Indocyanine green retention is a potential prognostic indicator after splenectomy and pericardial devascularization for cirrhotic patients

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BACKGROUND: Splenectomy and pericardial devascularization (SPD) is an effective treatment of upper gastrointestinal bleeding and hypersplenism in cirrhotic patients with portal hypertension. Indocyanine green retention at 15 minutes (ICGR15) was reported to offer better sensitivity and specificity than the Child-Pugh classification in hepatectomy, but few reports describe ICGR15 in SPD. The present study was to evaluate the prognostic value of ICGR15 for cirrhotic patients with portal hypertension who underwent SPD.

METHODS: From January 2012 to January 2015, 43 patients with portal hypertension and hypersplenism caused by liver cirrhosis were admitted in our center and received SPD. The ICGR15, Child-Pugh classification, model for end-stage liver disease (MELD) score, and perioperative characteristics were analyzed retrospectively.

RESULTS: Preoperative liver function assessment revealed that 34 patients were Child-Pugh class A with ICGR15 of 13.6%-43.0% and MELD score of 7-20; 8 patients were class B with ICGR15 of 22.8%-40.7% and MELD score of 7-17; 1 patient was class C with ICGR15 of 39.7% and MELD score of 22. The optimal ICGR15 threshold for liver function compensation was 31.2%, which offered a sensitivity of 68.4% and a specificity of 70.8%. Univariate analysis showed preoperative ICGR15, MELD score, surgical procedure, intraoperative blood loss, and autologous blood transfusion were significantly different between postoperative liver function compensated and decompensated groups. Multivariate regression analysis revealed that ICGR15 was an independent risk factor of postoperative liver function recovery (P=0.020).

CONCLUSIONS: ICGR15 has outperformed the Child-Pugh classification for assessing liver function in cirrhotic patients with portal hypertension. ICGR15 may be a suitable prognostic indicator for cirrhotic patients after SPD.

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KEY WORDS: **indocyanine green; liver function test; liver cirrhosis; splenectomy; pericardial devascularization**

Introduction

In China, portal hypertension due to liver cirrhosis can cause a lethal esophageal variceal rupture and hepatic encephalopathy with an estimated incidence of 30% and a 30-day mortality of 20%.[1] About 10%-30% patients died after the initial onset of gastrointestinal bleeding, so splenectomy and pericardial devascularization (SPD) are universally used to prevent bleeding as well as to support surgical procedures.[2]

Complications subsequent to impaired liver function usually occur after cirrhosis. Though Child-Pugh classification is typically used to estimate surgical safety for treating portal hypertension in cirrhotic patients, postoperative ascites, hepatic encephalopathy and liver failure can occur after SPD in patients with preoperatively normal Child-Pugh classification. This indicates that this technique is not optimal for identifying liver functional reserve,[3] especially for a surgical procedure.

The model for end-stage liver disease (MELD) score has been accepted as a useful tool for estimating mortality in patients awaiting liver transplantation. It has been also applied to predict the postoperative mortality of patients receiving hepatectomy. But the total bilirubin, creatinine and international normalized ratio (INR) in MELD system could easily be affected by generation rate, organ perfusion and bile duct disease. Indocyanine green

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(ICG) clearance is the most commonly used quantitative assessment of liver function, and ICG retention at 15 minutes (ICGR15) has been reported to be closely associated with hepatectomy outcomes,[4] its utility for predicting cirrhotic liver transplantation succeeded.[5, 6] However, few studies have used ICGR15 for SPD prognosis. Thus, we analyzed the relationship between ICGR15 and perioperative liver function and SPD outcomes and described the prognostic value of ICGR15 for SPD.

Methods

Patients

A total of 43 patients with portal hypertension and hypersplenism caused by liver cirrhosis who underwent SPD in our center from January 2012 to January 2015 were analyzed retrospectively. Diagnosis of cirrhosis was based on clinical symptoms, biochemical data, upper gastrointestinal radiology, and endoscopic findings, and all patients had a history of hematemesis or melena. Upper gastrointestinal endoscopy was performed to diagnose esophageal and gastric varices. Clinical examinations included laboratory data with hemograms, serum electrolytes, liver function tests, and a complete coagulogram. Patients with regional portal hypertension caused by portal vein thrombosis or splenic vein drainage reflux were excluded.

Surgical procedures

The open or laparoscopic procedure was chosen depending on the patient's will, history of left upper abdominal surgery and preoperative assessment of abdominal space according to CT scan. The traditional open procedure was performed using Hassab's operation as previously described by Yang and Qiu.[7] The laparoscopic procedure was performed as described by Hong et al.[8] In brief, the abdomen was insufflated with carbon dioxide, 4 or 5 operative ports were used, and the placement of the trocars depended on the volume of the spleen. After the stomach was suspended to the abdominal wall with an 8# urine catheter, splenic artery was exposed and occluded by Hem-o-Lock. Once the splenogastric and lienorenal ligament were dissected by LigaSure™ Vessel Sealing System (LVSS, Covidien, USA), a posterior hilum tunnel was made meticulously from the low to the upper edge of the spleen by a blunt dissection. Then the splenic pedicle was transected *en bloc* with the application of linear laparoscopic vascular stapler (Endo GIA™, Covidien, USA). The gastric coronary vein, branches toward the proximal stomach and esophagus were cut by LVSS or blocked by Hem-o-Lock. At least 6 cm of the distal paraesophageal venous collaterals was dissected.

ICG test

The ICG test was performed as described by Sakka.[9] A solution of 50 mg ICG (Dandong Yichuang Pharmaceutical Co., Ltd, Dandong, China) in 10 mL of sterilized water (5 mg/mL) was injected (0.2 mg/kg) through the median cubital vein within 5-10 seconds, and blood ICG concentrations were monitored using a dilator naris optical probe (DDG-3300K, Nihon Kohden, Tokyo, Japan). ICGR15 was calculated automatically.

Subgroup

Clinical data and perioperative characteristics were recorded and analyzed, and postoperative liver function was classified as compensated group with no ascites, no or mild jaundice (total bilirubin <51.3 μmol/L), no hepatic encephalopathy or normal liver function within one week and decompensated group with ascites, moderate or severe jaundice (total bilirubin ≥51.3 μmol/L) for one week, or death from liver failure. The receiver operating characteristic (ROC) curve for postoperative liver function was used to establish a threshold for ICGR15, and high and low ICGR15 groups were formed.

Statistical analysis

Data were analyzed using IBM SPSS version 19 (IBM Co., Armonk, NY, USA). Data were analyzed with a Student's *t* test or a Chi-square test. Relationships were assessed with multivariate regression analysis. Thresholds were established using the highest Youden index retrieved from ROC curves. A P value <0.05 was considered statistically significant.

Results

Patients characteristics

Demographic data and clinical characteristics of patients are shown in Table 1. According to the postoperative liver function, the area under the ROC curve for ICGR15 was 0.724 (Fig.), and the optimal ICGR15 threshold for liver function compensation was 31.2%, with a sensitivity of 68.4% and a specificity of 70.8%.

Univariate and multivariate analysis

Preoperative liver function assessment revealed that 34 patients were Child-Pugh class A with ICGR15 of 13.6%-43.0% and MELD score of 7-20; 8 patients were class B with ICGR15 of 22.8%-40.7% and MELD score of 7-17; 1 patient was class C with ICGR15 of 39.7% and MELD score of 22. Univariate analysis revealed there was no difference in age, gender, admission status, Child-Pugh classification, operation time, or postoperative plasma