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Original Research Article

Dysnatremia and Dyskaliaemia in Resuscitation: Epidemiological, Clinical, Therapeutic and Evolutionary Aspects

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Abstract: ***Introduction*:** Ionic disorders are an imbalance between the ions entering and leaving the body. We studied dysnatremia and dyskaliaemia in patients admitted in resuscitation department. ***Patients and Method*:** This is a retrospective, descriptive and analytical study of dysnatremias and dyskaliaemias in patients hospitalized in the resuscitation department Peace Hospital of Ziguinchor from January 1st, 2021 to December 31th, 2021. The objectives were to assess the prevalence of these ionic disorders in resuscitation, to clarify the epidemiological profile, to identify clinical and paraclinical signs, to evaluate management and to monitor the evolution of patients. ***Results*:** During the study period, the Peace Hospital resuscitation service recorded 287 hospitalizations, among which we identified 66 cases of ionic disorders (dysnatremias and dyskaliaemias) at admission. We found a frequency of 22.9% of hospitalized patients. The average age was 40.71 ± 23.83 years. Males were the most represented in 53%. The majority of patients, 62.1%, came from outside the city of Ziguinchor. Diabetes was the most common medical history in 50% of patients. Patients were from 53% of emergency department. Stroke was the most common cause in 16.7%. Dysnatremias were found in 57 patients, or 86.4%. Dyskaliaemias were found in 32 patients or 48.5%. Clinical signs were marked by the disorder of consciousness in 37.9%. Electrical signals were more marked by the flattened/negative T wave and ST depression in 60%. We reported a 53% mortality rate. Deaths occurred in 60% within 72 hours of hospitalization. Severe malaria and hyperkalemia were factors of poor prognosis. ***Conclusion***: The ionic disorders, frequent in resuscitation, are of multifactorial origin. They are associated with significant morbidity and mortality and require early and accurate management.

Keywords: Dysnatremia-Dyskaliaemia-Resuscitation-Ziguinchor.

INTRODUCTION

Ionic disorders denote an imbalance between the ions entering and leaving the body. They are frequent in resuscitation and have multifactorial origin. Under normal conditions, the blood sodium content remains within physiological limits despite variations in hydrosodic infusions. This is due to a mainly renal regulatory system consisting of several hormonal mechanisms: the renin-angiotensin-aldosterone system and the neuro-sympathetic system as well as the presence of the auricular natriuretic hormone and the cerebral natriuretic peptide [1, 2]. The dysnatremias, responsible for changes in plasma tonicity, have a considerable influence on the brain whose sudden volume changes are poorly tolerated. In case of plasma hypotonia, cerebral edema leads to intracranial hypertension. However, in case of plasma hypertension, intracerebral dehydration sets in with risk of subdural hematoma. These changes in intracerebral volume are responsible for neurological clinical manifestations with a negative impact on prognosis [3].

The ratio of potassium concentrations in intra- and extracellular fluid strongly influences cell membrane polarization, which in turn influences cellular processes such as the conduction of nerve flow and the contractions of muscle cells including myocardial cells. Minor

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potassium disorders can have serious clinical consequences [4]. Dyskaliaemias are frequent hydro-electrolyte disorders and cause cardiac arrest or severe heart rhythm disorders [5, 6]. The prevalence of ion disorders varies from country to country. In the US, a study conducted in a resuscitation unit found an incidence of hyponatremia of 15% to 25% [7]. In Mali, a study on hydro-electrolyte disorders in brain-damaged patients in the intensive care unit found 93.3% of patients with hydro-electrolyte disorders at admission [8].

In Senegal, few studies have been conducted on ionic disorders, especially the prevalence of resuscitation, hence the interest of this study which aimed to clarify the epidemiological profile, to identify clinical and paraclinical signs, to assess management and report on patient outcomes.

MATERIALS AND METHODS

It is a retrospective, descriptive and analytical study. It was spread over a period of one year from January 1st to December 31th, 2021. It affected all patients hospitalized in the resuscitation unit during the study period. Included were all patients who had a serum electrolytes with ionic disorders at admission type of dysnatremia and dyskaliaemia. Data was manually listed from the medical records of patients meeting our criteria in the service.

