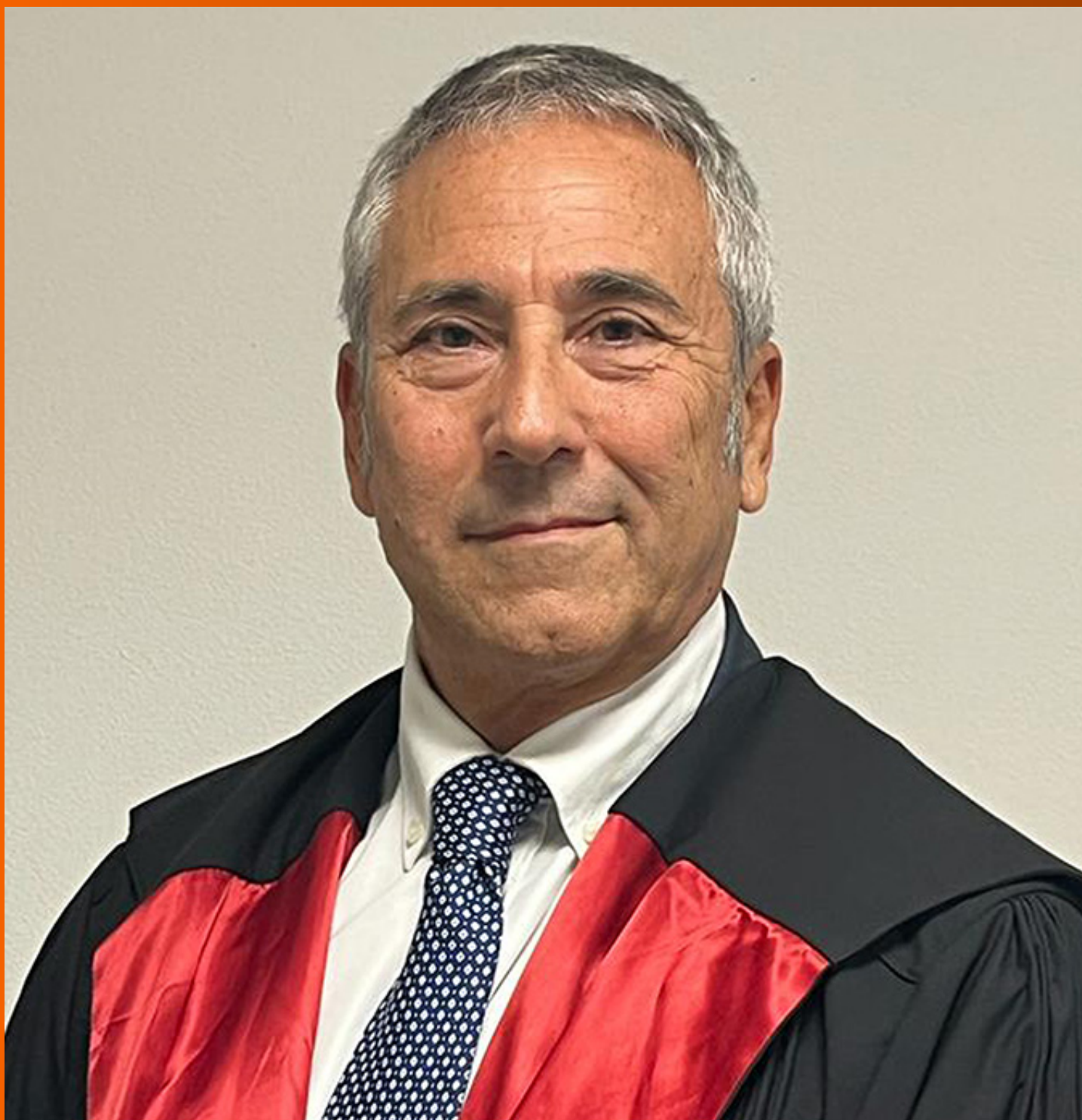


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Contents

Monthly Volume 16 Number 1 January 27, 2024

EDITORIAL

- 1 Novel prognostic factors after radical resection of hepatocellular carcinoma: Updating an old issue
Bencini L
- 6 Prospects in the application of ultrasensitive chromosomal aneuploidy detection in precancerous lesions of gastric cancer
Qian ST, Xie FF, Zhao HY, Liu QS, Cai DL

MINIREVIEWS

- 13 Prognostic value of ultrasound in early arterial complications post liver transplant
Zhao NB, Chen Y, Xia R, Tang JB, Zhao D

ORIGINAL ARTICLE

Case Control Study

- 21 Added value of ratio of cross diameters of the appendix in ultrasound diagnosis of acute appendicitis
Gu FW, Wu SZ

Retrospective Cohort Study

- 29 Oncological features and prognosis of colorectal cancer in human immunodeficiency virus-positive patients: A retrospective study
Yang FY, He F, Chen DF, Tang CL, Woraikat S, Li Y, Qian K

Retrospective Study

- 40 Laparoscopic *vs* open surgery for gastric cancer: Assessing time, recovery, complications, and markers
Lu YY, Li YX, He M, Wang YL
- 49 Single-incision laparoscopic transabdominal preperitoneal repair in the treatment of adult female patients with inguinal hernia
Zhu XJ, Jiao JY, Xue HM, Chen P, Qin CF, Wang P
- 59 Computerized tomography-guided therapeutic percutaneous puncture catheter drainage-combined with somatostatin for severe acute pancreatitis: An analysis of efficacy and safety
Zheng XL, Li WL, Lin YP, Huang TL
- 67 Impact of open hepatectomy on postoperative bile leakage in patients with biliary tract cancer
Wu G, Li WY, Gong YX, Lin F, Sun C
- 76 Clinical observation of gastrointestinal function recovery in patients after hepatobiliary surgery
Zeng HJ, Liu JJ, Yang YC

- 85** Predictive value of machine learning models for lymph node metastasis in gastric cancer: A two-center study
Lu T, Lu M, Wu D, Ding YY, Liu HN, Li TT, Song DQ
- 95** Post-operative morbidity after neoadjuvant chemotherapy and resection for gallbladder cancer: A national surgical quality improvement program analysis
Kim M, Stroeve S, Aploks K, Ostapenko A, Dong XD, Seshadri R
- 103** Risk factors for recurrence of common bile duct stones after surgical treatment and effect of ursodeoxycholic acid intervention
Yuan WH, Zhang Z, Pan Q, Mao BN, Yuan T
- 113** Clinical efficacy of modified Kamikawa anastomosis in patients with laparoscopic proximal gastrectomy
Wu CY, Lin JA, Ye K
- 124** Clinical effect of laparoscopic radical resection of colorectal cancer based on propensity score matching
Liu Y, Wang XX, Li YL, He WT, Li H, Chen H
- 134** Different timing for abdominal paracentesis catheter placement and drainage in severe acute pancreatitis complicated by intra-abdominal fluid accumulation
Chen R, Chen HQ, Li RD, Lu HM
- 143** Comparison of different preoperative objective nutritional indices for evaluating 30-d mortality and complications after liver transplantation
Li C, Chen HX, Lai YH
- 155** Predictive value of NLR, Fib4, and APRI in the occurrence of liver failure after hepatectomy in patients with hepatocellular carcinoma
Kuang TZ, Xiao M, Liu YF
- 166** Practical effect of different teaching modes in teaching gastrointestinal surgery nursing
Rong XJ, Ning Z

