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Diagnosis of periampullary duodenal diverticula: the value of new imaging techniques

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Abstract

Objective The purpose of this study was to evaluate and demonstrate the clinical and imaging features of symptomatic duodenal diverticula presenting as or mimicking acute abdomen.

Methods The imaging studies of 10 patients, all presenting with acute abdomen and diagnosed with duodenal diverticula as the possible underlying cause, over a time period of 20 months were retrospectively analyzed.

Results Eleven duodenal diverticula were depicted in 8 Multidetector Computed Tomography (MDCT) exams, 2 MRI-MRCP exams and in one intraoperative cholangiography. Acute abdominal symptomatology resulting from duodenal diverticula was as follows: one patient presented with perforation-diverticulitis, two patients with pancreatitis, one patient with acute acalculous cholecystitis, four patients with biliary dilation and two patients with acute postprandial discomfort-pain. The mean maximal diameter of the diverticula examined was 2.67 cm (range 0.96-4.98 cm). Further image analysis of the MDCT exams revealed that both the axial and the coronal plane demonstrated the presence of the diverticula but the depiction of the diverticular neck was demonstrated in five cases in the axial plane and in all cases in the coronal plane.

Conclusion Although duodenal diverticula constitute a rare cause of acute abdomen, careful analysis of imaging studies can aid to the identification of this uncommon factor of abdominal symptomatology.

Keywords periampullary/duodenal diverticulum, acute abdomen, imaging/diagnosis

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Introduction

Duodenal diverticula occur very commonly with a reported incidence of 1-6% in upper gastrointestinal barium studies and prevalence as high as 22% in autopsy studies [1,2]. Despite their incidence, duodenal diverticula are usually asymptomatic [2]. For that reason the duodenum is often overlooked on cross sectional imaging studies as an underlying cause in the setting of acute abdominal symptomatology [3]. Due to the continuing evolution of Multidetector Computed Tomography (MDCT) and Magnetic Resonance Imaging (MRI) technology and the application of post-processing techniques, accurate depiction and demonstration of duodenal anatomy and pathology is now feasible [4,5]. Although the role of imaging in complications resulting from duodenal diverticula has been described, to the best of our knowledge this is the first study focusing solely on acute abdominal symptomatology. Furthermore we provide comparative data regarding the depiction of duodenal periampullary diverticula in the axial and coronal plane in MDCT exams and secondly we examine the ability of diverticular neck demonstration in the aforementioned planes.

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Conflict of Interest: None

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Materials and methods

The study was conducted with data from January 2009 to September 2010 in a single center and included patients of all ages. All patients who were referred for acute abdominal symptomatology and had a discharge diagnosis of duodenal diverticular disease were included. The computer search yielded 10 patients (6 males and 4 females, age range of 49–88 years, mean 69.9) who underwent 12 examinations. There

were 8 MDCT exams, 2 MRI and 2 Magnetic Resonance Cholangiopancreatography (MRCP) studies and 1 intraoperative cholangiography available for review. All patients underwent an ultrasound exam upon their admission to the emergency room before computer tomography (CT) and MRI scans. The medical records of the aforementioned patients were also reviewed retrospectively regarding the clinical presentation and the final treatment applied.

Owing to the retrospective nature of the study, informed written consent was not required. The electronic records were reviewed in consensus, by two observers, a clinical fellow in abdominal imaging and one consultant radiologist with 11 years experience in abdominal imaging. The CT examinations were performed with a 16-row MDCT scanner (Siemens Somatom Sensation 16, Erlangen) following administration of both oral and intravenous contrast medium and the MR with a 1.5 T scanner (Vision Hybrid, Siemens, Erlangen), applying standard protocols-sequences for abdominal imaging.

