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TO STUDY MEAN CORPUSCULAR VOLUME IN ALCOHOLIC LIVER DISEASE PATIENTS AND TO COMPARE WITH CHILD-PUGH SCORE TO PREDICT THE SEVERITY

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ABSTRACT

Introduction: Alcoholic Liver Disease (ALD) is a prevalent consequence of chronic alcohol abuse, characterized by progressive liver damage that can culminate in cirrhosis and death. The mean corpuscular volume (MCV) is a routinely available hematological parameter that may reflect alcohol-induced macrocytosis and hepatic dysfunction. This study evaluates the relationship between MCV and the Child-Pugh score in predicting the severity and prognosis of ALD.

Objective: The primary objective was to determine whether MCV correlates with the severity of liver dysfunction in ALD, as graded by the Child-Turcotte-Pugh (CTP) score, and to assess its potential as a prognostic marker.

Materials and methods: This observational study included 83 patients diagnosed with ALD and admitted to the Medicine Dept of G.R. Medical College, Gwalior. Detailed clinical, biochemical, and hematological data were recorded. MCV and CTP scores were calculated and analyzed in relation to Child-Pugh classes (A, B, and C) and clinical outcomes.

Results: A statistically significant increase in MCV values with advancing Child-Pugh class ($p < 0.0001$). The mean MCV was lowest in Class A (97.36 fL) and highest among Class C mortality cases (109.5 fL). A parallel rise in CTP scores was also observed, supporting the hypothesis that elevated MCV reflects worsening liver function and correlates with mortality risk.

Conclusion: MCV is significantly associated with disease severity in ALD and may serve as a simple, cost-effective predictor of morbidity and mortality, especially in resource-limited settings.

Keywords: Alcoholic Liver Disease, Mean Corpuscular Volume, Child-Pugh Score, Cirrhosis, Prognosis, Liver Dysfunction, Mortality Predictor

INTRODUCTION

Alcoholic liver disease (ALD) is a significant global health concern, representing a major cause of chronic liver disease worldwide. It includes a spectrum of liver disorders caused by prolonged and excessive alcohol consumption, ranging from hepatic steatosis to alcoholic hepatitis, fibrosis, and cirrhosis. Among these, cirrhosis marks the advanced stage of ALD, characterized by widespread scarring, distortion of liver architecture, and compromised function. Chronic alcohol exposure initiates a series of pathological mechanisms, including oxidative stress, mitochondrial dysfunction,

lipid peroxidation, and immune system activation. These processes collectively result in hepatocyte injury, inflammation, and fibrosis, thereby reducing the liver's capacity to perform essential metabolic and detoxification functions [1,2].

The systemic effects of alcohol are not confined to the liver but extend to hematological alterations, particularly red blood cell indices. One notable parameter is mean corpuscular volume (MCV), which measures the average size of red blood cells. Chronic alcohol use is often associated with elevated MCV, a phenomenon known as macrocytosis. This condition arises from several factors, including direct toxic effects of ethanol on red blood cell membranes, suppression of bone marrow activity, and nutritional deficiencies such as folate and vitamin B12 depletion. Ethanol disrupts red blood cell membrane composition, alters lipid balance, and reduces deformability, which shortens cell survival. Additionally, alcohol impairs red blood cell production in the bone marrow. The consistent presence of elevated MCV in chronic alcohol consumers highlights its dual role as both a marker of systemic alcohol toxicity and a reflection of associated nutritional deficits [3,4].

In the clinical setting of ALD, the utility of MCV extends beyond its recognition as a marker of alcohol intake. Increasing evidence suggests that MCV correlates with disease severity and progression. Higher values often parallel advanced liver dysfunction, highlighting the cumulative effects of chronic alcohol use, systemic inflammation, and nutritional depletion. This makes MCV a potentially useful marker for assessing liver disease severity, especially in environments where access to advanced diagnostic tests may be limited. Understanding this relationship could improve the clinical assessment of ALD and offer a simple, cost-effective adjunct to traditional methods [5].

Cirrhosis, the end stage of ALD, is associated with serious complications including portal hypertension, ascites, hepatic encephalopathy, and variceal bleeding. Portal hypertension develops due to structural changes in the liver, leading to increased resistance to blood flow. This results in the formation of collateral vessels that can rupture and cause life-threatening hemorrhage. Managing cirrhosis requires addressing these complications and accurately assessing the severity of liver dysfunction to guide therapy [6].