Observational Study

- 173** Predictive factors and model validation of post-colon polyp surgery *Helicobacter pylori* infection
Zhang ZS

Randomized Controlled Trial

- 186** Micro-power negative pressure wound technique reduces risk of incision infection following loop ileostomy closure
Xu DY, Bai BJ, Shan L, Wei HY, Lin DF, Wang Y, Wang D
- 196** Paravertebral block's effect on analgesia and inflammation in advanced gastric cancer patients undergoing transarterial chemoembolization and microwave ablation
Xiong YF, Wei BZ, Wang YF, Li XF, Liu C

META-ANALYSIS

- 205** Unraveling the efficacy network: A network meta-analysis of adjuvant external beam radiation therapy methods after hepatectomy
Yang GY, He ZW, Tang YC, Yuan F, Cao MB, Ren YP, Li YX, Su XR, Yao ZC, Deng MH
- 215** Estimation of Physiologic Ability and Surgical Stress scoring system for predicting complications following abdominal surgery: A meta-analysis spanning 2004 to 2022
Pang TS, Cao LP
- 228** Role of Oncostatin M in the prognosis of inflammatory bowel disease: A meta-analysis
Yang Y, Fu KZ, Pan G

CASE REPORT

- 239** Endoscopic treatment of extreme esophageal stenosis complicated with esophagotracheal fistula: A case report
Fang JH, Li WM, He CH, Wu JL, Guo Y, Lai ZC, Li GD
- 248** Intestinal tuberculosis with small bowel stricture and hemorrhage as the predominant manifestation: Three case reports
Huang G, Wu KK, Li XN, Kuai JH, Zhang AJ

LETTER TO THE EDITOR

- 257** Sarcopenia in cirrhotic patients: Does frailty matter while waiting for a liver transplant?
Li XJ, He K

ABOUT COVER

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The primary aim of *World Journal of Gastrointestinal Surgery* (WJGS, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, *etc.*

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Retrospective Study

Comparison of different preoperative objective nutritional indices for evaluating 30-d mortality and complications after liver transplantation

Chuan Li, Hong-Xia Chen, Yan-Hua Lai

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Abstract

BACKGROUND

The nutritional status is closely related to the prognosis of liver transplant recipients, but few studies have reported the role of preoperative objective nutritional indices in predicting liver transplant outcomes.

AIM

To compare the predictive value of various preoperative objective nutritional indicators for determining 30-d mortality and complications following liver transplantation (LT).

METHODS

A retrospective analysis was conducted on 162 recipients who underwent LT at our institution from December 2019 to June 2022.

RESULTS

This study identified several independent risk factors associated with 30-d mortality, including blood loss, the prognostic nutritional index (PNI), the nutritional risk index (NRI), and the control nutritional status. The 30-d mortality rate was 8.6%. Blood loss, the NRI, and the PNI were found to be independent risk factors for the occurrence of severe postoperative complications. The NRI achieved the highest prediction values for 30-d mortality [area under the curve (AUC) = 0.861, $P < 0.001$] and severe complications (AUC = 0.643, $P = 0.011$). Compared to those in the high NRI group, the low patients in the NRI group had lower preoperative body mass index and prealbumin and albumin levels, as well as higher alanine aminotransferase and total bilirubin levels, Model for End-stage Liver Disease

scores and prothrombin time ($P < 0.05$). Furthermore, the group with a low NRI exhibited significantly greater incidences of intraabdominal bleeding, primary graft nonfunction, and mortality.

CONCLUSION

The NRI has good predictive value for 30-d mortality and severe complications following LT. The NRI could be an effective tool for transplant surgeons to evaluate perioperative nutritional risk and develop relevant nutritional therapy.

Key Words: Liver transplantation; Nutritional indicator; Complications; Prognosis; Nutrition assessment

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Core Tip: The preoperative nutritional status of liver transplant patients is closely related to prognosis. In this study, we analyzed clinical data from 162 patients to compare the value of different objective nutritional indices in predicting 30-d mortality and complications following liver transplantation. This provides insights for the preoperative assessment of liver transplant prognosis.

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INTRODUCTION

Liver transplantation (LT) is considered to be the most effective and definitive treatment option for patients suffering from end-stage liver disease. These conditions provide these patients with the opportunity not only to survive but also to extend their lifespan significantly. However, the occurrence of posttransplant complications remains prevalent and can greatly influence postoperative prognosis. This can largely be attributed to the compromised preoperative state of liver transplant recipients and the intricate nature of the surgical procedure. Recently, there has been increasing recognition of the critical roles played by preoperative nutrition and immune status in modulating surgical outcomes.

The serum prealbumin concentration, which can objectively reflect nutritional status and is almost unaffected by external supplementation, is an accurate biomarker for assessing the severity of liver disease. It can also be used for preoperative nutritional assessment and risk stratification[1-4]. The controlling nutritional status (CONUT), prognostic nutritional status index (PNI), and nutritional risk index (NRI) are widely used objective indicators for evaluating nutritional status. These indicators are associated not only with cancer-related complications but also with the long-term prognosis of cancer patients[5-10]. However, few studies have investigated the role of these nutritional indices in predicting liver transplant outcomes. Therefore, this study delves into this matter.

MATERIALS AND METHODS

Patient characteristics

This study was approved by the Ethics Committee of the People's Hospital of Guangxi Zhuang Autonomous Region. The inclusion criteria were as follows: (1) First-time liver transplant recipients aged 18-65 years; (2) Organ donation from deceased citizens; and (3) Complete clinical data. The exclusion criteria were: (1) Multiple organ transplants; (2) Severe pneumonia or severe cardiovascular and cerebrovascular diseases before surgery; (3) Receiving marginal livers[11]; or (4) Incomplete follow-up data. This study was approved by the ethics committee of the People's Hospital of Guangxi Zhuang Autonomous Region (KY-ZC-2023-056). All patients provided written informed consent for data analysis before transplantation.

Study design

Before performing a LT, patient demographic information, which include age, sex, body mass index (BMI), and relevant medical history, such as hypertension, diabetes, and hepatitis B, were collected. Additionally, donor age, graft weight, and various laboratory values, such as prealbumin, albumin (ALB), lymphocyte count, alanine aminotransferase (ALT), aspartate aminotransferase, total bilirubin, and creatinine, were collected. The Model for End-Stage Liver Disease (MELD) score, total cholesterol level, type of donor liver, prothrombin time (PT), and platelet count are also important factors to consider. During LT, data such as operating time, anhepatic phase time, total ischemic time, intraoperative blood loss, and intraoperative urine output were collected. After LT, the incidences of pneumonia, abdominal infection, abdominal bleeding, graft rejection, primary graft nonfunction, early graft dysfunction, severe complications (Clavien-Dindo grade $\geq$

3), bile leakage, biliary stricture and mortality within 30 d were recorded.

Complications above Grade III include various conditions such as portal vein stenosis, portal vein thrombosis, hepatic artery stenosis, hepatic artery thrombosis, bile leakage, bile duct stenosis, retransplantation, pleural effusion requiring thoracentesis, peritoneal effusion requiring peritoneal puncture, intra-abdominal hemorrhage, respiratory failure necessitating extracorporeal membrane oxygenation support, liver insufficiency requiring artificial external liver support, renal failure requiring hemodialysis treatment, intracranial hemorrhage, and mortality.