Results

Eleven duodenal juxtapapillary diverticula were depicted in our population study group (ten patients). One patient demonstrated two diverticula. In all cases acute abdominal symptomatology was possibly or definitely attributed to complications resulting from the presence of duodenal diverticulosis. There were two patients with pancreatitis attributed to the presence of a diverticulum that exerted pressure on the main pancreatic duct (Fig. 1), one patient with acute acalculous cholecystitis as a result of the common bile duct outlet into a diverticulum, four patients with biliary dilation due to duodenal compression (Fig. 2), one patient with diverticular perforation-diverticulitis (Fig. 3), and two patients with acute colic postprandial discomfort-pain due to the presence of a duodenal diverticulum. The mean diameter of the long axis of periampullary diverticula was 2.67 cm (range 0.96-4.98 cm). Measurement of the diameter of the diverticula detected on intraoperative cholangiography was considered subjective

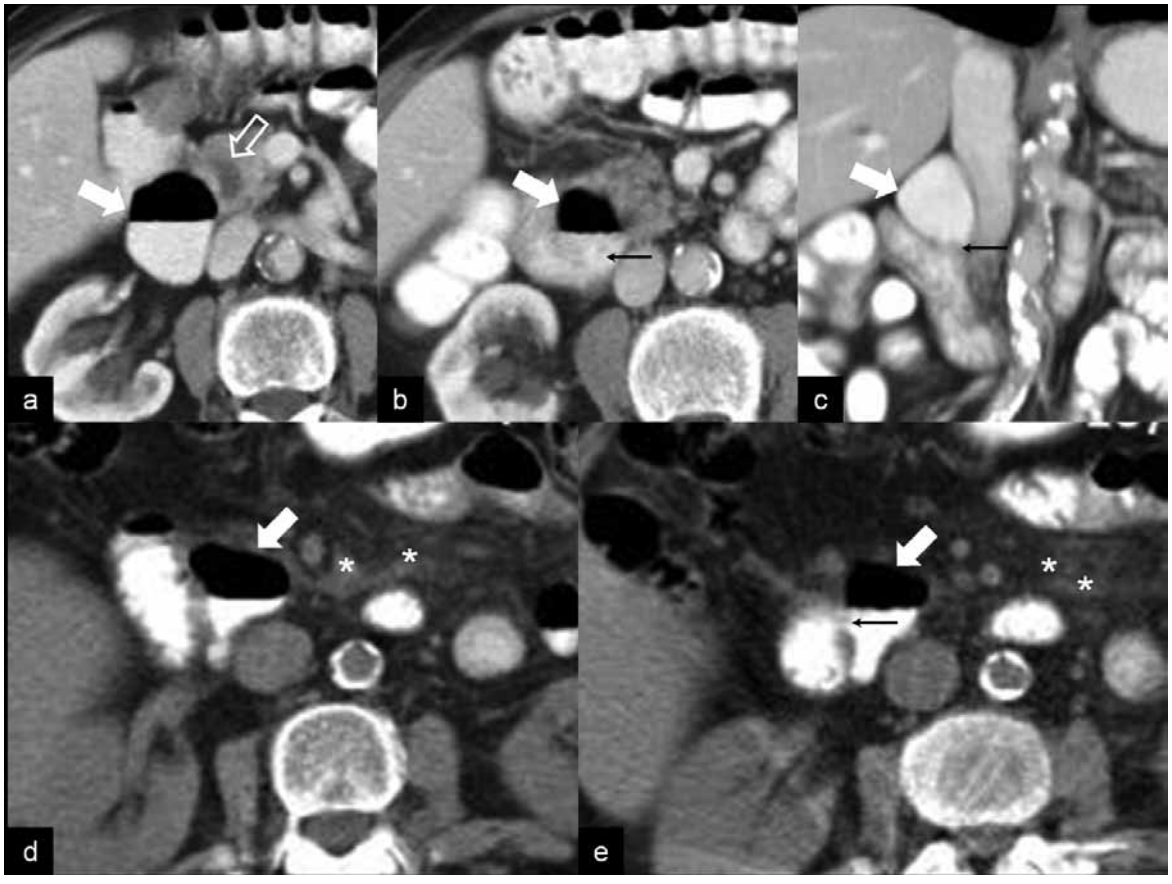

Figure 1 (a to c) An 82-year-old male patient presenting with postprandial right upper quadrant colic pain. The axial (a), (b) and coronal (c) contrast enhanced MDCT images show the presence of a periampullary diverticulum (white arrows) causing extrinsic