대한영상의학회지

Differentiation of Adenomyoma from Localized Adenocarcinoma of the Ampulla of Vater Using Multidetector CT

다중 검출 전산화단층촬영 영상에서 바터 팽대부의 샘근종과 국소적 샘암종의 감별

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Purpose To determine the multidetector CT (MDCT) findings that differentiate adenomyoma of the ampulla of Vater (AOV) from localized adenocarcinoma of the AOV.

Materials and Methods Sixteen and 30 patients with adenomyoma and localized adenocarcinoma of the AOV, respectively, were evaluated using MDCT. We analyzed the size and attenuation value and presence of uniform enhancement of the lesions, diameters of the extrahepatic bile duct (EHD) and main pancreatic duct, presence of regional lymph node enlargement, and laboratory findings. We determined the independent findings for differentiating adenomyoma from localized adenocarcinoma of the AOV using multivariate analysis.

Results The size of the lesion and diameter of the EHD were significantly smaller for adenomyoma than those for localized adenocarcinoma of the AOV (all $p < 0.001$). In multivariate analyses, a lesion size of ≤ 1.3 cm, an EHD diameter of ≤ 1.3 cm, and an alanine transaminase level of ≤ 31 IU/L significantly differentiated adenomyoma from localized adenocarcinoma of the AOV. When all of these three findings were met, the specificity for adenomyoma of the AOV was 93.3%.

Conclusion MDCT imaging may facilitate the differential diagnosis of adenomyoma and localized adenocarcinoma of the AOV based on the size of the lesion and diameter of the EHD.

Index terms Adenomyoma; Ampulla of Vater; Multidetector Computed Tomography

INTRODUCTION

Adenomyoma is a nodular lesion that shows smooth muscle hyperplasia or ductal or

linear epithelial hyperplasia on histological examination. It is a benign disorder that does not lead to malignant transformation (1). While it can occur anywhere in the hepatobiliary system or the gastrointestinal tract, it often occurs in the fundus of the gallbladder. Its occurrence has also been reported in the extrahepatic bile duct (EHD), duodenum, and other regions of the small intestine. However, it has been known to rarely occur in the ampulla of Vater (AOV) (2). Regarding the ampullary location, fewer than 60 cases of adenomyoma involving the major papilla have been reported (2-4). However, small adenomyomas (2–5 mm) are common and reported in 60% of the population in autopsies, with no relevant associated clinical history (2). Adenomyoma in the AOV is usually detected incidentally without symptoms (2, 3), but it may manifest symptoms such as abdominal pain and jaundice when the lesion causes biliary obstruction (5, 6).

Various CT imaging findings, such as dilation of the bile duct (3) or presence of a periampullary mass (7), have been reported for adenomyoma in the AOV; rarely, it has been reported to be accompanied by the dilation of the pancreatic duct (2). Although an adenomyoma itself is benign, it is difficult to differentiate it from adenoma or malignant ampullary tumor because a mass can be seen around the AOV or dilated biliary or pancreatic duct in adenoma or malignant ampullary tumor. In some cases, unnecessary extensive surgical excision is performed because of overlapping imaging findings (5, 6, 8, 9).

Because endoscopic retrograde cholangiopancreatography (ERCP) enables the inspection of the periampullary region and visualization of the pancreatobiliary tract, it may serve as a useful tool for diagnosing adenomyoma of the AOV. However, considering that adenomyoma may show an ampullary mass or bulging during endoscopy and biliary or pancreatic duct dilation with delayed contrast passage and a filling defect around the AOV in fluoroscopic images, it is still difficult to differentiate it from other ampullary tumors using ERCP. A biopsy is usually required to confirm the diagnosis. However, it is difficult to approach an adenomyoma with ERCP when it does not protrude into the duodenum, or it is relatively small and located in the submucosal or muscular layer of AOV without ulcer formation. Therefore, the diagnostic yield of a biopsy has not been reported to be high (5, 10). In South Korea, some cases were reported in which extensive surgery had been performed to rule out malignancy because of nonspecific results of an endoscopic biopsy (7, 11, 12).

