Case Report Open Access

# A case of deeply located small hepatocellular carcinoma in cirrhotic liver treated with laparoscopic small anatomic liver resection

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## Abstract

The laparoscopic approach has weaknesses in terms of its inability to provide an adequate overview of the operative field and its lack of tactile sensation, easily leading to disorientation during surgery. This is especially true in liver resection for deeply located small tumors. Anatomic resection, which removes the portal territory of the tumor-bearing area, is recommended for treatment of hepatocellular carcinoma (HCC) because it increases the chance of removing all transportal tumor cell dissemination and secures clearance of small tumors inside the area. Preservation of residual liver volume is also required for patients with deteriorated liver function. We performed laparoscopic small (one segment or less) anatomic liver resection for a deeply located small tumor in a cirrhotic liver with preoperative three-dimensional computed tomography (3D-CT) simulation.

A 70-year-old man with hepatitis C virus-related liver cirrhosis was admitted for treatment of a lesion in liver segment 6. CT demonstrated a 1.0-cm lesion deep within segment 6 between the portal branches of subsegments 6a and 6c. The patient underwent laparoscopic anatomic liver resection of subsegments 6a and 6c using 3D-CT simulation. The deeply located small HCC was contained in the resected specimen with a negative margin, and pathological examination showed well-differentiated HCC. The patient's postoperative course was uneventful, and he was well without recurrence 26 months postoperatively.

Laparoscopic small anatomic liver resection with preoperative 3D-CT simulation facilitates removal of deeply located small tumors with an increased chance of removing transportal cancer cell dissemination, maximizing liver preservation, and achieving negative-margin resection.

**Keywords:** laparoscopic liver resection, anatomic liver resection, subsegmentectomy, hepatocellular carcinoma, liver cirrhosis

## Introduction

Since the first report of successful laparoscopic liver wedge resection in 1992,[1] laparoscopic liver resection (LLR) has been thought to be a less invasive procedure than open liver resection and especially beneficial for patients with hepatocellular carcinoma (HCC) and chronic liver disease.[2,3] Recent accumulation of experience and technological development of devices have facilitated the expansion of indications for LLR.[4-6] A comprehensive review and meta-analysis of patients with HCC and chronic liver disease, based on the Second International Consensus Conference on LLR, showed that LLR is advantageous in several aspects including reduced intraoperative bleeding, reduced morbidity (including postoperative ascites and liver failure), and a shorter hospital stay without differences in oncological outcomes.[3] Additionally, it is becoming clear that a high-quality magnified laparoscopic view from the caudal direction (especially for the hilar and dorsal areas of the liver) is beneficial in certain cases.[6-8] However, the laparoscopic approach has weaknesses in terms of its inability to provide an overview of the operative field and its lack of tactile sensation, easily leading to disorientation during surgery. This is also true during LLR for deeply located small tumors. Anatomic resection, which removes the portal territory of the tumor-bearing area, is the technique of choice for resection of HCC because of the increased chance of removing transportal dissemination of tumor cells[9] and the ability to clear small tumors inside the portal territory. Conversely, preservation of residual liver volume is required for resection of HCC in patients with deteriorated liver function.[9] We herein present a case in which we performed laparoscopic small (one segment or less) anatomic liver resection for a deeply located small tumor in a cirrhotic liver with high-quality preoperative three-dimensional computed tomography (3D-CT) simulation.

