

Clinical evaluation of endoscopic ultrasonography-guided drainage using a novel flared-type biflanged metal stent for pancreatic fluid collection

Shuntaro Mukai, Takao Itoi, Atsushi Sofuni, Takayoshi Tsuchiya, Takuji Gotoda, Fuminori Moriyasu
Department of Gastroenterology and Hepatology, Tokyo Medical University, Tokyo, Japan

ABSTRACT

Background and Objectives: Endoscopic ultrasonography (EUS)-guided transluminal drainage for pancreatic fluid collections (PFCs) has become the standard therapy worldwide as a minimally invasive therapy compared with surgical drainage. Recently, a novel flared-type biflanged metal stent (BFMS) designed specifically for the treatment of PFCs has been developed. The aim of this study was to retrospectively assess the feasibility and safety of EUS-guided drainage and direct endoscopic necrosectomy (DEN) for PFCs using the novel flared-type BFMS. **Patients and Methods:** Twenty-one patients were treated by EUS-guided drainage using a flared-type BFMS for PFCs (pancreatic pseudocyst, 2 patients; walled-off necrosis, 19 patients). **Results:** The present study showed a technical success rate of 100%, a final clinical success rate of 100%, a procedure-related adverse event (AE) rate of 0%, an early AE rate of 28.6% (moderate and severe AE rate of 9.5%), a mortality rate of 0%, and a recurrence rate of 9.5%. DEN (mean, 2.3 sessions) was required in 38% of the patients. **Conclusion:** The present study clarified that the EUS-guided drainage using the flared-type BFMS is an effective and safe treatment approach for PFCs. Further studies using randomized controlled multicenter trials are warranted.

Key words: Biflanged metal stent, endoscopic ultrasonography-guided drainage, pancreatic fluid collection, walled-off necrosis

INTRODUCTION

Currently, endoscopic ultrasonography (EUS)-guided transluminal drainage using the placement of 1 and more plastic stents (PSs) or a nasocystic catheter for pancreatic fluid collections (PFCs), which includes pseudocysts and walled-off necrosis (WON), has become a standard minimally invasive therapy worldwide compared with surgical drainage.^[1-3] However, apart from pseudocyst, WON contains necrotic debris, which

often requires aggressive therapy like direct endoscopic necrosectomy (DEN) for the removal of necrotic tissue to improve inflammation.^[4,5]

At present, EUS-guided drainage for PFCs using a large-bore fully covered biliary self-expandable tubular metal stent has been developed.^[6,7] A tubular metal stent is easier to place than multiple PSs. Furthermore, sufficient drainage is expected, and quick fistula formation appears to be promoted. However, longer tubular stents need to be used to prevent displacement and migration. In addition, when a metal stent is removed before DEN, it is mandatory to replace multiple PSs after DEN to keep the fistula for the next session of DEN. Recently, a novel metal stent, which is a fully covered and biflanged metal stent (BFMS) designed specifically for the treatment of PFCs, has

Access this article online

Quick Response Code:



Website:

www.eusjournal.com

DOI:

10.4103/2303-9027.156738

Address for correspondence

Dr. Shuntaro Mukai, Department of Gastroenterology and Hepatology, Tokyo Medical University, 160-0023 Nishishinjuku 6-7-1, Shinjuku-ku, Tokyo, Japan. E-mail: maezora1031@yahoo.co.jp

Received: 2014-08-15; Accepted: 2014-09-21

been developed.^[8-12] It is a dedicated and short-length metal stent for PFCs and allows sufficient drainage. The feasibility and safety of this stent for the treatment of PFCs have been reported.^[13]

Biflanged metal stent is divided into two types: A lumen-apposing type BFMS^[8-10,12] and a flared-type BFMS (not a lumen-apposing BFMS).^[11] At present, few reports concerning EUS-guided drainage using BFMS are available. In this study, we retrospectively assessed the feasibility and safety of EUS-guided drainage for PFCs using the novel flared-type BFMS.

PATIENTS AND METHODS

Twenty-one patients were treated by EUS-guided drainage using a flared-type BFMS for PFCs (pancreatic pseudocyst [PPC], 2 patients; WON 19 patients) between June 2011 and May 2014 at a single institution (Tokyo Medical University Hospital). PFC was diagnosed on the basis of the medical history and findings from EUS, computed tomography (CT) and magnetic resonance imaging, following the revised Atlanta classification.^[14] All patients provided written informed consent. The use of a flared-type BFMS for PFC drainage was approved by our Institutional Review Board.

