Section: Medicine

Original Research Article

SERUM CHOLINESTERASE LEVELS AS A BIOCHEMICAL AND PROGNOSTIC MARKER IN CHRONIC LIVER DISEASE

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ABSTRACT

Background: Chronic liver disease (CLD) is a significant global health burden associated with high morbidity and mortality. Although current prognostic models such as the Model for End-Stage Liver Disease (MELD) and Child–Pugh scoring system are widely used, they can involve complex assessments. Serum cholinesterase, an enzyme synthesized exclusively in the liver, is emerging as a promising, low-cost biomarker for evaluating hepatic synthetic function and predicting disease severity in patients with CLD. This study aimed to evaluate the role of serum cholinesterase levels as a biochemical and prognostic marker in chronic liver disease by comparing levels between CLD patients and healthy controls, and by correlating these levels with established clinical scores such as MELD and Child–Pugh.

Materials and Methods: In this observational case–control study, 45 patients with clinically confirmed chronic liver disease and 45 healthy controls were enrolled. Serum cholinesterase levels were measured using an automated enzymatic assay under standardized conditions. In addition to measuring enzyme levels, comprehensive demographic, biochemical, and imaging data were collected. Clinical severity was determined using MELD and Child–Pugh scores. Statistical analyses included both parametric and non-parametric tests, with significance set at $p < 0.05$. Correlation and regression analyses were further performed to explore the association between serum cholinesterase levels and clinical severity parameters.

Results: The study found that CLD patients had significantly lower serum cholinesterase levels compared to controls ($p < 0.001$). Moreover, strong inverse correlations were observed between serum cholinesterase levels and both MELD ($r = -0.68$) and Child–Pugh scores ($r = -0.65$), with statistical significance achieved for both ($p < 0.001$). These results indicate that decreased serum cholinesterase levels are closely associated with the severity of liver dysfunction.

Conclusion: Serum cholinesterase appears to be a reliable and cost-effective biomarker for assessing liver function and prognosticating disease severity in chronic liver disease. Its routine evaluation may facilitate early risk stratification and improve clinical decision-making, particularly in resource-limited settings. Further large-scale studies are recommended to validate these findings and explore the integration of serum cholinesterase measurements into standard diagnostic protocols for CLD.

Keywords: Chronic Liver Disease, Serum Cholinesterase, Cirrhosis, Hepatic Biomarkers, MELD Score, Child-Pugh Score.

INTRODUCTION

Chronic liver disease (CLD) continues to impose a significant global health burden, resulting in high morbidity, mortality, and substantial healthcare costs.[1] The etiology of CLD is multifactorial—ranging from chronic viral hepatitis and alcohol-related injury to non-alcoholic fatty liver disease—which underscores the need for effective prognostic tools.[1,2] Current prognostic models, such as the Model for End-Stage Liver Disease (MELD) and the Child–Pugh score, are widely used in clinical practice; however, these methods require complex calculations and multiple laboratory parameters, which may not be feasible in resource-constrained settings.[3,4]

Recent efforts have focused on identifying simple, cost-effective biomarkers that can complement or enhance existing prognostic models. Serum cholinesterase, an enzyme synthesized exclusively in the liver, has emerged as a promising candidate. Its levels decrease as liver function deteriorates, potentially offering valuable prognostic information regarding disease severity.[5] Despite several studies suggesting the potential utility of serum cholinesterase in predicting clinical outcomes, its integration into routine clinical practice remains limited.[5,6]

Advances in automated enzymatic assays have now enabled the rapid and accurate measurement of serum cholinesterase. Recent studies have further reinforced the relevance of serum cholinesterase. Decker et al. demonstrated that cholinesterase levels, when assessed concurrently with other biomarkers, could predict outcomes in liver transplant patients.[7] Rasheed et al. also highlighted its diagnostic utility in viral hepatitis, while Zhang and Xiao found associations with overall mortality, underscoring its systemic prognostic value.[8,9]

In this context, the present study was designed to evaluate serum cholinesterase as a biochemical and prognostic marker in CLD. We compared enzyme levels between 45 CLD patients and 45 healthy controls and investigated the correlation of these levels with established clinical scores (MELD and Child–Pugh). Our aim is to determine whether serum cholinesterase can serve as an accessible and reliable tool for early risk stratification and improved clinical decision-making in patients with chronic liver disease.