CT is a non-invasive imaging modality that is widely used to assess the pancreaticobiliary system and to identify the cause of obstructive pancreaticobiliary duct dilatation. Therefore, it may have the potential to differentiate adenomyoma from malignant tumors of the AOV, thereby facilitating the exclusion of unnecessary surgery. The purpose of the present study was to determine the findings that could help differentiate adenomyoma of the AOV from adenocarcinoma of the AOV using multidetector CT (MDCT).
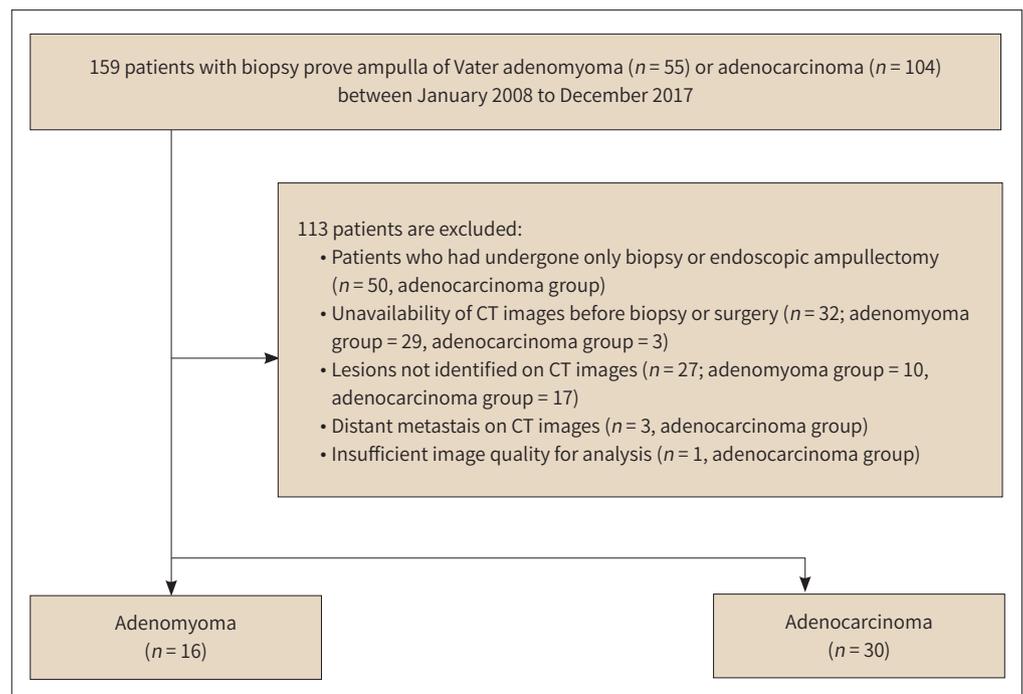
MATERIALS AND METHODS

PATIENT SELECTION

This retrospective study involving analysis of clinical and imaging data was approved by the Institutional Review Board, and the requirement for obtaining informed consent was waived (IRB No. CBNUH 2018-10-013). We reviewed the medical records of patients from Jan-

uary 2008 to December 2017 in our institution and enrolled 159 patients who had been diagnosed with adenomyoma or adenocarcinoma of the AOV according to their histopathological report. "Adenomyoma" ($n = 55$) and "adenocarcinoma" ($n = 104$) were histopathologically confirmed by endoscopic biopsy in 97 patients (adenomyoma group, $n = 49$, adenocarcinoma group, $n = 48$), endoscopic ampullectomy in 4 patients (adenomyoma group, $n = 3$, adenocarcinoma group, $n = 1$), surgical excision in 3 patients (adenomyoma group, $n = 2$, adenocarcinoma group, $n = 1$), or pylorus-preserving pancreaticoduodenectomy (PPPD) in 55 patients (adenomyoma group, $n = 1$, adenocarcinoma group, $n = 54$).

Among the patients diagnosed with adenocarcinoma, those who had undergone only biopsy or endoscopic ampullectomy were excluded from analysis to determine the T stage ($n = 50$). Additional 63 patients were excluded because of the following reasons: unavailability of CT images before biopsy or surgery ($n = 32$; adenomyoma group, $n = 29$, adenocarcinoma group, $n = 3$); lesions not identified on CT images ($n = 27$; adenomyoma group, $n = 10$, adenocarcinoma group, $n = 17$); distant metastasis on CT images ($n = 3$, adenocarcinoma group); and insufficient image quality for analysis ($n = 1$, adenocarcinoma group). Finally, a total of 46 patients were included in the present study. Sixteen patients were diagnosed with adenomyoma of the AOV (10 men; mean age, 64.4 ± 9.8). To these 16 patients, the following treatment methods were applied: endoscopic biopsy ($n = 11$), endoscopic ampullectomy ($n = 3$), surgical excision ($n = 1$), and PPPD ($n = 1$). Thirty patients were diagnosed with adenocarcinoma of the AOV using surgery (21 men; mean age, 67.8 ± 9.3) (Fig. 1). With regard to patients diagnosed with adenocarcinoma, we checked the histopathological reports and divided the patients according to T and N stage based on the American Joint Committee on Cancer Cancer Staging Manual, 8th edition as follows: T1, adenocarcinoma was localized to the

Fig. 1. Flowchart of the study.

159 patients with biopsy prove ampulla of Vater adenomyoma ($n = 55$) or adenocarcinoma ($n = 104$) between January 2008 to December 2017

113 patients are excluded:
- Patients who had undergone only biopsy or endoscopic ampullectomy ($n = 50$, adenocarcinoma group)
- Unavailability of CT images before biopsy or surgery ($n = 32$; adenomyoma group = 29, adenocarcinoma group = 3)
- Lesions not identified on CT images ($n = 27$; adenomyoma group = 10, adenocarcinoma group = 17)
- Distant metastais on CT images ($n = 3$, adenocarcinoma group)
- Insufficient image quality for analysis ($n = 1$, adenocarcinoma group)

Adenomyoma ($n = 16$)

Adenocarcinoma ($n = 30$)

sphincter of Oddi in the AOV or had invaded duodenal submucosa (n = 4); T2, adenocarcinoma had invaded into the muscularis propria in the duodenum (n = 13); and T3, adenocarcinoma had directly invaded the pancreas or spread to peripancreatic tissue but the celiac axis or superior mesenteric artery was not involved (n = 13); N0, no regional lymph node (peripancreatic, hepatic artery, and portal vein nodes) involvement (n = 18); N1, metastasis to one to three regional lymph nodes (n = 9); N2, metastasis to four or more regional lymph nodes (n = 3) (13). We also investigated symptoms and liver function test results of the patients, which include data on aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), and total bilirubin levels, at the time of diagnosis by reviewing medical records.

