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Research Article

Epidemiological And Evolutive Aspects Of Hyponatremia, Dyskaliemia And Hypocalcemia In Patients Affected By Chronic Kidney Disease At The Departmental Teaching Hospital Of Borgou(Benin).

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Abstract

Introduction: Chronic kidney disease (CKD) is a major public health problem on a continental and global scale. The existence of fluid and electrolyte disorders in patients suffering from CKD is thought to be a risk factor for the progression of this condition.
Objective: To study the epidemiological and evolutionary aspects of hyponatremia, dyskalemia and hypocalcemia in patients with chronic kidney disease at the Departmental Teaching Hospital of Borgou (CHUD-B) in (Benin) from 2022 to 2023.
Method: This was a longitudinal study in which data were collected from 1 January 2022 to 31 October 2023, with a follow-up period of three months.It concerned patients with CKD monitored in the nephrology department of CHUD-B/A who met the study's inclusion criteria. The hydroelectrolytic disorders studied were hyponatremia, hypokalemia, hyperkalemia and hypocalcemia. Logistic regression was used to identify factors associated with each of the above-mentioned fluid and electrolyte disorders.
Results: A total of 89 patients with CKD were included. Their mean age was 53 14.37 years and the sex ratio was 1.82. Of the 89 patients, 65 had at least one hydroelectrolytic disorder, giving an overall prevalence of hydroelectrolytic disorders of 73.0%. Hyponatremia, hypocalcaemia, hypokalaemia and hyperkalaemia were found in 46.1%, 56.2%, 13.5% and 19.1% respectively. Of the 65 patients who initially presented with hydroelectrolytic disorders, 46 (70.8%) had an unfavourable outcome, with persistent disorders in 28 (43.1%) and the appearance of a new disorder in 12 (18.5%). Of these patients, 06 (09.2%) died.
Conclusion: Hyponatremia, dyskalemia and hypocalcemia were common in patients with CKD. The outcome is sometimes unfavourable. It is therefore necessary to implement strategies for early detection.

Keywords : Chronic kidney disease, hydroelectrolyte disorders, evolution, Benin.

INTRODUCTION

Chronic kidney disease (CKD) is a major public health problem worldwide. Approximately 1.3 million people die each year from kidney failure and an additional 1.4 million die from cardiovascular disease related to impaired kidney function [24]. The prevalence of CKD is increasing at an alarming rate. Deaths from CKD will increase by 41.5% between 1990 and 2020, from 17th to 10th leading cause of death [1]. According to some projections, CKD will become the fifth leading cause of death worldwide by 2040 [1]. Studies in Guinea Conakry showed that 80% of hospital admissions to nephrology departments were due to CKD [2]. In Burkina Faso, 4-22% of deaths were reported to be due to CKD [3].

The incidence of CKD is increasing in Africa due to longer life expectancy, sedentary lifestyles, higher rates of type II diabetes and hypertension, but most importantly the use of banned drugs on the parallel market and uncontrolled use of phytotherapies [4]. Experts estimate that 10% of CKD cases can be prevented, and that 30% can be delayed for several

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years if the patient has benefited from early detection and appropriate management. In fact, at an advanced stage of renal function deterioration, there are disturbances in the metabolism of water and most electrolytes, especially sodium, potassium and chlorine. In addition to hemodialysis and renal transplantation, the management of CKD also relies on the control of metabolic disorders [4,5]. These include hydroelectrolytic disorders (corresponding to hydration disorders, electrolyte disorders, acid-base disorders) and disorders of phosphocalcium metabolism [6,7]. The risk of developing hydroelectrolyte disorders increases exponentially after the age of 65 [8]. In any case, the analysis of a hydroelectrolytic disorder requires evaluation of renal behavior (not adapted or) [6]. These disorders can complicate medical, surgical and obstetrical conditions of all kinds; they can also favor the unfavorable evolution of chronic kidney disease[8]. However, very few specific studies on the evolution of hydroelectrolytic disorders in chronic kidney disease patients have been carried out in the epidemiological context of Benin. It therefore seemed appropriate to initiate this study, the objective of which was to study the evolutionary aspects of frequent hydroelectrolytic disorders such as hyponatremia, hypocalcemia and dyskalemia, in chronic kidney disease patients at the Departmental Teaching Hospital of Borgou (CHUD-B) in (Benin) from 2022 to 2023