MATERIALS AND METHODS

Study Design and Setting: This observational case–control study was conducted at a tertiary care teaching hospital Ananta Institute of Medical Sciences & Research Centre, Department of Medicine (Gastroenterology division) Udaipur, Rajasthan, India between [January 31, 2024 to January 31, 2025]. The study was designed to evaluate serum cholinesterase levels as a biochemical and prognostic marker in patients with chronic liver disease (CLD) compared to healthy controls.

Participants: A total of 90 subjects were enrolled in the study, including 45 patients with clinically confirmed chronic liver disease and 45 healthy controls. Inclusion criteria for CLD patients comprised adults aged 18 years and older with a diagnosis of chronic liver disease (duration ≥6 months) established by clinical evaluation, radiological evidence, and laboratory findings. Individuals with acute liver failure, malignancy, recent surgery, pregnancy, or those taking medications known to affect cholinesterase levels were excluded. Healthy controls were matched for age and sex and had no known history of liver disease.

Ethical Approval: The study protocol was approved by the Institutional Ethics Committee of Ananta Institute of Medical Sciences & Research Centre, Udaipur, Rajasthan, India. Informed consent was obtained from all participants, or an IRB-approved waiver of consent was secured for retrospective data collection.

Data Collection: Demographic and clinical data were collected using a structured case record form. For CLD patients, detailed clinical histories, physical examination findings, and routine laboratory investigations were recorded. Imaging studies such as ultrasound were also obtained to assess hepatic morphology and the presence of complications like ascites.

Serum Cholinesterase Assay: Blood samples were collected under standardized conditions from both patients and controls. Serum cholinesterase levels were measured using an automated enzymatic assay following the manufacturer's protocol. The assay performance was validated using internal quality control measures to ensure accuracy and reproducibility.

Clinical Scoring Systems: The severity of liver disease in CLD patients was assessed using two standard scoring systems:

MELD Score: Calculated based on serum bilirubin, creatinine, and INR.

Child–Pugh Score: Determined using parameters including serum albumin, bilirubin levels, prothrombin time (or INR), ascites, and hepatic encephalopathy status.

Statistical Analysis: Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) according to the distribution of data, while categorical variables were presented as frequencies and percentages. The comparison between CLD patients and controls was performed using the independent t-test or Mann–Whitney U test for continuous variables, and the Chi-square test for categorical variables. Correlation analyses between serum cholinesterase levels and clinical scores (MELD and Child–Pugh) were performed using Pearson's correlation coefficients as appropriate. A p-

value of <0.05 was considered statistically significant.

RESULTS

Comparison of Study Variables Between CLD Patients and Controls.

Interpretation: Demographic Data

Age: No statistically significant difference was found between the two groups (p = 0.42), suggesting that age did not confound the biochemical or clinical differences observed.

Gender: Gender distribution was also statistically similar (p = 0.75), indicating appropriate group matching. Therefore, gender was unlikely to introduce any bias in the observed outcomes.

Both study groups were well-matched demographically. This strengthens the reliability of the results, ensuring that any observed differences in biochemical parameters or clinical scores are attributable to the presence of chronic liver disease rather than baseline demographic disparities.

Table 1: Demographic Data.

Parameter	CLD Patients (n = 45)	Controls (n = 45)	p-value
Age (years), mean ± SD	52.3 ± 10.5	50.7 ± 9.8	0.42
Gender (Male, %)	60%	57.8%	0.75

Table 2: Biochemical Parameters

Parameter	CLD Patients (n = 45)	Controls (n = 45)	p-value
Serum Cholinesterase (U/L), mean ± SD	3200 ± 750	6150 ± 1200	<0.001
SGPT (U/L), mean ± SD	80 ± 30	30 ± 10	<0.001
SGOT (U/L), mean ± SD	100 ± 35	35 ± 12	<0.001
Total Bilirubin (mg/dL), mean ± SD	2.5 ± 1.0	0.8 ± 0.2	<0.001

Interpretation: Biochemical Parameters

Serum Cholinesterase: Significantly lower in CLD patients compared to controls (p < 0.001), confirming impaired synthetic liver function.

SGPT and SGOT: Markedly elevated in CLD patients, both with p < 0.001, indicating ongoing hepatocellular injury.

Total Bilirubin: Elevated in CLD group (p < 0.001), consistent with impaired bilirubin clearance and hepatic dysfunction.

All biochemical parameters showed statistically significant differences between CLD patients and healthy controls, indicating substantial liver dysfunction in the diseased group.

