

The Use of Double Lasso, Fully Covered Self-Expandable Metal Stents with New “Anchoring Flap” System in the Treatment of Benign Biliary Diseases

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Abstract

Background Many benign biliary diseases (BBD) can be treated with fully covered, self-expandable metal stents (FCSEMS) but stent migration occurs in up to 35.7 %. The aim of this study was to prospectively assess the rate of, safety and effectiveness and stent migration of a new biliary FCSEMS with an anti-migration flap (FCSEMS-AF) in patients with BBD.

Patients and Methods This was a prospective study from four Italian referral endoscopy centers of 32 consecutive patients (10 females and 22 males; mean age: 60.1 ± 14.8 years; range: 32–84 years) with BBD who were offered endoscopic placement of a FCSEMS-AF as first-line therapy.

Results Were 24 strictures and 8 leaks. Stent placement was technically successful in 32/32 patients (100 %). Immediate clinical improvement was seen in all 32 patients (100 %). One late stent migration occurred (3.3 %).

FCSEMS-AF were removed from 30 of the 32 patients (93.7 %) at a mean (\pm SD) of 124.4 ± 84.2 days (range: 10–386 days) after placement. All patients remained clinically and biochemically well at 1- and 3-month follow-up. One patient (3.3 %) with a post-laparoscopic cholecystectomy stricture developed distal stent migration at 125 days. **Conclusion** This new FCSEMS with anti-migration flap seems to be a safe and effective first-line treatment option for patients with BBD.

Keywords Fully covered metal stent · Benign biliary diseases · Biliary tract injuries · Biliary leak · Biliary stenosis · Biliary strictures

Introduction

Benign biliary diseases are divided into leaks and strictures. Biliary leaks are most often a consequence of surgery. Benign biliary strictures may be associated with post-operative injury (particularly after cholecystectomy or liver transplantation), chronic pancreatitis, primary sclerosing cholangitis or gallstones [1–5].

Partially and fully covered self-expanding metal stents (FCSEMS) have been used to treat biliary leaks and strictures [6–9]. However, stent migration and occlusion remain downsides. Recently, a new type of FCSEMS with a novel “anchoring flap” (FCSEMS-AF) system made of four flaps in the proximal end, flared ends and one proximal and one distal lasso for retrieval (Hanaro, M.I. Tech, Seoul, Korea) has been developed.

The aim of this study was to prospectively assess safety and effectiveness and rate of migration of this new biliary FCSEMS-AF placement for treatment of benign biliary diseases.

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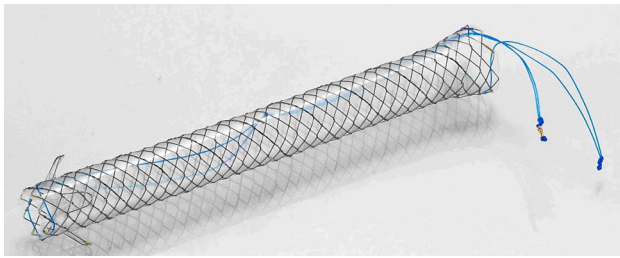


Fig. 1 Hanaro biliary fully covered, removable, metal stent with the four “anchoring flaps” and the proximal and the distal lasso

Materials and Methods

Patients

Between January 2010 and September 2012, 32 consecutive patients (10 females and 22 males; mean age: 60.1 ± 14.8 years; range: 32–84 years) with benign biliary diseases we prospectively evaluated. Patients were offered endoscopic placement of a FCSEMS-AF, as first-step therapy, in four Italian referral endoscopy centers (San Paolo Hospital, Milan; Sacco Hospital, Milan; Valduce Hospital, Como; San Gerardo Hospital, Monza).

Exclusion criteria were neoplastic disease, previous treatment with a FCSEMS or plastic stent, and refusal to sign informed consent. The study protocol was approved by the institutional review boards of the participating centers, and written informed consent was obtained from all patients.

Methods

Endoscopic retrograde cholangiopancreatography (ERCP) was performed with standard therapeutic channel duodenoscopes (Pentax Hamburg, Germany; Fujinon, Saitama, Japan; Olympus, Hamburg, Germany). All procedures were performed under deep sedation with propofol (Propofol B. Braun 1 %; Melsungen, Germany) using anesthesia support.

Type of Stent, Stent Insertion, and Removal

A novel type of biliary FCSEMS was used in our study. This stent has a new “anchoring flap” system made of four flaps in the proximal end, flared ends and one proximal and one distal lasso for retrieval of the stent (Hanaro, M.I. Tech, Seoul, Korea), which will be heretofore referred to as FCSEMS-AF). The purpose of the flaps and of the flared ends is to avoid proximal and distal migration of the stent.

