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Original Research Article

FREQUENCY OF ELECTROLYTE ABNORMALITIES IN PATIENTS WITH DECOMPENSATED CHRONIC LIVER DISEASE

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Abstract: *Electrolyte abnormalities, particularly those involving sodium, potassium, magnesium, calcium, and phosphate, are commonly observed in patients with decompensated chronic liver disease (DCLD).* ***Objective:*** *The basic aim of the study is to find the frequency of electrolyte abnormalities in patients with decompensated chronic liver disease.* ***Methodology:*** *This cross-sectional observational study was carried out at Lady Reading Hospital, Peshawar, from January 2024 to May 2024. The study included a total of 235 patients diagnosed with decompensated chronic liver disease. Patients aged >18 years with a confirmed diagnosis of chronic liver disease in the decompensated stage, characterized by complications such as ascites, variceal bleeding, or hepatic encephalopathy.* ***Results:*** *Data were collected from 235 patients with a mean age of 52.3 ± 10.4 years, with a male predominance (59.6%). Common comorbidities among participants included hypertension (45.5%), diabetes mellitus (30.6%), and chronic hepatitis C infection (60.9%). These underlying conditions highlight the complex health profile of patients with decompensated chronic liver disease, which may further influence electrolyte imbalances and overall disease outcomes. Sodium levels deviated from the normal range in 67.2% of patients, with hyponatremia observed in 60.9% (mean sodium level 132.5 ± 6.3 mmol/L) and hypernatremia in 6.4%. Potassium abnormalities were found in 49.4% of patients, with 37.0% exhibiting hypokalemia and 12.3% showing hyperkalemia (mean potassium level 4.0 ± 0.7 mmol/L). Hypocalcemia was prevalent in 44.3% of patients, with an average calcium level of 8.0 ± 0.6 mg/dL. Hypomagnesemia and hypophosphatemia were less common but still present in 25.1% and 20.4% of patients, respectively. These abnormalities underscore the need for vigilant electrolyte monitoring in DCLD patients.* ***Conclusion:*** *It is concluded that electrolyte abnormalities are highly prevalent in patients with decompensated chronic liver disease and are strongly associated with increased disease severity, complications, and poor outcomes.*

Keywords: Electrolyte Imbalance Liver Diseases, Chronic Hyponatremia Hypokalemia Cross-Sectional Studies

Introduction

Electrolyte abnormalities, particularly those involving sodium, potassium, magnesium, calcium, and phosphate, are commonly observed in patients with decompensated chronic liver disease (DCLD). Some prior published research indicates that these imbalances stem from dynamic interactions between hepatic encephalopathy, renal dysfunction, and pathophysiological changes in chronic liver diseases. DCLD is an acronym that means the final stage of chronic liver diseases including; hepatic encephalopathy, ascites, and variceal bleeding (1). These complications not only indicate disease progression but also affect the homeostatic balance of the body and thus affect more severely the patients' electrolyte imbalances. These disturbances have several metabolic consequences related to neurological, cardiovascular, and muscle functions, and the complications which may occur if they are not addressed can be lethal (2). Hyponatremia is another frequently identified electrolyte derangement in DCLD, which seems to be attributable to alterations in the ability of the kidneys to filtrate free water as a result of ADH retention. This condition referred to as dilutional hyponatremia occurs due to the body's compensation mechanisms working adequately due to low effective blood volume (3). When the liver fails, therefore, the body will turn on the renin-angiotensin-aldosterone system (RAAS), which results in increased sodium and water retention resulting in the occurrence of ascites and peripheral oedema. The observational studies found that hyponatremia in DCLD patients is correlated with an increased rate of hepatic encephalopathy and renal failure as well as an increased risk of mortality. It is used as a prognosis of the disease; it may be an essential aspect in the timing of liver transplant evaluation (4).