Eligibility criteria

Regarding PFC, our general criteria for EUS-guided drainage are as follows:

1. Infected PPC or WON,
2. Sterile PPC or WON with an increase in the size of the collection or worsening symptoms, and
3. PPC or WON that is near the stomach or duodenum and is punctured safely.

In addition, since the length of the current flared-type BFMS between 2 flanges is 20 mm or 30 mm, our criteria for EUS-guided drainage using the flared-type BFMS are follows:

1. The size of the cavity is >30 mm, and
2. The distance between the gastrointestinal (GI) tract and the cavity measured under EUS is >20 mm.

The novel flared-type biflanged metal stent

The flared-type BFMS (Niti-S Nagi stent, Taewoong Medical Co., Seoul, Korea) is a novel fully covered metal stent developed for EUS-guided drainage, in which the diameter of the stent is 16 mm and the length is 20 mm or 30 mm [Figure 1]. This stent is made of nitinol wire and is fully covered with a silicon membrane. Both ends

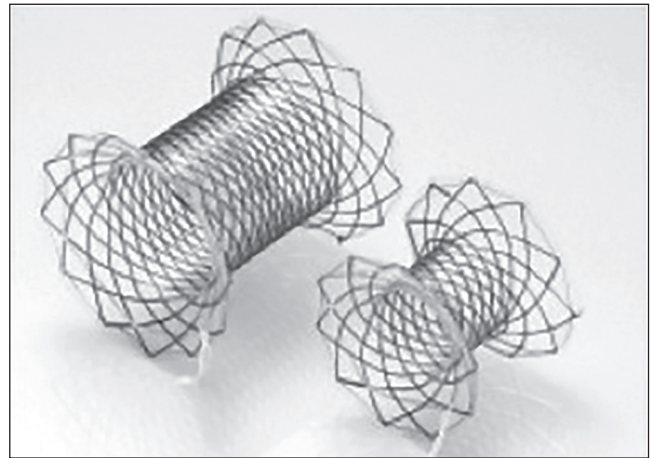


Figure 1. The novel flared-type biflanged metal stent (fully covered self-expandable metal stent, Niti-S Nagi stent, Taewoong Medical Co., Seoul, Korea)

take the form of a flared-type stent, and the diameter of a flared region is 26 mm. Both ends fix a GI tract wall and a cyst wall, and prevent migration of the stent. The stent length is short, and the stability is sufficient to insert a normal upper gastric endoscope into the cyst. A retrieval suture is attached to the GI tract side, and stent removal can be easily carried out. The delivery sheath is 10 Fr, thus, the stent can be inserted through the working channel of an echoendoscope. In addition, the delivery system is as simple as a conventional biliary metal stent.

Procedures

The study involved the use of a conventional curved linear array echoendoscope with a 3.7 mm-diameter accessory channel (GF-UCT240 or GF-UCT260, Olympus Medical Systems, Tokyo, Japan). A 19-gauge needle for EUS-guided fine-needle aspiration was used to puncture the PFC under EUS-guidance with a color Doppler to avoid intervening blood vessels. If several cavities were separated, the largest cavity was punctured. A 0.035-inch guidewire was placed into the cyst. Then, until 2011, the tract was dilated over a guidewire using a rigid dilator (6-Fr Sohendra dilator catheter, Cook Endoscopy, Winston-Salem, N.C., USA) and a 4-6 mm dilating balloon (Hurricane, Boston Scientific Japan, Tokyo, Japan). As of 2012, the tract was dilated using electrocautery (6-Fr Cysto-Gastro Sets, Endo-Flex GmbH, Dusseldorf, Germany) and a 4-6 mm dilating balloon. After dilation of the tract, the delivery sheath was advanced into the cyst over the wire. The distal flange was deployed under EUS and fluoroscopic guidance. Next, after slowly pulling the delivery sheath through to the point in which the stent was aligned with the internal cavity of the cyst,

the fistula was identified on the endoscope view while slowly pulling on the echoendoscope. Then, after the proximal flange was deployed, the fluid inside the cyst was drained all at once, demonstrating the effectiveness of a large-bore stent for drainage. The selection of the stent length (20 mm or 30 mm) was determined by the distance between the GI tract and the cavity. The placement location of a 5-Fr or 6-Fr nasocystic catheter (Hanako Medical, Tokyo, Japan) for irrigation was left to the operator's discretion. When inadequate drainage occurred after EUS-guided drainage with the BFMS, DEN was performed the following day. A standard upper GI endoscope was directly advanced through the stent into the cavity without dilation of the tract. Necrotic tissue was removed using stone retrieval baskets, biopsy forceps, and snare forceps while using CO₂ insufflation [Figure 2]. The endpoint of DEN was the relief of symptoms and systemic inflammatory response syndrome. The procedure time for DEN was limited to 1 h per procedure and DEN was performed twice a week.

