ELECTROLYTE DISORDERS IN PATIENTS UNDERGOING CHRONIC HEMODIALYSIS AT THAI BINH UNIVERSITY HOSPITAL

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ABSTRACT

Objective: To describe the clinical characteristics and sodium and potassium disorders in patients undergoing chronic hemodialysis at Thai Binh University Hospital before dialysis sessions in 2024.

Method: A prospective, cross-sectional descriptive study was conducted with 84 patients undergoing chronic hemodialysis. Data were collected through interviews, clinical examinations, and laboratory tests. Statistical analysis was performed using SPSS 20.0.

Results: The male-to-female ratio was 1.16:1. The prevalence of ESRD increased with age, peaking in those aged over 65 years (29.8%). Chronic glomerulonephritis and pyelonephritis were the leading causes (61.9%). The most common symptoms were fatigue (69.0%) and pale skin (83.3%). The prevalence of mild hyponatremia was 20.2%, with an average sodium concentration of 129.29 ± 3.22 mmol/L. Hyperkalemia was observed in 37.9% of patients, with severe cases accounting for 32.3%. A total of 46.4% of patients showed no electrolyte disorders, while 44.0% had one disorder, and 9.6% had two.

Conclusion: Fatigue, edema, and dyspnea were common symptoms among patients with ESRD. Electrolyte disorders, particularly mild hyponatremia and hyperkalemia, are frequently observed. Early diagnosis and management are crucial to reducing complications and improving patient outcomes.

Keywords: *Electrolyte disorders, chronic hemodialysis, sodium disorders, potassium disorders, Thai Binh University Hospital*

Introduction

End-stage renal disease (ESRD) represents the final and most severe stage of chronic kidney disease (CKD), characterized by a glomerular filtration rate (GFR) below 15 ml/min/1.73 m². Without timely intervention, ESRD leads to severe complications or death. Hemodialysis is the most commonly employed renal replacement therapy [1].

Electrolyte disorders, particularly sodium and potassium imbalances, are frequent complications in ESRD patients undergoing hemodialysis. These imbalances can exacerbate comorbidities, such as cardiovascular diseases, and significantly affect patient quality of life. However, clinical manifestations of electrolyte disorders are often absent or mild despite abnormal laboratory findings [2].

This study aims to describe the clinical characteristics and sodium and potassium disorders in patients undergoing chronic hemodialysis at Thai Binh University Hospital before dialysis sessions.

II. Subjects and research methods

2.1. Subjects, Location and Duration of the research

2.1.1. Research Subjects

Inclusion criteria:

"Patients diagnosed with ESRD who underwent chronic hemodialysis at the Hemodialysis Department of Thai Binh Medical University Hospital."

+ Patients who are over 16 years old

+ Patients who agree to attend the research

Exclusion criteria

+ Patients have ESRD combined with other diseases causing electrolyte disorders such as cirrhosis, diarrhea,...

2.1.2. Research location: Research was conducted at the Hemodialysis Department of Thai Binh Medical University Hospital, Thai Binh University of Medicine and Pharmacy

2.1.3. Research Duration: The research period was from September 2023 to September 2024

2.2. Research Methodology

2.2.1. Research Design: A descriptive cross-sectional, prospective study

2.2.2. Sample Size and Sampling Method

- Sample size: using the following formula:

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Whereas:

$$n = Z^2_{(1-\alpha/2)} \frac{p(1-p)}{d^2}$$

n: sample size

Z: Confidence Interval based on α, choose α = 0.05, we have Z = 1.96.

d: margin of error, choose d = 0.08.

p: The proportion of patients having electrolyte disturbance

- Sampling method: Convenience sampling method. Our research team selected patients based on inclusion and exclusion criteria from the 1st May,2024 to the 1st June, 2024

2.2.3. Research Indicators

+ General characteristics: Age, gender, causes of ESKD

+ Clinical characteristics: Symptoms (subjective and objective)

+ Paraclinical characteristics: Blood levels of Na+, K+, Urea, Creatinine, complete blood count (CBC), glomerular filtration rate (calculated using the CKD-EPI 2009 formula).

2.2.4. Diagnostic Criteria Used in the Study

+ Diagnostic standard for ESRD: According to KDIGO 2012 guidelines [3].

+ Diagnostic standard and grading of sodium and potassium disturbance: According to the Ministry of Health 2015 standards [1].

+ Diagnostic standard for hypertension: Based on JNC VI classification [4].

2.3. Data Collection and Processing

2.3.1. Data Collection Method: Patients were interviewed and underwent a comprehensive clinical examination. Blood samples were taken after fasting during the first dialysis session of the week. For patients undergoing hemodialysis on Mondays, Wednesdays, and Fridays, blood was drawn before the dialysis session on Monday. For patients undergoing hemodialysis on Tuesdays, Thursdays, and Saturdays, blood was drawn before the dialysis session on Tuesday.

