CT EVALUATION OF GASTRIC LYMPHOMA

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Abstract: The purpose of our study was to determine the value of computed tomography (CT) with a drug-induced hypotonia and water filling in the diagnosis and preoperative staging of 27 patients with gastric lymphoma (GLy) confirmed by endoscopic biopsy.

CT scans were performed in a supine and prone position with drug-induced hypotonia and water-filling of stomach with 500–700 ml., and intravenous administration of a non-ionic contrast agent. The prone position and drug-induced hypotonia allowed visualization of the whole gastric wall and prevented gas artifacts, commonly present during supine imaging.

CT scans were analysed with respect to the thickness of the stomach wall, rugal thickening, presence of wall infiltration, mucosal nodularity, ulcerations and tumour masses, regional tumour spread, lymph node deposits and presence of distant metastases. The most common findings in GLy were ulcers of variable size, depth and number in 43% of cases, a mass with or without an ulcer in 36% of cases, and rugal thickening in 21% of cases. According to CT results, GLy was staged in four groups: I, II1, II2, III and IV. Precise preoperative staging was achieved in 73%, overstaging in 18% and understaging in 9% of patients. The sensitivity and specificity of the technique was 93% and 85% respectively. There was low grade MALT lymphoma in 69% and high grade MALT lymphoma in 31% of cases.

We believe that CT performed using this method is a useful non-invasive method for preoperative evaluation and staging of gastric lymphoma and should be used before surgery is planned.

Key words: CT, gastric lymphoma, MALT lymphoma, staging.
Primary lymphomas of the gastrointestinal tract usually involve only one site. Dawson et al. [1] cited five criteria that must be met for the diagnosis of a primary gastrointestinal lymphoma to be made:

1. No palpable superficial lymph nodes are seen.
2. Chest radiographic findings are normal (i.e., no adenopathy).
3. The white blood cell count (both total and differential) is normal.
4. At laparotomy, the alimentary lesion is predominantly involved, with lymph node involvement (if any) confined to the drainage area of the involved segment of gut.
5. There is no involvement of the liver and spleen.

Primary gastrointestinal lymphoma is the most common extra-nodal manifestation of non-Hodgkin lymphoma, accounting for up to 20% of all cases [2, 3].

The stomach is the most common primary site of extra nodal lymphoma. Primary gastric lymphoma is uncommon, constitutes only 2%-5% of malignant gastric lesions, and is the most common type of extranodal lymphoma, accounting for 50%-70% of all primary gastrointestinal lymphomas [4]. However, there is normally no lymphoid tissue in the gastric mucosa, and this paradox can be explained by the fact that chronic Helicobacter pylori gastritis is associated with the development of lymphoid tissue in the lamina propria [15]. Most low-grade primary gastric lymphomas arise from this mucosa-associated lymphoid tissue (MALT) and are therefore classified as MALT lymphomas [16]. As a result, it has been postulated that chronic infection of the stomach by Helicobacter pylori causes lymphoid proliferation in the gastric mucosa, with subsequent development of gastric MALT lymphoma [17].

At histological analysis, gastric MALT lymphoma can be classified into two types: low grade and high grade [18]. Low-grade MALT lymphoma diagnosed at an early stage has a good prognosis [5, 19].

The classification and staging of primary gastrointestinal lymphomas is best made with the classification system adopted at the Consensus Conference in Lugano in 1993 [6]:

- stage I – tumour confined to gastrointestinal tract, single primary site, and multiple noncontiguous lesions;
- stage II – tumour extends into the abdominal cavity from the primary gastrointestinal site (II1, local nodal involvement; II2, distant nodal involvement);
- stage III – penetration through serosa to involve adjacent organs or tissues; and
• stage IV – disseminated extranodal involvement or a gastrointestinal tract lesion with supradiaphragmatic nodal involvement.

Most patients present with stage II disease.

The most commonly used imaging modalities are a barium examination and computed tomography (CT). These modalities are complementary, although CT provides a better overall assessment of the disease stage.

