



Retrospective Analysis of Incidental Duodenal Diverticulum: CT and MRI Findings

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MRM and HA designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors IGT and OS managed the literature searches, analyses of the study. Authors MRM, HA and OA performed the CT and MRI analysis. Authors MK and HA managed the experimental process and identified the whole procedure. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JSRR/2014/11984

Editor(s):

(1) Vito Di Maio, Institute of Cybernetics "E. Caianiello" CNR, C / O Complex Olivetti, Via Campi Flegrei, 34, Italy.

Reviewers:

(1) Anonymous, Second University of Naples – Naples, Italy.

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Complete Peer review History: <http://www.sciencedomain.org/review-history.php?iid=664&id=22&aid=6136>

Original Research Article

Received 12th June 2014
Accepted 30th July 2014
Published 16th September 2014

ABSTRACT

Purpose and Objective: To detect retrospectively the duodenal diverticula in the routine abdominal CT and MRI.

Materials and Methods: Between March 2005 to June 2013, 151 incidental duodenal diverticulas were found out through 120.000 abdominal CT and/or MRI. Two abdominal radiologists evaluated the suspicious diverticula cases together with consensus. CT examinations were performed at 16 and 64 detector, Philips multislice CT and MR

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imaging was performed at 1.5 T Intera- Achievva, Philips Medical systems.

Results: Incidence of duodenal diverticula in this research was about 0.013%, 112 diverticulas along the second part of duodenum, 3 at duodenal bulb, 5 diverticulas at jejunum, 2 along fourth part of the duodenum, 37 along third part were discovered. 16 diverticula patients regarded complications, Urgent laparotomy was performed for 3 patients with perforated diverticulum, other complicated diverticulas were treated conservatively

Conclusion: Duodenal diverticula may lead to severe complications like perforation and/or diverticulitis, Multislice CT may show diverticulum in most cases, along with inflammatory exudates and surrounding extraluminal gas and contrast agent accumulation.

Keywords: Duodenum; diverticula; CT; MRI; perforation; complications.

ABBREVIATIONS

AML: Acute myeloid leukemia; LAP: Lymphadenopathy; RCC: Renal cell carcinoma; Ca: Carcinoma; HCV: Hepatitis C infection; BPH: Benign prostate hyperplasia; IBD: Inflammatory bowel disease; GIST: Gastrointestinal stromal tumor; HCC: Hepatocellular ca; Presence of hiatal hernia:1, Absence of hiatal hernia:0; Location of diverticulas: 2-3-4: second-third and fourth part of duodenum; J: jejunum.

1. INTRODUCTION

Duodenum is the second most common location for gastrointestinal diverticula after sigmoid Colon [1-3]. These diverticulas typically occur in the periampullary region, along the medial aspect of second and third portions of the duodenum, juxtapapillary diverticulum at peripapillary locations [1-4]. Majority of these diverticulas are discovered incidentally on upper gastrointestinal barium examinations and/or on endoscopic examinations, also can be easily depicted on CT and/or MRI if diverticulas are filled with fluid and gas [2-4]. They are usually asymptomatic but may become inflamed or perforated that can be caused as a complication of diverticulitis, ulceration or traumatic insertion of endoscope [3,5,6].

Perforation and bleeding which are the most frequent complications, may cause acute abdominal pain and acute abdomen, but due to the retroperitoneal location of the duodenum, most clinical signs and symptoms are insidious which may result in delayed diagnosis with substantial morbidity and mortality [3,6-8]. Before CT, diagnosis and treatment was based on surgery which was consisted of diverticulectomy and retroperitoneal drainage but nowadays, conservative treatment with antibiotics might regard an alternative approach to surgery [3,7,8]. Previous reports for non-colonic diverticulas were limited and less knowledge about their complications were defined.

We report here 151 patients with duodenal diverticulas retrospectively which were found out incidentally during abdominal CT and/or MRI examinations, the prevalence-physiopathology and complications of duodenal diverticulas were reviewed and performances of CT and/or MRI were also emphasized upon the definitive diagnosis of diverticulas.

2. MATERIALS AND METHODS

Two abdominal radiology departments, named as multicenter trial were included in this retrospective research. Between March 2005 to June 2013, 154 incidental duodenal diverticulas were found out through 120.000 abdominal CT and/or MRI in both centers which were referred to radiology departments for several reasons, e.g urolithiasis, genitourinary malignancy, hemangiomas of liver, adrenal adenomas, abdominal aortic aneurysm, etc. There were 80 males and 71 females in the research, age ranging between 33-84, 58 mean. The clinical presentation, diagnosis before and after CT and/or MRI, site-size- location and content of the diverticulas, treatment and postoperative complications were evaluated.

