Three-Dimensional Computed Tomography Image Based Endovascular Treatment for Hepatic Vein

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Abstract

Along with the expansion of living donor liver transplantation, whereby hepatic venous anastomosis is mandatory, the frequency of hepatic venous stenosis that need interventional treatment is increasing. Due to its anatomical features, there are several pitfalls in the process of endovascular intervention for hepatic vein. Insufficient information of and around the hepatic vein may lead to miss-diagnosis of target lesion. Simulation by using three-dimensional computed tomography images was useful in planning the direction of X-ray projection and, as a consequence, contributed to safe endovascular treatment for hepatic venous stenosis.

Key words: Simulation・Hepatic vein・3D-CT

Introduction

Endovascular treatment is an effective treatment option for hepatic venous stenosis after liver surgery including liver transplantation and extended hepatectomy. Along with the expansion of living donor liver transplantation, whereby hepatic vein anastomosis is mandatory, the frequency of hepatic venous stenosis that need interventional treatment is increasing[1)2)]. Here we report the usefulness of the simulation for hepatic venous intervention by using three-dimensional (3D) computed tomography (CT).

Case Presentation

A 46-year-old man who underwent extended right hepatectomy for a treatment of intrahepatic cholangiocellular carcinoma complicated with chronic liver failure after the surgery. The patient showed hyperbilirubinemia and refractory ascites.

Assessment of hepatic venous flow by spectral Doppler ultrasound revealed monophasic waveform, suggesting the presence of hepatic venous stenosis. The patient subsequently underwent a cathetelization into hepatic vein (HV) via right jugular vein. Although hepatic venography with anteroposterior view could not clearly depict the hepatic venous stenosis (Fig. 1A), the pressure gradient between HV and right atrium (RA) was elevated to 13.2 mmHg. Thus, we had confirmed the presence of HV stenosis[3)].

Before undergoing endovascular treatment, 3D-CT image simulation was performed. Volume rendering images were generated using Advantage Workstation software (GE Healthcare). The region of interest (ROI) was placed at HV and inferior vena cava (IVC). Because remaining single HV was directed anteriorly with slight caudal inclination from the confluence of IVC, the

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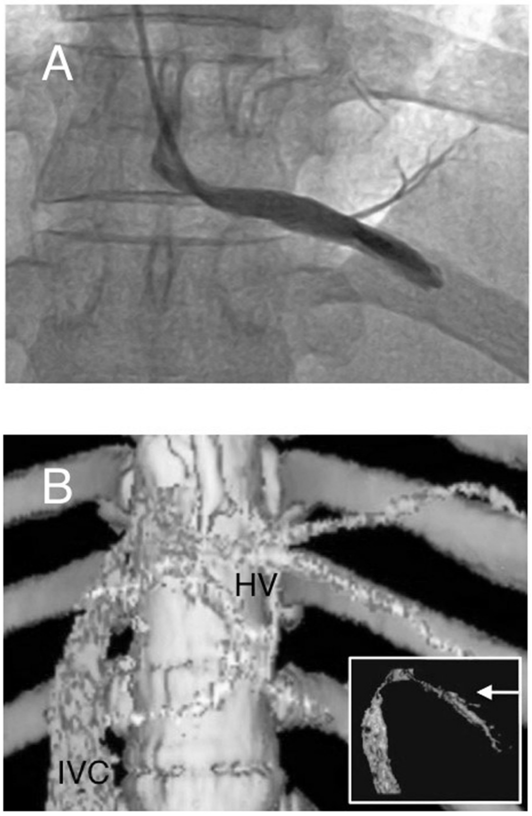

Fig. 1 (A) Hepatic venography with anteroposterior view. The stenotic site could not clearly visualized from this study. (B) Three-dimensional CT image of hepatic vein and inferior vena cava with anteroposterior view. Image on right-lower corner is the view from right side. Arrow indicates the axis of anteroposterior view. HV, hepatic vein ; IVC, inferior vena cava.

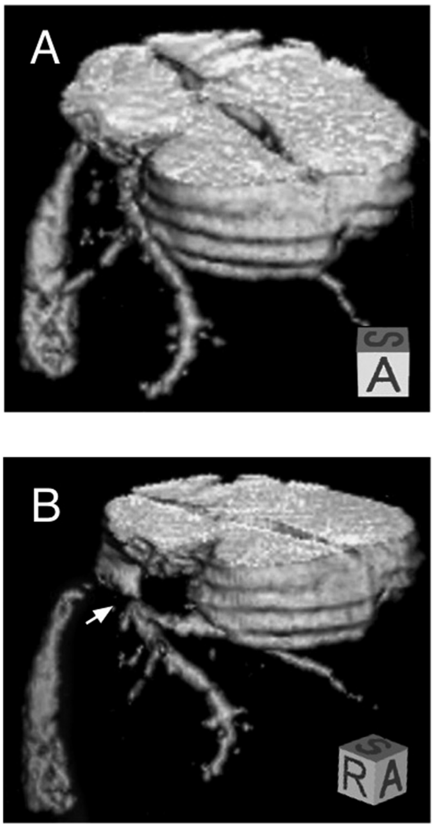

Fig. 2 (A) Three-dimensional CT image of hepatic vein from superoanterior. The root of hepatic vein was hidden by overlaid cardiac shadow. (B) Viewing angle was further declined to right-anterior oblique, and then, the stenosis of hepatic vein at its root became evident (arrow).