compression upon the common bile duct (open arrow in a). The neck of the diverticulum is demonstrated both in the axial and in the coronal plane (small black arrows in b, c). Note also the air-fluid level in the axial plane and positive contrast agent demonstrating the communication between bowel lumen and diverticulum, which also aided to the diagnosis. (d to e) A 66-year-old female patient with pancreatitis. The axial (a), (b) MDCT images show the presence of a duodenal diverticulum (white arrows) with air fluid level. The diverticular neck is nicely depicted (small black arrow) and delineated with positive oral contrast media. Note also fluid and haziness of the abdominal fat, findings attributed to pancreatitis.

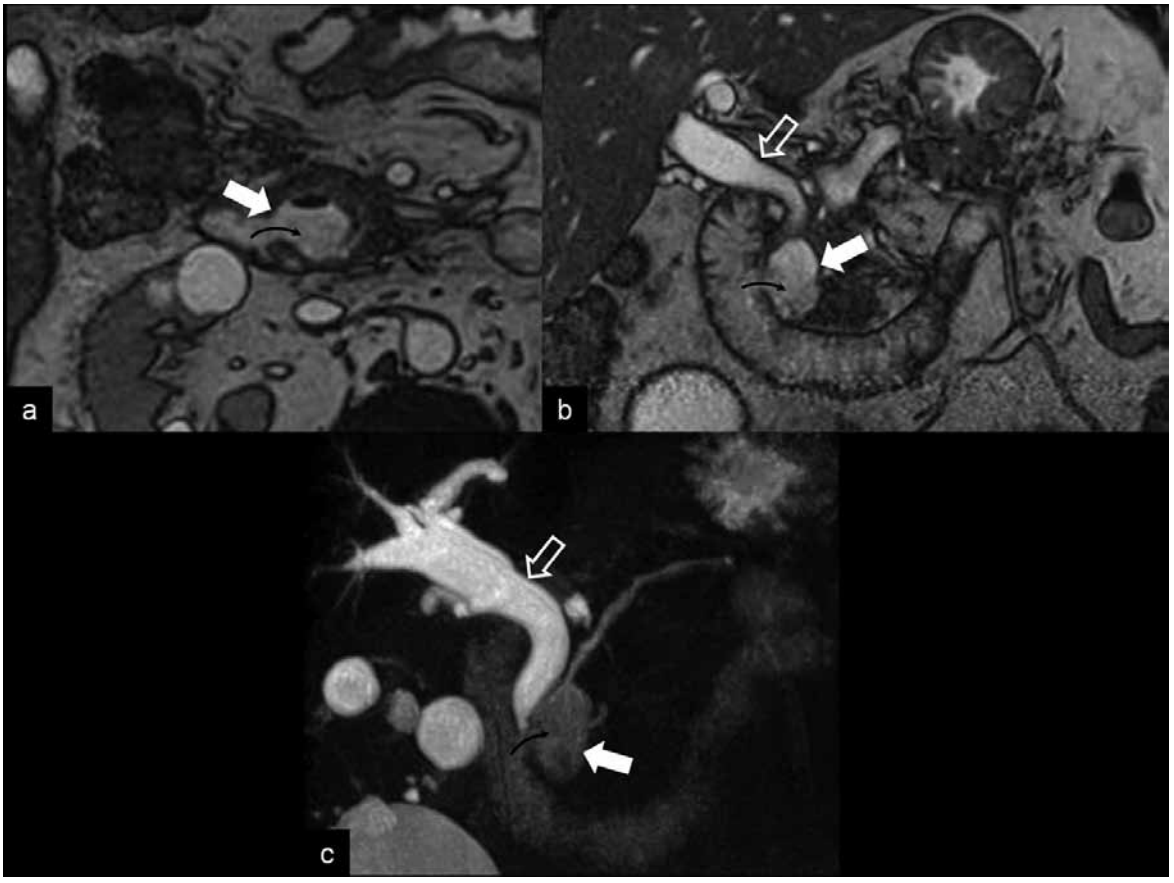

Figure 2 (a to c) An 80-year-old male patient presenting with acute right upper quadrant colic pain. The axial (a) and coronal (b) true FISP MR images and the coronal c) MIP image from the 3D respiratory-triggered, thin slice T2-w fast spin-echo MRCP sequence demonstrate the presence of a periampullary divericulum (thick white arrows) exerting compression upon the common bile duct outlet. Note associated biliary dilation (open arrow in b, c). The communication of the diverticular false lumen with the true duodenal lumen is also demonstrated (black curved arrows).

