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Modified Thoracoscopic Hepatectomy For Segment VIII

A Case Report

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Abstract: Although previous studies have reported the use of total thoracoscopic hepatectomy (TH) for malignant liver tumors, it is technically impossible to perform intraoperative ultrasonography (IUSO) to exclude intrahepatic metastasis for the whole liver via a thoracic approach. Therefore, total TH may be inappropriate for these patients. We here report the first case of modified TH for a malignant liver tumor in China.

The patient was a 26-year-old man with a 10-year HBV infection. Preoperative CT showed a 1.2 cm × 0.9 cm mass located in segment VIII. His alpha-fetal protein level was 444 ng/mL. Child–Pugh was Grade (A, 6), whereas an ICG-15 test yielded 2.7%. HCC was diagnosed preoperatively. The indications for TH were difficult tumor location, HCC, and a young patient with good resilience.

The modified TH included 2 steps: (1) the patient was placed in a supine position. IUSO was used to locate the tumor in segment VIII and determine that intrahepatic metastasis had not occurred. The hepatoduodenal ligament was hanged over using a Pringle maneuver; (2) patient was then placed in the left-lateral position with single-lung ventilation. Three trocars were placed into the right thoracic cavity. The intrathoracic space was observed using a regular 10-mm rigid scope. The diaphragm was transected and retracted. IUSO was used again to confirm the tumor location. Under the Pringle maneuver (once every 10 min), the superficial portion of the liver was transected by ultrasonic shears, whereas the deeper tissue was transected by LigaSure. Bipolar was used for hemostasis. The specimen was put into a retrieval bag and removed from the abdominal trocar. The diaphragm was repaired by running suturing. The operation time was 260 minutes and estimated blood loss was 30 mL. The patient was discharged on postoperative day 5 with normal liver function. No complications arose.

Total TH may be inappropriate for malignant liver tumors due to the limitation of IUSO for the whole liver. The 2-step modified TH is technically feasible and suitable for malignant liver tumors located in segments VII or VIII.

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Abbreviations: AFP = alpha-fetal protein, CT = computed tomography, HBV = hepatitis B virus, HCC = hepatocellular carcinoma, ICG = indocyanine green, IUSO = intraoperative ultrasonography, LH = laparoscopic hepatectomy, TH = thoracoscopic hepatectomy.

BACKGROUND

Although laparoscopic hepatectomy (LH) has proved a safe and effective approach for most patients with liver tumors,¹ for tumors located in segments VII or VIII, it may not be always feasible. Due to the difficulty of locating and manipulating tumors in these segments, the risks of intraoperative bleeding and conversion are high when performing LH for segments VII or VIII.² Previous studies^{3,4} have reported thoracoscopic hepatectomy (TH) for malignant liver tumors, including hepatocellular carcinoma (HCC) and metastatic liver tumors, but it is technically difficult to perform intraoperative ultrasonography (IUSO) for the whole liver via a thoracic approach. IUSO is commonly considered a necessary step to exclude intrahepatic metastasis or satellite lesions. As a result, total TH may be inappropriate for malignant liver tumor resection. We here report the first case of modified TH in China.

CASE REPORT

Patient

A 26-year-old man was admitted to the Liver Surgery Department of West China Hospital with a 10-year hepatitis B virus (HBV) infection history and a suspicious liver mass found by upper abdominal ultrasonography. Preoperative CT evaluation revealed a 1.2 cm × 0.9 cm mass located in segment VIII, beneath the diaphragm, along with liver cirrhosis and portal hypertension (Figure 1A and B). Laboratory tests showed that AFP was 444 ng/mL and HBV-DNA levels were normal. The preoperative Child-Pugh Grade was (A, 6), whereas an ICG-15 test yielded 2.7%. Preoperative diagnoses were HBV-related liver cirrhosis and HCC. The indications for TH were: (1) difficult tumor location; (2) a young patient with good resilience; and (3) HCC. Results of the preoperative evaluation were presented to the ethics committee of West China Hospital, Sichuan University. The surgical team stated that TH had not previously been performed in our medical center. The feasibility and advantages of TH, as well as the risks and possibility of conversion to laparotomy, had been explained to the patient and his family. Informed consents were obtained from the patient himself and his parents after a full explanation of the potential risks of TH. The West China Hospital administration and the ethics committee authorized the surgery.

