Int J Clin Exp Med 2016;9(2):1878-1883
www.ijcem.com /ISSN:1940-5901/IJCEM0012261

Original Article

Differential diagnosis of primary gastric lymphoma on multi-detector computed tomography

Songshi Quan[1], Wenzhong Zhang[2], Huiyan Cui[2], Yulan Shen[3], Bi Zhou[3], Chungen Wu[3], Yuping Pan[3], Qun Shang[2], Xiao Gong[2]

[1]Department of Radiology, Yanbian University Affiliated Hospital, Yanji 133000, China; [2]Department of Radiology, Zibo Central Hospital, Zibo 255020, China; [3]Department of Radiology, Shanghai Jiaotong University, Six People's Hospital, Shanghai 201306, China

Received July 2, 2015; Accepted January 25, 2016; Epub February 15, 2016; Published February 29, 2016

Abstract: We evaluate the differences between primary diffuse large B-cell lymphoma (DLBCL) and mucosa-associated lymphoid tissue (MALT) lymphoma of the stomach on multi-detector computed tomography (MDCT) to better define the radiological hallmarks of primary gastric lymphoma. We retrospectively reviewed the contrast enhanced MDCT scans of 33 patients with pathological diagnoses of DLBCL (n=23) and MALT lymphoma (n=10), as well as 1 case of DLBCL associated with MALT lymphoma. The MDCT findings of each case were analyzed for tumor location, tumor type, gastric wall thickness, enhancement and infiltration of gastric serosa, and the presence of perigastric lymph nodes. The 23 DLBCL patients were subdivided based on the type of lesion observed on MDCT and included tumoral (n=5, 21.7%), nodular (n=1, 4.3%), ulcerative (n=5, 21.7%), and infiltrative types (n=12, 52.2%). The 10 cases of MALT lymphoma were all classified as infiltrative on MDCT. The mean gastric wall thickness was 19.43 mm (range: 6-68 mm) in the DLBCL group compared to 10.75 mm (range: 6-22 mm) in the MALT lymphoma group. No statistically significant difference in gastric wall enhancement was noted between groups, though serosal infiltration was significantly greater in the DLBCL group (52.2% infiltrative) compared to the MALT lymphoma group (30.0% infiltrative). Relatively increased gastric wall thickness, gastric stenosis, epigastric serosal infiltration, and perigastric lymphadenopathy may be suggestive of DLBCL on MDCT. While classification of primary gastric lymphoma using MDCT may be possible, larger scale studies are necessary to determine the true radiological diagnostic potential.

Keywords: Diffuse large B-cell lymphoma, mucosa-associated lymphoid tissue, lymphoma, multi-detector computed tomography, gastric lymphoma

Introduction

Primary gastric lymphoma is relatively rare and constitutes only 3%-5% of malignant gastric lesions [1]. Two of the most common types of B-cell non-Hodgkin lymphoma (NHL) are mucosa-associated lymphoid tissue (MALT) lymphoma and diffuse large B-cell lymphoma (DLBCL). Lymphomas of the gastrointestinal (GI) tract have diverse radiological manifestations and may mimic a variety of diseases and malignancies. Differentiation between low-grade extranodal marginal zone B-cell lymphoma-MALT lymphoma-and other types of B-cell NHL is critical due to their differing treatments and prognoses [2].

Several imaging modalities have been proposed for the pretreatment evaluation and staging of upper GI tumors including an upper GI series, ultrasonography, computed tomography (CT), and magnetic resonance imaging. These modalities have been widely used in the detection of abdominal tumors with a 60-90% diagnostic accuracy [3, 4]. The most common imaging modality is a barium study or CT, and multi-detector computed tomography (MDCT) provides a very good mean for disease staging.