Co-existing abdominal pathologies were also reported. Two trainees had performed the retrospective scan of 120.000 CT and/or MRI exams and two abdominal radiologists evaluated the suspicious diverticula cases together with consensus. Inter and intra-observer variability of readers were not determined, all cases had abdominal CT sessions and 33 of them had abdominal MRI scan. Parameters of abdominal CT examinations are; 25-30 cm FOV, 3-7 mm collimation, pitch range 1-1.5, 125-150 kVp/ 150-200 mAs, 2.5-5 mm slice thickness under axial-coronal and sagittal 3D reconstructions, duration of scans were about 0.5-1.5 min. CT examinations were performed at 16 and 64 detector, Philips multislice CT (Philips Medical systems, Netherlands). Urovisit Angiografín-Telebrix were used as oral

Contrast agents, meanwhile Iopamiro-Ultravist 300 mg I/MI were administered as non-ionic IV contrast materials with an injection rate of 2-2.5 mL/sec. Scan delay between the beginning of CT exam and the start of bolus IV infusion were 40-60 sec.

MR imaging was performed at 1.5 T (Intera and Achieva, Philips Medical systems, Netherland scanners) by using phased array body coils. Patients were requested to drink half liter water before MRI scan, Magnevist-Omniscan and Dotarem 15 cc contrast agents were administered at a dosage of 0.2-0.3 mmol/kg followed by a rapid flush of 15-25 cc saline solution. The following MR imaging sequences and parameters were used in the patients; Axial breath-hold T2-weighted fat-saturated TSE, T1-weighted gradient-echo in phase and Opposed-phase axial images, axial and coronal T2-weighted HASTE sequence and finally, a Breath-hold 3D- T1-weighted fat-suppressed gradient-echo sequences before and after IV contrast agent administration during arterial-portal and late venous phases.

CT and/or MRI were performed for following reasons: Non-specific abdominal symptoms and/or general clinical-laboratory findings such as pain, enzyme elevation, anemia, idiopathic etc (n=30), suspected or histologically-proven malignancy in liver-pancreas-colon-prostate-bladder and/or metastasis, presence of ascites and lymphadenopathy (n:71), to rule out infections like cholecystitis, hepatitis, pancreatitis, colitis and etc (n:11), for cystic lesions of liver, pancreas, kidney, spleen etc (n:13), nephrolithiasis or urolithiasis and/or cholelithiasis (n:6) and others like diverticulitis, genital infections and myoma uteri, cirrhosis, cushing syndrome, colonic adenoma, hepatic hemangioma and etc (n:20). CT criteria for defining the diverticula is; Collections of gas and oral contrast agent in round or oval sac-like protrusions, arising at periampullary duodenum, along the second and third portions of the duodenum [1,7].

3. RESULTS

Clinical and imaging findings of each patient were illustrated on (Table 1), including age and sex of all patients, site and size of diverticulas. Among all evaluated CT scans, the incidence

of duodenal diverticula in this research was about 0.013%. CT and/or MRI request forms did not mention any suspicious duodenal diverticula or complicated diverticulas, all involved patients in this research, had abdominal Ultrasound (US) examinations but both readers were unaware of US results.

Retrospective analysis of CT findings by two experienced readers, yielded 112 diverticulas along the second part of duodenum(90 at medial wall-32 at lateral wall), 3 at duodenal bulb, 5 diverticulas at jejunum, 2 along fourth part of the duodenum, 37 along third part (22 at anterior wall and 15 at posterior wall) (Figs. 1-3). The complications of observed duodenal diverticulas were diverticulitis (n:13) and perforation (n:3), only 16 diverticula patients regarded complications and we had learned all these details from patient's follow-up reports. None of the patients were death due to the complicated diverticulas. Urgent laparotomy with diverticulectomy and retroperitoneal drainage were performed for 3 patients with perforated diverticulum and the other complicated diverticulas were treated conservatively by parenteral antibiotics and nasogastric suctions. The rest of patients with non-complicated duodenal diverticulas did not undergo any surgical treatment, 3 years follow-up were determined for all diverticulas. There were 27 concomitant existing sliding hiatal hernias in conjunction to all duodenal diverticulas.