- **Ethical Aspects:** This study was conducted with the agreement of the local ethics committee of the hospital, as well as that of the patients' rights holders. The information collected is confidential.
- **Diagnostic Criteria for Ionic Disorders:** We defined the presence of an ionic disorder as a change in ion concentration based on laboratory values, as shown in the table below.

Normal Laboratory Values at the Peace Hospital

- Sodium (Na^+): 135-145 mmol/l
- Potassium (K^+): 3.5-5.10 mmol/l

- **Dosage Technique:** This is the approach to be taken in analyzing. It includes all the conditions to be implemented from sampling to completion of the various reviews of the study. It will be done in three phases:

- **Pre-Analytical Phase:** The pre-analytical phase comprises all the conditions to be implemented before dosing. It consists of taking blood samples from patients and keeping the samples taken.

This requires:

- Wear a clean white coat to wash hands
- Wear gloves
- Clean the workplace
- Place the dry tubes on a rack identifying them by patient name and first name and record in the workbench book
- Perform blood sampling
- Do the external cleaning of the automaton and start it
- Clean the spectrophotometer externally and start it.

The sample is usually taken at the fold of the elbow without a withers or at the inguinal level (in case of problem do it on the back side of the hand).

The route to the laboratory is fast in order to avoid hemolysis. The samples will be centrifuged for plasma alone.

- **Analytical Phase:** This phase represents the dosing phase. For each patient, the blood ions will be measured on dry tubes.
- **Post-Analytical Phase:** This will be the transcription of results on the patient's examination reports which will be distributed to the prescriber.

RESULTS

During the study period, the Peace Hospital Resuscitation Department recorded 287 hospitalizations, of which 66 were cases of ionic disorders (dysnatremia and dyskaliaemia) at admission. We found a prevalence of 22.9%. The mean age was 40.71±23.83 years with extremes of 1 and 84 years. Males were the most represented in 53% with a sex ratio of 1.13. The majority of patients, 62.1%, came from outside Ziguinchor. Diabetes was the most common medical history in 50% of cases. The patients admitted to resuscitation department came in more than half of the cases, or 53% of the emergency department followed by maternity in 18.2% of the cases. Stroke was the most common cause in 16.7%, followed by severe malaria and peri-operative haemorrhagic shock in 12.1% (Table I).

Dysnatremia was the most common ionic disorder in 62.1% followed by mixed disorders (Figure 1).

Table I: Distribution of patients by etiology

Diagnosis	Effective	Percentage (%)
Stroke	11	16,8
Severe malaria	8	12,1
Percutaneous hemorrhagic shock	8	12,1
Acute respiratory distress	6	9,1
Severe head injury	5	7,6
Eclampsia/Condition of Eclamptic Disease	4	6,1

Diagnosis	Effective	Percentage (%)
Pulmonary embolism	3	4,5
Severe sepsis	3	4,5
Diabetic ketoacidosis	3	4,5
Septic shock	2	3
Acute renal failure	2	3
Cardiac arrest	2	3
Other	9	13,7
Total	**66**	**100**

