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## Mirror Image Hepatectomy in a Patient with Situs Inversus Totalis

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### Abstract

**Background** : Hepatectomy in a patient with situs inversus patient is technically challenging because of its complete mirror image anatomy, especially for a tumor located deep in the liver. Incorrectly identifying intrahepatic vessels and biliary system would lead to serious complications. We experienced a hepatectomy for a tumor in a patient with situs inversus totalis with referring to computer-generated mirror images.

**Methods** : A 66-year-old female patient with situs inversus totalis was diagnosed with hepatocellular carcinoma, 5 cm in diameter, centrally located just above the hepatic hilum compressing the right and left hepatic duct. The liver infected with hepatitis C was cirrhotic with a moderate amount of ascites. We preoperatively created several diagrams of the mirror image anatomy and made plans for how to resect this tumor, presupposing the patient had an ordinary anatomy. The tumor was successfully enucleated with referring to these diagrams.

**Results** : The operation time was 454 minutes. Five units of fresh frozen plasma was transfused intraoperatively. Although she suffered refractory ascites which needed repeated paracentesis, she managed to leave the hospital two months after the operation.

**Conclusion** : Creating a mirror image anatomy enables surgeons to safely perform a complex hepatectomy in a patient with situs inversus totalis.

**Key words** : Situs inversus totalis · Hepatectomy · Hepatocellular carcinoma · Mirror image

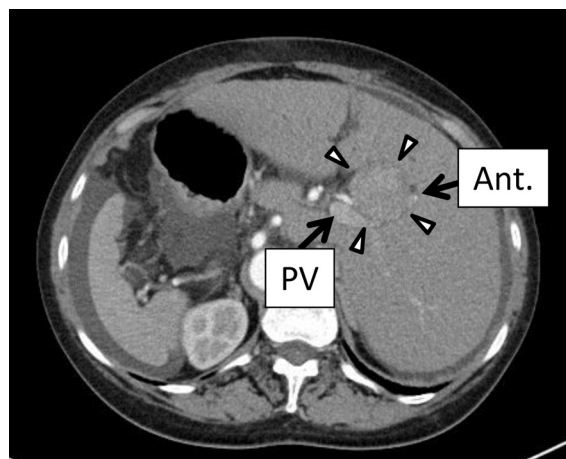
### Introduction

Resecting a hepatic tumor in patients with situs inversus totalis is technically challenging because they have a complete mirror image anatomy<sup>1)–4)</sup>, especially when the tumor was located deep in the liver. If intrahepatic vessels and biliary system were incorrectly identified in such patients, serious complications would ensue. We performed a hepatectomy for a tumor located just above the hepatic hilum compressing the right and left

hepatic ducts in a situs inversus totalis patient. Preoperatively creating mirror images of the liver helped us easily recognize these intrahepatic structures.

### Case Report

A 66-year-old female with situs inversus totalis was diagnosed as having a hepatocellular carcinoma, 5 cm in diameter, located deep just above the hepatic hilum (Fig. 1). The tumor compressed the right and left hepatic duct. In order to simply



**Fig. 1** A : Contrast-enhanced CT of the patient  
The tumor was located deep just above the hepatic hilum compressing the inverted right and left hepatic ducts. There was a moderate amount of ascites.  
Ant., the inverted anterior branch of the right portal vein ; PV, the portal vein

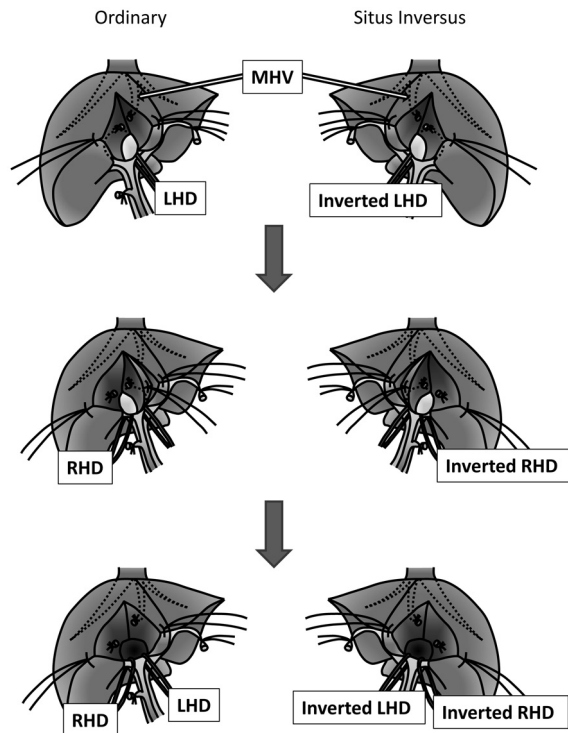
**Table 1** Preoperative laboratory data of the patient

items	preoperative value	normal range
total bilirubin (mg/dl)	1.53	0.30-1.20
aspartate aminotransferase (IU/L)	90	13-33
alanine aminotransferase (IU/L)	61	6-30
alkaline phosphatase (IU/L)	893	115-359
albumin (g/dl)	3.5	4.0-5.0
white blood cell (/ $\mu$ l)	4100	4000-8000
hemoglobin (g/dl)	11.7	11.3-14.9
platelet ( $\times 10^3$ / $\mu$ l)	124	120-380
prothrombin time (%)	80	70-140
indocyanine green dye retention at 15 minutes (%)	22	0-10
alphafetoprotein (ng/ml)	57.7	0.0-20.0
des-gamma-carboxy prothrombin (mAU/ml)	314	0.0-40.0

understand the anatomy of this patient, we called the left-sided hepatic duct the inverted right hepatic duct, and the right-sided hepatic duct the inverted left hepatic duct. The liver which had been infected with hepatitis C virus was in a condition of decompensated cirrhosis with a moderate amount of ascites. The preoperative laboratory data are summarized in Table 1. Although we suggested that only a liver transplant would yield a long-term prognosis, she stubbornly refused to undergo a transplant and hoped for the resection of the tumor. We performed an enucleation hepatectomy after the

ascites was controlled by diuretics and albumin administration. We preoperatively created diagrams of the mirror image anatomy, presupposing she had an ordinary anatomy (Fig. 2).