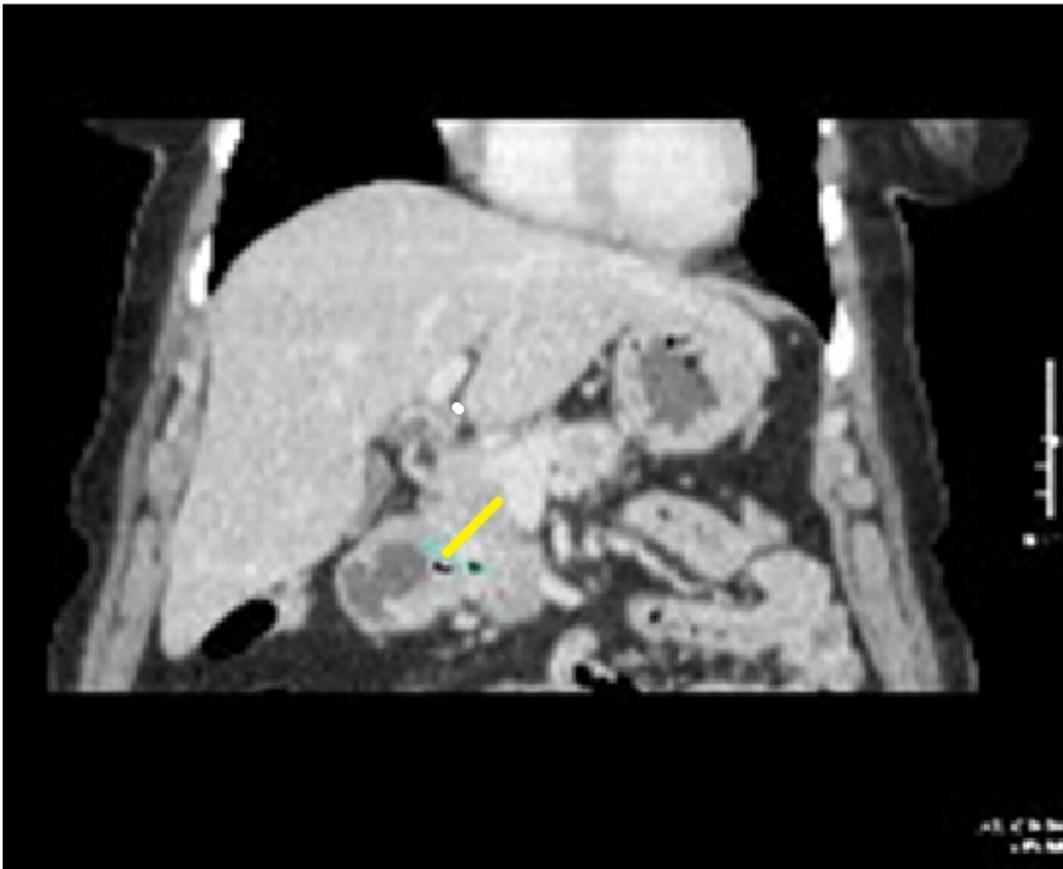


Fig. 1. Descending duodenal diverticula in a patient with pancreatic adenocarcinoma, there was invasion of cancer at diverticular wall

Table 1. Presenting name-age of patients, location and sizes of diverticulas in the reports of CT with or without presence of hiatal hernias

| Name | Age | Probable diagnosis | CT reports and probable diagnosis | Diverticula size | Location | Hiatal hernia |
|-------------|------------|---------------------------|--|-------------------------|-----------------|----------------------|
| SK | 63 | AML? | AML | 31X31 | 2 | 0 |
| AR | 58 | bladder ca | nonspecific | 20X20 | 2 | 1 |
| HK | 53 | abdominal pain | pancreatic cyst | 20X20 | 2 | 0 |
| SD | 73 | LAP | malignity | 50X41 | 2 | 0 |
| SA | 50 | liver cyst | liver cyst | MM | 3 | 0 |
| HG | 80 | lung mass | cardia mass | 35X26 | 2 | 1 |
| MO | 71 | bladder ca | invasive bladder ca | 11X11 | 2 | 0 |
| OB | 70 | bladder ca | metastatic prostate ca | 41X38 | 3 | 0 |
| FE | 72 | coelithiasis | coelithiasis | 35X35 | 2 | 1 |
| MG | 52 | liver cyst | liver cyst | 8X8 | 2 | 0 |
| SO | 84 | malignity? | IBD? | 38X38 | 2 | 0 |
| AK | 73 | operated pancreatic mass | operated pancreatic mass | 27X25 | 2 | 0 |
| EY | 43 | abdominal pain | nonspecific | 12X12 | 2 | 0 |
| NT | 55 | abdominal pain | myoma | 10X10 | 2 | 0 |
| AK | 57 | operated ovarian mass | metastatic ovarian ca | 20X20 | 2 | 0 |
| SB | 72 | renal mass? | RCC? | 30X30 | 2 | 0 |
| KT | 62 | metastatic colon ca | metastatic colon Ca | 25X23 | 3 | 0 |
| ID | 70 | abdominal pain | gastritis | 32X38 | 2 | 0 |
| EY | 69 | pancreatitis? | pancreatitis | 35X33 | 2 | 0 |
| HY | 61 | abdominal pain | nonspecific | 10X10 | 3 | 1 |
| FT | 82 | nefrolithiasis | nefrolithiasis | 5X5 | 3 | 0 |
| KB | 49 | | liver hemangioma | 21X21 | J | 0 |
| MP | 71 | operated colon ca | liver cyst | 24X15 | 2 | 0 |
| HO | 72 | | chronic liver disease? | 33X33 | 2 | 0 |
| SG | 52 | abdominal pain | gastritis | 12X12 | 2 | 0 |
| AK | 58 | operated bladder ca | operated bladder ca | 29X29 | 2 | 0 |
| HC | 62 | colecystitis? | Hidatic cyst | milimetric | 2 | 0 |
| AC | 68 | AML? | AML | 24X21 | 2 | 1 |
| HG | 69 | prostate ca? | prostate ca | 41X28 | 2 | 0 |
| ID | 69 | abdominal pain | aortic aneurysm | 32X38 | 2 | 0 |
| RG | 57 | bladder ca | bladder Ca | 23X23 | 2 | 1 |
| GD | 66 | | thick gastric wall | 22X26 | 2 | 0 |

