

Child-Turcotte-Pugh (CTP) Score: A Predicting Model for Liver Failure Patients Who Wait for Liver Transplantation

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Abstract

The Child-Turcotte-Pugh (CTP) score is used to classify the severity of chronic liver disease (CLD), cirrhosis, and liver failure to estimate prognosis and mortality. It is based on the severity of three objective parameters, such as serum albumin, serum total bilirubin, and prothrombin time; and two subjective parameters, such as ascites and encephalopathy that is currently used for surgical risk evaluation and robust prediction. It has been the reference for assessing the prognosis of cirrhosis for six decades at the end-stage liver disease. It has been used extensively to risk-stratify patients with cirrhosis to evaluate efficacy of therapeutic procedures. In this study an attempt has been taken to discuss the survival predictive value of CTP scoring system in patients of decompensated cirrhosis and other related factors.

Keywords: Child-Turcotte-Pugh (CTP) score, liver transplantation, hepatic encephalopathy, ascites

1. Introduction

Liver cirrhosis has a high morbidity and mortality that is the 11th most common cause of death all over the world. Patients with decompensated liver cirrhosis often have a limited survival, and liver transplantation (LT) is the only treatment option to effectively prolong their lifespan (Mohajan, 2024s). Cirrhosis is defined as the formation of fibrosis type of delicate broad scars, nodules containing regenerating hepatocytes encircled by fibrosis, and disruption of the architecture of the entire liver. All forms of cirrhosis may be clinically silent (Ianova, 2016). Liver cirrhosis is diagnosed on the basis of histological, clinical and biochemical results, as well as by echosonographic and endoscopic examination. It has been a challenging issue for physicians to elaborate reliable tools for predicting outcome (Durand & Valla, 2005).

The Child-Turcotte-Pugh (CTP) classification can be used to predict short-term prognosis in persons waiting for LT (Pugh et al., 1973). It was originally utilized to assess the outcome of patients with cirrhosis and portal hypertension. Later, the use of it was extended to predict the general prognosis of cirrhotic patients and prioritizing patients for LT (Christensen, 2004). The CPT score has been the main prognostic tool for cirrhotic patients for six decades. It is based on five variables: ascites, encephalopathy, serum bilirubin, serum albumin and prothrombin time that are empirically selected. Among these three laboratory parameters are serum bilirubin, serum albumin, and prothrombin time; and two clinical variables are ascites, and encephalopathy. These five variables are arranged so as to define their groups of severity. The selection of these five variables was based on clinical experience and not on multivariable analysis (Aiello et al., 2017).

The CTP score for LT was introduced in 1996 on the basis of the concept of 'sicker patient first' for fulminant hepatic failure. Since the last 60 years, CTP score has been used successfully for assessing the prognosis of patients with CLD. At present the Model for End-Stage Liver Disease (MELD) score is an alternative to CTP (Lucey et al., 1997).

2. Literature Review

In any research, the literature review section is an introductory unit of research, where works of previous researchers are presented in brief that helps the novice researchers to understand the subject area (Polit & Hungler, 2013). Teck-Jin Yang and her coworkers have aimed to determine whether clinical findings through the CTP score and abdominal ultrasound could be used simultaneously to predict medical resource utilization in patients of acute hepatitis. They have also investigated the medical cost and length of hospital stay (LOHS) for patients with acute hepatitis (Yang et al., 2014). Rachit Magazine and his coworkers have studied the etiology, precipitating insults of patients presenting with acute on chronic liver failure and predictors of mortality of acute chronic liver failure (Magazine et al., 2018). Andres Rufa and his coworkers have designed the CTP and the MELD scores that are designed to predict the outcome of decompressive therapy for portal hypertension. These are prospectively validated to predict mortality risk in patients with a wide spectrum of liver disease etiology and severity (Ruf et al., 2022).

Ying Peng and her coworkers have found that the CTP and MELD scores have been widely used to predict the outcomes of cirrhotic patients, but both of them have some drawbacks. They have compared the discriminative ability of CTP versus MELD score for the assessment of prognosis in cirrhotic patients. In patients undergoing surgery, CTP score had a higher specificity than MELD score (Peng et al., 2016). Teh-Ia Huo and his coauthors have studied the CTP system that has a score range of 5-15, and has a ceiling effect that may compromise its predictive power. They have proposed a refined CTP scoring method and have investigated its predictive ability. The modified CTP system has a better performance than the original system and is as efficient as the MELD for outcome prediction (Huo et al., 2006).