Surgical Procedure

We modified TH into 2 steps:

Step one: laparoscopy was performed under CO₂ pneumoperitoneum. The insufflation pressure was set at 13 mmHg.

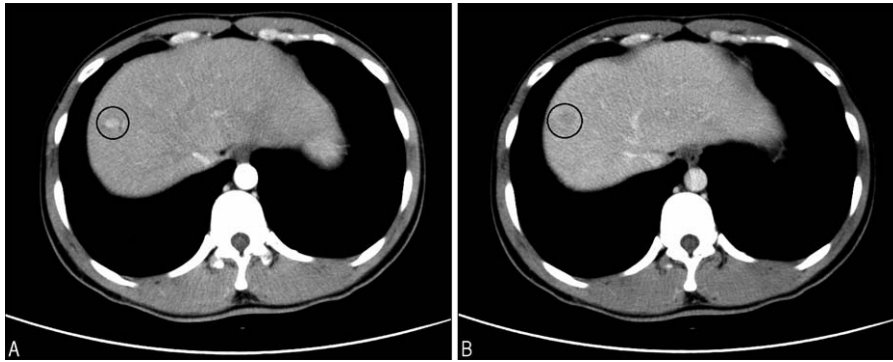


FIGURE 1. Preoperative CT: (A) arterial phase; (B) portal venous phase. CT = computed tomography.

The patient was placed in a supine position. The surgeon stood at the patient’s right side and the scopist stood at the patient’s left side. Two 12-mm trocars (Ethicon Endo-Surgery, Cincinnati, OH) were used (Figure 2A). IUSO was used to precisely locate the tumor and exclude intrahepatic metastasis and satellite lesions (Figure 3A and C). The tumor was marked by cautery (Figure 3B), and the hepatoduodenal ligament was hanged over using the Pringle maneuver (Figure 3D).

Step two: the CO₂ pneumoperitoneum was stopped. The patient was then placed in the left-lateral position under general anesthesia with single-lung ventilation. Three 12-mm (Ethicon Endo-Surgery, Cincinnati, OH) trocars were inserted into the right chest (Figure 2B). The trocars’ positions were as follows: (A) for the scopist, the posterior axillary line, 7th intercostal space (ICS); (B) for manipulating, the middle axillary line, 8th ICS; (C) for manipulating, the anterior axillary line, 6th ICS. The intrathoracic space was observed using a regular 10-mm rigid scope (Olympus, Tokyo, Japan) (Figure 4A). The diaphragm was transected by ultrasonic shears (Ethicon Endo Surgery, Cincinnati, OH) (Figure 4B and C) and retracted to expose the liver segment. IUSO (Hitachi Aloka, Ltd., Tokyo,

Japan) was used on the liver surface again to confirm the tumor position (Figure 4D).

For the resection, with the Pringle maneuver (once every 10 minutes), the superficial portion of the liver was transected by ultrasonic shears (Harmonic scalpel, Ethicon Endo-Surgery, Inc., Cornelia, GA) (Figure 5A), whereas the deeper tissue and vessels were transected by laparoscopic LigaSure (LigaSure 5-mm BluntTip™, Covidien, Boulder, CO) (Figure 5B). Bipolar (Erbe Elektromedizin, Germany) was used for hemostasis (Figure 5C). The specimen was put into a retrieval bag and removed from the abdominal cavity using a 12-mm trocar. The diaphragm was repaired by running suturing (Figure 5D). A closed thoracic drainage was placed into the right chest, and the repaired diaphragm was checked again by laparoscopy. Finally, the modified TH for segment VIII was completed without abdominal drainage being placed.

