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## Case Report

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# Anatomical Hepatic Resection of Segment VIII with Preoperative 3-Dimensional Volumetry using Synapse Vincent and Ultrasound-Guided Vessel Compression : Report of a Case

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### Abstract

We report a case of 90-year-old patient who underwent preoperative 3-dimensional (3D) computed tomography (CT) volumetric analysis using SYNAPSE VINCENT imaging software and anatomical resection of segment VIII using ultrasound-guided vessel compression. Preoperative abdominal CT revealed a liver mass measuring 5.0 cm in diameter, and the patient was diagnosed with hepatocellular carcinoma. Liver function was preserved. Preoperative 3D volumetry using SYNAPSE VINCENT revealed the volume of the entire liver to be 1,339 mL and the volume of segment VIII to be 327 mL. Anatomical hepatic resection of segment VIII was performed using ultrasound-guided vessel compression. Operative duration was 372 min and estimated blood loss was 760 mL. Resected liver volume was 290 g. The patient's postoperative course was uneventful, and there has been no evidence of recurrence since the surgery.

**Key words :** Anatomical resection · Hepatocellular carcinoma · Preoperative volumetry · Intraoperative ultrasonography

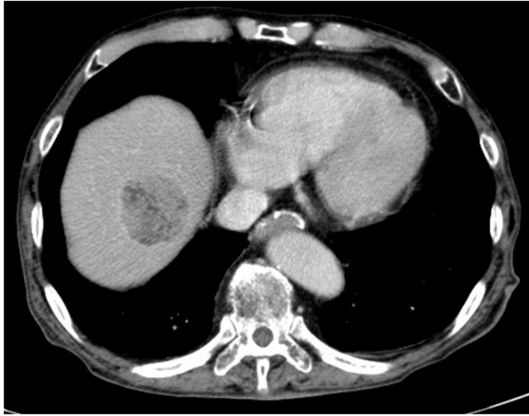
### Introduction

Hepatic resection has been established an effective treatment for hepatocellular carcinoma (HCC)<sup>1)~3)</sup>. For liver parenchymal transection, various surgical techniques have been developed to reduce surgical blood loss<sup>4)~6)</sup>. Computed tomography (CT) volumetry is a critical part of preoperative evaluation to prevent liver failure after hepatic resection<sup>7)~9)</sup>. A high-speed 3-dimensional (3D) image analysis system (SYNAPSE VINCENT ; Fuji Photo Film Co., Ltd., Tokyo, Japan) has recently been developed that calculates liver volume and is capable of simply, quickly, and accurately extracting each vessel

territory in the liver using contrast-enhanced CT images and displaying 3D images<sup>10)</sup>. Some reports have described hepatic resection for elderly HCC patients<sup>11)12)</sup>, but there have been no such reports on the extremely elderly, such as a 90-year-old patient, with HCC. We report the case of a 90-year-old man who underwent successful anatomical hepatic resection of segment VIII for HCC with ultrasound-guided vessel-compression technique and preoperative 3D volumetry using SYNAPSE VINCENT.

