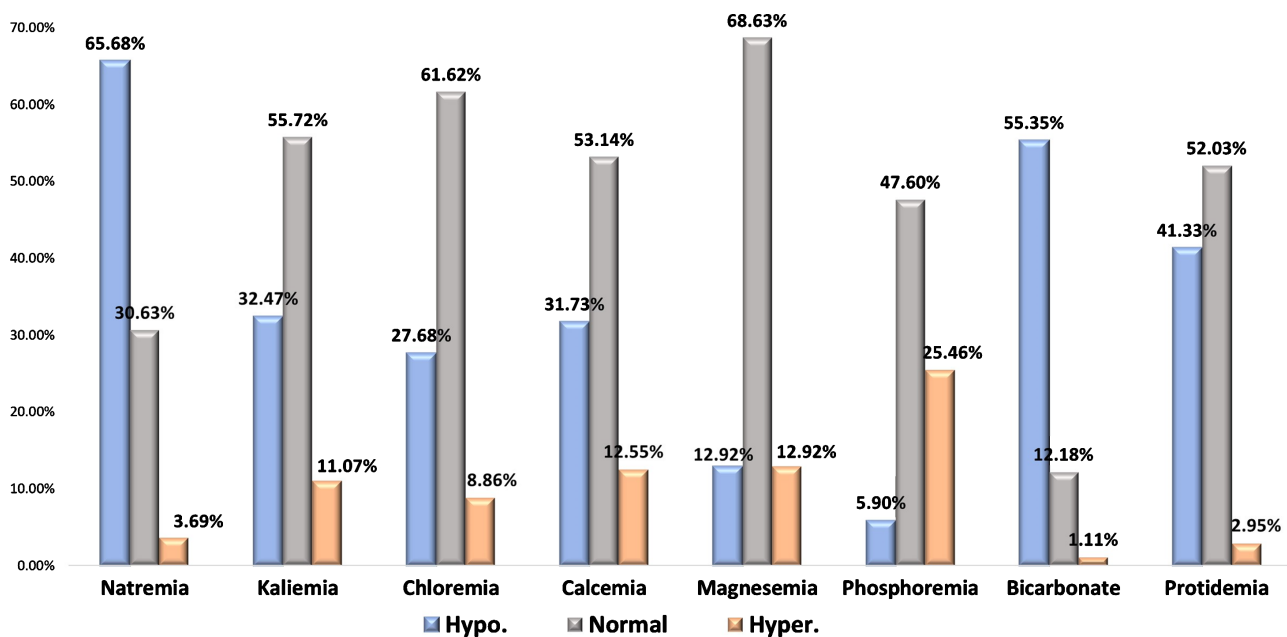


Figure 2. Frequency of ionic disorders in severely emaciated infants (N = 271).

3.3. Bivariate Analysis

In terms of factors associated with ionic disorders, we found that hypokalemia was statistically associated with diarrhea (OR = 3.44; 95% CI: 1.99 - 5.94, p-value = 0.000) (Table 3).

In addition, rural residence (urban or rural), was significantly associated with

Table 3. Sociodemographic characteristics and reasons for consultation associated with hypokalemia in univariate.

Characteristics	N	Hypokalemia		OR	IC ⁹⁵	p-value
		Yes n (%)	No n (%)			
Sexe	268	87 (32.5)	181 (67.5)			
Male	157	48 (30.6)	109 (69.4)			
Female	111	39 (35.1)	72 (64.9)	1.2300	0.7336 - 2.0624	0.4324
Age (months)	269	88 (32.7)	181 (67.3)			
6 to 12	121	41 (33.9)	80 (66.1)			
12 to 24	148	47 (31.76)	101 (68.24)	0.9075	0.5443 - 1.5131	0.7114
Residence	252	86 (34.1)	166 (65.9)			
Urban area	153	54 (35.3)	99 (64.7)			
Rural area	99	32 (32.3)	67 (67.7)	0.8845	0.5177 - 1.5112	0.6533
Mother	268	88 (32.8)	180 (67.2)			
In life	263	86 (32.7)	177 (67.3)			
Dead	5	2 (40)	3 (60%)	1.3721	0.2251 - 8.3634	0.7316
Fever	269	88 (32.7)	181 (67.3)			
Yes	32	6 (18.8)	26 (81.3)			
No	237	82 (34.6)	155 (65.4)	2.2925	0.9071 - 5.7938	0.0795
Diarrhea	269	88 (32.71)	181 (67.29)			
No	133	26 (19.55)	107 (80.45)			
Yes	136	62 (45.59)	74 (54.41)	3.4480	1.9985 - 5.9490	0.0000
Vomiting	269	88 (32.71)	181 (67.29)			
No	126	40 (31.75)	86 (68.25)			
Yes	143	48 (33.57)	95 (66.43)	1.0863	0.6516 - 1.8109	0.7508
Cough	269	88 (32.7)	181 (67.3)			
No	168	60 (35.7)	108 (64.3)			
Yes	101	28 (27.7)	73 (72.3)	0.6904	0.4032 - 1.1823	0.1771
Refusal to eat	269	88 (32.7)	181 (67.3)			
No	253	82 (32.4)	171 (67.6)			
Yes	16	6 (37.5)	10 (62.5)	1.2512	0.4397 - 3.5605	0.6745

hypochloremia in infants (OR = 2.07; 95% CI: 1, 18 - 2.64, p-value = 0.010) (Table 4).