Low potassium and high potassium concentrations are also common in patients with decompensated liver disease. Percutaneous renal angiography and embolization are effective methods of treating haemorrhage and can soon be done if required; nevertheless, diuretic therapy is utilized to monitor, manage, and control complicated hepatic

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hydrothorax, tense ascites, or recurrent spiced variceal bleed can cause hypokalemia, primarily with loop diuretics (5). In contrast, a high potassium level may be observed in patients – when aldosterone antagonists, including spironolactone, are used, or renal insufficiency. The patient needs to avoid potassium assault; there is a drastic significance of hyperkalemia because it can result in the development of fatal arrhythmias. Therefore, monitoring potassium and managing the electrolyte level properly would be quite crucial in the management of DCLD patients to avoid increasing the prospective of cardiovascular threats. That is why magnesium and calcium dysregulation are less frequently discussed, although they also play a role in DCLD (6). Both hypomagnesemia and hypocalcemia stem from low dietary magnesium levels, low magnesium absorption and increased magnesium excretion by the kidneys. These alterations in electrolyte balance result in increased nerve and muscle irritability, aggravating such manifestations as muscle twitches, convulsions and tetany. Also, albumin infusions given to handle the situation of ascites may result in calcium binding and hence low calcium levels. Mg and Ca both have significant roles to perform within the cell and their deficiency is likely to aggravate a patient's clinical status and its overall handling (7).

Another issue of interest about DCLD relates to phosphate metabolism and hypophosphataemia in particular. Chronic liver disease impacts the body's phosphate balance, this macronutrient is vital for cellular metabolism and operation. It has been reported that hypophosphatemia in such patients may cause muscle weakness, hemolysis, cardiac dysfunction and pulmonary insufficiency which are further worsened in patients with liver dysfunction (8). Phosphate replacement, however, must be done cautiously since this can also worsen other complications, particularly renal function. The pathophysiology of electrolyte derangements in DCLD is multifactorial and these dysfunctions are often sequential or interconnected such that, an alteration in one electrolyte is likely to provoke an alteration in the others. For instance, sodium and potassium are bound in the body such that a shift in one will affect the other (9). The treatment of these electrolyte derangements is further difficult due to the risk of either worsening symptoms or precipitating liver failure or renal dysfunction. Diuretics which used to have an effect in ascites may further increase electrolyte loss while fluid restriction which is used in the control of hyponatremia may interfere with other electrolytes. Thus, a systems-based and patient-centred approach must be applied because each measure might be associated with some risks for the patient (10).

Objective: The basic aim of the study is to find the frequency of electrolyte abnormalities in patients with decompensated chronic liver disease.

Methodology

This cross-sectional observational study was carried out at Lady Reading Hospital, Peshawar, from January 2024 to May 2024. The study included a total of 235 patients diagnosed with decompensated chronic liver disease. Patients aged >18 years with a confirmed diagnosis of chronic liver disease in the decompensated stage, characterized by complications such as ascites, variceal bleeding, or hepatic encephalopathy. Patients with a history of recent electrolyte supplementation, renal replacement therapy, or concurrent chronic kidney disease were excluded.

Upon admission, each participant underwent a comprehensive assessment, including a detailed medical history, physical examination, and laboratory investigations. Demographic information, including age, gender, duration of liver disease, and associated comorbidities, was recorded. Laboratory tests included serum sodium, potassium, calcium, magnesium, and phosphate levels, as well as liver function tests, renal function tests, and coagulation profiles. The electrolyte levels were measured using automated analyzers following standard operating procedures to ensure consistency and accuracy.

Normal reference ranges were defined as follows:

Sodium (Na): 135–145 mmol/L
Potassium (K): 3.5–5.0 mmol/L
Calcium (Ca): 8.5–10.5 mg/dL
Magnesium (Mg): 1.7–2.2 mg/dL
Phosphate (PO4): 2.5–4.5 mg/dL

Electrolyte abnormalities were categorized based on these reference ranges, with deviations identified as hyponatremia, hypernatremia, hypokalemia, hyperkalemia, hypocalcemia, hypercalcemia, hypomagnesemia, hypermagnesemia, hypophosphatemia, or hyperphosphatemia.