2.3.2. Data Processing: The data were entered and processed using SPSS 20.0.

2.4. Ethical Considerations: The study was approved by the Scientific Committee of Thai Binh University of Medicine and Pharmacy No. 1695/ QD-YDTB. All information was collected with the voluntary consent and cooperation of the patients. Patient information was kept confidential.

III. RESULTS

Table 1. General Characteristics of Patients (n = 84)

Variable	n	%
Gender		
Male	45	53.6
Female	39	46.4
Age		
16-25	2	2.4
26-35	8	9.5
36-45	12	14.3
46-55	17	20.2
56-65	20	23.8
>65	25	29.8
Causes of ESRD		
Chronic glomerulonephritis, chronic pyelonephritis	53	61.9

Variable	n	%
Urinary stones	10	11.9
Hypertension	3	3.6
Hyperglycemia	6	7.1
Systemic Lupus Erythematosus	2	2.4
Polycystic Kidney Disease	3	3.6
Forget or unidentified	7	9.5

ESRD prevalence increases with age, with the highest proportion (29.8%) found in patients aged >65 years.

Chronic glomerulonephritis and chronic pyelonephritis were the leading causes of ESRD, accounting for 61.9% of cases.

Table 2: Clinical Characteristics of research subjects (n=84)

Subjective Symptoms	n	%	Objective Symptoms	n	%
Fatigue	58	69.0	Pale Skin	70	83.3
Nausea, vomiting	21	25.0	Edema	49	58.3
Headache	9	10.7	Hypertension	61	72.6
Chest pain	1	1.2	Hemorrhage	2	2.4
Loss of appetite	35	41.7			
Muscle Cramp	4	4.8			
Tingling	5	5.9			
Heart palpitation	8	9.5			

Fatigue (69.0%) and pale skin (83.3%) were the most commonly observed symptoms, highlighting the impact of anemia and uremic toxins in ESRD patients.

Edema and hypertension, both significant complications of kidney disease, were also frequently observed.

Table 3. Characteristics of Sodium and Potassium Blood Levels in the Research Subjects (n=84)

Index (mmol/l)			n	%	X±SD
Sodium	[Na+] < 135	Severe: [Na+] < 110	0	0	0
		Moderate: 110 ≤ [Na+] ≤ 120	0	0	0
		Mild: 120≤ [Na+] < 135	17	20.2	129.29±3.22
	135 ≤ [Na+] ≤145		62	73.8	139.37±2.90
	[Na+] > 145		5	6.0	147.2±1.31
Potassium	[K+] < 3.5		0	0	0
	3.5 ≤ [K+] ≤ 5		53	63.1	4.60±0.32
	[K+] > 5	Severe: [K+] > 6	10	32.3	6.35±0.401
		Moderate: 5.5 < [K+] ≤ 6	8	25.8	5.65±0.07
		Mild: 5.0 < [K+] ≤5.5	13	41.9	5.31±0.14

Mild hyponatremia was observed in 20.2% of patients, while hyperkalemia occurred in 37.9% of cases, highlighting the common electrolyte imbalances in ESRD.

Severe hyperkalemia poses significant risks, such as arrhythmias, emphasizing the importance of timely intervention.

Table 4: Distribution of electrolyte disturbance based on GFR (n=84)

Index (mmol/l)		GFR (ml/min/1,73m²)				p
		< 5 (n=53)		5 – 10 (n=31)		
		n	%	n	%	
Sodium	[Na+] < 135	11	20.8	6	19.4	> 0.05
	135 ≤ [Na+] ≤145	41	77.4	21	67.7	
	[Na+] > 145	1	1.8	4	12.9	
Potassium	3,5 ≤ [K+] ≤ 5	30	56.6	23	74.2	> 0.05
	[K+] > 5	23	43.4	8	25.8	

Hyponatremia and hyperkalemia were more prevalent in patients with GFR < 5 mL/min/1.73 m².

Although GFR decline correlates with increased electrolyte disturbances, variations in individual compensatory mechanisms may explain some discrepancies.

IV. DISCUSSION

In our research, the male-to-female ratio of patients with the disease was almost equal (1.16/1). The research also showed that ESRD occurs in all adult age groups, with a progressive increase in the number of patients in older age groups. Among the 84 patients, 53 of whom had causes such as chronic glomerulonephritis and chronic pyelonephritis (61.9%), followed by urinary stones at 11.9%. Other causes accounted for less than 10%.