(calculated in magnification views in the operating room) and thus omitted from the mean diameter calculation. The detailed analysis of our population study is shown in Table 1.

The MDCT exams were further analyzed regarding the demonstration of the diverticula in the axial-coronal plane. In all cases the presence of the diverticula was confirmed both in the axial and in the coronal plane (Fig. 1, 4). On the contrary, the demonstration of the diverticular neck was detected in five cases in the axial plane and in all eight cases in the coronal plane (Fig. 4). Neck demonstration was delineated with oral contrast in five cases and with air in three cases (Fig. 1, 4). The presence of air-fluid level and intradiverticular debris was also evaluated both in the axial and coronal plane. The detailed analysis of our MDCT findings is shown in Table 2.

Discussion

Duodenal diverticula are classified as primary-true or secondary-pseudodiverticula [2,3]. Primary diverticula are believed to arise due to abnormalities of recanalization of the duodenal lumen during gestation [3]. Secondary duodenal diverticula are most commonly related to underlying chronic duodenal ulcer and they occur in the duodenal bulb in contradiction to periampullary ones [2-5]. The most common location is along the medial wall of the second and third portions of the duodenum. They are usually depicted within 2.0 cm of the ampulla of Vater, therefore are characterized as juxtapapillary or periampullary [6,7]. Similarly in our study all the diverticula detected were located along the medial wall of the duodenum and in close proximity to the ampulla of Vater. Despite their high incidence in autopsy studies (up to 22%) duodenal diverticula are usually asymptomatic. The most commonly reported complications result either from perforation and associated diverticulitis or from failure of cannulation of the common bile duct during endoscopic retrograde cholangiopancreatography (ERCP) [6,7].

Acute abdomen resulting from common intraabominal pathology has been extensively covered in the medical literature as well as the role of cross sectional imaging in depicting acute or subacute abdominal conditions [8-10]. On the other hand,