METHODS

This was a longitudinal follow-up study, running from January 1st,2022 to August 31, 2023, and involved patients with advanced chronic kidney disease followed up in the nephrology department of CHUD-B/A. The patient recruitment period was from January 1st, 2022, to May 31, 2023. All patients suffering from stage 3, 4 and 5 chronic kidney disease, aged over 15 years and having given informed consent were included. Patients undergoing replacement therapy were not included. Patients who were lost to follow-up or who failed to comply with the follow-up schedule were excluded. The census was exhaustive.

The primary dependent variable was the existence of at least one of the hydroelectrolytic disorders (hyponatremia, hypokalemia, hyperkalemia, hypocalcemia) in a patient with stage 3, 4 and 5 chronic kidney disease. These were dichotomous variables with “Yes” or “No” as modalities.

- Hyponatremia was defined as a plasma sodium concentration below 135 mmol/L with hypoosmolality ‘ 280 mosmol/kg [9]. It was considered mild or severe if the natraemia was between]135-130 mmol /L] or ‘ 130 mmol /L respectively
- Hypokalemia was defined as a plasma potassium concentration below 3.5 mmol/L [9]. It was considered mild and moderate if kalemia was between [3.0- 3.5 mmol /L[and [2.5- 3.0 mmol /L [respectively.
- Hyperkalemia was defined as a plasma potassium concentration greater than 5.5 mmol/L [9]. It was considered moderate and severe if kalemia was between [6.0 - 6.5 mmol /L [or greater than 6.5 mmol /L respectively.
- Hypocalcemia was defined as a blood calcium level of less than 85 mg/L [ ]22. It was moderate and severe if the blood calcium level was between [70.0-80.0 mg /L [or less than 70.0 mg /L respectively.

The secondary dependent variable was the progression of hydroelectrolytic disorders, which was favorable or unfavorable.

Judging criteria

- A favorable outcome was achieved when values returned to normal after the final biological tests and clinical signs disappeared.

Specifically

- Regarding natremia, the evolution was considered favorable if it was between [135-148 mmol/L] with normal plasma osmolality and absence of clinical signs.
- Regarding kalemia, the evolution was said to be favorable if it was between [3.5-5.3 mmol/L] with no clinical signs of hyperkalemia or hypokalemia.
- As far as blood calcium levels are concerned, favorable evolution is considered when they are between [85-108mg/L], with no clinical signs of hypocalcemia.

Progression was unfavorable in the event of the appearance or persistence of hydroelectrolytic disorders after the last biological examinations had been carried out, or in the event of the patient’s death.

Independent sociodemographic, behavioral, clinical and paraclinical variables were studied

Data collection, analysis and processing

The data were collected via the following methods: individual interviews, complete physical examinations and a review of the patients’ medical records. The patients included in the study were systematically monitored over a period of three months. The clinical examinations, blood ionograms and calcium levels were monitored at 3 (D3), 7 (D7), 14 (D14) days, one month (M1) and three months (M3). The qualitative variables were expressed as percentages, while the quantitative variables were expressed as means and standard deviations. The proportions were compared on a case-by-case basis using statistical tests such as Pearson’s Chi-square test or Fisher’s exact test. The employment of a logistic regression model was utilised in the pursuit of identifying potential associations between hydroelectrolytic disorders and the independent variables, in a cohort of patients afflicted with chronic renal failure. The threshold of statistical significance was set at

p=0.05. The explanatory variables were presented in terms of odds ratio values and their 95% confidence intervals.

RESULTS

Participation rates

During the study period, 102 patients were included. 13 were excluded, including 5 women. A total of 89 patients with advanced chronic kidney disease were selected for the study, representing a participation rate of 90.7% Descriptive study Epidemiological aspect

Socio-demographic and socio-economic data

The mean age of patients was 53± 14.37 years [extremes 18 and 82 years]. The most represented age group was 60 to 70, with a proportion of 30.3%. Males accounted for 64.0%, i.e. a sex ratio of 1.8. Among the 89 patients, 21.3% were shopkeepers, 64.0% had a monthly income of over 52,000 CFA francs, 89.9% were married and 30.3% had a primary education.