| Name | Age | Probable diagnosis | CT reports and probable diagnosis | Diverticula size | Location | Hiatal hernia |
|--------|-----|------------------------|-----------------------------------|------------------|----------|---------------|
| GD | 44 | breast ca | nonspecific | 7X7 | 2 | 0 |
| FP | 58 | renal cyst | nefrolithiasis | 34X30 | 2 | 0 |
| MC | 82 | ileus | thick jejunal wall | 34X13 | 2 | 1 |
| IG | 57 | prostate ca | prostate ca | 28X16 | 2 | 0 |
| NC | 69 | abdominal pain | nonspecific | 47X30 | 3 | 0 |
| AH | 60 | prostate ca | metastatic prostate ca | 30X30 | 2 | 0 |
| IY | 63 | breast ca | breast ca | 15X15 | 2 | 0 |
| CC | 54 | bladder ca | nonspecific | 10X10 | 2 | 0 |
| DU | 72 | abdominal pain | liver metastasis | 40x28 | 3 | 0 |
| EK | 72 | abdominal pain | gastritis | 31X18 | 2 | 1 |
| HC | 70 | elevated liver enzymes | hemangioma | 35X35 | 3 | 0 |
| NO | 66 | | nonspecific | 17X16 | BULBUS | 0 |
| ZA | 60 | abdominal pain | nonspecific | 10X10 | 2 | 0 |
| AS | 33 | metastatic breast ca | steatosis | 10X10 | 3 | 0 |
| HA | 70 | bladder ca | bladder Ca | 48X40 | 2 | 0 |
| ED | 33 | abscess? | nefrolithiasis | 6X6 | 2 | 0 |
| ZK | 45 | AML? | AML | 30X30 | 2 | 0 |
| AK | 41 | breast ca | liver metastasis? | 27X27 | 2 | 0 |
| MO | 70 | rectum ca | colon ca | 13X6 | 2 | 0 |
| FK | 73 | bladder ca | bladder septation | 10X10 | 2 | 0 |
| AK | 35 | bladder ca | nonspecific | 13X13 | 3 | 0 |
| MU | 60 | RA+ | nonspecific | 12X12 | 3 | 0 |
| HM | 62 | IBD? | intestinal inflammation | 19X19 | 2 | 0 |
| CH | 69 | metastatic stomach ca | gastric ca, colon metastasis | 8X8 | 2 | 0 |
| MA | 58 | operated rectum ca | operated rectum ca | 28X28 | 2 | 0 |
| SA | 46 | anemia | heterogeneous myometrium | 12X12 | 2 | 0 |
| NC | 40 | AML? | gastritis | 11X11 | 2 | 0 |
| EK | 76 | elevated sedimentation | nonspecific | 17X14 | 3 | 1 |
| OU | 56 | renal mass | AML | 13X13 | J | 0 |
| SULTAN | 56 | endometrial ca | invasive endometrium ca | 11X11 | 3 | 0 |
| SC | 72 | abdominal pain | nonspecific | 43X30 | 2 | 1 |
| HO | 58 | anemia | nonspecific | milimetric | J | 0 |
| AK | 67 | nefrolithiasis | nefrolithiasis | milimetric | 3 | 0 |
| AA | 82 | metastasis? | bone metastasis | 21X21 | 2 | 0 |

| Name | Age | Probable diagnosis | CT reports and probable diagnosis | Diverticula size | Location | Hiatal hernia |
|------|-----|-----------------------------|------------------------------------|------------------|----------|---------------|
| IC | 72 | weight loss | thick cecal wall | millimetric | 2 | 0 |
| FT | 64 | operated rectum ca | operated rectum ca | 20X20 | 2 | 0 |
| ZA | 60 | abdominal pain | ovarian cyst | 9X9 | 2 | 0 |
| BK | 56 | HCC? | chronic liver disease? | 10X10 | BULBUS | 0 |
| NY | 62 | adrenal mass | adrenal hyperplasia | 10X10 | 2 | 0 |
| HC | 78 | bladder ca | bladder Ca | 6X6 | BULBUS | 0 |
| TT | 72 | lenfoproliferative disease? | nonspecific | 27X22 | 3 | 0 |
| HE | 56 | ulcerative colitis | IBD | 19X17 | 2 | 0 |
| AT | 63 | nefrolithiasis | nefrolithiasis | 13X13 | 3 | 0 |
| KS | 51 | chronic renal failure | nefrolithiasis | 10X10 | 3 | 0 |
| FP | 58 | renal cyst? | renal cyst | 34X30 | 2 | 0 |
| YG | 48 | diverticulitis? | nonspecific | 32X35 | 2 | 0 |
| GB | 72 | none | gastric ca? | 40X40 | 2,3 | 0 |
| SY | 54 | vasculitis? | panniculitis | 10X10 | 2 | 0 |
| OO | 77 | pancreatic cyst? | diverticula | 12X12 | 2 | 0 |
| KB | 48 | none | nonspecific | 8X8 | 3 | 0 |
| AG | 42 | lymphoma | non Hodgkin lymphoma | 15X15 | 2 | 0 |
| AK | 48 | malignity? | nefrolithiasis | 20X20 | 2 | 1 |
| KU | 80 | anemia | operated cyst hydatidis | 10X10 | 3 | 0 |
| HF | 82 | nefrolithiasis | nefrolithiasis | 13X13 | 2 | 0 |
| MU | 52 | renal ca? | mesenteric cyst | 23x19 | 2,3,4 | 0 |
| SC | 64 | elevated lefy hemidiafragma | IBD | 18X18 | 2 | 1 |
| KB | 69 | colon ca | jejunal diverticula | 35X27 | J | 0 |
| HA | 72 | none | nonspecific | 20X16 | 2 | 1 |
| MC | 55 | metastatic lung ca | metastatic lung ca | 23X14 | 2 | 0 |
| EG | 83 | renal ca? | renal cyst | 17X13 | 2 | 0 |
| SY | 82 | bladder ca | bladder ca | 18X10 | 2 | 1 |
| NY | 44 | abdominal pain | nonspecific | 10X9 | 2 | 0 |
| AA | 63 | liver mass | cysts(lhepatic, renal, pancreatic) | 19X14 | 2 | 0 |
| NE | 70 | abdominal pain | diverticula | 46X46 | 3 | 0 |
| GY | 62 | none | diverticula | 30X30 | 3 | 1 |
| MY | 42 | colon ca? | cecal mass | 11X7 | 3 | 0 |
| IA | 59 | sigmoid adenoma | appendix mucocele | 14X14 | 2 | 0 |
| IK | 43 | none | mesen lipoma | 5X5 | 2 | 0 |