Outcomes

The operation time was 260 minutes, and estimated blood loss was 30 mL. The patient resumed eating on postoperative day 2. A chest x-ray on postoperative day 4 showed a normal

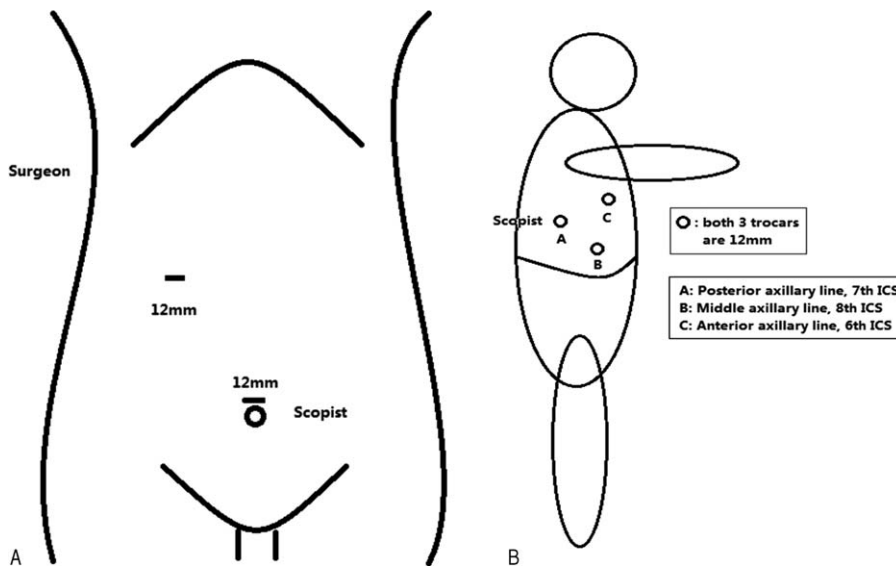


FIGURE 2. Port positions: (A) supine position; (B) left-lateral position.

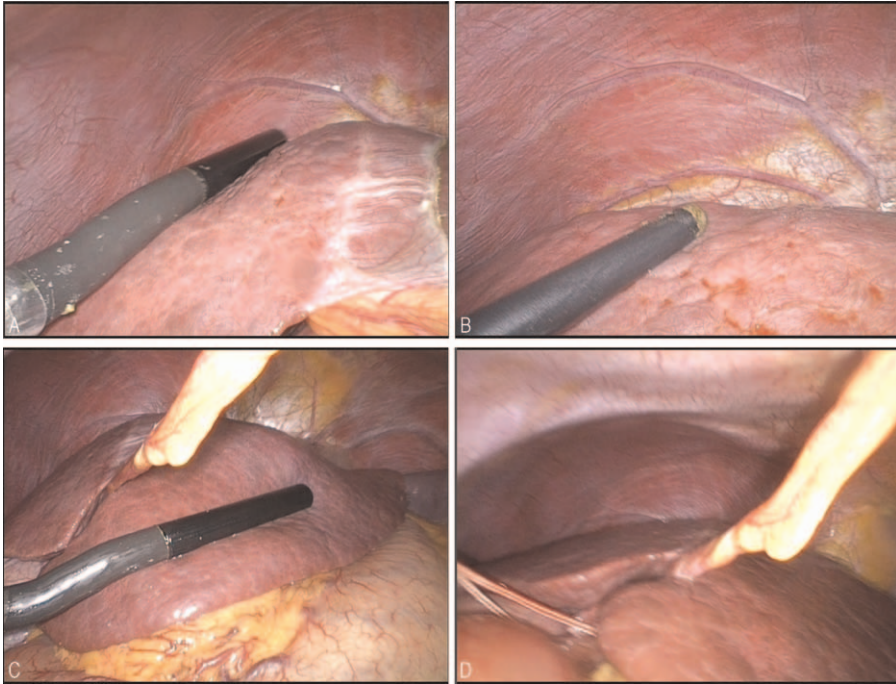


FIGURE 3. Step 1: (A) IUSO for right lobe; (B) marking by cautery; (C) IUSO for left lobe; (D) Pringle maneuver. IUSO = intraoperative ultrasonography.

