Assessment of Sodium Disturbances in Chronic Liver Disease Suffering from Diarrhea with Dehydration

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Abstract

Background: Chronic liver disease (CLD) significantly impacts global health, affecting nearly 1.5 billion individuals. Sodium disturbances are common in CLD and can lead to severe systemic effects. However, the relationship between these disturbances and CLD-related complications such as diarrhea and dehydration is complex and not fully understood.

Objective: To assess the sodium disturbances in chronic liver disease patients suffering from diarrhea with dehydration presenting at a tertiary care hospital, in Karachi, Pakistan.

Methodology: A cross-sectional study was conducted from October 2022 to July 2023, including individuals aged >18 years diagnosed with CLD, experiencing diarrhea and dehydration, and on diuretic therapy. The blood sample was collected from all of the participants and sent to a laboratory for analysis. The blood is then tested to measure the concentration of sodium in milliequivalents per liter (meq/L). The normal range for sodium levels in the blood typically falls between 135 to 145 meq/L. Levels below or above this range can indicate sodium imbalances. Descriptive statistics and inferential statistics were performed on SPSS.

Results: The mean age of the participants was 33.35 years, with a standard deviation of 8.01. Of 126 patients, 38.1% were male, 27% had hypertension, and 15.1% had diabetes. The mean sodium concentration was found as 132.17±14.23 meq/L, with 42.9% of CLD patients experiencing diarrhea and dehydration having sodium levels <135 meq/L. Diabetic CLD patients showed a significant association with low sodium levels (73.7% with sodium <135 meq/L).

Conclusion: A high prevalence of sodium imbalances among CLD patients suffering from diarrhea and dehydration, with diabetes being a significant contributing factor.

Keywords: *Sodium, chronic liver disease, diarrhea, dehydration, hyponatremia.*

INTRODUCTION

Chronic liver disease represents a significant global health burden, impacting almost 1.5 billion individuals worldwide [1]. Chronic liver disease (CLD) encompasses a spectrum of pathological conditions that result from prolonged inflammation and liver injury, leading to cirrhosis, fibrosis, and impaired hepatic function [2]. In Europe, the estimated incidence rate of CLD is 26 per 100,000, while, in Asia, rates vary between 16.5 to 23.6 per 100,000 [1].

One of the common complications of CLD is the development of sodium disturbances, and almost 20% of the patients with cirrhosis have sodium levels less than 130 meq/L [3]. Sodium plays a pivotal role in maintaining fluid balance, cellular homeostasis, and neuromuscular function [4]. Alterations in sodium levels can have profound systemic effects, especially in the context of CLD, where hepatic dysfunction disrupts the intricate regulatory mechanisms involved in sodium handling [5, 6]. Furthermore, sodium disturbance is relatively higher in individuals suffering from diarrhea with dehydration [6].

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Diarrhea is a frequent complication in individuals with CLD, affecting almost 13.3% of individuals. It can be attributed to various factors, including impaired bile acid metabolism and bacterial overgrowth [7, 8]. Chronic diarrhea contributes to electrolyte imbalances and dehydration, exacerbating the challenges in sodium homeostasis [9].

The interplay between sodium disturbances and CLD-related complications, such as diarrhea and dehydration, remains a complex and poorly understood area of research. This study aims to assess the sodium disturbances in individuals with CLD who experience diarrhea and dehydration. By elucidating the complex relations between hepatic dysfunction, sodium homeostasis, and fluid balance, this study seeks to provide valuable insights into the pathophysiological underpinnings of sodium disturbances in this specific clinical context.

METHODOLOGY

This was a cross-sectional study conducted at the Department of Gastroenterology, Zubeida Medical Care, Karachi, Pakistan from Oct 2022 to Jul 2023. A sample size of 126 was estimated using the Open Epi Sample Size Calculator, by taking statistics of sodium level <130 meq/L as 20% in CLD [3], margin of error as 7%, and 95% confidence level. Inclusion criteria encompassed

individuals aged>18 years diagnosed with CLD, including cirrhosis and other related conditions, experiencing diarrhea and dehydration, and were on diuretics use. Exclusion criteria comprised patients with cancer, heart diseases, hepatic encephalopathy gastrointestinal bleeding, and history of renal dysfunction.

This study adhered to the ethical guidelines outlined by the IRB of the institute. Written informed consent was obtained from all participants before their inclusion in the study. Confidentiality of participant data was rigorously maintained throughout the research process. The presence of abnormally loose or liquid bowel movements, occurring at a frequency of three or more times within 24 hours was labelled as diarrhea episodes, while dehydration was assessed through clinical evaluation by increased thirst, dry mouth, decreased urine output, dark-colored urine, dry skin, sunken eyes, and altered mental status. Demographic and clinical data were gathered through comprehensive medical history reviews, physical examinations, and laboratory assessments. All data was recorded on pre-designed proforma. The blood sample was collected from all of the participants and sent to a laboratory for analysis. The blood is then tested to measure the concentration of sodium in milliequivalents per liter (meq/L). The normal range for sodium levels in the blood typically falls between 135 to 145 meq/L. Levels below or above this range can indicate sodium imbalances.