CT PROTOCOL

Single-phase contrast-enhanced CT was performed in 26 patients and multiphase contrast-enhanced CT was performed in 20 patients using 64-detector MDCT scanner (Brilliance CT 64 Channel, Philips Medical, Eindhoven, the Netherlands) without the administration of oral contrast agent. In case of multiphase contrast-enhanced CT, 2 ml non-ionic contrast medium (Xenetics 350, Guerbet, Roissy, France; Omnipaque 350, GE Healthcare, Milwaukee, WI, USA; Iomeron 350, Bracco, Milan, Italy) was injected per kilogram of body weight into the antecubital vein at the rate of 3.0–3.5 mL per second by using a power injector. The acquisition of arterial phase images was set to begin after 12 s when a circular region of interest in the abdominal aorta at the level of L3 vertebral body reached 150 Hounsfield units (HU) as determined using bolus tracking method. Portal venous and equilibrium phase images were obtained 70–80 s and 180 s after the injection of the contrast medium, respectively. Single-phase portal venous CT images were obtained 70–80 s after the injection of contrast medium at a flow rate of 2.0–2.5 mL/s. We used the following CT parameters: detector configuration, 64 × 0.625 mm; rotation time, 0.5 s; pitch, 0.891; section thickness, 3.0 mm; reconstruction interval, 3 mm; effective amperage setting, 200 mA; tube voltage, 120 kVp; and matrix, 512 × 512. The mean time between CT examination and biopsy was 14.2 days (range, 0–188 days), and the mean time between CT examination and surgery was 24.7 days (range, 6–193 days).

IMAGE ANALYSIS

CT findings were measured independently by two radiologists (J.L. and Y.P. with 8 years and 2 years of experience in abdominal imaging, respectively). In case of disagreement, reviewers reached a consensus by jointly reviewing the images with a third radiologist (Y.K. with 8 years of experience in abdominal imaging). Both observers were aware of the alternative diagnoses of adenomyoma or adenocarcinoma, but were blinded to the clinical, laboratory, and histopathological results in each case. The lesion in the AOV was defined as a soft tissue lesion that had a boundary with surrounding organs at the intersection between the duodenum and the EHD (13, 14). On portal venous CT images, reviewers recorded the lesion size (maximum diameter), HU values of the lesion before and after contrast injection, ratio of the HU values of the lesion and the spinal erector muscle before and after contrast injection, presence or absence of uniform contrast enhancement of the lesion, the maximum diameters of the EHD and main pancreatic duct, and presence or absence of regional lymph node enlargement. The diameter of the EHD was measured at the widest region perpendicu-

lar to the long axis of the EHD on coronal images. The diameter of the main pancreatic duct was measured at the widest region perpendicular to the long axis of the main pancreatic duct on axial images. The EHD was considered to be dilated when the maximum diameter of the EHD was > 7 mm in patients younger than 60 years, > 9 mm in those aged ≥ 60 years, or > 10 mm in those who had undergone cholecystectomy. The main pancreatic duct was considered to be dilated when the maximum diameter of the main pancreatic duct was > 3 mm in the head of the pancreas or > 2 mm in the body or tail of the pancreas (15-17). The regional lymph nodes included peripancreatic, hepatic arterial, and portal venous nodes (18). The diameter of the lymph nodes was measured as the maximal short-axis diameter. The regional lymph node was considered to be enlarged when the diameter of one or more lymph nodes was > 8 mm (19).

STATISTICAL ANALYSIS

We compared clinical findings and CT imaging findings between the adenomyoma and adenocarcinoma groups. We used the χ^2 test or Fisher's exact test to analyze categorical variables and Student's t test to analyze continuous variables. Multivariate logistic regression analyses were performed to determine significant findings for differentiating adenomyoma form adenocarcinoma of the AOV. By using the receiver operating characteristic analysis, optimal cut-off values for quantitative variables with maximal Youden indices were determined. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of each significant finding and combinations of these findings were also calculated.

All statistical analyses were conducted using MedCalc (version 18, MedCalc Software, Mariakerke, Belgium). p values less than 0.05 were considered to be statistically significant.

