

Relationship between Child-Turcotte-Pugh Score and Esophageal Varices in Patients with Liver Cirrhosis

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Abstract

Background: Esophageal varices represent a serious complication of portal hypertension in patients with liver cirrhosis. Their development relates to the severity of underlying hepatic dysfunction and portal hypertension. The Child-Turcotte-Pugh (CTP) score is a well-known tool for evaluating the severity of chronic liver disease through clinical and biochemical parameters. The current study assessed the association between the presence of esophageal varices and CTP score in patients with liver cirrhosis.

Objective: To evaluate the association between Child-Turcotte-Pugh score and the presence of esophageal varices in patients with liver cirrhosis.

Methods: A hospital-based prospective cross-sectional study was conducted in the Department of General Medicine, Navodaya Medical College and Research Centre, Raichur, Karnataka from January 2022 to June 2023. 100 patients with liver cirrhosis and portal hypertension aged 18–60 years were included by simple random sampling. Clinical assessment, laboratory investigations, abdominal ultrasonography and upper gastrointestinal endoscopy were performed. CTP scores were calculated using encephalopathy, ascites, bilirubin, albumin and prothrombin time/INR according to the scoring system described. Subjects were divided according to whether they had esophageal varices on endoscopy or not. CTP scores were compared between the two groups.

Results: The mean CTP score in the overall study population was 7.52 ± 1.93 . Thirty-four percent of participants were classified as CTP class A, 46% as class B and 20% as class C. Esophageal varices were detected in 50% of participants. The mean CTP score was significantly higher among patients with esophageal varices than among those without varices (8.52 ± 1.90 vs 6.52 ± 1.36 ; $p < 0.0001$). The between-group t statistic was 6.0525. The findings demonstrated a significant association between greater CTP score and the presence of esophageal varices.

Conclusion: Patients with esophageal varices had significantly higher CTP scores compared with patients without varices. The findings suggest that higher CTP scores are associated with a greater likelihood of esophageal varices in patients with liver cirrhosis. Nevertheless, as CTP is primarily a measure of liver disease severity and no independently validated diagnostic cut-off was established in this study, it should not be used instead of endoscopic evaluation.

Keywords: Child-Turcotte-Pugh; CTP Score; Liver Cirrhosis; Esophageal Varices; Portal Hypertension; Hepatic Dysfunction; Endoscopy.

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Introduction

Liver cirrhosis is the last stage of chronic liver disease. It is characterized by progressive fibrosis, distortion of hepatic architecture and development of portal hypertension. Portal hypertension is responsible for many of the major complications of cirrhosis, including ascites, hepatic encephalopathy

and gastroesophageal varices. Esophageal varices are of particular importance because variceal hemorrhage is a major cause of morbidity and mortality in patients with advanced liver disease.[1,2] Esophageal varices are related to the progression of portal hypertension and to the

development of increasing portosystemic collaterals. Consequently, the risk of varices generally increases with the severity of liver disease. Upper gastrointestinal endoscopy allows direct visualization of esophageal varices and is still an important method for their detection and risk assessment. But endoscopic screening is invasive and resource dependent. This has led to interest in clinical and non-invasive methods to help identify patients at higher risk.[3,4]

One of the most common clinical systems used to grade the severity of cirrhosis is the Child-Turcotte-Pugh (CTP) score. It includes encephalopathy, ascites, serum bilirubin, serum albumin and coagulation parameters to classify patients into Child-Pugh classes A, B and C. While the CTP score was originally devised as a measure of hepatic functional severity and prognosis, its components also represent several consequences of advanced cirrhosis and portal hypertension.

The relationship between severity of liver disease and esophageal varices has been investigated in several studies. Non-invasive markers of portal hypertension, particularly platelet count and spleen-related measurements, have shown promise in identifying patients with varices but their diagnostic performance varies across populations.[5,6]

A systematic review and meta-analysis showed that the platelet count/spleen diameter ratio was useful in the diagnosis of esophageal varices, but the authors concluded that the available evidence was insufficient to totally replace endoscopy.[5]

Recent developments in the evaluation of portal hypertension have been focused on risk stratification based on non-invasive parameters and on the concept that the probability of clinically significant portal hypertension is stage-dependent.[2] However, the association of a simple measure of overall cirrhosis severity such as CTP with the presence of endoscopically detected esophageal varices is still clinically relevant, particularly in resource-limited settings where comprehensive non-invasive assessment may not always be available.