Computed tomography (CT) is indispensable for evaluation of higher-stage tumors and extragastric involvement. However, CT is of limited value in diagnosing low-grade MALT lymphoma featuring minimal gastric wall thickening or a shallow lesion [20].

As a result, double-contrast upper gastrointestinal (UGI) examination is the most effective tool for detecting lesions at the earliest and curable stage. The appearance of gastric MALT lymphoma at UGI examination was first reported as innumerable tiny nodules throughout the stomach [17]. Later, several studies demonstrated mucosal nodularity, a shallow or deep ulcer, single or multiple masses, rugal thickening, and enlarged areae gastricae [8, 21].

The purpose of our study was to determine the value of computed tomography (CT) with a drug-induced hypotonia and water filling in the diagnosis and preoperative staging of 27 patients with gastric lymphoma (GLy) confirmed by endoscopic biopsy.

**Material and Methods**

We reviewed 27 patients, 10 women and 17 men, age range between 34–75 years, mean age 58 years, (Table 1) with GLy histopathologically proved at endoscopic biopsy. The presence of Helicobacter pylori infection was histopathologically confirmed in 23 patients, and the remaining 4 patients had a history of treatment for gastritis or peptic ulcers.

Table 1 – Таблица 1

<table>
<thead>
<tr>
<th>GENDER</th>
<th>AGE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 40</td>
<td>41–50</td>
</tr>
<tr>
<td>Male</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Female</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>4</td>
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</tbody>
</table>

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All patients underwent double-contrast upper GI examinations and computed tomography (CT) for the analysis and staging of the lesions. CT scans were performed in supine and prone positions with drug-induced hypotonia and watere-filling of stomach with 500–700 ml, and intravenous administration of a non-ionic contrast agent. The prone position and drug-induced hypotonia allowed visualization of the whole gastric wall and prevented gas artifacts, commonly present during supine imaging.

The radiologic signs evaluated were the presence of an ulcer, mass formation, mucosal nodularity, and rugal thickening. The extent of the lesions was categorized as being in the antrum, body, or fundus.

The depth of invasion, presence of ulcer, mass formation, rugal thickening, and involvement of lymph nodes were also determined at CT examination, and we performed a CT staging of the disease. We then correlated the findings of double-contrast upper GI examinations and CT examinations with those of pathologic examinations.

**Results**

The clinical symptoms were epigastric pain or discomfort in 22 patients, anorexia in 2, no symptoms in 2, and GI bleeding in 1.5 patients had anaemia at laboratory examination.

All 27 patients with GLy showed abnormal findings at upper GI examination. Of these patients, 9 had lesions in the antrum, 7 had lesions in the body, 8 had lesions in the antrum and body, 1 had lesions in the fundus, and 2 had lesions in the body and fundus. Biopsy specimens demonstrated low-grade MALT lymphoma in 19 patients (70%) and high-grade MALT lymphoma in 8 patients (30%). The high-grade MALT lymphomas included a background of low-grade MALT lymphoma at pathologic examination. (Table 2)

<table>
<thead>
<tr>
<th>Patient distribution according to Consensus Conference in Lugano 1993</th>
<th>Дистрибуција на пациентите според Consensus Conference во Лугано 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Grade Lymphoma</td>
<td>19 (70%)</td>
</tr>
<tr>
<td>High-Grade Lymphoma</td>
<td>8 (30%)</td>
</tr>
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</table>

Double-contrast studies may reveal ulcerative, polypoid, or infiltrative patterns. The diagnosis of lymphoma may be suggested by the presence of multiple polypoid tumours, (Fig. 1b) especially with central ulceration (‘bull’s
eye" appearance), giant cavitating lesions, or extensive infiltration with gastric fold thickening. (Fig. 1a) The latter finding may be distinguished from linitis plastica on the basis of the preservation of gastric distensibility.

CT scans were analyzed with respect to the thickness of the stomach wall, rugal thickening, presence of wall infiltration, mucosal nodularity, ulcerations and tumor masses, regional tumor spread, lymph node deposits and presence of distant metastases.