Descriptive statistics, such as means, standard deviations, and percentages, were used to summarize numeric and categorical data, respectively. Numeric data included age, BMI, duration of CLD, and sodium concentration. Categorical data included gender, causes of CLD, hypertension, diabetes, and sodium levels. Comparison of age, BMI, duration of CLD, gender, causes of CLD, hypertension, and diabetes with sodium levels was done using the Chi-square/Fisher Exact test. A p-value≤0.05 was considered statistically significant.

RESULTS

The mean age of the participants was 33.35 years, with a standard deviation of 8.01. Participants had an average body mass index (BMI) of 26.39 kg/m², with a standard deviation of 4.39. The mean duration of chronic liver disease was 8.17 months, with a standard deviation of 1.67. Among the participants, 38.1% were male, 27% had hypertension, and 15.1% had diabetes. The majority of CLD cases were attributed to hepatitis C virus (HCV), accounting for 91 cases (72.2%). Hepatitis B virus (HBV) was responsible for 16 cases (12.7%), while 12 cases (9.5%) were attributed to co-infection with both HCV and HBV. Additionally, 7 cases (5.6%) had an unknown cause of CLD (**Table 1**).

The mean serum sodium concentration was 132.17±14.23 meq/L. About 47.6% of the patients had sodium levels in the normal range (135-145 meq/L), whereas, 42.9% of the patients had sodium levels <135 meq/L and 9.5% had sodium levels>145 meq/L (**Fig. 1**).

Table 1: Baseline characteristics of study participants (n=126).

Variables	Mean±SD or n (%)
Age (years)	33.35±8.01
BMI (kg/m2)	26.39±4.39
Duration of CLD (months)	8.17±1.67
Gender	
Male	48 (38.1%)
Female	78 (61.9%)
Hypertension	
Yes	34 (27%)
No	96 (76.2%)
Diabetes	
Yes	19 (15.1%)
No	107 (84.9%)
Causes of CLD	
HCV	91 (72.2%)
HBV	16 (12.7%)
HCV+HBV	12 (9.5%)
Unknown	7 (5.6%)

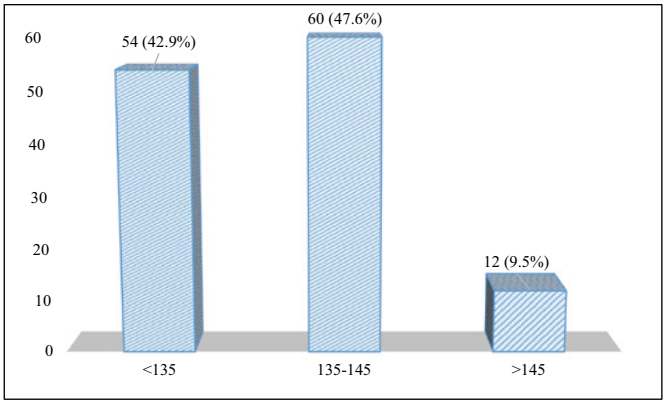

Fig. (1): Frequency distribution of sodium levels (n=126).

Sodium levels were found to be significantly different among diabetic and non-diabetic patients with p-value=0.001. About 73.7% of the diabetic patients had sodium<135 meq/L. However, no significant difference was observed between sodium levels and age groups, gender, BMI categories, duration of CLD, hypertension, and causes of CLD with p-values>0.05 (**Table 2**).

Table 2: Comparison of baseline characteristics and sodium levels (n=126).

Variables	Level of sodium			p-value
	<135 n(%)	135-145 n(%)	>145 n(%)	
Age groups				
≤25 years	16 (53.3)	10 (33.3)	4 (13.3)	0.192
>25 years	38 (39.6)	50 (52.1)	8 (8.3)	
Gender				
Male	29 (37.2)	40 (51.3)	9 (11.5)	0.224
Female	25 (52.1)	20 (41.7)	3 (6.3)	
BMI categories				
<30 kg/m²	45 (43.3)	50 (48.1)	9 (8.7)	0.699
≥30 kg/m²	9 (40.9)	10 (45.5)	3 (13.9)	

Variables	Level of sodium			p-value
	<135 n(%)	135-145 n(%)	>145 n(%)	
Duration of CLD				
≤6 months	8 (32)	16 (64)	1 (4)	0.241
>6 months	46 (45.5)	44 (43.6)	11 (10.9)	
Diabetes				
Yes	14 (73.7)	5 (26.3)	0(0)	0.010*
No	40 (37.4)	55 (51.4)	12 (11.2)	
Hypertension				
Yes	18 (52.9)	13 (38.2)	3 (8.8)	0.389
No	36 (39.1)	47 (51.1)	9 (9.8)	
Causes of CLD				
HCV	36 (39.6)	45 (49.5)	10 (11)	0.525
HBV	6 (37.5)	9 (59.3)	1 (6.3)	
HCV+HBV	8 (66.7)	4 (33.3)	0(0)	
Unknown	4 (57.1)	2 (28.6)	1 (14.3)	