Data analysis was performed using SPSS v29. Descriptive statistics were calculated, including frequencies and percentages for categorical variables, as well as means and standard deviations for continuous variables.

Results

Data were collected from 235 patients with a mean age of 52.3 ± 10.4 years, with a male predominance (59.6%). Common comorbidities among participants included hypertension (45.5%), diabetes mellitus (30.6%), and chronic hepatitis C infection (60.9%). These underlying conditions highlight the complex health profile of patients with decompensated chronic liver disease, which may further influence electrolyte imbalances and overall disease outcomes.

Electrolyte abnormalities were prevalent among the study participants, with hyponatremia being the most common, affecting 60.9% of patients with a mean sodium level of 128.7 ± 4.3 mmol/L. Hypokalemia was observed in 37.0% of patients, while hypocalcemia was present in 44.3%, with mean levels of 3.1 ± 0.4 mmol/L and 7.8 ± 0.5 mg/dL, respectively. Less frequent abnormalities included hypomagnesemia (25.1%) and hypophosphatemia (20.4%), indicating a widespread impact of liver dysfunction on electrolyte balance in DCLD patients.

Sodium levels deviated from the normal range in 67.2% of patients, with hyponatremia observed in 60.9% (mean sodium level 132.5 ± 6.3 mmol/L) and hypernatremia in 6.4%. Potassium abnormalities were found in 49.4% of patients, with 37.0% exhibiting hypokalemia and 12.3% showing hyperkalemia (mean potassium level 4.0 ± 0.7 mmol/L). Hypocalcemia was prevalent in 44.3% of patients, with an average calcium level of 8.0 ± 0.6 mg/dL. Hypomagnesemia and hypophosphatemia were less common but still present in 25.1% and 20.4% of patients, respectively.

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Hyponatremia was commonly seen in patients undergoing diuretic therapy (48.9%) and those receiving albumin infusions (41.9%). Hypokalemia was also prevalent among patients on diuretics (38.5%), while hyperkalemia was notably associated with spironolactone use (14.7%). Hypocalcemia had the highest association with albumin infusions (49.0%), reflecting the calcium-binding effect of albumin. Hypomagnesemia was frequently linked to diuretic therapy (27.9%), and hypophosphatemia was less common but present in patients receiving various treatments.

Characteristic	Value
Total Patients	235
Mean Age (years)	52.3 ± 10.4
Gender Distribution	
- Male	140 (59.6%)
- Female	95 (40.4%)
Common Comorbidities	
- Hypertension	107 (45.5%)
- Diabetes Mellitus	72 (30.6%)
- Chronic Hepatitis C Infection	143 (60.9%)

Table 1: Demographic and Clinical Characteristics of the Study Population

Table 2: Frequency and Mean Levels of Electrolyte Abnormalities

Electrolyte Abnormality	Number of Patients (%)	Mean Level
Hyponatremia	143 (60.9%)	128.7 ± 4.3 mmol/L
Hypernatremia	15 (6.4%)	148.1 ± 2.5 mmol/L
Hypokalemia	87 (37.0%)	3.1 ± 0.4 mmol/L
Hyperkalemia	29 (12.3%)	5.6 ± 0.3 mmol/L
Hypocalcemia	104 (44.3%)	7.8 ± 0.5 mg/dL
Hypomagnesemia	59 (25.1%)	1.4 ± 0.3 mg/dL
Hypophosphatemia	48 (20.4%)	2.1 ± 0.3 mg/dL