The Child-Pugh scoring system is one of the most widely accepted tools for assessing the severity of cirrhosis. It evaluates patients based on five parameters: serum bilirubin, serum albumin, ascites, hepatic encephalopathy, and coagulation status. Each parameter is scored from one to three, and the total score stratifies patients into three classes representing compensated, moderately decompensated, and severely decompensated cirrhosis. Despite its simplicity and effectiveness in predicting prognosis and guiding management, the Child-Pugh score has limitations. It does not encompass systemic hematological abnormalities frequently associated with ALD. Integrating additional parameters such as MCV may enhance its predictive power by capturing broader aspects of alcohol-induced pathology [7,8].

Macrocytosis, commonly observed in ALD, reflects the toxic interplay between alcohol, nutritional status, and hematopoiesis. Ethanol-mediated oxidative stress not only damages hepatocytes but also suppresses bone marrow activity, exacerbating red blood cell abnormalities. This systemic effect links hematological alterations directly with the pathophysiology of liver disease progression. The association between elevated MCV and markers of hepatic dysfunction, such as serum bilirubin and albumin, as well as established tools like the Child-Pugh score, suggests its value as a surrogate marker for disease severity [9].

The clinical relevance of MCV in ALD is further supported by its practicality. It is routinely measured in complete blood counts, requires no advanced equipment, and is inexpensive. In resource-constrained settings, where access to specialized diagnostics may be limited, MCV could provide a simple yet reliable means of identifying high-risk patients and predicting disease progression. Its integration into routine assessment could facilitate early intervention and improve clinical decision-making [10].

ALD is a multifaceted disease involving hepatic injury, fibrosis, systemic complications, and hematological alterations. While the Child-Pugh scoring system remains a cornerstone for evaluating

cirrhosis severity, incorporating parameters such as MCV may enhance its utility by offering a more comprehensive assessment. Elevated MCV not only reflects chronic alcohol toxicity and nutritional deficiencies but also appears to correlate with disease progression. This study seeks to highlight the role of MCV as a valuable adjunct marker in ALD assessment, with the potential to improve management and outcomes, particularly in resource-limited healthcare settings [11,12].

The present study aims to evaluate the role of mean corpuscular volume (MCV) as a predictive tool in alcoholic liver disease by assessing its correlation with the severity of the condition in affected patients. It further seeks to establish the relationship between MCV levels and the Child-Turcotte-Pugh score in order to predict disease severity more accurately. Additionally, the study emphasizes the potential utility of MCV as a simple, cost-effective marker for predicting morbidity and mortality in resource-limited settings, where advanced diagnostic facilities may not be readily available.

MATERIAL AND METHODS

This prospective observational study was conducted at the Department of General Medicine, G.R. Medical College , Gwalior (M.P.), India from April 2023 to April 2025. Ethical approval was obtained from the Ethical Approval Committee of G.R. Medical College , Gwalior (M.P.), India.

Study Population

The study population consisted of 83 patients, determined using a standard sample size estimation formula for infinite population at a 95% confidence level with a z value of 1.96, margin of error of 10%, and purposive sampling from hospital admission records. Participants included non-diabetic patients over 18 years of age with alcoholic liver disease ,admitted to the Department of Medicine, JAH, Gwalior. Exclusion criteria were other causes of chronic liver diseases, hypothyroidism, haematological disorders, pregnancy, age below 18, chronic steroid therapy, or recent psychiatric illness.

Data Analysis

All data were entered in Microsoft Excel and analyzed using SPSS Version 22.0, applying descriptive statistics including mean, standard deviation, frequencies, and percentages. Continuous variables were compared using Student's t-test or ANOVA, while categorical variables were assessed using Chi-square tests. Pearson's correlation evaluated the relationship between MCV and CTP scores, and regression analysis assessed MCV as an independent predictor of mortality. Standardized quality control measures were implemented, and a p-value < 0.05 was considered statistically significant.