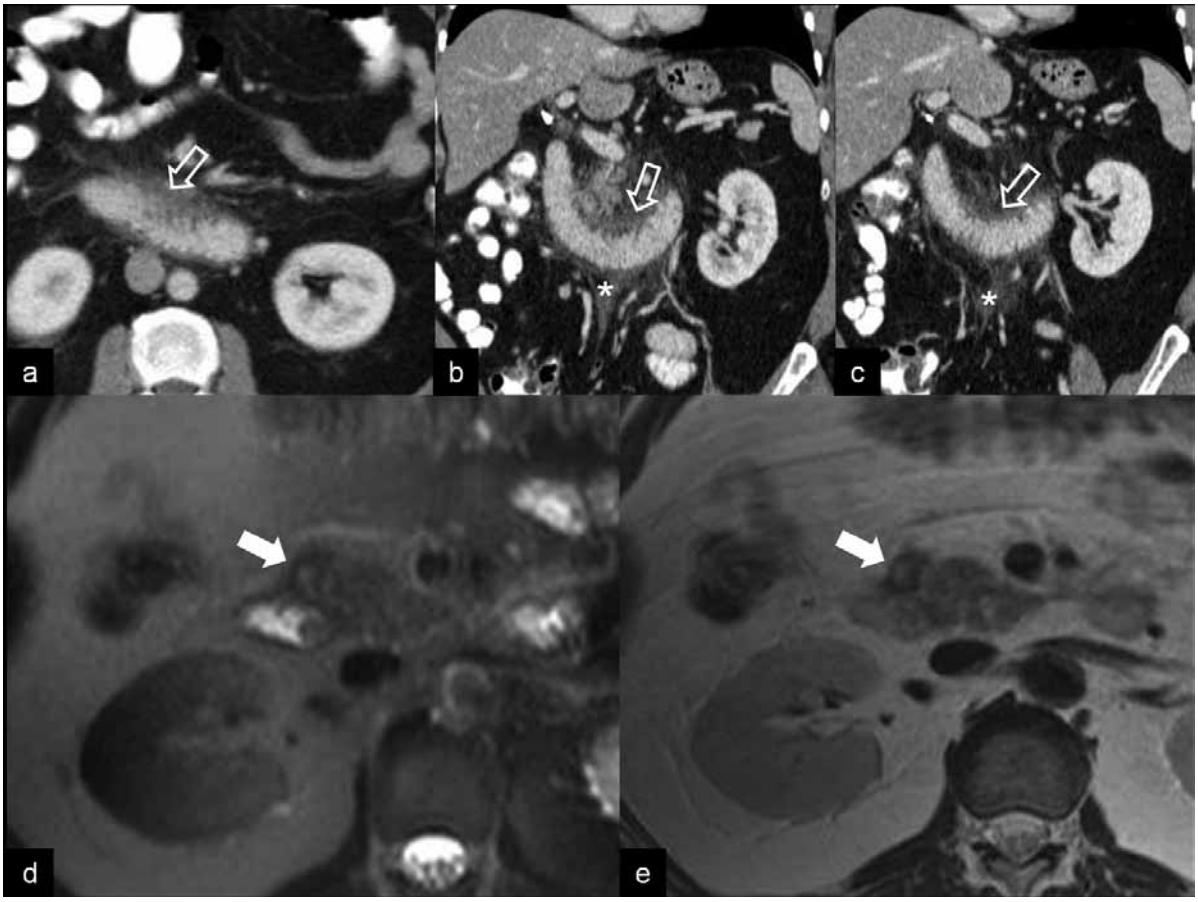

Figure 3 A 58-year-old male patient presenting with acute abdominal symptomatology. The axial (a) and the coronal (b), (c) contrast enhanced MDCT images show duodenal mural thickening (open arrows) and free fluid (asterisks) findings compatible with inflammation. A retrospective analysis of an MRI exam [(d): axial T2-w HASTE, (e): axial T2-w] performed 18 months ago show the presence of a small duodenal diverticulum (thick arrows).

the role of imaging in the diagnosis of symptomatic duodenal diverticula is an under reported entity. Our retrospective study focuses on this uncommon cause of acute abdominal pathology and provides further information regarding the clinical and imaging characteristics of periampullary diverticula and the possible association of duodenal diverticulosis with acute abdominal symptomatology.

Coulier et al reported three cases of non-colonic diverticulitis and described the CT characteristics and findings in complicated diverticula affecting the duodenum, jejunum and distal ileum respectively [11]. Ames et al provided the clinicoradiological features in a case series of 8 patients with diverticular perforation [12]. Kouraklis et al in their study on small bowel diverticular disease described 3 cases of symptomatic duodenal diverticula focusing on the clinical findings without imaging correlation [13]. Larger case series regarding cannulation difficulties of the common bile duct during ERCP due to the presence of juxtapapillary diverticula can be found in the gastroenterology literature [6,7,14,15]. Sparse case reports on various complications of duodenal diverticula have also been published and in our study we tried to provide the clinical information and illustrate the imaging findings in patients with acute abdomen that could possibly or definitely be attributed to duodenal diverticulosis [16-18]. Not surprisingly in our patients the clinical suspicion of duodenal diverticula as an underlying cause of abdominal pathology was very low. This is mainly due to absence of specific-pathognomonic symptoms and signs. Furthermore the low conspicuity during ultrasonography and the inherent limited ability of ultrasound to examine bowel pathology also resulted in non depiction of the diverticula. Even in the case of acute acalculous cholecystitis the ultrasound failed to demonstrate the common bile duct opening into the diverticulum, which was later shown during the intraoperative cholangiography and was considered retrospectively to be the actual underlying pathology leading to acute cholecystitis.

