**Table 1.** Descriptive reporting format for endometrial cytology for JSCC group study

## (I) Specimen type

Conventional method、Liquid-based method

## (II) Specimen adequacy

Satisfactory, Unsatisfactory (rejected specimen, fully evaluated, unsatisfactory specimen)

## (III) Result

### Negative for malignancy

Endometrium in proliferative phase, in secretory phase, in menstrual phase, Atrophic endometrium, Benign reactive change (IUD, TAM etc.), Endometrial polyp, Simple endometrial hyperplasia

### ATEC: Atypical endometrial cells)[-US or –A must be selected]

ATEC-US: Atypical endometrial cells, of undetermined significance

ATEC-A: Atypical endometrial cells, cannot exclude atypical Endometrial hyperplasia or more

### Endometrial hyperplasia

Complex endometrial hyperplasia

### Atypical endometrial hyperplasia

Atypical endometrial hyperplasia, Endometrial adenocarcinoma in situ, Atypical polypoid adenomyoma

### Malignant tumor

Endometrioid adenocarcinoma (G1, G2, G3, Squamous diff.)), serous adenocarcinoma, clear cell adenocarcinoma, mucinous adenocarcinoma, squamous cell carcinoma, mixed carcinoma, undiferentiated carcinoma, mesenchymal tumors, endometrial stromal sarcoma, leiomyosarcoma, carcinosarcoma, homologous type, heterologous type, other malignant tumors, extrauterine malignant tumors

**Table 2.** Cell samplers

*(n=10152)*

| Cell samplers | *Total* |
|---|---|
| Uterobrush or Honest uterine brush N | 3742 |
| Endocyte | 2074 |
| Endosearch | 2718 |
| Soft Cyto | 429 |
| Tube | 1189 |
| Cotton swab | 10 |
| *Total* | 10152 |

**Table 3.** Unsatisfactory specimens

*(n=557)*

| Reasons for unsatisfactory specimens | *No.(%)* |
|---|---|
| Specimen rejected, not processed | |
| *Not labeled* | 0(0) |
| *Slide broken* | 0(0) |
| Specimen processed and examined, but unsatisfactory for evaluation of cellular abnormality | |
| *Poor fixation* | 0(0) |
| *Poor preservation* | 0(0) |
| *Dry specimen* | 6(1.1) |
| *Obscured by inflammation* | 4(0.7) |
| *Obscured by blood* | 8(1.4) |
| *Distortion of cells or cell clumps at the time of cell preparation* | 1(0.2) |
| *Lack or insufficient clinical information* | 151(27.1) |
| *Scant cellularity* | 344(61.8) |
| Estimated as unsatisfactory for any two reasons | 39(7.0) |
| Estimated as unsatisfactory for any three reasons | 3(0.5) |
| Estimated as unsatisfactory for any four reasons | 1(0.2) |
| Total | 557 |

**Table 4.** Comparisons of histological diagnosis and cytological results *(n=8436)*

| Cytological Result / Histological diagnosis *No.* (%) | Negative for malignancy | ATEC-A | Complex hyperplasia | Atypical endo-metrial hyperplasia | Malignant tumor |
|---|---|---|---|---|---|
| Normal endometrium | 433(5.41) | 6(17.14) | 15(19.48) | 2(7.70) | 9(3.08) |
| Benign reactive changes | | | | | |
| *due to hormonal dysfunctions* | 33(0.41) | 1(2.86) | 6(7.80) | 0(0) | 0(0) |
| *due to iatrogenic effects* | 1(0.01) | 0(0) | 0(0) | 0(0) | 0(0) |
| *due to inflammatory effects* | 9(0.11) | 0(0) | 0(0) | 0(0) | 0(0) |
| *unclassified* | 13(0.16) | 1(2.86) | 4(5.20) | 0(0) | 2(0.68) |
| Endometrial polyp | 44(0.55) | 0(0) | 1(1.30) | 0(0) | 0(0) |
| Simple endometrial hyperplasia | 13(0.16) | 1(2.86) | 6(7.80) | 0(0) | 0(0) |
| Complex endometrial hyperplasia | 15(0.19) | 2(5.71) | 12(15.58) | 0(0) | 1(0.34) |
| Atypical endometrial hyperplasia | 17(0.21) | 2(5.71) | 14(18.18) | 8(30.77) | 3(1.03) |
| Atypical polypoid adenomyoma(APA) | 4(0.05) | 1(2.86) | 5(6.50) | 0(0) | 1(0.34) |
| Malignant tumors | 33(0.41) | 21(60) | 14(18.18) | 16(61.54) | 276(94.52) |
| Histological test, not done | 7391(92.32) | 0(0) | 0(0) | 0(0) | 0(0) |
| *Total* | 8006 | 35 | 77 | 26 | 292 |

Normal endometrium; proliferative, secretory, menstrual, and atrophic endometrium

**Table 5.** Comparisons of histological diagnosis and cytological results *(Atypical endometrial hyperplasia)* *(n=26)*

| Cytological result / Histological diagnosis | *NOS (%)* | *Atypical Endometrial Hyperplasia (%)* | *Endometrial Adenocarcinoma In situ (%)* | *Atypical Polypoid Adenomyoma (%)* |
|---|---|---|---|---|
| Normal endometrium | 0(0) | 2(8.3) | 0(0) | 0(0) |
| Benign reactive changes | | | | |
| *due to hormonal dysfunctions* | 0(0) | 0(0) | 0(0) | 0(0) |
| *due to iatrogenic effects* | 0(0) | 0(0) | 0(0) | 0(0) |
| *due to inflammatory effects* | 0(0) | 0(0) | 0(0) | 0(0) |
| *unclassified* | 0(0) | 0(0) | 0(0) | 0(0) |
| Endometrial polyp | 0(0) | 0(0) | 0(0) | 0(0) |
| Simple endometrial hyperplasia | 0(0) | 0(0) | 0(0) | 0(0) |
| Complex endometrial hyperplasia | 0(0) | 0(0) | 0(0) | 0(0) |
| Atypical endometrial hyperplasia | 0(0) | 8(33.3) | 0(0) | 0(0) |
| Atypical polypoid adenomyoma(APA) | 0(0) | 0(0) | 0(0) | 0(0) |
| Malignant tumors | 2(100) | 14(58.3) | 0(0) | 0(0) |
| Histological test, not done | 0(0) | 0(0) | 0(0) | 0(0) |
| *Total* | 2 | 24 | 0 | 0 |

*NOS: :cytological result was "Atypical endometrial hyperplasia", but cannot be subdivided more minutely.*

Normal endometrium; proliferative, secretory, menstrual, and atrophic endometrium

**Table 6.** Comparisons of histological diagnosis and cytological results *(ATEC-US)* *(n=76)*

| Cytological result / Histological diagnosis | ATEC-US (Atypical endometrial cells, of undetermined significance) *No.* (%) |
|---|---|
| Normal endometrium | 14(18.4) |
| Benign reactive changes | |
| *due to hormonal dysfunctions* | 0(0) |
| *due to iatrogenic effects* | 3(3.9) |
| *due to inflammatory effects* | 1(1.3) |
| *unclassified* | 0(0) |
| Endometrial polyp | 2(2.6) |
| Simple endometrial hyperplasia | 1(1.3) |
| Complex endometrial hyperplasia | 2(2.6) |
| Atypical endometrial hyperplasia | 6(7.9) |
| Atypical polypoid adenomyoma(APA) | 0(0) |
| Malignant tumors | 15(19.7) |
| Histological test, not done | 32(42.1) |
| *Total* | 76 |