Therefore, the present study investigated the association between Child-Turcotte-Pugh score and endoscopically detected esophageal varices in patients with liver cirrhosis.

Primary Objective: To determine the relationship between Child-Turcotte-Pugh score and the presence of esophageal varices in patients with liver cirrhosis.

Secondary Objective: To describe the distribution of patients according to CTP class A, B and C within the study population.

Materials and Methods

Study design and setting: This was a hospital-based prospective cross-sectional study conducted in the Department of General Medicine, Navodaya Medical College and Research Centre, Raichur, Karnataka.

The study duration was 18 months, from January 2022 to June 2023.

Study Population: Patients attending the General Medicine outpatient department or admitted to the General Medicine wards with a diagnosis of liver cirrhosis were screened.

Inclusion Criteria

Participants were included if they:

1. Were aged 18–60 years.
2. Had liver cirrhosis with portal hypertension.

Exclusion Criteria

Patients were excluded if they had any of the following:

- refusal to participate;
- age below 18 years or above 60 years;
- hepatocellular carcinoma detected on ultrasonography;
- pregnancy;
- primary hematological disorders;
- active gastrointestinal bleeding at admission;
- medication for primary prophylaxis of variceal bleeding;
- previous variceal band ligation;
- previous transjugular intrahepatic portosystemic shunt; or
- Previous surgical intervention for portal hypertension.

Sample Size and Sampling: The study included 100 participants. The study reports a calculated sample size of 98, based on the reported expected performance of the EVendo score and allowing for non-response, with the final sample rounded to 100.

Simple random sampling was used for participant recruitment.

Clinical and Laboratory Assessment: After written informed consent, participants underwent clinical evaluation using a pre-structured questionnaire. Demographic characteristics, presenting symptoms, comorbidities and relevant clinical history were documented. Laboratory investigations included:

- complete blood count;
- liver function tests;
- renal function tests;
- coagulation profile;
- viral markers;

- Random blood glucose.

Abdominal ultrasonography and upper gastrointestinal endoscopy were also performed.

The overall cohort had a mean age of 48.17 ± 5.40 years, with 79% males and 21% females.

Assessment of liver disease severity: The severity of cirrhosis was assessed using the CTP score.

According to the CTP scoring system, the following parameters were assessed:

- encephalopathy;
- ascites;
- serum bilirubin;
- serum albumin; and
- Prothrombin time/INR.

The study records CTP class A as a total score of 5–6, class B as 7–9 and class C as 10–15.

Table 1: CTP classification used in the study

CTP class	Total score
Class A	5–6
Class B	7–9
Class C	10–15

Endoscopic assessment: Upper gastrointestinal endoscopy was performed to determine the presence of esophageal varices.

Participants were classified into two groups:

- **Esophageal varices present:** 50 participants.
- **Esophageal varices absent:** 50 participants.

Endoscopy was used to classify participants according to the presence or absence of esophageal varices. The available data do not provide sufficiently detailed endoscopic grading information for a separate analysis of small, large or high-risk varices. Therefore, the present manuscript evaluates the association between CTP score and presence of esophageal varices.

Outcome Measures

Primary Outcome: Presence of esophageal varices on upper gastrointestinal endoscopy.

Primary Predictor: CTP score.

Secondary Predictor: CTP class:

- A
- B
- C

Statistical Analysis: Continuous variables were expressed as mean±standard deviation. Categorical variables were expressed as frequencies and percentages. The CTP score was compared between participants with and without esophageal varices using the independent-samples t test, as reported. A p value <0.05 was considered statistically significant.

Results

Baseline Study Population: A total of 100 patients with liver cirrhosis and portal hypertension were included. The mean age was 48.17 ± 5.40 years. The majority of participants were aged 41–50 years (63%), followed by those aged >51 years (32%). Only 5% were younger than 40 years. Men constituted 79% of the study population.

Table 2: Baseline demographic characteristics

Characteristic	n (%)
Age	
<40 years	5 (5)
41–50 years	63 (63)
>51 years	32 (32)
Sex	
Male	79 (79)
Female	21 (21)
Total	100 (100)

Mean age: 48.17 ± 5.40 years

Distribution according to CTP class: The mean CTP score for the overall cohort was 7.52 ± 1.93 . Thirty-four participants (34%) were classified as CTP class A, 46 (46%) as class B and 20 (20%) as class C.

