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Prognostic Importance Of Serum Sodium Levels In Decompensated Chronic Liver Disease

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Abstract

Background: Hyponatremia is a common electrolyte abnormality in patients with decompensated chronic liver disease (DCLD). It is associated with disease progression, complications, and increased mortality. Serum sodium concentration has emerged as an important prognostic marker in advanced liver disease.

Objective: To assess serum sodium levels in patients with decompensated chronic liver disease and evaluate their prognostic significance in relation to disease severity, complications, and clinical outcomes.

Materials and Methods: This hospital-based cross-sectional observational study was done among 100 patients with decompensated chronic liver disease. Serum sodium levels were measured at admission. Disease severity was assessed using Child–Turcotte–Pugh (CTP) and Model for End-Stage Liver Disease (MELD) scores.

Results: Hyponatremia was seen in 70% of patients, 30% had normal serum sodium levels. 52% of patients belonged to CTP Class C. Lower serum sodium levels were significantly associated with advanced liver disease severity, more MELD scores, and more frequency of complications including ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and hepatorenal syndrome. Mortality increased significantly with worsening hyponatremia, reaching 52.9% among patients with severe hyponatremia compared with 3.3% among those with normal serum sodium levels Serum sodium showed a significant negative correlation with MELD score and CTP score.

Conclusion: Hyponatremia is highly prevalent in patients with decompensated chronic liver disease and is strongly associated with disease severity, complications, and mortality. Serum sodium is a simple, inexpensive, and reliable prognostic marker that should be routinely monitored in patients with DCLD for early identification of high-risk patients and improved clinical outcomes.

Keywords: Decompensated Chronic Liver Disease, Hyponatremia, Serum Sodium, Child–Turcotte–Pugh Score, MELD Score, Prognosis

Introduction

Chronic liver disease (CLD) is a major global health problem. It is a major cause of morbidity and mortality worldwide. Progressive hepatic injury occurs due to viral hepatitis, alcohol-related liver disease,[1] non-alcoholic fatty liver disease(NAFLD), autoimmune disorders, and metabolic diseases cause cirrhosis and liver failure. Cirrhosis is characterized by diffuse fibrosis and regenerative nodule formation, resulting in distortion of the hepatic architecture and impairment of liver function.[2]

Patients with cirrhosis may stay compensated for several years; and development of ascites, hepatic encephalopathy, variceal hemorrhage, spontaneous bacterial peritonitis, and hepatorenal syndrome marks the transition to decompensated chronic liver disease (DCLD).[3] Once decompensation occurs, survival

decreases, making early identification of prognostic markers essential for clinical management and risk stratification.

Low serum sodium concentration is associated with severe complications of cirrhosis, including refractory ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, hepatorenal syndrome, and increased mortality. Hyponatremia is an independent predictor of survival in patients with advanced liver disease and is considered a marker of poor prognosis.[4]

Prognostic assessment in chronic liver disease has relied on scoring systems such as the Child–Turcotte–Pugh (CTP) score and Model for End-Stage Liver Disease (MELD) score. Incorporation of serum sodium into prognostic models improves prediction of mortality, leading to the development of sodium-based indices such as MELD-Na and MESO score.[5] These models showed superior prognostic accuracy compared with MELD alone, especially in patients awaiting liver transplantation and those with decompensated cirrhosis. As serum sodium estimation is cheap. readily available, and routinely done in clinical practice, it has more value as a prognostic biomarker in resource-limited settings.[6] Understanding the relationship between serum sodium levels and disease severity may help clinicians in identifying high-risk patients, improving treatment strategies, and outcomes.[7,8]

Objective:

To assess serum sodium levels in patients with decompensated chronic liver disease and to assess their prognostic significance in relation to clinical outcomes and disease severity.

Patients And Methods

Study Design

This study was as hospital-based observational cross-sectional study done among patients diagnosed with decompensated chronic liver disease admitted to the Department of General Medicine/Gastroenterology at a tertiary care teaching hospital. The study was done from May 2025 to December 2025.

Study Population

Patients admitted with decompensated chronic liver disease during the study period were screened for inclusion in the study.

Sample Size

100 patients with decompensated chronic liver disease were included in the study.

