Staging of Advanced Gastric Cancer: Comparison of Conventional CT and Intraoperative Assessment

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Purpose: We performed a retrospective study to compare the accuracy between conventional CT staging and intraoperative staging for advanced gastric cancer.

Materials and Methods: Sixty patients with advanced gastric cancer were included in this study during the recent 2 year-period. All were pre- and postoperatively diagnosed as advanced gastric cancer. CT was performed with GE 9800 and Somatom DR3 under conventional technique in 50 and with others in 10 referred patients. The CT staging for T and N category with emphasis on incurable factor, if not resected, were performed. And we compared the accuracy between conventional CT and intraoperative staging. The final histo-pathologic staging was used as a gold standard.

Results: Accuracy of CT and operation for T4 (n=17) factor is 76.9% and 86.2% respectively. Overestimation rate for T4 was 9.3% by CT and 6.1% by operation, and underestimation rate for was 13.8% and 7.7% respectively. Accuracy of CT and operation for N (n=60) factor was 50% and 60% respectively. Overestimation rate for N factor was 18.3% by CT and 18.3% by operation, and underestimation rate for N factor was 31.7% and 21.7% respectively. Correct T and N staging was possible only in 33% by CT and 38% by intraoperative assessment.

Conclusion: Conventional CT and intraoperative staging for incurable T/N factor in advanced gastric cancer have a potential limitations, especially for N factor. Therefore, more reliable modality or technique such as dynamic scanning by spiral CT, transabdominal or endoscopic ultrasonography should be preoperatively performed to complement infrequent errors in intraoperative staging. Furthermore, a histology-oriented surgical approach seems essential in selecting the most appropriate surgical procedure.

Index Words: Stomach, neoplasms
Stomach, CT
Neoplasms, staging

INTRODUCTION

Accurate preoperative staging of gastric cancer is essential to plan appropriate treatment whether it is surgical or non-surgical(1). However, accuracies of radiologic methods including computed tomography (CT) are still conflicting (2, 6-16). Therefore, unnecessary exploratory laparotomy is still unavoidable.

On the other hand, recent studies revealed frequent errors even in intraoperative assessment which has been considered as the most reliable and final staging method (16-19). And Japanese Stomach Cancer Study Group is recently emphasizing the importance of curative resection and proposing the criteria of incurable factor, if not resected, in gastric resection(20).

In this study, we compared the accuracy of conventional CT and intraoperative staging for advanced gastric cancer with final pathologic staging as a gold standard.

MATERIALS and METHODS

In a 26-month period, we retrospectively studied 60
patients who had pathologically proved adenocarcinoma of stomach. They consisted of 37 men and 23 women (mean age: 54 years, range: 27-81 years). CT scans were performed with either GE 9800 (General Electric, Milwaukee, U. S. A.) in 38 patients or Somatom DR3 (Siemens, Erlangen, Germany) in 12 patients, and with other third generation CT scanners in 10 referred patients. Scanning variables were 120 kVp, 240 mA, scanning time 2 sec for GE 9800 system and 125 kVp, 350 mA, scanning time 4 sec for Somatom DR3. Ten-millimeter-thick contiguous sections with 3 mm interval were acquired from the diaphragm to the iliac crest. All of 50 inpatients received contrast medium [a bolus 50 ml and a drip infusion 100 ml of Ultravist 300 (Schering, Germany)] intravenously. All of 50 inpatients received contrast medium (500 ml water in 38 patients, 500 ml Gas trografin in 12 patients) orally before the CT procedure.

All CT scans were reviewed in respect to depth of invasion of primary lesion and lymph node metastasis by two radiologists (H. C. R., Y. Y. C.). Especially we focused on the incurable T/N factor (T4 or any N), if not resected, according to criteria of curative resection by Japanese Research Society for Gastric Cancer (20). T4 criteria on CT was defined as obliteration of fat plane between primary lesion and adjacent organ. T2 and T3 were considered as a single category because differentiation of two was very difficult by conventional technique. Total number of T lesions was 65 in 60 patients, including double T4 lesions in 5 patients.

