学 位 論 文 の 要 旨

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学 位 論 文 名	Coil Volume Embolization Ratio for Preventing Recanalization after Portal Vein Embolization
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論 文 内 容 の 要 旨

INTRODUCTION

The safety of major hepatectomy can be increased by inducing compensatory hypertrophy of the remaining liver through portal vein embolization (PVE). Satisfactory embolization of the hepatic portal branches is necessary before performing extended hepatectomy, because partial PVE and recanalization after PVE can result in insufficient hypertrophy of the remaining liver. However, there is no obvious endpoint during embolization because portal vein flow is lost after PVE. Prediction of remaining liver function after hepatectomy has been reported to be facilitated by the use of technetium-99m galactosyl human serum albumin single-photon emission computed tomography (^{99m}Tc-GSA SPECT/CT) fusion imaging. However, the influence of recanalization on future remaining liver function has not been evaluated in previous studies.

The purpose is to evaluate the optimum coil volume embolization ratio (VER) for prevention of recanalization after PVE and the influence of recanalization on future liver remaining function.

MATERIALS AND METHODS

Patients

We analyzed 18 patients (male: 14, female: 4) who underwent PVE from 2015 to 2018. PVE was conducted in patients who were scheduled for major hepatectomy. A total of 29 portal branches were embolized (anterior branch: 12, posterior branch: 11, left branch: 4, right branch: 2) using absolute ethanol combined with detachable coils by the trans-ileocecal method. This study

protocol was approved by the Research Ethics Committee of Shimane University (study number: 3568).

Assessments

Non-recanalization or recanalization after PVE

Portal vein recanalization was evaluated three weeks after PVE by contrast-enhanced CT (CE-CT). We divided the treated portal branches into two groups. Embolized portal branches with no enhancement observed on portal venous phase CE-CT at three weeks after PVE were classified as not showing recanalization (non-recanalized group), whereas embolized branches with enhancement at three weeks after PVE were classified as showing recanalization (recanalized group).

Volume embolization ratio (VER)

The VER was deciphered as follows: VER = (coil volume/target vessel volume) × 100 (%). The VER was compared between the non-recanalized group and recanalized group. The measurements were performed on curved planar reformation images using a three-dimensional image analysis system, and both coil and target vessel volume were calculated.

Functional-volumetric ratio

CE-CT and ^{99m}Tc-GSA SPECT/CT fusion imaging were performed before and three weeks after PVE. Subsequently, the ration of future liver remaining volume to total liver volume (volumetric %future liver remaining [FLR]), future liver remaining count to total liver count on ^{99m}Tc-GSA SPECT/CT fusion imaging (functional %FLR), and functional-volumetric ratio = functional %FLR/volumetric %FLR were calculated and evaluated. After the 18 patients were classified into the non-recanalized and recanalized groups, we compared the functional-volumetric ratio between them.

RESULTS AND DISCUSSION

Twenty-six portal branches showed no recanalization (non-recanalized group, n=26, 89.7%), but three portal branches showed recanalization (recanalized group, n=3, 10.3%). The median VER was 4.94 (3.12–11.1)% in the non-recanalized group and 3.49 (2.76–4.32)% in the recanalized group, which was significantly different between groups (P=0.045, Mann–Whitney U test). The median functional-volumetric ratio was 1.16 (1.03–1.50) in the non-recanalized patients (n=15, 83.3%) and 1.01 (0.96–1.13) in the recanalized patients (n=3, 16.7%), and it was significantly higher in the non-recanalized patients (P=0.021, Mann–Whitney U test).

The present study demonstrated that the VER for prevention of recanalization after PVE was approximately 5% (>4.94%) and ^{99m}Tc-GSA SPECT/CT fusion imaging showed that recanalization decreased future remaining liver function. In the present study, the recanalized group (n=3, 16.7%) did not use antiplatelet drugs or anticoagulants. In two patients, both the

anterior and posterior branch were embolized with coils and the VER of the recanalized branch was smaller than that of other branch in both patients. Accordingly, adequate coil embolization may prevent recanalization after PVE and achieve more effective hepatic hypertrophy. Several studies have shown that ^{99m}Tc-GSA SPECT/CT is more efficient for assessing the function of future remaining liver than CT volumetry. If PVE is inadequate, the functional shift from the embolized liver to the future remaining liver will be incomplete. Accordingly, the functional-volumetric ratio was smaller in our recanalized patients (n=3, 16.7%) than in our non-recanalized patients (n=15, 83.3%), emphasizing that it is important to prevent recanalization after PVE.

There were several limitations of this study. First, it was a retrospective investigation conducted at only one center in only few subjects. Thus, our current observations should be taken as preliminary, and confirmatory future studies are required. In addition, other embolic materials for preventing recanalization after PVE were not evaluated. Furthermore, ^{99m}Tc-GSA SPECT/CT fusion imaging cannot be used in clinical application in many countries, even though there have been several reports about the use of this radiopharmaceutical method in Japan and elsewhere.

CONCLUSION

Satisfactory embolization of the portal branches is necessary for sufficient hypertrophy of the remaining liver before major hepatectomy. The VER for preventing recanalization after PVE was approximately 5% (>4.94%). ^{99m}Tc-GSA SPECT/CT fusion imaging revealed a decrease in future liver remaining function due to recanalization after PVE.