Clinical data

Of the 89 patients, 78.7% had hypertension, 30.3% type II diabetes, 23.6% heart failure, 6.7% stroke and 1.1% hepatitis B virus. Two women had pre-eclampsia.

Fashion-wise, among the 89 patients, 74.2% drank alcohol, 5.6% consumed more than 10 grams of alcohol a day, and 26.2% were exposed to tobacco. Herbal medicine abuse was observed in 12.3% of patients, and 86.2% did not engage regular physical activity. All patients regularly self-medicated; among them, 53.9% regularly took non- steroidal anti-inflammatory drugs.

On admission, asthenia and edema of the lower limbs were reported as functional signs by 61.8% and 49.4% respectively. Exercise-induced dyspnoea, headache, fever, heart palpitations, vomiting, insomnia and somnolence were reported by 32.6%, 24.7%, 20.2%, 16.9%, 11.1% and 7.9% respectively. Of the patients selected, 59.6% were in poor general condition on admission, and 32.3% had pale conjunctival mucous membranes. On admission, 96.6% were conscious. In 87.5% of cases, diuresis was preserved, 53.9% had edema of the lower limbs and 3.4% had dehydration folds. On examination, 21.3% of patients showed signs right heart failure, 20.2% hepatomegaly, 13.5% ascites, 12.4% crepitus rales and 7.9% signs of left heart failure. From an anato-clinical standpoint, chronic vascular nephropathy, chronic glomerular nephropathy, chronic tubulointerstitial nephropathy and polycystic fibrosis were evoked in 57.3%, 32.6%, 7.9% and 2.2% respectively.

Stages 3, 4 and 5 of chronic kidney disease were found in 23.6%, 20.2% and 56.2% respectively.

Therapeutic data

Of the 89 patients, 86.5% were on antihypertensive drugs, 74.2% on calcium carbonate, 70.8% on sodium bicarbonate, 62.9% on iron derivatives (oral and parenteral), 46.1% on diuretics, 9.0% on statins, 7.9% on oral antidiabetics and 3.4% on potassium supplements. As antioxidants, 96.9% received ascorbic acid.

Epidemiological data

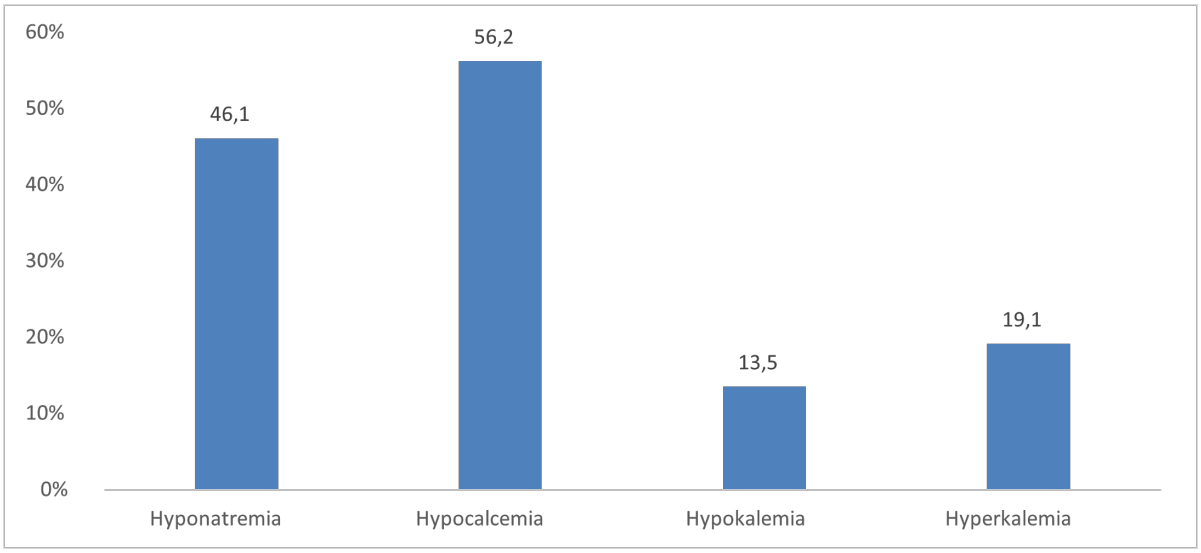
Frequency fluid and electrolyte disorders

Of the 89 patients, 65 had at least one hydroelectrolytic disorder, giving an overall prevalence of hydroelectrolytic disorders of 73.0%.