Normal endometrium; proliferative, secretory, menstrual, and atrophic endometrium

**Table 7.** Performance Characteristics of Endometrial Cytology

| | Sensitivity | Specificity | PPV | NPV |
|---|---|---|---|---|
| Endometrial cytology* No.(%) | 328/415(79.0) | 7996/8021(99.7) | 328/353(92.9) | 7996/8083(98.9) |
| Endometrial cytology** No.(%) | 376/445(84.5) | 7937/7991(99.3) | 376/430(87.4) | 7937/8006(99.1) |

PPV indicates positive predictive value; NPV, negative predictive value; NA, not appliciable

* "Malignant tumor", "Atypical endometrial hyperplasia" and "ATEC-A" interpretations were considered positive as evidence of malignancy

** "Malignant tumor", "Atypical endometrial hyperplasia", "ATEC-A" and "complex hyperplasia interpretations were considered positive as evidence of neoplastic disease

CLINICAL STUDY

# Safety and Efficacy of Primary Metallic Biliary Stent Placement with Tract Embolization in Patients with Massive Ascites: A Retrospective Analysis of 16 Patients

Keitaro Sofue, MD, Yasuaki Arai, MD, Yoshito Takeuchi, MD, Hiroyasu Fujiwara, MD, Hiroyuki Tokue, MD, and Kazuro Sugimura, MD, PhD

## ABSTRACT

**Purpose:** To evaluate the safety and efficacy of primary metallic biliary stent placement with tract embolization in patients with massive ascites.

**Materials and Methods:** Sixteen patients with malignant biliary obstruction and massive ascites (age range, 44–79 y; median age, 59 y) were treated with primary percutaneous stent placement with tract embolization. These patients were unsuitable candidates for endoscopic intervention. Etiologies of biliary obstruction were gastric cancer with hilar nodal metastases (n = 9), pancreatic carcinoma (n = 5), cholangiocarcinoma (n = 1), and gallbladder carcinoma (n = 1). Eight patients had nonhilar lesions and the remaining eight had hilar lesions. Percutaneous accesses to the biliary system and stent placements were performed in a one-step procedure, and catheters were removed with tract embolization with metallic coils.

**Results:** Stent placement and tract embolization were successful in all patients, without external drainage catheters left in place. Significant reduction of serum bilirubin level was observed in 14 patients (87.5%). No bile peritonitis or intraperitoneal hemorrhage occurred. Major complications included postprocedural cholangitis (12.5%), bloody bowel discharge (6.2%), and right pleural effusion (25.0%). One patient who died 19 days after intervention was deemed to represent a procedure-related mortality. During the survival period (range, 19–175 d; median, 66 d), stent occlusion was noted in two patients at 6 and 159 days after the procedure. Primary stent patency was achieved in 14 patients (87.5%).

**Conclusions:** Primary biliary stent placement with tract embolization is technically safe and offers an effective palliative treatment option for patients with malignant biliary obstruction and massive ascites when endoscopic intervention is not possible.

## ABBREVIATION

PTBD = percutaneous transhepatic biliary drainage

Most patients with malignant biliary obstruction have advanced-stage cancers with dismal prognoses (1). Percutaneous transhepatic biliary drainage (PTBD) and metallic stent placement are established methods to manage malignant biliary obstruction (2–4) when endoscopic intervention is not possible.

The disadvantage of PTBD is its association with hemorrhage, bile leakage, and catheter dislodgment, with reported incidences of less than 5% each (5–8). Especially in patients with massive ascites, PTBD is thought to be relatively contraindicated because of the high risk of intraabdominal bleeding and peritonitis caused by bile leakage, which is believed to be secondary to the presence of a tube passing through ascites (9). As a result, selection of the treatment approach can be difficult in patients with malignant obstructive jaundice and massive ascites who are unsuitable candidates for endoscopic intervention.

Some studies have demonstrated that transhepatic tract

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**Table 1.** Disease and Treatment Details of Patients Undergoing One-Step Biliary Stent Placement with Transhepatic Tract Embolization

| Pt. No. | Age (y)/ Sex | Primary Tumor | Biliary Obstruction | Degree of Biliary Dilation | Puncture Site/No.* | Stents | Paracentesis |
|---|---|---|---|---|---|---|---|
| 1 | 57/ F | PC | Nonhilar | Moderate | Right/1 | 2 | No |
| 2 | 59/ M | PC | Nonhilar | Moderate | Right/1 | 1 | Yes |
| 3 | 72/ M | PC | Nonhilar | Severe | Right/1 | 1 | Yes |
| 4 | 74/ F | PC | Nonhilar | Mild | Left/1 | 2 | No |
| 5 | 57/ M | GC | Nonhilar | Moderate | Right/1 | 1 | No |
| 6 | 65/ M | GC | Nonhilar | Mild | Right/1 | 1 | Yes |
| 7 | 74/ F | GC | Nonhilar | Moderate | Right/1 | 1 | Yes |
| 8 | 50/ M | GBC | Nonhilar | Moderate | Right/1 | 1 | No |
| 9 | 60/ M | GC | Hilar (Bismuth I) | Severe | Left/1 | 2 | No |
| 10 | 66/ M | GC | Hilar (Bismuth I) | Moderate | Left/1 | 1 | No |
| 11 | 58/ M | GC | Hilar (Bismuth II) | Moderate | Left/1 | 4 | No |
| 12 | 52/ M | GC | Hilar (Bismuth III) | Moderate | Right/1 | 1 | Yes |
| 13 | 68/ F | GC | Hilar (Bismuth III) | Moderate | Right/2 | 3 | No |
| 14 | 44/ M | PC | Hilar (Bismuth III) | Moderate | Right/2 | 3 | No |
| 15 | 79/ M | CC | Hilar (Bismuth III) | Severe | Right/1 | 1 | No |
| 16 | 56/ M | GC | Hilar (Bismuth IV) | Moderate | Right/3 | 3 | No |

Note.— CC = cholangiocarcinoma, GBC = gallbladder carcinoma, GC = gastric cancer, PC = pancreatic carcinoma.
* Puncture number refers to the number of accesses into the biliary system.

embolization can prevent the complications associated with percutaneous intervention (10–15). Stent placement in a one-step procedure could immediately resolve biliary obstruction, shortening the duration of placement of the temporary drainage catheter (4,16–18). In addition, percutaneous biliary metallic stent placement with tract embolization performed in a single session might be a favorable method to manage biliary obstruction in patients with massive ascites who are not suitable candidates for endoscopic intervention or in whom endoscopic treatment has failed.

The purpose of the present study was to evaluate the safety and efficacy of primary metallic biliary stent placement with tract embolization in patients with massive ascites.