The most common CT findings in GLy were ulcers of variable size, (Fig. 2) depth and number in 12 (43%) cases, a mass with or without an ulcer in 10 (36%) cases, and extensive infiltration with gastric fold thickening in 5 (21%) cases. (Fig. 3) (Table 3)

Single or multiple ulcers were found in 12 patients (43%), and were the most common finding, especially in low-grade MALT lymphoma. (Fig. 4) The ulcers were of varying size and were shallow or deep. Single or multiple masses were seen in 10 patients (36%).

Figure 1 – High-grade gastric MALT lymphoma: a) Radiography shows diffuse, homogeneous thickened folds with a mass and lobulated inner surface of a gastric wall in the corpus and antrum of the stomach, b) Radiography shows a mass with nodular margins in the fornix and corpus of the stomach

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Figure 2 – Low-grade gastric MALT lymphoma. Axial contrast-enhanced CT scan obtained through the stomach shows segmental and mild wall thickening of the body, with deep ulcer. Note MS deposit in perigastric lymph node.

Figure 3 – High-grade MALT lymphoma of the stomach: Axial contrast-enhanced CT scan obtained through the stomach shows diffuse thickening of entire gastric wall in region of corpus and fornix. Note that inner contour of gastric wall is diffusely irregular.
Table 3 – Таблица 3

<table>
<thead>
<tr>
<th>Radiology findings in low and high grade lymphomas</th>
<th>Радиологически наоди кај ниско и високостепенит лимфоми</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rtg. finding</td>
<td>Total Cases</td>
</tr>
<tr>
<td>Ulcer (shallow or deep)</td>
<td>12</td>
</tr>
<tr>
<td>Mass with or without ulcer</td>
<td>10</td>
</tr>
<tr>
<td>Infiltration with fold thickening</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 4 – Low-grade MALT lymphoma of the stomach: Axial contrast-enhanced CT scan obtained through the stomach shows segmental and mild wall thickening of the body of the stomach, with minimal contrast enhancement. MS deposit in the perigastric lymph node

Слика 4 – Нискосеоен МALT лимфом на желудник. Аксијален контраастен АМ CT скен низ желудникот, покажува сегментално и умерено задебелување на телото на желудникот со минимално контраастно пребојување. Се забележува МС депозит во перигастричен лимфен Јазол

A mass with or without an ulcer was the second most common finding, along with thickened folds. In cases of high-grade MALT lymphoma, a mass was the most common finding. (Fig. 5) The diameter of the masses was larger in cases of high-grade lymphoma (5–10 cm) than in cases of low-grade lymphoma (1–5 cm).

Six patients had multiple masses, whereas four patients had a single mass. Most of the patients with a single or with multiple masses had an accompanying ulcer in the mass. Some of the patients had mucosal convergence around the mass.

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Figure 5 – High-grade MALT lymphoma of the stomach: Axial contrast-enhanced CT scan obtained through the stomach shows diffuse wall thickening of the body, with minimal contrast enhancement. MS deposits in lymph nodes

Rugal thickening was found in 10 patients (36%) of cases. Thickened folds were an accompanying finding (converged) to other lesions, such as masses, ulcers, or mucosal nodularity, rather than a unique finding. (Fig. 4) (Fig. 5)

Precise preoperative staging was achieved in 73%, overstaging in 18% and understaging in 9% of patients. The sensitivity and specificity of the technique was 93% and 85% respectively. There was low grade MALT lymphoma in 70% and high grade MALT lymphoma in 30% of cases.

According to the classification system adopted at the Consensus Conference in Lugano in 1993 and CT results, GLy was staged in five groups: I, II1, II2, III and IV. (Table 4)

Table 4 – Таблица 4

<table>
<thead>
<tr>
<th>Group</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stadium</td>
<td>3</td>
<td>12</td>
<td>8</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Barium studies may demonstrate subtle lesions not seen at CT but do not demonstrate the true extraluminal extent of the disease and are of little value in staging. In addition, the stomach remains pliable even with extensive lymphomatous infiltration, and the lumen is preserved, making gastric outlet obstruction a rather uncommon feature.

