Original Article

A One-step Procedure by Using Linear Echoendoscope to Perform EUS-guided Choledochoduodenostomy and Duodenal Stenting in Patients with Irresectable Periampullary Cancer

Carolina Rebello, Andre Bordini, Andre Yoshida, Bruno Viana, Pedro E.N. Ramos, Jose P. Otoch, Luiz Marcelo Cirino, Everson L.A. Artifon*

Department of Surgery, University of Sao Paulo (USP), Brazil

Abstract:
Objective: Endoscopic ultrasound-guided choledochoduodenostomy (EUS-CD) has become an alternative method after unsuccessful endoscopic retrograde cholangiopancreatography (ERCP) treatment. We present a case series study and its feasibility by using only a linear therapeutic channel echoendoscope to create both a biliary-enteral fistula and anatomic enteral recanalization.

Methods: We presented seven cases of unresectable periampullary cancer with both biliary and duodenal obstruction. In these cases, the EUS-guided technique might be an alternative to double stenting (biliary and enteral) in the same procedure and equipment.

Results: In all cases, the location of the biliary obstruction was in the distal common bile duct (CBD) and the grade of proximal dilation diameter varied from 15 mm to 20 mm. Two patients had type I (28.6%) and five had type II (71.4%) duodenal obstruction. Technical success of EUS-CD, by the stent placement, occurred in 100% of the cases. There were no early complications. Biliary drainage was effective clinically as well as in laboratory in 6 cases (6/7), by relieving obstructive jaundice and decreasing bilirubin levels.

Conclusion: EUS equipment may offer an alternative to double stenting in the same procedure and with palliative propose.

Keywords: endoscopic retrograde cholangiopancreatography; endoscopic ultrasound; choledochoduodenostomy; periampullary cancer

INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) is the first-line therapy for palliative biliary drainage in patients with unresectable periampullary cancer. Its success rate varies from 90% to 95%; however, even when performed by experienced endoscopists, cannulation may be failed.

Percutaneous transhepatic biliary drainage (PTBD) is an rationale option prior to the surgery, but may cause several complications, which can be bleeding, hemobilia, peritonitis and liver abscess, and poor quality of life due to the presence of an external catheter. Complication, morbidity and mortality rates of PTBD are 30%, 7% and 5%, respectively. Surgical treatment offers long period of drainage patency, but also with high rates of morbidity and mortality.

Endoscopic ultrasound (EUS) is an established method for diagnosis of biliary and pancreatic diseases. In 1996, Wiersema et al. published the first case of EUS-guided cholangiopancreatography. Giovannini et al. pioneered, in 2001, by performing a EUS-guided choledochoduodenostomy (EUS-CD). Several case studies analyzed the role of EUS-CD as an alternative method after unsuccessful ERCP in patients with unresectable periampullary cancer.

That tumors when in advanced stages, causes biliary obstruction and also duodenal obstruction. Although biliary obstruction usually occurs prior to duodenal, they can occur simultaneously. In these cases, the use of self-expandable metal stents (SEMS) to stent the biliary duct and the duodenal lumen has been proved effective as palliative treatment.

We present here a case series study and the feasibility by using only a linear therapeutic channel echoendoscope to create both a biliary-enteral fistula and anatomic enteral recanalization in seven patients with obstructive jaundice.
and duodenal obstruction due to unresectable periampullary cancer.

**PATIENTS AND METHODS**

EUS-CD, in the first portion of the duodenum, associated with duodenal SEMS placement was performed in seven patients with unresectable periampullary cancer that presented with obstructive jaundice and invasive duodenal obstruction.

ERCP treatment for biliary drainage was attempted in all cases but failed due to a complete obstruction of the distal common bile duct (CBD) or papillary invasion by the tumor.

The concept of EUS-CD was discussed with patients’ family as an alternative treatment to avoid PTBD or surgery procedures. All participants were provided with written informed consent and this study was approved by the Institutional Review Board of our institution’s committee.

