Original Research Article
Comparative Predictive Accuracy of Child-Pugh and MELD Scores in Prognosis of Liver Cirrhosis and Evaluation of Serum Ferritin Levels

ABSTRACT

Background: Liver cirrhosis is a leading cause of morbidity and mortality worldwide. Accurate prognostication is crucial for timely interventions and optimal management. Child-Pugh and MELD scores are widely used prognostic tools, but their relative effectiveness remains debated.
Aim: To compare the predictive accuracy of Child-Pugh and MELD scores in determining mortality in liver cirrhosis patients and evaluate the prognostic value of serum ferritin levels.
Methods: This prospective observational study enrolled 50 patients with liver cirrhosis admitted to a tertiary care hospital between November 2022 and March 2023. Patients were assessed using Child-Pugh and MELD scores at admission and after three months. Serum ferritin levels were measured, and clinical outcomes were recorded. Statistical analysis employed SPSS version 22.0.
Results: The majority of patients (46%) were aged 41-60 years, with a male predominance (90%). Jaundice (94%), ascites (38%), and hepatic encephalopathy (16%) were common presentations. The overall mortality rate was 24%. Child-Pugh scores correlated significantly with mortality ($p < 0.01$). Survival rates for Child-Pugh classes A, B, and C were 100%, 80%, and 45%, respectively. Patients with serum ferritin levels >500 ng/mL had significantly lower survival rates (61%) compared to those with levels <500 ng/mL (88%). The Child-Pugh score demonstrated greater short-term predictive accuracy (AUC = 0.85) compared to the MELD score (AUC = 0.78).
Conclusion: This study highlights the importance of Child-Pugh and MELD scores in predicting mortality in liver cirrhosis. Elevated serum ferritin levels (>500 ng/mL) emerge as an independent prognostic marker for poor outcomes. Integration of clinical scoring systems and biomarkers can enhance predictive accuracy and guide therapeutic decision-making. These findings have significant implications for risk stratification, personalized treatment, and liver transplant prioritization. Future research should focus on validating these findings and exploring underlying mechanisms to improve liver cirrhosis management.

*Keywords:*Liver Cirrhosis,Child-Pugh Score, MELD Score, Serum Ferritin, Prognosis

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INTRODUCTION

Liver cirrhosis, a pathological endpoint of chronic liver diseases, is characterized by the histomorphological hallmark of regenerative nodules surrounded by fibrous tissue, culminating in significant hepatic dysfunction and hemodynamic disturbances (1). This irreversible scarring process results from prolonged liver injury, inflammation, and fibrogenesis, ultimately compromising liver function and patient survival. Cirrhosis accounts for over 1 million deaths annually worldwide, emphasizing the need for early diagnosis and effective management strategies (2). The global prevalence of cirrhosis is estimated to be 0.15-1.5%, with varying etiologies, including hepatitis B and C, alcohol consumption, non-alcoholic fatty liver disease (NAFLD), and non-alcoholic steatohepatitis (NASH) (3).

Early diagnosis of cirrhosis is often hindered by the asymptomatic nature of initial stages, delaying intervention until complications arise, such as variceal bleeding, ascites, hepatic encephalopathy, and spontaneous bacterial peritonitis. The Child-Pugh (CP) and Model for End-Stage Liver Disease (MELD) scores are widely employed prognostic tools, but their relative effectiveness remains debated (4). The CP score integrates clinical parameters, including albumin, bilirubin, prothrombin time, ascites, and encephalopathy, while the MELD score relies on objective laboratory values, such as bilirubin, creatinine, and international normalized ratio (INR).

This study aims to compare the predictive accuracy of CP and MELD scores in determining liver cirrhosis patient prognosis and evaluate the prognostic value of serum ferritin levels in these patients. Elevated serum ferritin levels have been linked to liver inflammation, fibrosis, and poor prognosis in cirrhotic patients (5).

METHODS

Study Design

This prospective observational study employed a cohort design to investigate the predictive accuracy of Child-Pugh and Model for End-Stage Liver Disease (MELD) scores in patients with liver cirrhosis, while evaluating the prognostic utility of serum ferritin levels.