RESULTS

Patient characteristics are shown in Table 1. Adenomyomas were more frequently detected incidentally than were adenocarcinomas [8/16 (50.0%) vs. 7/30 (23.3%)]. In the adenocarcinoma group, the most common symptom was abdominal pain (11/30, 36.7 %). However, there were no statistically significant differences in symptoms between the groups (p = 0.149). The adenomyoma group showed significantly lower levels of AST, ALT, ALP, and total bilirubin (p = 0.003, 0.003, 0.006, and 0.002, respectively) than did the adenocarcinoma group. The mean lesion size in the adenomyoma group was significantly smaller than that in the adenocarcinoma group (1.1 ± 0.2 cm vs. 1.8 ± 0.4 cm; p < 0.001). The dilatation of EHD and main pancreatic duct occurred significantly less frequently in the adenomyoma group (p = 0.002 and 0.039, respectively). The adenomyoma group also showed significantly smaller diameters of EHD (1.0 cm ± 0.5 vs. 1.8 cm ± 0.6, p < 0.001) and main pancreatic duct (0.1 cm ± 0.1 vs. 0.3 cm ± 0.3, p = 0.025) than did the adenocarcinoma group (Figs. 2–4). The presence of uniform contrast enhancement of the lesion was noted more frequently in the adenomyoma group than in the adenocarcinoma group (p = 0.036). Enlargement of regional lymph nodes was observed more frequently in the adenocarcinoma group than in the adenomyoma group (p < 0.001) (Table 2). Although the diameter of the EHD (p = 0.041) and lesion size (p = 0.715) increased with an increase in T stage of the adenocarcinoma, there was a statistically signifi-

cant difference between EHD diameter and T stage alone. The diameter of the main pancreatic duct did not show any trend or significant difference depending on the T stage ($p = 0.586$). Although T1 adenocarcinoma was the least severe stage, the lesion size and the diam-

Table 1. Baseline Clinical Characteristics of the Patients

Characteristics	Adenomyoma ($n = 16$)	Adenocarcinoma ($n = 30$)	p-Value
Age (years)*	64.4 ± 9.8	67.8 ± 9.3	0.274
Sex, male	10 (62.5)	21 (70.0)	0.605
Symptom			0.149
Incidental	8 (50.0)	7 (23.3)	
Abodminal pain	5 (31.3)	11 (36.7)	
Other (jaundice, etc.)	3 (18.7)	12 (40.0)	
Laboratory finding			
AST (IU/L)*	32.6 ± 24.9	103.0 ± 87.1	0.003
ALT (IU/L)*	28.6 ± 29.1	128.6 ± 123.6	0.003
ALP (IU/L)*	149.1 ± 83.9	751.1 ± 826.4	0.006
Total bilirubin (mg/dL)*	1.2 ± 2.1	6.1 ± 5.9	0.002

Unless otherwise specified, data presented as numbers of patients with percentages in parentheses. Percentages were calculated separately for each group.
*Data are presented as means ± standard deviations.
ALP = alkaline phosphatase, ALT = alanine transaminase, AST = aspartate transaminase

