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Using multi-detector-row CT to diagnose ampullary adenoma or adenocarcinoma *in situ*

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ABSTRACT

Objective: To assess the diagnostic accuracy of multi-detector-row computed tomography (MDCT) for the detection of ampullary adenomas or adenocarcinomas *in situ*.
Materials and methods: We retrospectively reviewed 21 computed tomography (CT) images from 20 patients with ampullary tumors, and 22 CT images from 22 patients without periampullary tumor. Three radiologists blindly and independently reviewed CT images. The sensitivities and specificities for identification of ampullary masses were calculated in all cases and in cases with adequate duodenal distension. The sensitivities and specificities for the diagnosis of ampullary tumors were calculated using the following criteria: identification of mass alone; presence of extrahepatic bile duct (EBD) dilation or identification of mass; presence of pancreatic duct (PD) dilation or identification of mass. Paired *t*-tests were performed to assess differences in mean values.
Results: The mean sensitivity and specificity of MDCT for the detection of an ampullary mass in all cases were 47.6% and 86.4%, and in cases with adequate duodenal distension, 66.7% ($p = 0.07$) and 80.5% ($p = 0.32$), respectively. When the presence of EBD dilation or identification of mass were used as criteria, the mean sensitivity and specificity were 73.0% ($p = 0.03$) and 60.6% ($p = 0.03$), respectively. When presence of PD dilation or identification of mass were used as criteria, the mean sensitivity and specificity were 47.6% and 81.8% ($p = 0.23$).
Conclusions: MDCT is moderately accurate for the diagnosis of ampullary adenoma or adenocarcinoma *in situ*. When EBD dilation or identification of mass were used as criteria, the sensitivity can be improved.

1. Introduction

Various benign and malignant neoplasms occur in the periampullary region. Ampullary adenomas are histologically benign tumors, but are capable of malignant progression. Endoscopic resection is an option for therapeutic management when an ampullary tumor is diagnosed at the stage of an adenoma or adenocarcinoma *in situ* [1–8]. Currently, endoscopy followed by histologic evaluation is the primary diagnostic modality for ampullary tumors [9]. Although computed tomography (CT) is reported to be not comparable to endoscopic ultrasonography for the detection of periampullary tumors, it still remains important for the detection of metastatic lesions or spread to regional lymph nodes from malignant ampullary tumors [10–15]. Advances in multi-detector-row computed tomography (MDCT) have allowed the visualization of non-diseased duodenal papillae and an ampullary adenoma as an incidental finding on CT examination. To our knowledge, there have been no reports specifically addressing the use of CT scan for the detection of ampullary adenoma or adenocarcinoma *in situ*. The objective of this study was to assess the utility of a currently available MDCT scanner for the diagnosis of ampullary adenoma or adenocarcinoma *in situ*.

2. Materials and methods

2.1. Patients

A retrospective search of medical records (from Jan 2003 to May 2007) of the patients treated at our institution (Severance Hospital, Seoul, Korea) identified 32 patients who had undergone biopsy to diagnose an ampullary adenoma with or without an area of intramucosal carcinoma (carcinoma *in situ*). Twenty of these patients underwent MDCT examinations prior to having an ampullectomy or other surgical intervention. One patient underwent two

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Table 1
Demographics and clinical characteristics of the patients and controls.

	Patient	Control	*p*-Value
Sex			
Male	10	12	0.88[a]
Female	11	10	
Age (mean ± SD)	57.8 ± 12.5	58.8 ± 11.5	0.78[b]
CT indication			
Abdominal pain	9	16	
Jaundice	1		
General weakness	1		
Abnormality on checkup	6	3	
Routine follow-up for other medical condition	4	3	
Pathology of ampullary lesion			
Adenoma, low-grade	9		
Adenoma, moderate-grade	1		
Adenoma, high-grade	6		
Carcinoma *in situ*	5		

[a] Chi-square test.
[b] Independent *t*-test.

Table 2
CT scanning protocols.

	Patient ($n = 21$)	Control ($n = 22$)
Scanner		
Siemens sensation 64	5	18
Siemens sensation 16	9	4
Others	7	0
Enhancement phase[a]		
2-Phase	4	0
2-Phase (without pre-contrast)	3	0
3-Phase	10	20
4-Phase	2	2
4-Phase (dual arterial phase)	2	0
kVp		
120	18	22
130	2	0
140	1	0
mA[b]		
Range (mean ± SD)	210–380 (266 ± 43)	240–320 (264 ± 40)
Reconstruction thickness (mm)		
≤3	15	22
>3, ≤5	6	0
Oral contrast agent		
Not used	5	10
Water	9	11
Positive contrast media	7	1

[a] 2-phase protocol includes pre-contrast scan and post-contrast scan; 2-phase(without pre-contrast) protocol includes arterial phase scan and portal venous phase scan; 3-phase protocol includes per-contrast scan, arterial phase scan and portal venous phase scan; 4-phase protocol includes pre-contrast scan, arterial phase scan, portal venous phase scan and delayed phase scan; 4-phase(dual arterial phase) protocol includes pre-contrast scan, early-arterial phase scan, late-arterial phase scan and portal venous phase scan; specific timing for each scan phase is not taken into consideration.
[b] In patients group, exact mA settings were not available in 6 cases.

