

# Endovascular Repair of Celiac Artery Aneurysm with the Use of Stent Grafts

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## ABSTRACT

**Purpose:** To determine the feasibility, safety, and long-term outcome of stent-graft insertion for endovascular repair of celiac artery aneurysm (CAA).

**Materials and Methods:** From January 2010 to April 2015, 10 patients (three men and seven women; mean age, 51.6 y  $\pm$  12.1; age range, 39–81 y) with CAAs underwent endovascular repair via stent-graft insertion in a single center. During treatment, the stent graft was placed at the celiac and common hepatic arteries. Standard follow-up protocol included abdominal CT angiography and clinical examinations at 1, 3, 6, and 12 months and annually thereafter. Follow-up was performed every 2–3 months via telephone for the duration of the follow-up period to confirm patients' general condition. Data on patient characteristics, technical success, procedure-related complications, and follow-up were collected and analyzed retrospectively.

**Results:** CAA was successfully sealed by the stent graft in all patients. The common hepatic artery was patent after stent insertion in all patients, and no procedure-related complication occurred. All patients were followed up for 1–64 months (mean, 19.3 mo  $\pm$  18.9). Abdominal CT angiography demonstrated no endoleak, stent obstruction, or splenic infarction during follow-up. All patients experienced CAA shrinkage with formation of thrombi or increase in the quantity of thrombi in the CAA sac.

**Conclusions:** Stent-graft insertion is a safe and effective method for endovascular repair of CAA.

## ABBREVIATIONS

CAA = celiac artery aneurysm, VAA = visceral arterial aneurysm

Visceral arterial aneurysm (VAA) is a rare disease with an incidence of 0.1%–2% (1). Celiac artery aneurysm (CAA) constitutes 4.8%–6.3% of all VAA cases (1,2). It frequently presents as a life-threatening emergency and is often fatal if associated with rupture (3). An aneurysm  $\geq$  20 mm in size is considered significant enough to warrant treatment if the patient's overall condition permits it (3). Recent studies have reported treatment options for CAAs consisting of vascular surgery or coil embolization (1,2,4). Few publications have reported

stent-graft insertion for endovascular repair in patients with CAAs (5–9).

The present study aimed to determine the feasibility, safety, and long-term outcome of stent-graft insertion for endovascular repair of CAAs.

## MATERIALS AND METHODS

The institutional review board approved the present retrospective single-center study. Before treatment, all patients received details of endovascular repair of CAA and provided written informed consent for treatment.

### Patients

From January 2010 to April 2015, 11 patients with CAA were admitted to our center. We excluded one patient from the study because he underwent coil embolization. Therefore, a total of 10 patients (three men and seven women; mean age, 51.6 y  $\pm$  12.1; age range, 39–81 y) who underwent endovascular repair with stent-graft insertion were included in the study. Patient characteristics are shown in **Table 1**. Six patients had abdominal pain. Four patients were asymptomatic but were

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**Table 1.** Baseline Data of Patients

Pt. No./Sex/Age (y)	Aneurysm Neck				
	Artery Location	Length (cm)	Aneurysm Size (cm)	Thrombi in Aneurysm	Symptom
1/M/39	Celiac	2	2.3 × 1.8	No	Abdominal pain
2/M/57	Celiac	2	2.7 × 1.3	No	Abdominal pain
3/F/48	Celiac, common hepatic, splenic	3	6.2 × 5.4	Yes	Asymptomatic
4/F/44	Celiac, common hepatic	3	5.9 × 5.8	Yes	Abdominal pain
5/F/53	Celiac, common hepatic	3	4.7 × 3.8	Yes	Asymptomatic
6/F/48	Celiac, common hepatic	2	2.1 × 1.6	No	Asymptomatic
7/F/59	Celiac	2	4.9 × 3.5	No	Abdominal pain
8/M/81	Celiac, common hepatic	4	8.8 × 7.1	Yes	Asymptomatic
9/F/42	Celiac	2	2.6 × 2.1	No	Abdominal pain
10/F/45	Celiac	2	3.2 × 1.9	No	Abdominal pain

suspected to have CAAs based on abdominal ultrasound examination before confirmation of CAA by abdominal CT angiography. Aneurysm size and neck location were evaluated based on CT angiography results.

### Treatment Procedure

All procedures were performed under fluoroscopic guidance by three interventional radiologists. A 5-F Cobra or RH catheter (Cordis, Warren, New Jersey) was inserted into the celiac artery, and angiography was performed. The aneurysm neck length and celiac artery diameter were measured on the angiogram. A 0.035-inch Radifocus guide wire (Terumo, Tokyo, Japan) and the catheter were inserted to the hepatic artery, and the guide wire was exchanged for a 0.035-inch Radifocus stiff guide wire (Terumo). Finally, the 9-F stent introducer was advanced over the stiff guide wire, and the stent graft (Fluency; Bard, Murray Hill, New Jersey) was deployed to seal the aneurysm. The stent graft was placed at the celiac and common hepatic arteries. The stent diameter was 1 mm larger than that of the celiac artery, and the stent length was at least 20 mm longer than the aneurysm neck length (at least 10 mm at the distal and proximal margins). Stent placement was performed with roadmapping. After stent placement, celiac angiography was repeated to confirm the treatment result (Fig). Per previous literature (10), several abdominal collateral pathways may develop as follows: (i) celiac artery to common hepatic artery to proper hepatic artery to right gastric artery to left gastric artery to celiac artery; (ii) celiac artery to common hepatic artery to gastroduodenal artery to right gastroepiploic artery to left gastroepiploic artery to splenic artery to celiac artery; and (iii) celiac artery to common hepatic artery to proper hepatic artery to left hepatic artery to accessory left hepatic artery to left gastric artery to celiac artery (10). Therefore, celiac angiography was also used to confirm whether there was a type II endoleak. Hemostasis was obtained by using a vascular closure

device (Perclose ProGlide; Abbot Vascular, Redwood City, California) after treatment.

All patients were prescribed oral clopidogrel (75 mg/d) and aspirin (100 mg/d) for 3 months. Thereafter, only aspirin was administered for 1 year or for the patient's lifespan in patients  $\geq 50$  years of age.

### Definition and Endpoints

Technical success was defined as no contrast medium filling the aneurysm with common hepatic artery patency. Procedure-related complications were classified as major and minor according to the guidelines of the Society of Interventional Radiology (11).

The standard follow-up protocol included abdominal CT angiography and clinical examinations at 1, 3, 6, and 12 months and annually thereafter. Follow-up via telephone was performed every 2–3 months for the duration of the follow-up period to confirm the patients' general condition. Patients were followed until death or the end of the study (May 2015). The primary endpoint was endoleak, and secondary endpoints included stent obstruction, splenic infarction, anticoagulation-related bleeding, and death.

## RESULTS

### Assessment of Treatment

The CAA was successfully sealed by the stent graft in all patients. No patient experienced a type II endoleak after treatment. The common hepatic artery was patent after stent insertion in all patients. Treatment details are shown in Table 2. No procedure-related complication occurred in any patient. The mean time of the entire procedure was 60.5 minutes  $\pm$  9.0 (range, 45–75 min). The abdominal pain experienced preprocedurally by six patients resolved in all six after treatment.

### Follow-up

All patients were followed up for 1–64 months (mean, 19.3 mo  $\pm$  18.9). No patient was lost to follow-up, and

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