Inclusion Criteria

1. Patients aged ≥18 years.
2. Patients diagnosed with chronic liver disease based on clinical, biochemical, radiological, and/or endoscopic findings.
3. Patients presenting with features of decompensation such as:
    - Ascites
    - Hepatic encephalopathy
    - Variceal bleeding
    - Spontaneous bacterial peritonitis
    - Hepatorenal syndrome
    - Jaundice with evidence of liver failure
    - Patients who provided consent

Exclusion Criteria

1. Patients with chronic kidney disease on dialysis.
2. Patients with congestive cardiac failure.
3. Patients receiving drugs known to significantly alter serum sodium levels (except standard diuretic therapy for cirrhosis).
4. Patients with endocrine disorders affecting sodium balance such as hypothyroidism or adrenal insufficiency.
5. Patients with acute liver failure.
6. Pregnant women.

Data Collection Procedure

After obtaining approval from the Institutional Ethics Committee and written informed consent from the participants, detailed clinical history was recorded using a structured proforma.

Measurement of Serum Sodium

Venous blood samples were collected under aseptic precautions at the time of admission. Serum sodium concentration was measured using an ion-selective electrode method in the central biochemistry laboratory.

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Based on serum sodium levels, patients were classified into:

1. Normal sodium: >135 mEq/L
2. Mild hyponatremia: 131–135 mEq/L
3. Moderate hyponatremia: 126–130 mEq/L
4. Severe hyponatremia: ≤125 mEq/L

Assessment of Disease Severity

Child–Turcotte–Pugh (CTP) Score

Disease severity was assessed using the Child–Turcotte–Pugh scoring system based on:

1. Serum bilirubin
2. Serum albumin
3. INR/prothrombin time
4. Ascites
5. Hepatic encephalopathy

Patients were classified into:

1. Class A (5–6 points)
2. Class B (7–9 points)
3. Class C (10–15 points)

MELD Score

Model for End-Stage Liver Disease (MELD) score was calculated using:

1. Serum bilirubin
2. Serum creatinine
3. INR

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 22.0

1. Continuous variables were expressed as mean ± standard deviation.
2. Categorical variables were expressed as frequencies and percentages.
3. Student's t-test and Analysis of Variance (ANOVA) were used for comparison of quantitative variables.
4. Chi-square test was used for comparison of qualitative variables.
5. Pearson's correlation coefficient was used to assess the relationship between serum sodium levels and CTP/MELD scores. p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrollment.

Results

Age Distribution:

32% of the patients belongs to 41-50 years age group.

Table 1: Age distribution among patients

Age Group (Years)	Number of Patients	Percentage (%)
18–30	10	10%
31–40	18	18%
41–50	32	32%
51–60	25	25%
>60	15	15%
Total	**100**	**100**

Gender Distribution:

72% of the patients were male.

Serum Sodium Levels:

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30% of the patients had >135 (Normal) serum sodium levels.

Table 2: Serum sodium levels

Serum Sodium (mEq/L)	Number of Patients	Percentage (%)
>135 (Normal)	30	30%
131–135 (Mild Hyponatremia)	25	25%
126–130 (Moderate Hyponatremia)	28	28%
≤125 (Severe Hyponatremia)	17	17%

Prevalence of Hyponatremia:

70% of the patients had hyponatremia.

Table 3: Prevalence of hyponatremia

Serum Sodium Status	Number of Patients	Percentage (%)
Hyponatremia (≤135 mEq/L)	70	70%
Normal Sodium (>135 mEq/L)	30	30%
Total	**100**	**100**