At CT, gastric wall thickening has been noted to be much less severe in low-grade lymphoma than in high-grade lymphoma, and abdominal lymphadenopathy is less common in low-grade lymphoma.

Perigastric adenopathy was found in 12 patients, and in 8 patients bulky lymph nodes were found, extending below the renal, which is highly predictable for MS deposits. In one patient MS deposits in the liver were found.

Discussion

Gastric MALT lymphoma showed variable radiologic features at UGI examination. In particular, low-grade MALT lymphoma had a wider spectrum of appearances than high-grade MALT lymphoma [5, 14].

A variety of findings have been described in both low- and high-grade MALT lymphomas at upper gastrointestinal examination, including single or multiple ulcers of varying size; single or multiple masses with or without an ulcer, along with thickened folds; submucosal masses, centrally ulcerated (bull's-eye) lesions; polypoid lesions; rugal thickening, commonly converging to an ulcer or a mass; mucosal nodularity of varying size, either focal or diffuse; and coarse areae gastricae [8, 17].

Low-grade MALT lymphoma has a wider spectrum of appearances than does high-grade MALT lymphoma, in which a mass-forming lesion or severe fold thickening is present in most cases [5, 7, 9].

It has also been postulated that the absence of abnormality at CT is highly predictive of low-grade MALT lymphoma [10], and greater than minimal thickening should be considered as possibly indicating transformation to a higher grade [7, 11].

Preservation of the perigastric fat planes at CT is more likely to be seen in lymphoma than in adenocarcinoma, particularly in the presence of a bulky tumour [5, 7, 12]. However, non-Hodgkin gastric lymphoma should be recognized as another cause of linitis plastica, an appearance that results from dense infiltrates of lymphomatous tissue in the gastric wall without associated fibrosis [13].

Adenopathy is seen with both adenocarcinoma and lymphoma, but if it extends below the renal hila, or the lymph nodes are bulky, lymphoma is more likely [11, 12].

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The most common finding in low-grade MALT lymphoma was an ulcer (50% of cases), which was the second most common finding in the report by Kim et al. [21].

The most common finding in high-grade MALT lymphoma was a mass, which was present in most cases (67%).

Multiple shallow lesions tended to occur in low-grade rather than high-grade MALT lymphoma. A mass with or without an ulcer was the second most common finding in gastric MALT lymphoma (36% of cases). A mass was the most common finding in cases of high-grade MALT lymphoma (67%), and masses were seen in only 27% of patients with low-grade MALT lymphoma. The masses were larger in high-grade than in low-grade MALT lymphoma. Masses in gastric MALT lymphoma were accompanied by an internal ulcer in 70% of cases.

The study by Kim et al. [21] revealed thickened mucosal folds converging on the ulcer in 75% of patients, and a mass in 16% of patients, with low-grade MALT lymphoma. It was difficult to differentiate gastric MALT lymphoma manifesting as an ulcer from other stomach diseases, especially gastric adenocarcinoma.

Rugal thickening was the second most common finding, along with masses. Rugal thickening was an accompanying finding to other lesions, such as ulcers or masses, rather than a unique finding. [7, 8, 21]

The paradox of lymphoma arising in the stomach has been explained by the observation of MALT in the stomach in response to infection with H pylori and by the presence of this organism in more than 90% of gastric MALT lymphomas [15]. In addition, MALT lymphomas with associated H pylori gastritis tended to manifest as multiple lesions more often than MALT lymphomas without H pylori gastritis.

The lesions in high-grade MALT lymphoma tend to be more aggressive than those in low-grade MALT lymphoma. Differentiation of gastric MALT lymphoma from gastritis or gastric carcinoma is extremely difficult, especially in cases of low-grade lymphoma.