**Received** 18 July 2015, **Accepted** 16 September 2015

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## Case Presentation

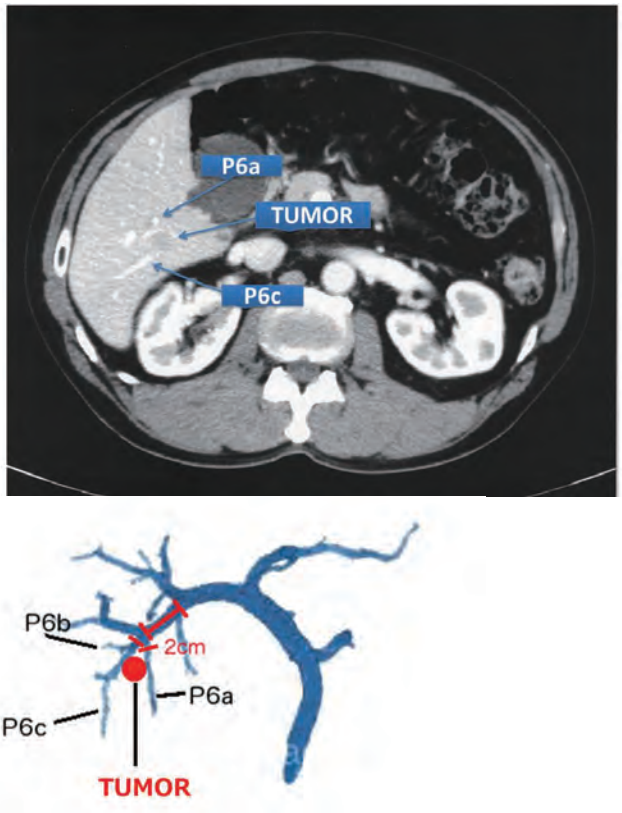
A 70-year-old man with hepatitis C virus-related liver cirrhosis (LC) was admitted to our department for treatment of a lesion in liver segment 6. The lesion had been identified on abdominal ultrasonography during the LC follow-up. He had no history of hepatic encephalopathy, hepatic ascites, or specific treatment except that for the liver disease.

The patient's laboratory data were as follows: platelet count, 84,000/μL (normal range, 131,000-362,000/μL); prothrombin time (percentage of standard value), 78% (70%-100%); plasma albumin concentration, 3.6 g/dL (4.0-5.0 g/dL); plasma cholinesterase concentration, 186 U/L (214-466 U/L); plasma aspartate transaminase, 70 IU/L (13-33 IU/L); and alanine

transaminase, 99 IU/L (6-30 IU/L). The plasma level of PIVKA-II was within the normal range, and the alpha-fetoprotein (AFP) concentration was mildly elevated at 55.2 ng/mL (0-39 ng/mL). The indocyanine green retention rate at 15 minutes was 23.1% (0%-10%).

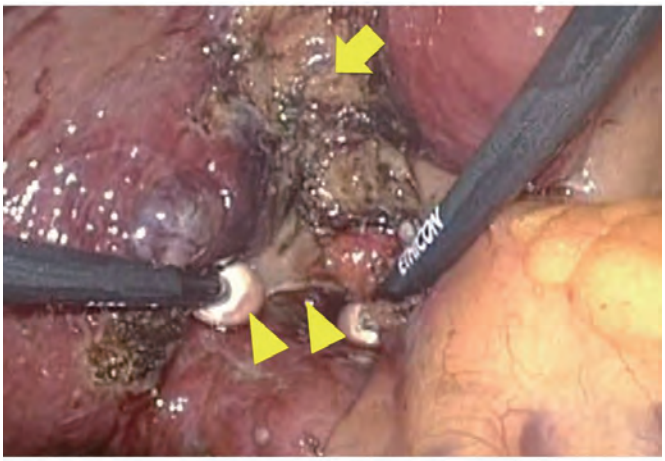
CT demonstrated a 1.0-cm low-density lesion in the deep area of liver segment 6 between the portal branches of subsegments 6a and 6c (Figure 1). The lesion was enhanced with contrast during the arterial phase, and wash-out of the enhancement was observed in the portal venous phase. The patient was scheduled to undergo laparoscopic small anatomic liver resection of subsegments 6a and 6c with a diagnosis of early HCC in a moderately cirrhotic liver to remove possible tumor cell dissemination while preserving a maximum volume of the deteriorated liver.