After confirming the size reduction of the collection on CT, the BFMS was removed using a snare or biopsy forceps. If possible, the BFMS was exchanged for 1 or more 7-Fr double-pigtail PSs (Zimmon Biliary Stent Sets, Cook Endoscopy, Winston-Salem, N.C., USA). The deployed PSs were left permanently in place to reduce recurrence risk.

Evaluation of therapy

Technical success was defined as successful BFMS placement. Clinical success was defined as disappearance of symptoms or inflammation regardless of collection size. Adverse events (AEs) were classified into two types: Procedure-related and early (within 1 month of the procedure). AEs were graded according to the severity grading system of the American Society for Gastrointestinal Endoscopy lexicon.^[15]

RESULTS

All patient characteristics are presented in Table 1. EUS-guided drainages using flared-type BFMSs for 21 symptomatic sterile or infected PFCs were performed. The most common etiology in this study was alcoholism.

Treatment outcomes are presented in Table 2. In all the patients, the flared-type BFMS was successfully deployed under EUS guidance without procedure-related

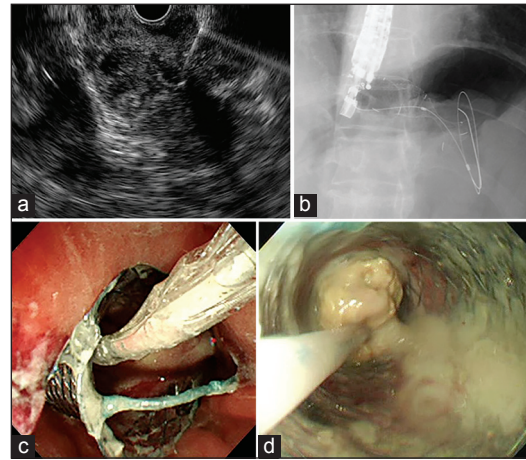


Figure 2. (a) Walled-off necrosis, which contained a large amount of necrotic tissue, was punctured with a 19-gauge aspiration needle under the guidance of a convex ultrasound endoscope; (b) a novel flared-type biflanged metal stent (BFMS) was placed after the fistula was dilated with a cautery dilator and a dilatation balloon; (c) endoscopic view after the stent placement. The necrotic fluid was drained through the stent all at once; (d) an upper gastrointestinal endoscope was inserted into the cyst through the BFMS and necrosectomy was performed under endoscopy

Table 1. Patient characteristics (n = 21)

Characteristic	Value
Mean age (years)±SD	57.3±19.3
Range (years)	31-95
Sex	
Male	17
Female	4
Etiology	
Gallstone	4
Alcoholism	11
Tumor	1
Idiopathic pancreatitis	4
Other	1
Diagnosis	
Infected pancreatic pseudocyst	2
Sterile WON	9
Infected WON	10
Morphology of cyst	
Unilocular	13
Multilocular	8
Location of the main lesion	
Pancreatic head	5
Pancreatic body	10
Pancreatic tail	6
Mean size of a long axis of the lesion (mm)±SD	91.1±32.2
Range (mm)	30-155

SD: Standard deviation, WON: Walled-off necrosis

complications. In eight patients with PFCs (8/21, 38%), additional DEN was required. In all the eight patients, DEN was performed by inserting a standard upper GI endoscope directly through the deployed BFMS successfully, contributing to the complete resolution

Table 2. Treatment outcomes of EUS-guided drainage using a flared-type BFMS (n = 21)

Characteristic (%)	Value
BFMS and nasocystic catheter in EUS-guided drainage	
BFMS (20 mm)	3
BFMS (20 mm)+nasocystic catheter	3
BFMS (30 mm)	12
BFMS (30 mm)+nasocystic catheter	3
Drainage route in EUS-guided drainage	
Transgastric	20
Transduodenal	1
DEN, number	8 (38)
Mean number of sessions of DEN	2.3±1.9
Range	1-6
Mean procedure time of first EUS-guided drainage (min)	27.7±7.7
Range	20-46
Mean duration of hospital stay (days)	23.7±18.1
Range	4-69
Technical success, number	21 (100)
Final clinical success, number	21 (100)
Adverse event, number	6 (28.6)
Mild	
Migration of BFMS after treatment	4
Moderate	
Bleeding from the cavity (oozing)	1
Severe	
Bleeding from the cavity (rupture of pseudoaneurysm)	1
Mortality, number	0 (0)
Stent removal, number	16 (76.2)
Removal only	5
Exchange for 7-Fr PS	11
Mean time to stent removal (days)	43.1±20.1
Range	14-90
Recurrence, number	2 (9.5)