## MATERIALS AND METHODS

### Patient Population

This retrospective study was conducted in accordance with the principles of the amended Declaration of Helsinki, and with the approval of the institutional review board. Between July 2005 and June 2010, 16 patients with malignant biliary obstruction and massive ascites, in whom conventional endoscopic drainage failed or could not be performed because of altered anatomy after surgery, were treated with primary percutaneous expandable metallic stent placement. The patient population included 12 men and four women with a mean age of 62 years (median, 59 y; range, 44–79 y; **Table 1**).

Etiologies of malignant biliary obstruction were gastric cancer with nodal metastases (n = 9), pancreatic carcinoma (n = 5), cholangiocarcinoma (n = 1), and gallbladder carcinoma (n = 1). The diagnosis of biliary obstruction was confirmed by computed tomography (CT) and/or ultrasonography (US; **Fig 1a**). Eight patients had lesions involving the middle and distal common bile duct, and eight had proximal bile duct (ie, hilar) lesions. The latter were classified according to Bismuth classification as follows: type I, n = 2; type II, n = 1; type III, n = 4; and type IV, n = 1 (**Table 1**). All 16 patients had massive ascites caused by peritoneal dissemination and/or advanced disease, and five patients had liver metastases. Massive ascites was defined as a large amount of fluid in the paracolic regions and around the liver at the proposed puncture site, and resulted in a tense abdomen determined with imaging and physical examination (9,19). Cytologic examination of the ascites was performed in 12 of 16 patients, and a malignant cytologic result was revealed in nine patients.

In 11 of the 16 patients, endoscopic intervention was attempted, but resulted in failure because of gastroduodenal invasion by the primary disease (n = 8) or rigidity of the papilla of Vater (n = 3). In the remaining five patients, the endoscopic approach was not attempted because of previous surgery with Roux-en-Y conversion.

### Procedures

Written informed consent was obtained from all patients before the procedures. All procedures were performed under local anesthesia with 1% lidocaine and conscious sedation with midazolam and pentazocine or fentanyl. Intravenous broad-spectrum antibiotic prophylaxis was routinely administered 6 hours before the procedure in all patients

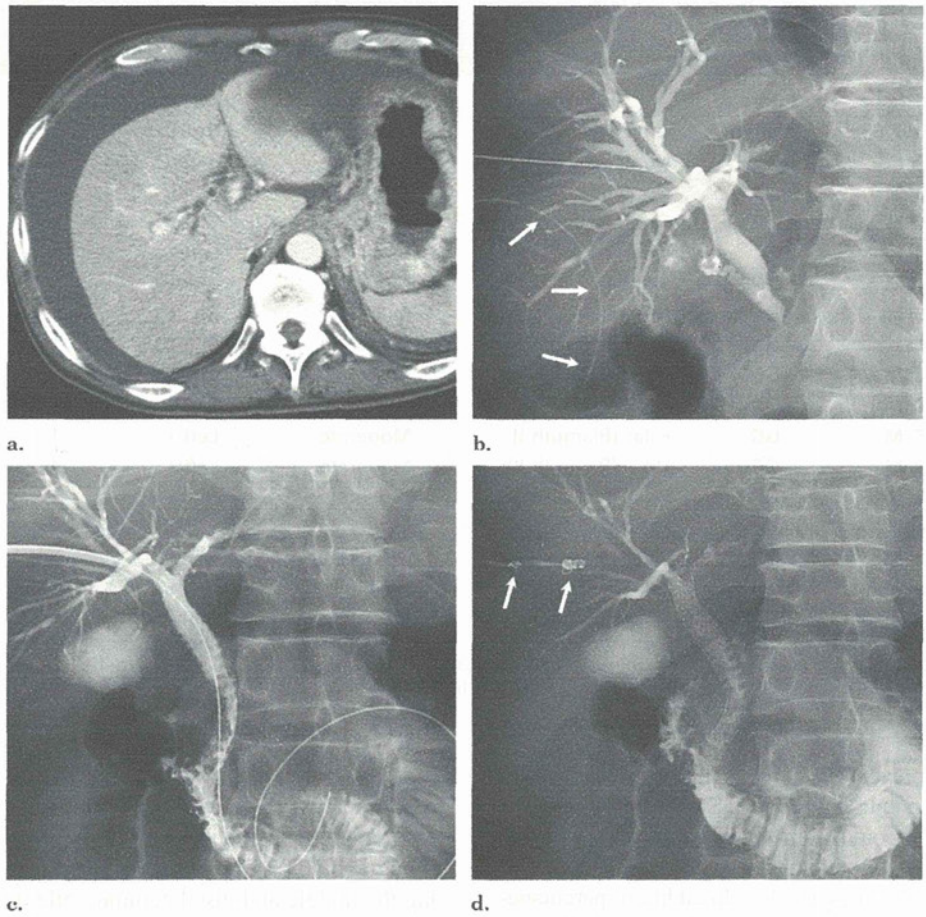



**Figure 1.** Gastric cancer with nodal metastasis in a 65-year-old man (patient 6; Table 1). **(a)** Contrast-enhanced CT before stent placement shows dilated intrahepatic biliary ducts and massive ascites. **(b)** Percutaneous transhepatic cholangiography reveals tight stricture at the distal common bile duct. Note that a 6-F tube was placed around the liver surface (arrows). **(c)** Cholangiography performed after stent placement shows good expansion of the stent and good flow of contrast material through the stent. **(d)** Embolization of the transhepatic tract was performed with metallic coils (arrows).

and continued for as long as 5 days after the procedure. Percutaneous puncture, insertion of the catheter into the intrahepatic biliary duct, and stent placement were performed in a single session without leaving an external drainage catheter. No patients had suspected cholangitis before the procedure, as we performed stent placement only for patients without combined infection. In five of the 16 patients, 6-F catheters were placed around the liver surface to monitor for intraperitoneal hemorrhage during the procedure before PTBD.

The appropriate intrahepatic bile duct was punctured with a 21-gauze needle (Top, Tokyo, Japan) under US guidance, and percutaneous transhepatic cholangiography was then performed to confirm obstruction of the bile duct (**Fig 1b**). After placement of a 6.5-F catheter (Seeking catheter; Hanako, Saitama, Japan) and a 0.035-inch angled hydrophilic guide wire (Radifocus Guide Wire M; Terumo, Tokyo, Japan) past the obstruction and into the duodenum, the overall length of the obstruction was confirmed with injection of contrast material. The guide wire was exchanged for a 0.035-inch guide wire (Amplatz Extra-Stiff Guide Wire; William Cook Europe, Bjaeverskov, Denmark), an introducer sheath (Create Medic, Yokohama, Japan) was inserted to increase the diameter of the tract, and the expandable metallic stent was then placed. Uncovered stents were placed through 7-F sheaths, and covered stents were placed through 10-F sheaths. Covered stents were mainly used in patients with aggressive pancreatic cancer based on operator preference. Seven patients who had common bile duct or Bismuth type I obstructions were each treated with a single stent. There were three patients in whom it was difficult to span the distance with a single stent (**Table 1**). In the six patients with Bismuth type II, III, and IV obstructions, attempts were made to minimize the number of punctures to prevent bile leakage or intraperitoneal hemorrhage as much as possible and to place the minimum number of stents required to drain at least 50% of the liver volume (3). The stents placed in the common bile duct extended 1 cm beyond the papilla of Vater in all patients. All placed stents were fully expanded with predilation (n =