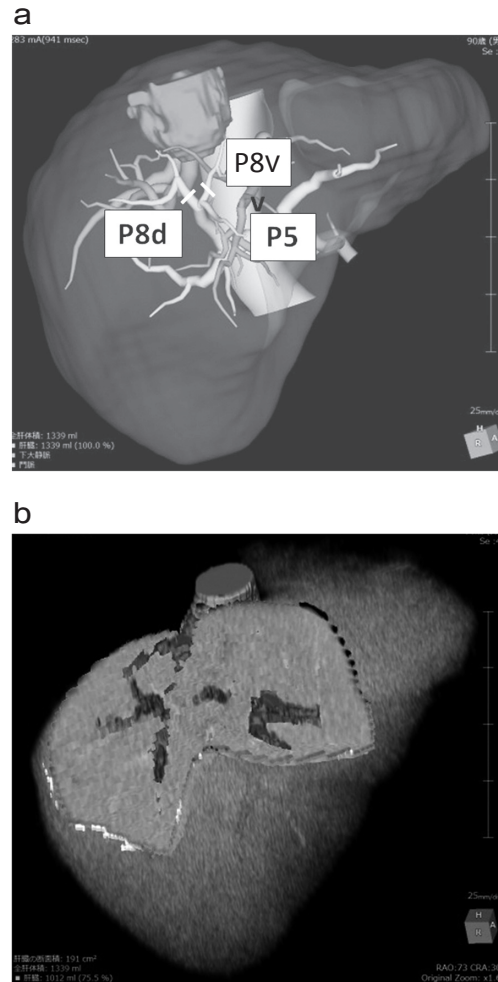
### Case Report

A 90-year-old man was admitted to Tagawa Municipal Hospital with complaints of cough and



**Fig. 1** Computed tomography showing a peripherally enhanced low-density mass 5 cm in diameter located in segment VIII in the right lobe of the liver.

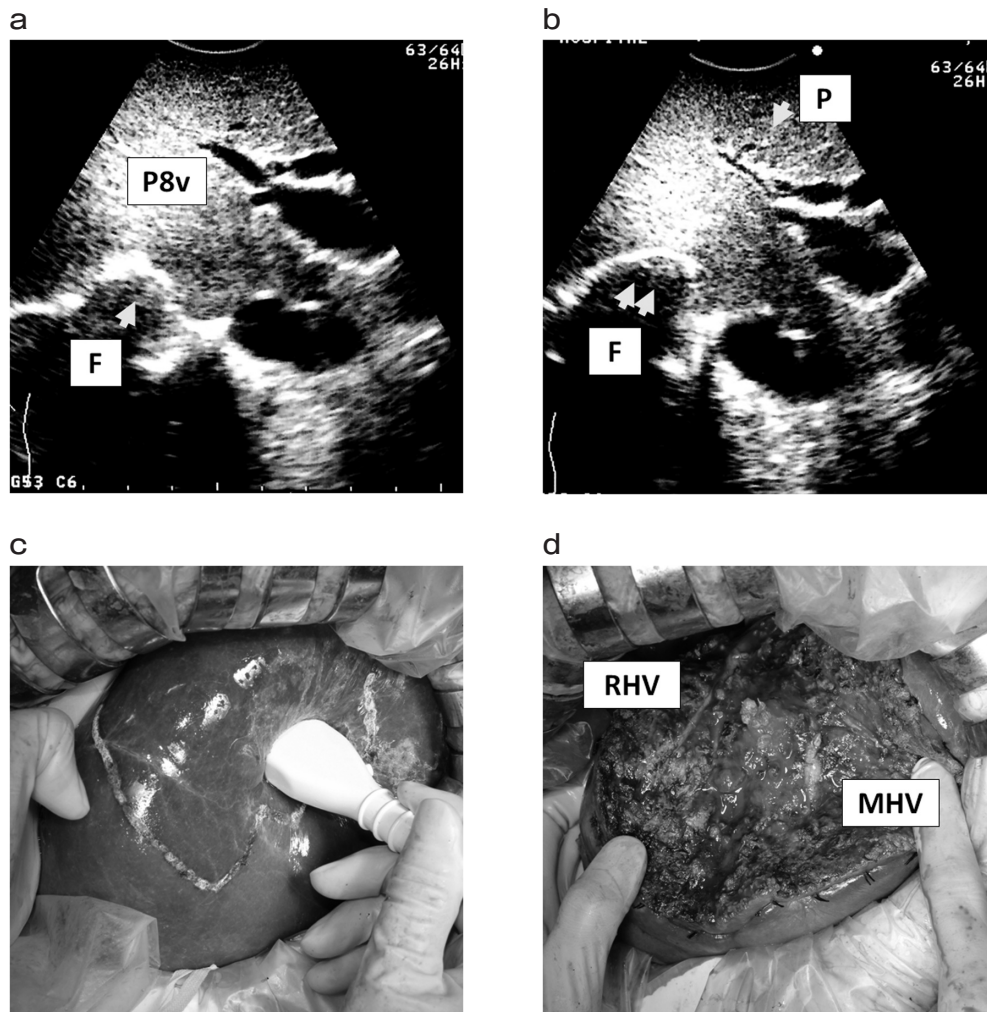
intermittent fever. His medical history revealed that he had undergone total gastrectomy with splenectomy and cholecystectomy for the treatment of gastric cancer 20 years prior to admission. Chest x-ray revealed a consolidation, and laboratory examination revealed an elevated white blood cell count. The patient was diagnosed with pneumonia and treated with an antibiotic. After resolution of the pneumonia, he underwent follow-up examination. An abdominal CT scan with contrast revealed an enhancing mass 5 cm in diameter in segment VIII of the right liver lobe (Fig. 1). Laboratory data were as follows : white blood cell count,  $6,500/\mu\text{L}$  ; platelet count,  $26.8 \times 10^4/\mu\text{L}$  ; total bilirubin, 0.2 mg/dL ; albumin, 3.4 g/dL ; prothrombin time, 95.3% ; indocyanine green retention rate at 15 minutes (ICGR15), 6.1% ;  $\alpha$ -fetoprotein, 685.5 ng/mL ; des-gamma-carboxy prothrombin, 1,530 mAU/mL ; and a positive hepatitis C virus antibody. These findings led to a diagnosis of HCC. A Child-Pugh classification of class A and an ICGR15 within normal limits demonstrated liver function to be well preserved. Preoperative 3D volumetry using SYNAPSE VINCENT was performed and 3D images of the tumor, portal vein, hepatic vein, hepatic artery and liver parenchyma were extracted (Fig. 2a). The segmental branches of the dorsal (P8d) and ventral (P8v) portions of segment VIII were identified, and the segmental branch of segment V