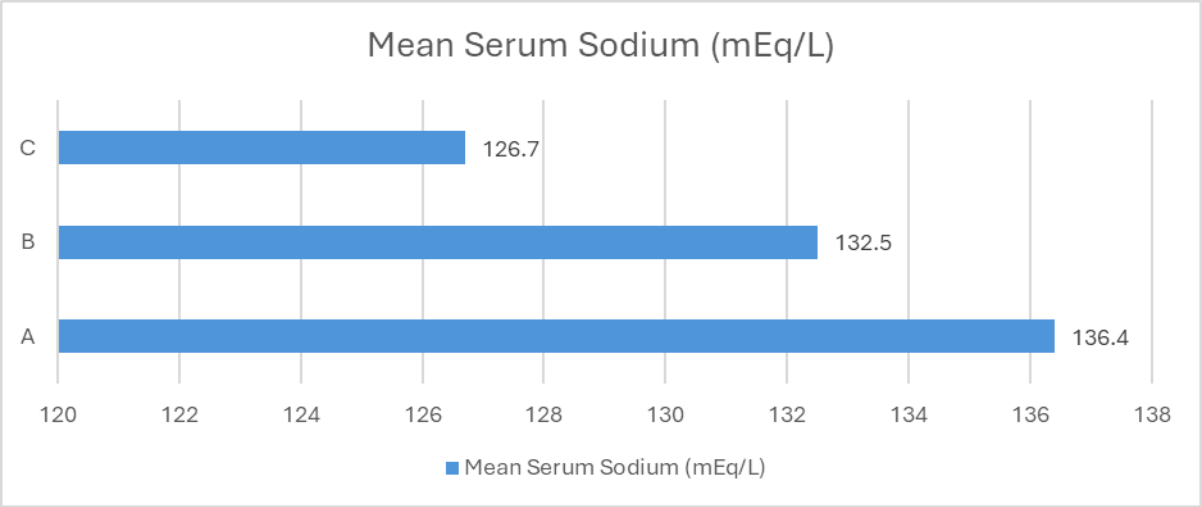
Child–Turcotte–Pugh (CTP) Classification:

52% of the patients belonged to CTP class C, 12% belonged to class A, 36% belonged to class B

Sodium and CTP Class:

There is significant association between serum sodium and CTP class.(P= 0.031)

Graph 1: Serum sodium levels and CTP class



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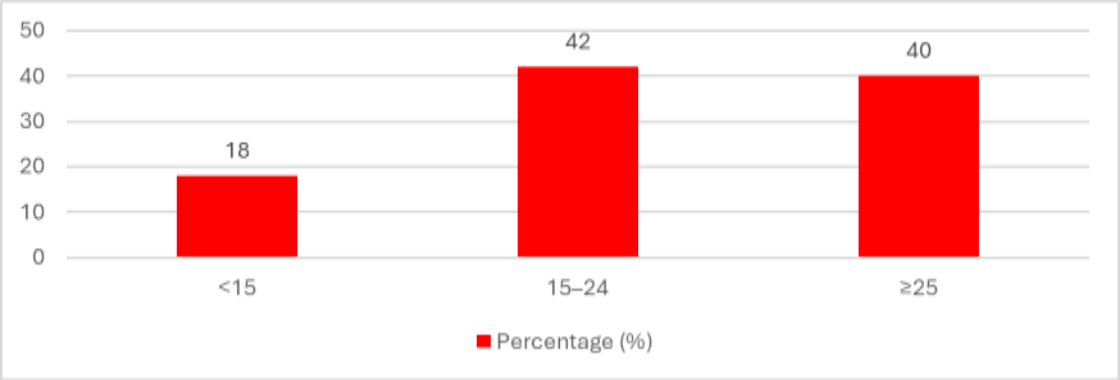
Graph 3: MELD Score distribution

MELD Score Distribution:

42% of the patients had MELD score 15-24.



Association of Serum Sodium Levels with Disease Severity, Complications and Clinical Outcome in Patients with Decompensated Chronic Liver Disease

Table 4: Association of Serum Sodium Levels with Disease Severity, Complications and Clinical Outcome

Variable	>135 mEq/L (n=30)	131–135 mEq/L (n=25)	126–130 mEq/L (n=28)	≤125 mEq/L (n=17)	p-value
CTP Class C, n (%)	5 (16.7)	10 (40.0)	20 (71.4)	17 (100.0)	<0.001
Mean MELD Score (Mean ± SD)	12.8 ± 2.4	16.7 ± 3.1	22.4 ± 4.2	28.6 ± 5.1	<0.001
Ascites, n (%)	20 (66.7)	22 (88.0)	27 (96.4)	16 (94.1)	0.012
Hepatic Encephalopathy, n (%)	4 (13.3)	7 (28.0)	14 (50.0)	13 (76.5)	<0.001
Spontaneous Bacterial Peritonitis, n (%)	2 (6.7)	3 (12.0)	7 (25.0)	8 (47.1)	0.003
Hepatorenal Syndrome, n (%)	1 (3.3)	2 (8.0)	5 (17.9)	7 (41.2)	<0.001
Improved/Discharged, n (%)	29 (96.7)	23 (92.0)	22 (78.6)	8 (47.1)	<0.001
Mortality, n (%)	1 (3.3)	2 (8.0)	6 (21.4)	9 (52.9)	<0.001