Figure 1



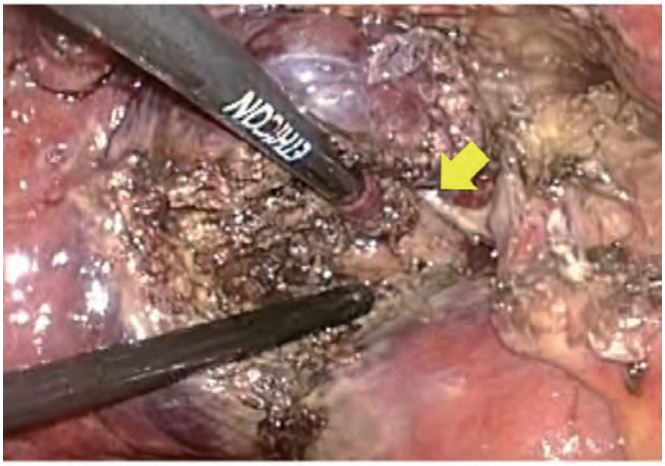

Preoperative contrast-enhanced CT image and 3D imaging of the portal vein and tumor. The preoperative contrast-enhanced CT image demonstrated a 1.0-cm low-density lesion in the deep area of liver segment 6 between the portal branches of subsegments 6a and 6c. The 6a and 6c branches diverged 2 cm distal to the bifurcation of the anterior and posterior portal branches in the hilar plate. The patient was scheduled to undergo resection of subsegments 6a and 6c (red lines: resection lines of portal branches) with preservation of subsegment 6b.
P6a: portal branch of subsegment 6a, P6b: portal branch of subsegment 6b, P6c: portal branch of subsegment 6c, TUMOR: hepatocellular carcinoma to be resected

Figure 2



Intraoperative findings-1. After cholecystectomy, the surface of the right posterior Glissonian branch was exposed in the hilar area and dissected, and the liver parenchyma of Rouviere's sulcus was opened. The arrow indicates the gallbladder bed after cholecystectomy, and the arrowheads indicate the surface of the right posterior Glissonian branch.

Figure 3

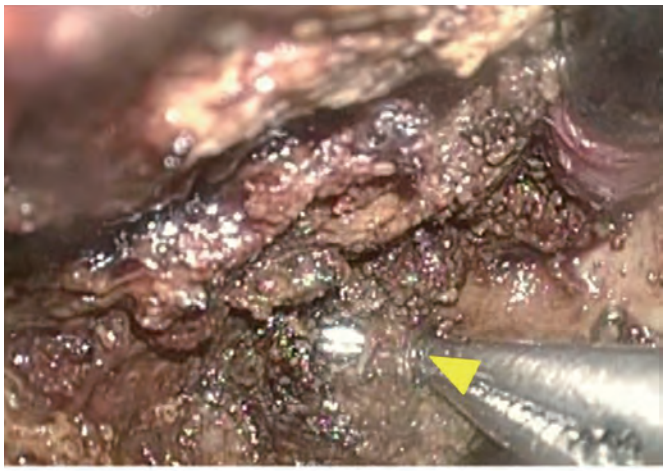


Intraoperative findings-2. A small Glissonian branch of segment 5 (arrow) that diverged from the bifurcation of the anterior and posterior branches was preserved.