RESULTS

In this study of 83 patients with Alcoholic Liver Disease, a striking male predominance was noted, with 96.4% males and 3.6% females, a statistically significant difference reflecting national and global patterns of higher alcohol use in men. Most patients were middle-aged, with the highest prevalence in the 41–50 year group (37.3%), followed by 51–60 years (34.9%), and males predominated across all age brackets. Mean Corpuscular Volume (MCV) increased progressively with age, with significant differences observed between younger (31–40 years) and older groups (>50 years), highlighting possible links to macrocytosis and hepatic dysfunction. Child-Pugh classification revealed that the majority had advanced disease, with 47% in Class C and 41% in Class B, while only 12% were in Class A, indicating delayed diagnosis and advanced presentation. These findings stress the importance of targeted interventions in high-risk male groups, early screening in middle age, and timely clinical management to improve outcomes.

Table 1: Outcome of Mean MCV with Child Pugh Class

Outcome	Child pugh Class	No of cases	Mean MCV	SD	p-value
Discharge	A	10	97.36	1.2	$p < 0.05$
Discharge	B	34	102.78	1.12	$p < 0.05$
Discharge	C	25	107.44	1.14	$p < 0.05$
Mortality	A	-	-	-	-
Mortality	B	-	-	-	-
Mortality	C	14	109.5	1.26	$p < 0.05$

The analysis shows a progressive rise in mean MCV with worsening Child-Pugh class, from near-normal in Class A discharged patients to markedly elevated in Class C, with the highest values observed in Class C mortality cases, indicating a strong association between elevated MCV, disease severity, and poor prognosis.

Table 2: Distribution of mean CTP score and child pugh class

Outcome	Child Pugh Class	No of cases	Mean CTP	SD	p-value
Discharge	A	10	5.9	0.67	$p < 0.0001$
Discharge	B	34	8.20	0.98	$p < 0.0001$
Discharge	C	25	11.76	1.33	$p < 0.0001$
Mortality	A	-	-	-	-
Mortality	B	-	-	-	-
Mortality	C	14	13.07	1.26	$p < 0.0001$

The findings show a progressive increase in mean CTP scores from Class A to Class C, with the highest values in Class C mortality cases, indicating a strong statistically significant correlation between rising CTP scores, worsening liver disease, and poor survival outcomes.

Table 3: Discharge and mortality on the basis of Mean MCV, Mean CTP score and child pugh class

Outcome	Child Pugh Class	No of cases	Mean MCV	SD	Mean CTP	SD
Discharge	A	10	97.36	1.2	5.9	0.67
Discharge	B	34	102.78	1.12	8.2	0.98
Discharge	C	25	107.44	1.14	11.76	1.33
Mortality	A	-	-	-	-	-
Mortality	B	-	-	-	-	-
Mortality	C	14	109.5	1.26	13.07	1.26

Chi-square :18.99 ; p-value :<0.0001

Both mean MCV and mean CTP scores showed a progressive rise from Child-Pugh Class A to C, with the highest values observed in Class C mortality cases, indicating that increasing MCV and CTP strongly correlate with worsening liver function, disease severity, and poor prognosis.

Table 4: Mean and Standard Deviation of MCV, CTP Score, Haemoglobin, SGOT

Variable	Mean	Standard Deviation
MCV	104.75	1.05
CTP Score	9.75	0.95
Hb(gm/dl)	11.95	1.24
SGOT	157.24	93.07
SGPT	98.18	30.74

The descriptive analysis shows elevated MCV indicating macrocytic anemia, a mean CTP score of around 10 suggesting moderate to severe hepatic dysfunction, mildly reduced hemoglobin consistent with anemia in chronic liver disease, and markedly raised SGOT with higher variability compared to SGPT, reflecting significant hepatic injury typical of alcoholic liver disease.

The mean Total Leukocyte Count in the study population was 10,872.39 cells/µL with a standard deviation of 6,505.01, reflecting wide variability in white blood cell levels. The mean Platelet Count was 149,557.2 cells/µL with a standard deviation of 76,098.87, indicating substantial variation across patients. These hematological alterations likely reflect the impact of underlying liver dysfunction and disease severity, highlighting the importance of monitoring blood parameters in Alcoholic Liver Disease.

Table 5: Liver Function Test (LFT) Parameters by Gender

Parameter	Mean (Male)	SD (Male)	Mean (Female)	SD (Female)	p-value
Bilirubin	3.52	1.40	2.42	0.18	0.427
Total Serum Protein	6.85	1.03	6.73	0.86	0.83
Serum Alkaline Phosphatase	197.42	56.93	202.66	52.30	0.87
Serum Globulin	3.97	0.88	3.83	0.92	0.82
S. Albumin	2.88	0.49	2.89	0.73	0.98

Liver function test parameters, including bilirubin, serum proteins, alkaline phosphatase, globulin, and albumin, showed no statistically significant differences between males and females, indicating that gender does not influence LFT outcomes in alcoholic liver disease.

