

Focal Thickening at the Fundus of the Gallbladder: Computed Tomography Differentiation of Fundal Type Adenomyomatosis and Localized Chronic Cholecystitis

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Background/Aims: The objective of our study was to identify useful computed tomography (CT) findings for differentiating fundal type adenomyomatosis from localized chronic cholecystitis involving the fundus of the gallbladder. **Methods:** We retrospectively identified cases of 41 patients with pathologically proven adenomyomatosis (n=21) or chronic cholecystitis (n=20) who had fundal thickening of the gallbladder on preoperative abdominal CT. Analysis of the CT findings included evaluation of the thickness, contour, border, intralésional cystic area, adjacent gallbladder wall thickening, presence of inner layer enhancement, enhancement grade, enhancement pattern, and presence of stones. Statistical analyses were performed using the Mann-Whitney U test and Fisher exact test. **Results:** Oval contour, inner layer enhancement and intralésional cystic area were more frequently noted in adenomyomatosis than in chronic cholecystitis (p<0.05 for each finding). Flat contour and adjacent gallbladder wall thickening were more frequently observed in chronic cholecystitis than in adenomyomatosis. No differences between adenomyomatosis and chronic cholecystitis in terms of the thickness, enhancement grade, enhancement pattern and presence of stones were apparent. **Conclusions:** CT may help to differentiate fundal type adenomyomatosis from localized chronic cholecystitis involving the fundus of the gallbladder. (*Gut Liver* 2014;8:219-223)

Key Words: Adenomyomatosis; Chronic cholecystitis; Fundal type; Computed tomography

INTRODUCTION

Focal gallbladder wall thickening at the fundus portion is

a relatively uncommon computed tomography (CT) finding. This finding can result from a broad spectrum of pathologic conditions, such as chronic cholecystitis, gallbladder cancer, and adenomyomatosis. Among these conditions, fundal type adenomyomatosis and localized chronic cholecystitis involving fundus of the gallbladder are often indistinguishable from each other.¹⁻³

Adenomyomatosis and chronic cholecystitis are benign diseases, so clinical significance of both diseases is not that great compare with gallbladder cancer. But they are common disease involving gallbladder and sometimes hard to distinguish. Therefore radiologic differentiation of adenomyomatosis and chronic cholecystitis might be academically meaningful and interesting.

Efforts to differentiate wall thickening of the gallbladder have been vigorously made in research using various imaging modalities including sonography, CT, and magnetic resonance imaging.²⁻⁵ Although sonography has been the screening method of choice in the diagnosis of gallbladder disease,⁶ making an accurate diagnosis may be difficult because thickening of the gallbladder wall is nonspecific.^{7,8} Furthermore, the fundus of the gallbladder may be insufficiently visualized with sonography, owing to intestinal gas and the most anterior part of gallbladder.⁹ Recently, multidetector CT (MDCT) has become the imaging technique that is more widely used to detect and to characterize gallbladder wall thickening. Although there was a report related to enhancement pattern of diffuse gallbladder wall thickening on MDCT,⁴ to our knowledge, no previously published investigation has focused on the differential diagnosis between fundal type adenomyomatosis and localized chronic cholecystitis involving fundus of the gallbladder by means of MDCT.

The purpose of this study was to evaluate the CT findings of fundal type adenomyomatosis and localized chronic cholecys-

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titis involving the fundus of the gallbladder and to identify the useful CT findings for differentiating the two diseases.

MATERIALS AND METHODS

1. Patients

This retrospective study was approved by our Institutional Review Board and the requirement for informed consent was waived. We searched the radiology database of our hospital for cases of focal fundal thickening of the gallbladder during the period from January 2007 to June 2011. We determined 189 patients as having focal thickening of the gallbladder fundus in our data. Of these 189 patients, 95 patients had a histopathologically confirmed diagnosis by cholecystectomy. We excluded 54 patients from the analysis for one of the following reasons: a segmental or diffuse wall thickening of the gallbladder (n=38); pathologically confirmed with gallbladder cancer (n=6); none of the CT images was available (n=10). Finally, the remaining 41 patients were enrolled in our study—that is, 21 patients with fundal type adenomyomatosis (mean age, 56.3±10.4 years; age range, 36 to 76 years old; male:female ratio, 15:6) and 20 patients with localized chronic cholecystitis (mean age, 56.3±10.4 years; age range, 36 to 76 years old; male:female ratio, 14:6). In two of the 21 patients with adenomyomatosis and three of the 20 patients with chronic cholecystitis, incidental cholecystectomy was performed at the time of abdominal surgery for other reasons such as gastric and colon cancer. The mean interval between CT and cholecystectomy was 28.8 days (range, 5 to 60 days) for adenomyomatosis and 32.0 days (range, 12 to 104 days) for chronic cholecystitis.