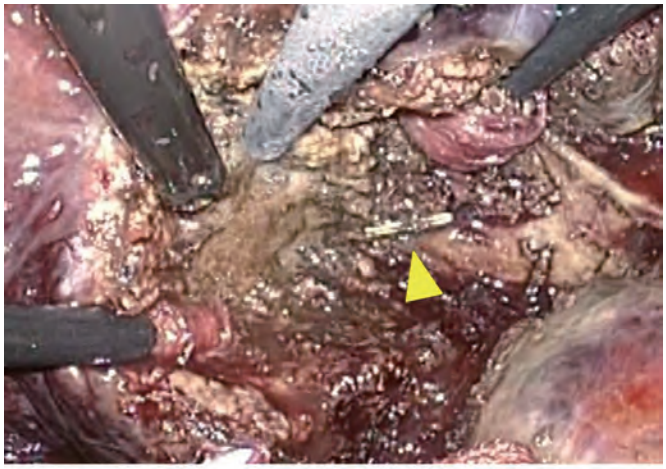
During the surgery, the patient was placed in the supine position. The first trocar port was introduced with a mini-laparotomy at the umbilicus, and 8- to 12-mmHg $CO_2$ pneumoperitoneum was established through this port. This port was also used for laparoscopy. Three other 12-mm ports and one 8-mm port were placed in the right subcostal area and used to introduce the surgeons' forceps and other devices. After the cholecystectomy, the surface of the right posterior Glissonian branch was exposed at the hilar area and dissected, and the liver parenchyma of Rouviere's sulcus was opened (Figure 2). The small Glissonian branch of segment 5 that diverged from the bifurcation of the anterior and posterior branches was preserved (Figure 3). At a point on the posterior branch 2 cm distal to the bifurcation, the 6a branch that diverged from the posterior main trunk was recognized, encircled, and divided (Figure 4). This was followed by encircling and dividing the 6c branch, which diverged from

Figure 4

(A)



(B)

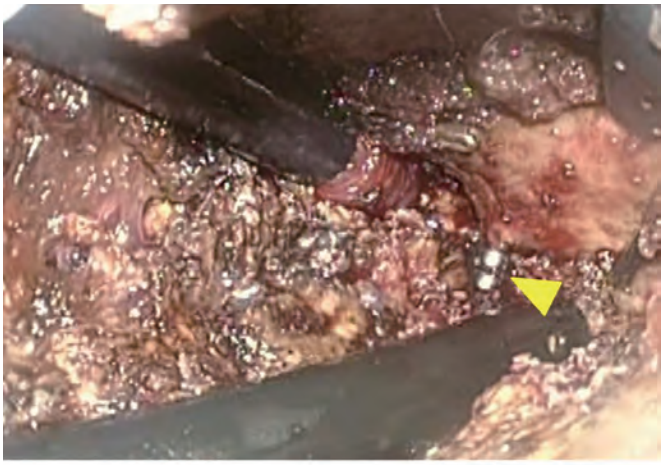


Intraoperative findings-3. At a point on the posterior branch 2 cm distal to the bifurcation, the 6a branch that diverged from the posterior main trunk (arrowhead) was (A) encircled and (B) divided.

Figure 5

(A)

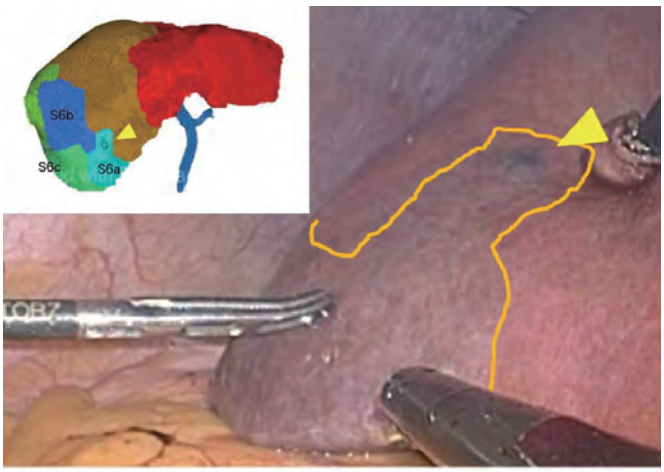
(B)



Intraoperative findings-4. After division of the 6a branch, the 6c branch that diverged from the dorsal area of the posterior branch was (A) encircled and (B) divided with preservation of the 6b branch.