EUS: Endoscopic ultrasonography, BFMS: Biflanged metal stent, DEN: Direct endoscopic necrosectomy, PS: Plastic stent

of PFCs and symptom relief. The final clinical success rate was 100% in PFC patients (21/21). Endoscopic retrograde pancreatography (ERP) was performed after EUS-guided drainage and DEN in four patients. Pancreatic duct disruption was not observed in ERP. However, transpapillary placements of pancreatic duct stents were performed in two patients due to their pancreatic duct strictures.

There were no procedure-related AEs. However, bleeding from the cavity as an early AE occurred in two PFC patients. In one patient, oozing bleeding from the cavity wall occurred 7 days after drainage, and endoscopic hemostasis was performed by argon plasma coagulation. In the other patient, severe bleeding from the cavity due to the pseudoaneurysm rupture occurred 7 days after the first DEN session. Emergency interventional radiologic procedures were

performed, and hemostasis was achieved by coil embolization.

In 16 PFC patients (16/21, 76.2%), the BFMS was successfully removed after the confirmation of complete resolution following a CT mean time of 43 days (range: 14-90 days) after treatment. The BFMSs were left in place in one advanced pancreatic cancer patients. The BFMSs had spontaneously migrated into the stomach without causing any symptoms in four PFC patients (4/21, 19%), and they were retrieved endoscopically. The BFMS was exchanged for 1 or 2, 7-Fr double-pigtail PSs to prevent recurrence in 11 of the PFC patients (11/16, 68.8%). PFC recurred in 2 patients (2/21, 9.5%) in whom 7-Fr double-pigtail PSs had not been placed at the removal of BFMS. In one patient, the recurrence of PPC due to minor pancreatic leak was occurred with symptom of abdominal pain 4 months after the initial treatment. In ERP, pancreatic duct disruption was not observed, and EUS-guided drainage using a PS and a nasocystic catheter was performed again. In the other patient, mild acute pancreatitis and small PPC due to papillary mucosal dysfunction were occurred 5 months after the initial treatment. In ERP, pancreatic duct disruption was not observed, and endoscopic pancreatic sphincterotomy was performed for the purpose of preventing a recurrence of pancreatitis.

DISCUSSION

In the present study, we demonstrated that the EUS-guided drainage using a flared-type BFMS is an effective and safe treatment approach for PFCs with its high technical and clinical success rate and low AE rate. EUS-guided drainage, irrigation, and DEN using multiple PSs and a nasocystic catheter have improved the endoscopic treatment success rate for PFCs. However, a high rate of complications of these therapies, such as migration, peritonitis, or bleeding, has been reported, particularly in infected WON patients.^[16] Thus, more effective and safe treatment methods or endoscopic accessories have been required to date.

The clinical success rate in this study (21/21, 100%) was slightly better than the treatment results of EUS-guided drainage and DEN using double pigtail PSs in the previous literature (22/25, 88%) with similar AEs. Besides, the clinical success rate of EUS-guided drainage only in this study (13/21,

62%) was also better than the treatment results of EUS-guided drainage using double pig-tail PSs in the previous literature (9/20, 45%).^[17] Several advantages of using a larger diameter BFMS compared with conventional PS placement are as follows. First, the procedure with the placement of only 1 BFMS is easier than that with the placement of multiple PSs with or without the nasocystic catheter. Thus, BFMS placement may lead to fewer numbers of sessions and reduce the procedure time compared with PS placement, potentially reducing the number of AEs and improving the safety of endoscopic treatment. Second, more sufficient drainage is expected because of the large diameter of the BFMS (16 mm) compared with the PS, resulting in rapid improvement. Third, if necessary, DEN as an additional procedure can be performed easily through a large-bore stent, leading to additional cost savings since a dilating balloon is not required.^[13,18] Fourth, bleeding into the cyst due to pseudoaneurysm rupture or injuries to the cavity vessels are reported as fatal complications.^[5] In BFMS placement, it is easier to check for the presence of pseudoaneurysm in the cavity or the oozing from the cavity vessels and cope with the complications immediately. In fact, even though the clinical success rate for WON using EUS-guided drainage and DEN was approximately 80% in a previous report,^[19] in the present study, all 19 cases of WON were treated successfully using a flared-type BFMS. In 8 cases, DEN was required because solid necrosis could not be drained completely despite a large-bore. However, in this study, we could treat such complicated WON using fewer sessions of DEN than previously reported (2.3 sessions vs. 6.2 sessions).^[20] There were two serious bleeding complications during the treatment course. However, we were able to check the bleeding point through the BFMS, enabling quick and proper management.

