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ORIGINAL ARTICLE

# Effect and influence factor analysis of intrahepatic Glisson's sheath vascular disconnection approach for anatomical hepatectomy by three-dimensional laparoscope

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## Summary

***Purpose:*** *To investigate the effects and influence factor analysis of intrahepatic Glisson's sheath vascular disconnection approach for anatomical hepatectomy by three-dimensional (3D) laparoscope.*

***Methods:*** *82 patients with liver cancer were selected and divided into the control group with 45 cases and observation group with 37 cases according to different treatment methods. The control group was subjected to conventional laparotomy or resection under two-dimensional (2D) laparoscope while the observation group was subjected to anatomical hepatectomy by intrahepatic Glisson's sheath vascular disconnection approach under 3D laparoscope, and the therapeutic effects were compared.*

***Results:*** *The operation time and porta hepatis anatomy time were not significantly different (p>0.05). The amount of bleeding in the observation group was less than that of the control group, and the difference was statistically significant (p<0.05). The achievement ratio of the operation in both groups was compared and showed no statistical difference (p=1.00). With a median follow-up time of 26.5 months, the complication occurrence rate in the observation group was significantly lower than that of the control group (p<0.05). Comparison of the survival rate of both groups showed no differences. The multivariate logistic regression analysis suggested that the average maximum diameter of tumor and tumor close to porta hepatis were independent risk factors that influenced the operative results of the observation group.*

***Conclusion:*** *Intrahepatic Glisson's sheath vascular disconnection approach by 3D laparoscope for anatomical hepatectomy was superior in terms of safety and effectiveness, and the average maximum diameter of tumor and tumor close to porta hepatis were independent risk factors that influenced the operative results.*

***Key words:*** *hepatectomy, intrahepatic Glisson's sheath vascular disconnection, three-dimensional laparoscope*

## Introduction

Hepatectomy under a 2D laparoscope leads to similar treatment effects as conventional laparotomy, with less complications [1]. However, it lacks organization structure layering, which requires that surgeon to be familiar with regional anatomy, have significant operational experience and understand the adjacent relationships of organization structure by applying collision and displacement distance during the operation [2]. This prolongs the operation time undoubtedly, and the Pringle total hepatic vascular exclusion time is an importance influencing factor for the recovery of liver function [3]. Meanwhile, the separation process can easily lead to various complications, such as blood vessels injury, nerve injury, bile leakage, infection, pleural effusions, ascites,

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and can also lead to an increase in the occurrence rate of postoperative liver dysfunction [4]. Intrahepatic Glisson's sheath vascular disconnection approach requires a declining hepatic plate, hepatic pedicle with blunt dissection and increasing wound bleeding and can also result easily in a caudate lobe vascular tear and accidental injury of bile duct [5]. For patients with lobus quadratus hepatis, caudate lobe hypertrophy, involvement of the first porta hepatic and severe cirrhosis, the anatomy is much more difficult to operate [6]. A 3D laparoscope imaging system increases the visual depth information and improves the clarity of the organization structure and accuracy of operation. In addition, it provides the possibility for intrahepatic Glisson's sheath vascular disconnection approach to realize separation and dissection one by one [7]. Currently, the 3D laparoscope is being widely applied to the surgical treatment of many systems, such as urinary, gynecology and obstetrics and other general operations [8,9].

This research investigated the effects of intrahepatic Glisson's sheath vascular disconnection approach for anatomical hepatectomy by 3D laparoscope and analyzed its influencing factors, aiming at improving the clinical treatment effects and offer a reference basis for the patient follow-up.

## Methods

*Sample selection*

Eighty-two patients diagnosed with early liver cancer and operated for the first time between January 2013 to January 2016 in our hospital were selected. Liver cancer diagnosis was confirmed by pathology. Inclusion criteria: (1) TNM stage I-II, with a resectable tumor focus and (2) Complete clinical data. Exclusion criteria: (1) Liver metastases, hepatic dysfunction and other hepatic diseases, such as autoimmune liver disease, hepatitis, severe liver cirrhosis and so on; (2) intolerable pneumoperitoneum, extensive intrabdominal adhesions, tumor close to great vessels, locating nearby to the first, second or the third porta hepatis, and in need of large-scale lymph node dissection for porta hepatis; and (3) severe comorbidities, such as heart, lung, brain, kidney etc. dysfunction.

This study got approval by the Ethics Committee of our hospital and informed consent was obtained from patients and their families. Patients were divided into the control group with 45 cases and the observation group with 37 cases, according to different treatment methods.

In the control group, there were 30 males and 15 females, with an average age of 56.4±12.3 years and tumor average maximum diameter of 3.5±1.2 cm. All cases had only one lesion. There were 17 cases of stage I and 28 cases of stage II. Seven cases were located at II, III segment, 12 cases at V, VI segments, 10 cases at VI, VII segments, 8 cases at VI, VII and VIII segments and 8 cases at V, VI, VII and VIII segments.