The CONUT score consists of three components: The serum ALB concentration, total cholesterol concentration, and lymphocyte count[12]. The PNI can be calculated using the formula: $\text{ALB (g/L)} + 5 \times \text{lymphocyte count} (\times 10^9/\text{mL})$. The following equation was used to determine the NRI: $(1.519 \times \text{ALB, g/L}) + (41.7 \times \text{actual body weight/ideal body weight})$ [13]. The ideal weight for males and females can be calculated as follows: For males, 2.3 kg per foot is added to a base weight of 50 kg (if height > 5 feet, with 1 foot equal to 30.48 cm); for females, 1.65 kg per foot is added to a base weight of 48.67 kg (if height > 5 feet, with 1 foot equal to 30.48 cm)[14]. If the actual weight exceeds the ideal weight, set the ratio to one[15].

This study aimed to analyze the risk factors associated with severe postoperative complications (Clavien-Dindo grade ≥ 3) and 30-d mortality following LT. Moreover, the researchers compared the effectiveness of the CONUT score, NRI, PNI, and prealbumin concentration as predictors of postoperative complications and mortality after LT using receiver operating characteristic (ROC) curves. Based on the area under the curve (AUC), the most accurate predictive index was identified and utilized to stratify patients into low-risk and high-risk groups using an appropriate cutoff value. Furthermore, the study compared the differences in baseline characteristics and postoperative complications between the two groups.

Postoperative assessment

After transplantation surgery and before discharge, the functionality of the transplant was assessed through routine laboratory tests. Surgical complications are typically diagnosed by evaluating clinical symptoms and conducting diagnostic examinations. These postoperative complications were documented in the patients' medical records. The Clavien-Dindo classification system was employed to assess and classify these complications. In this study, complications classified as Clavien-Dindo III or higher were considered severe. We recorded all adverse reactions, including pneumonia, abdominal infection, abdominal bleeding, graft rejection, primary graft nonfunction, early graft dysfunction, death, biliary leakage, and biliary stricture, in patients after surgery.

Statistical analysis

The statistical analysis was performed using SPSS 23.0 software. Continuous variables are represented using the median, 25th percentile, and 75th percentile, while categorical variables are represented using the frequency. A binary logistic regression model was used for both univariate and multivariate analyses of the entire sample. In the univariate analysis, indicators with a significance level of $P < 0.05$ were included in the multivariate analysis. However, given the existence of multicollinearity between the serum ALB concentration and the NRI, PNI, and CONUT score, the total serum ALB concentration was not incorporated into the multivariate analysis. The diagnostic results of multicollinearity, following the exclusion of ALB, indicated that the values for the variance inflation factor were less than 5. Consequently, no collinearity issues were observed within the model. The predictive values, optimal thresholds, sensitivities, and specificities for complications and mortality were calculated using ROC curves and AUC. MedCalc 10.2 software was used for the Z test, and the Delong test was used to compare the AUC of the different scoring systems. A P value of less than 0.05 was considered to indicate statistical significance.

RESULTS

Patient characteristics

A total of 162 patients were included in the study, including 133 males and 29 females. Fourteen patients (8.6%) died within a 30-d period following LT. The median age of the patients was 53.0 (45.0-57.0) years. The preoperative BMI was recorded as 23.0 (21.1-25.1). Preoperative hypertension was observed in 18 patients, diabetes was present in 22 patients, and 118 patients tested positive for hepatitis B surface antigen (Table 1).

Univariate and multivariate analyses of severe complications and mortality

The factors correlated with the 30-d mortality rate are outlined in Table 2. Univariate analysis revealed that the following factors were significantly correlated with 30-d mortality: BMI, operation time, blood loss, intraoperative urine volume, prealbumin concentration, NRI, CONUT, PNI, ALT, total bilirubin, preoperative MELD score, and PT. The multivariate analysis confirmed that blood loss [odds ratio (OR) = 1.001, 95%CI: 1.000-1.002, $P = 0.034$], the NRI (OR = 0.665, 95%CI: 0.446-0.991, $P = 0.045$), the CONUT (OR = 2.088, 95%CI: 1.016-4.291, $P = 0.045$), and the PNI (OR = 0.920, 95%CI: 0.848-0.997, $P = 0.042$) were risk factors for the 30-d mortality rate (Table 2).

Factors associated with severe complications (Clavien-Dindo grade ≥ 3) included operation time, blood loss, intraoperative urine volume, NRI, PNI, ALB, total bilirubin, preoperative MELD score, and PT. However, the results of the multivariate analysis showed that blood loss (OR = 1.003, 95%CI: 1.001-1.005, $P = 0.004$), the NRI (OR = 0.942, 95%CI: 0.901-0.986, $P = 0.011$), and the PNI (OR = 0.994, 95%CI: 0.989-0.999, $P = 0.013$) were risk factors associated with severe complications (Clavien-Dindo grade ≥ 3 ; Table 3).

Table 1 Patient characteristics

Characteristics	Total (n = 162)
Age, yr	53.0 (45.0-57.0)
Male/female	133/29
BMI	23.0 (21.1-25.1)
Hypertension, yes/no	18/144
Diabetes, yes/no	22/140
HBsAg-positive, yes/no	118/44
Operation time (min)	535.0 (440.0-600.0)
Anhepatic phase (min)	58.0 (47.3-66.0)
Donor age, yr	45.0 (36.0-55.0)
Total ischemia time (min)	305.0 (250.5-372.6)
Graft weight (kg)	1.4 (1.3-1.7)
Split LT/whole LT	20/142
Blood loss (mL)	1750.0 (975.0-3925.0)
Intraoperative urine volume (mL)	2650.0 (1600.0-4000.0)
Prealbumin (mg/L)	95.0 (89.7-101.8)
NRI	95.1 (89.7-101.8)
CONUT	6.0 (4.0-6.0)
PNI	42.6 (38.7-46.4)
ALB (g/L)	37.2 (33.6-40.7)
Lymphocyte count ($\times 10^9$ /mL)	0.9 (0.6-1.5)
Alanine aminotransferase (U/L)	31.0 (19.0-53.3)
Aspartate aminotransferase (U/L)	46.5 (31.0-90.1)
Total bilirubin (μ mol/L)	30.8 (15.2-107.2)
Creatinine (μ mol/L)	71.0 (58.8-85.3)
Preoperative MELD score	12.0 (8.0-22.0)
Total cholesterol (mmol/L)	3.4 (2.2-4.6)
Prothrombin time (s)	16.4 (14.1-20.8)
Platelet ($\times 10^9$ /mL)	67.0 (44.0-150.3)
Death, yes/no	14/148

The data are presented as the median (25th-75th percentile) or *n*. BMI: Body mass index; HBsAg: Hepatitis B surface antigen; CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index; MELD: Model for end-stage liver disease; LT: Liver transplantation; ALB: Albumin.