Table 3: Distribution of study participants according to CTP class

CTP class	n	%
Class A	34	34
Class B	46	46
Class C	20	20
Total	100	100

Mean CTP score: 7.52 ± 1.93

Figure 1. Distribution of participants according to Child-Turcotte-Pugh class

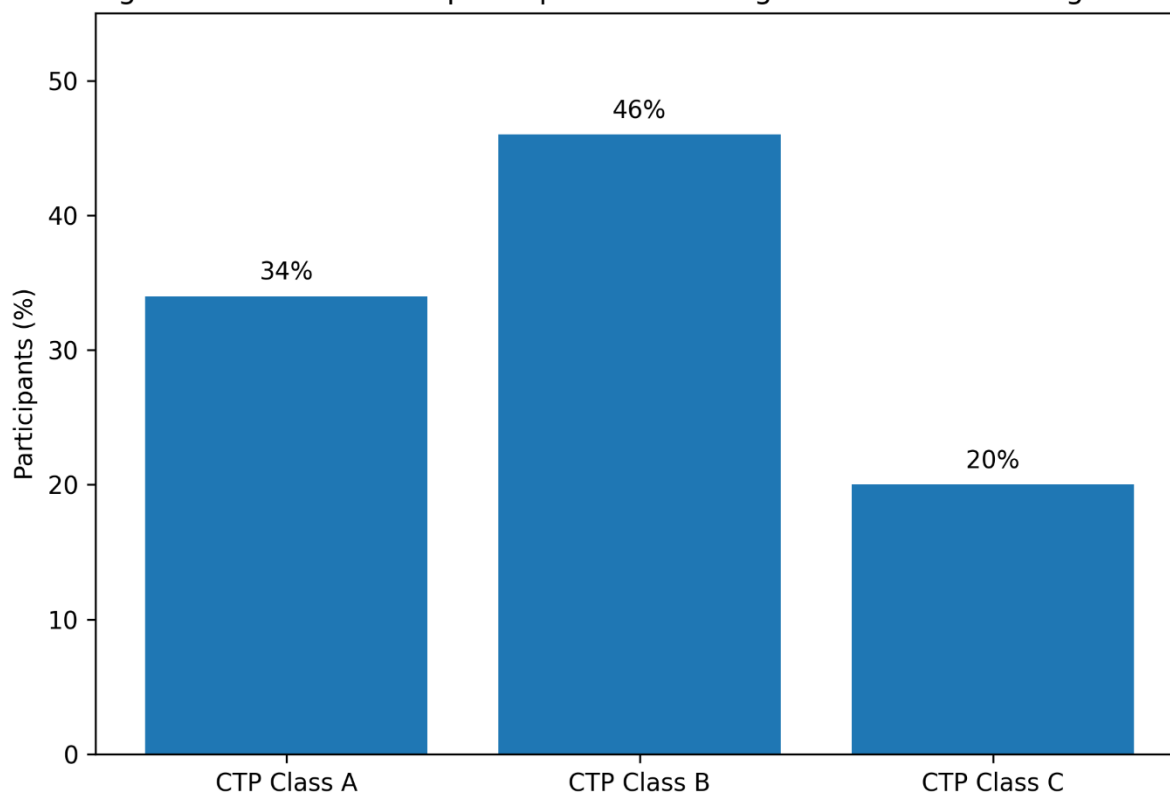


Figure 1: Distribution of participants according to Child-Turcotte-Pugh class

Esophageal Varices According to CTP Score:

Esophageal varices were identified in 50% of the study population, with 50 participants having varices and 50 having no varices.

The mean CTP score was substantially higher among participants with esophageal varices.

Participants with varices had a mean CTP score of 8.52 ± 1.90 , whereas participants without varices had a mean score of 6.52 ± 1.36 . The difference was statistically significant ($t=6.0525$, $p<0.0001$).

Table 4: Comparison of CTP score according to esophageal variceal status

Esophageal varices	n	Mean CTP score	SD
Present	50	8.52	1.90
Absent	50	6.52	1.36
Between-group comparison		$t=6.0525$	$p<0.0001$

The mean difference between the two groups was 2.00 CTP points, with higher scores observed among participants with esophageal varices.