Specific frequencies of fluid and electrolyte disorders

Of the 89 patients, 41 (46.1%) had hyponatremia, 12 (13.5%) hypokalemia, 17(19.1%) hyperkalemia and 50 (56.2%) hypocalcemia; this is illustrated in **Figure 1**.

Figure 1. Distribution of hydroelectrolytic disorders in patients with chronic kidney disease in the nephrology department of CHUD-B/A from 2022 to 2023.



Severity of fluid and electrolyte disorders

Of the 41 patients with hyponatremia, 29 (70.7%) had severe form. In relation to the extracellular sector, dilution hyponatremia was found in 31 patients (75.6%). Of the 12 patients with hypokalemia, 10 (83.3%) had the moderate form. Of the 17 patients with hyperkalemia, 10 (58.8%) had the moderate form. Of the 50 patients with hypocalcemia, 35 (70.0%) had the moderate form. **Table 1** shows the different disorders in terms of severity

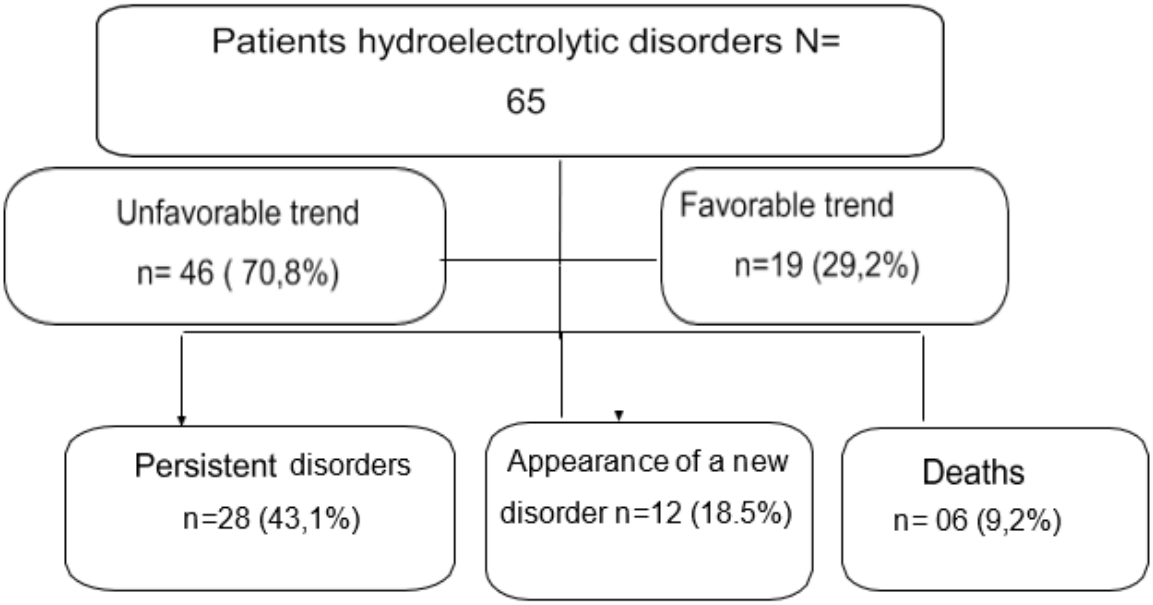
Table I. Distribution of chronic kidney diseasepatients with hydro electrolytic disorders in the CHUD B/A nephrology department from 2022 to 2023, according to severity.

