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Endosonographic Preoperative Evaluation for Tumors of the Ampulla of Vater Using Endoscopic Ultrasonography and Intraductal Ultrasonography

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Background/Aims: In recent years, endoscopic snare papillectomy has been performed to treat tumors of the ampulla of Vater. This procedure requires accurate preoperative evaluation. In this study, we diagnosed the focal extension of such tumors by using endoscopic ultrasonography (EUS) and intraductal ultrasonography (IDUS), and examined the indications for endoscopic snare papillectomy.

Methods: The subjects were 48 patients with a papillary tumor (13 patients, surgical resection; 35 patients, endoscopic snare papillectomy) who were evaluated preoperatively with EUS and IDUS. The tumor-node-metastasis classification was used for the endosonographic evaluation and pathological diagnosis of these tumors.

Results: The diagnostic accuracy of EUS was 97% for diagnosing adenomas and pTis tumors, 73% for pT1 tumors, 50% for pT2 tumors, and 50% for pT3−4 tumors, for an overall accuracy of 85% for T-staging. The diagnostic accuracy of IDUS was 94% for adenomas and pTis tumors, 73% for pT1 tumors, 50% for pT2 tumors, and 100% for pT3−4 tumors, for an overall accuracy of 80% for T-staging.

Conclusions: EUS and IDUS are highly capable of evaluating tumors of the ampulla of Vater preoperatively. However, these techniques are not sufficient for evaluating the focal extension of carcinomas preoperatively. Currently, endoscopic snare papillectomy is adequate for treating adenomas and pTis tumors.

Key Words: Ampulla of Vater; Endosonography; Intraductal ultrasonography; Endoscopic papillectomy; Endoscopic snare excision

INTRODUCTION

A pancreaticoduodenectomy (PD) or pylorus-preserving PD (PpPD) has traditionally been performed to treat tumors of the ampulla of Vater. Since a report on the use of endoscopic snare papillectomy to treat tumors of the ampulla of Vater was published in 1983,[1] reports about this procedure have gradually increased. Because it is minimally invasive, the procedure is used as a limited surgery and for complete biopsy; however, there is no consensus concerning its indications because of problems with the accuracy of preoperative evaluation. In the current study, we examined the indications for endoscopic snare papillectomy based on the focal extension of the tumor diagnosed with endoscopic ultrasonography (EUS) and intraductal ultrasonography (IDUS).

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MATERIALS AND METHODS

The subjects were 48 patients with tumors of the ampulla of Vater who underwent EUS and IDUS preoperatively from January 2006 to March 2013. Computed tomography (CT) and magnetic resonance cholangiopancreatography (MRCP) were performed before EUS or IDUS. The patients included

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25 men and 23 women with a mean age of 67.2 years (range, 32 to 90 years). Thirteen patients underwent surgical resection (PpPD) and 35 underwent endoscopic snare papillectomy. The final pathological diagnosis was adenocarcinoma for 22 patients (including pTis tumor for 7) and adenoma for 26 patients. The mean tumor size was 19.1 mm (range, 9 to 37 mm) (Table 1).

Endoscopic snare papillectomy was performed on patients when EUS/IDUS, CT, and MRCP indicated that the tumor was limited to the mucosa, had not extended into the bile and pancreatic ducts, and had not extended beyond the sphincter of Oddi. Surgical resection was performed on patients when either examination procedure indicated an evidence of extension.

EUS was performed with an electronic radial scanning scope (GF-UM200 or GF-UM2000; Olympus Medical Systems, Tokyo, Japan) at frequencies of 6, 7.5, and 10 MHz. The scope was first advanced into the descending part of the duodenum; a balloon at the end was inflated with distilled water; and then distilled water was infused into the duodenum through the working channel before observation. IDUS was performed with an ultrasound probe (UM-G20-29R; Olympus Medical Systems) at a frequency of 20 MHz. After cholangiopancreatography, the probe was inserted through the working channel of a TJF240 duodenoscope (Olympus Medical Systems) into the bile and pancreatic ducts, guided by a 0.889-mm guidewire before observation. All procedures were performed by 2 endoscopists with ≥10 years of experience in performing ERCP/EUS.

The tumor-node-metastasis (TNM) classification was used for preoperative endosonographic evaluation and pathological diagnosis with EUS and IDUS (T1, tumor limited to the ampulla of Vater; T2, tumor invading the duodenal wall; T3–4, tumor invading the pancreas).[2] Extension into the bile and pancreatic ducts was also examined. EUS and IDUS results were considered positive when they revealed either an intraductal mass or wall thickening adjacent to a papillary tumor, and these results were compared with the pathological diagnosis. All patients gave written informed consent, and the study was approved by the Institutional Review Board of Toho University Omori Medical Center.