Among the 83 patients with Alcoholic Liver Disease, abdominal distension was the most frequent presenting complaint (25.89%), likely reflecting ascites and advanced disease. Fatigue (17.33%), abdominal pain (16.76%), and loss of appetite (17.32%) were also common, pointing to systemic weakness, hepatic inflammation, and gastrointestinal involvement. Vomiting, pedal edema, and shortness of breath were each reported by 6.93% of cases, while rare symptoms like blood-mixed vomiting (0.57%) suggested severe complications such as portal hypertension and gastrointestinal bleeding.

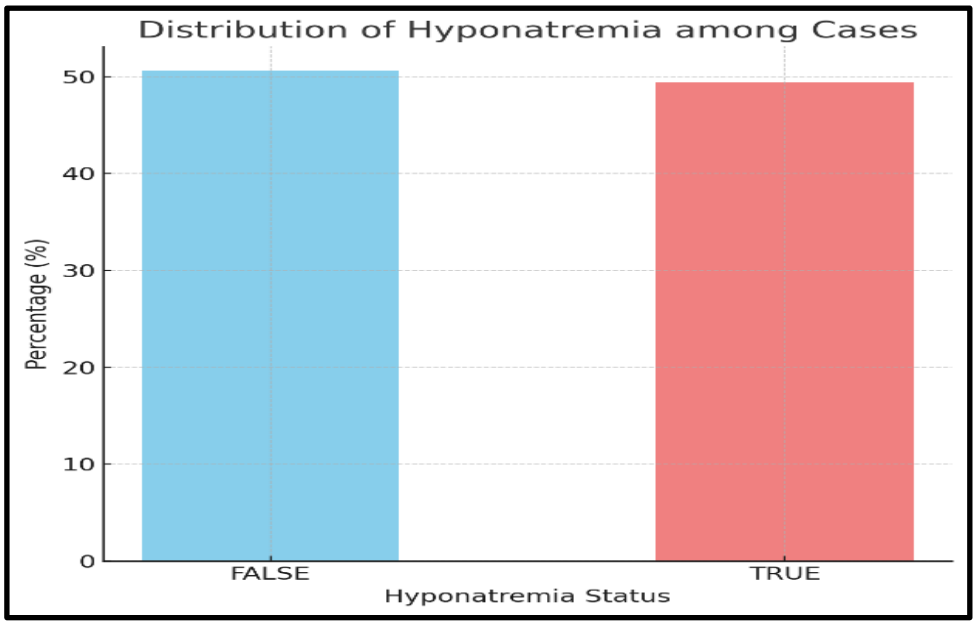

Figure 1: The chart with reduced bar thickness and minimal spacing between the bars

Hyponatremia was present in nearly half (49.4%) of alcoholic liver disease patients, showing high prevalence despite no statistical significance, highlighting its clinical importance as a marker of advanced disease and complications.

