—Original Article—

Performance of the forward-view echoendoscope for pancreaticobiliary examination in patients with status post-upper gastrointestinal surgery

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ABSTRACT

Background and Objectives: Failures of endoscopic ultrasound (EUS) imaging of the head of the pancreas (HOP) and the common bile duct (CBD) have been reported in up to 50% of patients with status postsurgery (e.g., Billroth II and Roux-en-Y). This is attributable to inability to intubate the afferent limb or the duodenum. Recently, a forward-view (FV) echoendoscope has become available. The frontal endoscopic and ultrasound field of view theoretically allow easier manipulation throughout the gastrointestinal tract compared to the traditional echoendoscopes. The aim of our study was to evaluate the safety and performance of the FV echoendoscope for the investigation of the biliary tree and the pancreas, including fine-needle aspiration (FNA), in patients with surgically altered upper gastrointestinal anatomy. **Patients and Methods:** This was a retrospective evaluation of a prospectively maintained database. All EUS procedures were performed at our institution by one experienced endosonographer from March to September 2009 under conscious sedation. The FV echoendoscope was used for all procedures. **Results:** Twenty-five (25) out of 37 presented status post-Billroth II and 12 out of 37 with status post-Roux-en-Y surgery. Overall, HOP and CBD were adequately visualized in 28 out of 37 (75.7%). All the failures occurred in the Roux-en-Y patients. EUS-FNA was successfully performed in 16 patients. No adverse events were observed. **Conclusions:** The FV echoendoscope proved to be safe and effective in reaching the periampullary area in patients with previous Billroth II, allowing complete exploration of the HOP and the CBD and performance of EUS-FNA. However, FV EUS was unsuccessful in the majority of patients with Roux-en-Y, which still remains a challenging condition.

Key words: Billroth II, endoscopic ultrasound (EUS), fine-needle aspiration (FNA), forward-view (FV) echoendoscope, gastric surgery, Roux-en-Y

INTRODUCTION

It has been reported that pancreaticobiliary endoscopic procedures, including endoscopic ultrasound (EUS) with or without fine-needle aspiration (FNA), are difficult or even impossible in patients with status post-upper gastrointestinal surgery. In particular, limitations with these techniques are frequently

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encountered in patients with Billroth II and Roux-en-Y gastric surgery.[1-14]

In the past, this type of surgery was performed mainly for peptic ulcer disease. Nowadays, it is often performed for neoplastic lesions of the upper gastrointestinal tract and the pancreas. Furthermore, laparoscopic Roux-en-Y gastric bypass is the most common bariatric procedure nowadays;[15,16] for this reason, it is expected that gastroenterologists have to deal with this condition more frequently than in the past.

The main limitation for a complete imaging of the head of the pancreas (HOP) and common bile duct (CBD) was adequately explained by Wilson *et al.*,[17] who reported on the incapability of intubating the afferent limb with conventional radial and linear echoendoscopes. Moreover, an increased complication rate has been reported in these difficult patients when undergoing endoscopic retrograde cholangiopancreatography (perforation rate up to 18% and a mortality of 0-3%). Consequently, it is assumed that EUS may also be at increased risk of complications in patients with postsurgical upper gastrointestinal anatomy.[17]

In a context of rapidly expanding indications for EUS-guided procedures, a dedicated forward-view (FV) echoendoscope has been developed mainly for delivering EUS-guided therapy [Table 1]. The FV echoendoscope is equipped with front endoscopic and EUS view, allowing deployment of needles and other devices through the working channel in a straight direction like a gastroscope.[17,18]

The FV echoendoscope was originally designed for EUS-guided pseudocyst drainage. Subsequently, it became clear that several procedures could be accomplished with the FV echoendoscope, such as celiac plexus neurolysis, biliary and pancreatic drainage, variceal hemostasis treatment, and fiducial implantation.[19-27]

Eventually, it became evident that the FV echoendoscope can be an excellent tool for diagnostic EUS-FNA too. Larghi *et al.* have recently demonstrated how the FV echoendoscope is safe and highly effective in performing FNA of solid and cystic lesions in the gastrointestinal tract and in subepithelial lesions.[28-30]

The aim of our study was to evaluate the safety and performance of the FV echoendoscope for the investigation of the biliary tree and the pancreas, including performance of FNA, in patients with surgically altered upper gastrointestinal anatomy.