**Table 2.** Outcomes of Patients Undergoing One-Step Biliary Stent Placement with Transhepatic Tract Embolization

| Pt. No. | Clinical Success | Total Bilirubin (mg/dL) | | Complications | Stent Occlusion (d) | Survival (d) | Cause of Death |
|---|---|---|---|---|---|---|---|
| | | Before | After | | | | |
| 1 | Yes | 4.5 | 0.7 | None | NA | 61 | Progression |
| 2 | Yes | 5.4 | 2.7 | None | NA | 74 | Progression |
| 3 | Yes | 10.8 | 0.9 | None | NA | 39 | Progression |
| 4 | Yes | 1.1 | 0.7 | None | NA | 86 | Progression |
| 5 | Yes | 4.8 | 0.7 | Right pleural effusion | NA | 153 | Progression |
| 6 | Yes | 13.4 | 2.3 | None | NA | 66 | Progression |
| 7 | No | 6.4 | 17.4 | Cholangitis | NA | 19 | Complication |
| 8 | Yes | 2.7 | 0.5 | Right pleural effusion | 159 | 175 | Progression |
| 9 | Yes | 12.7 | 3.5 | Bloody bowel discharge | NA | 43 | Progression |
| 10 | Yes | 5.1 | 0.3 | Self-limiting hemobilia | NA | 169 | Progression |
| 11 | Yes | 7.3 | 3.4 | Cholangitis | NA | 33 | Progression |
| 12 | Yes | 8.8 | 0.8 | None | NA | 56 | Progression |
| 13 | Yes | 7.1 | 0.7 | Right pleural effusion | NA | 93 | Progression |
| 14 | Yes | 4.1 | 1.6 | Right pleural effusion | NA | 128 | Progression |
| 15 | Yes | 4.3 | 0.8 | None | NA | 66 | Progression |
| 16 | No | 8.7 | 16.4 | None | NA | 24 | Progression |

Note.—NA = not applicable.

12) or postdilation (n = 8) with 6–10-mm balloon catheters (Synergy [Boston Scientific, Natick, Massachusetts] or Powerflex [Cordis/Johnson and Johnson, Oosteinde, The Netherlands]).

After stent placement, the introducer sheath was replaced by a 6.5-F catheter, confirming good flow of contrast material through the biliary system (**Fig 1c**). The biliary access point and distal end of the transhepatic tract were carefully determined by injecting contrast material. Tract embolization was performed by advancing and tightly packing one to three 0.035-inch metallic coils (5 mm × 5 cm, 4 mm × 3 cm, 3 mm × 4 cm; MReye embolization coil; William Cook Europe) through a 6.5-F catheter. The coils were pushed by using a 0.035-inch wire, and the 6.5-F catheter was gently removed (**Fig 1d**).

## Study Endpoints and Definitions

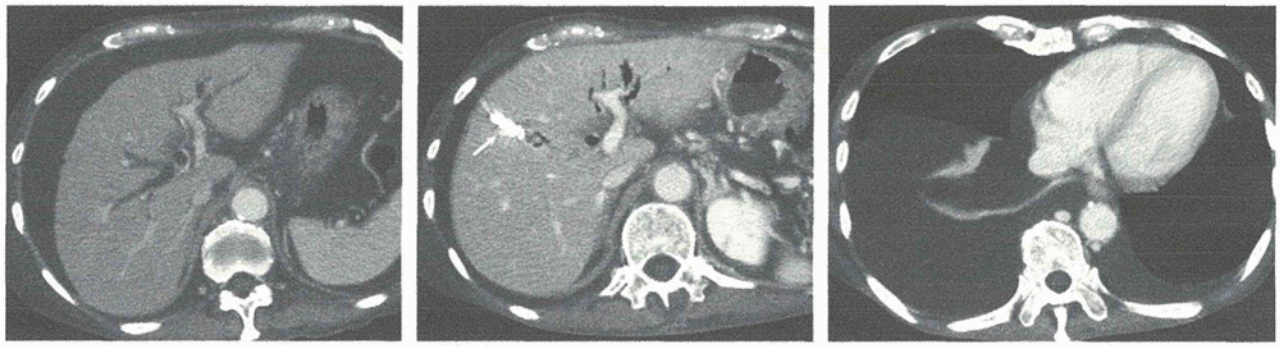
Technical success, clinical success, complications, stent patency, and duration of survival were retrospectively assessed. Technical success was defined as percutaneous transhepatic stent placement in the expected position and successful embolization of the tract without an external drainage catheter left in place. Clinical success was defined as a decrease in serum total bilirubin levels within 30 days of stent placement compared with levels recorded before the procedure. All complications arising from the procedure were divided into major and minor categories according to the reporting standards of the Society of Interventional Radiology (20).

Follow-up, which consisted of clinical examination and laboratory testing, including serum total bilirubin, serum liver enzyme levels, and complete blood count, was performed as needed until the time of death. US examination was performed to assess postprocedural biloma, ascites, and pleural effusion. When total serum bilirubin levels were increased and stent occlusion was suspected, CT or US examination was performed to confirm stent malfunction by dilation of the intrahepatic bile ducts. Stent patency was judged based on the absence of increased total serum bilirubin levels or the absence of dilation of intrahepatic bile ducts on CT or US examination even if total serum bilirubin level was increased. If there was no evidence of stent malfunction during the patient's life, the stent patency period was considered to be equal to the survival period.

# RESULTS

## Technical Success

Stent placement and tract embolization were successful in all patients without leaving an external drainage catheter, and the technical success rate was 100% (**Table 2**). All 16 patients received stent placement via the left (n = 4) or right (n = 12) hepatic lobe approach. Two patients received multiple stent placements through two puncture sites on the right, and one patient received three punctures on the right. In each of the remaining 13 patients, stents were placed through one puncture site. One patient received bilateral stent placement through one puncture site on the right in a "T" configuration. Consequently, a total of 20 transhepatic tracts were embolized. A total of 28 expandable metallic stents were inserted according to availability and operator preference. A total of 21 uncovered stents (Zilver; William Cook Europe) were placed in 11 patients, and seven cov-



a. b. c.

**Figure 2.** Gastric cancer with nodal metastasis in a 57-year-old man (patient 5). **(a)** Contrast-enhanced CT before the procedure shows dilated intrahepatic biliary ducts and massive ascites. **(b)** Contrast-enhanced CT after the procedure revealed improvement of obstructive jaundice and decreased ascitic fluid. Note that the transhepatic tract was tightly packed with metallic coils (arrow). **(c)** Contrast-enhanced CT also showed significantly increased right pleural effusion.

ered stents (VIABIL; W.L. Gore and Associates, Flagstaff, Arizona) were placed in five patients in the common bile duct.

## Clinical Success

Reduction of the total serum bilirubin level compared with the preprocedural level was achieved in 14 of 16 patients, yielding a clinical success rate of 87.5%. The mean total serum bilirubin level before the stent placement was 6.7 mg/dL ± 3.5 (SD) (median, 5.9 mg/dL; range, 1.1–13.4 mg/dL), and that after the stent placement was 3.3 mg/dL ± 5.4 (median, 0.9 mg/dL; range, 0.3–17.4 mg/dL). The mean total serum bilirubin levels after the procedure were significantly lower than those before the procedure ($P = .009$).