The value of different preoperative objective nutritional indicators for predicting severe complications and mortality

ROC curve analysis revealed that the NRI, CONUT score, PNI, and prealbumin concentration were significantly associated with 30-d mortality ($P < 0.05$). Among these, the NRI had the highest AUC value (0.861) for prediction (Tables 4 and 5, Figure 1). When the predictive ability of various indicators for severe complications was compared, the NRI, PNI, and prealbumin concentration all showed good predictive value for severe complications ($P < 0.05$). Among them, the NRI exhibited the highest predictive ability (AUC = 0.643; Tables 5 and 6, Figure 2).

Comparison of clinical characteristics and postoperative complications between the high NRI group and low NRI group patients

In terms of clinical characteristics, the high NRI group exhibited a greater BMI, improved liver function, and a lower preoperative MELD score than did the low NRI group. In terms of prognosis, the high NRI group had a significantly lower incidence of postoperative intra-abdominal bleeding, primary graft dysfunction, and 30-d mortality than did the low NRI group ($P < 0.05$). These findings are summarized in Tables 7 and 8.

Table 2 Univariate and multivariate analyses of predictors of 30-d mortality

Variables	Univariable OR (95%CI)	P value	Multivariable OR (95%CI)	P value
Age	1.054 (0.996-1.114)	0.066		
Male	0.781 (0.204-2.999)	0.719		
BMI	0.772 (0.616-0.967)	0.024	0.720 (0.336-1.542)	0.397
Hypertension	2.418 (0.606-9.648)	0.211		
Diabetes	1.067 (0.222-5.124)	0.936		
HBsAg-positive	0.644 (0.203-2.040)	0.454		
Operation time	1.005 (1.002-1.009)	0.008	1.004 (0.996-1.011)	0.367
Anhepatic phase	1.039 (1.010-1.069)	0.091		
Donor age	1.004 (0.995-1.020)	0.475		
Total ischemia time	1.000 (0.996-1.005)	0.984		
Graft weight	1.002 (0.999-1.004)	0.253		
Split LT	0.938 (0.195-4.503)	0.936		
Blood loss	1.003 (1.001-1.004)	< 0.001	1.001 (1.000-1.002)	0.034
Intraoperative urine volume	0.999 (0.999-1.000)	0.004	0.999 (0.998-1.000)	0.295
Prealbumin	0.988 (0.977-0.999)	0.040	0.975 (0.929-1.023)	0.310
NRI	0.258 (0.082-0.811)	0.020	0.665 (0.446-0.991)	0.045
CONUT	5.756 (1.695-19.540)	0.005	2.088 (1.016-4.291)	0.045
PNI	0.160 (0.051-0.500)	0.002	0.920 (0.848-0.997)	0.042
ALB	0.798 (0.706-0.903)	< 0.001		
Lymphocyte count	0.723 (0.301-1.736)	0.468		
Alanine aminotransferase	1.002 (1.000-1.004)	0.045	1.002 (0.993-1.011)	0.639
Aspartate aminotransferase	1.001 (1.000-1.002)	0.231		
Total bilirubin	1.007 (1.003-1.012)	0.001	1.004 (0.988-1.021)	0.606
Creatinine	1.003 (0.999-1.007)	0.173		
Preoperative MELD score	1.099 (1.042-1.158)	< 0.001	1.003 (0.517-1.946)	0.994
Total cholesterol	0.694 (0.452-1.065)	0.095		
Prothrombin time	1.114 (1.042-1.191)	0.001	0.773 (0.309-1.931)	0.773
Platelet	1.002 (0.997-1.007)	0.432		

BMI: Body mass index; HBsAg: Hepatitis B surface antigen; CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index; MELD: Model for end-stage liver disease; OR: Odds ratio; LT: Liver transplantation; ALB: Albumin.

DISCUSSION

Early posttransplant mortality is the main factor affecting the overall effectiveness of LT, with most recipients dying within 1 mo after LT. In the current situation of severe shortage of donor livers and an increasing number of patients awaiting for LT, there is an urgent need for ideal risk prediction models to evaluate posttransplantation effectiveness and further determine the patients who are most likely to benefit from LT.

The MELD score is extensively applied in clinical practice and successfully predicts the likelihood of mortality in patients awaiting LT, as well as the risk of mortality after the transplant procedure[16,17]. However, the MELD score itself has limitations, as research has shown that it does not predict perioperative outcomes well in liver cancer patients without cirrhosis[18,19]. In recent years, scholars have shown greater interest in the relationship between nutritional status and post-LT complications. The serum prealbumin concentration serves as a reliable marker of liver synthesis capacity and nutritional status, making it a useful tool for predicting long-term survival in liver cancer patients undergoing liver resection[20]. Recent research has shown that prealbumin also demonstrates significant superiority in predicting complications after LT (AUC = 0.754)[1]. The COUNT score, PNI, and NRI are commonly used inflammatory nutritional indices in clinical practice. The CONUT score is a measure of the immune-nutritional status of patients and has been

Table 3 Factors that predict a Clavien-Dindo grade ≥ 3

Variables	Univariable OR (95%CI)	P value	Multivariable OR (95%CI)	P value
Age	0.997 (0.968-1.028)	0.852		
Male	0.518 (0.222-1.212)	0.129		
BMI	0.918 (0.819-1.028)	0.138		
Hypertension	1.073 (0.359-3.210)	0.900		
Diabetes	1.044 (0.380-2.868)	0.934		
HBsAg-positive	0.813 (0.377-1.754)	0.598		
Operation time	1.004 (1.001-1.006)	0.004	1.003 (1.000-1.006)	0.078
Anhepatic phase	1.019 (0.999-1.041)	0.069		
Donor age	1.010 (0.998-1.022)	0.113		
Total ischemia time	1.001 (0.999-1.003)	0.350		
Graft Weight	1.065 (0.978-1.158)	0.146		
Split LT	1.515 (0.477-4.812)	0.582		
Blood loss	1.004 (1.002-1.005)	< 0.001	1.003 (1.001-1.005)	0.004
Intraoperative urine volume	0.998 (0.996-1.000)	0.042	0.999 (0.995-1.002)	0.382
Prealbumin	0.995 (0.990-1.001)	0.089		
NRI	0.945 (0.904-0.988)	0.013	0.942 (0.901-0.986)	0.011
CONUT	1.037 (0.984-1.094)	0.169		
PNI	0.856 (0.738-0.994)	0.041	0.994 (0.989-0.999)	0.013
ALB	0.910 (0.848-0.977)	0.009		
Lymphocyte count	1.113 (0.814-1.522)	0.502		
Alanine aminotransferase	1.002 (0.999-1.004)	0.138		
Aspartate aminotransferase	1.000 (1.000-1.001)	0.314		
Total bilirubin	1.004 (1.002-1.006)	< 0.001	1.005 (0.999-1.010)	0.079
Creatinine	1.001 (0.997-1.004)	0.685		
Preoperative MELD score	1.057 (1.020-1.097)	0.003	0.894 (0.763-1.047)	0.165
Total cholesterol	0.886 (0.721-1.088)	0.886		
Prothrombin time	1.075 (1.019-1.134)	0.009	1.075 (0.923-1.252)	0.354
Platelet	1.001 (0.998-1.005)	0.422		

BMI: Body mass index; HBsAg: Hepatitis B surface antigen; CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index; MELD: Model for end-stage liver disease; LT: Liver transplantation; ALB: Albumin.

