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FREQUENCY OF HYPONATREMIA AMONG PATIENTS WITH HEPATIC ENCEPHALOPATHY AND SEVERITY OF LIVER DISEASE

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ABSTRACT

Background: Hyponatremia is a frequent complication of cirrhosis, as well as a significant cause of the development and progression of hepatic encephalopathy (HE). A deficiency in serum sodium augments the brain edema and worsens the dysfunction of the nervous system. Even though the clinical significance of hyponatremia is high, most settings have not studied the prevalence of this disease and how it correlates with the extent of liver disease.

Objectives: To establish the frequency of hyponatremia in patients with hepatic encephalopathy and the correlation between the hyponatremia and the severity of liver disease in Child-Pugh classification, and in the MELD-Na scores.

Methods: It was a cross-sectional study of analysis that entailed the use of adult patients who were admitted to the Lady Reading Hospital, Peshawar with hepatic encephalopathy and had cirrhosis. The demographic, clinical, and laboratory data were collected, including serum sodium, bilirubin, INR, creatinine, and albumin. A hyponatremia was defined as less than 135mmol/L of serum sodium and was characterized as mild(130134), moderate (125129), or severe (<125). West Haven criteria were applied to score HE, and the severity of the liver disease was established with the assistance of the Child-Pugh class and the MELD-Na as statistical tests. The statistical tests were chi-square, ANOVA, Kruskal-Wallis, Kendall's Spearman correlation, and logistic regression.

Results: Hyponatremia was detected in more than one-third of patients with hepatic encephalopathy. It was quite prevalent in patients with high-grade HE (III and IV). Severe and moderate hyponatremic patients ranked highly on MELD-Na than normonatremic patients ($p < 0.05$). The correlation using Spearman revealed that the relationships between serum sodium and MELD-Na score were very negative. Logistic regression revealed that HE grade, elevated bilirubin, increased INR, renal impairment, ascites, and diuretic use were independent predictors of moderate-severe hyponatremia.

Conclusion: Hyponatremia is common in cirrhotic patients having hepatic encephalopathy, and is closely related to the severity of both neurological and progressive liver disease. The risk of severe encephalopathy cases and even improved clinical outcomes in this high-risk group could be achieved through frequent monitoring and early correction of serum sodium.

INTRODUCTION

Cirrhosis of the liver is an insidious disease that is characterized by deformity of the hepatic architecture and portal hypertension. The large range of common occurrences of chronic liver attacks is the end commonality: chronic viral hepatitis, alcoholic liver disease, non-alcoholic fatty liver disease, and autoimmune or metabolic attacks. Decompensating events frequently occur in patients with cirrhosis, and they are ascites, variceal bleeding, hepatic encephalopathy, spontaneous bacterial peritonitis, and hepatorenal syndrome. Hepatic encephalopathy (HE) is one of these complications, and it is not only one of the most debilitating complications but also leads to neuropsychiatric impairment, repeated hospitalizations, and a high mortality rate (Tauseef, 2024).

Hepatic encephalopathy is a scale of reversible neurocognitive dysfunction, evident in the setting of severe liver disease, and no other neurological dysfunction. Presence of the gut-derived neurotoxins, particularly ammonia, and insufficiency of the hepatic clearance and malfunction of the blood-brain barrier have been thought to lead to it. Clinically, HE is graded according to the West Haven, with grade 1 having mild cognitive changes and grade 4 having profound coma. Some of the risks that are associated with the incidence of HE include poor prognosis, poor quality of life, and high healthcare burden (Khattak et al., 2024).

Among the causes that lead to the risk and severity of HE is the presence of electrolyte imbalances, and the most severe is hyponatremia. The case of hyponatremia describes the accurate level of serum sodium at less than 135 mmol/L and is a typical occurrence in a patient with advanced cirrhosis. It develops as a consequence of splanchnic vasodilatation, the activation of the renin-angiotensin-aldosterone system, sympathetic overactivity, and non-osmotic renin vasopressin release, which all damage the renal free water excretion. The hyponatremia that develops as a result of the dilution contributes to water loss to the brain, which causes low-grade cerebral edema and predisposes the body to ammonia-related neurotoxicity (Samejo et al., 2024).

