

# The CTP and MELD Scores: Both Are Used for the Prediction of Mortality for the Patients with Decompensated Liver Cirrhosis

Haradhan Kumar Mohajan<sup>1</sup>

<sup>1</sup> Associate Professor, Department of Mathematics, Premier University, Chittagong, Bangladesh

Correspondence: Haradhan Kumar Mohajan, Associate Professor, Department of Mathematics, Premier University, Chittagong, Bangladesh.

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## Abstract

The Child-Turcotte-Pugh (CTP) score (range: 5-15) and the Model for End Stage Liver Disease (MELD) score (range: 6-40) have been used for predicting the survival of liver cirrhosis patients. Both scores are general indicators of the severity of liver failure in patients with end-stage liver disease, and have been validated for short- and long- term survival in cirrhosis. The liver cirrhosis is the development of hepatic fibrosis and regenerative nodules as a result of chronic liver injury that may lead to portal hypertension and end-stage liver diseases, such as chronic viral hepatitis, cirrhosis, hepatocellular carcinoma (HCC), and liver failure. The aim of this study is to evaluate and compare the aspects of CTP classification and MELD scores for predicting the severity of the cirrhosis to the liver transplantation patients.

**Keywords:** CTP score, MELD score, decompensated cirrhosis, survival

## 1. Introduction

The Child-Turcotte-Pugh (CTP) score is developed in 1964 by American surgeon and portal hypertension expert Charles Gardner Child (1908-1991), and American liver transplant surgeon Jeremiah G. Turcotte; and modified it in 1973 by British surgeon R. N. H. Pugh and her coauthors (Pugh et al., 1973). In 1999, the Model for End Stage Liver Disease (MELD) score is originally developed at the Mayo Clinic of the USA through the effort of a group of researchers lead by Dr. Patrick Kamath, professor of gastroenterology and hepatology (Kamath et al., 2001). Later in 2000, it is refined and modified by American hepatologist Michael Malinchoc (Malinchoc et al., 2000).

The MELD score is based on objectively measured and widely available laboratory tests, compared with the CTP score (Mohajan, 2024u). Calculation of CTP score is easier but that of MELD score needs calculator or internet. The MELD score compared with the CTP score provides the mean values to measure liver disease severity more objectively and more accurately (Wiesner et al., 2001). Although the prediction models use mathematical calculation, the variables are found from laboratory tests, and are based on multivariable analyses have limitations of precision and reproducibility due to clinical and methodological reasons (Pagliaro, 2002).

## 2. Literature Review

In any type of research, literature review is an introductory section, where works of previous researchers are included (Polit & Hungler, 2013). It is a secondary source and does not report a new or an original experimental work (Gibbs, 2008). In qualitative research, literature review helps novice researchers to understand the subject, and it serves as an indicator of the subject that has been carried out before. It also assists all researchers to improve research questions and to move forward energetically in the current research (Creswell, 2007). Ramesh Kumar Chaurasia and his coworkers have compared the survival predictive values of MELD and CTP scoring systems in hospitalized patients of decompensated cirrhosis and other associated factors. They have found that MELD score is superior to CTP score in predicting survival at the time of discharge in hospitalized patients with decompensated

cirrhosis (Chaurasia et al., 2013).

Evangelos Cholongitas and his coauthors have studied the accuracy of MELD score versus CTP score in non-transplant settings. They think that both models for end-stage liver disease need further evaluation (Cholongitas et al., 2005). Samiullah Shaikh and his coauthors have compared the predictive value of MELD and CTP scores in patients with decompensated cirrhosis of liver. In their study the MELD score was not found to be superior to CTP score for short-term prognostication of patients with cirrhosis (Shaikh et al., 2010). Ashok Kumar and his coauthors have observed the scores of the MELD and CTP on in-patients of cirrhosis, and have predicted the outcome of patient according to both scores. They have noticed that the CTP score offers a clear advantage in predicting mortality than the MELD score (Kumar et al., 2018).

Kazim Abbas Virk and his coauthors have studied on the number of patients with acute variceal hemorrhage (AVH) on the MELD and CTP scores of each patient. On their study they have found that the MELD score is better in its discriminative ability and more accurate in predicting six weeks mortality in patients with AVH than CTP scores (Virk et al., 2021). Daniela Benedeto-Stojanov and her coauthors have shown that in cirrhotic patients the MELD score is an excellent survival predictor at least as well as the CTP score. Increase in both scores is associated with decrease in residual liver function (Benedeto-Stojanov et al., 2009).

