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Invited Review Article

# Endoscopic approach to benign biliary obstruction

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A B S T R A C T

During the past 30 years, the endoscopic approach to benign biliary strictures (BBS) became the preferred "mini-invasive" treatment modality for benign diseases. Endoscopic plastic or metallic stenting, and balloon dilation represent the gold standard treatment for BBS. Side-by-side insertion of multiple plastic stents is a very effective treatment option for BBS following cholecystectomy or liver transplantation. This strategy has a low recurrence rate on long-term follow-up, with better results than fully covered self-expandable metal stents (FC-SEMS). FC-SEMS seems to have an advantage and higher stricture resolution rate in patients with BBS secondary to chronic pancreatitis. Dilation of dominant biliary strictures in patients with primary sclerosing cholangitis has a lower rate of infective complications than the stenting treatment. Endoscopic retrograde cholangiopancreatography represents a safe and effective approach to BBS, with a very high success rate, especially when such cases are managed in a multidisciplinary setting.



Keywords: benign biliary strictures, ERCP, fully covered, plastic stent, self-expandable metal stent

## Introduction

Benign biliary strictures (BBS) can be classified as postoperative and secondary to benign biliopancreatic diseases.

Postoperative biliary strictures can be related to an iatrogenic injury following cholecystectomy or can occur at the biliary anastomosis after liver transplantation. The most common diseases leading to benign biliary strictures are chronic pancreatitis (CP) and primary sclerosing cholangitis (PSC). Rare causes include portal biliopathy, polyarteritis nodosa, radiofrequency ablation, radiotherapy, and tuberculosis.

Endoscopic drainage of BBS is effective to restore bile flow. Multiple plastic stents insertion, and recently introduced fully covered self-expandable metal stents (FC-SEMS) can induce healing of BBS, especially after cholecystectomy, liver transplantation, and those secondary to CP. Endotherapy of PSC-related biliary strictures can obtain temporary improvement of the biliary strictures but chronic disease progression requires repeated treatments.

## Endoscopic treatment of benign biliary strictures: plastic and metal stents

### *Plastic stents*

Plastic stents were used for the first time in the late 1970s[1,2] for the endoscopic drainage of malignant biliary strictures. To date a variety of plastic stents are available, and improvement of endoscopes and devices (guidewires, catheters, or dilators) made possible plastic stent insertion in tight and angled strictures as in the setting of BBS.

Plastic stents are available in different lengths (up to 18 cm) and diameters [up to 11.5 French (Fr)]. They are usually tapered on one end to facilitate negotiation of the strictures; 10 Fr is the preferred diameter in BBS because it allows a good bile flow and can be easily pushed into the 4.2-mm working channel of the therapeutic duodenoscope.

Straight stents are the standard design for biliary and pancreatic indications. The choice of the stent depends on the bile duct anatomy and stricture features. Straight stents are usually slightly bent to conform to the anatomy of the biliary ducts. They may have side holes for better drainage, and are provided with side flaps to avoid displacement and migration.

The choice of the stent length is related to the distance between the proximal end of the stricture and the papilla of Vater, which can be measured by graduated catheters.

The availability of different plastic stent size, shape, and diameter permit to "tailor" the stent case by case, according to BBS characteristics. Plastic stents make also possible the treatment of postcholecystectomy BBS involving the main hepatic confluence.

### *Materials*

Three different polymers were used for biliary and pancreatic stents: polyethylene, Teflon, and polyurethane.

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Despite promising preliminary studies, none of these materials provided any definite advantage in terms of longer patency, when compared to standard polyethylene stents in clinical practice.[1,3–9]

Polyethylene is the material most commonly used for plastic stents.

*Plastic stents insertion*

In the setting of BBS, the biliary sphincterotomy is recommended to facilitate repeated stent exchange, insertion of multiple plastic stents, and possible retreatment. Angle- or straight-tip fully hydrophilic guidewires are recommended to negotiate tight BBS. Following mechanical or balloon dilation, the plastic stent can be inserted. Usually two or more plastic stents are placed side by side to dilate BBS. A good coordination between operator and assistant is required to place multiple plastic stents (MPS) and to avoid intrabiliary stent migration; this fact does not represent a clinical problem because bile can flow alongside the stents, but can make stent removal difficult during retreatments.

*Two or more plastic stents for BBS?*

Dilation of BBS was attempted by insertion of two 10 Fr plastic stents with planned exchange every 3 months for 1 year; at the end of 1-year treatment stents were removed, but stricture recurrence was high (20%).[2] An “aggressive” approach to obtain a progressive dilation of BBS was proposed in 2001[10] by insertion of an increasing number of plastic stents every 3 months until complete morphological stricture resolution; this approach lead to an 11% stricture recurrence rate after a very long-term mean follow-up of 13.7 years.[11] The main limitation of plastic stenting for BBS is the need for repeated endoscopic retrograde cholangiopancreatography (ERCP; usually 3–4) for a long period (at least 1 year).