The stent utilizes an 8.5 Fr introduction system. The deployed stent diameter is 10 mm with available lengths

of, 4, 5, 6, 7, 8 and 10 cm (Fig. 1). Gold radiopaque markers are present on both the proximal and distal ends of the stent to facilitate its deployment and positioning. The stent can be recaptured.

All stents were placed by experienced endoscopists. Biliary sphincterotomy was performed variably, per endoscopist discretion. In patients with an intact gallbladder, the proximal end of the stent was placed below the insertion of the cystic duct in all cases.

FCSEMS-AF were removed using rat-tooth forceps or a standard polypectomy snare by grasping one of the two lassos (proximally or distally). Traction applied to the proximal lasso caused inversion of the proximal part of the stent into the duodenal lumen. Following removal cholangiography was performed to confirm resolution of the underlying disease. Time to removal was decided on the basis of the type and length of the biliary disease and, for the leaks, also according to the Bergman classifications. The removal was generally programmed from 3 to 6 months from the placement, but we considered also delayed removal till 1 year in some possible particular cases.

Outcomes

Data collected included patient demographics and all technical and clinical details.

The procedure was defined as technically successful when the FCSEMS-AF was properly placed covering the biliary leak or stricture. The immediate clinical outcome was evaluated 72 h after placement of the FCSEMS-AF and was considered successful if bile flow in the external drainage catheter was absent in cases of biliary leakage and, if an abdomen x-ray confirmed the correct expansion of the stent, without migration in the patients with strictures.

Early adverse events were defined as any that occurred within 7 days of stent placement, while a late adverse event was defined as any that occurred more than 7 days after stent placement.

Radiological and Clinical Success with Duration of Follow-Up

Long-term clinical success was defined as radiological documentation of disease resolution at follow-up cholangiography performed at the time of stent removal of the FCSEMS-AF. The timing of stent removal was individualized based upon clinical response. Long-term outcome was also evaluated (by telephone and biochemical-clinical follow-up) at 1, 3 and 6 months.

The primary end-points of our study were to evaluate stent migration rates and the resolution of underlying

Table 1 Demographic and clinical data of the recruited patients

Number of patients	32
Age (mean \pm SD) (range), years	60.2 \pm 14.8 (32–84)
Sex (male)	31.2 %
<i>Leak (8 patients—25 %)</i>	
Causes of the biliary leaks (%)	
Laparoscopic cholecystectomy	6 (75 %)
Open cholecystectomy	1 (12.5 %)
Hepatic surgery	1 (12.5 %)
Site of leak (%)	
Cystic duct	5 (62.5 %)
Middle III CBD	2 (25 %)
Proximal III CBD	1 (12.5 %)
Clinical features (mean \pm SD) (range), days	
Absence of bile flow	1.3 \pm 0.6 (1–3)
<i>Strictures (24 patients—75 %)</i>	
Causes of biliary strictures (%)	
Laparoscopic cholecystectomy	7 (29.1 %)
Post-cholangitis of the distal part of the CBD	7 (29.1 %)
Post-surgical intervention	4 (16.7 %)
Chronic pancreatitis	3 (12.5 %)
Primary sclerosing cholangitis	2 (8.4 %)
Post-OLT	1 (4.2 %)
Site of strictures (%)	
Distal III of the CBD	15 (62.5 %)
Middle III of the CBD	5 (20.8 %)
Proximal III of the CBD	4 (16.7 %)
Time to stent removal (mean \pm SD) (range), days	124.4 \pm 84.2 (10–368)

disease. The secondary end-points were stent-related complications, FCSEMS-AF removability and clinical success rate.

Statistical Analysis

Continuous data are described by means, standard deviations and ranges, according to distribution. Categorical data are presented as numbers and percentages.

Results

Thirty-two consecutive patients with benign biliary diseases who met the inclusion criteria were prospectively enrolled. There were 10 females and 22 males with a mean age of 60.2 \pm 14.8 years. Twenty-four of the patients had strictures, and eight had leaks. Demographic and clinical data are presented in Table 1.

**Fig. 2** Leak after VLC

Stricture etiology was post-laparoscopic cholecystectomy in seven cases (29.1 %), post-cholangitis in seven (29.1 %), other post-surgical interventions in four (16.7 %), chronic pancreatitis in three (12.5 %), primary sclerosing cholangitis in two (8.4 %) and anastomotic stricture following orthotopic liver transplantation in one (4.2 %). Of these 24 strictures, 15 were localized in the distal third of the common bile duct (62.5 %), five in the middle third (20.8 %) and four in the proximal third (16.7 %).