Fig. 2. A 78-year-old male patient with adenomyoma of the ampulla of Vater.
A, B. CT images (A, axial view; B, multiplanar reconstruction image) show a 0.8-cm mass (white arrows) in the ampulla of Vater. There is no extrahepatic bile duct dilatation.
C. Duodenoscopic images show an ampullary mass. Alanine transaminase level is 17 IU/L. A pathologic diagnosis of adenomyoma in the ampulla of Vater was established by endoscopic biopsy.
D. Microscopic finding (hematoxylin and eosin stain, × 200): bland-looking proliferative glands comprising a single layer of epithelium are intermixed with smooth muscle fibers.
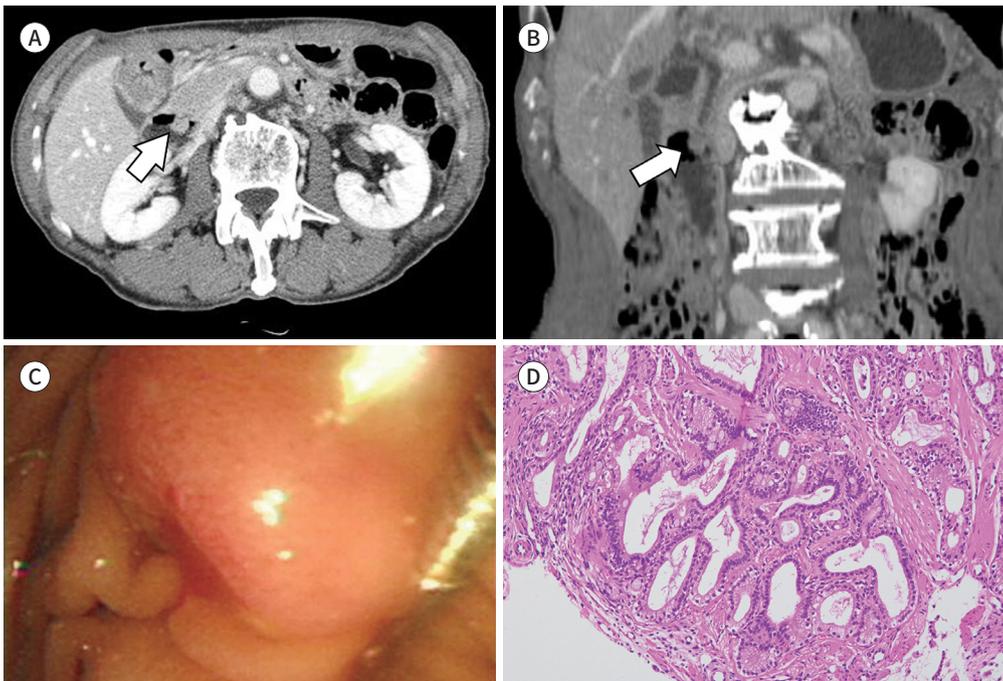
Fig. 3. A 75-year-old female patient with adenomyoma of the ampulla of Vater.
A, B. CT images (A, axial view; B, coronal view) showing a 1.3-cm mass (white arrows) in the ampulla of Vater and dilatation of extrahepatic bile duct (diameter, 1.4 cm).
C. Duodenoscopic image shows no definite ampullary mass or ulcer in the ampulla of Vater. Alanine transaminase level is 54 IU/L. A pathologic diagnosis of adenomyoma of the ampulla of Vater is established by pylorus-preserving pancreaticoduodenectomy.
D. Microscopic finding (hematoxylin and eosin stain, × 100): hyperplastic glandular lobules are surrounded by hyperplastic mesenchymal tissues comprising smooth muscle and fibrotic tissue.
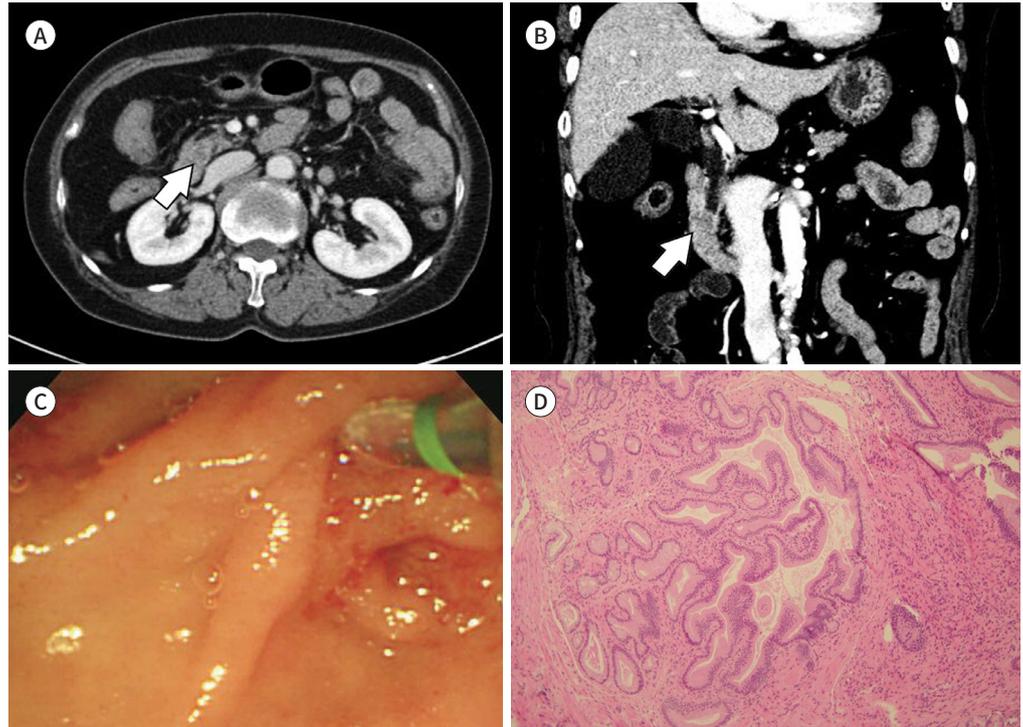
eter of the EHD in these patients were larger than those in patients with adenomyoma. The level of total bilirubin increased significantly with an increase in the T stage ($p = 0.040$) while levels of AST, ALT, and ALP were not significant different depending on the T stage ($p = 0.326$, 0.271, and 0.253, respectively) (Table 3).

Optimal cut-off values for differentiating adenomyoma from adenocarcinoma of the AOV were determined as 1.30 cm for lesion size, 1.30 cm for the EHD diameter, 0.25 cm for the main pancreatic duct diameter, 30 IU/L for AST, 31 IU/L for ALT, 1.26 mg/dL for total bilirubin, and enlargement of the regional lymph node. The multivariate analysis using these cut-off values showed that a lesion size of ≤ 1.30 cm, an EHD diameter of ≤ 1.30 cm, and an ALT level of ≤ 31 IU/L were independent findings that differentiated adenomyoma from adenocarcinoma of the AOV ($p = 0.001$, 0.002, and 0.017, respectively) (Table 4). When we used any 2 combinations of these 3 findings, 93.8% (15 out of 16) of the adenomyoma cases were identified with a specificity of 86.7%. When all these 3 findings were used, the specificity was 93.3% (Table 5).