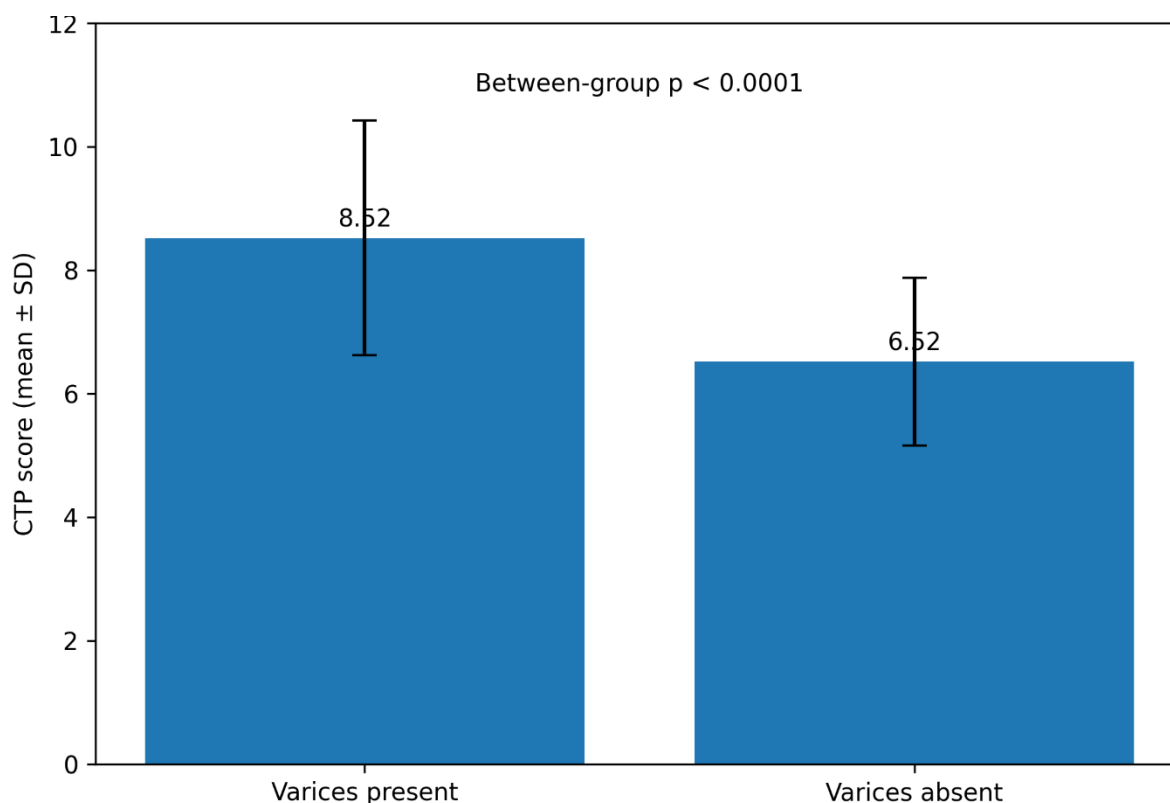


Figure 2: Comparison of CTP score according to esophageal variceal status

Interpretation of CTP Severity: The study population demonstrated a predominance of intermediate disease severity, with nearly half of the participants classified as CTP class B.

The mean CTP score among participants with varices (8.52) fell within the numerical range corresponding to CTP class B, whereas the mean score among participants without varices (6.52) was close to the boundary between classes A and B. This difference is clinically relevant because the CTP score incorporates manifestations and biochemical indicators of advanced liver disease. The observed association therefore suggests that patients with greater overall hepatic dysfunction were more likely to have esophageal varices.

However, because the Data provides only the overall distribution of CTP classes and the group-wise mean CTP scores, it does not permit a valid reconstruction of the number of patients with varices within each individual CTP class. Such values should not be inferred from the available means.

Discussion

The present study aimed to evaluate the association of CTP score with esophageal varices in 100 patients of liver cirrhosis and portal hypertension. The main finding was a significantly higher mean CTP score in patients with esophageal varices compared to patients without varices. The mean CTP score was 8.52 ± 1.90 in participants with

varices and 6.52 ± 1.36 in participants without varices, with a mean difference of 2.00 points ($t=6.0525$, $p<0.0001$).