| Name | Age | Probable diagnosis | CT reports and probable diagnosis | Diverticula size | Location | Hiatal hernia |
|------|-----|---------------------------|-----------------------------------|-------------------|----------|---------------|
| IS | 59 | elevated sedimentation | nonspecific | 12X9 | 3 | 0 |
| AS | 72 | abdominal pain | GIST | 15X13 | 3 | 0 |
| SC | 67 | right renal mass | nonspecific | 35X30, 29X22 | 2,2 | 0 |
| AY | 75 | prostate ca | prostate ca | 28X11 | 2,3 | 0 |
| FT | 64 | operated colon ca | operated colon ca | 20 | 2 | 1 |
| SS | 66 | cholesistitis | | 25X22 | 2 | 0 |
| AU | 73 | sigmoid ca | sigmoid ca | 13,14 | 2,2 | 1 |
| KG | 82 | prostate ca | operated prostate ca | 21X20 | 2 | 1 |
| HS | 80 | ovarian ca | metastatic ovarian ca | 24X23 | 2 | 0 |
| GK | 59 | gastric adenoCa | gastric adenoCa | 39X32,23X18,0 | 2,2,3 | 0 |
| AA | 52 | malignity? | nonspecific | 35X16 | 2 | 1 |
| SS | 60 | colon ca? | cecal mass | 21 | 3 | 0 |
| AS | 63 | bladder ca | bladder ca | 22X22 | 2 | 0 |
| KB | 36 | Cushing /adrenal adenoma? | nonspecific | 33X15 | 3 | 0 |
| HO | 52 | cyst hydadtitis | liver cyst | 33X27 | J | 0 |
| OA | 69 | prostate ca, met? | prostate ca | 15X15 | 2 | 1 |
| SO | 83 | | gastric mass | 66X41 | 2 | 1 |
| NT | 74 | liver cyst? | liver cysts | 34X34 | 2 | 1 |
| MH | 64 | ascites, malignity? | hepatosplenomegaly | 37X35 | 2 | 0 |
| HK | 55 | malignity? | nonspecific | 16 | 2 | 0 |
| HT | 61 | colon ca? | nonspecific | 16 | 2 | 0 |
| GA | 59 | renal cyst? | renal cyst | 28X25 | 2 | 0 |
| OE | 66 | prostate ca? | nonspecific | 14X12,22X18,11X13 | 2,3 | 0 |
| RG | 57 | bladder ca | bladder ca | 23x23 | 2 | 1 |
| GU | 58 | pancreatitis? | nonspecific | 28x21 | 2 | 0 |
| TB | 56 | renal cyst | splenic cyst | 10 | 2 | 0 |
| BC | 56 | renal cyst | renal cyst | 20X20 | 2 | 1 |
| IK | 43 | renal cyst | renal cyst | 17X14 | 2 | 0 |
| IB | 77 | prostate ca | prostate ca | 18X18 | 2 | 0 |
| TE | 85 | operated RCC | operated RCC | 40X30 | 2 | 0 |
| MK | 66 | bladder ca | bladder ca | 20X20 | 3 | 0 |
| HK | 65 | anemia | hepatosplenomegaly | 17x17 | 2 | 0 |
| KT | 50 | left renal mass | AML | 18X18 | 4 | 0 |
| NO | 72 | gastric ca? | gastric mass | 13X13 | 3 | 0 |