Nevertheless, the routine use of BFMS remains controversial. The major disadvantage of the BFMS compared with the PS is cost.^[13] The cost of 1 BFMS is as high as 5 or 6 times the cost of 1 PS. However, in our previous study,^[13] we showed that there was no statistically significant difference in the total procedure cost between PS and BFMS in the treatment of WON. Furthermore, we showed that BFMS might have an advantage over PS in complicated WON in which re-intervention, such as DEN, was required. Another concern is the effect of the long-term placement of BFMS, which is not yet fully clarified. Hence, it is

considered that BFMS should be removed after the confirmation of complete resolution. In all 16 cases in which we attempted to remove the flared-type BFMS, the stents were easily removed with no complications 1 or 2 months following the stent placement. In two recurrence cases, despite the absence of pancreatic duct disruption or complete disappearance of the cavity, the stents were removed without exchanging for PSs. According to previous reports,^[21] as in the BFMS case, the PS should be left in place as many as possible to prevent recurrence in complicated pseudocyst and WON.

The present BFMS, called “Nagi stent,” belongs to a flared-type BFMS but not a lumen-apposing-type BFMS like the “AXIOS stent.”^[8] Several investigators have reported that a lumen-apposing-type BFMS is a useful device for PFC or gallbladder drainage under EUS guidance in a pilot observational study.^[8-10] In this study, the spontaneous stent migration rate of a flared-type BFMS (4/21, 19%) was higher than that of a lumen-apposing-type BFMS described in our previous report (1/20, 5%),^[8] although in these four cases, the decrease in the cyst size with effective drainage may cause the stent migration without any clinically serious issue. It may be caused by that the stability of a lumen-apposing-type BFMS is better than that of a flared-type BFMS. However, prospective randomized controlled trials are warranted for precise comparisons between a lumen-apposing-type BFMS and a flared-type BFMS.

In contrast, a flared-type BFMS has some advantages compared with a lumen-apposing-type BFMS. First, the length of the Nagi stent between two flanges is longer than that of a lumen-apposing-type BFMS (20 mm or 30 mm vs. 10 mm). When the part for drainage is located at a distance from the GI tract, a flared-type BFMS is placed more safely. Second, the delivery system is simpler resembling that of conventional biliary metal stents. As the delivery system of a lumen-apposing-type BFMS is unique, it requires operators to get accustomed to it.

We described here how EUS-guided drainage using a flared-type BFMS is feasible for the treatment of PFCs. However, a major limitation is that this is a retrospective pilot study involving a small case series at a single institution, and it lacks a control group. Further studies using randomized controlled multicenter trials are required to validate the efficacy of this flared-type BFMS.

ACKNOWLEDGMENTS

The authors are indebted to Ms. Maya Vardaman and Associate Professor Edward Barroga, Senior Medical Editor of the Department of International Medical Communications of Tokyo Medical University, for their editorial review of the English manuscript. All flared-type BFMSs were provided free of charge by Taewoong Company. This study was financially supported in part by the Research Committee of Intractable Pancreatic Diseases (Principal investigator: Tooru Shimosegawa) as provided by the Ministry of Health, Labour and Welfare of Japan.