This finding supports the hypothesis that the presence of esophageal varices is associated with an increased severity of underlying cirrhosis. Progressive cirrhosis results in increased intrahepatic vascular resistance and portal hypertension, which favors the formation of portosystemic collateral vessels, such as esophageal varices.[1,2]

Esophageal Varices and CTP Score: The most important finding of this study is the statistically significant difference in CTP score between two groups. Patients with varices had a mean CTP score two points higher compared to patients without varices. This difference is clinically important because the CTP score includes multiple features of advanced liver disease, rather than a single laboratory parameter. The components of the CTP system are serum bilirubin, serum albumin, coagulation status, ascites and hepatic encephalopathy. Worsening of these parameters usually reflects lower hepatic functional reserve and greater clinical severity. Thus, the elevated CTP score in patients with varices could be a marker of a more diffuse pattern of advanced cirrhosis, in which portal hypertension and its complications are more frequent.

However, the relationship should be interpreted as an association with disease severity, not proof that CTP independently predicts varices. CTP was developed primarily as an indicator of hepatic functional status and prognosis. It is not a direct measurement of portal pressure or esophageal collateralization.

This is an important difference to consider for the clinical application of the finding. Although the CTP score may be helpful in identifying groups of patients at higher risk for portal-hypertensive complications, it cannot be used to diagnose individual patients with esophageal varices.

Classification of CTPs: In the current cohort, 34% of patients were CTP class A, 46% class B and 20% class C with an overall mean CTP score of 7.52 ± 1.93 .

The high prevalence of CTP class B indicates that the study population had a substantial proportion of patients with moderate hepatic dysfunction. This is relevant in the interpretation of the association between CTP and varices, as the association between severity of liver disease and portal-hypertensive complications may differ according to the clinical spectrum of the studied population.

Previous studies on noninvasive prediction of esophageal varices have also been characterized by high heterogeneity in patient characteristics and severity of cirrhosis. Systematic reviews have demonstrated variable diagnostic performance of non-invasive markers depending on study population, disease stage and prevalence of varices.[4,5]

Therefore, the CTP distribution in this study should be taken into account when extrapolating the results to other cirrhosis populations, especially patients with mainly compensated disease.

Pathophysiological basis for association: The association between CTP score and esophageal varices seen in our study is biologically plausible.

When chronic liver disease progresses to cirrhosis, fibrosis and regenerative nodules increase resistance to the flow of portal blood. The resultant portal hypertension leads to development of collateral circulation, including gastroesophageal varices. Worsening hepatic dysfunction may also cause ascites, hypoalbuminemia, hyperbilirubinemia and impaired coagulation, all of which increase the CTP score. [1,2]

Therefore, the higher CTP scores in patients with varices may represent the coexistence of two associated processes:

1. Progressive hepatic dysfunction, as reflected by the Child-Turcotte-Pugh (CTP) score

2. Progressive portal hypertension, as reflected clinically by complications such as esophageal varices.

The present study does not prove a direct causal relationship between CTP score and variceal formation, but the significant association is consistent with this underlying pathophysiology.

Non-invasive evaluation of esophageal varices:

The limitations of universal endoscopic screening have led to growing interest in non-invasive prediction of esophageal varices. Several markers have been studied including platelet count, spleen diameter, platelet to spleen diameter ratio, liver stiffness and spleen stiffness. [4-6]

A systematic review of non-invasive tests in compensated cirrhosis showed that platelet count/spleen diameter ratio had relatively good diagnostic performance with a summary area under the curve of around 0.85 for detection of esophageal varices. [4] Another systematic review reported pooled sensitivity of 89% and specificity of 74% for the platelet count/spleen diameter ratio but noted limitations in the quality of evidence and heterogeneity.[5]

These results show that non-invasive assessment has great potential but illustrate that no one clinical parameter should be automatically assumed to replace endoscopy.

In this context, the present study adds evidence that the presence of esophageal varices is associated with the overall hepatic disease severity represented by CTP score. However, unlike a dedicated diagnostic prediction model, the CTP does not include particular parameters to quantify portal hypertension. It is therefore more appropriate to view its role as part of a wider clinical risk assessment.

Conclusion

In this prospective hospital-based study of patients with liver cirrhosis, the Child-Turcotte-Pugh score was significantly higher in patients with esophageal varices than in patients without varices. The mean CTP score was 8.52 ± 1.90 in patients with varices as against 6.52 ± 1.36 in patients without varices ($p < 0.0001$).

These data indicate a significant association between the presence of esophageal varices and the severity of hepatic dysfunction. Therefore, the CTP score may contribute to clinical risk assessment in patients with cirrhosis. However, the CTP score is a global measure of cirrhosis severity and was not independently validated as a diagnostic test for varices in this study and should not replace endoscopic evaluation.

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