Fig. 4. An 80-year-old female patient with adenocarcinoma of the ampulla of Vater.
A, B. CT images (**A**, axial view; **B**, coronal view) showing a 1.8-cm mass (white arrows) in the ampulla of Vater and dilatations of extrahepatic bile duct (diameter, 1.8 cm) and main pancreatic duct (diameter, 0.7 cm).
C. Duodenoscopic images showing a bulging mass with a central ulcerative lesion. Alanine transaminase level is 152 IU/L. A pathologic diagnosis of adenocarcinoma of the ampulla of Vater was established by pylorus-preserving pancreaticoduodenectomy.
D. Microscopic finding (hematoxylin and eosin stain, × 200): atypical glandular proliferation can be observed in the desmoplastic stroma, consistent with moderately differentiated adenocarcinoma.
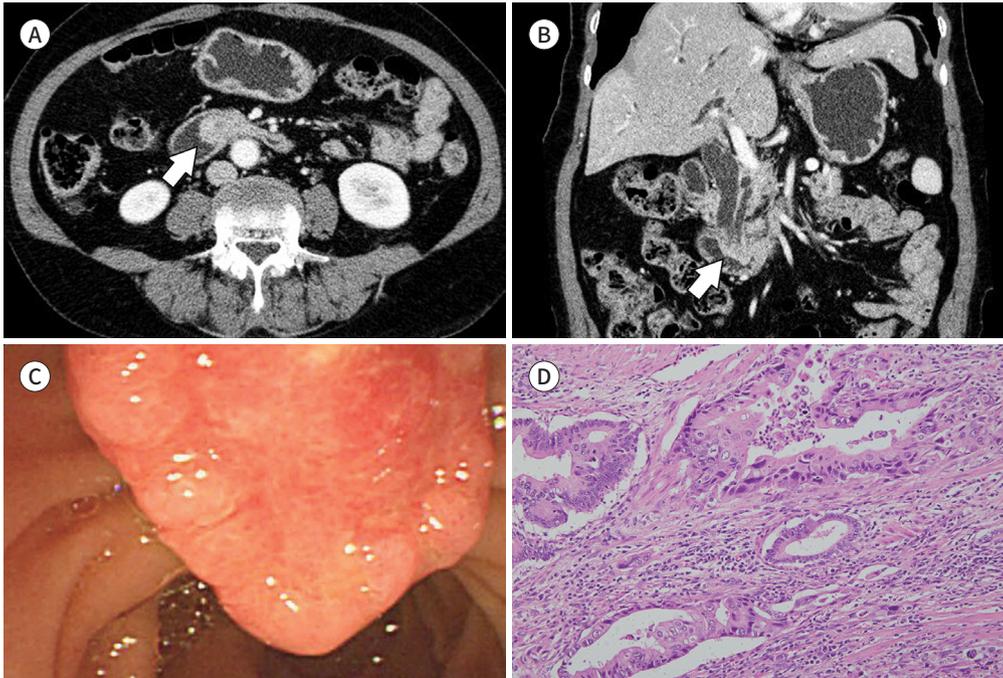
DISCUSSION

The present study evaluated independent MDCT and laboratory findings that could be used to differentiate adenomyoma from adenocarcinoma of the AOV. In this study, a lesion size of $\leq$ 1.3 cm, an EHD diameter of $\leq$ 1.3 cm, and an ALT level of $\leq$ 31 IU/L were found to be independent findings for differentiating adenomyoma from adenocarcinoma of the AOV. The size of adenomyoma in our study was comparable to that of some adenomyomas of the AOV showing lesion sizes ranging from 1–3 cm (2, 3). However, the size of adenocarcinoma of the AOV in the present study was larger than that in a study by Lee et al. (20) (1.8 $\pm$ 0.4 cm vs. 1.35 $\pm$ 0.36 cm). Lee et al. (20) included adenocarcinoma in situ lesions of lower T stages; this may have been the reason behind this difference. Furthermore, they used oral contrast agents for performing CT scans, which dilated the duodenum and possibly revealed smaller lesions.

Our results showed that EHD dilation appeared significantly less frequently in the adenomyoma group than in the adenocarcinoma group and that the measured EHD diameter was significantly smaller in the adenomyoma group than in the adenocarcinoma group. Histologically, adenocarcinoma causes obstructive dilatation of the bile duct because of the proliferation of malignant glands accompanied by desmoplastic stroma (21). It may have contrib-

uted to the differences in the degree of biliary duct dilatation between the two groups; however, less stiff adenomyomas can exert a mass effect on the bile duct and cause dilation of bile duct. In our study, the adenomyoma group showed lower AST, ALT, and total bilirubin levels than did the adenocarcinoma group. These results can also be interpreted as a conse-

Table 2. Multidetector CT Findings of Adenomyoma and Adenocarcinoma of the AOV

Characteristics	Adenomyoma ($n = 16$)	Adenocarcinoma ($n = 30$)	p-Value
Size (cm)*	1.1 ± 0.2	1.8 ± 0.4	< 0.001
Homogeneity of enhancement	16 (100)	23 (76.6)	0.036
HU values of the AOV lesion			
Pre-contrast*	39.1 ± 6.9	36.6 ± 7.6	0.291
Post-contrast*	101.4 ± 16.9	96.9 ± 15.9	0.372
Ratio of HU values of the AOV lesion and the spinal erector muscle (%)			
Pre-contrast*	83 ± 20	87 ± 21	0.559
Post-contrast*	164 ± 22	161 ± 37	0.740
Dilation of extrahepatic bile duct			0.002
Presence	8 (50.0)	27 (90.0)	
Absence	8 (50.0)	3 (10.0)	
Diameter of extrahepatic bile duct (cm)*	1.0 ± 0.5	1.8 ± 0.6	< 0.001
Dilation of main pancreatic duct			0.039
Presence	3 (18.8)	15 (50.0)	
Absence	13 (81.2)	15 (50.0)	
Diameter of main pancreatic duct (cm)*	0.1 ± 0.1	0.3 ± 0.3	0.025
Presence of regional LN enlargement			0.008
Presence	4 (33.3)	23 (76.7)	
Absence	12 (66.7)	7 (23.3)	