Laboratory tests and clinical follow-up were performed after 7 and 30 days of the procedure, and monthly until patients’ death. The mean follow-up was 140 days (30 days to 17 months). Subsequently, all patients underwent palliative chemotherapy.

The EUS-CD procedure was performed by an experienced endoscopist under conscious sedation, using a combination of intravenous midazolam, fentanyl and propofol. Prophylactic antibiotic (ciprofloxacin 400mg I.V.) was used at the beginning of the procedure, routinely used in cases of obstructed biliary system.

The CBD was visualized in the duodenal bulb window using a linear echoendoscope (GFUCT160, Olympus, Tokyo, Japan) (Fig. 1A). Color Doppler Ultrasound was used to identify vascular anatomy on the traject. The dilated bile duct was punctured with a 19-gauge FNA needle (EUSN-19-T, Cook Endoscopy, Winston- Salem, NC, USA) (Fig. 1B). The puncture position was chosen based on EUS evaluation, at the CBD above the tumor, through the distal part of the duodenal bulb.

For confirmation of biliary access, bile was aspirated and followed by iodine contrast injection under fluoroscopy view to demonstrate biliary opacification (Fig. 1C).

A 0.035-inch guidewire was introduced through the needle, under fluoroscopy view (Fig. 1D). It was attempted to pass the guidewire through the lesion, to reach the duodenum, as a Rendezvous maneuver, however in all cases without success.

After that, the needle was withdrawn and a wire-guided needle knife (KD-441Q, Olympus, Tokyo, Japan) was used to enlarge the site puncture in the duodenal wall (Fig. 1E), using the coagulation power to avoid bleeding. Then, a partially covered self-expandable metallic stent (Wallfex®, Boston Scientific) was passed over the guide (Fig. 1F, 1G), through the choledochoduodenal fistula, without any dilatation procedure.

Duodenal SEMS placement was performed during the same endoscopic procedure without the need to change EUS device for a frontal view endoscope and/or duodenoscope. Stricture evaluation was performed by injection of contrast above and immediately downstream it, to assess morphology, length, and degree of obstruction. Duodenal stricture was passed with a 5-6 French (Fr) ERCP catheter and a hydrophilic guidewire was inserted distally. When the guidewire was correctly positioned distally to the stricture, the stent catheter was advanced over the guidewire. At this time, the stent was released (Fig. 1H) and its correct position and performance were documented immediately after deployment by contrast injection.

**RESULTS**

The procedure was performed in seven patients, including five females and two males. The mean age was 66 years old, ranging between 34 and 86 years old. All cases were diagnosed by imaging studies as unresectable cancer. Six of them had pancreatic adenocarcinoma and one had papillary...
adenocarcinoma.

In all cases, the location of the biliary obstruction was in the distal CBD and the grade of proximal dilation diameter varied from 15 mm to 20 mm. Two patients had type I (28.6%) and five had type II (71.4%) duodenal obstruction (Tab. 1).

Technical success of EUS-CD, by the stent placement, occurred in 100% of the cases. There were no early complications (Tab. 2). Biliary drainage was effective clinically as well as in laboratory in 6 cases (6/7), by relieving obstructive jaundice and a decreasing bilirubin levels (Tab. 3). Duodenal SEMS placement was effective in 100% of the cases that remained alive after a follow up of 7 and 30 days. The major cause of failure over time was ingrowth phenomenon, requiring the placement of another duodenal SEMS over the previous one in one patient. Duodenal obstruction relief and follow-up period are represented in