In the observation group, there were 22 males and 15 females, with average age 55.8±13.4 years, and tumor average maximum diameter 3.4±1.3 cm. All patients had only one lesion. There were 14 cases of stage I and 23 cases of stage II. Five cases were located at the hepatic segments II, III segment, 10 cases at V, VI segments, 9 cases at VI, VII segments, 7 cases at VI, VII, VIII segments and 6 cases at V, VI, VII, VIII segments. The baseline information of two groups were comparable.

*Research methods*

The control group was subjected to conventional laparotomy or resection under a 2D laparoscope, while the observation group was subjected to anatomical hepatectomy by intrahepatic Glisson's sheath vascular disconnection approach under a 3D laparoscope, which was performed by the same surgical and nursing team according to standard medical methods. The main operation steps of the observation group were as follows: (1) Operation preparation: intratracheal general anesthesia was administered. The trocar location was distributed by arc, based on the hepatic segment excision, with quadripuntal method and pneumoperitoneum pressure of 13-15mm Hg. The surgeon and nurse wore passive polarization 3D glasses. (2): Intrahepatic Glisson's sheath vascular disconnection approach for the first porta hepatis: (a) Treatment of right porta hepatic anatomy and vessel: Gallbladder was cut off, and ductus cysticus nub was pulled to clear the connective tissue of the common hepatic duct and right hepatic duct initial segment. The right hepatic artery's main trunk located at the rear-right gallbladder was present along the initial segment of the cystic artery nub. The ultrasonic knife was used to eliminate connective tissue around the right hepatic artery and separated the right-front and rear-right branch of the right hepatic artery and traction with thread. A hem-o-lok was applied for the right hepatic artery occlusion, with direct separation and right hepatectomy, to separate rear-right liver lobar artery or right-front lobar artery respectively and to conduct rear-right liver lobar removal and right-front lobar or V, VII segment cutting. The far end and front wall of the artery were lifted, and the right anterior portal branches appeared after back separation. After ultrasonic knife separated the lower-posterior and anterior-superior connective tissue, a blunt dissection of tangential clamp run through the main trunk of the right portal vein, pulled by 7-0 thread, showing portal vein furcation and left branch. Right-front and rear-right branches of the portal vein were further separated from the intrahepatic sheath far end, with traction by thread. The right branch main trunk, rear-right branch and right-front branch of the portal vein were separated respectively and the corresponding liver regions were removed. The ductus cysticus nub was lifted with bottom-right traction and the right hilar plate declined. The right hepatic duct was dissected in the back of the right portal vein and right-front and rear-right branches of bile duct were also separated; traction was done with thread. Right hepatic duct, rear-right branch and right-front branch were separated and removed. (b) Treatment of the left porta hepatis anatomy and vessel: Ultrasonic knife was used to separate the connective tissue of the first porta hepatis vertically and to dissect the main trunk of the proper hepatic artery, isolating right and left hepatic artery with traction of the left hepatic artery far end. When vessel sheath was separated by ultrasound, the front wall of portal vein left branch appeared. The left hepatic artery, main trunk of portal vein left branch and left hepatic duct were separated and left liver resection followed; the left lateral hepatic artery was separated and the blood flow was blocked when the left branch of the portal vein was performed with hepatectomy with thread and left lobe resection. (c) Anatomy and liver parenchyma separation of the second and third porta hepatis: Separating from the falciform ligament of the liver to the second porta hepatis to isolate bilateral coronary ligaments, the initial segment and hepatic vein fossa of 3 branches of the second porta hepatis appeared. After a right lobectomy and a right posterior lobectomy, it was required to further separate and ligate the third porta hepatis' short vein. During right liver, left lobe and left liver resection, only a periodontal ligament of the liver was dissociated. Ultrasonic knife of 1 cm thickness was used to separate liver parenchyma step by step, and the communicating branch of the portal vein within liver and hepatic vein applied med-small Hem-o-lok to clip and separate. The Endo-GIA was used to divide right or left hepatic vein main trunk within the liver parenchyma. The liver tissue that was resected was placed in a specimen bag, crosscut and taken out below the umbilicus.

*Follow-up details*

Follow-up visits were done with a median of 26.5 months (range 5-40). The operation time, porta hepatis anatomy operation time, amount of bleeding, achievement ratio of operation, complication occurrence during perioperative period and survival rates were recorded and compared.

*Statistics*

SPSS 20.0 software was used to process and analyze the data, which was presented as mean ± standard deviation. For comparison between the groups the independent-sample T-test was used. The enumeration data was shown by case or rate (%), and comparison between the groups was done with $x^2$ test. The influence factor analysis was done with univariate logistic regression analysis and multivariate analysis followed ($\alpha \leq 0.10$ for inclusion criteria, <0.05 for exclusion criteria) A p value <0.05 meant that the difference was statistically significant.

## Results

*Comparison of operation and porta hepatis anatomy time and amount of bleeding*

The operation time and porta hepatis anatomy time were compared; there were no significant differences (p>0.05). The amount of bleeding in the observation group was less than that of the control group, and the difference was statistically significant (p<0.05) (Table 1).