PATIENTS AND METHODS

Study design

A retrospective analysis was made of a prospectively maintained database. All consecutive patients with previous upper gastrointestinal surgery (e.g., Billroth II gastrectomy, Roux-en-Y) who had undergone EUS for pancreaticobiliary indications from March to September 2009 were included.

For each case, the following data were collected: Gender, age, indication for EUS procedure, type of previous surgery, adequate visualization of the HOP and CBD, performance of FNA, and final diagnosis.

Table 1. Comparison between FV and CLA echoendoscope features

	FV echoendoscope GF-UCT160J-AL5	CLA echoendoscope GF-UCT180
Optical system		
Direction of view	Forward view	Oblique view
Field of view	120°	100°
Insertion tube		
Distal end outer diameter (mm)	14.2	14.6
Insertion tube outer diameter (mm)	11.8	12.6
Working length (mm)	1250	1250
Instrument		
Working channel diameter (mm)	3.7	3.7
Elevator function	No	Yes
Exit trajectory of devices	Parallel to the scope axis	Oblique to the scope axis
Angulation range	Up 180°, down 100°, right/left 90°	Up 130°, down 90°, right/left 90°
Ultrasound function		
Scanning range	90°	180°
Frequencies (MHz)	5, 6, 7.5, 10	5, 6, 7.5, 10

FV: Forward-view, CLA: Curved linear array

All patients provided written informed consent for the endoscopic procedure and for anonymous review of their data for research purposes. This retrospective study was conducted in accordance with the principles of the Declaration of Helsinki (Edinburgh revision, 2000).

EUS procedure

EUS examinations were performed at a single institution by the same experienced endosonographer (P.F.). All patients received sedation with meperidine and midazolam administered by a gastroenterologist. EUS was performed using the prototype FV echoendoscope (XGF-UCT160J-AL5, Olympus Medical Systems Corp., Tokyo, Japan). EUS-guided FNA was performed using a standard 22-gauge EUS needle (Echotip 22-3, Cook Medical, Limerick, Ireland).

RESULTS

Thirty-seven patients (19 male, 18 female; median age 71 years) were included [Table 2]. Twenty-five presented with partial gastrectomy with typical reconstruction according to Billroth II and 12 with partial gastrectomy and Roux-en-Y gastrojejunal anastomosis. Overall, adequate visualization of the HOP and CBD was achieved in 28 out of 37 patients (75.7%). No adverse events were experienced.

HOP and CBD visualization

Table 3 shows the EUS diagnostic outcome according to the type of upper gastrointestinal surgery. The HOP and the CBD were adequately visualized in 25 out of 25 (100%) patients with Billroth II gastrectomy; on the other hand, HOP and CBD were adequately visualized in only 3 out of 12 (25%) of Roux-en-Y patients (Fisher's exact test, $P < 0.0001$). All 9 failed EUS examinations were due to inability to intubate the duodenal limb up to the ampulla of Vater in patients with previous Roux-en-Y intervention.

FV-EUS-guided FNA

EUS-FNA was performed in 16 patients with Billroth II surgery. The diagnostic accuracy of EUS-FNA was 100%: 12 pancreatic cancer, 1 mass-forming chronic pancreatitis, 1 hemangiopericytoma [Figure 1], 1 pancreatic neuroendocrine tumor [Figure 2], 1 pancreatic pseudocyst. EUS-FNA was not indicated in the 3 patients with Roux-en-Y surgery who had adequate EUS.

In the remaining 12 patients, EUS-FNA was not indicated (8 CBD stones, 2 side-branch intraductal papillary mucinous neoplasms, 1 ampulloma, 1 chronic pancreatitis).