| Case | Age | Sex | Primary cancer | Level of Biliary Obstruction | Extension of Biliary Stenosis | Level of Duodenal Obstruction / Type | Extension of Duodenal Obstruction |
|------|-----|-----|----------------|----------------------------|------------------------------|-------------------------------------|----------------------------------|
| 01   | 75  | F   | Pancreatic adenocarcinoma | distal CBD | 20 mm | Duodenal Bulb type I | 30 mm |
| 02   | 59  | M   | Pancreatic adenocarcinoma | distal CBD | 20 mm | Duodenal second portion Type II | NA |
| 03   | 34  | F   | Pancreatic adenocarcinoma | distal CBD | 20 mm | Duodenal second portion Type II | 20 mm |
| 04   | 71  | F   | Pancreatic adenocarcinoma | distal CBD | 15 mm | Duodenal second portion Type II | 50 mm |
| 05   | 86  | F   | Papillary adenocarcinoma | distal CBD | 18 mm | Duodenal second portion Type II | NA |
| 06   | 85  | F   | Pancreatic adenocarcinoma | distal CBD | 20 mm | Duodenal Bulb Type I | 30 mm |
| 07   | 52  | M   | Pancreatic adenocarcinoma | distal CBD | 18 mm | Duodenal second portion Type II | 20 mm |

| Table 1. Description of cases age, gender, primary cancer and correlation between endoscopic findings of biliary and duodenal lesions |

| Case | Biliary SEMS | Needle diameter | Puncture enlargement with needle-knife | Duodenal SEMS | Duodenal balloon dilation | Success technique | Complications |
|------|--------------|-----------------|--------------------------------------|---------------|--------------------------|-------------------|---------------|
| 01   | PCSEMS 10 mm × 60 mm | 19 G | Yes | 18 mm × 90 mm | No | Yes | No |
| 02   | PCSEMS 10 mm × 80 mm | 19 G | Yes | 18 mm × 110 mm | No | Yes | No |
| 03   | PCSEMS 10 mm × 60 mm | 19 G | Yes | 22 mm × 60 mm | No | Yes | No |
| 04   | PCSEMS 8 mm × 60 mm | 19 G | Yes | 18 mm × 110 mm | No | Yes | No |
| 05   | PCSEMS 8 mm × 60 mm | 19 G | Yes | 22 mm × 90 mm | No | Yes | No |
| 06   | PCSEMS 8 mm × 60 mm | 19 G | Yes | 18 mm × 90 mm | No | Yes | No |
| 07   | PCSEMS 10 mm × 80 mm | 19 G | No | 18 mm × 90 mm | No | Yes | No |

SEMS: self-expandable metal stent.
Patients with periampullary cancer, which includes lesions from papilla, head of the pancreas, distal CBD and duodenum or metastatic lesions are usually diagnosed in advanced stages, when curative surgical treatment is not feasible. The mean survival time of these patients ranges from 6 to 12 months. However, when concomitant duodenal obstruction occurs, their survival decreases.

Simultaneous palliative treatment in cases of biliary and duodenal obstruction remains controversial in literature. Surgical treatment with biliary-digestive bypass combined with gastro-jejunal anastomosis has high rates of morbidity (25%-37%) and mortality (2.5%). In addition, it also has

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**Table 3.** Direct bilirubin levels and clinical jaundice according to follow-up time period

| Case | DB Pre SEMS | DB after 7 days | DB after 30 days | DB after 60 days | DB after 90 days | DB after 120 days |
|------|-------------|----------------|-----------------|-----------------|-----------------|-----------------|
| 01   | 17,7        | 8,2            | 2,1             | 0,5             | Death¹          | --              |
| 02   | 16,9        | 5,14           | 2,31            | 0,6             | 0,17            | 0,21            |
| 03   | 16,83       | 11,58          | Death¹          | --              | --              | --              |
| 04   | 3,20        | 6,20           | 15,54           | 8,54            | Surgery²        | CI              |
| 05   | 14,6        | 5,3            | 0,3             | CI/NA           | CI/NA           | CI/NA           |
| 06   | 12,22       | CI/NA          | 3,1             | 0,87            | CI/NA           | 0,18            |
| 07   | 6,3         | 1,8            | Death¹          | --              | --              | --              |

DB: direct bilirubin; SEMS: self-expandable metal stent; CI: clinical improvement; NA: laboratory no available; ¹: death before this follow up, because of the disease; ²: biliary surgery for biliar drainage.