Daniela Benedeto-Stojanov and her coauthors have tried to evaluate the survival prognosis of cirrhotic patients and patients with complications by means of the MELD score compared to the CTP one. They have also analyzed the prognostic value of the MELD score in patients with both liver cirrhosis and variceal bleeding (Benedeto-Stojanov, et al., 2009). Evangelos Cholongitas and his coauthors have observed that the MELD score is now used for allocation in LT waiting lists, replacing CTP score. They have found that the MELD score does not perform better than CTP score in non-transplant settings. They have proposed that both the CTP and the MELD scores need further evaluation (Cholongitas et al., 2005). David E. Kaplan and his coauthors have found that the CTP score is a widely used and validated predictor of long-term survival in cirrhosis. They have identified the evidence-based cut-points for the CTP laboratory sub-scores to improve its predictive capacity for transplant-free survival. They have proposed an evidence-based recalibration of CTP score cut-points that optimizes this model's capacity to predict transplant-free survival in patients with cirrhosis (Kaplan et al., 2016).

3. Research Methodology of the Study

Research is the procedures of systematic investigations that requires collection, interpretation and refinement of data. It is a creative work that needs systematic investigations. It is an essential and powerful device to the academicians for the leading in academic disciplines (Pandey & Pandey, 2015). Methodology is the organized and meaningful procedural works in any creative research that follow scientific methods efficiently (Kothari, 2008). It is the systematic and theoretical analysis of the methods applied to a field of study (Patel & Patel, 2019). Therefore, research methodology is the specific procedures that are used to identify, select, process, and analyze materials (Somekh & Lewin, 2005).

I have consulted secondary data sources unsparingly to complete the article with a satisfaction (Mohajan, 2024a-t). I have unsparingly consulted the published and unpublished research papers, books and handbooks of renowned authors, various research reports, internet, websites, etc. to enrich this article (Mohajan, 2017, 2018, 2020). Throughout of this entire research I have tried to maintain the reliability and validity as far as possible (Mohajan & Mohajan, 2023a-e, 2024).

4. Objective of the Study

Liver cirrhosis has a high morbidity and mortality. The CPT score is used to assess the prognosis of patients with cirrhosis. It bears two continuous variables: bilirubin and albumin, and three discrete variables: ascites, encephalopathy and international normalized ratio (INR). The score is divided into three classes: class A (score range 5-6), class B (score range 7-9), and class C (score range 10-15). It has both successes and limitations (Acharya et al., 2019). It has been widely used to assess the severity of liver dysfunction in clinical work, and to predict the survival of cirrhosis patients. Main objective of this article is to discuss the properties and strengths of CPT score. Other minor objectives of the study are as follows:

- to highlight on liver and its transplantation,
- to focus on historical background of CTP, and
- to discuss CTP score and its classification.

5. Overview of Liver

The liver is one of the two largest organs (another is skin) of our body. It is considered as a central essential vital organ for survival (Mohajan, 2024b). It is located in the upper right-hand portion of the abdominal cavity (right hypochondrium and epigastrium), below the diaphragm, on top of the stomach, right kidney, and intestines; and extends into the left hypochondrium. It is a wedge shaped dark pinkish-brown peritoneal organ (Juza & Pauli, 2014). In an average adult human it weighs 1.5 to 2kg that is roughly 2-3% of the total body weight. It performs various functions of the body. Mean liver volumes of CTP class A is 1,100cm³ (± 337), of CTP class B is 1,040cm³ (± 365), and of CTP class C is 800 cm³ (± 205). These are required to determine the strength of the treatment and the necessity of liver transplantation (Cholongitas et al., 2005).

It cleans the body of toxins chemicals and bacteria, and filters bile salts that cause irritation and itching in the skin (Heathcote, 2007). It stores essential substances, such as fat, sugar, and vitamins (Mohajan, 2024j). It makes vital substances of the body, such as albumin and proteins that help with blood clotting and metabolizes lipids and carbohydrates (Morgan et al., 2022). It affects visceral organs, joints, gastrointestinal tissues, and the skin. One of the main functions of the liver is to conjugate bilirubin into a secreteable form that can lead to both unconjugated and conjugated hyperbilirubinemia (Faust & Reddy, 2004).

6. Overview of Liver Transplantation

Liver transplantation (LT) is a well-recognized comparatively life-saving treatment option for people when liver cannot regenerate and the damage becomes about life-threatening due to liver cirrhosis, decompensated disease, liver cancer, acute liver failure, and hepatocellular carcinoma (HCC) (Mohajan, 2024q). It is the second most common solid organ transplantation after kidney transplantation worldwide (Mahillo et al., 2013). The first LT was performed in 1963 by American physician 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 liver donor will be a family member or non-family member with blood matching who can provide support before, during, and after surgery (Hashikura et al., 1994).

It is estimated that in 2018 more than 32,000 LTs were conducted globally, and among them 8,200 were in the USA (Statistics Portal, 2018). More than 10,000 LTs are performed each year in Europe, and about 119,803 LTs took place across Europe between 1988 and 2015 (Blachier et al., 2013). Most of the LT persons are able to return to a normal and healthy lifestyle, and can enjoy an improved quality of life (Lewis & Howdle, 2003).