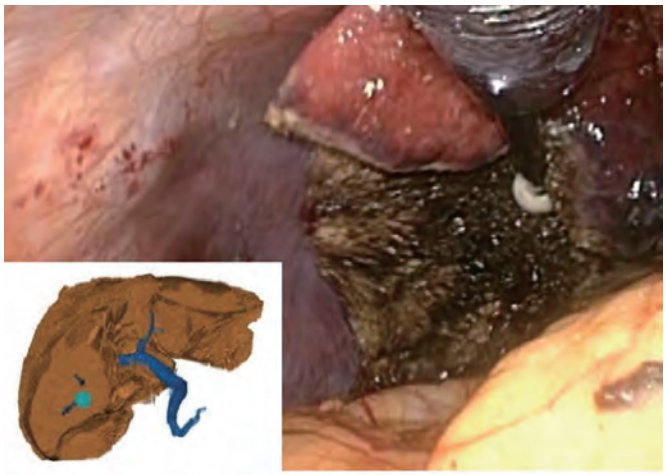
the dorsal posterior branch, while preserving the 6b branch (Figure 5). After dividing the 6a and 6c branches, the area containing the HCC was clearly recognized as ischemic (Figure 6). The shape of this area was matched to that from the preoperative 3D-CT simulation (Figure 6), and the area was resected laparoscopically (Figure 7). The operation time was 405 minutes, and the operative bleeding volume was 400 mL. The deeply located small HCC was contained within the resected specimen, which had a negative margin. Pathological examination revealed well-differentiated HCC (Figure 8). The patient's postoperative course was uneventful, and he was well without recurrence 26 months after surgery.

Figure 6



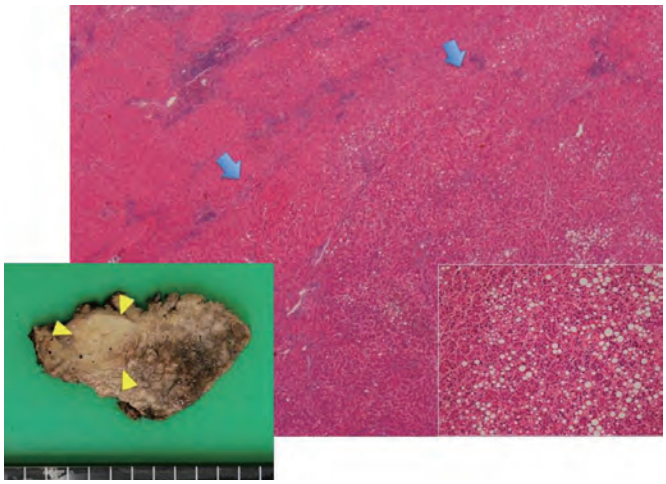

Intraoperative findings-5 and preoperative 3D-CT simulation findings (left upper). After dividing the 6a and 6c branches, the area containing the HCC was clearly recognized as ischemic (area framed with a yellow line). The shape of the area was matched to that from the preoperative 3D-CT simulation (shown as blue and green areas in the left upper figure of the preoperative 3D-CT simulation). The arrowheads show the cyst inside the area.
S6a: subsegment 6a, S6b: subsegment 6b, S6c: subsegment 6c

Figure 7



Intraoperative findings-6 and preoperative 3D-CT simulation findings (left lower). The area of subsegments 6a and 6c containing the HCC (ischemic area) was resected laparoscopically. The small blue lesion in the left lower figure (preoperative 3D-CT simulation) is the HCC, and the dark blue lines in the resected area show the resected portal vein branch of 6a and 6c.

Figure 8



Resected specimen (left lower) and pathological findings (X40, X200; right lower). The deeply located small HCC was contained within the resected specimen with a negative margin, and pathological examination revealed well-differentiated HCC.