Table 2. Patients' characteristics

Patients' characteristics	Total (no. 37) (%)
Sex, male *N* (%)	19 (51.4)
Age in years, median (range)	71 (41-89)
Surgical interventions	
Billroth II	25 (67.6)
Roux-en-Y	12 (32.4)
EUS diagnostic failures	9 (24.3)
Billroth II	0/25
Roux-en-Y	9/12
Indications to EUS	
Imaging abnormalities	14
Suspected biliary stones	10
Jaundice	7
Biliary tree dilation	6
Diagnostic EUS	28 (75.7)
Pancreatic cancer	12
CBD*stones	8
Chronic pancreatitis	2
IPMN†	2
Ampulloma	1
Pancreatic pseudocyst	1
Hemangiopericytoma	1
Pancreatic neuroendocrine tumor	1

*CBD: Common bile duct, †IPMN: Intraductal papillary mucinous neoplasm

Table 3. Results according to the type of previous surgical intervention

Type of surgery	Billroth II (no. 25) (%)	Roux-en-Y (no. 12) (%)
Adequate EUS Visualization		
HOP*	25 (100)	3 (25)
CBD†	25 (100)	3 (25)
EUS-FNA‡		
Performance of FNA	16	0
Mean size (mm)	22±6	
Location		
Head	9	
Body	4	
Tail	2	
Perigastric	1	
FNA accuracy	100%	–

*HOP: Head of pancreas, †CBD: Common bile duct, ‡FNA: Fine-needle aspiration

DISCUSSION

The assessment of the biliary tree and the pancreas with standard echoendoscopes is challenging in patients with surgically altered upper gastrointestinal anatomy, due to the technical difficulty in reaching the ampulla of Vater. We hypothesized that the new FV echoendoscope could be useful to overcome this limitation, thus we evaluated the safety and diagnostic

performance of the FV echoendoscope in this specific setting.

In our experience, the use of the FV echoendoscope led to adequate visualization of both HOP and CBD in up to 76% of patients; moreover, in all cases in which EUS-FNA was indicated, the procedure was feasible and diagnostic. No adverse events occurred due to the use of the FV echoendoscope or the use of EUS-FNA.

Unlike the radial and linear echoendoscopes in previous studies, the use of the FV echoendoscope was safe and effective in reaching the periampullary area under direct endoscopic vision in all patients with previous Billroth II gastric surgery (25 out of 25), allowing complete exploration of the HOP and the CBD and even performance of EUS-FNA. Radial echoendoscopes with forward endoscopic view are available but they are not suitable for performing EUS-FNA.

On the other hand, the examination was adequate only in a few patients with previous Roux-en-Y gastric surgery (3 out of 12). The increased technical challenges in Roux-en-Y patients are ascribed to both the reduced flexibility and maneuverability of the echoendoscopes (compared to regular upper endoscopes) for intubating the afferent limb, especially when some degree of retroflexion is needed, and the variability of the limb length, which may be exceedingly long in some patients.

The achievement of adequate visualization of the HOP and CBD led to a major therapeutic change in the majority of patients. Furthermore, no more diagnostic examinations were needed after EUS.

We experienced some minor technical limitations with the FV echoendoscope, due to the narrow EUS field of 90° (compared to 180° of the linear echoendoscopes) and to the difficult intubation of the cervical esophagus. However, the latter problem, which was related to the prominent design of the tip, has been fixed in the definitive version of the FV echoendoscope that is now commercially available [Figure 3].

