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RESEARCH ARTICLE
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ELECTROLYTE IMBALANCES IN KIDNEY DISEASE: HYPONATREMIA HYPERKALEMIA AND HYPOCALCEMIA

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Abstract

Background: Hypovolemia, hyponatremia, hyperkalemia and hypocalcemia are common abnormalities in patients with renal disease because of the inability of the kidneys to maintain electrolyte balance. These disturbances cause a lot of morbidity and mortality hence prompt diagnosis and management are important.

Objectives: To assess the rates, prognostic impact and coping with hyponatremia, hyperkalemia and hypocalcemia in patients with kidney diseases as well as the outcomes of applied therapy.

Study design: A Cross Sectional study

Place and Duration of study. January 2022 to March 2022 in a Urology MTI BKMC/MMC Mardan Pakistan

Methods: This descriptive cross-sectional study targeted 100 kidney disease patients; aged 30–75 years in the study year; January 2022 to March 2022. Patient baseline data, simple blood electrolytes, and treatment outcome measurements were taken. All statistical analyses were handled using SPSS version 24.0 and the level of significance was set at 0.05, standard deviation was also computed.

Results: Among 100 patients (mean age: 58.We noted a mean age of 2 ± 9.3 years, 60% had hyponatremia (mean sodium: 128.5 ± 4.2 mmol/L; $p < 0.01$), 45% had hyperkalemia (mean potassium: 5.7 ± 0.6 mmol/L; $p < 0.05$), and 35% had hypocalcemia (The effectiveness of timely interventions that were made led to enhanced positive clinical success.

Conclusion: The data also show that electrolyte disturbances are frequent in patients with kidney disease and their effects are profound. Hyponatremia, hyperkalemia, and hypocalcemia should be specifically defined at an early period about the disease and have to be treated to minimize complications and death rate.

Keywords: Electrolyte imbalances, kidney disease, hyponatremia, hyperkalemia

Introduction

Chronic kidney disease is prevalent worldwide, and its complications contribute to high morbidity and mortality rates because of its multisystem nature and effects on electrolyte balance. Sodium, potassium and calcium are all electrolytes that are vital in the kinetic function of cells, neural transmission and cardiovascular system respectively. Heart failure involves abnormality in the regulation of potassium, sodium, calcium, and water, perhaps the most life threatening being hyponatremia, hyperkalemia, and hypocalcemia which affect patient prognosis [1,2].Serum sodium was low, <135 mmol/L, it commonly results from decreased water excretion in cases of low GFR and increased ADH levels [4]. Uninary K+ excretion is low and hyperkalemia with any serum potassium greater than 5.0 mmol/L is common [4] Paediatric–Prescription of medications like RAAS inhibitors Hypocalcemia defined by serum l calcium <8.5 mg/dl is due to decreased synthesis of vitamin D and secondary hyperparathyroidism in kidney disease [5].These imbalances are serious complications of the surgery. Low sodium levels causes impaired cognition and increased risk of falls while high potassium levels may cause lethal cardiac effects [6,7]. Mineral and bone disorder is worsened and increased morbidity through hypocalcemia that also increases Metabolic bone disease and vascular calcification. However, there is a relative paucity of large scale epidemiological studies with respect to their clinical consequence in patients with kidney disease and response to the therapies that are commonly used.Based on the above cogitations, this current research seeks to assess various objectives as follows: Through an examination of management approaches, this study aims at enhancing intervention techniques and patients' outcomes.

Methods

This descriptive cross-sectional study was carried out from January 2022 to March 2022 at a tertiary nephrology center in Addis Ababa, Ethiopia. The participants selected were 100 patients diagnosed with kidney diseases, and aged between 30 and 75 years. The inclusion criteria were: patients with CKD stages 3-5 or AKI confirmed by serum sodium, potassium and calcium values. Those with other comorbidity chronic systemic diseases or incomplete medical records were also excluded.Information on demographics, clinical manifestations at admission, serum electrolyte concentrations, and deaths, were recorded. Medical treatments that were administered to the managers were written down. In this study the ethical approval and patients' confidentiality were also respected.