*Self-expandable metal stents*

Self-expandable metal stents (SEMS) with a 30 Fr diameter, were developed in the early 1990s. Uncovered SEMS finds an indication in the setting of malignant biliary strictures, since are not removable. FC-SEMS have an indication in BBS due to their removability. A variety of SEMS are commercially available.

Most commonly used SEMS are made of a nickel-titanium alloy (nitinol). Nitinol has at least two unique properties: shape-memory and elasticity. Thermal shape-memory enables nitinol implants to be compressed for insertion into small caliber delivery systems and upon deployment *in situ*, at body temperature are restored to their original shape. Elasticity is advantageous when flexibility, constancy of applied stress, and large expansion or deformation ratios are needed. Because of this property, nitinol stents are more flexible than stainless-steel SEMS. Nitinol is nonferromagnetic with a very low magnetic susceptibility; thus, nitinol SEMS are compatible with magnetic resonance imaging.

*Fully covered SEMS*

SEMS with a plastic polymer covering were developed to resolve the problem of tissue ingrowth and to allow removability in the setting of BBS. SEMS covering membranes need to be durable to ensure removability. Usually FC-SEMS have flared distal ends to reduce the risk of migration. FC-SEMS are available in an 8- and 10- mm diameter and 4 cm, 6 cm, and 8 cm lengths. No specific mesh design demonstrated to facilitate or impair removability.

Removability of FC-SEMS in the setting of postoperative biliary strictures and chronic pancreatitis related biliary strictures was evaluated with good results in several studies.[12–20] Optimal time for FC-SEMS removal is maybe between 4 months and 6 months, unless there are not enough data.

*Deployment*

SEMS deployment is currently a standardized maneuver. SEMS deployment does not usually require any previous stricture dilation. SEMS introducers have a diameter varying from 8.5 Fr to 10 Fr, like the standard plastic stents. In the delivery system, the SEMS are constrained between an inner catheter (that allows the passage of the guidewire) and an outer sheath. The delivery system is advanced over the guidewire and positioned across the stricture. Because some SEMS significantly shorten after deployment, the appropriate SEMS length should be evaluated on preliminary cholangiography using appropriate graduated catheters.[21] FC-SEMS are released extending about 5–10 mm beyond the papilla into the duodenum for an easier removability with foreign body forceps or snares. After the delivery system is in position, the SEMS is released by carefully pulling back the outer sheath. This maneuver must be monitored by fluoroscopy to permit minor adjustments of the SEMS position before final release. In case of erroneous placement or inappropriate SEMS length, the stent can be reconstrained into the delivery system before it has been totally deployed.

**Postcholecystectomy biliary strictures**

BBS following cholecystectomy were treated by complex surgical repair with related morbidity and mortality[11]; a “mini-invasive” endoscopic approach is advisable in patients with iatrogenic lesions of the bile ducts[10,22] (Fig. 1). Our experience with 164 patients treated with multiple plastic stents over a 22-year period reported a 9.3% stricture recurrence rate after a mean follow-up of 7 years; endoscopic retreatment of stricture recurrences was always feasible and successful.

Postcholecystectomy strictures are short fibrotic scars and are typically located in the upper third of the common bile duct and can involve the main hepatic confluence. The bile duct below the stricture is usually not dilated. These features may limit the use of SEMS for a number of reasons. Correct positioning of partially covered SEMS strictures near the hilum may be technically challenging, with possible damage to the normal mucosa of the confluence. SEMS tend to stretch the nondilated distal common bile duct below the stricture, and this fact may have unpredictable consequences on accurate positioning of a foreshortening stent. Last, a high stent migration rate for FC-SEMS may limit its utility when compared to progressive placement of plastic stents. Further comparative studies with longer follow-up are needed before a firm recommendation can be made in favor of either approach. It is also noteworthy that SEMS removal may be technically challenging.[23]

Furthermore reported cases of postcholecystectomy biliary strictures treated with FC-SEMS are very rare (Table 1).[17,24–28]

**Anastomotic biliary strictures following liver transplantation**

In the past decades biliary strictures following orthotopic liver transplantation (OLT) were managed by surgical repair or percutaneous balloon dilation.[29–31] More recently, ERCP and endoscopic biliary plastic stent placement have been the primary therapeutic approach for such lesions.[32–38]

Anastomotic strictures may occur at the level of any biliary anastomosis, either duct-to-duct or hepatico-jejunostomy, in