At endoscopy, the lesions affected the body and the antrum and consisted of an irregular and large ulcer with raised edges and erosions, small nodules, and localized or diffuse rugal thickening [22].

Early gastric lymphoma was defined as lymphoma invasion limited to the mucosa or the submucosa of the stomach wall, regardless of the presence of lymph node metastases [24]. These tumours usually manifested as localized smooth enlargement of the rugae, poorly defined shallow ulcers, or well-defined deep ulcers. The ulcers were usually associated with mucosal convergence, enlargement of the rugae, and smooth marginal elevation. Multiple lesions were
noted in 40%–50% of cases [23, 24]. Kitamura et al. [23] reported that five of 10 early gastric lymphomas had pathologic features of MALT lymphoma.

Early lymphoma that arises from the lymphatic tissue in the deeper layer mainly produces submucosal tumour growth, and desmoplastic reaction is rare. Therefore, smooth enlarged rugae with slight convergence indicating the submucosal nature of early lymphoma and poorly defined ulceration indicating poor desmoplastic reaction were findings suggestive of early lymphoma [24].

Kitamura et al. [23] reported a higher prevalence of multifocal lesions in early gastric lymphoma than in gastric carcinoma. Our results suggest that disorganized convergent rugae, vague ulcer margins, and multiple lesions may be useful in differentiating low-grade gastric MALT lymphoma from gastric carcinoma, especially the ulcerative type.

**Conclusion**

Gastrointestinal lymphoma is an uncommon disease with a wide variety of imaging appearances. Although there is no characteristic appearance, features such as a bulky mass or diffuse infiltration with preservation of fat planes and no obstruction, multiple site involvement, and associated bulky lymphadenopathy are suggestive of lymphoma.

The most commonly used imaging modalities are barium examination and CT, which are complementary. However, CT is the most useful modality in that it provides a better overall assessment of the disease stage.

We believe that CT performed with this method is a useful non-invasive method for preoperative evaluation and staging of gastric lymphoma and should be used before surgery is planned.

**REFERENCES**


Резиме

**CT EVALUACIJA NA GASTRICHEN LIMFOM**

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Целта на студијата е да се одреди вредноста на компјутеризираната томографија (CT) во индукрирана хипотонија и исполнување на желудникот со вода во дијагностика и предоперативен стејкинг на 27 пациенти со гастрен лимфом (GLy) потврден со едноскопска биопсija.

CT скеновите беа изведени во положба на суписија и пронација во индуцирана хипотонија и исполнување на желудникот со 500–700 mL вода и и.в. апликација на нејонско контрастино средство. Положбата во пронација и индуцираната хипотонија, овозможуваат визуелизација на мидот на целиот желудник, ги превенираат артефактите од присутниот воздух, кои обично се јавуваат за време на прегледот во положба на суписија.

CT скеновите беа анализирани во однос на деловите на стомачниот сид, задебелување на слузничките набори, присуство на инфильтрација на мидот, волулярност на мукозата, улцерации, туморски маси, регионално ширење на туморот, депозити во лимфните јазли и присуство на далечни метастази. Најчест наод кај GLy bełe ulkus со различна големина и глобуларна кој bełe застапен кај 43% од случајите, потоа следувале ТУ маса со или без улцерација кај 36% од случајите и задебелување на слузничките набори кај 21% од случајите. Според CT наодот, GLy bełe градиран во четири групи: I, II, III и IV. Прецизен предоперативен стејкинг bełe постигнат кај 73%, надценување кај 18% и потценување кај 9% од пациентите. Сензитивноста и специфичноста на техниката belève 93% и 85%. Нискостепенит MALT лим-
фон беше застапен кај 69%, додека високостепениот МАЛТ лимфом беше застапен кај 31% од случаите.

Ние веруваме дека CT изведен со овој метод е корисен неинвазивен метод за предоперативна евалуација и стејцинг на гастрличниот лимфом и треба да се користи пред да биде испланиран оперативниот третман.

Ключни зборови: CT, гастрличен лимфом, MALT лимфом, стејцинг.

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