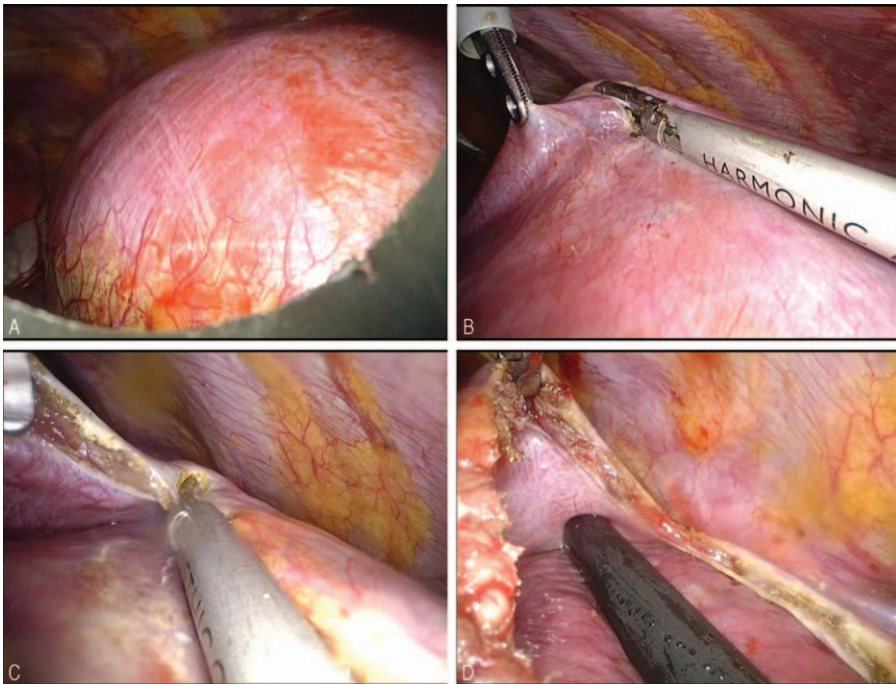


FIGURE 4. Transthoracic manipulation: (A) thoracic view of diaphragm; (B–C) transection of diaphragm by ultrasonic shears; (D) transthoracic IUSO for right lobe. IUSO = intraoperative ultrasonography.