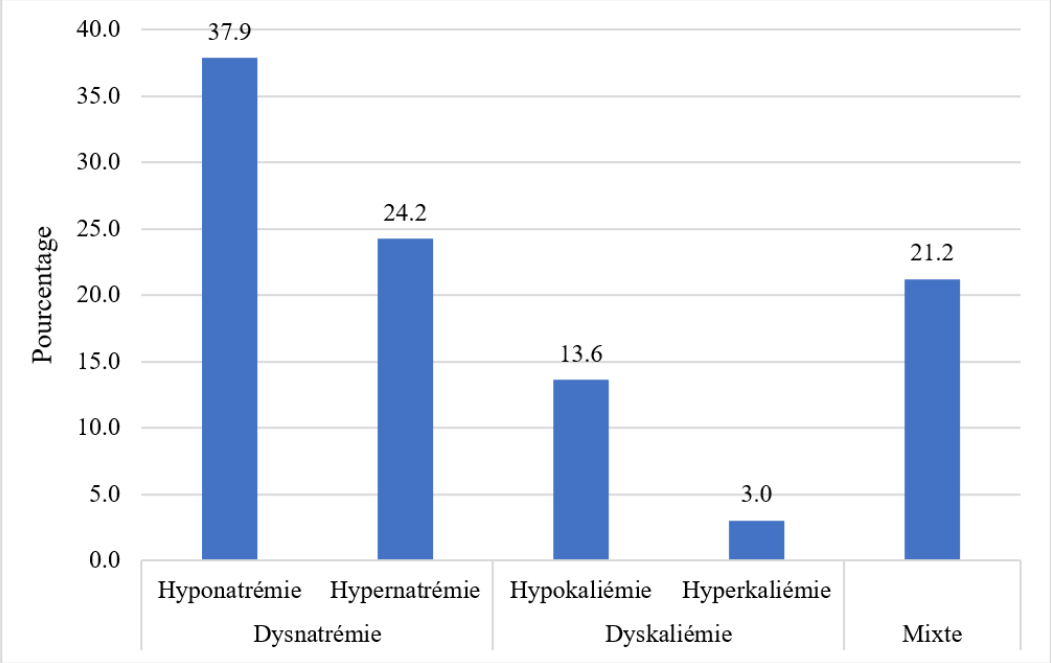

Figure 1: Repartition of patients according to ion disorders

Dysnatremias were found in 57 patients, or 86.4%. Among these dysnatremias, moderate hypernatremia was the most common with 29.8%, followed by mild hyponatremia in 22.8%. Severe hyponatremia was found in 19.3% (Figure 2).

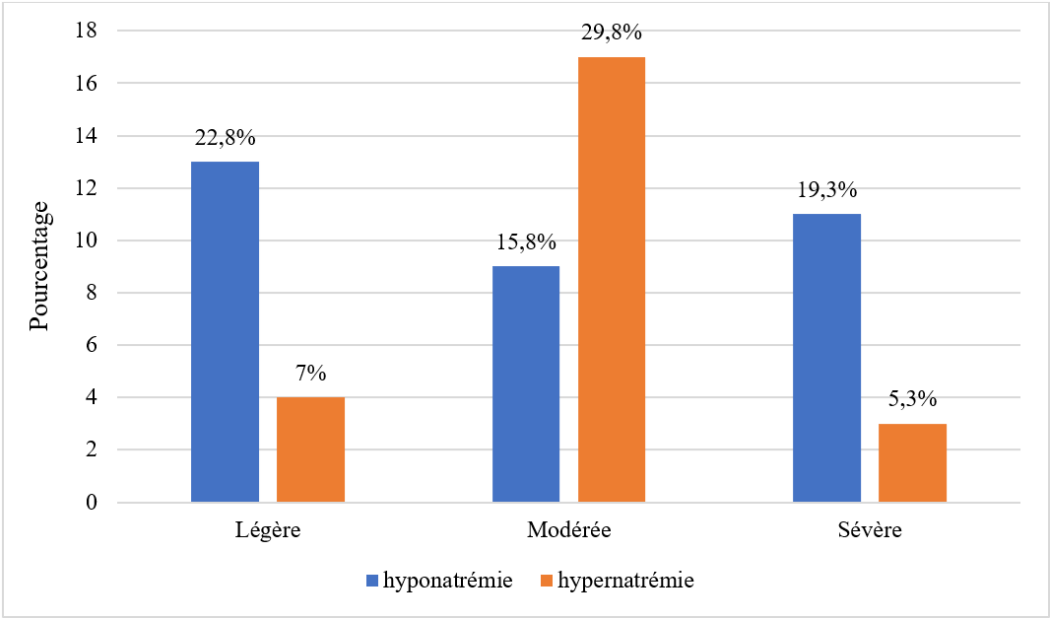

Figure 2: Distribution of patients according to the level of dysnatremia

Dyskaliaemias were found in 32 patients, or 48.5%. Among these dyskaliaemias, moderate hypokaliaemia was the most common dyskaliaemia with 31.3%, followed by severe hypokaliaemia in 25% and mild hyperkaliaemia in 18.7%. Severe hyperkaliaemia was found in 6.3% (Figure 3).