Our study presented several limitations. First, our study population was limited because the enrollment period was restricted to the 6 months for which the prototype FV echoendoscope was loaned to our unit. Second, as the design of the study was retrospective, some data may have been missing (information bias). However,

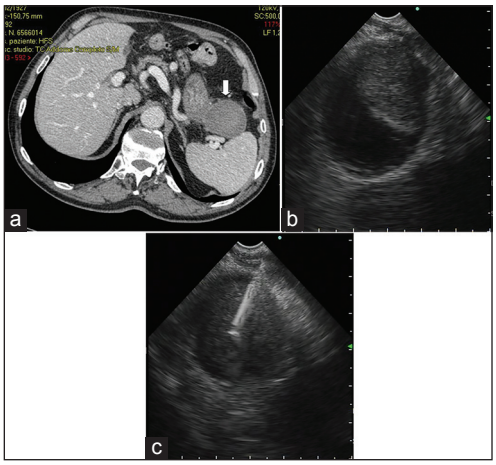

Figure 1. (a) Computed tomography shows a hypodense mass (arrow) between the gastric stump and the spleen (b) FV EUS shows a hypoechoic oval mass external to the gastrointestinal wall (c) FV EUS-FNA is performed with a 22-gauge needle. Cytology showed hemangiopericytoma

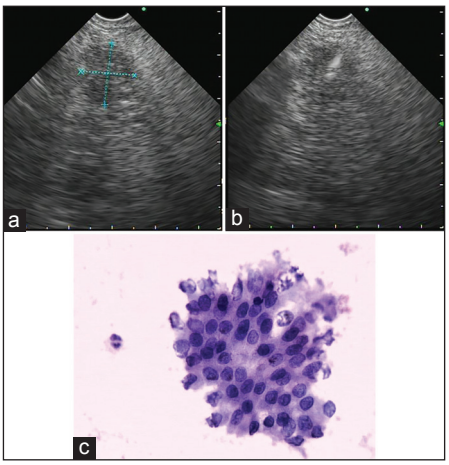

Figure 2. (a) A small hypoechoic lesion, with regular margins, located in the pancreatic head (b) FV EUS-FNA is performed with a 22-gauge needle (c) Cytology smear: Epithelioid cells with roundish/oval uniform nuclei, with granular eosinophilic cytoplasm (400×). The findings are compatible with a neuroendocrine tumor (NET)

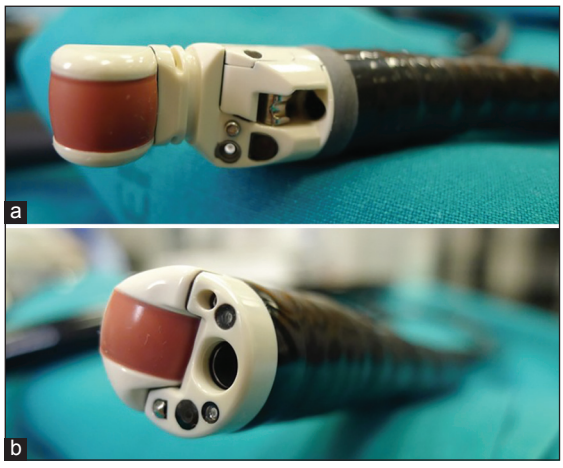

Figure 3. (a) Tip design of the standard linear echoendoscope (b) Tip design of the FV echoendoscope

our electronic database is accurately maintained in a prospective fashion with the intent of collecting material for clinical studies. For this reason, we believe that at least all the fundamental data were available for review. Third, a control group of postsurgical patients undergoing EUS with a standard echoendoscope was not available for direct comparison. In this respect, we deem that our results should be compared to the cohorts of patients with the same characteristics available in the literature usually reporting unsatisfactory results with standard echoendoscopes.[17]

CONCLUSION

In conclusion, the FV echoendoscope proved to be safe and effective in reaching the periampullary area thanks to its frontal endoscopic view in patients with previous Billroth II surgery, allowing complete exploration of the HOP and the CBD and performance of EUS-FNA, when indicated. Subsequent diagnostic/therapeutic management was altered as a direct consequence of FV EUS in the majority of these patients. Conversely, Roux-en-Y surgery still represented a major obstacle to the performance of EUS even with the use of the FV echoendoscope, probably due to the long distance of the papilla from the incisor teeth.

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Conflicts of interest
There are no conflicts of interest.

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