**Fig. 2** Three-dimensional volumetry. (a) Extraction of the tumor, portal vein, hepatic vein, hepatic artery, and liver parenchyma. The segmental branches for the dorsal (P8d) and ventral (P8v) portions of segment VIII and the segmental branch of segment V (P5) are identified. (b) Simulation of anatomical resection of segment VIII. Resected liver volume was 327 mL.

(P5) branched near P8v. Volumetric parameters calculated for anatomical resection of segment VIII revealed a total liver volume of 1,339 mL and a segment VIII volume of 327 mL (Fig. 2b).

Access was obtained via midline and right subcostal laparotomy. After adhesiotomy, routine intraoperative ultrasonography (IOUS) was performed using 5-10-MHz T-shaped and 5-10-MHz microconvex probes (Aloka Inc., Tokyo, Japan) to detect any changes from preoperative imaging in tumor location and vessel abnormalities. The hepatic hilum was encircled



**Fig. 3** (a) Intraoperative ultrasound (IOUS) on the left the P8v is shown at the site the surgeon aims to start the compression maneuver. (b) Compression of P8v is carried out (arrows) using the probe (P) itself and the surgeon's finger (F). (c) The area of segment VIII is marked on the liver. (d) At the end of resection of segment VIII, the right hepatic vein (RHV) and the middle hepatic vein (MHV) are exposed on the cut surface.

with a tourniquet, the right triangular and right coronary ligaments were divided, and the right hemi-liver was mobilized. The portal pedicle feeding the right anterior section (P5-8) and the segmental branch of segment VIII (P8) were identified using IOUS (Fig. 3a). Under IOUS guidance, the surgeon's left hand, together with the IOUS probe in the right hand, was positioned to show the P8 branch at the level selected for compression to perform anatomical hepatic resection of segment VIII. The compression site had to be selected to avoid inadvertent compression of other vascular structures, especially the segmental branch of segment V. Using the left fingertips and the IOUS probe itself, the surgeon compress-

ed the liver bilaterally at the targeted position, resulting in compression of the P8 vessels. This maneuver was monitored continuously using real-time IOUS by means of the probe used for compression (Fig. 3b). At this point, the assistant marked the discolored area with an electrocautery device and compression was released (Fig. 3c).