Biliary leaks developed after cholecystectomy in seven cases (87.5 %), and after open cholecystectomy plus IV hepatic segment resection in one other patient (12.5 %). The most frequent leak site was the cystic duct (five patients—62.5 %), two were in the middle third of the common bile duct (25 %) and one in the proximal third (12.5 %). According to Bergman's classification [10], three lesions were type A (9.3 %), one was type B (3.2 %), 26 were type C (81.3 %) and two were type D (6.2 %).

Endoscopic stent placement was technically successful in 32/32 patients (100 %), including the two patients with a type D lesion (complete transection of the common bile duct). Immediate clinical response was seen in all 32 patients (100 %) with absence of bile flow in external drains in cases of bile leakage and correct expansion of the FCSEMS-AF after a mean (\pm SD) of 1.3 \pm 0.6 days (range: 1–3 days) by abdominal X-ray. Only one FCS-EMS-AF was placed in each of the 32 patients. Stents lengths used were 10 cm (n = 4), 8 cm (n = 9), 7 cm (n = 6), 6 cm (n = 8), 5 cm (n = 4) and 4 cm (n = 1).



Fig. 3 Placement of Hanaro biliary fully covered, removable metal stent

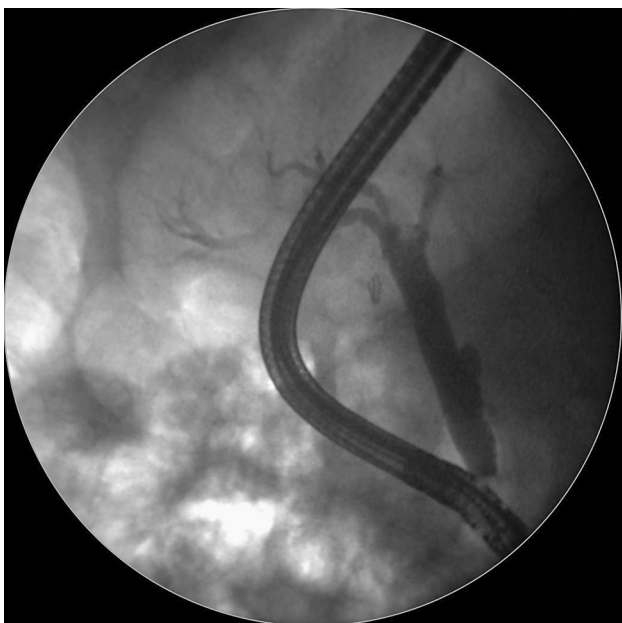


Fig. 4 Leak sealed at the cholangiography after FCSEMS-AF at 1-month retrieval

Biliary sphincterotomy was performed during stent placement in 71.8 % of the cases (23/32 patients).

There was only one (3.1 %) early adverse event, a mild [11] hemobilia due to a bilio-portal fistula, which resolved spontaneously. Of the 24 patients with biliary strictures, 11 (45.8 %) had abdominal pain for 24–48 h after stent

placement, which was easily controlled with administration of non-steroidal anti-inflammatory drugs. No patients with leaks had post-procedural pain (0 %). One distally stent migration occurred at 125 days after placement in one case (3.3 %). No post-ERCP pancreatitis was observed.

Thirty-two stents were placed, but only 30 were removed (93.7 %). One of the two patients in whom stent removal was not attempted died on day 122 after stent placement from underlying cardiovascular disease. The leak had clinically closed, and the abdominal drain had been removed. One patient was lost to follow-up (Figs. 2, 3, 4).

Stents remained in place for a mean (\pm SD) of 124.4 ± 84.2 days (range: 10–386 days) before removal. All the 30 stent removals were easily by withdrawal of the stent and endoscope, or withdrawal through the operative channel of the endoscope. At the time of stent removal, all stents were in the same position as when initially placed.

Clinical resolution of the underlying disease was seen in all patients at 1- and 3-month follow-up. One patient (3.3 %) with a post-surgical stenosis developed jaundice on day 125 because of complete distal migration of the stent out of the patient. The patient subsequently required percutaneous cholangiography. Of the remaining 29 patients, clinical success continued at the 6-month follow-up. When analyzed on an intent-to-treat basis, success was seen in 96.7 % at 6 months.

Discussion

This is the second prospective study specifically assessing FCSEMS-AF migration rate. Secondary end-points were safety and effectiveness of this new FCSEMS with anti-migration flaps as a first-step endoscopic therapy for benign biliary diseases.