Clinical success could not be achieved despite the procedure in two patients (12.5%). In one patient who had a Bismuth type IV obstruction, an additional stent was inserted into another intrahepatic biliary duct 6 days after the initial procedure to achieve drainage of the entire liver; however, the patient died 24 days after the procedure without showing any decrease of serum bilirubin level as a result of hepatic insufficiency caused by multiple liver metastases. The other patient, who had a distal bile duct obstruction, died of cholangitis 19 days after the procedure.

## Complications

Major complications occurred in seven patients (43.7%), and included postprocedural cholangitis with fever and leukocytosis treated by administration of antibiotic therapy in two patients (12.5%), bloody bowel discharge requiring blood transfusion in one patient (6.2%) who had undergone balloon dilation of a biliary stricture, and right pleural effusion in four patients (25.0%). In one patient who died of cholangitis 19 days after stent placement, the death was judged to be a procedure-related mortality. The patient had distal bile duct occlusion and also had distal intestinal obstruction caused by peritoneal dissemination, and developed reflux cholangitis complicated by sepsis after the procedure, resulting in death. All four patients in whom right pleural effusion occurred received stent placement via the right hepatic lobe approach without paracentesis during the procedure. CT examination after stent placement showed increased right pleural effusion and decreased ascites (Fig 2). The pleural effusions were treated successfully by percutaneous drainage and aspiration over a period of 3–5 days. A diagnostic pleural tap from the right chest did not reveal bile, and laboratory testing of pleural effusion did not show increased total bilirubin levels. No peritonitis caused by bile leakage or intraperitoneal hemorrhage occurred in any of the 16 patients.

A minor complication was seen in one patient (6.2%). Self-limited hemobilia was caused by balloon dilation of biliary stricture and confirmed by cholangiography during the procedure. The patient did not require blood transfusion.

## Follow-up

Complete follow-up until death was carried out for all patients. The survival period after stent placement ranged from 19 to 175 days (median, 66 d; mean, 80.3 d ± 50.5). Two patients died within 30 days after the procedure: one accounting for the procedure-related mortality mentioned earlier and another who died 24 days after the procedure because of hepatic insufficiency resulting from multiple liver metastases. The remaining 14 patients died of disease progression.

Of the 14 patients who survived for longer than 30 days after stent placement, three patients (21.4%) showed increased total serum bilirubin levels 37, 46, and 151 days after the procedure. One of these three patients showed stent occlusion, which was confirmed by US examination 159 days after stent placement, and died 175 days after the procedure without any repeat intervention. In the other two patients, no stent occlusion was evident on CT and/or US examination, and the patients died of hepatic insufficiency caused by disease progression 33 and 66 days after stent

placement. Overall, primary stent patency was achieved in 14 of 16 patients (87.5%), and secondary patency was achieved in an additional patient, for a total patency rate of 93.7%.

## DISCUSSION

This study demonstrates that tract embolization for percutaneous biliary metallic stent placement in patients with massive ascites is technically feasible and clinically effective, with a limited number of severe complications. These findings indicate that percutaneous biliary stent placement may be considered as a treatment option even in patients with massive ascites when the endoscopic approach is not feasible or has failed.

In this study, adequate stent placement to cover the stricture was successfully performed in all patients, and tract embolization with metallic coils was also successfully carried out in all patients. Our results also show no evidence of bile peritonitis, subcapsular biloma, or intraperitoneal hemorrhage. These findings suggest that tract embolization is quite useful for preventing bile leakage and bleeding into the peritoneal cavity even in patients with massive ascites, as described in some previously published studies (10–13). Conversely, Thornton et al (18) found that a few patients (5.6%) who received primary metallic biliary stent placement had symptoms of bile peritonitis after catheter removal. The discrepant findings may have come about because most of their patients did not undergo tract embolization (three of 52 patients received primary biliary stent placement), and it was not revealed whether these three patients developed bile peritonitis (18). Although Lammer et al (21) also reported simultaneous deposition of compressed gelatin sponge into the transhepatic tract in uncomplicated cases, they documented no precise number of patients who underwent tract embolization. Nevertheless, Thornton et al (18) speculated that immediate removal of the biliary access facilitated by tract embolization might be desirable, and this would have mandated a new biliary drainage procedure for patients with ascites. The present results clarify their speculation.

We used metallic coils to embolize transhepatic tracts because they can be delivered precisely and placed tightly in the appropriate location, although other embolic materials, including gelatin sponges (10), n-butyl cyanoacrylate (11,12,14), AMPLATZER Vascular Plugs (15), and metallic coils (13) have also been used. The use of gelatin sponge or n-butyl cyanoacrylate poses a risk of material migration into the biliary tree, possibly resulting in biliary obstruction, and incomplete embolization of the tract. The AMPLATZER Vascular Plug is reasonable to use in the transhepatic tract but is comparably expensive. In addition to complete tract embolization, optimization of bile flow by full expansion of the stents is crucial in the authors' opinion for the prevention of bile reflux; however, this could not be definitively proven by the present study.

By contrast, a significant right pleural effusion developed in four of 12 patients who were treated by a right hepatic lobe approach without paracentesis. We assume that transpleural puncture associated with the use of a right hepatic lobe approach leads to the leakage of ascites into the pleural cavity. This may have been prevented by a left hepatic approach or large-volume paracentesis before the procedure. In addition, we encountered one patient who died of postprocedure cholangitis. A possible reason is that all the patients in the present study had more advanced disease and were in poorer general condition than patients in other published reports, and this condition predisposed them to lethal complications. This possibility indicates that early infection potentially leads to death in such patients who have advanced disease.

The 87.5% clinical success rate of biliary stent placement in the present study is comparable to those of others (2–5,8). It should be noted that, despite successful drainage of the entire liver, one of two patients who showed clinical failure died of hepatic insufficiency caused by multiple liver metastases. This outcome highlights the fact that biliary intervention does not always lead to clinical improvement in patients with extremely advanced disease, even if adequate drainage can be achieved.

The median and mean survival durations after stent placement in the present study were 66 days and 80.3 days, respectively. This may be attributable to the poor clinical status of the patients in the study. These patients had extremely advanced malignancies, most of which not of hepatobiliary/pancreatic origin. These results are consistent with those reported by Thornton et al (18) and Meller et al (21), who reported poorer survival after biliary stent placement in non–hepatobiliary/pancreatic malignancies than in hepatobiliary/pancreatic malignancies. We consider that primary stent placement with tract embolization might have been beneficial for patients with ascites and a limited survival period, because it provides 100% catheter-free survival and eliminates lifestyle limitation and potential complications such as insertion-site pain, catheter dislodgment, and pericatheter leakage of bile or ascites related to the presence of an external drainage catheter (18). It would be difficult to assess the true stent patency rate because of the short observation of the limited survival period.

The present study has limitations. First, the study design was retrospective, and the sample size was small. However, we are aware of no published that have investigated the efficacy of primary percutaneous biliary stent placement in patients with massive ascites except for one case report (11). The second limitation was the lack of long-term follow-up as a result of the patients' short life expectancies, which limited assessment of long-term stent patency. Finally, no real evaluation of the tract for bile leakage was undertaken in any sort of systemic manner; only a diagnostic tap of ascites and patient-reported abdominal pain were assessed. Despite these limitations and the slightly higher rate of complications than in other studies, we believe percutaneous stent placement with tract embolization in a single session may be an important treatment

option for patients with obstructive jaundice that cannot relieved by endoscopic intervention, in addition to massive ascites.