Abdominal cross sectional imaging has been reported to be a useful diagnostic tool in defining duodenal pathology and overcoming the aforementioned difficulties of clinical and ultrasound examinations [1-4,19]. In our study we also focused on the characteristics and depiction rates of the diverticular neck in axial and coronal imaging planes. Coronal reformatted

Table 1 Population study group with acute abdominal symptomatology.

Patient	Gender	Age	Clinical presentation	Ultrasound report on emergency Department	Duodenal diverticulum demonstration	Final Diagnosis	Number of diverticula detected	Maximal diverticular diameter
1	female	68	Postprandial right upper quadrant colic discomfort-pain	Normal	MDCT	Duodenal diverticulum	1	1.77 cm
2	female	66	Postprandial right upper quadrant pain, epigastralgia, nausea	Minor peripancreatic fluid	MDCT	Pancreatitis-dudenal diverticulum	1	3.41 cm
3	male	82	Postprandial right upper quadrant colic pain,	Biliary dilation	MDCT	Biliary compression-duodenal diverticulum	1	4.98 cm
4	male	71	Epigastralgia, nausea, vomitting	Minor peripancreatic fluid	MDCT	Pancreatitis-dudenal diverticulum	1	3.11 cm
5	male	71	Postprandial right upper quadrant discomfort-pain	Biliary dilation	MDCT	Biliary compression-two duodenal diverticula	2	0.96 cm 3.94 cm
6	female	88	Right upper quadrant colic pain	Biliary dilation	MDCT	Biliary compression-duodenal diverticulum	1	1.73 cm
7	male	80	Right upper quadrant colic pain	Biliary dilation	MRI-MRCP	Biliary compression-duodenal diverticulum	1	2.15 cm
8	male	49	Postprandial right upper quadrant colic pain	Normal	MDCT	Duodenal diverticulum	1	2.01 cm
9	male	58	Epigastralgia, nausea, vomitting	Free fluid	MDCT-MRI	Perforated duodenal diverticulum	1	Ruptured
10	female	66	Right upper quadrant colic pain nausea	Acute cholecystitis	Intraoperative cholangiography	Acute cholecystitis-Common dile duct outlet in duodenal diverticulum	1	Not measured

MDCT, Multidetector Computed Tomography; MRI, Magnetic Resonance Imaging; MRCP, Magnetic Resonance Cholangiopancreatography

images seem to demonstrate the diverticular neck to a better extent than the axial images. This is in accordance with the anatomical location of most of the duodenal diverticula in the mesenteric border of the bowel loop. The demonstration of the diverticular neck as well as the identification of air-fluid level and intradiverticular debris is valuable information in making the differential diagnosis from other cystic lesions of the duodenal wall (e.g. duplication cysts) or from other periampullary cystic neoplasms. In addition, although we calculated the dimensions of diverticula in cross sectional imaging studies (mean long axis diameter 2.67 cm, range 0.96-4.98 cm) we could not establish a cut-off diameter of symptomatic duodenal diverticula. This seems to be in accordance with the literature that defines the location of the diverticula, the association with the pancreatobiliary structures and the width of the diverticular neck (stoma dimension) as the underlying factors of symptom provocation [2,11]. Morita et al in their article concluded that 3D-trueFISP-MRCP with an oral negative contrast agent can define juxtapapillary diverticula in comparison to conventional MRCP sequences