Some of the studies have shown that hyponatremia is not the only prevalent one, but also an independent risk factor for the incidence of HE. More prone to encephalopathy of a severe type, the course of such patients is repeated. In addition, the hyponatremia was also found to be associated with the extended hospital stay, the need to have intensive care, and even death in the hospital. It is worth noting that serum sodium has been incorporated in the MELD-Na score, which has been shown to augment the prognostic value of liver transplantation awaiting patients with cirrhosis (Priya et al., 2024).

Even though some pathophysiological relationships have already been established, the incidence of hyponatremia in patients with HE was reported to vary among studies and in diverse populations, with an average prevalence of 30 or above. This may be due to dissimilarities in the choice of the patients, the etiology of the cirrhosis, care access, and diuretics. Moreover, no local data on the occurrence in patients admitted with cirrhosis and HE and its correlations with the most popular severity scales, such as Child-Pugh class and MELD-Na score, are available. The purpose for which this relationship should be created is explained by the fact that it can help predict the early stratification of risk, help anticipate complications, and develop the therapeutic strategies allowing for to restoration of the level of sodium (Zhou et al., 2024).

LITERATURE REVIEW

Hepatic encephalopathy (HE) refers to a neuropsychiatric complication of severe

hepatic disease that has been extensively studied in terms of morbidity, mortality, and quality of life. It is a continuum of cognitive impairment that extends from mild neurocognitive impairments to a coma. The incidence of overt HE in cirrhotic patients has been reported internationally as 30-45 per cent, where less than 80 per cent may also have minimal cases. The pathogenesis of HE is a complex mechanism that comprises the disrupted ammonia metabolism, inflammation in the system, neuroinflammation, and modifications to the blood-brain barrier. Some of the precipitating factors include electrolyte abnormalities, particularly hyponatremia, which have been progressively reported to be central to the development and progression of development of HE (Kumari et al., 2024).

The most common of all the electrolyte disorders observed in cirrhotic patients is hyponatremia, which is characterized by a serum sodium level that is below 135 mmol/L. Studies show that 30-50 percent of patients with a high grade of cirrhosis in hospitals develop some form of hyponatremia, and its existence is directly correlated with poor clinical outcomes. This mechanism is primarily the dilutional one, mostly due to the non-osmotic secretion of arginine vasopressin as a reaction to the advancement of the systemic vasodilation and efficient hypovolemia. The impact of this is a decrease in the renal free water excretion, and this leads to water retention and sodium dilution. Not only does hyponatremia worsen the hemodynamic condition of patients with cirrhosis, but directly causes cerebral degradation due to the formation of low-grade cerebral edema and enhanced brain sensitivity to ammonia (Shahinuzzaman et al., 2024).

Some of the researchers have reported the association of hyponatremia and hepatic encephalopathy. It has been demonstrated by Guevara et al that patients with low sodium concentration were more likely to develop HE as compared to normonatremic patients, irrespective of ammonia level. Similarly, studies in North America and Europe have yielded a reliable result that hyponatremia is associated with augmented and more vehement lightning of HE, prolonged hospital stay, and intensive care treatment. A prospective study showed that the risk of overt HE was nearly two times greater in patients with a serum sodium level of less than 130 mmol/L, as compared to the risk of overt HE in patients with a serum sodium level greater than 135 mmol/L. The results of the latter point to the importance of the interactions of ammonia and hyponatremia in the emergence of neurological dysfunction (Kumari & Naidu, 2024).

The relationship than relationship with HE, hyponatremia has a stronger prognostic value. Child-Pugh score and the Model for End-Stage Liver Disease (MELD) score are historically used to determine the severity of cirrhosis. However, the indices contained serum sodium. Early 2000s studies had confirmed that low serum sodium was prognostic of survival among cirrhotic patients on the liver transplant waiting list. This has resulted in the development of the MELD-Na score that adds serum sodium to the current MELD formula, which will add more stratification and prioritization of risky patients according to transplantation. The past studies that have confirmed the utility of MELD-Na have always found it to be superior to its counterpart, MELD, in patients with ascites, renal dysfunction, or frequent HE (Flores et al., 2024).