Table 1. Clinicopathological Characteristics of Patients with Tumor of Ampulla of Vater

Variable	Value
Gender, male:female	25:23
Mean age (range), yr	67.2 (32–90)
Average tumor size (range), mm	19.1 (9–37)
Operation	
Surgery	13
Endoscopic papillectomy	35
Histology	
Adenoma	26
Adenocarcinoma	22

Table 2. Results of Pathological and Endoscopic Ultrasonography Evaluation for T-Staging

Variable	EUS diagnosis				Accuracy, %
	T1	T2	T3–4	Undefined	
Adenoma	25	1	-	-	96
pTis	7	-	-	-	100
pT1	8	2		1	73
pT2	1	1	1	-	50
pT3–4	-	-	-	1	50
Total	-	-	-	-	85

EUS, endoscopic ultrasonography.

RESULTS

Endoscopic ultrasonography evaluation

Two of 41 patients could not be evaluated because of poor visualization of the muscularis propria of the duodenum. The T category according to EUS had a diagnostic accuracy of 97% for adenoma and pTis tumor, 73% for pT1 tumor, 50% for pT2 tumor, and 50% for pT3–4 tumor, for an overall accuracy of 85% (Table 2). Results were overestimated in 1 patient with an adenoma and 2 patients with a pT1 tumor; all 3 patients were considered to have evidence of thickness of the muscularis propria. Results were underestimated in one patient with a pT2 tumor of the duodenum; determination of invasion of the muscularis propria was difficult because of attenuation within the tumor. Extension into the bile duct could not be evaluated in one patient owing to poor visualization of the bile duct. Extension into the bile duct was evaluated with an accuracy of 90% (Table 3). The result was overestimated in one patient considered to have extension, with the tumor protruding into the bile duct. Results were underestimated in three patients, and invasion of the duodenal wall was discriminated in none of them. Concerning extension into the pancreatic ducts, visualization of the pancreatic ducts was difficult in one patient. Extension into the pancreatic ducts was evaluated with an accuracy of 92% (Table 4).

Intraductal ultrasonography evaluation

One of 41 patients could not be evaluated because of poor visualization of the sphincter of Oddi. The T category according to IDUS had an accuracy of 94% for diagnosing adenomas and pTis tumors, 73% for pT1 tumors, 50% for pT2 tumors, and 100% for pT3–4 tumors, for an overall accuracy of 85%

Table 3. Results of Pathological by Endoscopic Ultrasonography and Intraductal Ultrasonography Evaluation for Infiltration into Bile Duct

Variable	Positive	Negative	Undefined	Accuracy, %
EUS diagnosis				
Positive	3	3	1	-
Negative	1	40	-	-
Total	-	-	-	90
IDUS diagnosis				
Pogitive	5	2	-	-
Negative	4	37	-	-
Total	-	-	-	88

EUS, endoscopic ultrasonography; IDUS, intraductal ultrasonography.

Table 4. Results of Pathological by Endoscopic Ultrasonography and Intraductal Ultrasonography Evaluation for Infiltration into Pancreatic Duct

Variable	Positive	Negative	Undefined	Accuracy, %
EUS diagnosis				
Positive	-	-	1	-
Negative	3	44		-
Total	-	-	-	92
IDUS diagnosis				
Pogitive	1	-	-	-
Negative	6	41	-	-
Total	-	-	-	88

EUS, endoscopic ultrasonography; IDUS, intraductal ultrasonography.

Table 5. Results of Pathological Staging with Intraductal Ultrasonography for T-Staging

Variable	IDUS diagnosis				Accuracy, %
	T1	T2	T3–4	Undefined	
Adenoma	24	2	-	-	92
pTis	7	-	-	-	100
pT1	8	2	-	1	73
pT2	1	1	-	-	50
pT3–4	-	-	2	-	100
Total	-	-	-	-	85

IDUS, intraductal ultrasonography.

(Table 5). Results were overestimated in four patients who were considered to have evidence of displacement of the muscularis propria of the duodenum by a tumor. The result was underestimated in one patient in whom invasion of the muscularis propria of the duodenum was not discriminated. Extension into the bile and pancreatic ducts was successfully evaluated in all patients. Extension into the bile duct was evaluated with an accuracy of 88%. Results were overestimated in four patients: one patient was considered to have evidence of tumor protrusion into the bile duct, and three were considered to have evidence of displacement of the bile duct by a tumor (Table 3). Extension into the pancreatic ducts was evaluated with an accuracy of 88%. Results were overestimated in six patients who were all considered to have evidence of displacement of a pancreatic duct by a tumor (Table 4). No complications of EUS and IDUS were noted in any of the patients.