On entering the abdominal cavity, the liver was substantially cirrhotic and there was still a moderate amount of ascites. Intraoperative ultrasound confirmed a deep located tumor just above the hepatic hilum compressing the inverted right and left hepatic ducts and just under the middle hepatic vein. First, the liver was divided along the Cantlie line in order to expose the right side of the tumor. During the parenchymal transection, the



**Fig. 2** Diagrams of hepatic anatomy of the patient (right-hand) and mirror image diagrams (left-hand)

The left-hand diagrams are the mirror images of hepatic anatomy of this situs inversus totalis patient. These diagrams depict ordinary hepatic anatomy.

LHD, the left hepatic duct ; MHV, the middle hepatic vein ; RHD, the right hepatic duct

middle hepatic vein was encountered and it was ligated and divided. Once the right side of the tumor was exposed, the tumor was freed from the surrounding liver parenchyma along the tumor capsule. The inverted right and left hepatic ducts were individually encircled with a tape. These ducts were sharply freed from the tumor using scissors. Then, a new plane of parenchymal transection was created in order to expose the left side of the tumor. After the left side of the tumor was exposed, the caudal portion of the tumor was sharply dissected from the surrounding liver parenchyma, then the tumor was taken out of the surgical field. The operation time was 454 min. and the intraoperative blood loss was 1427g (including ascites). Five units of fresh frozen plasma was transfused intraoperatively.

The patient postoperatively suffered refractory

ascites which needed repeat paracentesis. Nonetheless, she managed to return to her home two months after the operation.

## Discussion

Surgeons obtain their surgical skills mainly through tactile and visual perception. In performing a surgery in a patient with situs inversus totalis, these perceptions have to change to a complete mirror image, which makes surgeons confused and may lead to incorrect identification of intrahepatic vessels and, as a result, to serious complications. We preoperatively drew the mirror image diagrams of the hepatic anatomy of this patient and made the operative plan about how to resect the tumor. First, we imagined how the tumor could be resected using the mirror image diagrams, presupposing the patient had an ordinary anatomy. For convenience, we called the left-sided hepatic artery (the right hepatic artery in an ordinary anatomy) the inverted right hepatic artery, the right-sided artery (the left hepatic artery in an ordinary anatomy) the inverted left hepatic artery. Similarly, the left-sided hepatic duct was called the inverted right hepatic duct and the right-sided hepatic duct was called the inverted left hepatic duct. Then, we imagined the actual procedures using the true diagrams of hepatic anatomy of this patient. Fortunately, the patients had no hepatic vascular and biliary anomalies. These were complete mirror images of an ordinary anatomy. Patients with situs inversus totalis often have anomalies of their vascular and biliary systems<sup>5)</sup>. Precise preoperative imaging and planning are crucial for resecting hepatic tumors in such patients.

Recent advancements of computer graphics have enabled even surgeons to easily create anatomical diagrams and generate mirror images by simply clicking a reverse button on a computer. Once we created these diagrams, preoperative planning of the procedures could be easily accomplished. Then, we could safely enucleate the tumor even though it was located

deep in the liver.

In conclusion, creating a mirror image anatomy enables surgeons to safely perform a complex hepatectomy in a patient with situs inversus totalis.

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(和文抄録)

## 鏡面画像を利用した完全内臓逆位患者に対する肝切除の1例

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**【背景】** 完全内臓逆位患者に対する肝切除は、通常解剖とは完全に鏡面の解剖となるため、特に腫瘍が肝臓の深部に存在する場合には技術的に困難である。肝内脈管や胆道系の誤認は重篤な合併症に繋がる恐れがある。今回我々は完全内臓逆位患者に対する肝切除を、コンピュータで作成した鏡面画像を利用しながら行った1例を経験したので報告する。

**【方法】** 症例は66歳女性で、C型肝炎の経過観察中、肝門部直上の深部に存在する、左右肝管を圧迫する5cmの肝細胞癌を指摘された。肝臓は中等量の腹水を伴う肝硬変で、肝移植を提示したが拒否され、切除を強く希望した。術前に複数の鏡面画像をコンピュータで作成し、通常解剖と仮定した上での手術計画を立てた。この鏡面画像を参照しながら腫瘍を核出した。

**【結果】** 手術時間は454分で、術中5単位の新鮮凍結血漿を輸血した。術後は難治性腹水を合併し、腹水穿刺を必要としたが、術後2か月で自宅退院した。

**【結語】** 完全内臓逆位患者に対する肝切除を行う際、鏡面画像を作成することは、日ごろ親しんでいる通常解剖で手術計画を立てることができ、複雑な肝切除もより安全に手術を行うことが可能となる。