In conclusion, we report that primary biliary stent placement with coil embolization of the tract is technically safe in patients with massive ascites. It offers an effective palliative treatment option for malignant biliary obstruction when endoscopic intervention is not possible.

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BRIEF REPORT

# Anchoring System–Assisted Coil Tract Embolization: A New Technique for Management of Arterial Bleeding Associated with Percutaneous Nephrostomy

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## ABSTRACT

Anchoring system–assisted coil tract embolization (AACTE), a new nonvascular treatment technique for massive bleeding associated with percutaneous nephrostomy (PCN), consists of packing the tract with embolization coils, with a balloon catheter used as an anchoring system. After arterial bleeding associated with PCN was successfully treated with AACTE in three patients, no severe complications were noted, and renal function was not affected. AACTE is a potentially useful and safe method for management of vascular complications associated with nephrostomy.


## ABBREVIATIONS

AACTE = anchoring system–assisted coil tract embolization, PCN = percutaneous nephrostomy

Percutaneous nephrostomy (PCN) is a well established procedure with a technical success rate greater than 90% even in nondilated renal systems (1,2). Complications of PCN include pain, sepsis, bleeding, damage to adjacent organs, and renal pelvic injuries. Acute bleeding that requires blood transfusions has been regarded as the most life-threatening event associated with PCN, occurring in 2%–4% of patients during this procedure (1,2).

Most patients with persistent venous bleeding can undergo conservative management with deployment of a larger-caliber catheter as a tamponade or placing the patient in a supine position (3,4), although transcatheter arterial embolization may be required in severe cases of arterial damage (1,2,5–7). Although contrast agent allergies and impaired renal function are unfavorable conditions for transcatheter arterial embolization, life-threatening bleeding takes precedence over dialysis, and intervention should be performed. In this article, a new method for treatment of arterial bleeding associated with PCN consisting of an anchoring system–assisted coil tract embolization (AACTE) technique is reported.

## MATERIALS AND METHODS

The institutional review board of our institution approved a retrospective medical record research study to review the results of AACTE. Informed consent was obtained from each patient before the implementation of AACTE. This report was conducted in accordance with the amended Declaration of Helsinki.

Patient records were retrospectively reviewed during a 4-year period (January 2007 to December 2010), during which 158 PCNs were performed in 146 patients (92 men and 54 women; mean age, 52 y) in our department (National Cancer Center Hospital and Gunma University Hospital).

The renal systems were dilated in all cases, and PCN was performed to relieve urinary obstructions of benign or malignant nature. The mean serum creatinine level was 4.1 mg/dL (range, 3.5–8.2 mg/dL). The mean follow-up period was 62 days (range, 5–211 d) after PCN. In all patients, coagulopathy was corrected before the procedure.

In all patients who underwent PCN, the calyx of the

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**Table.** Characteristics of the Three Patients Treated by AACTE

| Pt. No. | Age (y) | Primary Disease | Coils Used | Follow-Up (d) | Prothrombin Time (%) | Platelets ($10^3$/mm$^3$) | Creatinine (mg/dL) |
|---|---|---|---|---|---|---|---|
| 1 | 62 | Bladder carcinoma | 6 | 62 | 90 | 20.1 | 4.1 |
| 2 | 60 | Gastric carcinoma | 7 | 94 | 75 | 12.8 | 4.9 |
| 3 | 49 | Esophageal carcinoma | 7 | 74 | 55 | 9.1 | 6.1 |

Note.—All patients were male. Patient 2 had a history of a major allergic reaction to contrast media. AACTE was performed on the right kidney in all patients. AACTE = anchoring system-assisted coil tract embolization.

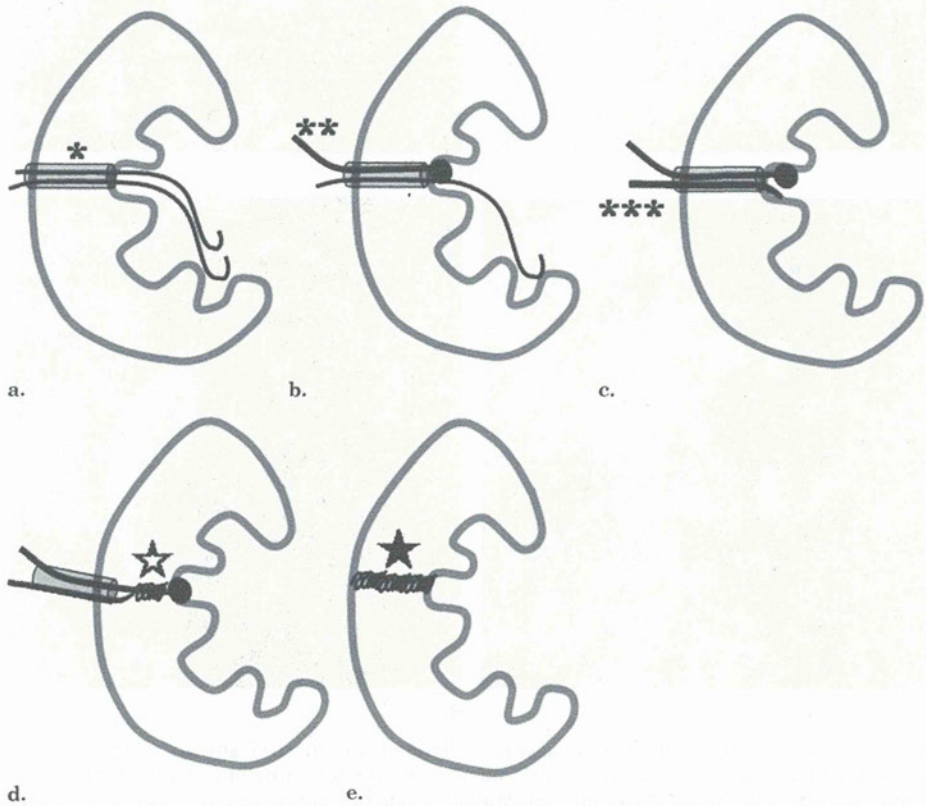


**Figure 1.** Schematic diagram of AACTE. The PCN tube is exchanged with the 10-F sheath (single asterisk). The sheath is kept in place with two guide wires **(a)**. A balloon catheter (double asterisks) is used as an anchoring device **(b)**. A 6.5-F catheter (triple asterisks) is advanced over the guide wire **(c)**, and metallic coils (white star) are released through the 6.5-F catheter **(d)**. Multiple metallic coils (black star) are packed as tightly as possible in the PCN tract **(e)**.

kidney was punctured with a 17-gauge needle (PTC needle; Hakko, Tokyo, Japan) under ultrasound (US) guidance. A 0.035-inch J-shaped guide wire (Fixed Core Wire Guides, Safe-T-JR Curved; Cook, Bloomington, Indiana) was then advanced through the 17-gauge needle. After tract dilation over the guide wire, a 10-F PCN tube (Malecot catheter; Bard, Salt Lake City, Utah) was advanced over the guide wire.