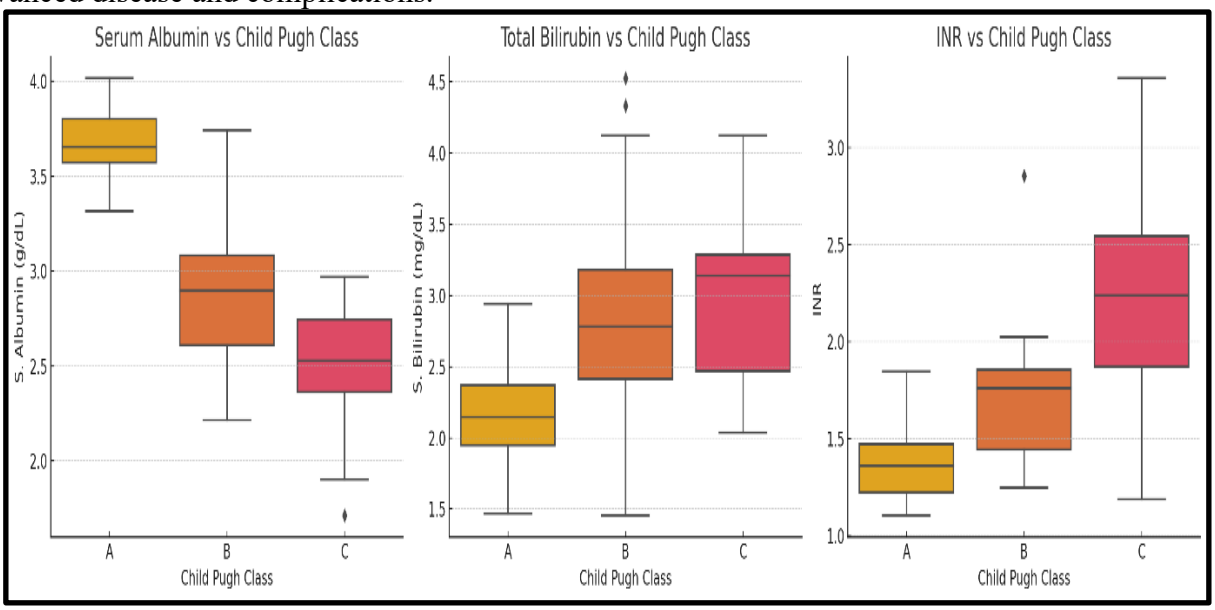

Figure 2: CTP Score Parameters and Their Variation Across Child-Pugh Classes

The analysis shows that with progression from Child-Pugh Class A to C, serum albumin declines while total bilirubin and INR rise, alongside worsening ascites and encephalopathy, highlighting their strong association with advancing liver dysfunction and their prognostic utility in staging alcoholic liver disease severity.

Among the 83 patients with Alcoholic Liver Disease, 69 (83.1%) were successfully discharged, while 14 (16.9%) died during hospitalization. Although the majority had favorable outcomes, the notable mortality rate underscores the impact of severe disease and complications, highlighting the importance of assessing prognostic indicators such as Child-Pugh class, CTP score, and associated comorbidities to better predict and manage high-risk cases.

Table 6: Distribution of mean Child-Turcotte-Pugh (CTP) scores, mean Mean Corpuscular Volume (MCV) values, and the number of cases with raised MCV across different Child-Pugh classes among discharged and mortality groups

Outcome	Child - Pugh Class	No. of cases	Mean CTP Score	SD (CTP)	No. of Cases with raised MCV	Mean MCV (fL)	SD (MCV)
Discharge	A	10	5.71	0.44	2	98.24	0.89
Discharge	B	34	8.38	0.81	30	103.86	0.92
Discharge	C	25	11.76	1.33	25	107.44	2.14
Mortality	A	0	-	-	-	-	-
Mortality	B	0	-	-	-	-	-
Mortality	C	14	13.07	1.26	14	109.31	1.26

p-value : <0.0001

Among discharged patients, the mean CTP score rose from 5.71 in Class A to 11.76 in Class C, and the mean MCV increased from 98.24 fL to 107.44 fL. Importantly, the number of patients with raised MCV also increased significantly with disease severity — from only 2 cases in Class A to all 25 cases in Class C. In mortality cases (all in Class C), the mean CTP score was highest at 13.07, and the mean MCV was further elevated to 109.31 fL.

Both mean CTP scores and mean MCV values showed a steady rise from Child-Pugh Class A to C, with all mortality cases in Class C showing the highest levels, indicating that increasing CTP and MCV strongly correlate with disease progression, severity, and poor prognosis in alcoholic liver disease.

DISCUSSION

Alcoholic liver disease (ALD) remains a major contributor to global liver-related morbidity and mortality, accounting for a significant proportion of chronic liver disease cases. It encompasses a spectrum of hepatic pathologies, ranging from fatty liver (steatosis) to more severe forms such as alcoholic hepatitis, fibrosis, and cirrhosis. The pathophysiological mechanisms involved in ALD are complex, including direct hepatotoxic effects of alcohol and its metabolite acetaldehyde, oxidative stress, mitochondrial dysfunction, and immune-mediated inflammation. Over time, these processes result in hepatocyte injury, impaired regeneration, and progressive fibrosis, ultimately leading to irreversible liver damage and functional decline [13].