7. CTP Scores

The Child-Pugh (CP) score is first proposed in 1964 by American surgeon and portal hypertension expert Charles Gardner Child (1908-1991) and American surgeon Jeremiah G. Turcotte (1933-2020). The two continuous variables, such as bilirubin and albumin, and three discrete quantitative variables, such as ascites, encephalopathy and nutritional status are used in this model (Child & Turcotte, 1964). These five variables and their respective cut-off values are arranged to classify Child-Pugh score into three distinct groups A, B and C for increasing severity (Durand & Valla, 2005). Later it is modified by British surgeon R. N. H. Pugh and renamed it as Child-Turcotte-Pugh (CTP) score. Now it has three objective laboratory variables, such as serum bilirubin and albumin levels, prothrombin time, and the presence and severity of two subjective clinical variables, such as ascites and encephalopathy (Pugh et al., 1973).

The five variables have been ascribed 1, 2 and 3 points according to whether their values fell within the limits of groups A, B, and C, respectively. The score is the sum of these points, ranging from 5 to 15, patients with a score between 5 and 8 belong to group A, patients with a score between 9 and 11 belong to group B and patients with a score between 12 and 15 belong to group C. It is found that in CTP the scores 5 to 15 is not equally distributed among the classes (Albers et al., 1989).

The CTP score has been widely used to predict mortality of various liver failure cases, such as ascites, ruptured oesophageal varices, subclinical encephalopathy, liver surgery, decompensated HCV-related cirrhosis, primary sclerosing cholangitis (PSC), primary biliary cirrhosis (PSC), alcoholic cirrhosis, hepatocellular carcinoma (HCC), Budd-Chiari syndrome, etc. (Shetty et al., 1997; Angermayr et al., 2003). The CTP scores ≥ 8 predicts the situation of 16% patients who had the prognosis of mortality or removal from the waiting list due to severe deterioration in 9 months. The score has been used by clinicians to assist in management decisions involving patients with cirrhosis (Kamath et al., 2001).

8. Historical Background of CTP

In 1964, Child and Turcotte have developed a classification to assess the operative risk in cirrhotic patients who recovered from variceal bleeding and undergoing portosystemic shunt surgery considering five variables: serum albumin, serum bilirubin, ascites, encephalopathy, and nutritional status (Child & Turcotte, 1964). They have also classified the patients in class A, B or C in relation to best (A), moderate (B), or worse (C) prognosis. The

CTP score has been widely applied prognostic markers in patients with cirrhosis and commonly used clinical instruments to risk-stratify cirrhotic patients (Kamath et al., 2001).

In 1973, Dr. Pugh and his coworkers have used a modified version of the Child-Turcotte classification for patients undergoing surgical transection for oesophageal varices by adding prothrombin time or international normalized ratio (INR) and removing nutritional status and by arbitrarily adjusting limits for serum albumin and better defining the encephalopathy grading system and assigned a score ranging from 1 to 3 to each variable. The score has been widely used to assess the severity of liver dysfunction in clinical work (Pugh et al., 1973).

In this stage, a difficulty arises from prothrombin. Because it is expressed as a time value in seconds in some countries, and is expressed as a percentage of the activity of normal plasma in index or ratio in some other countries (Durand & Valla, 2005). It is used to predict the outcome of surgery in cirrhotic patients, and to stratify patients on the waiting list for LT. Although it was formulated about 60 years ago, still it is considered as the cornerstone in prognostic evaluation of cirrhotic patients. But, it is not stainless and has some drawbacks, such as the subjectivity of clinical parameters, a limited discriminatory ability, not all cut-off values are optimal for defining significant changes in mortality risk, and not all variables have an independent influence (Benedeto-Stojanov et al., 2009).

9. Classification of CTP

The CTP is classified into three classes: best (A), moderate (B), or worse (C) prognosis depending on the chronic liver disease (Cholongitas et al., 2005). It is the first systematic approach that is used to determine the severity of cirrhosis and select those patients who could tolerate hepatic resection (Franco et al., 1990). 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).

Class A patients are generally considered good candidates for hepatic resection and good post-operative outcome is expected from them (Lau et al., 1997). The patients of class B have an estimated 1-year survival of 80%, and therefore need a LT (Pugh et al., 1973). Class C is considered an absolute contraindication for surgical treatment, whereas only few hepatectomies are performed in class B cirrhosis (Franco et al., 1990). The CTP classes B and C are associated with cirrhosis-related complications, such as ascites, hepatic hydrothorax, variceal bleeding, and encephalopathy (Child & Turcotte, 1964).

10. Conclusions

From this study, we have realized that the CTP score has proved to be useful in risk assessment in patients with chronic liver disease. The decompensated cirrhosis is a severe condition of liver. The high mortality of end-stage liver disease is a global public health problem. The CTP score is a useful asset for predicting short-term prognosis and complications of the end-stage liver disease. It is also the cornerstone in the prognostic evolution of cirrhotic patients that provides the standard criteria for liver transplantation.

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