2. CT scan acquisition

Contrast-enhanced CT examinations of all individuals were performed with a 16-detector row CT scanner (Somatom Sensation 16; Siemens Medical Solutions, Erlangen, Germany). Intravenous nonionic contrast material (Iopromide, Ultravist370; Schering, Berlin, Germany) was administered via the antecubital vein at a flow rate of 2 to 3 mL/sec, with an automatic power injector. CT scans were obtained routinely during full inspiration with the patient in a supine position. Single-breath hold scans were obtained from the dome of the diaphragm to the symphysis pubis in the late arterial phase (40 seconds after injection) and in the portal venous phase (70 seconds after injection). Scanning was performed with the following parameters; 120 kVp; 165 eff mAs; 16×0.75 mm² collimation; table speed 24 mm/sec; matrix size, 512×512. Axial and coronal images were reconstructed with 5.0 mm intervals.

3. CT image analysis

On a retrospective basis, two abdominal radiologists (J.Y.O. and H.J.K., with 15 and 9 years of abdominal CT experience, respectively) reviewed the CT findings in consensus. Reviewers

had no knowledge of the final radiologic or pathologic findings. The images were presented to the readers in a random sequence. All CT scans were reviewed on a PACS workstation (M-view™; Marotech, Seoul, Korea).

The following parameters were reviewed in each CT: thickness of involved gallbladder wall; lesion contour; border; intralesional cystic area; adjacent gallbladder wall thickening; presence of inner layer enhancement during the portal venous phase; enhancement grade; enhancement pattern; and presence of stones. The thickness of the gallbladder wall was measured at its most thickened portion. Lesion contours were classified as oval or flat (Fig. 1A and B). In addition, lesion borders were classified as well-defined versus ill-defined. Intralesional cystic area was defined as small cystic structures within the thickened gallbladder wall. The radiologists assessed the presence of adjacent gallbladder thickening (Fig. 1C) and inner layer enhancement of each lesion (Fig. 1D). The relative enhancement grade (high, iso, or low) of the lesion was compared with the attenuation of liver parenchyma during the portal venous phase. The enhancement pattern (homogeneous/heterogeneous) and the presence of stones were analyzed, as well.

4. Statistical analysis

Statistical differences in the CT features of adenomyomatosis and localized chronic cholecystitis were analyzed using the Mann-Whitney U test and the Fisher exact test. The Mann-Whitney U test was used for comparing of the mean thickness of the lesion between the two groups and the Fisher exact test for other variables. Findings with a p-value of less than 0.05 were considered statistically significant. Statistical analysis was performed using a statistical software system (SPSS version 19.0 for Windows; IBM Co., Armonk, NY, USA).

RESULTS

The comparison of the CT findings between fundal type adenomyomatosis and localized chronic cholecystitis is shown in Table 1. Mean wall thickness in the adenomyomatosis and chronic cholecystitis groups were 9.7 and 9.4 mm. This finding was not statistically significant.

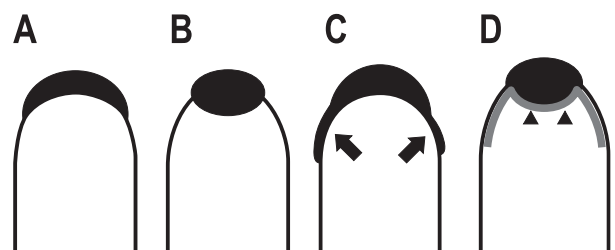


Fig. 1. Diagrams show (A, B) the type of contour, (C) adjacent wall thickening, and (D) inner layer enhancement (A, flat contour; B, oval contour; C, adjacent gallbladder wall thickening [arrows]; D, presence of inner layer enhancement [arrowheads]).