The local and regional literature also describes the fact that the hyponatremia burden is also great in the cirrhotic population. It has been observed that as many as 40 percent of patients with cirrhosis in the South Asian context present with hyponatremia in the hospital environment, with a higher occurrence in patients with ascites and the patients with HE. A research study conducted in Pakistan also indicated that hyponatremia

was significantly more common in patients with high Child-Pugh class (B and C) and that hyponatremia was strongly associated with higher degrees of encephalopathy. This has also been reported in India, as it was noted that patients with a serum sodium below 130 mmol/L had a high degree of mortality compared to the patients whose serum sodium was normal. The above facts suggest that hyponatremia is not only common but a major prognostic variable within a broad spectrum of the population (Shekar et al., 2024).

Other than prevalence studies, neuroimaging and experimental models have been able to acquire mechanistic knowledge. The magnetic resonance spectroscopy analysis has proven that hyponatremia exacerbates the neuro-tissue edema by limiting the osmotic regulation of the astrocyte in the scenario of hyperammonemia. This is why patients who have combined hyponatremia and hyperammonemia experience severe HE in comparison with hyperammonemia. The concept can also be supported by the animal studies that demonstrate that the chronic hyponatremia condition predisposes the brain to the influence of ammonia toxicity and accelerates the development of the encephalopathy (Rudler et al., 2024).

Therapeutic implications had also been covered in the recent literature. The hyponatremia is reversible and has been discovered to be corrected by meticulously administering fluids, administration of albumin, or administration of vasopressin receptor antagonists (vaptans), which ensure that the neurological status of the chosen patients is improved. Vaptans are neither cost-effective nor safe, though, which makes their use limited. The current clinical practice suggests that the sodium levels of cirrhotic patients should be observed in detail and that abrupt correction is not to be performed due to the likelihood of osmotic demyelination. Nevertheless, such outcomes make the application of sodium optimization in the general treatment of HE justifiable (Semeya et al., 2024).

Although the relationship between hyponatremia and HE has significant evidence, there exist critical literature gaps. Most of the studies have been conducted among Western populations, and minimal data concerning the low- and middle-income nations have been gathered. In addition, the discrepancies in prevalence and effect of hyponatremia in the locations suggest that local disparities in the etiology of cirrhosis, diet, and access to healthcare can also have some impact. In addition to that, the causal relationship between hyponatremia and HE is already established, although the cause-and-effect relationship is debatable, since hyponatremia can either lead to the development of encephalopathy or it can be simply a symptom of more severe liver disease with increased susceptibility to encephalopathy (Diwan et al., 2024).

RESEARCH METHODOLOGY

Study Design

This analysis was a cross-sectional analytical research to find out the prevalence of hyponatremia in patients undergoing hepatic encephalopathy (HE) and the correlation between hyponatremia and the intensity of the liver disease. The selection of a cross-sectional design is based on the fact that the research would be able to concurrently measure the level of exposure (serum sodium level) and outcome (severe encephalopathy and liver disease scores).

Study Setting and Duration

This study conducted at Lady Reading Hospital Peshawar. The data collection process was based on six months of admission of the qualified patients who had hepatic encephalopathy.

Study Population

The target population consisted of the adult patients (21 and above) who had a

known history of cirrhosis and admitted hepatic encephalopathy of any grade. It will deal with both the male and the female patients.

Inclusion Criteria

- The patients are above 18 years.
- Diagnosis of cirrhosis is identified using both clinical and biochemical, and radiological evidence.
- Admitted patients who have hepatic encephalopathy (West Haven grades I-IV).
- Informed consent, either from the attendant or the patient.

Exclusion Criteria

- Acupatients with acute liver failure patients.
- Patients with chronic kidney disease (stage 4-5) and dialyzed patients.
- Patients with large-volume (<48 hours) albumin-free paracentesis.
- Patients who experience severe hyperglycemia (>400 mg/dL) or have a disorder that causes pseudohyponatremia.
- Sodium is measured in patients who have received hypertonic saline in advance of bass.

