Hepatic Arterial Embolization with an Indocyanine Green-Lipiodol Mixture before Laparoscopic Anatomical Liver Resection

1) Department of Radiology, Wakayama Medical University, Japan
2) Second Department of Surgery, Wakayama Medical University, Japan

Ryota Tanaka¹, Tetsuo Sonomura¹, Masaki Ueno¹, Shinya Hayami², Hironobu Ihira¹, Shota Ueda¹, Ryuta Okuhira¹, Masataka Koike¹, Nobuyuki Higashino³, Atsufumi Kamisako¹, Takao Koyama¹, Hirotatsu Sato⁵, Hiroki Yamaue⁵

Abstract

Here, we report a case of hepatocellular carcinoma detected on computed tomography and treated with laparoscopic anatomical liver resection in a 69-year-old woman who was being followed-up for hepatitis C. Intraoperative liver segmentation is necessary to accomplish laparoscopic anatomical liver resection. Therefore, the day before surgery, hepatic artery embolization was performed with an indocyanine green-Lipiodol mixture and Gelpart containing indocyanine green to mark the region for hepatectomy. The next day, surgeons visually confirmed the resection segments on indocyanine green fluorescence imaging and performed laparoscopic anatomical liver resection. No major complications resulted from this method. In conclusion, hepatic artery embolization with an indocyanine green-Lipiodol mixture is effective and safe for liver segment identification during laparoscopic anatomical liver resection.

Key words: hepatic artery embolization, indocyanine green, Lipiodol

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Introduction

Laparoscopic hepatectomy is more difficult compared to laparotomy because of the utilization of two-dimensional images (no stereoscopic effect or depth of field) and narrow visual field. Therefore, intraoperative liver segmentation is necessary to accomplish laparoscopic anatomical liver resection (LALR). Ueno et al. reported the usefulness of hepatic artery embolization (HAE) with indocyanine green (ICG; Diagnogreen for injection, 2.5 mg/mL, Daiichi Sankyo, Tokyo, Japan) to identify the liver segments for resection [1]. They mixed ICG with a water-soluble contrast medium and had to perform surgery on the same day because ICG washes out within 24 h after infusion. In the present case, we mixed ICG with Lipiodol® (Lipiodol 480 injection; Guerbet Japan, Tokyo, Japan), a lipid-soluble contrast medium, to delay the washout of ICG, enabling us to perform surgery the next day.

Institutional review board approval was obtained for publication of this case report, and informed consent was obtained from the patient.

Case Report

A 69-year-old woman was being followed-up for hepatitis C. Blood tests showed high levels of tumor markers (α-fetoprotein: 174 ng/mL, protein induced by vitamin K absence or antagonist II: 50 mAU/mL). Because computed tomography (CT) revealed hepatocellular carcinoma (HCC) in segment VIII, we decided to perform LALR.

The day before surgery, HAE was performed to mark the
Fig. 1. (a) Computed tomography during arteriography of the right hepatic artery shows that the tumor’s feeding artery is A8 (light blue). (b) Computed tomography during arteriography of A8 confirms that the tumor is fed by A8 alone.

Fig. 2. (a) Computed tomography performed immediately after hepatic artery embolization shows accumulation of the indocyanine green-Lipiodol® mixture in segment VIII, which includes the entire tumor. (b) Computed tomography after laparoscopic anatomical liver resection shows that segment VIII has been selectively resected.

Discussion

The tattooing method [2, 3] or the Glissonian approach [4] are commonly used to identify hepatic segments in conventional open liver surgery. Using the Glissonian approach, we can observe ICG fluorescence in the remnant liver by clamping the target Glissonian pedicle and injecting ICG intravenously (counter perfusion method). However, technical difficulties occasionally arise when performing LALR of segment V, VI, VII, or VIII. In such situations, the tattooing method (direct perfusion method) is performed. However, it is occasionally difficult to inject ICG into the portal vein under laparoscopic intraoperative ultrasonography (IOUS), and ICG washes out from the liver rapidly. To overcome these challenges, Ueno et al. performed HAE using ICG mixed with a water-soluble contrast medium [1]. In our past clinical experience with this method, ICG had completely washed out from the liver within 24 h after HAE. Therefore, it is necessary to perform HAE and LALR simultaneously in a hybrid operation room. However, performing angiogra-
which the Lipiodol experimental studies including pigs to assess the degree of vascular plexus, around the tumor. We are now planning ex vivo vessels, including the portal vein branches and peribiliary material that prevents the washout of ICG by blocking microvessels. This new method has some limitations. Preoperative HAE with Lipiodol® could cause tumor necrosis before LALR contrary to the original technique performed immediately before surgery. If the entire tumor is necrotic, a pathologic diagnosis cannot be made. This approach might become more difficult in patients with significant arteriovenous shunting or arterial communication around the target region. IR also increases surgical costs, although laparoscopic hepatectomy is associated with lower hospital costs compared to open hepatectomy. The additional time taken to perform IR is another disadvantage of this method. However, surgeons can perform LALR without losing the cutting direction by using ICG fluorescence imaging. This enables surgeons to reduce the frequency of laparoscopicIOUS to confirm the cutting direction during hepatectomy. Consequently, our method might reduce the overall operating time.

In conclusion, HAE with an ICG-Lipiodol® mixture and Gelpart® containing ICG delays the washout of ICG and helps surgeons identify the liver segments during LALR. Further studies including more patients are required to confirm the efficacy of this method.

Conflict of interest: The authors declare that they have no conflicts of interest to report.

This case report has been presented at CIRSE2019.

Abbreviations: CT: computed tomography. HAE: hepatic artery embolization. HCC: hepatocellular carcinoma. ICG: indocyanine green. IR: interventional radiology. IOUS: intraoperative ultrasonography. LALR: laparoscopic anatomical liver resection. TACE: transcatheter arterial chemoembolization.

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