Study Setting and Duration

The study was conducted at the Medicine department of Chhatrapati Shivaji Subharti Hospital, Meerut, UP, India, over a period of six months (November 2022 to March 2023).

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) and informed consent was secured from all participants prior to enrollment.

Inclusion and Exclusion Criteria

Inclusion Criteria:

1. Patients aged ≥ 18 years
2. Clinically and radiologically confirmed liver cirrhosis
3. Ability to provide informed consent

Exclusion Criteria:

1. Pre-existing renal disease
2. Bleeding disorders
3. Ascites due to causes other than cirrhosis

Data Collection

A structured questionnaire was used to collect:

1. Demographic data (age, sex, ethnicity)

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2. Clinical parameters (medical history, physical examination)

3. Laboratory parameters:

- Liver function tests (LFTs): alanine transaminase (ALT), aspartate transaminase (AST), total bilirubin, albumin

- Coagulation profiles: prothrombin time (PT), international normalized ratio (INR)

- Renal function tests (RFTs): serum creatinine, urea

- Serum iron studies: ferritin, iron, total iron-binding capacity (TIBC)

4. Radiological findings: ultrasound, computed tomography (CT) scans

Child-Pugh and MELD Scoring

Child-Pugh and MELD scores were calculated for each patient at admission and after three months using standard formulas.

Serum Ferritin Measurement

Serum ferritin levels were measured using enzyme-linked immunosorbent assay (ELISA) kits.

Data Analysis

Statistical analysis was performed using IBM SPSS Statistics version 22.0.

1. Descriptive statistics: mean, standard deviation (SD), frequency

2. Inferential statistics:

- Chi-square test for categorical variables

- Independent t-test for continuous variables

- Pearson's correlation coefficient for correlation analysis

- Multivariate regression analysis for adjusting confounding variables

3. Significance level: $p < 0.05$

Sample Size Calculation

The sample size was calculated using the formula:

$n = (Z^2 * p * (1-p)) / E^2$

where n = sample size, Z = Z-score (1.96), p = expected proportion (0.5), E = margin of error (0.05)

Power Analysis

A post-hoc power analysis was conducted to determine the study's power to detect significant differences.

By employing this rigorous methodology, this study aimed to provide valuable insights into the predictive accuracy of Child-Pugh and MELD scores and the prognostic utility of serum ferritin levels in patients with liver cirrhosis.

RESULTS

Demographic and Clinical Characteristics

The study cohort consisted of 50 patients with liver cirrhosis, exhibiting a notable demographic distribution:

- Age: 41-60 years (46%); ≥ 61 years (24%); ≤ 40 years (30%)

- Sex: Male (90%); Female (10%)

Clinical Presentation

Patients presented with:

- Jaundice (94%)

- Ascites (38%)

- Hepatic encephalopathy (16%)

- Hematemesis (16%)

- Melena (40%)

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Mortality and Survival Outcomes

The overall mortality rate was 24%. Notably:

- Child-Pugh scores correlated significantly with mortality ($p < 0.01$)

- Survival rates for Child-Pugh classes:

  - A: 100%

  - B: 80%

  - C: 45%

- Serum ferritin levels >500 ng/mL associated with lower survival rates (61%) vs. ≤ 500 ng/mL (88%)

Prognostic Accuracy and Predictive Value

The study revealed:

- Child-Pugh score demonstrated superior short-term predictive accuracy for liver cirrhosis prognosis (AUC = 0.85)

- MELD score effectively identified patients at high risk of poor outcomes (AUC = 0.78)

- Elevated serum ferritin levels (>500 ng/mL) emerged as an independent prognostic marker for increased mortality (HR = 2.5, 95% CI: 1.3-4.7)

DISCUSSIONS

Comparative Analysis of Child-Pugh and MELD Scores

The Child-Pugh score, initially designed to predict surgical mortality in cirrhotic patients [6], remains a reliable tool for assessing liver disease severity and prognosis. This scoring system incorporates five clinical measures: encephalopathy, ascites, bilirubin, albumin, and prothrombin time/international normalized ratio (INR). Patients are classified into three classes (A, B, and C) based on the total score [7]. In this study, survival rates for Child-Pugh classes A, B, and C were 100%, 80%, and 45%, respectively, demonstrating its utility in predicting short-term mortality [8].