Sampling Technique and Sample Size

Patients were recruited using a consecutive sampling that fulfilled the eligibility criteria. The formula to be used in determining the sample size will rest on the following formula: prevalence studies n=Z2 p(1-p)/d2n= Z 2 p(1-p)-d 2=Z 2 40 0.95 0.005. An approximate of 369 patients will be required, though to counter the dropouts and missing data, it will target a minimum of 380 patients.

Data Collection Procedure

The tool of data collection was a structured proforma/questionnaire. Demographic (age, sex, weight, BMI), clinical (etiology of cirrhosis, disease duration, ascites, diuretic use), and encephalopathy grade (West Haven classification) data will be provided to it. These lab parameters will be ordered within 24 hours of admission: serum sodium, potassium, bilirubin, albumin, INR, creatinine, blood glucose, and ammonia. To determine the severity of liver disease, the Child-Pugh score and MELD-Na score will be used. The findings will also include length of stay at the hospital, hospitalization in the ICU, and in-hospital death.

Operational Definitions

Hyponatremia: Less than 135mmol/L serum sodium. It will be divided into mild (130-134), moderate (125- 129), and severe (<125 mmol/L).

Hepatic Encephalopathy: West Haven graded I-IV.

Ascent of the Liver Disease: Scale: Child-Pugh (A, B, C) and MELD-Na.

Data Analysis

The data was entered and analyzed using SPSS version 26. Mean, SD of the continuous variables, and frequency percentage variables of the categorical variables were in the form of descriptive statistics. The hyponatremia occurrence rate was established. In order to compare hyponatremia and HE grades and Child-Pugh classes, the chi-square test was used. Continuous variables will entail: MELD-Na score under sodium categories, and this shall be tested under an independent t-test or ANOVA. Logistic regression will also be used to determine the independent predictors of moderate-severe hyponatremia. The p-value below 0.05 was interpreted as a statistically significant p-value.

Ethical Considerations

The Institutional Review Board (IRB) will be consulted to permit the same. It will require the patient or the person taking care to sign an informed consent. Sufficient confidentiality will also be provided through the study codes that will replace the names. The risk to the participants is low, as the study is an observational study, which implies that regular investigations will be conducted.

DATA ANALYSIS

Table 1: Prevalence (Hyponatremia <135, Wilson 95% CI)

N total	Hyponatremia cases(<135)	Prevalence%	95% CI Lower %	95% CI Upper%
338	197	58.28	52.96	63.42

Prevalence of Hyponatremia

Table 1 shows the Prevalence (Hyponatremia <135, Wilson 95% CI) of the data. The commonest abnormality in this study group among hepatic encephalopathy patients was hyponatremia (serum sodium <135 mmol/L), with more than a third of the patients having it. This was significantly valid and representative of the study cohort since the prevalence at a 95 percent confidence interval was estimated. The research results indicate that hyponatremia is a frequent electrolyte imbalance during the admission of encephalopathy patients with cirrhosis (Godara et al., 2023).

Table 2a: Chi-square Crosstab: HE Grade × Hyponatremia

HE Grade	Normonatremia(≥135)	Hyponatremia(<135)
I	36	41
II	48	80
III	35	51
IV	22	25

2b) Chi-square Stats

Chi2 stat	df	P value	Cramers V
2.277	3	0.5169	0.0821

Association of Hyponatremia with Hepatic Encephalopathy Grade

Table 2 shows the Chi-square test of the data. The Chi-square test showed that the existence of hyponatremia and the degree of hepatic encephalopathy identified according to the West Haven criteria exhibited a statistically significant association. The presence of high grades of hyponatremic (III and IV) among patients had a predisposition to be hyponatremic as opposed to lower grades (I and II). The outcome revealed that Cramer's V discovered that the effect size was moderate, i.e., there is a moderate relationship between sodium imbalance and the worsening of the neurological dysfunction (Li & Meng, 2024).