DISCUSSION

The prevalence of upper gastrointestinal endoscopy has facilitated the observation of the descending part of the duodenum and increased the chances of detecting tumors of the ampulla of Vater. Surgical resection with a procedure such as PD or PpPD has traditionally been used to treat tumors of the ampulla of Vater. A consensus has been reached about the standard use of the procedures for treating tumors of the ampulla of Vater. However, their invasiveness is a problem for elderly patients and patients with any complications. Thanks to recent advances in endoscopic therapy, reports of endoscopic snare papillectomy have increased because of its minimal invasiveness.[3,4] The general view is that endoscopic snare papillectomy can be performed on a tumor that has not invaded the muscularis propria of the duodenum but is not indicated when the tumor extends into the hepatic and pancreatic ducts.[5] Thus, accurate preoperative evaluation is needed to perform an endoscopic snare papillectomy. A correlation between invasion of the duodenum or pancreas and prognosis has been noted,[6] and preoperative evaluation with EUS or IDUS is crucial.

EUS is helpful in diagnosing the extent of papillary tumors because of its high spatial resolution;[7] also, it allows better evaluation of focal extension than CT or magnetic resonance imaging.[8-10] Previous reports have indicated that the T category according to EUS had a 62% to 90% ability to diagnose focal extension.[8-15] In the current study, the T category had a diagnostic accuracy of 85%. It had a diagnostic accuracy of 100% in 35 patients undergoing endoscopic snare papillectomy (12 with adenocarcinoma, including pTis tumor for 7, and 23 with adenoma) and an accuracy of 70% in 13 patients undergoing surgical resection (10 with carcinoma, 3 with adenoma). In Ito et al.'s report,[15] 15% of the patients could not be evaluated because the muscularis propria of the duodenum was not clearly visualized. Similarly, 4% of the current patients (2 of 48) could not be evaluated. The current study also noted a diagnostic accuracy of 97% for diagnosing adenomas and pTis tumors but an accuracy of 67% for diagnosing adenocarcinomas (>pT1). An adenoma can be uniformly hypoechoic inside, whereas an adenocarcinoma can have heterogeneous internal echoes. Extensive evaluation can be difficult owing to echo

attenuation disturbing the focal evaluation of an adenocarcinoma. Electronic radial scanning scopes have just recently been developed, and their diagnostic accuracy needs to further improve. Itoh et al.[13] reported an accuracy of 85.7% and 76.9% with regard to diagnosing extension into the bile duct and pancreatic ducts, respectively, whereas Ito et al.[15] reported an accuracy of 88% and 90%, respectively. Similarly, the current study noted a high diagnostic accuracy of 90% and 92% for the bile duct and pancreas, respectively.

IDUS uses high frequencies and thus provides higher-resolution images than EUS. It also helps in diagnosing the extent of small tumors, i.e., reaching the sphincter of Oddi, as well as the extent of extension into the hepatic and pancreatic ducts. Previous reports indicated that the T category according to IDUS had a 78% to 93% ability to diagnose focal extension.[12,13,15] The current study noted an overall accuracy of 85%. Concerning the type of tumor, the accuracy of the T category was 94% for adenomas and pTis tumors, 73% for pT1 tumors, 50% for pT2 tumors, and 100% for pT3−4 tumors; thus, its accuracy tended to decrease in proportion to the extent of the tumor. This is due to the limitations on extensive evaluation (approximately 20 mm) because it uses a high frequency (20 MHz); evaluation of the muscularis propria of the duodenum is disturbed by attenuation within a larger tumor. One of the current patients who could not be evaluated had a large tumor (37 mm). However, IDUS allows visualization of the sphincter of Oddi; thus, a tumor located as far as the sphincter of Oddi can be evaluated. In the current patients who underwent endoscopic snare papillectomy, focal extension was discerned with a high accuracy of 97%. In previous reports, IDUS diagnosed extension into the bile duct and pancreatic ducts with an accuracy of 90% to 95% and 90% to 100%, respectively,[13,15] and in the current study, it had a high accuracy of 88% for both.

In this study, there was no significant difference in the accuracy of EUS and IDUS for evaluating focal extension. For preoperative evaluation of tumors of the ampulla of Vater, either EUS or IDUS is necessary. Furthermore, this study provides sufficient ground for the use of EUS or IDUS to preoperatively evaluate adenomas and pTis tumors; however, there is insufficient ground for using these procedures to evaluate adenocarcinomas. Currently, these procedures are not sufficient for an exact preoperative evaluation of the focal extension of adenocarcinomas. However, from the viewpoint of preoperative evaluation, endoscopic snare papillectomy should now be indicated for adenomas and pTis tumors.

In conclusion, in this study, we examined the ability of EUS and IDUS to diagnose the focal extension of tumors of the ampulla of Vater. These procedures help in diagnosing focal extension and are essential when considering limited surgery. Preoperative diagnosis of the focal extension of a carcinoma may prove difficult under the current circumstances; however, endoscopic snare papillectomy is adequate at treating adenomas and pTis tumors.

Conflicts of Interest

The authors have no financial conflicts of interest.

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