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A Study of Electrolyte Imbalance in Patients with Chronic Liver Disease

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ABSTRACT

Introduction: Chronic liver disease is a progressive condition associated with significant metabolic, hemodynamic, and renal alterations that frequently lead to electrolyte disturbances. Abnormalities of sodium, potassium, calcium, and magnesium are particularly common in advanced liver disease and may contribute to complications such as ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and renal dysfunction. Therefore, the present study aims to determine the pattern of electrolyte imbalance among patients with chronic liver disease. **Methods & Materials:** This prospective cross-sectional analytical study was conducted in the Department of Medicine of Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh from January 2023 to December 2023 to assess electrolyte imbalance among patients with chronic liver disease (CLD). A total of 110 adult patients diagnosed with CLD were selected by purposive sampling. Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. **Result:** Among 110 patients with chronic liver disease, 71.8% had at least one electrolyte abnormality. Hyponatremia was the most common disturbance (43.6%), followed by hypocalcemia (37.3%), hypomagnesemia (28.2%), and hypokalemia (24.5%). Electrolyte imbalances were significantly more frequent in decompensated liver disease, with hyponatremia present in 56.9% of decompensated patients compared with 18.4% of compensated patients. Hyponatremia was also significantly associated with ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and renal dysfunction. **Conclusion:** Electrolyte abnormalities were very common in patients with chronic liver disease, with hyponatremia occurring most frequently, followed by hypocalcemia, hypomagnesemia, and hypokalemia. These imbalances were observed significantly more often in patients with decompensated liver disease and showed a strong association with important clinical complications, including ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and renal dysfunction.

Keywords: *Electrolyte Imbalance, Chronic liver disease, Hyponatremia*

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INTRODUCTION

Chronic liver disease (CLD) is defined as a progressive deterioration of liver structure and function lasting for more than six months, characterized by persistent hepatic inflammation, fibrosis, and eventual cirrhosis with portal hypertension and hepatic insufficiency [1]. The condition results from a variety of etiologies, including chronic hepatitis B and C infections, alcohol-related liver disease, non-alcoholic fatty liver disease (NAFLD), autoimmune hepatitis, and metabolic disorders. As the disease advances, profound disturbances occur in fluid balance, renal function, and electrolyte homeostasis. CLD is a major public health challenge worldwide. According to global estimates, cirrhosis accounts for more than 1.3 million deaths annually and is among the leading causes of years of life lost [2]. The burden is particularly high in low- and middle-income countries where viral hepatitis remains prevalent, and access to specialized hepatology care is limited. In South Asia, including Bangladesh, chronic hepatitis B and NAFLD are increasingly recognized as major contributors to cirrhosis and its complications [3]. The rising prevalence of obesity, diabetes mellitus, and metabolic syndrome is expected to further increase the burden of chronic liver disease in the coming decades [4]. Electrolyte imbalance is one of the most frequent and clinically significant complications of CLD. Electrolytes such as sodium, potassium, calcium, magnesium, and chloride are essential for maintaining cellular membrane potential, neuromuscular activity, acid–base equilibrium, and extracellular fluid balance. In cirrhosis, marked splanchnic vasodilation leads to a reduction in effective arterial blood volume, which activates the renin–angiotensin–aldosterone system, sympathetic nervous system, and non-osmotic release of arginine vasopressin [5]. These neurohormonal changes promote sodium and water retention, impair renal free-water excretion, and predispose patients to dilutional hyponatremia and other electrolyte abnormalities. Hyponatremia is the most common electrolyte disorder in cirrhosis, occurring in approximately 20–50% of hospitalized patients with advanced liver disease [6]. It is strongly associated with refractory ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, hepatorenal syndrome, prolonged hospital stay, and increased mortality. Because of its prognostic importance, serum sodium has been incorporated into the MELD-Na score used for liver transplantation prioritization [7]. Potassium disorders are also common; hypokalemia may result from secondary hyperaldosteronism, excessive diuretic therapy, vomiting, diarrhea, or poor nutritional intake, whereas hyperkalemia may occur in advanced liver failure or renal dysfunction [5]. Both abnormalities may precipitate cardiac arrhythmias and worsen hepatic encephalopathy. In addition, hypocalcemia and hypomagnesemia are frequently observed in patients with decompensated cirrhosis due to malnutrition, vitamin D deficiency, impaired hepatic metabolism, hypoalbuminemia, and renal losses [8]. These disturbances may contribute to muscle cramps, weakness, neuromuscular irritability, osteoporosis, and reduced quality of life. Previous studies have demonstrated that the frequency and severity of electrolyte imbalance increase with worsening liver function and are more common in decompensated than compensated disease [6,7]. Despite the recognized clinical importance of electrolyte abnormalities, data from Bangladesh remain limited, and local patterns may differ because of variations in etiology, nutritional status, healthcare access, and treatment practices. Regular monitoring and timely correction of electrolyte disturbances are recommended by international guidelines as an integral component of the management of decompensated cirrhosis [9]. Therefore, the present study aims to determine the pattern

of electrolyte imbalance among patients with chronic liver disease.