Ying Peng and her coworkers have studied the CTP and MELD scores confidently, and have realized that these have similar prognostic values in most of the cases, and their benefits might be heterogeneous in some specific conditions. These scores have been widely used for the assessment of prognosis in liver cirrhosis (Peng et al., 2016). Koffi Alain Attia and his coworkers have compared the performance of the CPT and MELD scores in predicting survival of a retrospective cohort of 172 Black African patients with cirrhosis on a short- and mid- term basis. In their study they have found that both models show same prognostic significance (Attia et al., 2008).

### 3. Research Methodology of the Study

Research is a hard-working search, scholarly inquiry, and investigation that aims for the discovery of new facts and findings (Adams et al., 2007). Methodology is a system of explicit rules and procedures in which the research is based, and against which claims of knowledge are evaluated (Ojo, 2003). It provides the research design and analysis procedures to perform a good research (Hallberg, 2006). Research methodology is the procedure to accomplish a research in a systematic and process oriented way that provides a guideline to the researchers to investigate a problem (Abbasi, 2015). To prepare this article, I have used secondary data that are collected from both published and unpublished data sources (Mohajan, 2017, 2018, 2020). The data are collected from various sources, such as websites, national and international journals and e-journals, books and handbooks of famous authors, internet, etc. (Mohajan, 2024k-p; Mohajan & Mohajan, 2023a-e, 2024).

### 4. Objective of the Study

Both the CTP and the MELD scores are used as general indicators of the severity of liver failure in patients with end-stage liver disease (Mohajan, 2024q,t). The CTP scores are calculated using levels of prothrombin time, serum albumin, serum total bilirubin, and clinical ascites and encephalopathy findings. The severity of this disease is classified as class A (score 5-6), class B (score 7-9), and class C (score 10-15) (Hong et al., 2011). The MELD is a scoring system that provides the severity of the end-stage liver disease when the liver is almost completely damaged due to liver cirrhosis, liver failure, and hepatocellular carcinoma (HCC). It is assessed using three individual factors that affect the liver transplant prognosis: serum total bilirubin, serum creatinine, and the prothrombin time-international normalized ratio (PT-INR) (Mohajan, 2024c,s). Main objective of this article is to investigate the usefulness of predicting the CTP and the MELD scores of the patients who are waiting for the liver transplantation. Other minor objectives of the study are as follows:

- to highlight on liver function and liver transplantation,
- to focus on the CTP and the MELD scores, and
- to discuss their similarities and differences.

### 5. Overview of Liver

The liver is the largest solid internal visceral vital organ of the body that is a wedge or cone shaped. In an adult human it weighs between 1.5 and 2 kg (Mohajan, 2024a,d,f). It is the powerhouse of the body for metabolism and a center for numerous physiological processes. It is an essential organ of human to sustain life. In a healthy liver blood flows without or minimal resistance (Mohajan, 2024b,e,g). It accomplishes many complex functions of the body. The functions of liver are metabolism of carbohydrates, proteins and fat; storage of glycogen, vitamins (e.g., A, D, E, C), minerals (e.g., iron and copper); detoxification of drugs and toxins; excretion of bile and urea; reservoir of blood; filtration of bacteria, degradation of endotoxins and lactate metabolism; immunological functions with synthesis of immunoglobulins and phagocytic action by Kupffer cells; and haemopoiesis in the fetus (Katawala, 2024; Mohajan, 2024h,i,j). It is the only organ in the body that can regenerate itself. During the repair process,

scar tissue (fibrosis) may develop. Over time, the scar tissue increases and the large areas of the liver are surrounded by scar tissue; this is called liver cirrhosis (Alamri, 2018).

## 6. Overview of Liver Transplantation

Liver transplantation (LT) is a major surgical procedure for the patients of end-stage liver diseases. It is a life-saving treatment option of a diseased liver through the replacement with a healthy liver from a deceased donor or a portion of a healthy liver from a living donor (Lucas, 2021). At present liver resection is practicing worldwide widely to minimize morbidity and reduce mortality (Sumadewi, 2023). In 1955, Stuart Welch performed a heterotopic LT in the canine species. The first attempted human LT was performed in 1963 in the world by American physician, researcher, and expert on organ transplants Thomas Earl Starzl (1926-2017) on a three years old boy with biliary atresia who underwent LT, but he died due to coagulation disorder and uncontrolled bleeding (Starzl et al., 1963). The LT has modernized in the field of liver disease that creates a modern era in medical science. At present the treatment of liver disease has improved substantially (Mohajan, 2024r). Also the new immunosuppression and better supportive therapies are enabling sicker and higher-risk patients to be eligible for and survive to receive LT (Gotthardt et al., 2014). In 2021, there were about 34,694 LTs performed globally that is an increase of 6.5% from 2020 and a 20% increase from 2015 (Terrault et al., 2023).