We observed a low stent migration rate of 3.3 %, which is in contrast to other studies published in literature in which migration rates up to 37.5 % have been reported [12–17].

Park do et al. [18] recently reported similar data, with absence of stent migration, in 22 patients undergone to AF-FCSEMS placement, after a median period of placement of 6 months.

Almost half (45.8 %) of our patients with benign biliary strictures had pain in the 24–48 h after placement, probably explained by the relatively rapid expansion of the stent. This is comparable to that reported by Poley et al. [19] in the first published cohort in which this type of stent was used.

In the patient in which the stent was removed at 386 days was observed sludge in the CBD. Was then performed biliary tree toilet. This patient had a type D

Bergman's leak after LC with infective post-surgical complications. Two months and half after FCSEMS-AF placement the patient developed myocardial infarction and a successive coronaric stents placement. Due to the surgical complication and to the critical clinical conditions, according to surgeons, cardiologist and anesthesiologist, we decided to delay the stent removal. The patient in which the stent was removed at 10 days had only a low-flow Bergman's type A leak.

Absence of resolution of the stenosis occurred in one patient (4.3 % of 23 patients) at day 125 because of FCSEMS-AF migration.

All of the FCSEMS-AF were easily removed either by capturing the distal lasso or by inversion when capturing the proximal lasso.

The latter technique may prevent injury to the biliary wall. Injury to the bile duct is a concern in patients with biliary leaks following orthotopic liver transplantation. In one study, clinically significant biliary strictures developed at the proximal end of FCSEMS; extensive mucosal ulcerations were visualized during choledochoscopy [20].

The other advantage of this new stent is the anti-migration flaps that enable anchorage to the choledochal wall, preventing both proximal and distal stent migration. This might be especially important in patients with biliary leaks where there is an absence of stricture to hold the stent in place. There was moreover developed two other prototype of biliary FCSEMS, with anti-migration system. Only few data are published in literature. The first presents two characteristic features: Firstly, a 10 cm radiopaque nylon string incorporated into the distal end of the stent to facilitate endoscopic retrieval, and secondly, it has a waist which is 2 mm narrower than each end allowing an anti-migration feature [21]. The second FCSEMS is studied for placing it above the papilla and minimize stent-induced bile duct injury in patients with refractory benign biliary strictures. It presents short length, and its design is similar to the first one. This stent has a convex margin at both ends to prevent tissue hyperplasia. The central portion of 1–2 cm of each stent has a cross-wired structure and smaller-diameter waist, whereas the remainder has a fixed hook and cross-wired structure to prevent early migration [22].

In our study, the technical, immediate clinical and long-term clinical success rates were 100 % (30/30 patients) for the treatment of biliary leaks with leak sealing at a mean of 1.3 days and a mean hospital stay after FCSEMS placement of 3.5 days. This suggests that FCSEMS placement is an excellent first-line endoscopic therapy [23].

Temporary endoscopic placement of multiple plastic stents is now the preferred treatment option for benign biliary strictures.

The European Society of Gastrointestinal Endoscopy (ESGE) guidelines propose that the first-line treatment of cicatricial biliary stenosis is with multiple plastic stents [24]. Using this approach, good results up to 10 years of follow-up are seen. However, a large and increasing number of studies have shown the usefulness of FCSEMS in the treatment of benign biliary strictures. It should, however, be acknowledged that, unlike for plastic stents, long-term follow-up data are not available on FCSEMS.

The two most important, recently published experiences with FCMEMS were reported by Kahaleh et al. and Tarantino et al. [25]. The study by Tarantino et al. enrolled 62 patients in whom the mean period of indwelling FCSEMS was 96.7 days. Biliary strictures resolved in 90.3 % with a migration rate of 24.2 %. Importantly, they showed there was no difference in failure rate whether the FCSEMS was used as a first- or second-line approach. Recurrent stenosis occurred in 7.1 % of the patients, all of who were liver transplant patients.

The second study, involving 133 patients, is the largest published series to date. The mean stent duration was 95.5 days. Stent migration occurred in 10.5 % of patients and in 2.2 % of the cases the stent unraveled during removal [26]. Stricture resolution rate was similar to that seen by Tarantino et al. One interesting finding from the logistic regression analysis was that previous placement of a plastic stent was associated with a lower rate of resolution of stenosis.

In summary, we found this new FCSEMS had a very low migration rate, was easily removable, and produced a high rate of clinical success and low rate of adverse events. We believe that FCSEMS-AF placement is a good option for the treatment of benign biliary diseases. The main limitation of this study is the lack of a control arm.

Conflict of interest None.

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