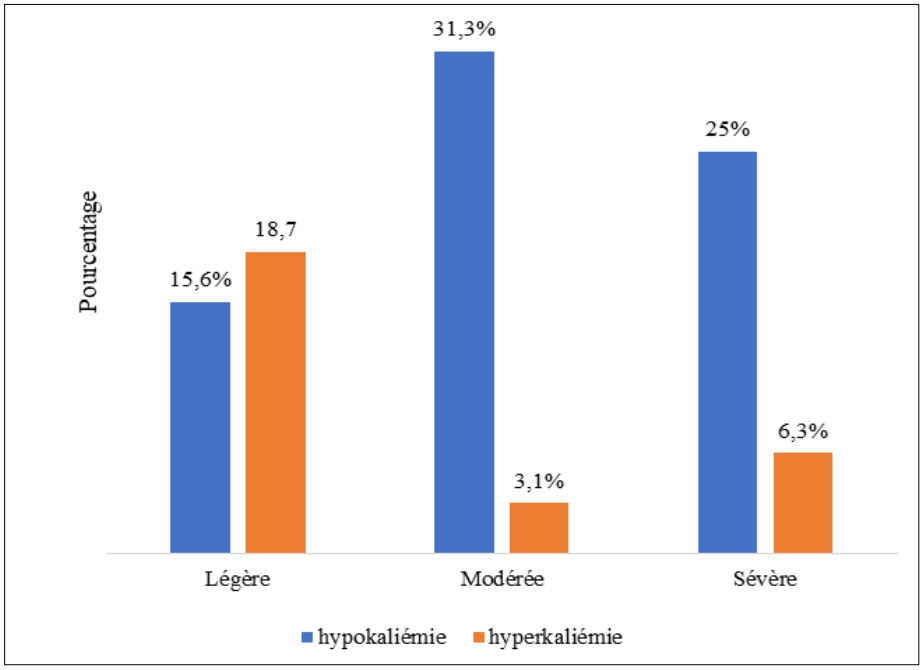

Figure 3: Distribution of patients according to the level of dyskaliaemias

Clinical signs were marked by the disorder of consciousness in 37.9% followed by hemodynamic instability in 21.2% and oedematous syndrome in 13.6%. Electrical signals were more marked by the flattened/negative T wave and a ST depression in 60%. Our response to ionic disorders was to identify and correct the underlying cause and type of disorder. We reported a mortality rate related to ion disorders in 53%. The overall mortality in resuscitation department during the study period was 12.2% corresponding to the number of deaths from ionic disorders. Death occurred in 60% within 72 hours of hospitalization. At the end of our analytical study, it was found that severe malaria and hyperkaliaemia were found to be factors of poor prognosis.

DISCUSSION

Very few studies have been done on ion disorders in resuscitated patients. The prevalence of ionic disorders in our study represents 22.9% of hospitalized patients. A study carried out in the Gabriel TOURE Hospital's resuscitation department on ionic disorders had identified a prevalence of 15.17% [8]. This prevalence is close to ours and could be explained by the same study population. However, this prevalence may be much higher in some centers, particularly at the Abidjan University Hospital where it was 55% [9]. This difference in the prevalence of ionic disorders in resuscitation remains variable according to the population studied, the diagnoses, the type of dysnatremia and dyskaliaemia considered at admission or acquired or both. The average age of our patients was 40.71 years old. The young average age is explained by the high incidence of head injuries affecting mainly young male populations but also malaria which is an endemic disease that affects many young people in our areas. More than half of the patients (62.1%) came from outside the municipality of Ziguinchor. This may be explained by insufficient medical facilities in rural areas able to do the serum electrolytes but also qualified medical personnel unavailable in these areas for early diagnosis and adequate correction of ionic disorders.

Diabetes and high blood pressure were found in 50% and 27.8% of patients respectively. These high proportions of hypertension and diabetes may be explained by the emergence of non-communicable diseases in recent years in sub-Saharan Africa [10]. The emergence of non-communicable diseases is explained by rampant and uncontrolled urbanization, obesity, major changes in lifestyles and sedentary lifestyle. These pathologies are often responsible for cardiovascular and neurological complications such as stroke, myocardial infarction and peripheral neuropathy but also metabolic complications including metabolic syndrome. Most patients came from the emergency department (53%) followed by the maternity hospital (18.2%). A study conducted in the Gabriel TOURE resuscitation department in Mali also found that 58.7% of patients came from the emergency department [8]. This strong "emergency department" origin is explained by a policy of setting up emergencies in our countries. Health emergencies are high on the international agenda with the implementation of an emergency management

programme by the World Health Organization (WHO). This programme works closely with countries and partners in the preparation, Prevention, response and recovery in emergency situations but also in national priorities as in Senegal with the ESP (Emerging Senegal Plan) which makes the prevention and management of risks and disasters a priority for human capital development. Almost all patients therefore first go through the emergency department before being transferred to other services according to their diagnoses.