DISCUSSION

Sodium imbalances in CLD are crucial for patient management due to their broad spectrum of systemic effects [10], ranging from mild symptoms like malaise and fatigue to severe outcomes such as seizures and coma [11, 12]. Therefore, addressing sodium imbalances is integral to the overall care and prognosis of CLD patients [13-15]. Sodium imbalances in CLD are multifactorial, often arising from impaired hepatic function, ascites, renal dysfunction, and hormonal imbalances. The liver plays a crucial role in maintaining sodium balance by secreting proteins like albumin and producing hormones like aldosterone [16, 17] Consequently, hepatic dysfunction disrupts this delicate equilibrium, leading to sodium imbalances [18, 19]. Our study aimed to delve deeper into the dynamics of sodium disturbances in CLD, particularly in patients experiencing diarrhea with dehydration and on diuretic therapy, to address the gaps identified in the existing literature and to refine the understanding of sodium management in this vulnerable population.

Our analysis revealed that 42.9% of CLD patients with diarrhea and dehydration had sodium levels below 135 meq/L, indicating a significant prevalence of hyponatremia. This finding is consistent with other studies that have documented hyponatremia in CLD patients. In the study by Singh et al., the mean sodium concentration was 131.2±9.2 meq/L and almost 47% of the cirrhotic patients had sodium levels <130 meq/L [3]. In another study by Kim et al., 20.8% of the cirrhotic patients had sodium levels ≤135 mmol/L and 14.9% of the patients had sodium levels ≤130 mmol/L. Furthermore, they found a strong correlation between the severity of liver disease and sodium level (p=0.0001) [20]. In the study by Devrajani et al., out of 87 patients with liver disease and hepatic encephalopathy, 24 patients had hyponatremia [15]. Another study by Angeli *et al.* found low sodium levels (≤135 mmol/L) in 49.4% of cirrhotic patients [21]. However, our research further emphasizes the acute risks associated with dehydration and diuretic use. Diuretics, while essential for managing fluid overload in CLD [22], can complicate sodium balance, highlighting the need for careful sodium management strategies.

Addressing the critical concern of diarrhea-induced hyponatremia, our study elucidates how acute gastrointestinal losses disrupt the delicate sodium-water homeostasis in CLD patients [13, 23]. The rapid fluid and electrolyte shifts can exacerbate hyponatremia, underscoring the importance of proactive management to mitigate these disturbances swiftly [13, 23]. Our findings demonstrate the acute vulnerability of CLD patients to sodium imbalances, advocating for vigilant monitoring and tailored interventions, especially in the face of diuretic use and dehydration.

In addition, our research highlights the exacerbated risk of hyponatremia in diabetic CLD patients, contributing to the body of evidence on the complex interplay between diabetes and sodium regulation. Diabetes can influence sodium handling through multiple mechanisms, including alterations in the renin-angiotensin-aldosterone system (RAAS) and increased fluid intake due to polydipsia [24, 25]. These factors, when coupled with the disrupted sodium homeostasis inherent in CLD, exacerbate hyponatremia [25]. This underscores the importance of a multidisciplinary approach to care involving gastroenterologists, hepatologists, and endocrinologists, involving tailored dietary plans, fluid restrictions, and medications to optimize sodium levels and glycemic control.

Comparing our results with existing studies, we identify a gap in the literature regarding the specific challenges posed by diuretic use and acute dehydration in the context of CLD. Our study's unique demographic and clinical insights offer a new perspective on managing sodium disturbances, calling for further research into the underlying pathophysiological mechanisms. This gap points towards an urgent need for future studies to explore the complexities of sodium balance in CLD patients more comprehensively, aiming to develop targeted management strategies.

Our study has a few limitations. This study was conducted in a single tertiary care hospital in Karachi, Pakistan. The findings may not fully represent the diversity of CLD patients across different regions, and broader multi-center studies are needed for more comprehensive insights. The sample size of 126 participants may limit the generalizability of the findings. Larger sample sizes could provide a more robust understanding of sodium disturbances in CLD patients. The cross-sectional nature of this study allows for the observation of associations but doesn't establish causation. Longitudinal studies could provide valuable insights into the progression of sodium disturbances in CLD over time.

CONCLUSION

Our findings highlight a high prevalence of sodium imbalances among CLD patients suffering from diarrhea and dehydration, with diabetes being a significant contributing factor. This underscores the need for vigilant monitoring and tailored management strategies to address sodium disturbances in this patient population, ultimately aiming to improve clinical outcomes and quality of life.

ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Review Committee of Zubaida Medical Centre, Karachi (REF letter No. ERC – 1434/2023). All procedures performed in studies involving human participants were following the ethical standards of the institutional and/ or national research committee and with the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was taken from the participants.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

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Declared none.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

All the authors contributed equally to the publication of this article.

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