Table 4 Values of different preoperative objective nutritional indicators for predicting 30-d mortality

	AUC	Sensitivity	Specificity	95%CI	Optimal threshold value	P value
CONUT	0.724	0.58	0.80	0.646-0.794	6	0.015
NRI	0.861	0.70	0.83	0.765-0.958	88	< 0.001
PNI	0.781	0.64	0.80	0.682-0.829	38	0.001
Prealbumin	0.666	0.76	0.60	0.589-0.754	79	0.003

AUC: Area under the curve; CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index.

Table 5 Comparisons of the area under the curve of various nutritional indicators for predicting severe complications and 30-d mortality

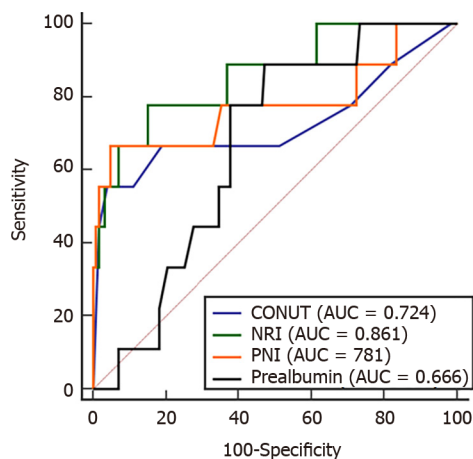
ROC	Severe complications		30-d mortality	
	Z value	P value	Z value	P value
CONUT <i>vs</i> NRI	1.851	0.064	1.550	0.121
CONUT <i>vs</i> PNI	1.945	0.051	0.832	0.405
CONUT <i>vs</i> Prealbumin	0.818	0.413	0.490	0.623
NRI <i>vs</i> PNI	0.749	0.454	1.061	0.288
NRI <i>vs</i> Prealbumin	0.582	0.560	2.337	0.019
PNI <i>vs</i> Prealbumin	0.176	0.860	1.062	0.288

CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index; ROC: Receiver operating characteristic.

Table 6 Values of different preoperative objective nutritional indicators for predicting severe complications

	AUC	Sensitivity	Specificity	95%CI	Optimal threshold value	P value
CONUT	0.547	0.17	0.96	0.463-0.627	8	0.410
NRI	0.643	0.50	0.72	0.555-0.712	91	0.011
PNI	0.615	0.23	0.94	0.522-0.678	34	0.047
Prealbumin	0.603	0.63	0.61	0.533-0.695	82	0.027

AUC: Area under the curve; CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index.



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Figure 1 Receiver operating characteristic curve for the cutoff values of multiple preoperative objective nutritional indicators for predicting postoperative death. CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index; AUC: Area under the curve.

reported to independently predict the prognosis of various malignant tumors[21]. Among liver transplant patients, those with intermediate to high CONUT scores have a higher incidence of postoperative Clavien-Dindo grade III/IV complications and infections than do those with high CONUT scores[22]. The PNI has a certain role in predicting post-LT renal injury and postliver cancer recurrence[23,24]. The NRI was first introduced in 2005 as an objective nutritional assessment tool that accurately predicts the mortality rate of elderly patients in internal medicine[25]. Subsequent multicenter studies have demonstrated that patients with an NRI of 98 or lower have a 1.5-fold greater risk of postoperative complications following abdominal surgery than patients with an NRI above 98. However, to date, the relationship between the NRI and post-LT complications has not been thoroughly elucidated[26]. Therefore, we further investigated the relationship between nutritional indices and the prognosis of LT patients.

Table 7 Comparison of the clinical characteristics among different nutritional risk index groups

Characteristics	Low NRI (n = 30)	High NRI (n = 132)	P value
Age, yr	53.0 (44.0-56.0)	52.5 (46.0-58.0)	0.587
Male/female	26/4	107/25	0.602
BMI	21.5 (19.0-23.4)	23.3 (21.4-25.4)	0.012
Hypertension, yes/no	4/26	14/118	0.747
Diabetes, yes/no	5/25	17/115	0.563
HBsAg-positive, yes/no	21/9	97/35	0.820
Operation time (min)	540.0 (452.5-650.3)	520.0 (440.0-600.0)	0.344
Anhepatic phase (min)	58.0 (48.5-65.0)	57.0 (47.0-66.0)	0.719
Donor age, yr	46.5 (39.0-59.6)	43.0 (35.1-53.0)	0.651
Total ischemia time (min)	329.5 (271.4-395.0)	286.5(234.7-356.2)	0.323
Graft weight (kg)	1.3 (1.2-1.6)	1.5 (1.4-1.8)	0.409
Split LT/whole LT	2/28	18/114	0.373
Blood loss (mL)	2000.0 (850.0-5000.0)	1650.0 (925.0-3500.0)	0.305
Intraoperative urine volume (mL)	2600.0 (1650.0-3225.0)	2800.0 (1600.0-4000.0)	0.636
Prealbumin (mg/L)	56.0 (33.0-82.0)	109.5 (54.5-172.0)	< 0.001
NRI	83.8 (81.2-85.5)	98.8 (93.1-103.5)	< 0.001
CONUT	8.0 (7.0-9.8)	5.0 (4.0-6.0)	< 0.001
PNI	34.9 (31.7-38.9)	43.7 (40.3-47.6)	< 0.001
ALB (g/L)	29.8 (27.4-31.2)	39.0 (35.6-41.4)	< 0.001
Lymphocyte count ($\times 10^9$ /mL)	0.9 (0.5-1.6)	0.9 (0.6-1.4)	0.978
Alanine aminotransferase (U/L)	41.5 (19.8-62.5)	29.5 (19.0-45.8)	0.154
Aspartate aminotransferase (U/L)	64.5 (38.8-126.3)	42.0 (29.3-77.5)	0.008
Total bilirubin (μ mol/L)	53.0 (20.4-250.4)	28.4 (14.8-87.8)	0.047
Creatinine (μ mol/L)	73.0 (57.0-86.3)	70.0 (59.3-85.0)	0.848
Preoperative MELD score	15.0 (11.8-24.8)	11.0 (7.3-20.8)	0.028
Total cholesterol (mmol/L)	2.7 (2.0-4.4)	3.6 (2.3-4.6)	0.050
Prothrombin time (s)	17.8 (16.2-23.4)	15.9 (14.1-20.0)	0.037
Platelet ($\times 10^9$ /mL)	63.5 (32.5-143.0)	67.5 (47.0-152.8)	0.386

BMI: Body mass index; HBsAg: Hepatitis B surface antigen; CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index; MELD: Model for end-stage liver disease; LT: Liver transplantation; ALB: Albumin.

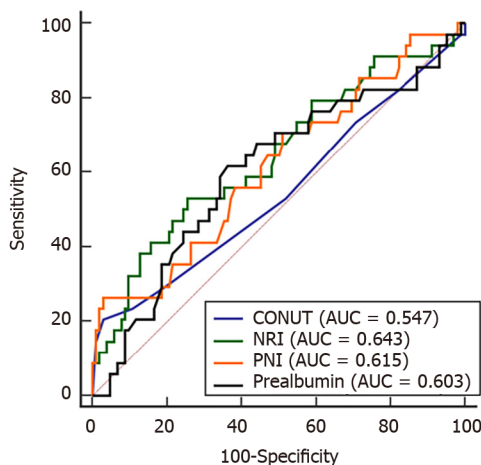
This retrospective analysis revealed that the NRI, PNI, and prealbumin have certain value for predicting 30-d mortality and severe complications in liver transplant recipients, with the NRI having the highest AUC value. The CONUT score can predict 30-d mortality in liver transplant recipients but cannot predict severe postoperative complications. In the multifactorial logistic regression analysis, blood loss, NRI, PNI, and CONUT were independent predictors of 30-d mortality, while blood loss, NRI, and PNI were independent predictors of severe postoperative complications. Based on the optimal cutoff value of the NRI, patients with an NRI > 88 had better preoperative liver function; lower rates of intra-abdominal bleeding (6.1% *vs* 20.0%, $P = 0.025$) and primary graft nonfunction (1.5% *vs* 10.0%, $P = 0.044$); and lower mortality rates (6.1% *vs* 20.0%, $P = 0.025$) than patients with an NRI < 88.