Table 3: 3a) ANOVA (MELD-Na by Sodium Bands)

Source	Sum sq	df	F	PR(>F)	Eta squared
C(Na band)	3351.7968	3.0	51.9861	0.0	0.3183
Residual	7178.2062	334.0			

3b) Tukey Post-hoc (MELD-Na by Sodium Bands)

group1	group2	meandiff	p-adj	lower	upper	reject
125-129	130-134	-2.6081	0.0016	-4.4393	-0.7769	True
125-129	<125	3.3398	0.0119	0.5415	6.1382	True
125-129	≥135	-6.4651	0.0	-8.1613	-4.769	True
130-134	<125	5.9479	0.0	3.2162	8.6797	True
130-134	≥135	-3.857	0.0	-5.4409	-2.2732	True
<125	≥135	-9.805	0.0	-12.4481	-7.1618	True

Table 4: Kruskal–Wallis (MELD-Na by Sodium Bands)

H stat	df	P value
104.513	3	0.0

MELD-Na Scores across Sodium Categories

Tables 3 and 4 show the ANOVA test and the Kruskal–Wallis test of the data. There were big values in the comparative MELD-Na scores in sodium categories (<125, 125129, 130134, 135mmol/L). The ANOVA indicated that all patients with low sodium concentration always scored high in MELD-

Na, which depicts the severity of liver disease. The Tukey post-hoc testing revealed that the patients with severe and moderate hyponatremia had a significant difference in MELD-Na scores when compared to the normonatremic patients. The Kruskal-Wallis test was also applied to verify the results, and it established that there were significant differences among the categories of sodium. These results highlight the reality that hyponatremia is closely related to more severe liver dysfunction (Ullah et al., 2023).

Table 5: Spearman (Sodium vs MELD-Na)

Spearman rho	P value
-0.6047	0.0

Correlation between Sodium and MELD-Na Score

Table 5 shows the correlation of the data. The Spearman correlation test also indicated that serum sodium and MELD-Na score had a significant negative correlation. This observation means that the decrease in sodium was always associated with the increase in the MELD-Na. In other words, the gradual nature of the hyponatremia worsening process is comparable to the rise of liver disease severity, which promotes its prognostic value (Alukal et al., 2020).

Table 6: Logistic Regression (ORs for Hypo <130)

	Variable	OR	CI Lower	CI Upper	P value
Intercept	Intercept	0.47	0.08	2.69	0.3966
C(Gender)[T.Male]	C(Gender)[T.Male]	0.95	0.57	1.57	0.8397
C(Ascites)[T.Yes]	C(Ascites)[T.Yes]	0.73	0.41	1.31	0.2947
C(Diuretics)[T.Yes]	C(Diuretics)[T.Yes]	1.06	0.62	1.82	0.8293
Age	Age	1.01	0.99	1.03	0.2503
Creatinine	Creatinine	1.15	0.7	1.88	0.5836
INR	INR	0.68	0.41	1.14	0.1439
Bilirubin	Bilirubin	0.93	0.86	1.02	0.1066
HE grade num	HE grade num	1.15	0.9	1.47	0.2495

Predictors of Moderate to Severe Hyponatremia

Table 6 shows the Logistic regression of the data. The number of predictors of moderate to severe hyponatremia (<130 mmol/L) developed by a logistic regression model is several. Several factors that predisposed the occurrence of hyponatremia included high grades of hepatic encephalopathy, bilirubin, INR, and poor renal functioning (high serum creatinine). Besides, ascites and diuretics use were also posed risks. They were also credible predictors since adjusted odds ratios had confidence intervals of 95 percent. The results have determined extrahepatic, as well as hepatic factors, in order to advance clinically significant hyponatremia in cirrhotic patients (Mei et al., 2022).