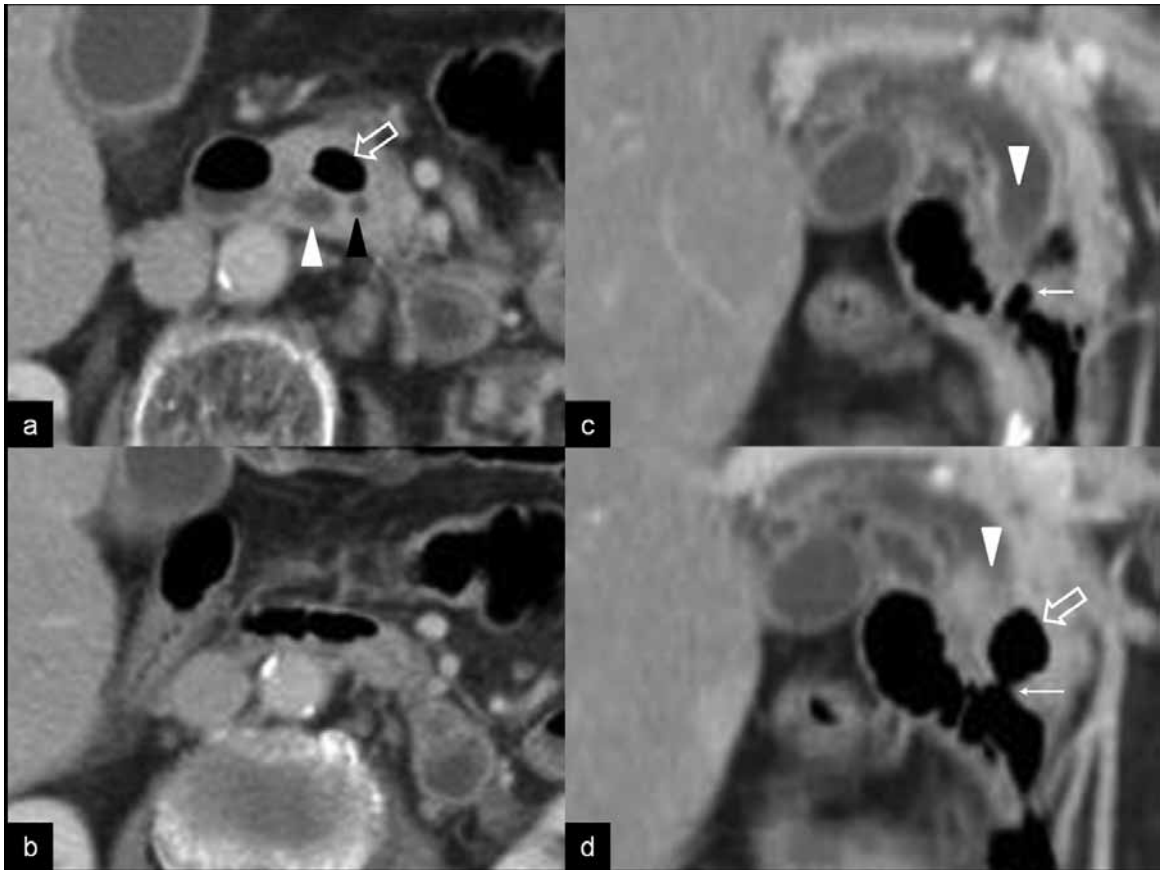

Figure 4 An 88-year-old female patient presenting with right upper quadrant pain. The axial (a), (b) and the coronal (c), (d) contrast enhanced MDCT images demonstrate the presence of a duodenal diverticulum (open arrows) compressing the common bile (white arrowheads) and pancreatic duct (black arrowhead). The diverticular neck is delineated with air and is better depicted in the coronal plane (small arrows in c, d).

[5]. We were also able to depict a duodenal diverticulum and demonstrate the diverticular neck by using a true FISP and a 3D respiratory-triggered, thin slice T2-w fast spin-echo MRCP sequence. Balci et al in their study of 14 patients with duodenal diverticula examined with MRI concluded that MRCP images obtained in the coronal plane best demonstrated the relationship of the diverticula to the papilla [20]. Our findings are in accordance with the above observations and we were able to depict and demonstrate the diverticular neck as well as the communication between bowel lumen and pseudolumen in the coronal MRI sequence-planes.

Symptomatic periampullary diverticula can be treated conservatively or operatively, depending on the type of complication. Conservative management consists of nasogastric decompression and wide spectrum antibiotic coverage in cases of perforation. Endoscopic treatment has been reported with high success rates [14,15]. Surgery is only reserved for severe complications and septic conditions. Diverticulectomy can be performed alone while in more complicated cases a more extensive surgical approach such as a subtotal gastrectomy followed by Billroth II reconstruction, or a Roux-en-Y gastroenteroanastomosis or a pylorus-preserving duodeno-pancreatectomy (pylorus-preserving Whipple procedure) can be applied [21-23]. In all our cases conservative therapy was chosen. Even in the case of one patient with a perforated diverticulum conservative treatment with nasogastric decompression and wide spectrum intravenous antibiotic coverage resulted in remission of symptoms. Furthermore three of our patients over 80 years old with other comorbidities present were not surgical candidates but are followed up clinically on a regular basis. There were no readmissions in our patients initially presented with pancreatitis. The two patients with postprandial right upper quadrant colic discomfort-pain upon admission are currently symptom free. Two of our patients (the one with acalculous cholecystitis and the other with the presence of two duodenal diverticula) were referred to a specialized center after discharge, but they finally refused the suggested surgical interventions. They also remain asymptomatic for the moment (verified by phone interviews).