Unless otherwise specified, data are presented as numbers of patients with percentages in parentheses. Percentages were calculated separately each group.
*Data are presented as means ± standard deviations.
AOV = ampulla of Vater, HU = Hounsfield unit, LN = lymph node

Table 3. Subgroup Analysis of Multidetector CT Findings in Patients with Adenocarcinoma of the Ampulla of Vater According to Pathologic T Stage

T Stage	T1 ($n = 4$)	T2 ($n = 13$)	T3 ($n = 13$)	p-Value
CT finding				
Size (cm)	1.7 ± 0.5	1.7 ± 0.3	1.8 ± 0.5	0.715
EHD diameter (cm)	1.5 ± 0.8	1.6 ± 0.5	2.1 ± 0.5	0.041
MPD diameter (cm)	0.2 ± 0.3	0.4 ± 0.3	0.3 ± 0.3	0.586
Lab finding				
AST (IU/L)	43.5 ± 32.5	105.4 ± 84.5	118.9 ± 97.3	0.326
ALT (IU/L)	44.8 ± 31.8	159.5 ± 154.8	123.5 ± 96.3	0.271
ALP (IU/L)	108.2 ± 65.2	866.9 ± 927.0	833.1 ± 793.9	0.253
Total bilirubin (mg/dL)	0.7 ± 0.2	5.1 ± 4.7	8.7 ± 6.7	0.040

Data are presented as means ± standard deviations.
ALP = alkaline phosphatase, ALT = alanine transaminase, AST = aspartate transaminase, EHD = extrahepatic bile duct, MPD = main pancreatic duct

quence of their histological differences in stiffness. AST, ALT, and total bilirubin levels are all related to hepatocellular damage (22). An increase in the extent of obstructive hepatocellular damage resulting from an increase in EHD dilatation in adenocarcinoma would explain the release of increased quantities of these enzymes. However, the subgroup analysis of the pres-

Table 4. Univariate and Multivariate Analyses for Differentiating Adenomyoma from Localized Adenocarcinoma of the Ampulla of Vater

Variables	Univariate Analysis		Multivariate Analysis	
	OR	p-Value	OR	p-Value
Size (cm)				
> 1.3	1		1	
≤ 1.3	45.5 (7.3–280.1)	< 0.001	26.3 (3.6–192.8)	0.001
EHD diameter (cm)				
> 1.3	1		1	
≤ 1.3	28.2 (5.5–145.0)	< 0.001	19.0 (2.9–122.6)	0.002
MPD diameter (cm)				
> 0.25	1			
≤ 0.25	7.0 (1.4–36.3)	0.021		
Regional LN enlargement				
Presence	1			
Absence	9.9 (2.4–40.5)	< 0.001		
AST (IU/L)				
> 30	1			
≤ 30	19.5 (4.2–91.5)	< 0.001		
ALT (IU/L)				
> 31	1		1	
≤ 31	21.7 (4.5–105.2)	< 0.001	10.8 (1.5–76.7)	0.017
Total bilirubin (mg/dL)				
> 1.26	1			
≤ 1.26	22.5 (2.6–193.6)	0.005		

For both analyses, 1 is the standard of reference. Data in parentheses are 95% confidence intervals.
ALT = alanine transaminase, AST = aspartate transaminase, EHD = extrahepatic bile duct, LN = lymph node, MPD = main pancreatic duct, OR = odds ratio

Table 5. Diagnostic Performance of the Three Findings and Their Combinations in Differentiating Adenomyoma from Localized Adenocarcinoma of the Ampulla of Vater

Parameter	Sensitivity	Specificity	Accuracy	PPV	NPV
Size ≤ 1.3 cm	87.5 (14/16)	86.7 (26/30)	87.0 (40/46)	77.8 (14/18)	92.9 (26/28)
EHD diameter ≤ 1.3 cm	81.3 (13/16)	86.7 (26/30)	84.8 (39/46)	76.5 (13/17)	89.7 (26/29)
ALT ≤ 31 IU/L	81.3 (13/16)	83.3 (25/30)	82.6 (38/46)	72.2 (13/18)	89.3 (25/28)
Any one parameter	100 (16/16)	76.7 (23/30)	84.8 (39/46)	69.6 (16/23)	100.0 (23/23)
Any two parameters	93.8 (15/16)	86.7 (26/30)	89.1 (41/46)	78.9 (15/19)	96.3 (26/27)
All	56.3 (9/16)	93.3 (28/30)	80.4 (37/46)	81.8 (9/11)	80.0 (28/35)

Data are presented as percentages. Data in parentheses are numerator/denominator.
ALT = alanine transaminase, EHD = extrahepatic bile duct, NPV = negative predictive value, PPV = positive predictive value

ent study revealed that patients with adenomyomas showed higher total bilirubin levels than did those with T1 adenocarcinoma. This difference may be attributable to the small sample size of T1 adenocarcinomas. Maintenance of normal liver function is very rate in patients with malignant bile duct strictures (23). A further study with a larger sample size may be needed to compare adenomyomas and T1 adenocarcinomas.