Table 1. Computed Tomography Findings of Fundal Type Adenomyomatosis and Localized Chronic Cholecystitis

Variable	Fundal type adenomyomatosis (n=21)	Localized chronic cholecystitis (n=20)	p-value
Mean thickness, mm	9.7±2.5	9.4±4.5	0.787*
Contour			0.025 [†]
Oval	18 (85.7)	12 (60.0)	
Flat	3 (14.3)	8 (40.0)	
Border			0.005 [†]
Well-defined	19 (90.5)	10 (50.0)	
Ill-defined	2 (9.5)	10 (50.0)	
Intralesional cystic area	9 (42.9)	1 (5.0)	0.006 [†]
Adjacent wall thickening	4 (19.0)	16 (80.0)	0.000 [†]
Presence of inner layer enhancement	20 (95.2)	6 (30.0)	0.000 [†]
Enhancement grade			0.464 [†]
High	5 (23.8)	8 (40.0)	
Iso	8 (38.1)	7 (35.0)	
Low	8 (38.1)	5 (25.0)	
Enhancement pattern			0.111 [†]
Homogeneous	5 (23.8)	10 (50.0)	
Heterogeneous	16 (76.2)	10 (50.0)	
Stone	3 (14.3)	7 (35.0)	0.119 [†]

Data are presented as mean±SD or number (%).

*Mann-Whitney U test; [†]Fisher exact test.

The presence of an oval contour was more frequent in patients with adenomyomatosis than in patients with chronic cholecystitis ($p=0.025$) (Fig. 2). However, a flat contour lesion was more commonly seen in patients with chronic cholecystitis than in those with adenomyomatosis (Fig. 3). More frequently, adenomyomatosis showed well-defined borders than chronic cholecystitis ($p=0.005$). An intralesional cystic area was more frequently demonstrated in adenomyomatosis than in chronic cholecystitis ($p=0.006$) (Fig. 4). Adjacent gallbladder wall thickening was more common in chronic cholecystitis than in adenomyomatosis ($p=0.000$) (Fig. 5). Inner layer enhancement of the lesion was more frequently detected in adenomyomatosis than in chronic cholecystitis ($p=0.000$) (Fig. 6). The enhancement grade and pattern were statistically not significant in both of them. There was no difference in the incidence of gallstone between the adenomyomatosis and chronic cholecystitis group.

DISCUSSION

Chronic cholecystitis is the most common form of clinically

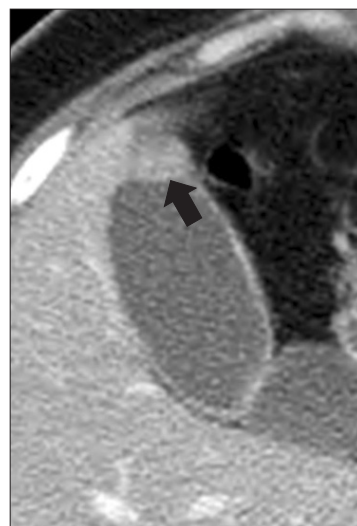


Fig. 2. A 51-year-old man with adenomyomatosis. Axial computed tomography scan shows oval-shaped focal thickening at the fundal portion of the gallbladder (arrow).

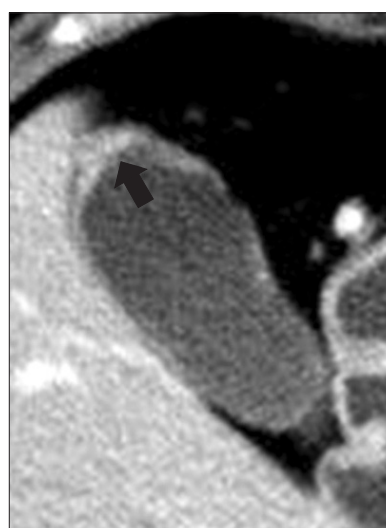


Fig. 3. A 70-year-old man with chronic cholecystitis. Axial computed tomography scan shows focal thickening at the fundus of the gallbladder with flat contour (arrow).

symptomatic gallbladder disease. Signs and symptoms are vague and include epigastric discomfort and nausea.¹⁰ The gallbladder appears small and contracted, with irregular and thickened walls. The thickened wall consists histologically of fibrosis and inflammatory cell infiltration in the subserosa and hypertrophy of the muscularis propria.¹¹ CT imaging usually demonstrates diffuse thickening of the gallbladder wall. However, sometimes thickening is localized to the fundal portion of gallbladder wall.

