Endoscopic stenting in bile duct cancer increases liver volume

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Background: Objective evaluation tools for assessing the effectiveness of stenting in palliative treatment of malignant biliary obstruction are not satisfactory. Effects of biliary stenting on liver volume change have never been studied.

Objective: We aimed to use volumetry to analyze liver volume changes after endoscopic stenting in bile duct cancer according to the location and number of stents.

Design: Retrospective review.

Setting: University hospital.

Patients: Patients with a diagnosis of hilar or distal bile duct cancer and who underwent biliary metal stenting.

Interventions: ERCP with self-expandable metal stent placement.

Main Outcome Measurements: Liver volume change after biliary stenting and its comparison according to the location (hilar vs distal common bile duct) and number (hilar bilateral vs hilar unilateral).

Results: There were 60 patients; 31 were treated for hilar bile duct cancer (13 for bilateral stent and 18 for unilateral stent) and 29 for distal bile duct cancer. Overall mean follow-up duration was 11.7 ± 4.9 weeks. Liver volume increased 17.4 ± 24.1%. The rate of liver growth was rapid during the early period from 4 to 8 weeks. Stenting in hilar bile duct cancer tended to increase liver volume more than distal biliary stents (22.5% vs 11.9%, $P = .091$). In hilar bile duct cancer, unilateral and bilateral stents showed similar liver volume increases (20.1% and 25.8%, respectively; $P = .512$).

Limitations: Single center, retrospective.

Conclusions: Biliary stenting markedly increased liver volume in both hilar and distal bile duct cancer. Our data suggest that liver volume assessment could be a useful tool for evaluating stent efficacy. (Gastrointest Endosc 2014;80:447-55.)

Bile duct cancers are one of the most common causes of biliary obstruction, and endoscopic biliary stenting is widely used to decompress obstructive lesions.[1,2] Most bile duct cancers do not cause any symptoms until they reach an advanced stage and are unresectable at the time of diagnosis.[3,4] Biliary stenting is an alternative to surgery for palliative treatment of patients with advanced bile duct cancer.

The optimal stent type or number for biliary stenting is an unresolved issue, and the relative merits of unilateral and bilateral stenting for treating hilar biliary obstruction are still under debate. Unilateral stenting is technically easier and less expensive than bilateral stenting and, in most cases, covers more than 25% to 30% of the liver volume, which is known as the minimum range, to relieve jaundice. However, in some instances, unilateral drainage

Abbreviations: AST, aspartate aminotransferase; 3D, 3-dimensional; SEMS, self-expandable metal stent.

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is not sufficient to improve symptoms, and, consequently, undrained lobes can cause adverse events such as cholangitis. Bilateral stenting can cover a greater range of liver volume than unilateral stenting and improve jaundice more rapidly. However, in many cases, bilateral stenting was not feasible for various anatomic and technical reasons.[5-9]

Most studies on effective biliary stenting have focused on successful deployment of stents to ameliorate jaundice, reduce cholangitis, or extend survival.[10] However, the effects of biliary stenting on liver regeneration have rarely been considered. Liver growth related to hepatic regeneration is receiving greater attention as a major concept of liver resection and transplantation to prevent postoperative hepatic failure.[11,12] Liver volume change can reflect liver function and regenerative capacity, and use of liver volumetry is increasing to measure remnant liver volume for preoperative management.[13,14] Therefore, liver volumetry could be a good method for comparing liver regeneration and determining the efficacy of biliary stenting for palliative therapy of bile duct cancer.

The aim of this study was to evaluate liver regeneration after endoscopic biliary stenting for bile duct cancer by volumetry and to compare liver volume changes according to hilar or distal stent location. The results of unilateral and bilateral stenting in hilar bile duct cancer were also compared.

Take-home Message

- In bile duct cancer, metal stent placement increased liver volume significantly regardless of the location, especially within 4 to 8 weeks. In hilar bile duct cancer, liver volume increases by bilateral stenting were similar to those by unilateral stenting.
- Liver volume assessment should be considered as a useful tool for evaluating stent efficacy.

METHODS

Patients

We retrospectively reviewed patients who underwent biliary SEMS placement at Chonbuk National University Hospital, Jeonju, South Korea, from January 2005 to December 2012. All of the patients included in the analysis had histologically defined malignancy and had a diagnosis of bile duct cancer. Patients with a diagnosis of carcinoma originating from adjacent organs such as the gallbladder, liver, pancreas, ampulla of Vater, and metastatic lymph nodes were excluded. Inclusion also required at least 2 consecutive sets of CT images before and after biliary stenting with a range of 4 to 20 weeks of follow-up as a predicted time period for liver regeneration. We classified patients into 3 groups by location or number of stents: hilar unilateral, hilar bilateral, and distal.

Clinical characteristics were obtained from medical records. Laboratory results, pathological results, baseline and follow-up enhanced abdominal CT images, and ERCP findings were also collected from the database.

This study was approved by the Institutional Review Board of Chonbuk National University Hospital, Chonbuk National University School of Medicine, Jeonju, South Korea (Institutional Review Board no. 2013-04-028-001).

Liver volume measurement

Liver volume was calculated by using baseline and follow-up CT images. We collected prephase, arterial phase, portal phase, and delayed phase CT images for each patient. The software for liver extraction measurements was Dr. Liver version 04.2013 (POSTECH Inc, Pohang, South Korea),[15] a 3-dimensional (3D) virtual liver surgery planning system that extracts liver information from abdominal CT images and estimates standard liver volume. The software obtained liver boundaries automatically. Manually corrected contours were retained, and 3D reconstruction images were generated by the program. We calculated the volume of liver parenchyma precluding tumor lesions and compared baseline and follow-up liver volume changes for each patient.

Statistical analysis

Descriptive analysis comparing definitive liver volumes before and at follow-up was performed by using a paired t test for qualitative variables. Comparison among the 3 groups based on the location or stent number was used for 1-way analysis of variance. An independent t test was used to compare hilar and distal bile duct lesions and unilateral and bilateral hilar lesions. $P < .05$ was considered statistically significant, and all reported P values were 2 sided. The statistical software package SPSS version 18.0 (SPSS Inc, Chicago, Ill) was used for analysis.

RESULTS

Patient characteristics

We enrolled 421 patients who underwent biliary SEMS placement in our hospital and excluded 335 patients who did not meet our inclusion criteria. A total of 243 patients were excluded because they did not meet the requirements of CT follow-up duration. Eighty-eight patients had a history of biliary stenting, 48 patients had a diagnosis of malignancy originating from an adjacent organ, and 4 patients had a diagnosis of benign lesions such as biliary stones or benign strictures. A flowchart of the study is shown in Figure 1.

The most frequent reason for obtaining a second set of CT images was the patients' symptoms. Abdominal pain (19 patients) was the most common symptom, and fever (16 patients), jaundice (8 patients), and hematemesis/melena (2 patients) were also experienced. Fifteen patients had no remarkable symptoms but a second CT scan was performed to check the state of malignancy. Distribution