MALT lymphomas associated with Helicobacter pylori infection are usually low-grade and have very similar radiological presentations to other NHL's on CT. We evaluate the differences between DLBCL and MALT lymphoma of the stomach on MDCT from a series of patients treated at our institution in order to better

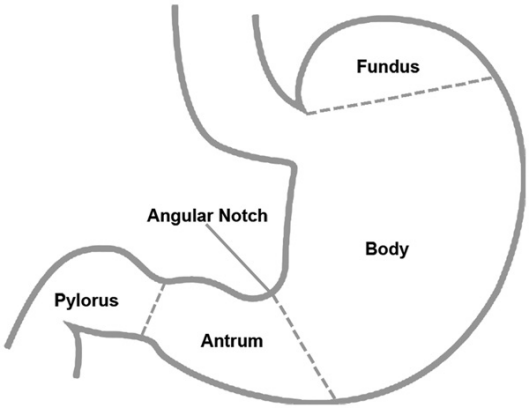

Figure 1. Regions of the Stomach. The stomach is divided into four segments, the fundus, body, antrum, and pylorus.

Table 1. The demographic and clinic information of included patients

	DLBCL patients (n=23)	MALT lymphoma (n=10)
Male (n)	11	5
Female (n)	12	5
Mean age (year)	49.8	57.4
Age range (year)	17-71	37-90

DLBCL, diffuse large B-cell lymphoma; MALT; mucosa-associated lymphoid tissue.

define the radiological hallmarks of these primary gastric lymphomas.

Materials and methods

Patient selection

Forty-eight consecutive cases of pathologically diagnosed primary gastric lymphoma at our institution from January 2003 to April 2010 were reviewed. Of these 48 patients, 15 did not have any record of MDCT and were excluded. Additional inclusion criteria were the absence of any palpable or superficial lymph nodes, normal chest radiography, and no involvement of the liver or spleen. All activities pertaining to this study were approved by our hospital's Institutional Review Board and informed consent was obtained for by each patient included.

MDCT protocol

All of the patients underwent MDCT following routine GI endoscopy for the biopsy of gastric lesions. Prior to scanning, each patient was given 600 mL of water to drink in order to distend the stomach wall. Twenty-one patients underwent MDCT using 16-slice MDCT scanner (LightSpeed H16; GE Healthcare) and 12 patients were scanned with a 64-slice MDCT (Volume CT; GE Healthcare). CT scanning parameters were 120 or 140 kVp, 250 mA, 35x35-cm FOV, 0.9375 pitch, and 0.5-s gantry rotation time. Contrasted-enhanced scans were performed using a non-ionic iodinated contrast agent (Ultravist; Schering, Berlin, Germany) administered via the antecubital vein at a rate of 1.5-3.0 mL/sec with a 20-gauge needle and an automatic injector. CT was performed in the late arterial phase (start delay of 40 s), in the portal venous phase (70 s), and in the delayed phase (150 s). The late arterial and delayed phases were used to evaluate the stomach wall thickness and degree of enhancement.

Imaging analysis

Two abdominal radiologists independently interpreted the MDCT imagery and were blind to previous endoscopic and histologic findings. Each radiologist was asked to evaluate the MDCT for the location of gastric involvement, lesion morphology, gastric wall thickness, the Hounsfield units (HU) of the thickened stomach wall, narrowing of the gastric cavity, and infiltration of the gastric serosa or perigastric lymph nodes.

Gastric lesions were divided into categories based on their main anatomical location-including fundal, body, angular, and antral-and were further classified as either nodular, ulcerative, or infiltrative types (**Figure 1**). Thickness of the gastric wall was measured at the most prominent point of thickening and gastric enhancement was measured on portal images using a region of interest. The presence of perigastric lymph nodes was considered when any nodes were greater than or equal to 10 mm in diameter [5].

Statistical analysis

Statistical analysis was performed using SPSS (Version 11.0; SPSS Inc.). Outcomes were described as percentages and data was analyzed using a t-test. Results were considered significant for P values less than 0.05.

Figure 2. Contrast-enhanced multi-detector computed tomography showing diffuse large B-cell lymphoma of the stomach in a 49-year-old male. Diffuse gastric wall thickening (diameter: 17 mm) and homogeneous enhancement (72 HU) of the gastric body is observed with mild perigastric infiltration.