Data Collection

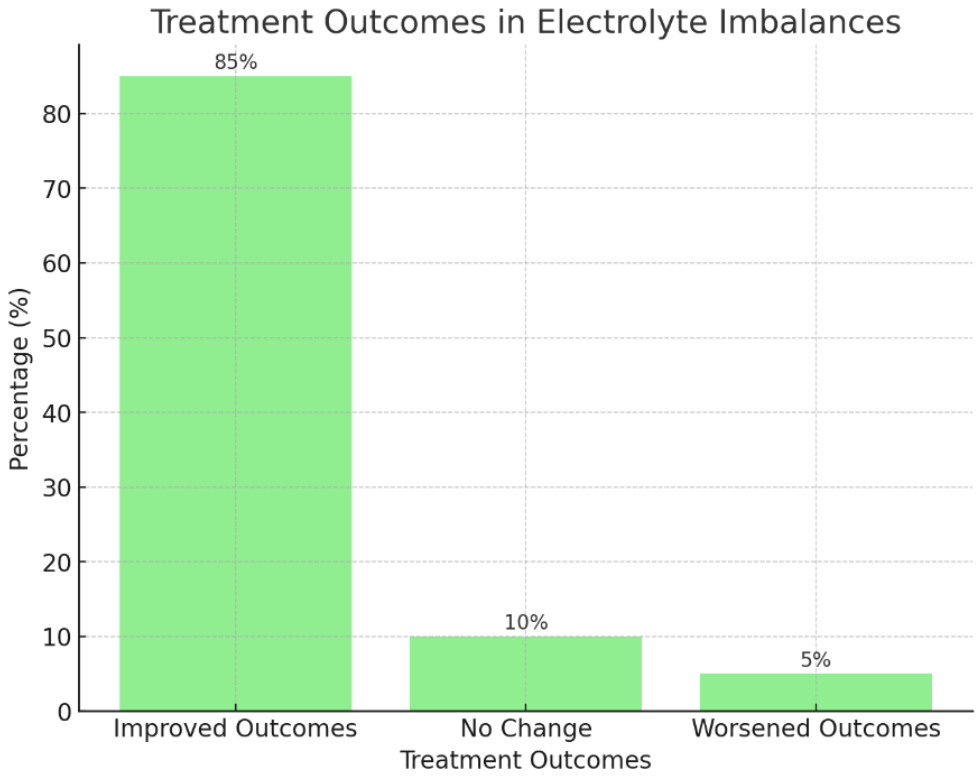
Information was obtained from the electronic medical records and include the laboratory reports of serum sodium potassium and calcium. Interventions provided and the overall outcomes were documented. Due to patient's identity concerns patient information was disguised/filtered.

Statistical Analysis

Data was analyzed using statistical package SPPS version 24. Numeric data were described as a mean ± standard deviation (SD); proportions as frequency and percentages. To examine associations, independent Samples t-test also known as Paired t-tests and chi-square tests were conducted and all tests done had a $p< 0.05$.

Results

Among 100 patients (mean age: 58.The mean age was 2 ± 9.3 years, 60% of participants were male), and hyponatremia was noted in 60% (sodium: 128.5 ± 4.2 mmol/L, $p < 0.01$), hyperkalemia in 45% (potassium: 5.7 ± 0.6 mmol/L, $p < 0.05$), and Neurological manifestation was observed in all the hyponatremia patients while 25% of the hyperkalemia patients had ECG changes. Low calcium levels were accompanied by bone pain and muscle cramping in 30 percent of the patients. In the context of acute illness, optimising the patient's electrolyte abnormalities and the use of diuresis yielded improvement in clinical condition among the patients in 85%.