*Comparison of the achievement ratio of operation*

Three cases (6.67%) died from massive hemorrhage, serious infection and acute hepatic failure during operation in the control group. In the observation group 2 cases (5.41%) had a laparotomy performed due to the poor location of the tumor and accidental injury of blood vessels during operation. The rest had uneventful recovery with a smooth discharge. The achievement ratio of the operation in these two groups was compared and showed no significant differences ($x^2$=0.000, p=1.000).

*Comparison of complication and survival rates during the perioperative period*

The complication rate in the observation group was significantly lower than the control group (p<0.05). The survival rate of the two groups was compared and showed no significant differences (Table 2).

**Table 1.** Comparison of operation and porta hepatis anatomy time and amount of bleeding

| *Groups* | *Mean operation time (min)* | *Mean porta hepatis anatomy time (min)* | *Mean amount of bleeding (ml)* |
|---|---|---|---|
| Control group | 312.5±52.6 | 35.6±8.9 | 1254.9±325.7 |
| Observation group | 356.7±43.8 | 42.3±12.5 | 653.8±156.5 |
| t | 0.125 | 0.234 | 6.528 |
| P | 0.864 | 0.723 | 0.015 |

**Table 2**. Comparison of complication and survival rates during the perioperative period

| *Groups* | *Cases* | *Injury of blood vessels and bile ducts* | *Intestinal obstruction* | *Infection of incision and splanchnocoele* | *Malnutrition* | *Overall incidence N (%)* | *Survival rate N (%)* |
|---|---|---|---|---|---|---|---|
| Control group | 45 | 3 | 6 | 3 | 3 | 15 (33.33) | 40 (88.89) |
| Observation group | 37 | 1 | 2 | 1 | 1 | 5 (13.51) | 33 (89.19) |
| $x^2$ | | | | | | 4.325 | 0.000 |
| P | | | | | | 0.038 | 1.000 |

**Table 3**. Influence factor analysis of the observation group

| *Factors* | β | *Wald* | *P* | *OR* | *95% CI* |
|---|---|---|---|---|---|
| Average maximum tumor diameter | 0.126 | 5.627 | 0.013 | 2.627 | 2.034-3.328 |
| Close to porta hepatis | 0.013 | 6.329 | 0.006 | 3.325 | 2.589-3.867 |

*Influence factor analysis of observation group*

The baseline information (including gender, age, tumor average maximum diameter, TNM stage, tumor location) of the observation group was taken as independent variable, and successful operation and non-complications were taken as dependent variables. Multivariate logistic regression analysis showed that the average maximum tumor diameter and tumor location were independent risk factors that influenced the operative results (Table 3).

## Discussion

Intrahepatic Glisson's sheath vascular disconnection and regional blood occlusion is an ideal control method of porta hepatis using laparoscope for anatomical hepatectomy [10]. The 3D laparoscope can increase the stereoscopic vision of the surgeon so that the cut, separation, ligation, suture and other actions will be more accurate. Intrahepatic Glisson's sheath vascular disconnection dissects from near to far, following the sequence of cystic artery, right hepatic artery, right hepatic portal vein and bile duct [11]. Forceps clip with no injury is applied to occlude the blood vessels and the bile duct, and traction with thread is reduced to pull and lift manipulations, which avoid injury of intima and muscular layer [12]. Ultrasonic knife is used to separate the intrathecal connective tissue, whose result is better and smog is less. It always keeps the surgery field clear, compared to electric coagulation hemostasis [13]. Realizing three-level branch vessel dissection, this research not only achieved an entire blocking of pre-cutting hepatic segment bloodstream, but also blocked the bloodstream temporarily for adjacent hepatic segments during the process of hepatectomy, which reduced the bleeding of wound surface and avoided accidental injury of blood vessels [14]. The main bleeding source is the communication branch of the hepatic venous system. The vision under a 3D laparoscope is clear so that the surgeon can identify the portal vein and the hepatic vein branches clearly. This allows to see in 3D the trend of vessels up and down, right and left, before and after, especially the longitudinal distribution of vessels, so that the dividing after occlusion will be more accurate [15]. At the same time, in terms of tear injury of the hepatic vein walls, the oppression and suture by 3D laparoscope is faster, which avoids the possibility of conversion to laparotomy [16].

This study concluded that the operation time and porta hepatis anatomy time were not significantly different. The amount of bleeding in the observation group was significantly less than that of the control group, and the differences were statistically significant. The complication rate in the observation group was significantly lower than that of the control group, which suggests that intrahepatic Glisson's sheath vascular disconnection approach by 3D laparoscope for anatomical hepatectomy may have superior safety and effectiveness. Multivariate logistic regression analysis confirmed that the average maximum tumor diameter and tumor close to the porta hepatis were independent risk factors that influenced the operative results. There is no doubt that the operational experience of the surgeon and the ability to handle complications are also important factors [17]. However, 3D laparoscope also has shortcomings; for example, its partial view is clear, but the entire vision is decreased, leading to smaller operation space for surgical instruments. The laparoscope assistant has to back and pull the scope surface to locate repeatedly, which adds to the operation time and leads to visual fatigue easily [18]. Secondly, the scope surface cannot rotate by 360°, without left and right side-looking for the whole anatomical position, which results in more difficulty for separation of the second porta hepatis [19].

## Conflict of interests

The authors declare no confict of interests.

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