Figure 3. Contrast-enhanced multi-detector computed tomography showing mucosa-associated lymphoid tissue lymphoma of the stomach in a 61-year-old female. Diffuse wall thickening of the gastric antrum (diameter: 9.5 mm) is observed with minimal contrast-enhancement (48 HU).

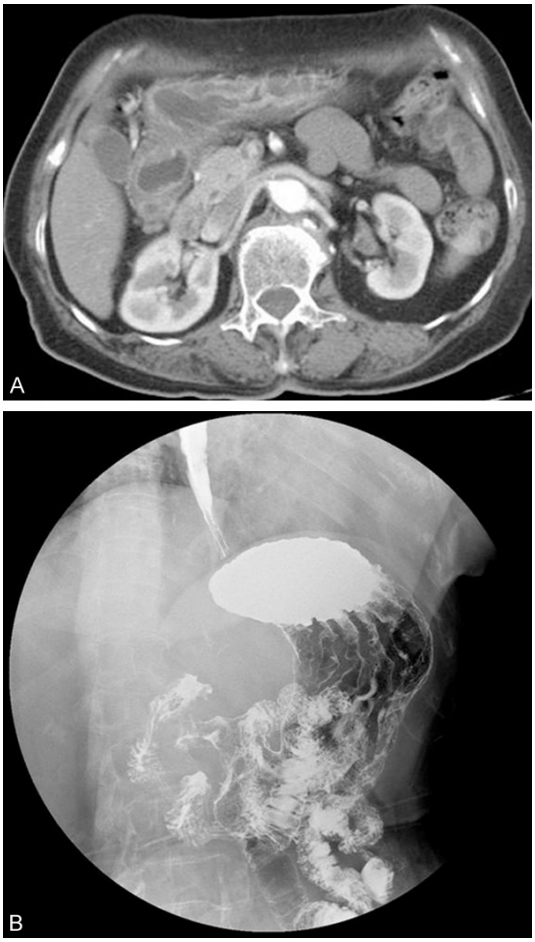

Figure 4. Diffuse large B-cell lymphoma of the stomach in an 81-year-old female who presented with epigastric pain. A. Contrast-enhanced multi-detector computed tomography showing diffuse homogeneous gastric wall thickening with perigastric infiltration. B. A spot radiograph from a double-contrast upper gastrointestinal study showing a mass with luminal narrowing in the antrum.

Results

Patient characteristics

Of the 33 patients, 23 were pathologically diagnosed with DLBCL, including 11 men and 12 women with a mean age of 49.8 years (range: 17-71 years); 10 patients were pathologically diagnosed with MALT lymphoma, including 5 men and 5 women with a mean age of 57.4 years (range: 37-90 years) (**Table 1**). Most patients complained of dull pain in the upper abdomen that was persistent, paroxysmally increased, and non-radiating. No patients reported diarrhea, vomiting, blood in the stool, fever, chills, jaundice, exhaust defecation, hematuria, urinary urgency, chest tightness, palpitations, headache, cold sweat, chills, skin-stained yellow sclera, or other symptoms. However, 3 patients with GI obstruction experienced nausea and vomiting in hospital.

Tumor location

Of the 23 DLBCL patients, 2 cases were considered fundal, 6 cases were considered body, 1 cases was angular, 11 were antral, 2 involved