Liver transection was performed using a Pringle maneuver intermittently with a Cavitron Ultrasonic Surgical Aspirator (CUSA system, Valleylab, Boulder, CO, USA) and monopolar soft-coagulation (SOFT COAG ; ERBE Elektromedizin, Tübingen, Germany). Each vessel thicker than 2 mm was ligated with sutures. The S8 Glissonian pedicles were ligated and divided.

The resection was completed with exposure of the right hepatic vein and the middle hepatic vein on the cut surface, and segment V was preserved (Fig. 3d). Duration of the operation was 372 min and estimated blood loss was 760 mL. Resected liver volume was 290 g. Pathological examination demonstrated the presence of HCC. The patient's postoperative course was uneventful, and there has been no evidence of recurrence 6 months after surgery.

### Discussion

Virtual hepatic resection using 3D CT volumetric analysis software based on hepatic circulation has been developed<sup>13</sup>. In fact, 3D CT volumetric studies are now used widely in the field of living-donor liver transplantation for preoperative planning of safe donor hepatectomy and successful liver transplantation<sup>14,15</sup>. The recently developed SYNAPSE VINCENT image analysis software is capable of extracting each vessel territory in the liver and displaying 3D images within a few minutes using a single click. In this case, P8v, P8d and P5 were identified quickly and accurately. Mochizuki et al.<sup>10</sup> reported that preoperative graft volumetric measurements of the left lateral segment using the SYNAPSE VINCENT were almost identical to the actual graft weights in 3 cases. In our case, preoperative volumetric measurement of segment VIII was 327 mL and resected liver volume was 290 g. We believe SYNAPSE VINCENT to be useful for 3D volumetry in liver surgery.

Anatomical hepatic resection of segment VIII is technically demanding. Ultrasound-guided vessel compression is a new, safe, and effective surgical procedure for anatomical resection in patients with HCC<sup>6</sup>. Kishi et al.<sup>16</sup> reported a median operative duration of 378 min and median estimated blood loss of 705 mL in 154 patients who underwent anatomical resection of segment VIII. In our case, operative duration of anatomical resection of segment VIII using ultrasound-guided vessel compression was 372 min and estimated

blood loss was 760 mL, making anatomical resection of the liver a feasible procedure in our hospital.

The age of patients with hepatic malignancies has been increasing in Japan. The number of older patients undergoing hepatic resection is increasing. Several authors have recently reported the feasibility of hepatic resection in patients older than 80 years of age<sup>11,12</sup>. In this case, the patient was 90 years old and had an uncomplicated postoperative course. Patients older than 80 years of age who are indicated for hepatic resection must have preserved liver function and controllable comorbidities.

In conclusion, we have reported a case of 90-year-old patient who underwent preoperative 3D volumetry using SYNAPSE VINCENT and successful anatomical hepatic resection of segment VIII using ultrasound-guided vessel-compression technique.

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(和文抄録)

## SYNAPSE VINCENT を用いた術前画像診断および術中超音波装置を用いた徒手の阻血法による肝 S8 亜区域切除術の 1 例

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症例は 90 歳. 男性. 発熱, 呼吸器症状にて当院紹介. 右肺炎の診断にて加療を行った. その際の精査にて肝 S8 に径 5cm の造影効果を持つ単発性腫瘍を認めた. 既往歴は胃癌に対して胃全摘術, 脾臓摘出術, 胆嚢摘出術後, 狭心症に対して経カテーテル的治療後. HCV 抗体陽性, Child Pugh 分類 grade A, 肝障害度 A. 肝細胞癌の臨床診断に基づき, 全身状態改善後に外科的手術を施行する方針とした. SYNAPSE VINCENT を用いた術前画像評価を行い, 予測肝容積および肝 S8 領域脈管走行を確認し, 術前肝切除シミュレーションを施行した. 術中超音波装置を用いた徒手の阻血法により S5 グリソンを温存させながら S8 グリソン枝を阻血し, 肝切離前に肝 S8 demarcation line を確認した. 肝 S8 亜区域切除術を施行した. 術後経過は概ね良好で術後 23 日目に退院となった. 以後無再発生存中である.