4. Discussion

The aim of the present study was to investigate disturbances in blood ionograms in infants 6 to 24 months with severe wasting at YO-TH and CDG-PTH. The

Table 4. Sociodemographic characteristics and reasons for consultation associated with hypochloremia in univariate analysis.

Characteristics	N	Hypochloremia		OR	IC ⁹⁵	p-value
		Yes	No			
Sexe	265	74 (27.9)	191 (72.1)			
Male	155	39 (25.2)	116 (74.8)			
Female	110	35 (31.8)	75 (68.2)	1.3880	0.8081 - 2.3841	0.2348
Age (months)	266	75 (28.2)	191 (71.8)			
6 to 12	123	29 (23.6)	94 (76.4)	0.650		
12 to 24	143	46 (32.17)	97 (67.83)	1.537	0.8918 - 2.6495	0.1217
Residence	250	71 (28.4)	179 (71.6)			
Urban area	151	34 (22.5)	117 (77.5)			
Rural area	99	37 (37.4)	62 (62.6)	2.0712	1.1855 - 3.6185	0.0105
Mother	265	74 (27.9)	191 (72.1)			
In life	260	71 (27.3)	189 (72.7)			
Dead	5	3 (60)	2 (40)	3.9930	0.6539 - 24.3817	0.1337
Fever	266	75 (28.2)	191 (71.8)			
Yes	32	8 (25)	24 (75)			
No	234	67 (28.6)	167 (71.4)	1.2036	0.5150 - 2.8128	0.6687
Diarrhea	266	75 (28.20)	191 (71.8)			
No	133	34 (25.56)	99 (74.44)			
Yes	133	41 (30.83)	92 (69.17)	1.2976	0.7593 - 2.2177	0.3407
Vomiting	266	75 (28.20)	191 (71.8)			
No	124	41 (33.06)	83 (66.94)			
Yes	142	34 (23.94)	108 (76.0)	0.6373	0.3725 - 1.0905	0.1002
Cough	266	75 (28.2)	191 (71.8)			
No	165	50 (30.3)	115 (69.7)			
Yes	101	25 (24.8)	76 (75.2)	0.7566	0.4318 - 1.3255	0.3296
Refusal to eat	266	75 (28.2)	191 (71.8)			
No	249	71 (28.5)	178 (71.5)			
Yes	17	4 (23.5)	13 (76.5)	0.7714	0.2433 - 2.4457	0.6593

main limit in this study was the retrospective data collection with high risk of missing data. Despite this, we were able to include 271 emaciated infants.

The mean age of the infants was 14.48 ± 5.44 months and the 12 - 18-month age group was most affected by severe acute undernutrition (42.07%). This age group is also found in Mali with 49.4% [3] and in Burkina with 51.8% [4]. This high frequency of severe emaciation in this group could be explained by the fact that it is the weaning period for infants therefore food can be insufficient (quantitatively and qualitatively) to cover the growth needs, thus causing nutrients deficiencies and immunodeficiency with a high risk of infections which, in turn, aggravate undernutrition.

The major ionic disorders were hyponatremia (65.68%), hypobicarbonatemia (55.35%), hypoprotidemia (41.33%) and hypokalaemia (32.47%) in infants aged 6 to 24 months. The high frequency of hyponatremia, hypobicarbonatemia, hypoprotidemia and hypokalaemia is reported by several authors in Guinea [5], India [6] [7] [8] [9] and in Pakistan [10]. Emaciated infants have profound physiological disturbances, particularly electrolyte imbalances and poor fluid distribution. This modification of the distribution of fluids influences the concentrations of several ions hence hyponatremia, hypokalemia, hypobicarbonatemia, hypoprotidemia [11]. Sodium, chloride and bicarbonate are the main ions contributing to the osmolality of extracellular fluid. Bicarbonate is the major ion that regulates the pH of extracellular fluid. The concentrations of individual ions influence the properties and behavior of excitable membranes such as nerve cells and the performance of many intracellular enzymes.

In undernutrition conditions, serum electrolytes do not reflect body content but only circulating concentration. Thus, high serum potassium leads to intracellular potassium deficiency while low serum sodium masks sodium overload, but correction of these disorders is important in the immediate treatment of life-threatening situations [12]. A reduction in bicarbonate levels occurred more often in infants with prolonged deterioration and undernutrition.

A significant association was found between hypokalemia and diarrhea. In severe acute malnutrition with diarrhea, there is a significant risk of fluid and electrolyte disturbances, especially with hyponatremia, hypokalemia and metabolic acidosis [13]. In infants, diarrhea continues to be a serious problem that can be fatal when added to undernutrition.

Place of residence was statistically associated with hypochloremia. Infants in the rural area were the most susceptible to hypochloremia. This could be explained by a deficit in chloride intake that could be observed in infants receiving chloride-deficient breastmilk substitutes or linked to excessive gastrointestinal and renal losses [14].

5. Conclusion

This study demonstrated the extent of major fluid electrolyte disturbances in emaciated infants aged 6 to 24 months. Also, it showed the association of two

factors, namely diarrhea and residence which were respectively associated with hypokalemia and hypochloremia. It is concluded that ionic disorders in emaciated infants become evident in the presence of diarrhea and vomiting.

Prospective cohort follow-up studies will shed more light on the factors associated with metabolic disorders in this 6-to-24-month age group.

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Conflicts of Interest

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

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