METHODS & MATERIALS

This prospective cross-sectional analytical study was conducted in the Department of Medicine of Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh from January 2023 to December 2023 to assess electrolyte imbalance among patients with chronic liver disease (CLD). A total of 110 adult patients diagnosed with CLD on the basis of clinical features, biochemical tests, and ultrasonographic findings were enrolled by purposive sampling after obtaining written informed consent. Patients with acute liver failure, advanced chronic kidney disease, congestive heart failure, those receiving dialysis, pregnant women, and critically ill patients were excluded. Data were collected using a pretested structured case record form that included demographic information, etiology of liver disease, clinical findings, and complications such as ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and renal dysfunction. Venous blood samples were analyzed for serum sodium, potassium, chloride, calcium, magnesium, liver function tests, and serum creatinine. Electrolyte abnormalities were defined according to standard laboratory reference values, including hyponatremia (<135 mmol/L), hypokalemia (<3.5 mmol/L), hyperkalemia (>5.0 mmol/L), hypocalcemia (<2.1 mmol/L), hypomagnesemia (<0.7 mmol/L), and hypochloremia (<96 mmol/L). Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Associations between categorical variables were assessed using the Chi-square test. A p-value of <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Review Board of the hospital, and confidentiality of all participants was strictly maintained throughout the study.

RESULTS

Most patients belonged to the 40–59 years age group (46.4%), followed by ≥60 years (33.6%). The mean age was 54.2 ± 11.8 years. Males predominated, accounting for 65.5% (72/110) of the study population (*Table I*).

Table I

Baseline Demographic Characteristics of the Study Population (*n* = 110).

Variables	Frequency (n)	Percentage (%)
Age		
18–39 years	22	20.0
40–59 years	51	46.4
≥60 years	37	33.6
Mean age ± SD	54.2 ± 11.8 years	
Sex		
Male	72	65.5
Female	38	34.5
Total	110	100.0

Chronic hepatitis B was the leading etiology (35.5%), followed by NAFLD (26.4%) and alcohol-related liver disease (20.0%). Nearly two-thirds of patients (65.5%) had decompensated CLD, indicating advanced liver disease in the majority of participants (*Table II*).

Table II

Etiology and Severity of Chronic Liver Disease (*n* = 110).

Variables	Frequency (n)	Percentage (%)
Etiology		
Chronic hepatitis B	39	35.5
Non-alcoholic fatty liver disease	29	26.4
Alcohol-related liver disease	22	20.0
Chronic hepatitis C	14	12.7
Others	6	5.4
Total	110	100.0
Severity		
Compensated CLD	38	34.5
Decompensated CLD	72	65.5
Total	110	100.0

Overall, 71.8% (79/110) of patients had at least one electrolyte abnormality. Hyponatremia was the most frequent disorder (43.6%), followed by hypocalcemia (37.3%), hypomagnesemia (28.2%), and hypokalemia (24.5%). Hyperkalemia was observed in 8.2% of patients (*Table III*).

Table III

Serum Electrolyte Profile and Incidence of Electrolyte Imbalance (*n* = 110*).

Electrolyte	Abnormality	n (%)
Sodium	Hyponatremia (<135 mmol/L)	48 (43.6)
Potassium	Hypokalemia (<3.5 mmol/L)	27 (24.5)
Potassium	Hyperkalemia (>5.0 mmol/L)	9 (8.2)
Calcium	Hypocalcemia (<2.1 mmol/L)	41 (37.3)
Magnesium	Hypomagnesemia (<0.7 mmol/L)	31 (28.2)
Chloride	Hypochloremia (<96 mmol/L)	22 (20.0)
Any electrolyte imbalance	At least one abnormality	79 (71.8)

**Multiple responses.*

Patients with hyponatremia had significantly higher rates of ascites (87.5% vs 59.7%), hepatic encephalopathy (43.8% vs 17.7%), spontaneous bacterial peritonitis (20.8% vs 6.5%), and renal dysfunction (33.3% vs 12.9%) (*Table IV*).

Table IV
Clinical Complications According to Hyponatremia Status (*n*=110).

Clinical complication	Hyponatremia (n=48)	Normal sodium (n=62)	p-value*
Ascites	42 (87.5%)	37 (59.7%)	0.001
Hepatic encephalopathy	21 (43.8%)	11 (17.7%)	0.003
Spontaneous bacterial peritonitis	10 (20.8%)	4 (6.5%)	0.024
Renal dysfunction	16 (33.3%)	8 (12.9%)	0.011

**Chi-square test.*

Electrolyte abnormalities were significantly more common in decompensated CLD. Hyponatremia was present in 56.9% of decompensated patients compared with 18.4% of compensated patients (p<0.001). Overall, 84.7% of decompensated patients had at least one electrolyte imbalance, versus 47.4% of compensated patients (*Table V*).

Table V
Association Between Electrolyte Imbalance and Severity of Liver Disease (*n*=110).