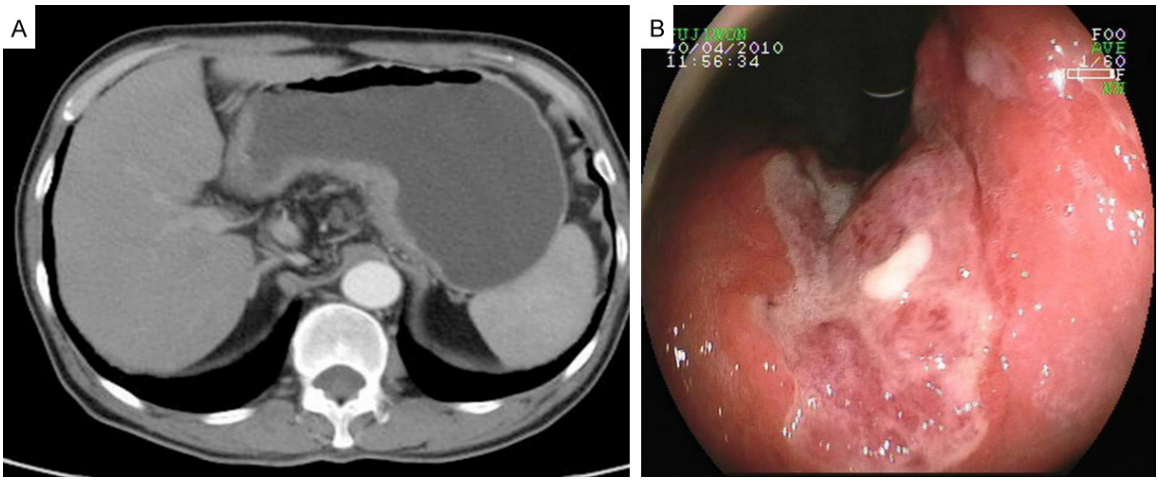

Figure 5. Mucosa-associated lymphoid tissue lymphoma of the stomach in a 68-year-old male. A. Minimally contrast-enhanced multi-detector computed tomography of the stomach showing minimal segmental thickening of the wall in the mid-body. B. Endoscopic photo showing an ulcerative-type lesion in the body of the stomach.

the whole stomach, and 1 did not have any visible lesions. Of the DLBCL patients 8 cases were involved more segments. Of the 10 MALT lymphoma patients, 5 cases were considered body, 3 were angular, and 2 were antral.

Gastric wall thickness

In the DLBCL group, 5 cases were classified as tumoral (21.7%), 1 as nodular (4.3%), 5 as ulcerative (21.7%), and 12 as infiltrative (52.2%). Gastric wall thickness ranged from 6 to 68 mm with an average wall thickness of 19.43±15.53 mm (**Figure 2**). In MALT lymphoma group, all cases were classified as infiltrative (100%). Gastric wall thickness ranged from 6 to 22 mm with an average wall thickness of 10.75±5.08 mm (**Figure 3**). The gastric wall thickness of the DLBCL group was significantly larger than that of the MALT lymphoma group (19.4±15.5 vs 10.8±5.1, P=0.038).

Gastric wall enhancement

In the DLBCL group the average enhancement was 58.76 HU compared to 55.15 HU in the MALT lymphoma group (**Figures 2** and **3**). The degree of gastric wall enhancement did not differ significantly between the two groups (58.8±11.3 vs 55.2±12.2, P=0.835).

Narrowing of the gastric cavity and serosal infiltration

In the DLBCL group, 13 cases (56.5%) of stenosis and 12 cases (52.2%) of epigastric serosal infiltration were observed (**Figure 4**). In the MALT lymphoma group, none of the patients had gastric stenosis and 3 patients (30.0%) had epigastric serosal infiltration (**Figure 5**). Using the independent sample t-test analysis, there was a statistically significant difference between the gastric cavity narrowing and epigastric infiltration between groups.

Perigastric lymph nodes

In the DLBCL group, 16 cases (69.6%) had one or more enlarged lymph nodes around the left gastric artery, right gastric artery, pyloric lymph nodes, and/or celiac lymph nodes. In 5 cases (21.7%), lymph nodes were fusion-like clumps with some stomach obstruction. In the MALT lymphoma group, only 2 cases (20%) of intra-abdominal lymph nodes were observed in the same locations as the DLBCL group.

Discussion

MALT lymphoma is an indolent low-grade primary extranodal small B-cell lymphoma whereas DLBCL is an aggressive high-grade lymphoma with a poor prognosis and a high rate of recurrence [2, 6]. It has been reported that more than 70% of cases of gastric MALT lymphoma are due to Hp infection and anti-Hp therapy in MALT lymphoma is an important early treatment [7, 8]. For aggressive lymphomas, early radiation therapy can result in complete remission in up to 90% of cases [7, 9]. Therefore, the early identification of these two types of lymphoma has real prognostic value.