Assessing the severity of liver damage in ALD is critical for prognosis and clinical management. The Child–Turcotte–Pugh (CTP) score is a widely used tool that incorporates both clinical and laboratory parameters such as bilirubin, albumin, prothrombin time, ascites, and hepatic encephalopathy. Based on these values, patients are stratified into Class A, B, or C, with increasing severity reflecting a higher risk of complications and mortality. Although effective, the CTP score requires a range of laboratory tests that may not be readily available in resource-limited healthcare settings. In such contexts, simpler, routinely measured markers such as mean corpuscular volume (MCV) could provide a practical adjunct for evaluating disease severity [8].

MCV, a component of the complete blood count, measures the average size of red blood cells and is frequently elevated in individuals with chronic alcohol use. This macrocytosis often occurs independently of folate or vitamin B12 deficiency and is primarily attributed to alcohol-induced bone marrow suppression and toxic effects on erythroid progenitors. Ethanol interferes with DNA synthesis and disrupts erythropoiesis, resulting in larger erythrocytes. Elevated MCV may appear even before overt biochemical evidence of liver dysfunction, making it a potential early marker of alcohol-related liver damage [14].

The cost-effectiveness and availability of MCV testing make it especially useful in resource-constrained settings. If its correlation with liver disease severity and prognostic scoring systems such as the Child-Pugh classification is consistently demonstrated, MCV could enhance risk assessment and guide clinical decision-making where advanced diagnostic facilities are limited. It could also assist in stratifying patients, predicting outcomes, and optimizing resource allocation in high-burden settings [15].

In our study of 83 patients with ALD, a clear male predominance (96.38%) was observed, with the most affected age group being middle-aged males between 41–60 years. This observation is consistent with earlier findings that reported higher ALD prevalence in men, though women remain more vulnerable to developing ALD at lower alcohol intakes and tend to progress more rapidly [16]. We also noted that MCV increased progressively with advancing age, with the highest values recorded in patients over 60 years, reinforcing its role as a marker of cumulative alcohol-induced marrow toxicity and hepatic dysfunction. Similar results were reported by **Jain R, et. al; 2020**, who highlighted significantly elevated MCV and red cell distribution width in ALD patients [17].

Most patients in our study presented at advanced stages, with 46.98% in Child-Pugh Class C and 40.96% in Class B, reflecting delayed diagnosis and severe hepatic dysfunction. This is consistent with previous studies that found the majority of ALD patients in decompensated stages at presentation [18]. Importantly, MCV showed a significant correlation with worsening Child-Pugh class, with the highest MCV recorded in Class C mortality cases. These results are supported by **Yang J, et. al; 2018,** who demonstrated progressively higher MCV values across Child-Pugh classes, reinforcing its utility as a prognostic marker [19].

The prognostic significance of the Child-Pugh score itself was confirmed, with lower scores observed in discharged patients and markedly higher scores in non-survivors, underscoring its role as a reliable predictor of mortality. This aligns with findings from **Trifan A, et. al; 2022,** who reported that advanced CTP classes strongly correlated with poor survival and increased complications. When analyzed together, both MCV and CTP scores in our study showed a strong association with clinical outcomes, highlighting their combined value in risk stratification and prognosis in ALD [20].

Biochemical analysis revealed elevated transaminases and reduced platelet counts, consistent with hepatocellular injury, portal hypertension, and marrow suppression. These findings are comparable to studies by **Singh S, et. al; 2020,** who observed that macrocytic anemia and elevated MCV correlated with advanced CTP and MELD classes [21]. Symptomatically, abdominal distension, fatigue, anorexia, and abdominal pain were the most common presenting features, aligning with prior studies that documented similar gastrointestinal and systemic manifestations in ALD patients. Hyponatremia was observed in nearly half of the patients, with mean sodium levels declining with higher CTP class, a trend consistent with previous literature linking hyponatremia to advanced cirrhosis and hepatorenal dysfunction [22]. Ascites and hepatic encephalopathy also showed strong correlations with worsening CTP class, reflecting progressive hepatic decompensation, in agreement with prior studies [23,24].

CONCLUSION

This study demonstrates a significant correlation between Mean Corpuscular Volume and the severity of Alcoholic Liver Disease as assessed by the Child-Pugh score. MCV appears to be a cost-effective, simple, and readily available marker that reflects hepatic dysfunction and may help predict clinical outcomes. Its accessibility makes it especially valuable in resource-limited settings. Further research is needed to validate these results in larger, diverse populations and explore its integration into standard prognostic models.

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