**Table 4.** Symptoms, type of feeding and duodenal obstruction relief during follow up period

| Case | 7 days | 30 days | 60 days | 90 days | 120 days | Total follow-up |
|------|--------|---------|---------|---------|----------|-----------------|
| 01   | Semi-solid diet | Semi-solid diet | Semi-solid diet | Semi-solid diet / Vomiting | Death¹ | 97 days |
| 02   | Semi-solid diet | Semi-solid diet | Semi-solid diet | Semi-solid diet / Vomiting | Liquid diet / vomiting² (Second stent) | 17 Months Death¹ |
| 03   | Semi-solid diet / Sporadic vomiting² | Death¹ | -- | -- | -- | 18 days |
| 04   | Semi-solid diet | Semi-solid diet | Semi-solid diet / Sporadic vomiting | Semi-solid diet / Sporadic vomiting² | Semi-solid diet / Sporadic vomiting² | 177 days Death¹ |
| 05   | Semi-solid diet | Semi-solid diet | Semi-solid diet | Vomiting² | Semi-solid diet / Sporadic vomiting² | 4 months |
| 06   | Semi-solid diet | Semi-solid diet | Semi-solid diet | Semi-solid diet | Semi-solid diet / Sporadic vomiting² | 143 days Death¹ |
| 07   | Semi-solid diet | Semi-solid diet / Sporadic vomiting² | Death¹ | -- | -- | 43 days |

¹Death before this follow up, because of the disease; ²Treatment with symptomatic and nasoenteral tube; ³Ingrowth phenomenon.

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**DISCUSSION**

Endoscopic Ultrasound
an increased length of hospital stay and financial costs as compared to endoscopic treatment. 20

PTBD is an alternative method for biliary drainage, even though it has a complication rate ranging from 10% to 30% and decreases the patients’ quality of life when internal drainage is not achieved and there is a necessity for an external catheter. 31 In cases with concomitant duodenal obstruction, symptoms reliefs are obtained with stent placement through upper endoscopy.

Endoscopic treatments with placement of SEMS for biliary drainage during ERCP 32 and duodenal SEMS, through upper endoscopy, 33 have been used as less invasive methods. However, some studies describe difficulties in these techniques, such as failure in cannulation or access to the biliary tree through ERCP, and the location of duodenal obstruction for upper endoscopy.

Recently, EUS-CD has become an alternative method after unsuccessful ERCP treatment. 36–41 Park et al, in 2009, 31 had 100% technical and clinical success in a study with 4 patients. In the same year, Hanada et al 20 obtained the same results without complications. Giovannini et al, 42 in 2011, reported a series of 9 patients who underwent EUS-CD and achieved technical and therapeutic success rates of 88.9%, and complication was observed in only one patient.

Our results suggest therapeutic EUS as an alternative for these patients, with good clinical success, feasible technique and safety. It is a less invasive procedure to biliary drainage in patients whose ERCP treatment failed due to tumor invasion.

Mutignani et al, 37 proposed a classification for the duodenal obstruction in relation to the papilla: Type I stenosis, involving duodenal bulb or first part of duodenum, without involvement of the papilla; Type II stenosis, affecting the second part of the duodenum, with involvement of the papilla; and Type III stenosis, involving the third part of the duodenum without involvement of the papilla. The procedure of dual stent placement is more difficult in type II cases due to technical difficulty in biliary access because of previous enteral stent or tumor local invasion. 22,23,34,35 In our cases most patients had the type II stenosis and all patients reported improvement of obstructive symptoms and quality of life after the stent placement.

This case series presents seven cases of unresectable periampullary cancer with both biliary and duodenal obstruction. In these cases, the technique may be an alternative to double stenting in the same procedure and equipment.

However, further studies are needed to standardize this procedure technique and compare it with PTBD.

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