Conventional upper GI double barium studies and gastroscopy only show the gastric lumen from the inside, whereas spiral CT clearly shows the gastric mucosa and lumen as well as any external gastric cavity lesions. As the spatial resolution of MDCT and density contrast continues to improve, MDCT can better assess gastric thickness and the involvement of epigastric lymph nodes and other organs. MDCT has become routine for inspecting malignant tumors of the stomach [8-12].

Gastric lymphoma can have well diversified manifestations on CT. In the DLBCL group, 82.6% of cases had involvement of the gastric antrum and/or body including 8 cases involving two or more segments. In the MALT lymphoma group, the gastric antrum and body were involved in 100% of cases.

Some reports have suggested the presence of lymphoma if the thickness of the gastric wall is greater than 10 mm [13]. In the present study the DLBCL group had 5 cases classified as tumoral (21.7%), 1 as nodular (4.3%), 5 as ulcerative (21.7%), and 12 as infiltrative (52.2%) with an average gastric wall thickness of 19.43±15.53 mm. These findings are similar to other reports in the literature [8, 10, 14]. In the present MALT lymphoma group, all cases were classified as infiltrative with an average gastric wall thickness of 10.75±5.08 mm. While thickening of the gastric wall is involved in both types of primary gastric lymphomas, with increased here in DLBCL group 12 patients (52.2%) and MALT lymphoma group 3 patients (30.0%) had epigastric serosal infiltration.

The density of gastric lymphomas is relatively constant with hardly any internal necrosis or small focal necrosis. In our DLBCL group, 19 patients had homogeneous enhancement and 2 had heterogeneous enhancement. One case with central areas of low-density indicating hemorrhage could have been related to necrosis. Additionally, 1 case had no significant enhancement and no lesion was observed. In the MALT lymphoma group, all 10 cases showed homogeneous enhancement and diffuse thickening of the gastric wall which may be due to the extensive edema caused by infiltration [14, 15]. Thus, primary DLBCL group with MALT lymphoma group compared the early involvement of the mucosal surface layer with homogeneous enhancement.

Levine et al. reported that stenosis in gastric lymphoma, caused by the accumulation of a large number of tumor cells, resulted in no destruction of cells without fibroblastic activity [16]. In this study, 13 cases (56.5%) of DLBCL had mild gastric wall thickening without obstruction. In 2 DLBCL cases, invasion and nodular changes of the whole stomach causing narrowing of the stomach cavity were noted, but there were no obvious signs of obstruction. In the MALT lymphoma group, gastric wall thickening was less than that observed in the DLBCL group and no stenosis found. Additionally, the gastric serosal surface and perigastric space are used to determine the presence of gastric lymphoma [17].

Although CT is very sensitive to observing perigastric lymph nodes, there are limitations and the rate of observations is less than that provided by PET/CT scan-though lymph node metastasis is rare [18]. In DLBCL group, 16 cases (69.6%) showed one or more enlarged lymph nodes (≥10 mm). In 5 cases (21.7%), the lymph nodes were fusion-like clumps with compression of stomach. In the MALT lymphoma group, only 2 patients (20%) had lymph nodes enlargement. These findings are similar to comparable reports in the literature.

This study is limited by its retrospective nature and the small number of subjects-especially within the MALT group. Additionally, this study only compares two types of B-cell NHL.

Conclusion

Relatively increased gastric wall thickness and the presence of gastric stenosis, epigastric serosal infiltration, and perigastric lymphadenopathy may be suggestive of DLBCL on MDCT. While classification of primary gastric lymphomas may be possible using MDCT, larger scale studies are necessary to determine the true radiological diagnostic potential.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Yulan Shen, Department of Radiology, Shanghai Jiaotong University, Six People's Hospital, 222 Huanhu West Three Road, Pudong New District, Shanghai 201306, China. Tel: +86-21-38297255; Fax: +86-21-38297739; E-mail: shenyulan_sh@126.com

References

[1] Kelessis NG, Vassilopoulos PP, Tsamakidis KG, Bai MG, Avital S, Rosenthal RJ. Is gaetroecopy still a valid diagnostic tool in detecting gastric MALT lymphomas? A dilemma beyond the eye mucosa-associated lymphoid tissue. Surg Endoec 2003; 17: 469-474.