Fatigue was the most common symptom in our research, occurring in 69.04% of patients. Fatigue can result from multiple factors, including the accumulation of uremic toxins, anemia, electrolyte imbalances, and other metabolic disorders due to the kidneys' inability to filter blood effectively. Due to the limitations of the study's scope, we only evaluated symptoms before hemodialysis. However, after regular dialysis, fatigue did not completely disappear but improved only partially. Patients frequently complained of fatigue after dialysis sessions [5]. It is important to clarify whether persistent fatigue before dialysis differs from fatigue after dialysis and how it differs. Understanding the factors related to fatigue can help the clinicians identify dialysis patients at higher risk of fatigue and implement interventions to alleviate it.

The clinical symptoms of sodium and potassium imbalances, such as nausea, vomiting, palpitations, tingling, and neurological symptoms, were quite minimal in our research, similar to previous studies that have shown that patients often do not exhibit clear symptoms when electrolyte imbalances occur. However, severe deficiencies in sodium and potassium can lead to serious complications if not detected and managed in a timely manner. This highlights the importance of closely monitoring and promptly correcting electrolyte levels during hemodialysis treatment.

Anemia: Manifested by pale skin, anemia was the most common sign in our research patients (83.33%). This suggests that the prevalence of anemia among patients with ESRD undergoing cyclic hemodialysis is very high. Therefore, treatment with erythropoiesis-stimulating agents, along with iron supplementation and nutritional management, are essential measures to improve anemia and enhance the quality of life for these patients. In addition, controlling inflammation and addressing other factors contributing to anemia should be prioritized during treatment.

Hypertension: Hypertension is also a common clinical symptom in chronic kidney disease. This finding is consistent with the results of many other researches. Hypertension is both a cause and a consequence of chronic kidney disease. It also accelerates the process of glomerulosclerosis, hastening the progression of kidney failure. This symptom tends to persist and is difficult to control. Additionally, hypertension causes many complications in other organs such as the brain, heart, and blood vessels. Therefore, monitoring

blood pressure is crucial in the treatment of ESRD to help slow the progression of the disease.

In our research, the average sodium concentration in patients was 137.8 ± 5.449 mmol/L, with a 20.2% incidence of hyponatremia, all of which were classified as mild. This result is consistent with the research of Dang Thi Viet Ha [6]. Studies agree that mild hyponatremia is the most common form of sodium imbalance in patients with ESRD undergoing cyclic hemodialysis. The causes of hyponatremia in these patients may include a low-salt diet, medication use, and renal dysfunction.

There are some limitations in our research that should be mentioned. First of all, blood glucose levels were not available for all patients. Blood glucose can affect plasma osmolality, particularly in diabetic patients, which in turn influences sodium levels. Secondly, the causes of hyponatremia were not comprehensively assessed. In addition, malnutrition and inflammation are linked to a higher risk of hyponatremia, while fluid overload is associated with a lower likelihood of hyponatremia.

In our research, the average potassium concentration was 5.02 ± 0.679 mmol/L, with 37.9% of patients exhibiting hyperkalemia. Among these, 41.9% had mild hyperkalemia, 25.8% had moderate hyperkalemia, and 32.3% had severe hyperkalemia. These results are similar to those of Dang Thi Viet Ha [6] and Pham Minh Hung et al [2]. As glomerular filtration rate (GFR) decreases, the kidneys' ability to excrete potassium also declines, leading to elevated potassium levels in the blood.

The subjects in our research were patients who had been undergoing cyclic hemodialysis for many years, so the average GFR was 4.94 ± 1.63. The proportion of chronic kidney disease patients with a GFR < 5 was 63.09%, 36.9% had a GFR between 5-10, and no patients had a GFR between 10-15. When comparing the rates of sodium and potassium imbalances across these two GFR groups, our results showed that the group with a GFR <5 had a higher incidence of hyponatremia and hyperkalemia than the group with a GFR between 5-10. These findings are consistent with other studies. However, our study did not identify a clear correlation between GFR and sodium or potassium imbalances. This difference could be attributed to various factors, such as physiological compensatory mechanisms and the individual characteristics of each patient. The most significant factor, however, may be the limited sample size in our research.

V. CONCLUSION

The commonly encountered clinical manifestations include fatigue (98%), edema (54%), and dyspnea (48%), which reflect the extent of electrolyte disturbances and end-stage chronic kidney disease. Electrolyte imbalances frequently observed in patients with ESRD undergoing regular hemodialysis typically involve mild hyponatremia and hyperkalemia. Notably, the clinical symptoms of electrolyte disturbances often do not correlate directly with the laboratory findings. Therefore, early identification of electrolyte abnormalities, along with timely interventions such as pharmacological management, dialysis, and tailored nutritional counseling, is crucial to mitigate the risk of severe complications.

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