Adenomyomatosis of the gallbladder is a common, distinct, noninflammatory, benign condition that has been reported in up to 2% to 8.7% of cholecystectomy specimens.^{1,3,9,12} Adenomyomatosis is characterized by excessive proliferation of

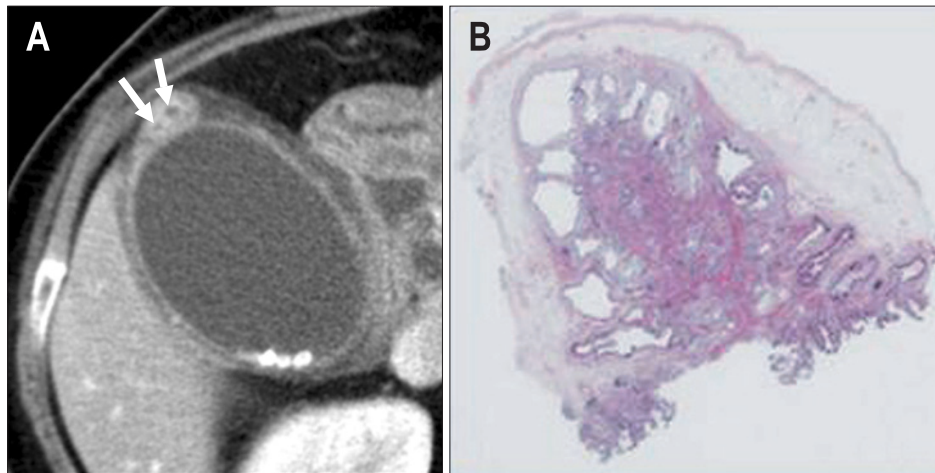


Fig. 4. A 74-year-old woman with adenomyomatosis. (A) Axial computed tomography image shows nodular thickening with multiple cystic foci (arrows) at the fundus of the gallbladder, which represent Rokitansky-Aschoff sinuses. (B) Photomicrograph reveals multiple cystically dilated glandular structures surrounded by hyperplastic smooth muscle (H&E stain, $\times 40$).

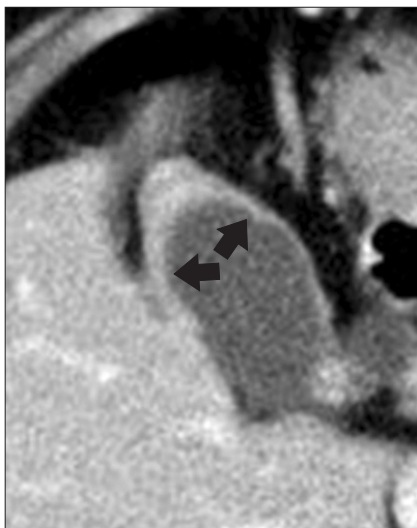


Fig. 5. A 72-year-old man with chronic cholecystitis. Axial computed tomography scan shows focal thickening at the fundal portion of the gallbladder with adjacent wall thickening (arrows).

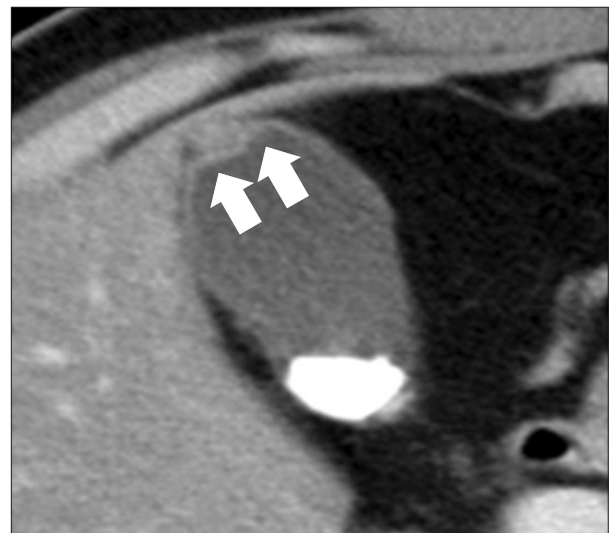


Fig. 6. A 57-year-old man with adenomyomatosis. Axial computed tomography scan shows inner layer enhancement (arrows) overlying nodular thickening at the fundus of the gallbladder.