There were eight patients with suspected vascular injuries associated with PCN; this suspicion was based on continued blood flow from the PCN tract and a decrease in hemoglobin level of more than 2.0 mg/dL (range, 2.0–5.1 mg/dL) was noted. It was difficult to distinguish between arterial and venous injuries. A total of five of these patients recovered after the 10-F nephrostomy tube was used to apply tamponade, and AACTE was employed in three patients who had hydronephrosis of a single functioning kidney. One of these patients (patient 2) had a history of a major allergic reaction to iodinated contrast media. In these three patients, the 10-F nephrostomy tube was changed to a 12-F nephrostomy tube, and the nephrostomy tube was clamped to apply tamponade to temporarily improve the situation. However, the bleeding was not controlled, and arterial bleeding was suspected based on the presence of a forceful flow of pulsatile blood from the PCN tract. Characteristics of the three patients are listed in the **Table**. In

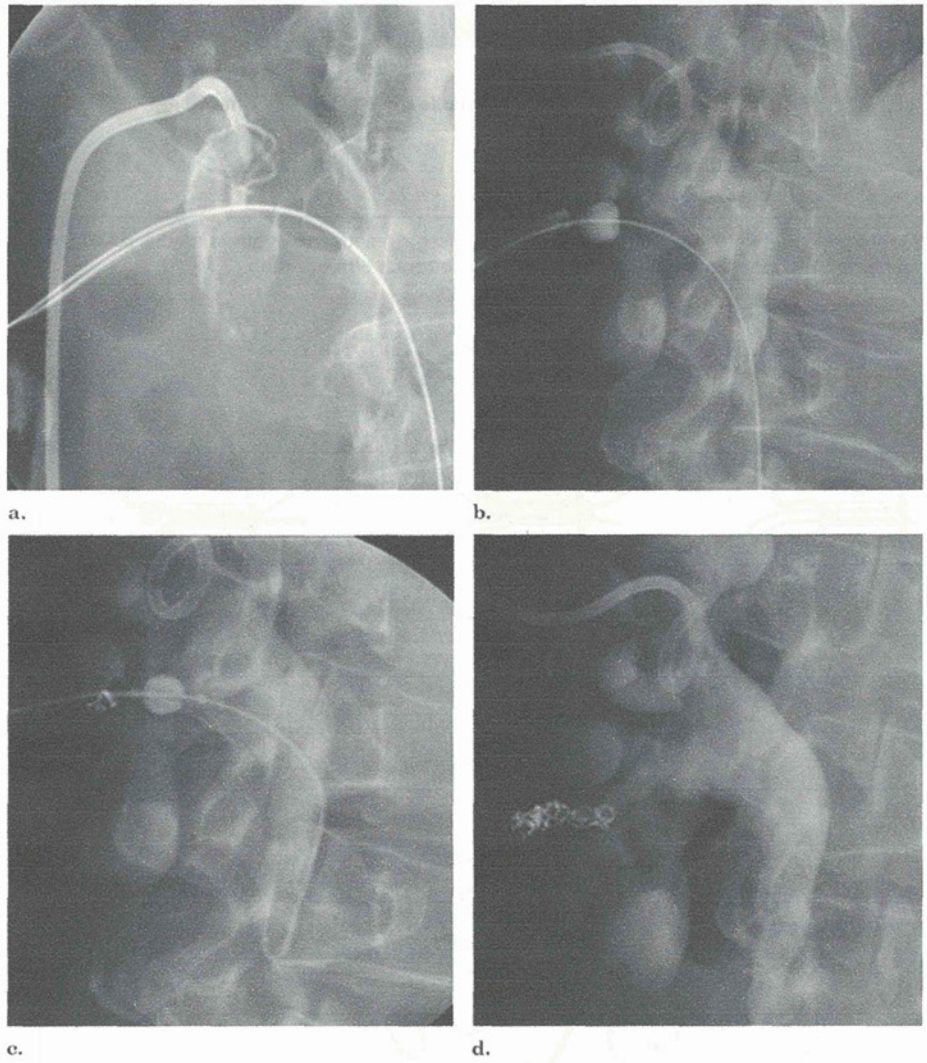


**Figure 2.** Radiographic images of AACTE. The PCN tube was exchanged with the 10-F sheath, which was kept in place with two guide wires **(a)**. A balloon catheter was used as an anchoring device **(b)**. A 6.5-F catheter was advanced over the guide wire, and metallic coils were released through the 6.5-F catheter **(c)**. Multiple metallic coils were packed as tightly as possible in the PCN tract **(d)**.

patient 1, bleeding through the PCN tube was initiated at the time of tract dilation for PCN insertion, and AACTE was attempted immediately. In patients 2 and 3, sudden massive bleeding from PCN commenced on postoperative days 3 and 17, respectively. AACTE was performed on postoperative days 5 and 19, respectively. Patient 3 refused treatment at first, and subsequently developed hemorrhagic shock with 800 mL of blood loss.

AACTE was performed under local anesthesia by using a 0.035-inch J-shaped guide wire inserted into the 10-F PCN tube under fluoroscopy guidance. The tube was then exchanged with a 10-F sheath (Super Sheath; Medikit, Tokyo, Japan). Another 0.035-inch J-shaped guide wire was inserted through the sheath after the first guide wire had been secured; thus, two guide wires kept the route open (**Figs 1a, 2a**). As an anchoring device, a 5-F balloon catheter (9-mm-diameter Selecon MP Catheter II; Terumo/Clinical Supply, Gifu, Japan) was advanced into the renal pelvis over the guide wire and placed as close as possible to the renal pelvic wall to prevent coil migration into the renal pelvis (**Figs 1b, 2b**). This device marked the pelvic side of the bleeding tract and was kept in place during the entire coil deployment. Traction on the occlusion catheter was only intermittently required. The other guide wire was used for insertion of a 6.5-F catheter (Seeking catheter; Hanaco, Saitama, Japan; **Fig. 1c**). After the 10-F sheath was extracted, a tractogram was performed through the sheath to visualize the bleeding point and the edge of the kidney. Metallic coils (0.035-inch, 5 mm × 5 cm; MReye embolization coil; Cook) were packed as tightly as possible in the bleeding tract through a 6.5-F catheter (**Fig 1c, 1d**) until no arterial bleeding was observed through the catheter. The