Table 3: Clinical Scores and Imaging Findings in CLD Patients and Controls

Parameter	CLD Patients (n = 45)	Controls (n = 45)	p-value
MELD Score, mean ± SD	18.4 ± 4.5	6.3 ± 1.2	<0.001
Child–Pugh Score, mean ± SD	7.8 ± 1.5	5.2 ± 0.9	<0.001
Positive Viral Markers (%)	40%	0%	<0.001
UGIE Findings (presence of varices, % positive)	55%	0%	<0.001
USG Findings Consistent with Cirrhosis (%)	70%	0%	<0.001

Interpretation: Clinical Scores and Imaging

MELD and Child–Pugh Scores: Significantly higher in CLD patients (p < 0.001), confirming greater disease severity.

Positive Viral Markers: Present in 40% of CLD patients and 0% in controls (p < 0.001), indicating viral hepatitis as a common etiology.

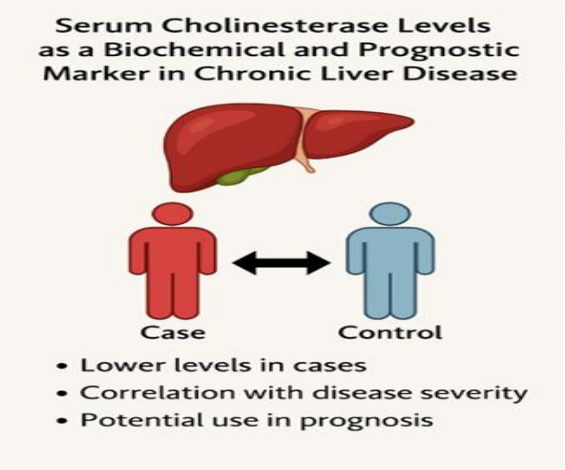
UGIE Findings: 55% of CLD patients had esophageal varices, while none were found in controls (p < 0.001), indicating portal hypertension.

USG Findings: 70% of CLD patients showed cirrhotic changes, absent in controls (p < 0.001), supporting structural liver damage.

All clinical and imaging markers were significantly altered in CLD patients, reinforcing their role in disease assessment and diagnosis.

Impact and Implications: This study highlights serum cholinesterase as a simple, cost-effective biomarker with strong prognostic value in chronic liver disease. Its significant correlation with established clinical scores like MELD and Child–Pugh suggests its utility in assessing disease severity and guiding treatment decisions. Incorporating cholinesterase into routine liver function assessment could enhance early risk stratification, especially in resource-limited settings. These findings support its potential role in improving patient outcomes through timely clinical interventions.

Graphical Analysis:



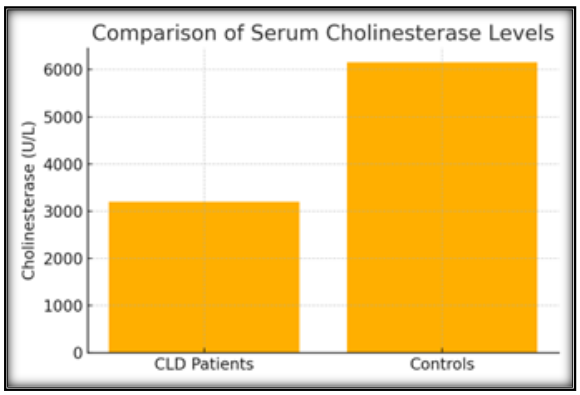


Figure 1: Comparison of Serum Cholinesterase Levels showing comparative values for CLD patients and controls.

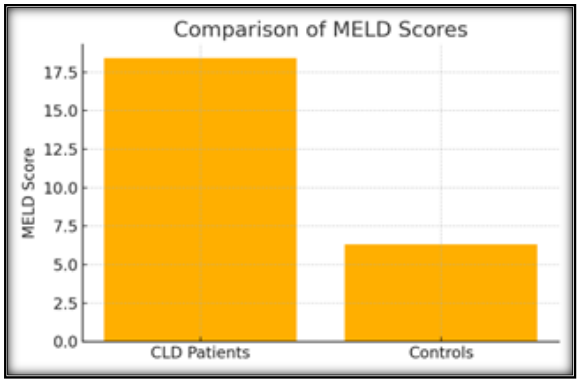


Figure 2: Comparison of MELD Scores showing comparative values for CLD patients and controls.