The serum prealbumin concentration has good predictive ability for 30-d mortality and severe complications after LT, consistent with previous findings[1]. The variation in AUC values may be attributed to varying definitions of severe complications. Serum prealbumin is a carrier protein entirely produced by liver cells, and its main physiological function is to transport thyroid hormones and vitamin A, enhancing the body's immune function by promoting lymphocyte maturation [27]. Moreover, due to its short half-life and small amount of interference factors, prealbumin can sensitively reflect liver synthesis function and has high sensitivity and specificity for detecting hepatocyte damage[28,29]. Therefore, the serum prealbumin concentration can be a potential indicator for predicting poor early outcomes after LT.

Table 8 Comparison of postoperative complications between the low nutritional risk index group and the high nutritional risk index group, *n* (%)

	Total (<i>n</i> = 162)	Low NRI (<i>n</i> = 30)	High NRI (<i>n</i> = 132)	<i>P</i> value
Pneumonia	37 (22.8)	8 (26.7)	29 (22.0)	0.631
Intra-abdominal infection	20 (12.3)	4 (13.3)	16 (12.1)	0.767
Intra-abdominal bleeding	14 (8.6)	6 (20.0)	8 (6.1)	0.025
Graft rejection	6 (3.7)	2 (6.7)	4 (3.0)	0.308
Primary graft nonfunction	5 (3.1)	3 (10.0)	2 (1.5)	0.044
Early graft dysfunction	4 (2.5)	0 (0.0)	4 (3.0)	1.000
Mortality	14 (8.6)	6 (20.0)	8 (6.1)	0.025
Clavien-Dindo grade ≥ 3	43 (26.5)	12 (40)	31 (23.5)	0.071
Biliary leakage	3 (1.9)	1 (3.3)	2 (1.5)	0.461
Biliary stricture	4 (2.5)	2 (6.7)	2 (1.5)	0.156

NRI: Nutritional risk index.



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Figure 2 Receiver operating characteristic curve for the cutoff values of multiple preoperative objective nutritional indicators for predicting severe complications. CONUT: Control nutritional status; PNI: Prognostic nutritional index; NRI: Nutritional risk index; AUC: Area under the curve.

We found that the AUC for predicting 30-d mortality was the highest for the NRI, followed by the PNI, CONUT, and prealbumin concentration. Similarly, the AUC for predicting severe complications was the highest for the NRI, followed by the PNI and prealbumin concentration. Although both the NRI and the PNI incorporate the measurement of ALB, the NRI also reflects the degree of weight loss in patients. Malnutrition is prevalent among patients with end-stage liver disease, and the incidence of malnutrition in individuals with decompensated cirrhosis and liver failure ranges from 50% to 90% [30]. Surgical intervention exacerbates liver injury, reduces ALB synthesis, impairs immune function and body repair capacity, increases the likelihood of postoperative complications, and adversely affects survival prognosis in malnourished patients. Recent studies have elucidated the association between sarcopenia and the prognosis of liver transplant recipients [22,31]. These findings indicate that diminished muscle mass is linked to unfavorable outcomes following LT and is a predictive factor for short-term survival. Furthermore, low muscle mass has an equally significant impact on the prognosis of patients with malignancies. In patients with nonmetastatic breast cancer, the overall mortality rate is significantly greater in individuals with sarcopenia (hazard ratio, 1.41; 95%CI, 1.18-1.69) [32]. Similarly, among patients diagnosed with colorectal cancer, those exhibiting sarcopenia have a notably elevated overall mortality rate (hazard ratio, 1.27; 95%CI, 1.09-1.48) compared to that of their counterparts without sarcopenia [33]. This finding suggested a strong association between wasting and unfavorable prognosis. However, the existing evidence is insufficient to establish a definitive link between lymphocyte count and nutritional status. Consequently, the predictive efficacy of the NRI surpasses that of the PNI, highlighting its potential in clinical prognostication. The CONUT score incorporates cholesterol as an indicator. Cholesterol is primarily synthesized in the liver, and its levels indirectly reflect liver synthetic function. Changes in liver function due to cellular damage can lead to alterations in cholesterol levels. Although a small-scale study suggested an association between low cholesterol levels and unsuccessful liver transplant, there is currently

insufficient evidence to support the role of cholesterol in the prognosis following LT[34]. Therefore, these findings may explain why the predictive efficacy of the CONUT score is lower than that of the NRI and PNI.

This study aimed to compare the role of multiple objective nutritional indicators in predicting the prognosis of LT patients, thereby facilitating a comprehensive preoperative nutritional assessment, early identification of malnutrition, timely and appropriate nutritional support for enhancing surgical safety, and reducing the incidence of postoperative complications. This study has several limitations, including the following: (1) The sample size was not large enough; (2) This was a retrospective analysis, and further prospective analysis is needed to clarify the predictive value of different scoring systems for post-LT outcomes; and (3) We analyzed only a portion of the nutritional indicators and did not include all nutritional indicators in our analysis. Despite these limitations, our results still demonstrate the superiority of the NRI as a nutritional indicator for predicting post-LT 30-d mortality and severe complications.

CONCLUSION

This study identified several independent risk factors associated with 30-d mortality, including blood loss, the PNI, the NRI, and the CONUT. The 30-d mortality rate was 8.6%. Blood loss, the NRI, and the PNI were found to be independent risk factors for the occurrence of severe postoperative complications. The NRI achieved the highest predictive values for 30-d mortality (AUC = 0.861, $P < 0.001$) and severe complications (AUC = 0.643, $P = 0.011$). Compared to those in the high NRI group, the patients in the low NRI group had lower preoperative BMIs; prealbumin, and ALT levels; and higher ALT, total bilirubin, MELD score, and PT ($P < 0.05$). Furthermore, the low NRI group exhibited significantly greater incidences of intraabdominal bleeding, primary graft nonfunction, and mortality. In conclusion, the NRI can serve as an effective tool for transplant surgeons to assess perioperative nutritional risk in patients and formulate relevant nutritional interventions.

ARTICLE HIGHLIGHTS

Research background

Nutritional status is closely associated with the prognosis of liver transplantation (LT) patients.

Research motivation

However, few studies have thoroughly investigated the relationship between the preoperative nutritional status of liver transplant recipients and postoperative prognosis. In clinical practice, there is a lack of a simple and effective tool for assessing the nutritional risk of patients during the perioperative period and for predicting the outcomes of LT.

Research objectives

The objective of this study was to compare the value of different preoperative objective nutritional indicators for predicting the 30-d mortality and the incidence of complications following LT.