MDCT examinations at an interval of 20 months and had subsequent endoscopic biopsies. Because of this, 21 MDCT scans were included in this study. In 20 cases, the patient underwent a CT scan prior to having an endoscopic biopsy. The interval between CT and biopsy ranged from 0 to 100 days (mean ± standard deviation [SD], 19.5 ± 28.4). In one case, the patient underwent an endoscopic biopsy 16 days before the CT scan.

For the control group, we identified 22 patients who underwent an MDCT examination using a specific protocol for the pancreatobiliary system during the same period as the patient group. Patients in the control group underwent a gastroduodenal endoscopy within one month before or after the CT scan, revealing no pathology in the periampullary area. Patients in the control group also had no history of ampullectomy or other history of surgical intervention on upper gastrointestinal or distal biliary structures at the time of the CT scan. The physician performed additional clinical investigation if necessary, such as laboratory tests, endoscopic ultrasonography, endoscopic retrograde cholangiopancreatography, magnetic resonance cholangiopancreatography, for the patients in the control group, and did not revealed any tumor lesion in periampullary region.

Demographics and clinical characteristics of the patient group and control group are shown in Table 1. The patient group was composed of 10 men and 11 women with an age range of 26–74 years (mean ± SD, 57.8 ± 12.5). In the control group, there were 12 men and 10 women with an age range of 29–78 years (58.8 ± 11.5). The CT scanners and scanning protocols used in the patient and control group are summarized in Table 2. In the patient group, a Sensation64 (Siemens, Forcheim, Germany) was used in five (24%) cases, a Sensation16 (Siemens, Forcheim, Germany) was used in nine (43%) cases, and in seven (33%) cases CT scans were performed at other institutions using various scanners. In the control group, a Sensation64 was used in 18 (82%) cases and a Sensation16 was used in four (18%) cases.

In all cases, an enhancement study using intra-venous contrast media was performed. A dynamic study that obtained pre-contrast, arterial-phase, and portal venous-phase images were the most commonly performed type of enhancement study. This was done in 10 (48%) cases in the patient group and 20 (91%) cases in the control group. In the patient group, a tube voltage of 120-kVp was used in 18 (86%) cases, 130-kVp was used in two (10%) cases, and 140-kVp was used in one (5%) case. In the control group, the tube voltage was 120-kVp in all cases. The tube current level ranged from 210 to 380 mA (mean ± SD, 266 ± 43) in the patient group and from 240 to 320 mA (264 ± 40) in the control group. In the patient group, the reconstruction thickness was less than or equal to 3 mm in 15 (71%) CT scans and 3–5 mm in six (29%). In the control group, all CT scans used a reconstruction thickness of 3 mm or less. Water was used as an oral contrast agent in nine (43%) cases in the patient group and positive contrast medium was used in seven (33%) cases. Water was used as a contrast agent in 11 (50%) cases in the control group. and positive contrast medium was used in one (5%) case.

2.2. Image analysis

Three radiologists (reviewer #1 had three years of experience in abdominal radiology; reviewer #2 had 10 years; and reviewer #3 had seven years) independently reviewed the CT images. The reviewers were aware of the age and sex of the patients but blinded to the pathological diagnoses of the patients. They recorded the following findings: whether duodenal distension was adequate for evaluation of the periampullary area; whether the duodenal ampulla was visualized; whether an ampullary mass was identified; whether extrahepatic bile duct (EBD) dilation was present; and whether pancreatic duct (PD) dilation was present. Ampullary mass was defined present when soft tissue enlargement larger than 1 cm was observed or when there was irregular contour at the junction of EBD and duodenum [16,17], and when present, measured diameter of the mass was recorded. The EBD diameter was measured as the short diameter at the level of maximal distension. Dilation was defined as a measured diameter larger than 7 mm in patients under age 60 without a prior history of cholecystectomy, or 9 mm in patients 60 years old or older without a prior history of cholecystectomy, or 10 mm in patients with a prior history of cholecystectomy. PD dilation was defined as a diameter larger than 2 mm in the body or tail of the pancreas, or 3 mm in the head of the pancreas [18–20].