Our study had limitations. The first limitation is the retrospective nature of the study and the small selected number of patients in our series. For that reason severe selection bias may be introduced. Surgical confirmation or ERCP exams were not performed since conservative management was applied in all patients and thus a gold standard for statistical analysis was not available but clinical

Table 2 Analysis of the MDCT findings.

Patient	Gender	Age	Number of diverticula detected	Maximal diverticula diameter	MDCT findings	Presence of air-fluid level	Presence of intradivericular debris	Depiction of the diverticulum in the axial-coronal plane		Demonstration of the diverticular neck in the axial-coronal plane		Delineation of the diverticular neck
								Axial	Coronal	Axial	Coronal	With oral contrast/air
1	female	68	1	1.77 cm	Duodenal diverticulum demonstration	present	not present	YES	YES	YES	YES	contrast
2	female	66	1	3.41 cm	Duodenal diverticulum demonstration Peripancreatic and mesenteric fat haziness	present	not present	YES	YES	YES	YES	contrast
3	male	82	1	4.98 cm	Duodenal diverticulum demonstration Biliary dilation due to compression fom diverticulum	present	not present	YES	YES	YES	YES	contrast
4	male	71	1	3.11 cm	Duodenal diverticulum demonstration Peripancreatic and mesenteric fat haziness	not present	not present	YES	YES	YES	YES	air
5	male	71	2	0.96 cm 3.94 cm	Duodenal diverticulae demonstration Biliary dilation due to compression from diverticulum	present present	not present present	YES YES	YES YES	NO NO	YES YES	contrast contrast
6	female	88	1	1.73 cm	Duodenal diverticulum demonstration Biliary dilation due to compression fom diverticulum	not present	not present	YES	YES	NO	YES	air
7	male	49	1	2.01 cm	Duodenal diverticulum demonstration	present	present	YES	YES	YES	YES	air
8	male	58	no	ruptured	Free fluid Duodenal mural thickening	-	-	-	-	-	-	-

MDCT, Multidetector Computed Tomography

follow up was available after treatment. Furthermore, since no ERCP was performed we must admit that we cannot evaluate the results of sphincterectomy and differentiate from other causes of right upper quadrant pain, including functional disorders especially in the patients presenting with biliary dilation. For all the reasons mentioned above the percentage of sensitivity, specificity, accuracy, and positive predictive value for correctly assessing duodenal diverticular

Summary Box

What is already known:

- Periampullary diverticula are usually detected along the medial wall of the duodenum and in close proximity to the ampulla of Vater.
- Duodenal diverticula are usually asymptomatic.
- The clinical suspicion of duodenal diverticula as an underlying cause of abdominal pathology is very low due to absence of specific-pathognomonic symptoms and signs.

What the new findings are:

- Although duodenal diverticula constitute a rare cause of acute abdomen, careful analysis of new imaging studies can aid to the identification of this uncommon factor of abdominal symptomatology.
- Coronal reformatted MDCT images seem to demonstrate the diverticular neck to a better extent than the axial images.

complications by imaging was not feasible and accurate to estimate.

In conclusion, our study strengthens the already widespread use of cross sectional imaging as the imaging method of choice in clarifying the etiology of acute abdominal pathology. Even though duodenal diverticula comprise a rare cause of acute abdomen, the detailed analysis of imaging studies and the use of appropriate postprocessing techniques can aid to the differential diagnosis of this uncommon etiology of abdominal symptomatology in the emergency room.

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