| Name | Age | Probable diagnosis | CT reports and probable diagnosis | Diverticula size | Location | Hiatal hernia |
|------|-----|---------------------|-----------------------------------|------------------|----------|---------------|
| HP | 71 | chronic HCV | duodenal diverticulitis | 65X52 | 2 | 1 |
| MA | 59 | | liver lesions | 25X17 | 3 | 0 |
| MY | 69 | renal cyst | adrenal adenoma | 18X18 | 2 | 0 |
| IM | 52 | abdominal pain | nonspecific | 25,36,21 | 2 | 1 |
| SC | 67 | left ureter stone | nephrolithiasis | 25X20,37X31 | 2 | 0 |
| AA | 77 | abdominal pain | cholecystectomy | 31X23 | 2 | 0 |
| TT | 71 | ascites, malignity? | chronic liver disease | 17X17 | 2 | 0 |
| HD | 53 | CA-19-9 elevation | adrenal adenoma, ovarian cysts | 25X25 | 2 | 0 |
| PB | 80 | pancreatic ca? | choledocolithiasis | 25X16 | 2 | 0 |
| OK | 63 | abdominal pain | ozefagus diverticula | 36X24 | 3 | 0 |
| HY | 89 | renal cyst | renal cyst | 24X22 | 2 | 1 |
| MD | 32 | bladder ca | BPH | 15X15 | 2 | 0 |
| AK | 57 | operated ovarian ca | metastatic ovarian ca | 20X20 | 2 | 0 |
| YC | 65 | gastric ca? | GIST | 22X18,12X7 | 2,3 | 0 |
| IT | 73 | bladder ca | bladder ca | 31X31 | 2 | 0 |
| YG | 63 | prostate ca | metastatic prostate ca | 7X7 | 2 | 0 |
| IC | 61 | liver disease? | chronic liver disease | 15X15 | 3 | 0 |

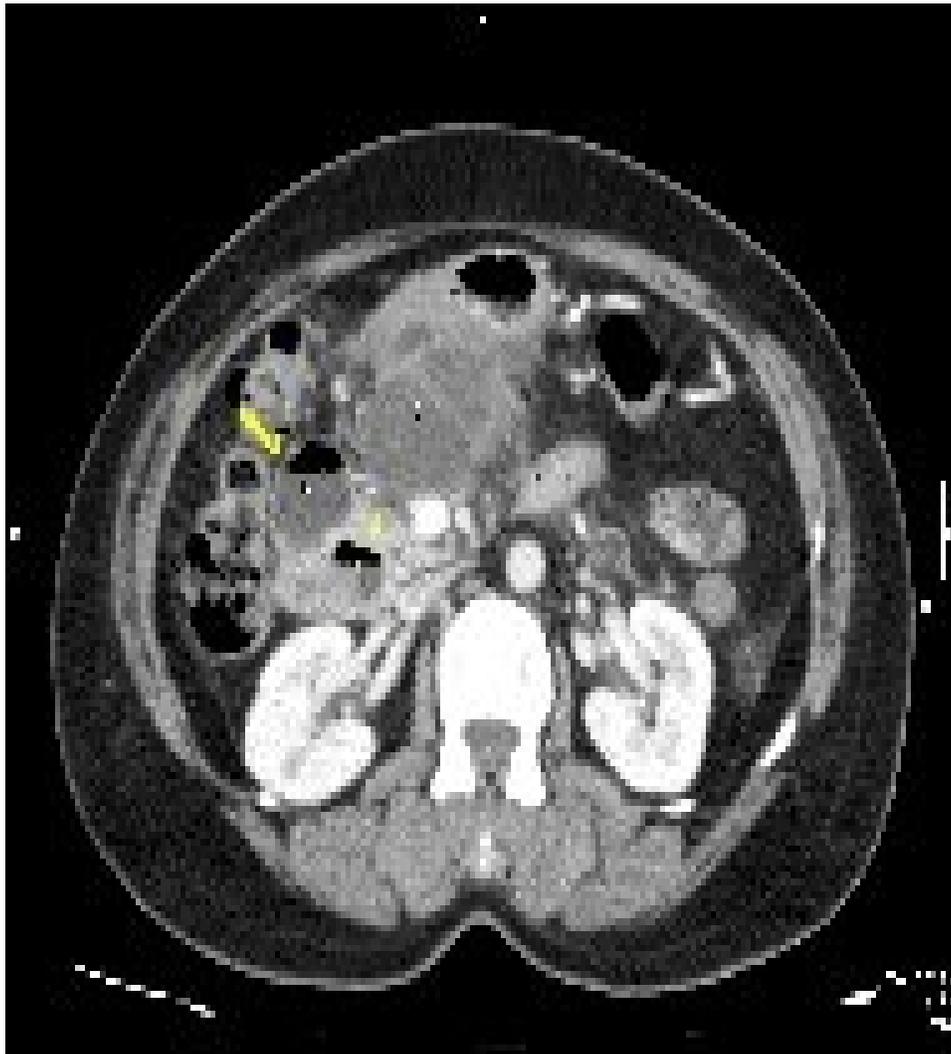


Fig. 2. Two different diverticulas, located at second and third part of duodenum in a patient with acute pancreatitis attacks, there were multipl conglomerating pseudo-cysts in the kaput and uncinete process of pancreas