Electrolyte abnormality	Compensated (n=38)	Decompensated (n=72)	p-value
Hyponatremia	7 (18.4%)	41 (56.9%)	<0.001
Hypokalemia	5 (13.2%)	22 (30.6%)	0.041
Hypocalcemia	8 (21.1%)	33 (45.8%)	0.009
Hypomagnesemia	6 (15.8%)	25 (34.7%)	0.031
Any electrolyte imbalance	18 (47.4%)	61 (84.7%)	<0.001

**Chi-square test.*

DISCUSSION

In this study of 110 patients with chronic liver disease (CLD), the largest age group was 40–59 years (46.4%), followed by ≥60 years (33.6%), with a mean age of 54.2 ± 11.8 years; males constituted 65.5% of the participants. Rahman et al. reported a male predominance of 68% and a mean age of 52 years among Bangladeshi CLD patients, showing a very similar demographic pattern [10]. The predominance of middle-aged and older men is also consistent with the epidemiology of chronic viral hepatitis and metabolic liver disease in South Asia [11]. Regarding etiology and disease severity, chronic hepatitis B was the leading cause in this study (35.5%), followed by non-alcoholic fatty liver disease (26.4%), alcohol-related liver disease (20.0%), and hepatitis C (12.7%); 65.5% of patients had decompensated CLD. Rahman et al. found hepatitis B in 42%, NAFLD in 24%, alcohol-related disease in 18%, and decompensated cirrhosis in 62% of cases [10]. The slightly lower hepatitis B and slightly higher NAFLD percentages in this study may reflect the ongoing epidemiologic transition toward metabolic liver disease, as highlighted in recent global data [11]. Electrolyte imbalance was highly prevalent in this cohort. Overall, 71.8% of patients had at least one electrolyte abnormality; hyponatremia was present in 43.6%, hypocalcemia in 37.3%, hypomagnesemia in 28.2%, hypokalemia in 24.5%, hyperkalemia in 8.2%, and hypochloremia in 20.0%. Singh et al. reported hyponatremia in 49%, hypokalemia in 30%, and hypocalcemia in 16% among 100 CLD patients [12]. Rahman et al. observed hyponatremia in 58%, hypokalemia in 36%, and hypocalcemia in 41% [10]. Although the exact frequencies differed, all studies identified hyponatremia as the most common electrolyte disturbance in CLD. The lower prevalence of hyponatremia in this study compared with Rahman et al. may be related to differences in the percentages of advanced cirrhosis and diuretic exposure. This study showed that hyponatremic patients had substantially more complications than patients with normal sodium levels. Ascites occurred in 87.5% versus 59.7%, hepatic encephalopathy in 43.8% versus 17.7%, spontaneous bacterial peritonitis in 20.8% versus 6.5%, and renal dysfunction in 33.3% versus 12.9% (all statistically significant). Barakat et al. found that hyponatremia was associated with ascites in 86%, hepatic encephalopathy in 44%, spontaneous bacterial peritonitis in 21%, and renal impairment in 31% of decompensated cirrhotic patients [13]. Younas et al. also demonstrated a strong association between hyponatremia and hepatic encephalopathy, with encephalopathy present in 87.5% of hyponatremic patients [14]. These findings support the concept that hyponatremia reflects severe circulatory and renal dysfunction in advanced cirrhosis. In this study, electrolyte abnormalities were markedly more frequent in decompensated than compensated disease. Hyponatremia was found in 56.9% versus 18.4%, hypokalemia in 30.6% versus 13.2%, hypocalcemia in 45.8% versus 21.1%, hypomagnesemia in 34.7% versus 15.8%, and any electrolyte imbalance in 84.7% versus 47.4%. Jiménez et al. described that electrolyte disturbances become increasingly common as cirrhosis progresses to ascites, renal failure, and other decompensating events [15]. Current EASL guidance also recognizes hyponatremia and associated electrolyte abnormalities as important markers of advanced liver disease and poor prognosis [16].

LIMITATIONS

It was conducted in a single tertiary care hospital with a relatively small sample size, which may limit the generalizability of the findings to the broader population of patients with chronic liver disease. In addition, variations in ongoing treatment, nutritional status, and diuretic use could have influenced serum electrolyte levels.

CONCLUSION

Electrolyte imbalance was seen among patients with chronic liver disease, with hyponatremia being the most common abnormality, followed by hypocalcemia, hypomagnesemia, and hypokalemia. These disturbances were significantly more frequent in decompensated liver disease and were strongly associated with major clinical complications such as ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and renal dysfunction.

RECOMMENDATION

Regular monitoring of serum electrolytes should be incorporated into the routine management of patients with chronic liver

disease, particularly those with decompensated cirrhosis. Early detection and prompt correction of electrolyte abnormalities may help reduce complications such as hepatic encephalopathy, renal dysfunction, and spontaneous bacterial peritonitis. Further multicenter studies with larger sample sizes are recommended to better evaluate the prognostic significance of electrolyte disturbances in chronic liver disease.

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CONFLICT OF INTEREST
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