	Number of employees (N)	Proportion (%)
Hyponatremia (N=41)		
In relation to severity		
Slight	10	24.4
Moderate	02	04.9
Severe	29	70.7
In relation to extracellular volume		
Dilution type	31	75.6
Depletion type	10	24.4
Hypokalemia (N=12)		
Slight	02	16.7
Moderate	10	83.3
Hyperkalemia (N=17)		
Slight	05	29.4
Moderate	10	58.8
Severe	02	11.8
Hypocalcemia (N=50)		
Slight	07	14.0
Moderate	35	70.0
Severe	08	16.0

Progression of fluid and electrolyte disorders

Of the 65 patients who initially presented with hydroelectrolytic disorders, 46 (70.8%) had an unfavorable outcome, with persistent disorders in 28 (43.1%) and the appearance of a new disorder in 12 (18.5%). Of these patients, 06 (09.2%) died. **Figure 2** shows the results.

Figure 2. Distribution of patients with chronic kidney disease in the nephrology department of CHUD-B/A from 2022 to 2023 according to the evolution of disorders (N=65)



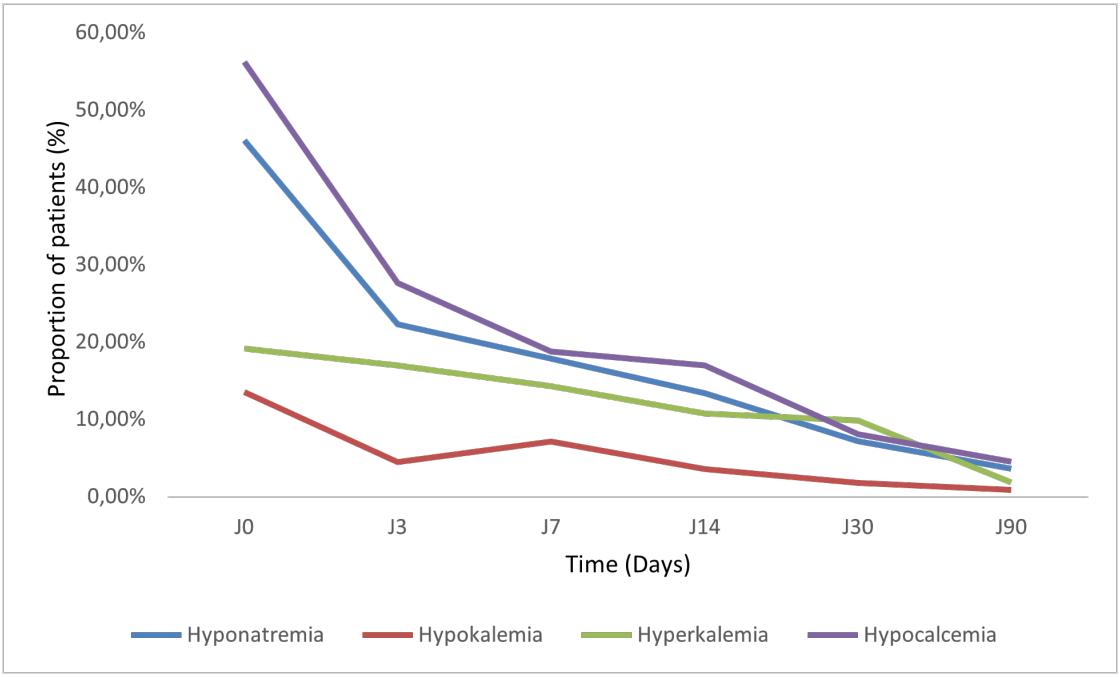
Evolution

During the three months of patient follow-up, it was found that

- Concerning hyponatremia, at D0, 41 (46.0%) patients were found to have hyponatremia. At D14, this proportion decreased to 13.4%, and finally to 03.6% at D90.
- Hypokalemia: at D0, 12 (13.5%) patients had hypokalemia; this proportion decreased to 07.1% at D7 and 0.9% at D90.
- At D0, 17 (19.1%) patients had hyperkalemia. This proportion decreased to 10% at D30 and to 02% at D90.
- Of the 50 (56.1%) patients with hypocalcemia at D0, 08% had it at D30 and 04.5% at D90.

Figure 3 shows the trend in the number of patients with hydroelectrolytic disorders over time.

