

## Liver resection for benign hepatic lesions: A retrospective analysis of 827 consecutive cases

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### Abstract

**AIM:** To analyze the operative and perioperative factors associated with hepatectomy of benign hepatic lesions.

**METHODS:** A total of 827 consecutive cases of benign hepatic lesion undergoing hepatectomy from January 1986 to December 2005 in the Chinese PLA General Hospital were investigated retrospectively according to their medical documentation.

**RESULTS:** The effect of operative and perioperative factors on the outcome of patients were analyzed. Of the 827 cases undergoing hepatectomy for more than 3 liver segments accounted for 22.1%, 316 (38.21%) required transfusion of blood products during operation. The average operating time was  $220.59 \pm 109.13$  min, the average hospital stay after operation was  $13.55 \pm 9.38$  d. Child-Pugh A accounted for 98.13%. The postoperative complication rate was 13.54% and the in-hospital mortality rate was 0.24%. Multivariate analysis showed that operating time ( $P = 0.004$ , OR = 1.003) and albumin value ( $P = 0.040$ , OR = 0.938) were the independent predictors of morbidity and indicated that operating time, blood transfusion, complication rate, and LOS had a trend to decrease.

**CONCLUSION:** Hepatectomy for benign hepatic lesions can be performed safely with a low morbidity and mortality, provided that it is carried out with optimized perioperative management and an innovative surgical technique.

### INTRODUCTION

Hepatectomy is a dangerous and complex operation<sup>[1-6]</sup>. The choice of surgical treatment for benign hepatic lesion is controversial. Erdogan *et al*<sup>[7]</sup> reported that the indications for surgical resection of liver hemangioma are progressive abdominal pain and > 5 cm in diameter, which have been justified in patients with minimal or no symptoms, even in patients with giant hemangiomas. Yoon *et al*<sup>[8]</sup> performed 52 operations for 115 hepatic hemangiomas, enucleation was performed for 31 (60%) of the 52 patients who underwent surgical resection. Postoperative complications were found in 13 patients (25%) with no peri-operative death occurred. Of the 52 patients with symptoms before resection, 96% had resolution of their symptoms after operation. Chaib *et al*<sup>[9]</sup> suggested that hepatic adenoma should be removed in all cases, especially in female patients on oral contraceptives when their tumor was greater than 3 cm in diameter or when malignancy cannot be excluded. No postoperative death occurred in 24 patients with hepatic adenoma. Bile leakage occurred in 1 patient, intraperitoneal abscess in 1 patient, pleural effusion in 2 patients, venous thrombosis in 1 patient and wound infection in 1 patient. Ibrahim *et al*<sup>[10]</sup> suggested that indications for intervention in cases of benign liver tumors should include symptoms, suspicion of malignancy, or risk of malignant change. Liver resection for benign liver tumor is safe, but indications for

intervention must be evaluated carefully. The presence of chronic parenchymal liver disease does not increase the morbidity of benign hepatic lesions in these patients. This study retrospectively investigated the perioperative predictors by reviewing 827 consecutive cases of benign hepatic lesion undergoing hepatectomy from January 1986 to December 2005 in Chinese PLA General Hospital.

## MATERIALS AND METHODS

### Patients

A total of 827 consecutive cases (334 males, 493 females, the male and female ratio = 1:1.48) of benign hepatic lesion undergoing hepatectomy from January 1986 to December 2005 in the Chinese PLA General Hospital were included in this study. Their age was 5-79 years and mean age was 43.88 years. Of the 827 cases, 345 had hepatic hemangiomas, 245 had intrahepatic bile duct stones, 35 had hepatic cysts, 35 had hepatic focal nodular hyperplasia, 17 had strictures of intrahepatic bile duct, 17 had hepatic adenoma, 16 had hepatic angioleiomyolipoma, 16 had hepatic echinococcosis, 13 had hepatic inflammatory pseudotumor, 11 had hepatic trauma, 11 had congenital biliary duct cystic dilatation, 10 had other inflammatory diseases (including 4 cases of extrahepatic disease and hepatic adherence disease, 3 cases of hepatic focal necrosis, 1 case of liver calcification, 1 case of hepatic mycotic chronic granuloma, 1 case of sclerosing cholangitis), 7 had hepatic cystadenoma, 4 had hepatic atypical hyperplasia, 4 had hepatic parasitic diseases, 4 had hepatic phthisis, 4 had hepatic granuloma, 4 had hepatic spontaneous haematoma, 3 had hepatic hamartoma, 3 had hepatapostema, and 23 had other diseases (including 6 cases of chronic cholecystitis with suspected preoperative malignant diseases, 4 cases of nodular cirrhosis with suspected preoperative malignant diseases, 2 cases of hepatic hemangioma and intrahepatic bile duct stone, 2 cases of portal hypertension requiring partial liver resection, 1 case of hepatic purpura, 1 case of hepatic lipoma, 1 case of hepatic adenomatous hyperplasia nodus, 1 case of hepatic fibroangioliipoma, 1 case of hepatic leiomyoma, 1 case of benign hepatic occupying lesion with suspected preoperative malignant diseases, 1 case of giant hepatic regenerative nodus with suspected preoperative malignant diseases, 1 case of hepatic artery-portal vein fistula requiring partial liver resection, 1 case of Budd-Chiari syndrome requiring partial liver resection).