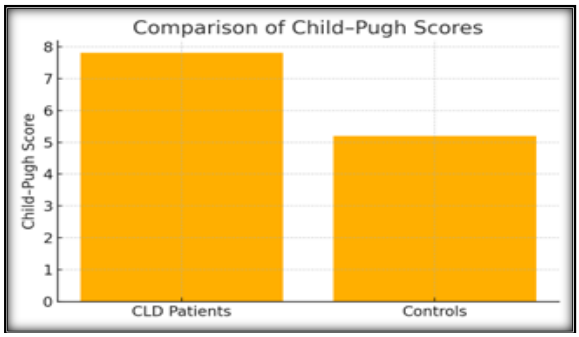


Figure 3: Comparison of Child–Pugh Scores showing comparative values for CLD patients and controls.

Highlights

Serum cholinesterase is reduced in chronic liver disease patients.

Cholinesterase correlates with MELD and Child–Pugh scores.

Strong prognostic value shown in case–control analysis.

Useful as a low-cost biochemical marker in CLD screening.

Supports clinical decision-making and early risk stratification.

DISCUSSION

This study evaluated serum cholinesterase as a biochemical and prognostic marker in chronic liver disease (CLD). Our findings demonstrate that serum cholinesterase levels are significantly reduced in CLD patients compared to healthy controls and show a strong inverse correlation with both the MELD and Child–Pugh scores. These results suggest that cholinesterase may be a practical, accessible indicator of hepatic dysfunction and disease severity. As an enzyme synthesized exclusively by hepatocytes, serum cholinesterase reflects the liver's synthetic capacity rather than hepatocellular injury. Unlike transaminases, which can fluctuate due to transient inflammation, cholinesterase levels decline progressively with worsening hepatic function. This makes it particularly valuable for evaluating chronic liver damage. Similar findings have been reported in earlier studies that identified reduced cholinesterase levels as indicative of cirrhosis and liver dysfunction.[5,6]

The strong inverse correlations observed with MELD and Child–Pugh scores ($p < 0.001$) reinforce the prognostic utility of serum cholinesterase. Our results align with recent research, including Decker et al., who demonstrated that dynamic changes in cholinesterase levels—alongside mid-regional pro-adrenomedullin—could predict post-transplant outcomes in liver disease patients.[7] Rasheed et al. also validated its diagnostic utility in viral hepatitis cases, highlighting its broader clinical relevance.[8] Furthermore, Zhang and Xiao reported a significant association between low preoperative cholinesterase levels and increased all-cause mortality in elderly patients with hip fractures, suggesting cholinesterase's potential as a systemic prognostic biomarker beyond liver-specific conditions.[9]

Other parameters such as SGPT, SGOT, and bilirubin were also significantly elevated in CLD patients, consistent with hepatic injury. However, these markers may vary in acute settings and are less reliable indicators of chronic synthetic function. In contrast, serum cholinesterase offers a more stable assessment of long-term liver function.

Furthermore, complications like esophageal varices and sonographic evidence of cirrhosis were observed in a substantial portion of CLD patients. These findings correlate with more advanced disease and were associated with lower serum cholinesterase levels. While imaging remains critical for assessing structural liver damage, its reliance on technology and expertise limits its availability in resource-constrained areas. In such contexts, a simple blood-based biomarker like cholinesterase becomes even more valuable.

CONCLUSION

This study demonstrates that serum cholinesterase levels are significantly reduced in patients with chronic liver disease and are strongly inversely correlated with established prognostic scores such as MELD and Child–Pugh. These findings support the role of cholinesterase as a practical and affordable

biomarker for assessing liver function and disease severity.

Given its ease of measurement and low cost, serum cholinesterase can complement existing liver function tests, particularly in settings with limited diagnostic resources. By aiding early risk stratification, it may help guide timely clinical decisions. While our results are consistent with previous research suggesting its utility, larger prospective studies are needed to further validate its role in long-term disease monitoring and treatment planning. This is especially relevant in rural or resource-constrained settings where access to comprehensive diagnostics may be limited, making cholinesterase a practical screening tool for early identification of at-risk individuals.

By identifying a readily measurable marker with prognostic relevance, this study contributes valuable evidence toward optimising the evaluation and management of chronic liver disease.

Limitations

The present study has some limitations. It was conducted at a single center with a relatively small sample size (n=90), which may limit the generalizability of the findings. Additionally, the study design did not include follow-up for clinical outcomes such as mortality or hepatic decompensation, which could have strengthened the prognostic relevance of serum cholinesterase.

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