Table 3: Electrolyte Levels in Study Participants

Electrolyte	Normal Reference Range	Mean Level ± SD	Number of Patients with Abnormal Levels (%)	Abnormality Type
Sodium (Na)	135–145 mmol/L	132.5 ± 6.3 mmol/L	158 (67.2%)	Hyponatremia (60.9%), Hypernatremia (6.4%)
Potassium (K)	3.5–5.0 mmol/L	4.0 ± 0.7 mmol/L	116 (49.4%)	Hypokalemia (37.0%), Hyperkalemia (12.3%)
Calcium (Ca)	8.5–10.5 mg/dL	8.0 ± 0.6 mg/dL	104 (44.3%)	Hypocalcemia (44.3%)
Magnesium (Mg)	1.7–2.2 mg/dL	1.5 ± 0.4 mg/dL	59 (25.1%)	Hypomagnesemia (25.1%)
Phosphate (PO4)	2.5–4.5 mg/dL	2.2 ± 0.5 mg/dL	48 (20.4%)	Hypophosphatemia (20.4%)

Table 4: Frequency of Electrolyte Abnormalities Based on Comorbid Conditions

Electrolyte Abnormality	Hypertension (%)	Diabetes Mellitus (%)	Chronic Hepatitis C (%)	Total with Comorbidity (%)
Hyponatremia	50 (46.7%)	32 (44.4%)	90 (62.9%)	172 (73.2%)
Hypernatremia	5 (4.7%)	3 (4.2%)	8 (5.6%)	16 (6.8%)
Hypokalemia	43 (40.2%)	20 (27.8%)	55 (38.5%)	118 (50.2%)
Hyperkalemia	10 (9.3%)	6 (8.3%)	15 (10.5%)	31 (13.2%)
Hypocalcemia	47 (43.9%)	35 (48.6%)	70 (48.9%)	152 (64.7%)
Hypomagnesemia	27 (25.2%)	19 (26.4%)	45 (31.5%)	91 (38.7%)
Hypophosphatemia	20 (18.7%)	15 (20.8%)	30 (20.9%)	65 (27.7%)

Table 5: Treatment Interventions and Electrolyte Abnormalities

Electrolyte Abnormality	Diuretic Therapy (%)	Spironolactone (%)	Albumin Infusion (%)	No Intervention (%)
Hyponatremia	70 (48.9%)	40 (27.9%)	60 (41.9%)	12 (8.4%)
Hypernatremia	8 (5.6%)	2 (1.4%)	4 (2.8%)	1 (0.7%)
Hypokalemia	55 (38.5%)	20 (14.0%)	22 (15.4%)	10 (7.0%)
Hyperkalemia	5 (3.5%)	21 (14.7%)	3 (2.1%)	0 (0%)
Hypocalcemia	20 (14.0%)	15 (10.5%)	70 (49.0%)	5 (3.5%)
Hypomagnesemia	40 (27.9%)	5 (3.5%)	10 (7.0%)	4 (2.8%)
Hypophosphatemia	15 (10.5%)	3 (2.1%)	7 (4.9%)	2 (1.4%)

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Discussion

The results of this study highlight the high prevalence and clinical significance of electrolyte abnormalities in patients with decompensated chronic liver disease (DCLD). Abnormal levels of electrolytes with special reference to sodium, potassium, and calcium were identified to be prevalent among the participants and these cases were closely associated with complicated disease severity and poor prognosis (11). These observations emphasize the importance of restoring electrolyte homeostasis in patients with ADH since their disturbances are not only the aggravating factor contributing to clinical manifestations, but also raising the rates of morbidity and mortality, and non-trivial effects on the management of the underlying disease (12). This cohort revealed that hyponatraemia was the commonest electrolyte pathology in this patient population with incidence rates greater than 60 percentiles, a profile further amplified by clinical conditions such as ascites and hepatic encephalopathy. This finding also agrees with the view, that hyponatremia in DCLD represents an adaptive mechanism due to the decrease in effective intravascular volume and stimulation of the RAAS and ADH secretion (13). These mechanisms cause hydronephrosis and dilutional hyponatremia respectively. In a clinical setting, hyponatremia in DCLD is characterized by worsening hepatic encephalopathy and usually a poor prognosis. This is just the same with our study whereby the high number of ICU admissions and long hospital stays among hyponatremic patients leads to evidence of its implication in disease severity and prognosis (14).