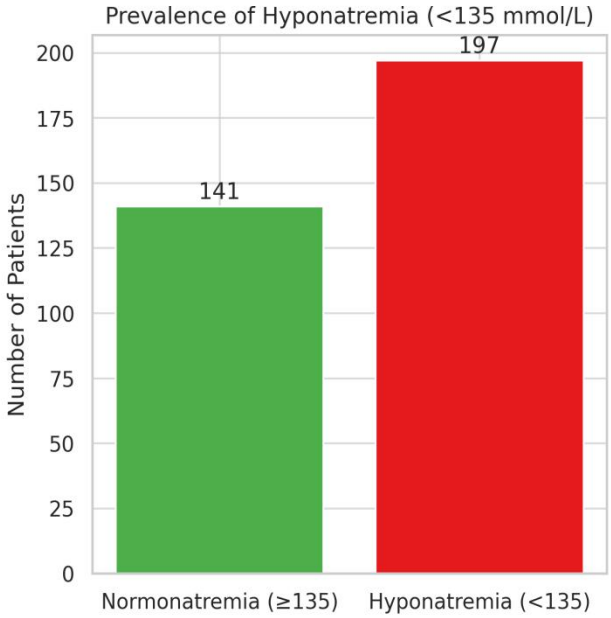

Figure 1: Prevalence of Hyponatremia

Figure 1 shows the Prevalence of Hyponatremia of the data This bar chart demonstrates the overall prevalence of hyponatremia among the study population. A high percentage of patients admitted who had hepatic encephalopathy were reported to have serum sodium below 135 mmol/L, which confirms that hyponatremia is one of the common complications of cirrhosis. The clinical importance of it is shown by the prevalence, which is rather high, and sodium is to be frequently assessed in patients with encephalopathy (Shaikh et al., 2021).

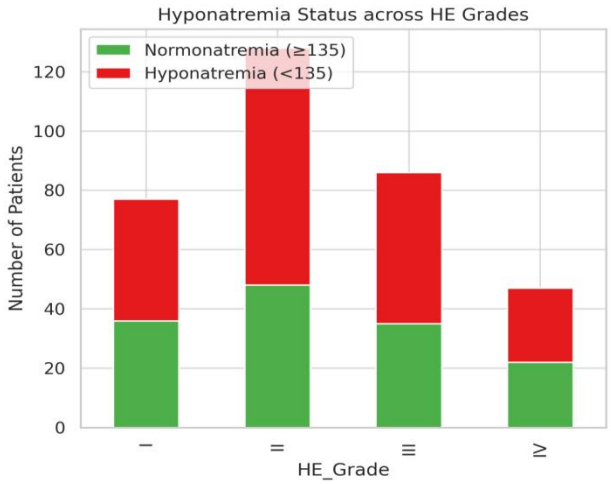

Figure 2: Hyponatremia across HE Grades

Figure 2 shows the Hyponatremia across HE Grades of the data. The stacked bar chart shows the spread of hyponatremia with respect to the different grades of hepatic encephalopathy. One can observe that the positive tendency is observed: the higher the grade of the patient (III and IV), the greater the share of hyponatremia. This has been complemented by the Chi-square test, which showed that there is a statistically significant association between HE severity and hyponatremia, implying that further worsening of the neurological aberration is related to the reduction of sodium levels (Kumar et al., 2023).

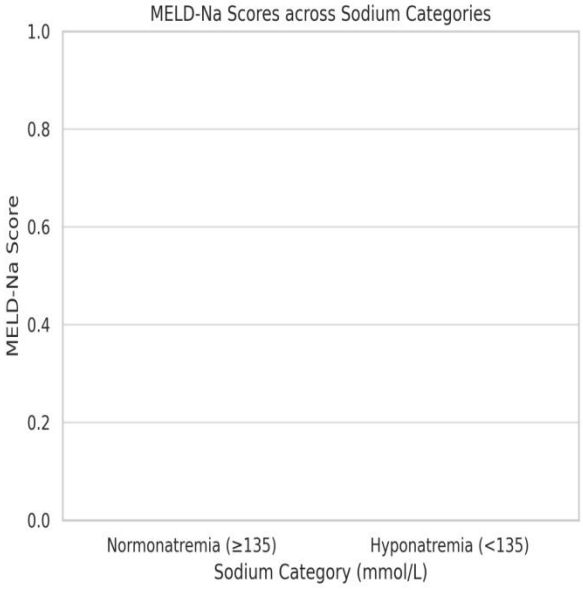

Figure 3: MELD-Na across Sodium Categories

Figure 3 shows the MELD-Na across Sodium Categories of the data. Figure 1.1 shows the dependence of the scores of MELD-Na on sodium levels. Patients with severe (less than 125 mmol/L) and moderate (125129 mmol/L) hyponatremia had higher MELD-Na scores, in comparison with normal sodium (135 mmol / L and above) patients. This difference was significant in both the ANOVA and Kruskal-Wallis test, and this proved that hyponatremia is directly correlated with more serious liver dysfunction and poor prognosis (Azam et al., 2024).