Stroke was the most common cause with 16.7% and of this portion 52% were in a coma, followed by severe malaria in 12.1%. A study in the Gabriel Touré Hospital of Mali found 94.7% altered consciousness, 58.7% of which were in a coma [8]. Diabetes and high blood pressure are risk factors for stroke [10]. The stroke will manifest itself by several signs including language disorder, motor and/or sensory deficit and especially a disturbance of consciousness. The stroke will be due to either a bilateral brain dysfunction, that is to say an involvement of both cerebral hemispheres, or to a dysfunction of the reticulated ascending activator system which can be caused by focal ischemia or hemorrhage. In the face of these signs, the patient becomes dependent and will need food and hydration by nasogastric probe and adequate solutes. Therefore, if all this support is not done or is done late, it may be the cause of ionic disorders. In addition, severe malaria can be responsible for neurological and renal failure. The severe malaria will cause an impairment of renal function with the occurrence of ionic disorders including hyperkalemia. Hyponatremia was the most frequent with 37.9 %, followed by hypernatremia in 24.2% and hypokaliaemia in 13.6%. In the study at the Abidjan University hospotal, results similar to those of our study were found with a frequency of hyponatremia at 65%, followed by hyperkaliaemia at 32%, hypokaliaemia at 26% and hypernatremia at 14%. This frequency of hyponatremia may be explained by poor management upstream with the infusion of hypotonic solutes and ignorance of other mechanisms of hyponatremia occurrence by transfer services. In our study, the most frequent clinical signs were disorders of consciousness in 37.9% followed by hemodynamic instability in 21.2%. In a study at the University Hospital Gabriel TOURE of Bamako, hemodynamic instability and consciousness disorder were found in 26.2% each [8]. This is explained by the most common etiology of stroke, with its many clinical manifestations including consciousness disorder. Complications of diabetes, the most common history, can also explain this. We can note a coma in case of very high blood sugar levels due to dehydration which is responsible for a hematoma or lactic acidosis due to an excess of acid or ketone acidosis by excess of ketone and acid.

Our conduct in our study of ionic disorders was to identify and correct the underlying cause and type of disorder [12-14]. We noted the same assumption in the study of University Hospital Gabriel Touré [8]. A retrospective study in India found that the same course of action was almost the same [15]. This is because the management of ionic disorders remains the same throughout the world. It should be noted that our study did not find any complications during the correction of ionic disorders. This is also the case for the Gabriel Touré hospital resuscitation study [8]. This is explained by the knowledge of complications of rapid corrections of ionic disorders by resuscitation services but also by the existence of well-codified protocols.

We reported a mortality rate of 53% and among them 60% died within 72 hours. The Abidjan study found a mortality of 22% at admission from ion disorders [9]. A study conducted in a resuscitation unit in Mali found a mortality rate of 73.3% [8]. This high mortality can be explained by the late management of ionic disorders because it was discovered late by the late completion of the serum electrolytes for lack of means. The high cost of managing patients admitted in resuscitation department is also a related factor.

In our analytical study, we found that severe malaria and hyperkaliaemia are factors of poor prognosis. The study in the resuscitation department of Gabriel Touré Teaching Hospital also found a link between death and hyperkaliaemia [8]. Severe malaria is a disease often responsible for acute renal failure. The most common complication of acute renal failure is hyperkaliaemia. The high death rate could thus be explained by the lack of hemodiafiltration in several reanimations in our developing countries.

CONCLUSION

Ionic disorders (dysnatremias and dyskaliaemias) denote an imbalance between the inputs and outputs of the Na+ and K^{+} ions in the body. Their inconsistent clinical signs are often the cause of a diagnostic and therapeutic delay leading to high mortality. The systematic completion of serum electrolytes in all hospitalized patients, the implementation of correction protocols and the availability of extra-renal purification should reduce mortality related to dysnatremias and dyskaliaemias.

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