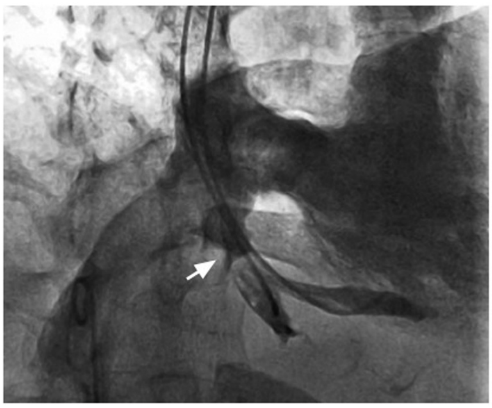

Fig. 3 Hepatic venography was performed from right-superoanterior view based on previous 3D-CT simulation. Arrow indicates the stenotic site at the root of hepatic vein.

stenosis of HV could not be visualized by 3D-CT image with anteroposterior view, which is near tangential to hepatic venous axis (Fig. 1B). When HV was looked down from superoanterior in order to view the HV at near a right angle against its axis, then HV was hidden by overlaid cardiac shadow (Fig. 2A). Further declination the angle to right-anterior oblique enabled visulalization of the stenosis at the root of HV (Fig. 2B).

After obtaining written informed consent from the patient, endovascular treatment was performed. Based on previous 3D simulation, hepatic venography was performed with the axis of X-ray projection inclined 10 degrees to superoanteriorly, and further 30 degrees to right-anteriorly. Under this condition, the stenotic site was clearly visualized by hepatic venography (Fig. 3).

Two self-expandable metallic stent (Luminexx, BARD, Covington, GA) with a diameter of 8 mm were successfully placed into the HV by using stent-in-stent technique. The pressure gradient across the HV and RA was decreased to 3 mmHg after stent placement. The Doppler ultrasound study at 3 weeks after stent placement showed an increased hepatic venous flow velocity and a pulsatile venous waveform. Along with the normalized bilirubin level, the ascitic fluid volume was also decreased favorably after the stent placement. Thus, the patient had recovered from liver failure.

Discussion

An adequate hepatic venous drainage is prerequisite for the recovery process of damaged liver. Hepatic venous complications are not uncommon following liver transplantation or hepatic resection[2)4)]. The definitive diagnosis of HV stenosis is made by hepatic venography or measurement of pressure gradient across the stenosis. As the initial treatment option for HV stenosis, endovascular balloon angioplasty or stent placement has been widely advocated[1)]. From the experience of this reported case, the presence of several pitfalls in the interpretation of hepatic venography was disclosed. At first, the antero-posterior view of left hepatic venography could not clearly depict the stenosis at its root. This phenomenon was thought to be attributable to the tangential relationship between the HV and X-ray projection axis. This trick was easily resolved when 3D-CT image was evaluated. PC workstation enables the assessment of 3D images from any direction, and help in deciding the most suitable direction for observation of the target lesion. The root of left hepatic vein was directed anteriorly with slight caudal inclination from the confluence of IVC. Therefore, it could be most clearly visualized when looked down from superoanterior direction. Second pitfall was that, because the root of hepatic vein was placed very close to the heart, its shadow might interfere the visualization of the part of HV. This is especially relevant to the case of the left hepatic vein. Such problem could also be resolved by simulation using 3D-CT images in advance. The hepatic venography under an adequate positioning based on previous 3D-CT simulation was useful not only in establishing the precise diagnosis but also for execution of the planned treatment. Miss-placement of the metallic stent would lead not only to therapeutic ineffectiveness but also to serious complication such as stent migration into the right atrium. Therefore, understanding and exposure of the entire morphology of target lesion are imperative in executing the endovascular intervention for HV.

In conclusion, the simulation by using 3D-CT images of HV was useful in planning the direction of X-ray projection in advance and, as a consequence, contributed to safe and smooth execution of endovascular treatment for HV.

Conflicts of interest : No conflicts of interest exist

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（和文抄録）

3D-CT 画像情報をもとにした肝静脈に対する血管内治療

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肝静脈吻合が必須の手技である生体肝移植術症例の増加に伴い，術後の肝静脈狭窄に対して経静脈的治療が必要となる症例が増えつつある．肝静脈はその解剖学的位置の特性により，経静脈的治療を行うにあたりいくつかのピットフォールが存在する．不十分な情報のもとに治療を行えば治療効果が得られないのみならず，合併症の発症にもつながる．三次元画像に基づいた治療前シミュレーションが安全で効果的な経静脈的肝静脈ステント治療に有効であったので報告する．