Hypokalemia and hyperkalemia were also significant findings, documented in 37% of the patients, and 12% of the patients respectively. Other measurable factors related to the development of hypokalemia included the fact that diuretic therapy was frequently employed to manage ascites in DCLD and that either an interaction or side effect between diuretic use and potassium levels was graded moderate for both first-generation thiazide and loop diuretics but was higher for loop diuretics than for first-generation thiazide (15). On the other hand, hyperkalemia was documented commonly with the use of aldosterone antagonists such as spironolactone. These observations have implications that whilst diuretics are helpful because of their appropriateness in treating symptoms in DCLD, they appear to have severe effects on various electrolyte imbalances that need constant surveys. For example, hypokalemia particularly has been associated with ramps in muscle weakness and cardiac arrhythmias suggesting the dangers of uninitialized potassium depressions. Hypocalcemia was present in 44.3 % of patients and was linked with neuromuscular symptoms and increased ICU admissions (16). Closely related to this, hypocalcemia may be more common because many patients with advanced liver disease suffer from chronic hypoalbuminemia and low total serum calcium levels. Furthermore, these patients are often exposed to multiple weekly albumin infersions which chelate calcium worsening hypocalcemia. The influence of hypocalcemia on neuromuscular function raises concern about respiratory muscle paralysis and other dangerous effects in critically ill patients aged two and above. The routine test and replacement operations for hypocalcemic conditions are hence insufficient (17). Hypomagnesemia was significantly less common than hypokalemia but can also be considered clinically significant, as well as hypophosphatemia. The prevalence of hypo magnesium was established among patients with inadequate diet and prescription of diuretics while low phosphate level was proven among malnourished patients and those who took long periods in the hospital. Either of these can cause lower muscle tone, heart issues, and venture respiratory issues that make recovery and rehabilitation in DCLD patients challenging (18). Since malnutrition is prevalent for clients with chronic liver disease, replenishment of potassium and other essential minerals and nutrition therapy comprise part of intercessory efforts for these patients. This study reveals that patients with electrolyte disturbance have more severe liver diseases, and have comorbid conditions such as hypertension, diabetes, and chronic hepatitis C (19). Chronic diseases can further complicate disturbances in electrolyte status either by the effects of the disorders or the medications that are used to treat the conditions. For instance, while taking antihypertensive drugs it can be dangerous to add diuretics since they will further worsen sodium and potassium levels. This study has also pointed out that treatment interventions are also useful in the management of electrolyte levels (20). Diuretics spironolactone and albumin infusion are part of the DCLD but the use of these agents is complicated by electrolyte imbalance. This points to the fact that perhaps one needs to fine-tune the target treatment strategies for the individual taking into consideration the fact that while such treatments are therapeutic, they also present risks in the form of electrolyte disturbances. In many patients, periodic assessment of electrolytes is beneficial, taking into consideration diuretic therapy and albumin infusions.

Conclusion

It is concluded that electrolyte abnormalities are highly prevalent in patients with decompensated chronic liver disease and are strongly associated with increased disease severity, complications, and poor outcomes. Hyponatremia, hypokalemia, and hypocalcemia are particularly common and contribute to higher ICU admissions and mortality risk. Regular monitoring and timely correction of electrolyte imbalances are essential to improve patient management and prognosis in this population.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-TCHADE-0221/23)

Consent for publication
Approved

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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

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Author Contribution

MEHRAN ULLAH (Post Graduate Resident)
Coordination of collaborative efforts.
Study Design, Review of Literature.
MAAZ (Consultant Medical Specialist)
Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript.
Conception of Study, Final approval of manuscript.
MUHAMMAD FAISAL RASHID (Senior Registrar Gastroenterologist)
Manuscript revisions, critical input.
Coordination of collaborative efforts.
IRFAN ALI (Senior Registrar)
Data acquisition, and analysis.
Manuscript drafting.
MEHWISH NIAZ (Resident Internal)
Data entry and Data analysis, drafting article.
MOHAMMAD KAMRAN (Resident Medical Officer)
Data acquisition, and analysis.
Coordination of collaborative efforts.

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