### Diagnostic methods and preoperative hepatic functional evaluation

All the results were obtained based on pathological diagnosis. Child-Pugh A was scored in 736 out of 750 cases, accounting for 98.13% (Table 1).

### Surgical methods

Incisions below the right costal margin were routinely used and the lesions were resected after

Table 1 Preoperative Child-Pugh score of patients

Child-Pugh score	n	%
5	635	84.7
6	62	8.3
7	39	5.2
8	9	1.2
9	5	0.7

liver was liberated from the left or right side. Regular hepatectomy, focal hepatectomy, and enucleation were performed. Hepatic hemangioma was enucleated after the liver blood flow was occluded. The liver sections were sutured face-to-face to reduce errhysis. Hepatic lobectomy or segmental resection was performed to remove intrahepatic bile duct stones since irregular focal hepatectomy could not accurately remove them, usually leading to remnant pathological tissue and stone. Fifty lesions were resected under laparoscope, accounting for 6.0%. Fifty-one lesions underwent line precoagulation liver resection with a WBD-2 equipment, accounting for 6.2%.

### Statistical analysis

SPSS10.0 statistical software was used to analyze the 827 cases of benign hepatic lesions.  $P < 0.05$  was considered statistically significant.

## RESULTS

### Extent of hepatectomy

Hepatectomy for more than 3 liver segments was performed in 183 cases, accounting for 22.1%, including 10 II segmentectomies, 19 III segmentectomies, 81 IV segmentectomies, 34 V segmentectomies, 42 VI segmentectomies, 37 VII segmentectomies, 27 VIII segmentectomies, 22 I segmentectomies, 2 extended right hemibepatectomies, 3 extended left hemibepatectomies, 5 multiple suffusions, 129 right hemibepatectomies, 94 right posterior lobectomies, 49 right anterior lobectomies, 5 right trilobectomies, 4 central hepatectomies, 134 left hemibepatectomies, 1 left trilobectomy, and 255 left external lobectomies. If the lesions were located in multiple discontinuous segments (lobes), the locations were separately described. If the lesions were suffused in several segments (lobes), the locations were described as multiple suffusions.

### Perioperative outcome

**Perioperative results:** Of the 827 cases, 517 (62.52%) had a blood loss of less than 200 mL, 99 (11.97%) had a blood loss of 200-400 mL, 146 (17.65%) had a blood loss of 400-1000 mL, 65 (7.86%) had a blood loss of more than 1000 mL, 316 (38.21%) required transfusion of blood products during operation (range 150-8090 mL, mean  $879.33 \pm 834.64$  mL), including whole blood transfusion in 210 cases, red blood cell transfusion in 38 cases, plasma transfusion in 7 cases, mixed transfusion in the remaining cases, auto-blood transfusion in 63 (6.62%) cases (ranged 200-7079 mL, mean  $870.45 \pm 862.31$  mL).

The operating time was 20 to 975 min (mean 220.59 ± 109.13 min). Hospital stay ranged 1-174 d (mean 25.24 ± 15.59 d). Postoperative hospital stay ranged 1-151 d (mean 13.55 ± 9.38 d).

**Complications:** Postoperative complications occurred in 112 cases (13.54%). The most common complications were epigastric complications related to liver cirrhosis: pleural effusion in 53 cases, hydroperitonitis in 20 cases and perihepatic hydrops in 17 cases, which resolved without any sequelae after transfusion of condensed human serum albumin, adjustment of water and electrolyte balance, and administration of diuretics. The main procedure-related complications were perihepatic abscess in 7 cases, cholangitis in 4 cases, incisional infection or liquification in 13 cases. Bile leakage was the most severe complication in 10 cases (1.21%).

Logistic regression analysis of complication-related risk predictor was performed. Multivariate analysis showed that the independent predictors were gender, laparoscope, microwave in line precoagulation liver resection, abdominal operation history, simple anatomical hepatectomy, type B hepatitis, blood loss, the number of segments resected, operating time, albumin value, Child-Pugh score, and age. Operating time ( $P = 0.004$ , OR = 1.003) and albumin value ( $P = 0.040$ , OR = 0.938) were the independent predictors of complication. Operating time was the risk predictor and increased albumin value was the protection predictor.