Research methods

This study conducted a retrospective analysis of clinical data from 162 patients who underwent LT. The present study compared the ability of the serum prealbumin concentration, the controlling nutritional status (CONUT) score, the prognostic nutritional index (PNI), and the nutritional risk index (NRI) to predict the 30-d mortality rate and the incidence of severe complications after LT. This study also aimed to analyze the risk factors associated with the 30-d mortality rate and incidence of severe complications after LT. The area under the receiver operating characteristic curve was used to select the index with the best predictive ability. Patients were then divided into low-risk and high-risk groups based on the optimal cutoff value, and the differences in postoperative complications and mortality rates between the two groups were compared.

Research results

This study identified several independent risk factors associated with 30-d mortality, including blood loss, the PNI, the NRI, and the CONUT. The 30-d mortality rate was 8.6%. Blood loss, the NRI, and the PNI were found to be independent risk factors for the occurrence of severe postoperative complications. The NRI achieved the highest prediction values for 30-d mortality [area under the curve (AUC) = 0.861, $P < 0.001$] and severe complications (AUC = 0.643, $P = 0.011$). Compared to those in the high NRI group, the patients in the low NRI group had lower preoperative body mass index and prealbumin and albumin levels, as well as higher alanine aminotransferase and total bilirubin levels, Model for End-stage Liver Disease scores and prothrombin time ($P < 0.05$). Furthermore, the group with a low NRI exhibited significantly greater incidences of intraabdominal bleeding, primary graft nonfunction, and mortality.

Research conclusions

The NRI has good predictive value for 30-d mortality and severe complications following LT. The NRI could be an effective tool for transplant surgeons to evaluate the perioperative nutritional risk and provide relevant nutritional therapy.

Research perspectives

The purpose of this study was to investigate the predictive value of different objective nutritional indicators before surgery for the outcome of LT.

FOOTNOTES

Author contributions: Li C conceived the study, collected and analyzed the data and drafted the manuscript; Chen HC assisted with the data collection; Lai YH revised the manuscript; and all the authors read and approved the final version to be published.

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REFERENCES

- Li Y, Liu X, Jiang Y, Wan K, Liu W, Ou Y, Bai J, You Y, Hu F, Xu Z, Bie P, Zhang C, Zhang L. Low preoperative prealbumin predicts the prevalence of complications following liver transplantation. *BMC Gastroenterol* 2021; **21**: 233 [PMID: 34022800 DOI: 10.1186/s12876-021-01818-1]
- Beck FK, Rosenthal TC. Prealbumin: a marker for nutritional evaluation. *Am Fam Physician* 2002; **65**: 1575-1578 [PMID: 11989633]
- Loftus TJ, Brown MP, Sligh JH, Rosenthal MD. Serum Levels of Prealbumin and Albumin for Preoperative Risk Stratification. *Nutr Clin Pract* 2019; **34**: 340-348 [PMID: 30908744 DOI: 10.1002/ncp.10271]
- Dellièvre S, Cynober L. Is transthyretin a good marker of nutritional status? *Clin Nutr* 2017; **36**: 364-370 [PMID: 27381508 DOI: 10.1016/j.clnu.2016.06.004]
- Faramarzi E, Mahdavi R, Mohammad-Zadeh M, Nasirimotlagh B. Validation of nutritional risk index method against patient-generated subjective global assessment in screening malnutrition in colorectal cancer patients. *Chin J Cancer Res* 2013; **25**: 544-548 [PMID: 24255578 DOI: 10.3978/j.issn.1000-9604.2013.10.04]
- Schwegler I, von Holzen A, Gutzwiller JP, Schlumpf R, Mühlebach S, Stanga Z. Nutritional risk is a clinical predictor of postoperative mortality and morbidity in surgery for colorectal cancer. *Br J Surg* 2010; **97**: 92-97 [PMID: 20013933 DOI: 10.1002/bjs.6805]
- Migita K, Takayama T, Saeki K, Matsumoto S, Wakatsuki K, Enomoto K, Tanaka T, Ito M, Kurumatani N, Nakajima Y. The prognostic nutritional index predicts long-term outcomes of gastric cancer patients independent of tumor stage. *Ann Surg Oncol* 2013; **20**: 2647-2654 [PMID: 23463091 DOI: 10.1245/s10434-013-2926-5]
- Mohri Y, Inoue Y, Tanaka K, Hiro J, Uchida K, Kusunoki M. Prognostic nutritional index predicts postoperative outcome in colorectal cancer. *World J Surg* 2013; **37**: 2688-2692 [PMID: 23884382 DOI: 10.1007/s00268-013-2156-9]
- Kanda M, Fujii T, Kodera Y, Nagai S, Takeda S, Nakao A. Nutritional predictors of postoperative outcome in pancreatic cancer. *Br J Surg* 2011; **98**: 268-274 [PMID: 20960457 DOI: 10.1002/bjs.7305]
- Yoshida N, Baba Y, Shigaki H, Harada K, Iwatsuki M, Kurashige J, Sakamoto Y, Miyamoto Y, Ishimoto T, Kosumi K, Tokunaga R, Imamura Y, Ida S, Hiyoshi Y, Watanabe M, Baba H. Preoperative Nutritional Assessment by Controlling Nutritional Status (CONUT) is Useful to estimate Postoperative Morbidity After Esophagectomy for Esophageal Cancer. *World J Surg* 2016; **40**: 1910-1917 [PMID: 27220507 DOI: 10.1007/s00268-016-3549-3]
- Vodkin I, Kuo A. Extended Criteria Donors in Liver Transplantation. *Clin Liver Dis* 2017; **21**: 289-301 [PMID: 28364814 DOI: 10.1016/j.cld.2016.12.004]
- Ignacio de Ulíbarri J, González-Madroño A, de Villar NG, González P, González B, Mancha A, Rodríguez F, Fernández G. CONUT: a tool for controlling nutritional status. First validation in a hospital population. *Nutr Hosp* 2005; **20**: 38-45 [PMID: 15762418]
- Nozoe T, Ninomiya M, Maeda T, Matsukuma A, Nakashima H, Ezaki T. Prognostic nutritional index: a tool to predict the biological aggressiveness of gastric carcinoma. *Surg Today* 2010; **40**: 440-443 [PMID: 20425547 DOI: 10.1007/s00595-009-4065-y]