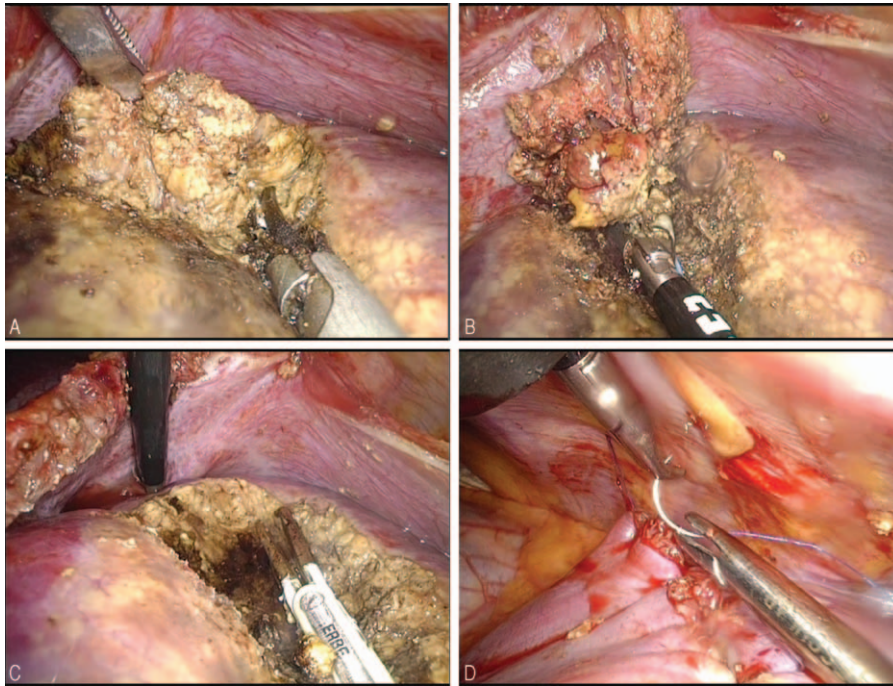


FIGURE 5. Hepatectomy (A) the superficial layer of the liver was transected by ultrasonic shears; (B) the deeper tissue and vessels were transected by laparoscopic LigaSure; (C) hemostasis was performed with bipolar probes; (D) the diaphragm was repaired by running suturing.

right thoracic cavity, and the thoracic drainage was removed. The patient was discharged on postoperative day 5 with normal liver function. No complications were encountered. Postoperative pathological testing revealed a poorly differentiated HCC without microvascular invasion. At the 6-month follow-up, there was no sign of recurrence or metastasis.

DISCUSSION

LH has proved to be a safe and technically feasible approach for liver tumor resection.¹ By 2008, laparoscopic left lateral segmentectomy was already considered the gold standard approach for lesions on segments II and III.¹ But for tumors located in segments VII or VIII, especially those fully covered by the costal cage, LH may not be the best option due to high risks of intraoperative bleeding and conversion. Previous studies have reported cases of TH for malignant liver tumors.³⁻⁶ Compared to the traditional laparoscopic view, a good exposure of segments VII and VIII can be achieved from the diaphragmatic surface after the diaphragm has been transected. Also, there is no need for mobilization of the entire right hemiliver to rotate it for exposure. And the blood supply from the right triangular and coronary ligaments can be preserved to the utmost extent to maintain postoperative liver function, especially for those with severe liver cirrhosis.

Although preoperative radiological examinations can detect and define most liver tumors, IUSO is still commonly considered a necessary step to exclude intrahepatic metastasis or satellite lesions, especially very small ones. Due to the presence of the mediastinal and falciform ligaments, the left liver lobe cannot be directly reached by IUSO. As a result, it is impossible to perform IUSO for the whole liver by a total thoracoscopic approach. For hepatic benign tumors such as

hepatic hemangioma, focal nodular hyperplasia and adenoma, total TH is theoretically applicable. But for malignant liver tumors, there may be a risk of missing tiny intrahepatic metastases when performing total TH. Therefore, performing IUSO laparoscopically before TH is essential.

During LH, hemorrhaging is always the primary concern for surgeons.⁷ The Pringle maneuver is the easiest and most common method for controlling intraoperative bleeding from the Glissons' vessels.⁸ Using a total thoracoscopic approach, it is impossible to hang over the hepatoduodenal ligament. Although most previous TH cases involved small, solitary HCC lesions located in the superficial parenchyma of the liver and it seemed that there was no need to perform the Pringle maneuver for these carefully selected patients, it should not be neglected during TH.⁸ In China, HCC is almost always accompanied by HBV-related liver cirrhosis and portal hypertension. Massive intraoperative bleeding often occurs in these patients if hepatic inflow occlusion is not performed. Therefore, a Pringle maneuver performed laparoscopically before TH is recommended.

As for those patients with a history of previous upper abdominal surgery or numerous previous abdominal interventions,^{4,6} there is a high possibility of severe adhesion around the liver and it is difficult to perform IUSO or the Pringle maneuver laparoscopically with a single trocar. Transthoracic-assisted LH might be more appropriate.

As a result, for malignant liver tumors, we modified total TH into 2 steps: (1) laparoscopic IUSO to detect the tumor and exclude intrahepatic metastasis, followed by a laparoscopic Pringle maneuver; and (2) thoracoscopic liver resection. This is the first case of modified TH in China. For select patients, the 2-step modified TH is technically feasible and suitable for malignant liver tumors located in segments VII or VIII.

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