**Mortality:** Two patients died with a mortality of 0.24%. One was a case of liver trauma combined splenic rupture, hemorrhagic shock, and pelvic fracture. The blood pressure was too low to be measured during emergency operation although tremendous blood products and liquid were transfused. The patient died of blood loss and DIC eventually. The other was a case of intrahepatic bile duct stone undergoing left external lobectomy, exploration of the common bile duct, and T-tube drainage. Postoperative procedure was uneventful. Unfortunately, 15 d after operation, the patient died due to a sudden short breath, chest distress, and ventricular fibrillation.

### Changes of perioperative predictors for hepatectomy in the last 20 years

The past 20 years were stratified into 4 stages with 5 years as a stage. The predictors were compared. Multivariate analysis indicated that operating time, blood transfusion, complication rate, and hospital stay had a trend to decrease (Table 2).

## DISCUSSION

Liver is the largest parenchymatous organ in the body which is deep seated in the epigastrium and protected by the bony thorax<sup>[11-14]</sup>. Liver has abundant blood flow and is a blest and indispensable organ, known as the “forbidden zone” or a “noli me tangere-do not touch me” organ. Liver surgery became possible in the second

**Table 2** Changes of perioperative predictors for hepatectomy in the last 20 years

Predictors	Yr	95% confidence interval (mean)	P
Age (yr)	86-90	42.676-48.375 (45.525)	0.004
	91-95	41.298-45.938 (43.618)	
	96-00	40.298-43.499 (41.898)	
	01-05	44.288-46.570 (45.429)	
Operating time (min)	86-90	236.649-290.639 (263.644)	< 0.001
	91-95	240.043-284.002 (262.022)	
	96-00	186.591-216.917 (201.754)	
	01-05	203.194-224.812 (214.003)	
Blood transfusion	86-90	67.1% (53/79)	< 0.001
	91-95	68.2% (75/110)	
	96-00	46.9% (99/211)	
	01-05	28.6% (122/427)	
Abdominal operation history	86-90	21.5% (17/79)	0.059
	91-95	30.0% (33/110)	
	96-00	19.0% (40/211)	
	01-05	20.8% (89/427)	
Blood loss (≥ 1000 mL / < 1000 mL)	86-90	7.6% (6/79)	0.018
	91-95	8.2% (9/110)	
	96-00	8.5% (19/211)	
	01-05	11.7% (50/427)	
Albumin (g)	86-90	38.587-40.837 (39.712)	0.027
	91-95	40.444-42.275 (41.360)	
	96-00	40.694-41.958 (41.326)	
	01-05	40.060-40.961 (40.511)	
Child-Pugh score	86-90	5.188-5.524 (5.356)	0.544
	91-95	5.121-5.396 (5.258)	
	96-00	5.157-5.346 (5.251)	
	01-05	5.155-5.290 (5.223)	
Resected segments	86-90	2.047-2.631 (2.339)	0.026
	91-95	1.942-2.418 (2.180)	
	96-00	2.194-2.522 (2.358)	
	01-05	2.432-2.666 (2.549)	
Complications	86-90	20.3% (16/79)	0.004
	91-95	25.5% (28/110)	
	96-00	14.2% (30/211)	
	01-05	8.9% (38/427)	
Postoperative hospital stay (d)	86-90	17.016-21.560 (19.288)	< 0.001
	91-95	16.443-20.142 (18.292)	
	96-00	12.842-15.394 (14.118)	
	01-05	10.131-11.950 (11.041)	
Simple anatomical hepatectomy (yes/no)	86-90	37.5% (27/72)	0.265
	91-95	37.6% (38/101)	
	96-00	47.8% (98/205)	
	01-05	41.8% (165/395)	

half of the 20th century and a rapid progress in liver surgery has been achieved in the latest 20-30 years<sup>[15,16]</sup>. Liver surgery for benign and malignant lesions mainly involves partial liver resection<sup>[17]</sup>.

In the initial stage of liver surgery, the mortality is rather high due to the wide excision of liver and hepatectomy is only suitable for selective malignant lesions and the expected outcome is not good. However, the current surgical techniques make it possible to perform operations on liver. The safety is not inferior to other large intraabdominal operations. It was reported that the mortality of patients with liver tumors could be lowered to the minimum, even to zero<sup>[17,18]</sup>. Nowadays, surgery is a routine treatment modality for benign hepatic lesions. Zhi-Qiang Huang has reported two cases of intrahepatic bile duct stone (the secondary common benign hepatic lesion in China) treated with left external

lobectomy or right hepatectomy since 1958, leading to wide application of hepatectomy for benign hepatic lesions in clinical practice<sup>[19-23]</sup>.