- 14 **Pai MP**, Paloucek FP. The origin of the "ideal" body weight equations. *Ann Pharmacother* 2000; **34**: 1066-1069 [PMID: [10981254](#) DOI: [10.1345/aph.19381](#)]
- 15 **Lai CC**, You JF, Yeh CY, Chen JS, Tang R, Wang JY, Chin CC. Low preoperative serum albumin in colon cancer: a risk factor for poor outcome. *Int J Colorectal Dis* 2011; **26**: 473-481 [PMID: [21190025](#) DOI: [10.1007/s00384-010-1113-4](#)]
- 16 **Pommergaard HC**, Daugaard TR, Rostved AA, Schultz NA, Hillingsø J, Krohn PS, Rasmussen A. Model for end-stage liver disease score predicts complications after liver transplantation. *Langenbecks Arch Surg* 2021; **406**: 55-65 [PMID: [33140185](#) DOI: [10.1007/s00423-020-02018-3](#)]
- 17 **Fung J**, Mak LY, Chan AC, Chok KS, Wong TC, Cheung TT, Dai WC, Sin SL, She WH, Ma KW, Seto WK, Lai CL, Lo CM, Yuen MF. Model for End-Stage Liver Disease With Additional Criteria to Predict Short-Term Mortality in Severe Flares of Chronic Hepatitis B. *Hepatology* 2020; **72**: 818-828 [PMID: [31872444](#) DOI: [10.1002/hep.31086](#)]
- 18 **Wagener G**. Assessment of hepatic function, operative candidacy, and medical management after liver resection in the patient with underlying liver disease. *Semin Liver Dis* 2013; **33**: 204-212 [PMID: [23943101](#) DOI: [10.1055/s-0033-1351777](#)]
- 19 **Teh SH**, Sheppard BC, Schwartz J, Orloff SL. Model for End-stage Liver Disease score fails to predict perioperative outcome after hepatic resection for hepatocellular carcinoma in patients without cirrhosis. *Am J Surg* 2008; **195**: 697-701 [PMID: [18367132](#) DOI: [10.1016/j.amjsurg.2007.05.054](#)]
- 20 **Jia RR**, Zhong JH, Huo RR, Su QB, Xiang X, Zhao FL, Qin ZB, Chen JH, Liao YY, Ma L, Xiang BD, Zhang CY, Li LQ. Correlation between serum prealbumin and prognosis of patients with hepatocellular carcinoma after hepatectomy. *J Surg Oncol* 2019; **119**: 794-800 [PMID: [30648280](#) DOI: [10.1002/jso.25378](#)]
- 21 **Liang RF**, Li JH, Li M, Yang Y, Liu YH. The prognostic role of controlling nutritional status scores in patients with solid tumors. *Clin Chim Acta* 2017; **474**: 155-158 [PMID: [28964833](#) DOI: [10.1016/j.cca.2017.09.021](#)]
- 22 **Dai X**, Gao B, Zhang XX, Li J, Jiang WT. Value of the controlling nutritional status score and psoas muscle thickness per height in predicting prognosis in liver transplantation. *World J Clin Cases* 2021; **9**: 10871-10883 [PMID: [35047598](#) DOI: [10.12998/wjcc.v9.i35.10871](#)]
- 23 **Kornberg A**, Kaschny L, Kornberg J, Friess H. Preoperative Prognostic Nutritional Index May Be a Strong Predictor of Hepatocellular Carcinoma Recurrence Following Liver Transplantation. *J Hepatocell Carcinoma* 2022; **9**: 649-660 [PMID: [35923612](#) DOI: [10.2147/JHC.S366107](#)]
- 24 **Min JY**, Woo A, Chae MS, Hong SH, Park CS, Choi JH, Chung HS. Predictive Impact of Modified-Prognostic Nutritional Index for Acute Kidney Injury within 1-week after Living Donor Liver Transplantation. *Int J Med Sci* 2020; **17**: 82-88 [PMID: [31929741](#) DOI: [10.7150/ijms.39014](#)]
- 25 **Bouillanne O**, Morineau G, Dupont C, Coulombel I, Vincent JP, Nicolis I, Benazeth S, Cynober L, Aussel C. Geriatric Nutritional Risk Index: a new index for evaluating at-risk elderly medical patients. *Am J Clin Nutr* 2005; **82**: 777-783 [PMID: [16210706](#) DOI: [10.1093/ajcn/82.4.777](#)]
- 26 **Hanada M**, Yamauchi K, Miyazaki S, Hirasawa J, Oyama Y, Yanagita Y, Takahata H, Kozu R. Geriatric Nutritional Risk Index, a predictive assessment tool, for postoperative complications after abdominal surgery: A prospective multicenter cohort study. *Geriatr Gerontol Int* 2019; **19**: 924-929 [PMID: [31342623](#) DOI: [10.1111/ggi.13750](#)]
- 27 **Siegel RL**, Miller KD, Jemal A. Cancer statistics, 2018. *CA Cancer J Clin* 2018; **68**: 7-30 [PMID: [29313949](#) DOI: [10.3322/caac.21442](#)]
- 28 **Saito M**, Seo Y, Yano Y, Miki A, Yoshida M, Azuma T. Short-term reductions in non-protein respiratory quotient and prealbumin can be associated with the long-term deterioration of liver function after transcatheter arterial chemoembolization in patients with hepatocellular carcinoma. *J Gastroenterol* 2012; **47**: 704-714 [PMID: [22350695](#) DOI: [10.1007/s00535-012-0535-x](#)]
- 29 **Liu F**, Cai LY, Zhong L, Chen C, Xu F, Zhao ZX, Chen XM. Model for end-stage liver disease combined with serum prealbumin to predict the prognosis of patients with decompensated liver cirrhosis. *J Dig Dis* 2010; **11**: 352-357 [PMID: [21091897](#) DOI: [10.1111/j.1751-2980.2010.00465.x](#)]
- 30 **Cheung K**, Lee SS, Raman M. Prevalence and mechanisms of malnutrition in patients with advanced liver disease, and nutrition management strategies. *Clin Gastroenterol Hepatol* 2012; **10**: 117-125 [PMID: [21893127](#) DOI: [10.1016/j.cgh.2011.08.016](#)]
- 31 **Kalafateli M**, Mantzoukis K, Choi Yau Y, Mohammad AO, Arora S, Rodrigues S, de Vos M, Papadimitriou K, Thorburn D, O'Beirne J, Patch D, Pinzani M, Morgan MY, Agarwal B, Yu D, Burroughs AK, Tsochatzis EA. Malnutrition and sarcopenia predict post-liver transplantation outcomes independently of the Model for End-stage Liver Disease score. *J Cachexia Sarcopenia Muscle* 2017; **8**: 113-121 [PMID: [27239424](#) DOI: [10.1002/jcsm.12095](#)]
- 32 **Caan BJ**, Cespedes Feliciano EM, Prado CM, Alexeeff S, Kroenke CH, Bradshaw P, Quesenberry CP, Weltzien EK, Castillo AL, Olobatuyi TA, Chen WY. Association of Muscle and Adiposity Measured by Computed Tomography With Survival in Patients With Nonmetastatic Breast Cancer. *JAMA Oncol* 2018; **4**: 798-804 [PMID: [29621380](#) DOI: [10.1001/jamaoncol.2018.0137](#)]
- 33 **Caan BJ**, Meyerhardt JA, Kroenke CH, Alexeeff S, Xiao J, Weltzien E, Feliciano EC, Castillo AL, Quesenberry CP, Kwan ML, Prado CM. Explaining the Obesity Paradox: The Association between Body Composition and Colorectal Cancer Survival (C-SCANS Study). *Cancer Epidemiol Biomarkers Prev* 2017; **26**: 1008-1015 [PMID: [28506965](#) DOI: [10.1158/1055-9965.EPI-17-0200](#)]
- 34 **Ishida H**, Furusawa M, Ishizuka T, Tojimbara T, Nakajima I, Fuchinoue S, Agishi T, Toma H. Short-term changes in cholesterol metabolism in 40 patients with liver transplants from living related donors. *Transpl Int* 2002; **15**: 142-144 [PMID: [11935172](#) DOI: [10.1007/s00147-002-0387-z](#)]



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