[2] De Jong D, Boot H, van Heerde P, Hart GA, Taal BG. Histological grading in gastric lymphoma: pretreatment criteria and clinical relevance. Gastroenterology 1997; 112: 1466-74.

[3] Isaacson PG. Gastrointestinal lymphoma. Hum Patho 1994; I25: 1020-1029.

[4] Schwarz RJ, Conners JM, Schmidt N. Diagnosis and management of stage IE and stageIIE gastric lymphomas. Am J Surg 1993; 165: 561-565.

[5] Fukuya T, Honda H, Hayashi T, Kaneko K, Tateshi Y, Ro T, Maehara Y, Tanaka M, Tsuneyoshi M, Masuda K. Lymph-node metastases: efficacy for detection with helical CT in patients with gastric cancer. Radiology 1995; 197: 705-11.

[6] Boot H. Diagnosis and staging in gastrointestinal lymphoma. Best Pract Res Clin Gastroenterol 2010; 24: 3-12.

[7] Hellmig S, Bartscht T, Fischbach W, Ott SJ, Rosenstiel P, Klapper W, Fölsch UR, Schreiber S. Germline variations of the MALT1 gene as risk factors in the development of primary gastric B-cell lymphoma. Eur J Cancer 2009; 45: 1865-70.

[8] Choi D, Lim HK, Lee SJ, Lim JH, Kim SH, Lee WJ, Lee JH, Kim YH, Rhee PL, Kim JJ, Ko YH. Gastric Mucosa-Associated Lymphoid Tissue Lymphoma: Helical CT Findings and Pathologic Correlation. AJR Am J Roentgenol 2002; 178: 1117-22.

[9] Erreria J, Cordio S, Ponzoni M, Villa E. Nonsurgical treatment with primary chemotherapy, with or without radiation therapy, of stage I-II high grade gastric lymphoma. Leuk Lymphoma 1999; 33: 531-541.

[10] Hargunani R, Maclachlan J, Kaniyur S, Power N, Pereira SP, Malhotra A. Cross-sectional imaging of gastric neoplasia. Clin Radiol 2009; 64: 420-9.

[11] Hur J, Park MS, Lee JH, Lim JS, Yu JS, Hong YJ, Kim KW. Diagnostic accuracy of multidetector row computed tomography in T-and N staging of gastric cancer with histopathologic correlation. J Comput Assist Tomogr 2006; 30: 372-7.

[12] Shimizu K, Ito K, Matsunaga N, Shimizu A, Kawakami Y. Diagnosis of gastric cancer with MDCT using the water-filling method and multiplanar reconstruction: CT-histologic correlation. AJR Am J Roentgenol 2005; 185: 1152-8

[13] Asai S, Miyachi H, Hara M, Fukagawa S, Shimamura K, Ando Y. Extensive wall thickening in intestinal Burkitt lymphoma. J Ultrasound Med 2002; 21: 657-61.

[14] Gollub MJ. Imaging of gastrointestinal lymphoma. Radiol Clin North Am 2008; 46: 287-312.

[15] Levine MS, Rubesin SE, Pantongrag-Brown I, Buck JL, Herlinger H. Non-Hodgkin'lymphoma of the gastrointestinal tract: radiographic findings. AJR Am J Roentgenol 1997; 168: 165.

[16] Asai S, Miyachi H, Hara M, Fukagawa S, Shimamura K, Ando Y. Extensive wall thickening in intestinal Burkitt lymphoma. J Ultrasound Med 2002; 21: 657-661.

[17] Gossios K, Katsimbri P, Tsianos E. CT features of gastric lymphoma. Eur Radiol 2000; 10: 425-30.

[18] K im YH, Lim HK, Han JK, Choi BI, Kim YI, Lee WJ, Kim SH. Low-grade gastric mucosa-associated lymphoid tissue lymphoma: correlation of radiographic and pathologic findings. Radiology 1999; 212: 241-8.