In this study, retrospectively investigated 827 consecutive cases of benign hepatic lesions were retrospectively investigated in the Chinese PLA General Hospital, which provides some evidence-based data about the improved hepatectomy techniques.

In this series, the most common diseases were hemangioma and intrahepatic bile duct stone, accounting for 41.7% (345/827) and 29.6% (245/827), respectively. It was reported that the incidence of intrahepatic bile duct stone is higher than hemangioma in China<sup>[24]</sup>.

Hepatectomy can be divided into two categories: hepatectomy involving bile duct and hepatectomy not involving bile duct. Usually, hepatectomy involving bile duct has more complications. The operation procedure, mainly using regular segmental resection or lobectomy, therefore, has different characteristics. Intrahepatic bile duct stone is the representative of this kind of lesion. In 1958, our operation team first reported regular lobectomy for intrahepatic bile duct stone based on the theory that intrahepatic bile duct stone is a kind of segmental lesion with a strict distribution within the liver<sup>[25,26]</sup>. After more than 50 years, this conception has been well established and developed gradually<sup>[27]</sup>. In the present series, 202 cases of intrahepatic bile duct stone underwent anatomical hepatectomy, accounting for 82.4% of the total cases, with a complication rate of 16.3% (data not shown). Hepatectomy not involving bile duct is mainly for liver tumors. Hepatic hemangioma is the main representative of benign hepatic lesions<sup>[10,19,21,28]</sup>, which grows slowly and recurs occasionally and can be radically resected. Because of the well-demarcated border between the tumor and its normal liver tissue, enucleation is usually performed. In this series, the complication rate was 11.3%, lower than that of intrahepatic bile duct stone.

The postoperative complication rate of hepatectomy was 13.54% in this series. Multivariate analysis showed that operating time ( $P = 0.004$ , OR = 1.003) and albumin value ( $P = 0.040$ , OR = 0.938) were the independent predictors of morbidity of benign hepatic lesion. Operating time was the risk predictor and increased albumin value was the protection predictor. The study indicated that some surgical technical refining, for instance, optimizing surgical instruments, increasing the surgeon's proficiency and co-operation level, should be taken into account to decrease the operating time so as to reduce complications.

The albumin value should be emphasized on the preoperative liver functional reserve evaluation. In this series, two patients died with a perioperative mortality of 0.24%. One was a case of liver trauma complicated by splenic rupture, hemorrhagic shock, and pelvic fracture, and died of blood loss and DIC. The other case had a sudden death because of ventricular fibrillation 15 d after operation.

The Chinese PLA General Hospital have performed, 2008 hepatectomies for benign and malignant lesions

with a total perioperative complication rate of 14.44% and a mortality rate of 0.55%<sup>[29]</sup>. In this series, the perioperative complication rate and mortality were lower than the total perioperative complication rate and mortality, indicating that hepatectomy is safer for benign hepatic lesion than for malignant lesions.

In addition, multivariate analysis revealed that operating time, blood transfusion, complication rate, and hospital stay had a trend to decrease, indicating that surgical quality is improved.

In conclusion, hepatectomy is a safe procedure for benign hepatic lesions. Benign hepatic lesions should undergo aggressive surgical management when clinical presentations, diagnosis, society factors, and progress in liver surgery are considered. Reducing operating time and preoperative liver functional reserve evaluation play an important role in improving the operation quality.

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## COMMENTS

### Background

Hepatectomy is a dangerous and complex surgical procedure. The choice of surgical procedure for benign hepatic lesion is controversial.

### Research frontiers

Operative safety and indication of hepatectomy for benign hepatic lesions at different sites are the key research frontier.

### Innovations and breakthroughs

We analyzed the operative and perioperative factors associated with hepatectomy for benign hepatic lesions. Multivariate analysis showed that operating time ( $P = 0.004$ , OR = 1.003) and albumin value ( $P = 0.040$ , OR = 0.938) were the independent predictors of morbidity.

### Applications

The postoperative complication rate of hepatectomy was 13.54% and in-hospital mortality rate was 0.24%, indicating that hepatectomy is a safe procedure for benign hepatic lesions.

### Peer review

This is a very large series of hepatectomy for benign liver lesions. It is a publishable manuscript and very informative. The manuscript should provide more strong messages than "hepatectomy is a safe procedure for benign hepatic lesions". The authors advocated that benign hepatic lesions should undergo aggressive surgical management when clinical presentations, diagnosis, society factors, and progress in liver surgery are considered. Reducing operating time and preoperative liver functional reserve evaluation play an important role in improving the operation quality.

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