REFERENCES

- Binmoeller KF, Seifert H, Walter A, *et al.* Transpapillary and transmural drainage of pancreatic pseudocysts. *Gastrointest Endosc* 1995;42:219-24.
- Mukai S, Itoi T, Moriyasu F. Interventional endoscopy for the treatment of pancreatic pseudocyst and walled-off necrosis (with videos). *J Hepatobiliary Pancreat Sci* 2014.
- Mukai S, Itoi T, Sofuni A, *et al.* Expanding endoscopic interventions for pancreatic pseudocyst and walled-off necrosis. *J Gastroenterol* 2014.
- Seifert H, Wehrmann T, Schmitt T, *et al.* Retroperitoneal endoscopic debridement for infected peripancreatic necrosis. *Lancet* 2000;356:653-5.
- Yasuda I, Nakashima M, Iwai T, *et al.* Japanese multicenter experience of endoscopic necrosectomy for infected walled-off pancreatic necrosis: The JENIPaN study. *Endoscopy* 2013;45:627-34.
- Penn DE, Draganov PV, Wagh MS, *et al.* Prospective evaluation of the use of fully covered self-expanding metal stents for EUS-guided transmural drainage of pancreatic pseudocysts. *Gastrointest Endosc* 2012;76:679-84.
- Kawakami H, Itoi T, Sakamoto N. Endoscopic ultrasound-guided transluminal drainage for peripancreatic fluid collections: Where are we now? *Gut Liver* 2014;8:341-55.
- Itoi T, Binmoeller KF, Shah J, *et al.* Clinical evaluation of a novel lumen-apposing metal stent for endosonography-guided pancreatic pseudocyst and gallbladder drainage (with videos). *Gastrointest Endosc* 2012;75:870-6.
- Binmoeller KF, Shah JN. Endoscopic ultrasound-guided gastroenterostomy using novel tools designed for transluminal therapy: A porcine study. *Endoscopy* 2012;44:499-503.
- Gornals JB, De la Serna-Higuera C, Sánchez-Yague A, *et al.* Endosonography-guided drainage of pancreatic fluid collections with a novel lumen-apposing stent. *Surg Endosc* 2013;27:1428-34.
- Yamamoto N, Isayama H, Kawakami H, *et al.* Preliminary report on a new, fully covered, metal stent designed for the treatment of pancreatic fluid collections. *Gastrointest Endosc* 2013;77:809-14.
- Moon JH, Choi HJ, Kim DC, *et al.* A newly designed fully covered metal stent for lumen apposition in EUS-guided drainage and access: A feasibility study (with videos). *Gastrointest Endosc* 2014;79:990-5.
- Mukai S, Itoi T, Baron TH, *et al.* EUS guided placement of plastic vs biflanged metal stents for therapy of walled-off necrosis: A retrospective single-centre series. *Endoscopy* 2015;47:47-55.
- Banks PA, Bollen TL, Dervenis C, *et al.* Classification of acute pancreatitis-2012: Revision of the Atlanta classification and definitions by international consensus. *Gut* 2013;62:102-11.
- Cotton PB, Eisen GM, Aabakken L, *et al.* A lexicon for endoscopic adverse events: Report of an ASGE workshop. *Gastrointest Endosc* 2010;71:446-54.
- Baron TH, Harewood GC, Morgan DE, *et al.* Outcome differences after endoscopic drainage of pancreatic necrosis, acute pancreatic pseudocysts, and chronic pancreatic pseudocysts. *Gastrointest Endosc* 2002;56:7-17.
- Gardner TB, Chahal P, Papachristou GI, *et al.* A comparison of direct endoscopic necrosectomy with transmural endoscopic drainage for the treatment of walled-off pancreatic necrosis. *Gastrointest Endosc* 2009;69:1085-94.
- Itoi T, Nageshwar Reddy D, Yasuda I. New fully-covered self-expandable metal stent for endoscopic ultrasonography-guided intervention in infectious walled-off pancreatic necrosis (with video). *J Hepatobiliary Pancreat Sci* 2013;20:403-6.
- Gardner TB, Coelho-Prabhu N, Gordon SR, *et al.* Direct endoscopic necrosectomy for the treatment of walled-off pancreatic necrosis: Results from a multicenter U.S. series. *Gastrointest Endosc* 2011;73: 718-26.
- Seifert H, Biermer M, Schmitt W, *et al.* Transluminal endoscopic necrosectomy after acute pancreatitis: A multicentre study with long-term follow-up (the GEPARD Study). *Gut* 2009;58:1260-6.
- Arvanitakis M, Delhaye M, Bali MA, *et al.* Pancreatic-fluid collections: A randomized controlled trial regarding stent removal after endoscopic transmural drainage. *Gastrointest Endosc* 2007;65:609-19.

How to cite this article: Mukai S, Itoi T, Sofuni A, Tsuchiya T, Gotoda T, Moriyasu F. Clinical evaluation of endoscopic ultrasonography-guided drainage using a novel flared-type biflanged metal stent for pancreatic fluid collection. *Endosc Ultrasound* 2015;4:120-5.

Source of Support: Nil. **Conflict of Interest:** None declared.