The incidence of regional lymph node enlargement was significantly higher in adenocarcinomas, but it was not an independent predictor in multivariate analysis. The recognition of malignant lymph nodes by the imaging methods relies on the size of a given lymph node, whereas histopathology shows infiltration by tumor cells, which—with the advancement of tumor growth—will also lead to enlargement of lymph nodes. However, during histological examination, enlarged lymph nodes may be observed because of an inflammatory reaction (24). Adenomyomas may also cause an inflammatory reaction owing to biliary duct obstruction, and this may be the cause of hyperplasia of regional lymph nodes. Therefore, it is considered that there are limitations to discriminating between these two diseases depending on the presence of regional lymph nodes using size criteria on CT images.

There is no established method to treat adenomyoma of the AOV. Endoscopic sphincterotomy or endoscopic papillotomy may help restore bile drainage, and surgical ampullectomy may be considered depending on the clinical need (3). In a case report, extensive surgery was avoided after the diagnosis of adenomyoma of the AOV by performing frozen section examination during surgery. Another case has been reported in which pancreaticoduodenectomy was performed for the final diagnosis of adenomyoma of the AOV because adenomyoma may not be diagnosed using a frozen sections (1, 23, 25, 26). Therefore, our results would be useful for performing accurate non-invasive diagnosis of adenomyoma of the AOV, thus aiding the use of an appropriate therapeutic option and avoidance of unnecessary extensive surgical treatment.

The present study had the following limitations. First, because it was a retrospective study conducted in a single institution, a certain degree of selection bias could not be avoided. In particular, the very small number of patients with T1 adenocarcinomas may have influenced the comparative results of subgroup analysis. Second, CT examinations were not performed with the same protocol. However, we assessed CT findings on portal venous phase images. Third, most adenomyomas were diagnosed by biopsy only because invasive surgery had not been considered for the treatment or differential diagnosis of the condition of these patients. Fourth, other conditions that cause bulging papilla were not included in this study. A bulging papilla can be encountered in healthy individuals as well as in patients with inflammatory diseases (papillitis from passage of biliary stones, parasites, infections, or periampullary diverticula) or benign or malignant tumors. In conclusion, MDCT imaging may aid in the differential diagnosis of adenomyoma and localized adenocarcinoma of the AOV based on the size of the lesion and the diameter of the EHD.

Author Contributions

Conceptualization, L.J.; data curation, P.Y., L.J., W.C.G.; formal analysis, L.J.; funding accquistion, L.J.; investigation, P.Y., L.J., K.Y.; methodology, L.J.; project administration, L.J.; resources, L.J., C.B.S., P.K.S.; supervision, L.J.; validation, L.J.; visualization, P.Y., L.J.; writing—original draft, P.Y.; and writing—review & editing, L.J.

Conflicts of Interest

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다중 검출 전산화단층촬영 영상에서 바터 팽대부의 샘근종과 국소적 샘암종의 감별

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목적 다중 검출 전산화단층촬영(multidetector CT; 이하 MDCT) 영상에서 바터 팽대부의 샘근종과 국소 샘암종을 감별할 수 있는 영상 소견을 알아보고자 하였다.

대상과 방법 MDCT 영상을 이용하여 바터 팽대부의 샘근종이 있는 16명의 환자와 국소 샘암종이 있는 30명의 환자를 평가하였다. 우리는 병변의 크기와 감쇠정도, 병변의 균일한 조영 증강의 여부, 간외담관과 주췌관의 직경, 국소 림프절 종대 유무를 측정하였고, 혈액검사 결과도 분석하였다. 바터 팽대부의 국소 샘암종과 비교하여 샘근종을 시사하는 독립적 소견을 확인하기 위해 다변량 분석을 수행하였다.

결과 병변의 크기와 간외담관의 직경은 샘근종에서 국소 샘암종군보다 유의하게 작았다(all $p < 0.001$). 다변량 분석에서 병변의 크기가 1.3 cm보다 작은 것, 간외담관의 직경이 1.3 cm보다 작은 것, alanine transaminase level이 31보다 낮은 소견은 바터 팽대부의 국소 샘암종과 비교하여 샘근종을 시사하는 통계적으로 의미 있는 독립적 소견으로 나타났다. 이러한 세 소견을 모두 만족하는 경우 바터 팽대부에 생긴 샘근종의 진단적 특이도는 93.3%였다.

결론 MDCT 영상에서 병변의 크기와 간외담관의 직경을 측정하여 바터 팽대부의 샘근종과 국소 샘암종의 감별에 도움을 받을 수 있다.

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