Lymph node metastasis were evaluated as following criteria; NO (No metastasis), N1(perigastric lymph nodes), N2(left gastric, common hepatic, splenic, celiac artery lymph node), and > N2 (the other intraabdominal lymph nodes). Lymph nodes were considered positive if they exceed 10 mm in greatest diameter. The results of CT and intraoperative surgical staging for T/N factor were compared with final histo-pathologic staging.

RESULTS

Accurate estimate for T4 factor was possible in 76.9% by CT and 86.2% by intraoperative staging (Fig. 1). Overestimation rate for T4 was 9.3% by CT and 6.1% by operation, and underestimation rate was 13.8% and 7.7% respectively (Table 1) (Fig. 2, 3). Pathologically proven T4 factors were invasion to pancreas (n = 10), transverse colon (n = 5), and liver (n = 2) (Fig. 2, 3). Estimation of N status was accurate in 50% by CT and 60% by intraoperative staging. Overestimation rate for N was 18.3% and 18.3%, and underestimation rate was 31.7% and 21.7% respectively (Table 2) (Fig. 4). Correct T and N staging was possible in 33% by CT and 38% by intraoperative assessment (Table 3).

DISCUSSION

An accurate preoperative staging of the most important prognostic factor of gastric cancer, such as depth of invasion (T) and lymph node metastasis (N) for planning of appropriate treatment (1), is crucial for planning of appropriate treatment (1), because overestimation may result in an unduly conservative operation and reduce the likelihood of cure, whereas underestimation may lead to inappropriate radical surgery with risk (13).

The previous reports on the accuracy of conventional CT staging is somewhat conflicting (6-16). Five out of twelve papers revealed pessimistic conclusions for CT's role (2, 13-16), while seven found CT to be useful (6-12). Major limitations of these optimistic data lie in retrospective evaluation with small sized materials and comparison with intraoperative surgical assessment as a gold standard. But recent prospective studies using pathologic staging as a gold standard has shown the low accuracy of conventional CT and intraoperative staging (19). Our data has shown the agreement with recent pessimistic views for the role of preoperative conventional CT staging (2, 13-16). Their accuracies for T and/or N categories ranged from 45% to 56%, which were comparable with ours.

Accuracy for T in our study seems to be higher than

Table 1. Staging for T Factor: CT versus Operation

<table>
<thead>
<tr>
<th>PATHOLOGY (n)</th>
<th>CT</th>
<th>OPERATION</th>
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<tbody>
<tr>
<td>T2 / 3 (48)</td>
<td>42</td>
<td>6</td>
</tr>
<tr>
<td>T4 (17)</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Accurate (%)</td>
<td>76.9</td>
<td>86.2</td>
</tr>
<tr>
<td>Overstage (%)</td>
<td>9.3</td>
<td>6.1</td>
</tr>
<tr>
<td>Understage (%)</td>
<td>13.8</td>
<td>7.7</td>
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Fig. 1. Hepatic invasion
Contrast-enhanced CT scan shows obliteration of fat plane (white arrow) between of gastric mass and lateral segment of liver with adjacent focal low-attenuation lesion (black arrow); true positive on CT and operation.
those of previous studies, because we excluded early gastric cancer and considered T2 and T3 as single category due to difficulty of differentiation between T2 and T3 by conventional CT. The criteria for T4 factor by CT is not reliable because the source of errors is unavoidable if the patients is emaciated or the perigastric inflammation around tumor is present. Endoscopic ultrasonography for T4 factor by Ziegler et al(19) revealed high sensitivity(89%), compared with conventional CT(44%) and intraoperative surgical assessment(22%).