Figure 3. Trend in the number of patients with hydroelectrolytic disorders over time in the CHUD B/A nephrology department from 2022 to 2023.



DISCUSSION

Comments and comparisons with results from other authors Clinical data

In our study, the most common functional signs were asthenia at 61.8%, followed by edema of the lower limbs at 49.4%. Ould et al had similar frequencies, with asthenia at 56.8% [10]. As did Kone et al, who found asthenia to be the most common functional sign at 59.5% [8]. Diakité et al found similar results, with asthenia the predominant functional sign at 94.0% [11]. Similarly, Ibrahim et al. in Mali in 2010 found asthenia at 96.2% [12]. Tangning et al found asthenia at 88%, followed by edema of the lower limbs at 56.0% [29].

Diagnostic data

Staging of patients according to plasma creatinine clearance revealed that 56.2% of patients were in the terminal stage of the disease, compared with 20.2% and 23.6% respectively for the severe and moderate stages. Ibrahim et al. found similar results, with 82.7% of patients in the terminal stage of the disease, compared with 11.5% and 5.8% respectively for the severe and moderate stages [12]. Diakité et al found that 67.0% of patients with severe to end-stage CKD were identified [11].

Tangning et al found similar results, with 78.0% of patients at the end-stage of CKD [29]. Similarly, Djobsou found 80.0% in end-stage CKD [13]. Ahoui et al, Coulibaly et al found 62.2% and 78.0% respectively in the end-stage CKD [14, 15]. Amekoudi et al, Toure et al found similar results, with 68.0% and 65.3% respectively in end-stage CKD [4,16].

Frequency of hydroelectrolytic disorders

In our study, of the 89 patients selected, 65 (73.0%) had at least one hydroelectrolytic disorder. This result was higher than those of Diakité et al in Guinea in 2019, who found a frequency of 45.2% [11], Dembélé in Mali in 2021, who reported a

prevalence of 15.2% [17] and Kone et al, who found a prevalence of 11.5% [8]. Lahouimel et al found similar results, with 58% of hydroelectrolytic disorders in CKD patients [18]. This may be explained by the late admission of patients in the complications phase.

Scalable data

In our study, hydroelectrolytic disorders progressed unfavorably in 70.8% of patients. This result concurs with that of Kone et al in Mali, who found that 51.0% of patients had an unfavorable evolution [8]. However, Dembélé . and Diakité et al found lower frequencies of unfavorable evolution at 26.1% and 43.3% respectively [11, 18]. Djobsou et al found lower frequencies of adverse hydroelectrolytic events at 28.2%, including 31.8% of cases of death [13]. In our study, the evolution of fluid and electrolyte disorders was unfavorable, with death recorded or persistence of fluid and electrolyte disorders in most cases. Parminder et al, in India in 2023 found similar results, where the evolution of hydroelectrolytic disorders was unfavourable for most patients with chronic kidney disease [19]. Gilligan et al in 2017 in the United States found similar results [20]. Toure ound an unfavorable evolution in 55.1% of patients [4].

CONCLUSION

The frequency of hydroelectrolytic disorders (hyponatremia, hypokalemia, hyperkalemia, hypocalcemia) in chronic kidney patients at CHUD-B/A was high. The majority of these cases have a poor outcome. It is therefore necessary to detect these disorders early and treat them effectively, in order to avoid their progression in this patient population.

Author Contributions

Conceptualization Séraphin Ahoui, Julien Attinon, Blaise Adelin Tchaou, Aimé Vinasse, Ingrid A. Makam Fokam . Validation and Formal Analysis Séraphin Ahoui, Julien Attinon, Blaise Adelin Tchaou, Aimé Vinasse, Ingrid A. Makam Fokam, Jacques Vigan. Investigation Aimé Vinasse, Ingrid A. Makam Fokam , Aubin M Melikan, Joseph Godonou. Writing-Original Draft Preparation Séraphin Ahoui, Julien Attinon, Joseph Godonou. Writing-Review and Editing Séraphin Ahoui, Julien Attinon, Blaise Adelin Tchaou. Supervision Jacques Vigan, Blaise Adelin Tchaou,

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Institutional Review Board Statement

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Conflicts of Interest

The authors declare no conflict of interest

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