The MELD score, based on a mathematical formula incorporating bilirubin, creatinine, and INR [9], was initially developed to predict mortality in patients undergoing transjugular intrahepatic portosystemic shunt (TIPS) procedures. Although the MELD score demonstrated high sensitivity in identifying patients at risk of poor outcomes, its overall predictive accuracy was slightly lower than that of the Child-Pugh score for short-term mortality.

Prognostic Value of Serum Ferritin

Serum ferritin, an acute-phase reactant and marker of iron stores [10], has been explored as a potential prognostic marker in various liver diseases. Elevated ferritin levels indicate increased hepatic iron deposition, inflammation, and oxidative stress, contributing to liver injury and fibrosis progression [11]. In this study, patients with serum ferritin levels >500 ng/mL had significantly lower survival rates (61%) compared to those with levels <500 ng/mL (88%), underscoring ferritin's potential role as an independent prognostic marker.

Clinical Implications and Future Research

This study's findings have important clinical implications for liver cirrhosis management:

- Child-Pugh score remains valuable for assessing disease severity and predicting short-term mortality.

- MELD score is useful for identifying patients at high risk of poor outcomes.

- Elevated serum ferritin levels correlate with poor prognosis.

Future research should:

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- Validate these findings in larger, multicenter cohorts.

- Explore underlying mechanisms linking elevated serum ferritin levels with adverse outcomes.

- Integrate novel biomarkers and advanced imaging techniques to enhance predictive accuracy.

CONCLUSION

This prospective observational study investigated the predictive accuracy of Child-Pugh and MELD scores in patients with liver cirrhosis and evaluated the prognostic value of serum ferritin levels. The findings demonstrate:

1. Child-Pugh score remains a reliable tool for assessing disease severity and predicting short-term mortality in liver cirrhosis.
2. MELD score is useful for identifying patients at high risk of poor outcomes.
3. Elevated serum ferritin levels (>500 ng/mL) are associated with significantly lower survival rates and poor prognosis.

These results underscore the importance of integrating clinical scoring systems and biomarkers to enhance predictive accuracy and guide therapeutic decision-making in liver cirrhosis management.

Clinical Implications

The study's findings have significant clinical implications:

1. *Risk Stratification:* Child-Pugh and MELD scores should be used in conjunction to stratify patients according to disease severity and predict short-term mortality.
2. *Serum Ferritin Monitoring:* Regular measurement of serum ferritin levels can help identify patients at high risk of poor outcomes and guide timely interventions.
3. *Personalized Treatment:* Integration of clinical scoring systems and biomarkers can facilitate personalized treatment approaches, improving patient outcomes and reducing healthcare costs.
4. *Liver Transplant Prioritization:* MELD score can inform liver transplant prioritization, ensuring timely allocation of organs to patients with the highest risk of mortality.
5. *Novel Biomarker Development:* The study's findings highlight the need for developing novel biomarkers to enhance predictive accuracy and improve patient stratification.

Future Directions

To further enhance liver cirrhosis management:

1. *Multicenter Studies:* Large-scale, multicenter studies are necessary to validate these findings and explore underlying mechanisms.
2. *Biomarker Discovery:* Research should focus on identifying novel biomarkers to complement existing scoring systems.
3. *Advanced Imaging Techniques:* Integration of advanced imaging techniques, such as MRI

and CT scans, may improve predictive accuracy.

4. *Therapeutic Interventions:* Investigations into targeted therapeutic interventions, such as iron chelation therapy, may improve outcomes in patients with elevated serum ferritin levels.

By implementing these recommendations, clinicians can optimize liver cirrhosis management, improving patient outcomes and reducing healthcare costs.

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