Accuracy of conventional CT for overall N staging according to N0, N1, N2, and N3 was 50%, which was

<table>
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<tr>
<th>PATHOLOGY (n)</th>
<th>CT</th>
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<tbody>
<tr>
<td>NO (6)</td>
<td></td>
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<tr>
<td>N1 (24)</td>
<td></td>
<td></td>
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<tr>
<td>N2 (17)</td>
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<tr>
<td>N3 (13)</td>
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<tr>
<td></td>
<td>50.0</td>
<td>60.0</td>
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<tr>
<td>Accurate(%)</td>
<td>18.3</td>
<td>18.3</td>
</tr>
<tr>
<td>Overstage(%)</td>
<td>31.7</td>
<td>21.7</td>
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</table>
a. Contrast-enhanced CT scan shows equivocal low-attenuation lesion (arrow), considered as partial volume effect of pancreas; false negative celiac nodes on CT and true positive on operation.
b. Contrast-enhanced CT scan shows 1.5 cm sized, ovoid low-attenuation lesion adjacent to portal vein (arrow), suggested as hepatoduodenal lymph node; true positive hepatoduodenal node on CT and false negative on operation.

This study showed two points: 1) the significant limitations were found in accurate T/N staging for gastric cancer by conventional CT, similar to recent pessimistic results, 2) the considerable errors are possible by intraoperative assessment without standardized frozen section.

In conclusion, conventional CT staging in advanced gastric cancer has potential limitations as well as intraoperative surgical assessment. Therefore, more reliable modalities or techniques such as dynamic scanning by spiral CT, high-resolution transabdominal, or endoscopic ultrasonography are required to complement a possible errors in intraoperative macroscopic staging. Furthermore, histology-oriented surgical approach with standardized frozen sections of T/N factor during operation seems essential for selecting the most appropriate surgical procedure, whether the aim of operation is curative or palliative.

**REFERENCES**

진행성 위암에 대한 병기결정: 고식적 CT와 수술상 병기결정의 비교

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목 적: 진행성 위암의 병기결정에 있어서 비절제시 치유불가인자로 알려진 T4 및 N을 중심으로 고식적 CT 및 수술상의 병기결정의 정확성을 후향적으로 비교하여 술전 및 술중 병기결정의 유용성 및 문제점을 알아보고자 하였다.

방 법: 최근 2년 동안 진행성 위암으로 진단 받아 위절제술을 받았던 60명의 환자를 대상으로 하여 고식적 CT검사에 및 수술 중 육안적으로 평가한 병변의 침윤도(T)와 임파선 전이 정도(N)에 대하여 후향적으로 평가하여 이를 최종병리학적 병기 결정을 기준으로 각각의 정확도를 비교분석하였다.

결 과: 병변의 침윤도에 대한 즉, 인접장기 침범(T4)에 대한 CT 및 수술진단의 정확도는 각각 76.9 %, 86.2 %였으며, 과대평가는 9.3 %, 6.1 %였고 과소평가는 13.8 %, 7.7 %였다. 임파선 전이정도(N)에 대하여 CT 및 수술진단의 정확도는 각각 50 %와 60 %였고 과대평가는 공히 18 % 과소평가는 각각 31.7 %와 21.7 %였다. 한편 병변의 침윤도 및 임파선 전이 정도를 모두 정확히 평가할 수 있었던 경우는 CT로서는 33 %에서 수술에서는 38 %에서 가능하였다.

결 론: 고식적 CT에 의한 진행성위암의 병기결정은 비절제시 치유불가인자로 여겨지는 주변장기로의 침범유무(T4)에 대해서는 어느 정도의 유용성을 견지하고 있으나 임파선 전이의 평가에 있어서는 낮은 정확도를 보였고, 이러한 문제점은 최종 병기결정 방법인 수술 병기 평가상에서도 나타나있음으로 확인되었다. 따라서 현행의 고식적 CT에 의한 보다 신뢰도 높은 수술 방사선학적 진단법으로의 전향이 필요하며, 수술 병기결정의 정확도의 향상을 위한 다각적인 노력도 이어져야 할 것으로 판단한다.
Case 4. F/30
C.C.; intermittent neck pain since 2 months ago
Answer; neurenteric cyst of C-spine