## Discussion

Intrahepatic metastasis of HCC along the portal vein is the basis for anatomic liver resection,[10] which involves complete removal of the tumor-bearing portal territory. Anatomic liver resection has the potential to remove undetected cancerous foci (portal vein metastases and satellite nodules) that have disseminated from the main tumor inside the portal territory. Several studies have demonstrated that significantly better overall and disease-free survival can be achieved with anatomic liver resection for small solitary HCC than with limited resection, without increasing the postoperative risk.[11,12]

However, preservation of residual liver volume is required for resection of HCC in patients with deteriorated liver function.[9] Small (one segment or less) anatomic liver resection for deeply located HCC in a cirrhotic liver is a possible solution for both complete removal of tumor cells that may have disseminated into the tumor-bearing portal territory and maximum preservation of the liver parenchyma, which may avoid liver failure induced by a too-small remnant liver with severe chronic injury. Although a hilar approach with individual vessel dissection and preparation is used for large anatomic liver resection, this procedure cannot be applied to small anatomic resection because of the difficulty dissecting the small vessels inside the liver parenchyma.[6] Instead, the Glissonian approach, which involves handling of the portal vein, hepatic artery, and hepatic duct as a bundle within the Glissonian sheath, is used for small anatomic resection.[13] However, it is difficult to recognize the small portal territory and perform the resection, even in open liver resection. The use of dye[14] and indocyanine green fluorescence[15] to identify the portal territory in small anatomic liver resection is reportedly helpful.

There are additional obstacles in LLR. The loss of tactile sensation and lack of overview of the whole operative field easily leads to disorientation. This increases the difficulty of handling small, deeply located tumors and ensuring resection with a negative surgical margin. Small anatomic LLR for deeply located HCC may also solve this problem (i.e., when the portal territory containing the tumor is resected, removal of the small, difficult-to-recognize tumor is secured). We used high-quality preoperative 3D-CT simulation and navigation combined with the Glissonian approach in the present case.

3D-CT-assisted preoperative surgical planning allows for determination of resectability and changes to the operative strategy (resection modifications/extensions, intrahepatic vascular reconstruction, study of the portal distribution and hepatic vein anatomy for adequate venous drainage, and study of the biliary distribution to avoid biliary fistula).[16] Preoperative surgical planning that incorporates imaging is particularly helpful for procedures requiring unconventional resection planes and/or involving central tumors. It also allows for the adaptation of subsegment or sub-subsegment anatomic liver resection for deeply located small tumors in highly injured livers. In the present study, we divided the liver parenchyma on an anatomical landmark (Rouviere's sulcus) and dissected the Glissonian pedicle to its peripheral aspect in the first step. We then examined the bifurcations of the targeted portal territories (subsegments 6a and 6c) and encircled and divided the roots of the branches on the dissecting Glissonian pedicle. Thereafter, subsegments 6a and 6c, which contained the HCC, were recognized as the ischemic area and easily resected laparoscopically. This case suggests that small anatomic liver resection with preoperative 3D-CT simulation and the Glissonian approach facilitates the removal of possible dissemination of cancer cells, preservation of a maximum amount of chronically injured liver parenchyma, and achievement of negative-margin resection for deeply located small tumors in LLR. The difficulty level of this approach differs according to the location of the tumor. Small anatomic resection of subsegments 7a, b, and c and 8b and c should be technically more demanding due to poor accessibility to these areas and the root of the Glissonian pedicle. Several reports have described LLR for tumors in the posterior section performed in the left lateral or semiprone position.[7,17] Postural changes under the laparoscopic-specific view are key to improving accessibility to such locations. Additionally, the extrahepatic approach (dissection from the

hilar plate to the peripheral Glissonian pedicle) or intrahepatic approach (with prior liver transection under guidance with a combination of preoperative CT simulation and intraoperative ultrasonography) to the root of the Glissonian pedicle should be evaluated and discussed for each individual case when performing such resections. Further study on this topic is needed.

## Conflict of interests

The authors have no conflict of interest to declare.

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