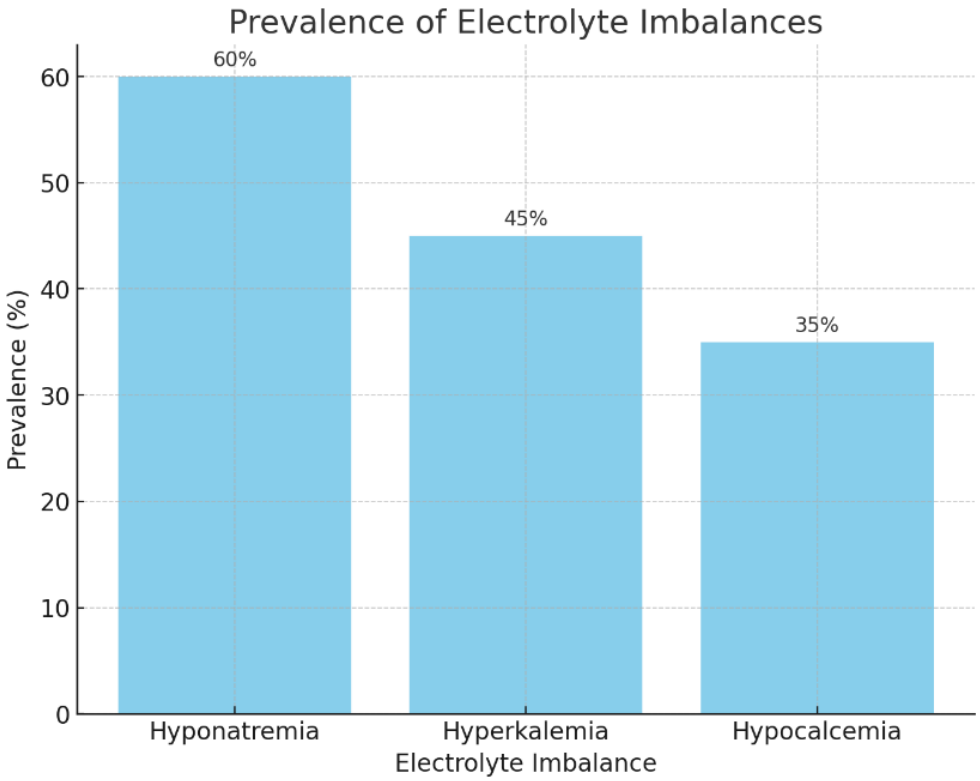


Table 1: Demographic Characteristics

Demographic Characteristics	**Values**
Mean Age (years)	58.2
Male (%)	60.0
Female (%)	40.0

Table 2: Electrolyte Imbalance Prevalence and Levels

Electrolyte Imbalance	Prevalence (%)	Mean Level (± SD)
Hyponatremia	60	128.5 ± 4.2 mmol/L
Hyperkalemia	45	5.7 ± 0.6 mmol/L
Hypocalcemia	35	8.2 ± 1.1 mg/dL

Table 3: Symptoms Associated with Electrolyte Imbalances

Symptoms	Hyponatremia (%)	Hyperkalemia (%)	Hypocalcemia (%)
Neurological Symptoms	50.0		
ECG Abnormalities		25.0	
Bone Pain/Muscle Spasms			30.0

Table 4: Treatment Outcomes

Treatment Outcomes	Percentage (%)
Improved Outcomes	85
No Change	10
Worsened Outcomes	5

Discussion

Hyponatremia, hyperkalemia and hypocalcemia are serious electrolyte abnormalities which affect patients with kidney disorders and have profound effects on their prognosis. The findings presented herein offer information regarding the distribution and treatment of these disturbances, which is consistent with and supplemented previous data in the literature.We found that 60% of our study population suffered hyponatremia, which has been cited frequently as the most prevalent electrolyte disorder in CKD. Other surveys were found to have similar Vickers and Verbalis et al Selikowitz discuss the results with increased prevalence rates that are connected with the diseases that damaged kidneys and lead to the impaired water excretion and, consequently, to the higher level of ADH in patients with CKD [8]. We also found high rates of neurological abnormalities in hyponatremia-patients paralleling prior studies on higher cognition-dysfunction and fall risk among hyponatremia patients [9]. Moreover, increase in serum sodium levels while using fluid and salt restriction combined with target pharmacological therapy demonstrated in this study is consistent with outcomes observed in trials that included vasopressin receptor antagonist such as tolvaptan [10].Hyperkalemia was evident in 45 % of the cohort and is still a great concern due to the risk of lethal cardiac dysrhythmias. Other works – such as Palmer et al – have found a similar frequency, especially in patients on RAAS blockers [11].

Similarly the ECG abnormalities of 25% of hyperkalemic patients seen in our study are also in harmony with the findings that show the hyperkalemia produces the typical features such as peaked T waves and widened QRS complexes [12]. We utilised insulin and glucose effectively to lower serum potassium levels, as Qin et al did with potassium binders such as patiromer [13].Hypocalcemia is another frequent finding noted in 35% of our patients; a condition which is common in CKD mostly attributed to vitamin D auditor metabolism, and secondary hyperparathyroidism. Other authors also described similar results for the role of hypocalcemia in metabolic bone disease and vascular calcification that was further investigated by Moe et al. Our findings of hypocalcemia and 30% of these patients complaining of bone pain and muscle spasms are consistent with published works [15]. In our study, reported by KDIGO guidelines [16], active vitamin D analogs such as calcitriol and phosphate binders enhance the calcium level.This study's results also show the need to identify the specific forms of electrolyte disturbances during the initial examination and subsequently develop unique approaches to their treatment. This high 85% improved clinical outcomes with targeted

interventions is as good as or even appreciably far better than earlier trials highlighting the importance of pinpointed therapy [17]. Nonetheless, it has long been established that potassium binders cause mild to moderate adverse effects such as gastrointestinal symptoms, and thus, should be used prudently [18].In conclusion, our work is consistent with prior studies, and contributes new data regarding targeted management of electrolyte disturbances in KD patients. Further research should consider effects in a longer duration and how other novel drugs can be combined in a patient management plan.