surface epithelium with deep and branching invaginations (Rokitansky-Aschoff sinuses) into the thickened muscularis propria.¹³ Gallbladder wall thickening and intramural diverticula containing bile, cholesterol crystals, sludge, or calculi are well correlated with distinctive multimodality imaging features of adenomyomatosis.¹⁴

Adenomyomatosis of the gallbladder can be classified into three types: generalized, segmental, and localized fundal.¹ Diffuse or generalized adenomyomatosis consists of widespread gallbladder involvement. Segmental adenomyomatosis appears as limited circumferential gallbladder wall involvement with luminal narrowing, typically within the gallbladder body, which may produce a characteristic hourglass configuration. Focal or localized adenomyomatosis is most common, manifesting as crescentic to rounded gallbladder wall thickening, usually at the fundus.

Several previous investigators reported the CT findings for

differentiating gallbladder cancer from chronic cholecystitis or adenomyomatosis. They indicated a thickened gallbladder wall with disruption or obliteration of the normal layered pattern of the wall suggests cancer.⁴ But, any previous reports have not focused on the differential diagnosis between fundal type adenomyomatosis and localized chronic cholecystitis.

So, in this study, we evaluated the CT findings of focal wall thickening involving the fundus of gallbladder to differentiate fundal type adenomyomatosis from localized chronic cholecystitis.

The contour and border of the lesions showed significant differences between adenomyomatosis and chronic cholecystitis ($p < 0.05$). Adenomyomatosis showed a tendency to have well defined oval contour, whereas chronic cholecystitis revealed ill defined flat contour. This finding was well correlated with pathologic findings. In case of adenomyomatosis, the invaginated hypertrophic glands in the muscularis of the gallbladder

wall were well correlated with CT features.

Adjacent gallbladder wall thickening was statistically significant in differentiating chronic cholecystitis (16/20, 80%) from adenomyomatosis (4/21, 19%). This finding may reflect that there was inflammatory extension to adjacent the gallbladder wall in chronic cholecystitis.

Kim *et al.*⁴ analyzed enhancement pattern of flat gallbladder wall thickening on MDCT. According to their results, inner layer enhancement was demonstrated in all cases of adenomyomatosis, but chronic cholecystitis showed one layer pattern without inner layer enhancement in four of 20 cases. In our study, we found similar results; inner layer enhancement was noted more commonly in adenomyomatosis (20/21, 95%) than in localized chronic cholecystitis (6/20, 30%). Therefore, identification of inner layer enhancement of thickened gallbladder wall may be helpful in differentiating adenomyomatosis from chronic cholecystitis.

Rokitansky-Aschoff sinus was defined as a small cystic structure that demonstrated water density within the thickened gallbladder wall. Identification of Rokitansky-Aschoff sinus on CT is highly specific in diagnosing adenomyomatosis.^{2,3,9} The detection rates of Rokitansky-Aschoff sinus on CT reported in previous studies were 36% and 38%.^{2,12} Similarly, the results of our study showed that intralesional cystic area was visualized in 42.9% of patients with adenomyomatosis on CT.

This study has several limitations. First, the number of patients who were enrolled in this study was small. Second, because this study was based on retrospective data, the precise correlation of the CT features with the histopathology findings was not possible. Third, because our patient population was a subset of all the patients at our institution who underwent surgery for gallbladder wall thickening, the possibility of selection bias must be considered.

In conclusion, when it comes to CT differential diagnosis of focal thickening at the fundus of gallbladder, oval contour, presence of inner layer enhancement, and intralesional cystic area are more frequently seen in fundal type adenomyomatosis than in localized chronic cholecystitis. Conversely, flat contour and adjacent gallbladder wall thickening are more favorable findings in chronic cholecystitis rather than in adenomyomatosis.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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