## 7. CTP Score

The first version of Child-Turcotte score has two continuous variables, such as bilirubin and albumin, and three discrete quantitative variables, such as ascites, encephalopathy and nutritional status (Mohajan, 2024u). American surgeon and portal hypertension expert Charles Gardner Child (1908-1991) and American surgeon Jeremiah G. Turcotte (1933-2020) have developed it in 1964 (Child & Turcotte, 1964). Later it is modified by British surgeon R. N. H. Pugh through the substitution of the normalized ratio (INR) (prothrombin time) for nutritional status (Pugh et al., 1973). These five variables and their respective cut-off values are arranged to classify Child-Pugh score into three distinct groups: patients with score 5-6 were named as CTP class A that is well-compensated, with 7-9 as class B that is significant functional compromise, and with 10-15 as class C that is decompensated (Reuben, 2002). The CTP classes B and C are associated with cirrhosis-related complications, such as ascites, hepatic hydrothorax, variceal bleeding, and encephalopathy (Franco et al., 1990).

## 8. MELD Score

The MELD score is introduced as a tool for predicting mortality risk and to assess the severity of the disease in patients with liver cirrhosis, as well as to determine organ allocation priorities (Yousfi et al., 2001). It was originally developed at the Mayo Clinic of the USA with the attempts of a group of researchers lead by Dr. Patrick Kamath, professor of gastroenterology and hepatology (Malinchoc et al., 2000). It has three objective variables: serum bilirubin, serum creatinine, and institutional normalized ratio (INR) (Singal & Kamath, 2013). The two quantitative variables; bilirubin and INR are related to the liver dysfunction, and the third, creatinine is related to the renal dysfunction (Mohajan, 2024s). Therefore, these are clinically well founded, and their predictive efficiency has a sound prior probability for MELD (Arroyo et al., 1991). The MELD score is defined by American hepatologist Michael Malinchoc, and is calculated according to the following formula (Malinchoc, et al., 2000):

$$\text{MELD} = 3.78 \times \ln(\text{serum bilirubin (mg/dL)}) + 11.2 \times \ln(\text{INR}) + 9.57 \times \ln(\text{serum creatinine (mg/dL)}) + 6.43 \quad (1)$$

The MELD scoring has been applied as a new liver organ allocation system for LT since 2002 in the USA and since 2006 in Europe, and at present it is using worldwide (Aiello et al., 2017).

## 9. CTP vs. MELD Scores

It is still not clear whether MELD is better than CTP score for predicting survival in patients with CLD outside of LT waiting lists (Heuman et al., 2005). Both bilirubin and prothrombin time are common in both scores. According to the CTP, the patients are classified into A, B and C, but MELD has no classification (Huo et al., 2006). The CTP classification uses discrete cut-offs to move from one to the next class through the influence of five variables, and MELD uses a continuous measurement of the three variables, implying a better discriminating power. The MELD score ranges from 8 to 40 and range of CTP score is from 5 to 15 (Pagliaro, 2002).

The MELD score does not include hepatic encephalopathy and ascites, instead it uses serum creatinine, but CTP does not use it, instead it uses ascites and encephalopathy and both are subjective, and these affect quality of life of patients (Shaikh et al., 2010). Therefore, these patients need to be allocated separately for LT if MELD is used to prioritize organ allocation (Said et al., 2004). Most of the researchers preferred MELD over CTP because it includes objective variables, lack of ceiling effect and similarity of its results in various centers and in particular inclusion of serum creatinine which is regarded as an independent predictor of survival during the course of the disease. The MELD score is obtained by using prospective and methodologically accurate methods; whereas the CTP classification is created on intuitive and empirical basis (Pagliaro, 2002).

Both CTP and MELD scores are predictive of waitlist mortality. However, the MELD score appears to be more

objective than the CTP because the version of the score that is currently used contains only three objective laboratory parameters (Cholongitas et al., 2005). The history of MELD score has been similar to that of CTP score, and both are used as a justice system to allocate donors for LT. However, the predictive accuracy of the MELD score in patients who have TIPS, variceal bleeding and chronic liver disease is not significantly superior to the CTP score (Schepke et al., 2003).

## 10. Conclusions

In this study, I have provided an overview regarding the comparison of CTP and MELD scores for the assessment of prognosis in liver cirrhosis. Both of them have some similar prognostic behaviors. Some researchers have found that the MELD score is significantly superior to CTP score in predicting survival in hospitalized patients with decompensated cirrhosis in addition to usefulness in predicting short-term and medium-term survival in patients with decompensated cirrhosis. On the other hand, some researchers eager to keep the CTP score for individual assessment of liver disease in daily clinical practices. But I am not clear whether MELD is better than CTP score for predicting survival in patients with chronic liver disease outside of liver transplant waiting lists. Also both of the scores have some drawbacks.

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