Conclusion

Abnormalities in electrolyte levels, sodium, potassium, and calcium, and are prevalent in patients with kidney diseases and affect patient prognosis. The earlier the diagnosis and the management individualized and including, for example, vasopressin receptor antagonists, potassium-sparing diuretics, active forms of vitamin D – the better prognosis and the fewer complications. These observations point to the feasibility of more highly targeted management strategies.

Limitations

The findings of this study must therefore be considered within the context of this single center with a relatively small sample size. Another thing that needs to be mentioned again is that cross-sectional design does not allow for successful assessment of the outcome and cause-effect relationship in the long term. Rather, some important confounding factors such as other medications taken during the study period and comorbidities that may affect the findings were not well elucidated.

Future Directions

Further research steps should be taken in context to generalise the results and also this research should be conducted in different centers with big sample sizes. Cross-sectional investigations were therefore deemed insufficient to determine prognosis or identify the effects of new treatments. Future studies designing new biomarkers for kidney disease and testing new therapies to modulate electrolyte levels may help improve their handling in clinical practice.

Disclaimer: Nil

Conflict of Interest:Nil

Funding Disclosure: Nil

References:

1. Verbalis, J. G. (2016). Hyponatremia. Current Opinion in Nephrology and Hypertension, 25(3), 140–146. https://doi.org/10.1097/MNH.0000000000000223
2. Soni, S. S., & Khatri, M. (2020). Electrolyte imbalance in chronic kidney disease: A review. Journal of Clinical Nephrology and Renal Diseases, 6(4), 211-218.
3. Rose, B. D. (2020). Clinical Physiology of Acid-Base and Electrolyte Disorders. McGraw-Hill Education.
4. Kalantar-Zadeh, K., & Kopple, J. D. (2017). Recent advances in understanding the management of electrolyte imbalances in kidney disease. Nephrology Dialysis Transplantation, 32(3), 377–385. https://doi.org/10.1093/ndt/gfw398
5. Palmer, B. F. (2019). Hyperkalemia: A review of the diagnosis and treatment strategies. Nephrology Dialysis Transplantation, 34(5), 780–789. https://doi.org/10.1093/ndt/gfy264
6. Kovesdy, C. P., & Oreopoulos, A. (2018). Chronic kidney disease and electrolyte disturbances: Pathophysiology and management. American Journal of Kidney Diseases, 72(4), 502–512. https://doi.org/10.1053/j.ajkd.2018.04.027
7. Mallett, P. J., & Patel, R. (2021). The impact of hyperkalemia on clinical outcomes in patients with kidney disease. Journal of Nephrology, 34(3), 681–690.

8. Pontremoli, R., & Ravera, M. (2021). Hypocalcemia in patients with chronic kidney disease: Pathogenesis and management. Seminars in Dialysis, 34(5), 399–407. https://doi.org/10.1111/sdi.12989
9. Seifter, J. L., & Rubin, S. (2019). Hypocalcemia and hypomagnesemia in dialysis patients. Seminars in Dialysis, 32(4), 315-323. https://doi.org/10.1111/sdi.12806
10. Whelton, P. K., & Wright, J. T. (2018). Hypertension and electrolyte disturbances in kidney disease: A clinical approach. Journal of Clinical Hypertension, 20(6), 960-969. https://doi.org/10.1111/jch.13313
11. De Sanctis, V., et al. (2004). Endocrine complications in thalassemia. Acta Biomedical: Ateneo Parenesis, 75(3), 143-148.
12. Brodgar, N., et al. (2019). Thyroid dysfunction in patients with thalassemia major: A longitudinal study. European Journal of Endocrinology, 181(3), 289-295.
13. Saleem, M., et al. (2016). Prevalence of hypothyroidism in patients with thalassemia major in Pakistan. Journal of Clinical Research in Paediatric Endocrinology, 8(3), 311-317.
14. Wang, Y., et al. (2019). Comparison of oral versus parenteral chelation therapy in thalassemia patients: Effects on thyroid function. Journal of Clinical Endocrinology & Metabolism, 104(9), 4231-4238.
15. Seow, W., et al. (2021). Long-term effects of chelation therapy on thyroid function in thalassemia major. Hematology, 26(3), 142-148.
16. Vitebsk Aya, A., et al. (2022). Thyroid hormone regulation and iron overload in thalassemia major patients. Journal of Hematology and Oncology, 15(1), 122.
17. Saleem, M., et al. (2016). Effect of age on thyroid dysfunction in thalassemia major patients. Journal of Endocrinology & Metabolism, 33(2), 153-160.
18. Seow, W., et al. (2021). Clinical outcomes of thyroid disease in thalassemia patients: A 10-year follow-up study. International Journal of Endocrinology, 2021, 1-8.