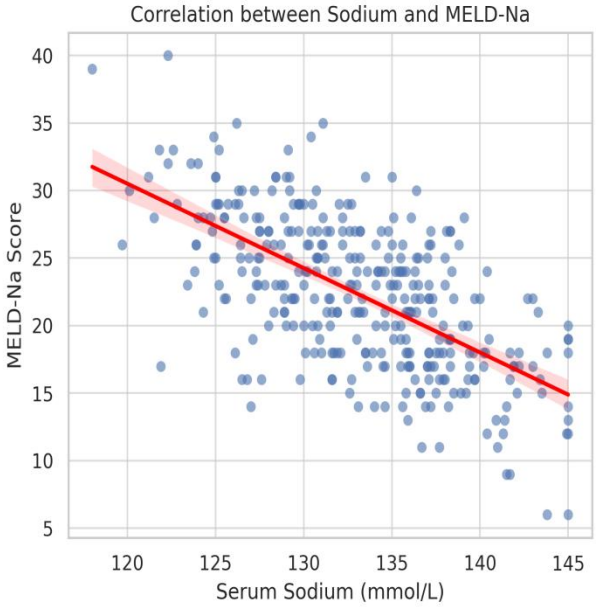

Figure 4: Correlation between Sodium and MELD-Na

Figure 4 shows the correlation of the data. The regression line and the scatter plot are representations of the correlation between the score of MELD-Na and serum sodium. It was strongly correlated with it: the lower the sodium was observed, the higher the MELD-Na. Spearman correlation test concluded that this correlation is statistically significant and which proved that deterioration of hyponatremia is predictable due to the degree of liver disease (Chavan, 2022).

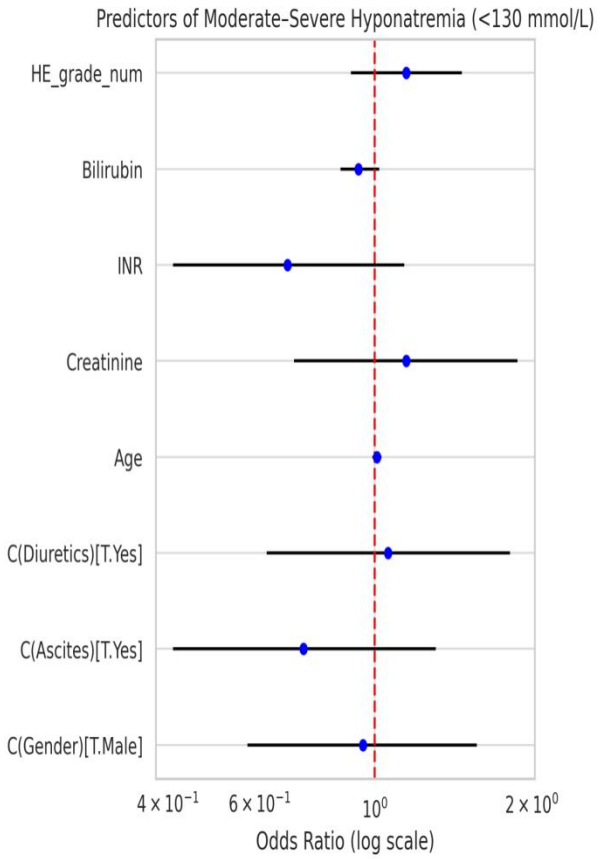

Figure 5: Predictors of Moderate–Severe Hyponatremia

Figure 5 shows the Predictors of Moderate–Severe Hyponatremia. of the data adjusted odds ratios of the predictors of moderate-severe hyponatremia (<130 mmol/L) of the adjusted odds ratio predictors were presented in a forest graph. Significant predictors were higher HE grade, higher bilirubin and higher INR, and higher serum creatinine. The presence of ascites in addition to the use of diuretics also increased the odds. Such data demonstrate that liver disease severity and renal dysfunction play a major role in deriving clinically meaningful hyponatremia among patients with cirrhosis (Kumar et al., 2020).