Lower serum sodium levels were significantly associated with advanced liver disease severity and adverse clinical outcomes. The proportion of patients in CTP Class C increased from 16.7% among patients with normal serum sodium to 100% among those with severe hyponatremia ($p<0.001$). Mean MELD scores also increased significantly with worsening hyponatremia ($p<0.001$). The frequencies of ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, and hepatorenal syndrome were significantly higher among patients with lower serum sodium levels. Mortality increased markedly from 3.3% in patients with normal sodium levels to 52.9% in those with severe hyponatremia ($p<0.001$), indicating that hyponatremia is a strong predictor of poor prognosis in decompensated chronic liver disease.

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Correlation between serum sodium levels and MELD, CTP

Serum sodium levels showed a significant negative correlation with MELD and CTP scores, indicating that lower serum sodium levels were associated with greater disease severity.

Table 5: Correlation between serum sodium levels and MELD, CTP

Variables	Pearson Correlation Coefficient (r)	p-value
Serum Sodium vs MELD Score	-0.68	<0.001
Serum Sodium vs CTP Score	-0.61	<0.001

Discussion

The present study included 100 patients with decompensated chronic liver disease (DCLD) and evaluated the prognostic significance of serum sodium levels. The prevalence of hyponatremia (serum sodium ≤135 mEq/L) in our study was 70%. This prevalence was higher than that reported by Angeli et al., who observed hyponatremia in 49.4% of 997 cirrhotic patients. More prevalence in our study may be due to the inclusion of only decompensated cirrhosis patients, the study by Angeli et al. included both hospitalized and outpatient cirrhotic patients.[5]

In the present study, serum sodium levels decreased with worsening Child–Turcotte–Pugh (CTP) class. Mean serum sodium level was lowest in CTP Class C patients, indicating advanced liver dysfunction. Comparable findings were reported in several studies, which showed that hyponatremia is associated with worsening hepatic function and portal hypertension.[10]

We found significant inverse relationship between serum sodium levels and MELD score. Patients with severe hyponatremia had significantly more MELD scores than those with normal serum sodium levels. These findings are comparable to those reported by Londoño et al., who showed that serum sodium concentration and MELD score were independent predictors of survival in patients awaiting liver transplantation.

Ascites was the most common complication in our study, being present in 85% of patients. Ascites was significantly more common among patients with hyponatremia. Angeli et al.[5] similarly reported a strong association between low serum sodium levels and severe ascites, refractory ascites, and impaired renal function.[11]

Hepatic encephalopathy was seen in 38% of our patients and occurred more frequently among those with lower serum sodium levels. Comparable findings were reported by Angeli et al.,[5] who showed more frequency of hepatic encephalopathy among cirrhotic patients with hyponatremia.

The incidence of spontaneous bacterial peritonitis (20%) and hepatorenal syndrome (15%) was higher in patients with moderate to severe hyponatremia. Similar associations have been documented in previous studies, where hyponatremia was linked with a greater occurrence of spontaneous bacterial peritonitis, hepatorenal syndrome, and renal dysfunction.[12]

In the present study, mortality was 18%, and the highest mortality was observed among patients with serum sodium levels ≤125 mEq/L. Ruf et al.[12] reported that hyponatremia was present in 63% of patients who died compared with only 13% of survivors, highlighting the strong association between low serum sodium levels and mortality. They also demonstrated that the addition of serum sodium to the MELD score improved prediction of mortality.

Londoño et al.[2] found that serum sodium concentration and MELD score were independent predictors of short-term and long-term survival in cirrhotic patients awaiting liver transplantation. Their findings support our observation that lower serum sodium levels are associated with poor prognosis and increased mortality.

Overall, the findings of the present study are in agreement with previous international studies and confirm that hyponatremia is a common complication of decompensated chronic liver disease and an important predictor of disease severity, complications, and mortality.

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Conclusion

The present study demonstrated that hyponatremia is a common electrolyte abnormality among patients with decompensated chronic liver disease, with a prevalence of 70%. Serum sodium levels were found to decrease progressively with increasing severity of liver disease.

Serum sodium level is an independent and reliable predictor of disease severity, complications, and mortality in patients with decompensated chronic liver disease. Regular monitoring of serum sodium should be incorporated into the routine evaluation of these patients to help early identification of high-risk subjects and improve clinical outcomes.

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