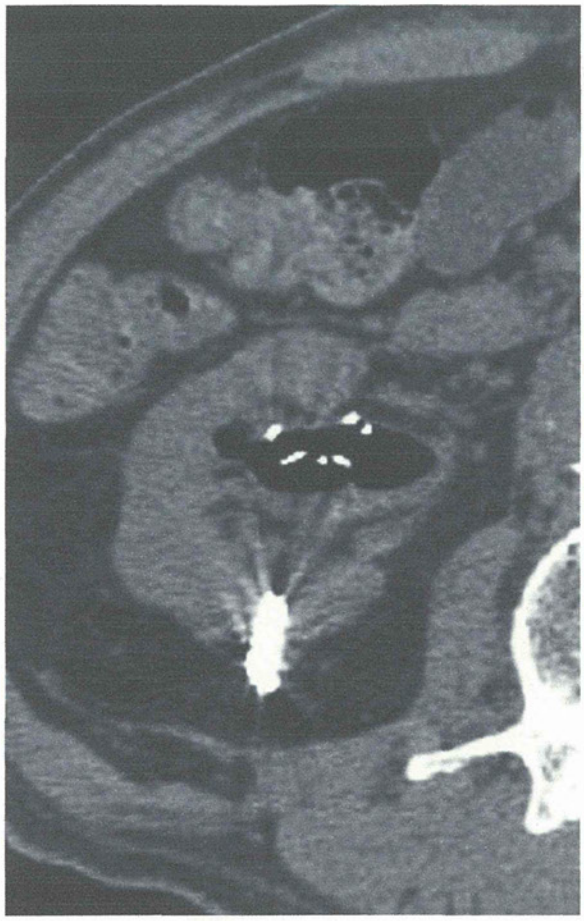

**Figure 3.** CT image of the right kidney in patient 3 on day 3 after AACTE. Appropriate placement of coils in the PCN tract was confirmed. The coils were also in the perirenal fat. The location of these coils outside the renal parenchyma very closely corresponded to that seen on a final tract image obtained at the time of AACTE.

coils were pushed with a 0.035-inch wire. The two catheters were then removed gently so as not to displace the coils (**Figs 1e, 2d**). The balloon catheter was removed over a wire to maintain access in case coils were displaced. After enough coils had been placed, there was no profuse bleeding through the tract after the sheath had been removed. A new PCN tube was inserted by US guidance from another route.

## RESULTS

In all three cases, hemostasis was achieved immediately after the AACTE, and a decrease in serum creatinine level to less than 2.0 mg/dL (range, 1.5–1.9 mg/dL) was noted on day 7 after the procedure. Unenhanced computed tomography (CT) of the abdomen just after the procedures confirmed appropriate coil placement in the renal parenchyma (**Fig 3**) in all three cases. No recurrent bleeding events occurred during the follow-up periods (range, 62–94), and no serious complications (eg, renal infarction, renal abscess formation, or migration of coils) were observed on follow-up CT examinations.

## DISCUSSION

AACTE was successful as a nonvascular method for managing active hemorrhage after PCN and was performed without any serious complications. To our awareness, there have been two reports of successful transrenal embolization therapy with steel coils placed in the damaged vessels and in the percutaneous tract (8,9). However, those procedures are extremely unusual to enter arterial branches, and therefore those techniques have not been widely used. To the best of our knowledge, AACTE is a novel technique for nonvascular treatment of patients with arterial bleeding associated with PCN.

There are some technical points of AACTE to consider. First, the tract must be totally embolized, and the coils should be placed as tightly together as possible, as the point of bleeding cannot usually be identified in the course of the tract. Second, dislodgment of the coil into the ureter should be prevented, as this may result in renal dysfunction. In the patients described herein, coils were placed tightly in the tract, preventing coil migration into the ureter, by using an anchoring system. Third, two guide wires were inserted into the tract, one for marker device (balloon catheter) insertion and the other for tract embolization.

There are limitations associated with AACTE. First, this method is not useful when the bleeding source is outside of the extraparenchymal area of the kidney. Fistulography of the bleeding tract might be helpful for identifying the bleeding source, but, because of the pressure gradients, these do not always show the bleeding source (1). Second, ACCTE, like transcatheter arterial embolization, might include a risk of renal infarctions despite the fact that it is a nonvascular technique. Peripheral arterial communications in the renal artery may compensate for this problem (10). However, it is also possible that renal artery collaterals will cause persistent bleeding, and the ACCTE technique may work for delayed pseudoaneurysm formation. Third, percutaneous tract embolization is not advocated as the standard method of controlling hemorrhage because of possible injury to a renal artery after nephrostomy. Transcatheter arterial embolization should be considered immediately as an alternate treatment because of its safety and efficacy in acute settings in patients with arterial lesions after percutaneous renal surgery (5,8).

The present study has a small sample size, and the evaluation of long-term follow-up was insufficient. A longer follow-up period in a larger sample size would improve the evidence of efficacy of this new technique.

In conclusion, three cases of successful tract embolization by AACTE for arterial bleeding associated with PCN are reported. The AACTE technique is a safe and poten-

tially useful method for management of vascular complications associated with nephrostomy.

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JOURNAL OF MEDICAL CASE REPORTS

CASE REPORT Open Access

# Ultrasound-guided thrombin injection for the treatment of an iatrogenic hepatic artery pseudoaneurysm: a case report

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## Abstract

**Introduction:** Percutaneous transhepatic portal embolization is often performed to expand the indications for hepatic resection. Various etiologies of hepatic artery pseudoaneurysm have been reported, but regardless of the etiology, hepatic artery pseudoaneurysm is usually managed with an endovascular approach or open surgery, depending on the location and clinical symptomatology. However, it is difficult to manage hepatic artery pseudoaneurysm after percutaneous transhepatic portal embolization, since embolization of the hepatic artery may cause hepatic infarction

**Case presentation:** A 58-year-old Japanese man with hilar bile duct cancer underwent percutaneous transhepatic portal embolization to expand the indication for hepatic resection. Two days after percutaneous transhepatic portal embolization, our patient suddenly complained of abdominal pain. Contrast-enhanced computed tomography confirmed a pseudoaneurysm arising from a segmental branch of his right hepatic artery. Since embolization of the hepatic arterial branches may cause hepatic infarction, ultrasound-guided thrombin injection therapy was successfully performed for the pseudoaneurysm.

**Conclusion:** We performed a thrombin injection instead of arterial embolization to avoid hepatic infarction. The rationale of this choice may be insufficient. However, ultrasound-guided percutaneous thrombin injection therapy may be considered as an alternative to percutaneous transarterial embolization or surgical intervention for an iatrogenic hepatic artery pseudoaneurysm.

## Introduction

Percutaneous transhepatic portal embolization (PTPE) is often performed to expand the indications for hepatic resection. Various etiologies of hepatic artery pseudoaneurysm (HAP) have been reported, but regardless of the etiology, HAP is usually managed with an endovascular approach or open surgery, depending on the location and clinical symptomatology. However, it is difficult to manage HAP after PTPE, since embolization of the hepatic artery may cause hepatic infarction. We herein describe a case of PTPE complicated by a HAP, in which the HAP was successfully managed with an ultrasound (US)-guided thrombin injection technique.

## Case presentation

A 58-year-old Japanese man with hilar bile ductal carcinoma underwent preoperative PTPE to expand the indication for right hepatic resection. We punctured the anterior branch of his right portal vein with a 21-gauge needle under US-guidance. A 5-Fr sheath was advanced into the portal branch and a 5-Fr balloon catheter was inserted into the anterior and posterior branches of his right portal vein. After inflating the balloon, absolute alcohol was injected. A portography confirmed the complete occlusion of these portal branches. Finally, two 5 mm × 5 cm 0.035-inch coils were deployed to perform tract embolization after PTPE. During these procedures our patient was asymptomatic.

Two days later, our patient suddenly complained of an acute abdominal pain, but his vital signs remained stable. A contrast-enhanced computed tomography (CT) confirmed the presence of a pseudoaneurysm arising from a

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