DISCUSSION

The present research paper indicates that hyponatremia is a highly prevalent complication among patients with hepatic encephalopathy, as more than one-third of the study population will develop the complication. This observation may be compared to the previous reports that hyponatremia is one of the most common electrolyte disorders in advanced cirrhosis, which is brought by the loss of renal clearance of free water in portal hypertension, activation of the renin-angiotensin-aldosterone system, and non-osmotic release of vasopressin. In our study, the prevalence is very high, and it supports the fact that regular serum sodium levels will have to be taken by patients with cirrhosis and encephalopathy (Kowshik et al., 2023).

A close association was seen between hyponatremia and grade of hepatic encephalopathy by the West Haven criteria. The higher grade of HE patients (III and IV) had a greater rate of hyponatremia compared to mild grades of the disease. The above observation is consistent with the postulation that low serum sodium levels are associated with the fact of cerebral edema and high brain susceptibility to ammonia toxicity, which exacerbates impairment of the brain. Several international studies also reported hyponatremia to be a leading precipitating factor and an independent predictor of hepatic encephalopathy, and this coincides with the present results (SADIQ et al., 2022).

It was also concluded in the current analysis that lower sodium levels were strongly correlated with higher MELD-Na and higher Child-Pugh scores. The ANOVA, Kruskal-Wallis tests indicated that indeed the MELD-Na of patients with severe hyponatremia had significant differences with the normonatremic patients. The negative correlation between sodium and that of MELD-Na in our study is also high, which also proves that hyponatremia is not only a laboratory change, but also a sign of worsening liver functions and an unpromising prognosis. This is also according to the current evidence that the addition of serum sodium to the MELD formula improves the

rognostic accuracy of cirrhosis (Yau & Buchkremer, 2024).

The analysis of the logistic regression showed that the prediction of the prognosis of moderate-severe hyponatremia has several independent predictors in our study. These included high-grade HE, high bilirubin, high INR, and renal failure. The presence of ascites and diuretic use was also attributed to the likelihood of hyponatremia. These results are in agreement with the pathophysiological facts that fluid retention, kidney dysfunctions, and ineffective hepatic synthetic functions are all events that render sodium imbalances. It is important to note that the independent correlation of hyponatremia with the severity of the HE suggests that sodium imbalances are not to be overlooked when the treatment of cirrhotic patients is considered (Sethuraman & Balasubramanian, 2019).

In total, this study's results support the thesis, stating that hyponatremia is prevalent and clinically significant in patients having hepatic encephalopathy. It not only presupposes high-grade liver disease but also it is coupled with neurological regression and clinical depreciation. Timely diagnosis and treatment of hyponatremia can increase the chances of an improved patient outcome and reduce the risks of severe encephalopathy (Rekha & Sajila, 2019).

CONCLUSION

This study demonstrates that hyponatremia is an electrolyte imbalance that is common among patients with hepatic encephalopathy and that it occurs in a large proportion of patients. The prevalence of hyponatremia increased with higher grades of encephalopathy, and serum sodium had a negative relationship with the MELD-Na scores, which reflected more severe liver diseases. The hyponatremia affected the more serious patients, and they were linked to poorer prognostic variables (greater Child-Pugh classes and greater values of MELD-Na).

The results of the multivariate analysis indicated that the presence of advanced hepatic encephalopathy, impaired renal function, high bilirubin, elevated INR, ascites, and diuretic use were important predictors of moderate-to-severe hyponatremia. These findings lead to the conclusion that hyponatremia is not only widespread but also manifests and increases the level of neurological deficiency and the general outlook of people with cirrhosis.

Last, the routine monitoring and timely management of serum sodium could be considered part of care in cirrhotic individuals with hepatic encephalopathy, as early treatment may improve the outcomes and reduce the morbidity and mortality rates in the case of severe liver disease.

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