Major CT reports for all 151 patients with duodenal diverticulum presented; 58 abdominal masses or LAP originating from gall bladder, pancreas, liver, colon, adrenals, prostate, urinary bladder and/or metastatic lesions, abdominal lymphoma and leukemia. 29 non-specific abdominal results, 19 cystic lesions from pancreas-liver-kidney and mesentery, 10 urinary and gall stones, 8 infectious processes from colon, pancreas, stomach and gall bladder, 12 other yields e.g aortic aneurysm, appendix mucosel, hepatosplenomegaly, chronic liver disease and etc (Figs. 4 and 5). Secondary co-existing CT findings were; Hepatosteatosi (n:39), adrenal adenomas (n:13), polyps of gall bladder (n:3), operated and absence of gall bladder (n:10), additional jejunal diverticulas (n:16), colonic diverticulas (n:10), urinary bladder diverticulas (n:2), inguinal hernia (n:2), benign prostatic hyperplasia

(n:5), others such as pancreatic lipoma, chilliatidi syndrome, annular pancreas, portal venous shunts, nutcracker syndrome and etc (n:8).

Abdominal MR examinations were performed due to prostate and urinary bladder tumors, endometrial carcinoma and renal masses, etiologic exploration of ascites, hydatid cysts and hemangiomas of liver, 15 duodenal diverticulas were also described in MRI reports. Size of duodenal diverticulas ranged between 5-65 mm, 34 mm mean. All perforated diverticulas regarded dimensions more than 4 cm but however in diverticulitis cases, size of diverticulas ranged between 0.8-3 cm. None of the patients presented any complications after the injection of IV contrast media during abdominal CT and MRI.

With regard to follow-up of patients, 40 patients were death due to primary or metastatic abdominal masses, 3 patients died due to colitis and cirrhosis. Remaining 108 patients were confirmed with 3 years follow-up but no more available informations were acquired after 3 years.



Fig. 3. Two conglomerating diverticulas at the junction of descending and transverse parts of duodenum



Fig. 4. A diverticula at the medial border of descending duodenum

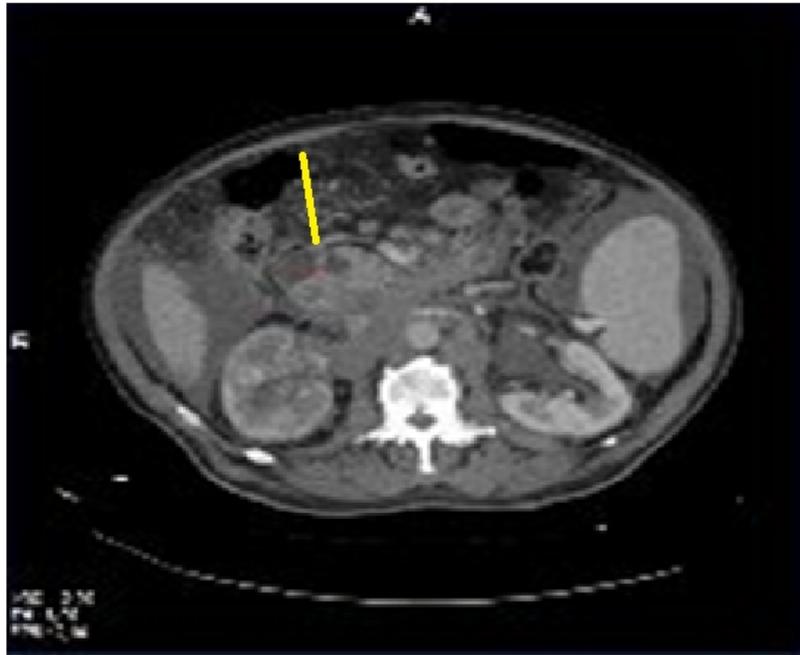


Fig. 5. A huge diverticula at the third part and junctional zone of descending-transverse duodenum in a patient with retroperitoneal fibrosis plus multiple abdominal lymphadenopathies

4. DISCUSSION

Duodenal diverticulas are the results of outpouchings of mucosa and muscularis mucosa through the defected intestinal wall, most frequent locations of duodenal diverticula are along medial wall of second and third portions of the duodenum, usually within 2.0 cm distance from ampulla of Vater (1,3,6).

Duodenum is the second most common location of intestinal diverticulas after the colon, incidentally discovered on upper gastrointestinal barium examinations as collections of gas and barium in round or oval sac-like protrusions, arising at perampullary duodenum and/or at abdominal CT which is a thin-walled collections of gas and oral contrast material situated along the second and third portions of the duodenum, on T2-weighted MR imaging; Duodenal diverticulas may contain both high signal intensity areas due to fluid accumulation and low signal areas due to the presence of gas [1,5-8], but however in the case of diverticulitis or perforated juxtapapillary diverticula; CT findings may be misleading which suggest any other conditions such as severe pancreatitis, perforated gastric or duodenal ulcer, retroperitoneal inflammation or hematoma, cystic pancreatic neoplasms or dilated first part of duodenum [4,7].

Duodenal diverticulas are accurately named as pseudodiverticula, as they are consisted of a mucosal, submucosal and serosal layer, lacking a muscularis layer which can be either congenital or acquired, more common in the elder patients, its prevalence ranges 5-10% at endoscopy and 22% at autopsy(2,3,5,6,9). Congenital diverticulum, named as traction diverticulas, contains all layers of the duodenal wall within an intraluminal and extraluminal subtype, acquired form represents a pulsion diverticulum due to a protrusion of mucosa, muscularis mucosa and submucosa through a wall weakness, particularly along the duodenal entry of the pancreatic and common bile ducts, most of the duodenal diverticulas are of acquired type [2,5].

A duodenal diverticulum can be important in patients who underwent ERCP, because bile duct cannulation is difficult if the ampulla drains into the diverticulum and patients may be referred to the clinicians with diverticulitis which can be complicated by bleeding and perforation into the retroperitoneal spaces [1,2,9,10]. Differential diagnosis of duodenal diverticulum can be cystic pancreatic neoplasms, inflammatory processes such as pseudocysts, infected duodenal duplication cysts, intramural hematoma, penetrating peptic ulcer, duodenitis, primary duodenal neoplasm, cholecystitis, retrocecal appendicitis and etc [1-7,11]. Complications of these duodenal diverticula may occur and 5-10% of patients will develop clinical symptoms due to acute diverticulitis with or without perforation in the peritoneum or retroperitoneum, abscess formation, fistula to colon or gall bladder, obstruction of common bile duct which may result in development of gall stones, jaundice, cholangitis or pancreatitis, most serious but rare complication of duodenal diverticula is the perforation [3,6,8,11-13].

CT features of diverticulitis include a thickened duodenal wall, ill-defined and blurred neighbouring soft tissues, dense linear streaks in the adjacent peritoneal or retroperitoneal fat due to edema, inflammation and/or hemorrhage furthermore when perforation results, it may appear as an abscess, extraluminal gas or contrast collection within pancreatic head or retroperitoneal fat, seldomly as pneumoperitoneum [4,6-8,12]. On MRI, HASTE and true FISP like gradient echo sequences demonstrated air-fluid level and diverticular wall easily, HASTE and steady-state precession sequences were non-sensitive techniques to patients

motion, respiratory and bowel artefacts, regarded a precise bowel wall anatomy via providing high signal to the fluid-containing structures [12,14-16].

In this research, only 15 duodenal diverticulas were diagnosed by MRI, remaining 139 incidental diverticulas were missed during the interpretation of MRI. To our belief, this may be due to less experience readers for MRI, technical failures, susceptibility artefacts due to intestinal motion and low image quality of abdominal MRI. With regard to retrospective analysis, upper gastrointestinal system barium fluoroscopic and endoscopic examinations were not performed for the evaluation of all these incidental duodenal diverticulas.

As two readers were highly experienced in abdominal CT exams, we didn't have any mis and/or over-registration of incidental duodenal diverticulas and no more difficulties especially for differential diagnosis were assigned during the interpretation of CT images. Because of the majority of patients having abdominal malignancy, the main focus of treatment on these patients were based on the nature of their masses so treatment and follow-up of diverticulas of those patients were somewhat misleading and didn't acquire the primary importance but in patients with inflammation, gall stones, urinary calculi and non-specific abdominal complaints; Incidentally discovered duodenal diverticulas were conservatively treated and the patients were followed-up due to probable complications. 3 perforated diverticula were surgically managed and no patients died due to diverticulas and their complications.

To our experience, this research was the first in the literature which analysed 154 incidental duodenal diverticulas retrospectively throughout 120.000 CT and/or MRI. Picture archiving computerized system (PACS) had quite importance for such retrospective-based researches with higher number of cases. PACS really aided in the evaluation and scanning of all imaging modalities and regarded high correlated informations for the follow-up, treatment and post-treatment complications of those patients.

Major limitations of this research were: Retrospective design of the study, only 16 Diverticulas (14%) having surgical confirmation due to complications, 43 patients died due to several reasons rather than diverticulas, remaining 95 diverticulas (62.5%) were clinically and conservatively followed-up for 3 years and no more patients were observed after 3 years None of the patients were evaluated by endoscopic and upper gastrointestinal fluoroscopic techniques which might alter the sensitivity and specificity of CT and/or MRI exams of duodenal diverticulas and there were no complications after contrast agent administration during CT and MRI of abdomen [17].

5. CONCLUSION

In a conclusion, diagnosis of non-colonic diverticulosis especially in the duodenum may be difficult as it is a rare condition, patients are mostly asymptomatic and can be mistaken for other acute abdominal disorders. Duodenal diverticula may lead to severe complications like perforation and/or diverticulitis whose symptoms may lack specificity, leading to a need for appropriate diagnosis. Imaging approaches especially Multislice CT will show diverticulum in most cases, along with inflammatory exudates and surrounding extraluminal gas and contrast agent accumulation. These CT datas may be encountered especially for the complicated diverticulas which will comprise for the treatment alternatives.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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