Endosonography for rectal carcinoma: Preoperative TNM staging compared to histology

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ABSTRACT: Transrectal endosonography was performed preoperatively in 58 patients with rectal carcinoma. The results of endosonography were compared to the histology of resected specimens according to the new (1987) TNM (tumour, nodes, metastases) classification. Endosonography was accurate in the staging of tumour categories except with T2 carcinomas because of concomitant peritoneal abscesses, inflammation or tissue changes after irradiation therapy. The overall accuracy of endosonography was 81%. Overstaging occurred in 17% and understaging in 2%. The accuracy of endosonography for staging regional lymph nodes was 74%, sensitivity was 95% and specificity 61%. Endosonography was not accurate in the staging of distant metastases due to the limited penetration depth of ultrasound used. In conclusion, endosonography will become the standard for staging rectal carcinoma. Can J Gastroenterol 1990;4(9):537-541

Key Words: Endosonography, Histology, Rectal carcinoma, TNM staging

Endoscopy is accurate in diagnosing rectal carcinoma. The submucosal extent of the tumour, however, cannot be assessed. Even computed tomography is not accurate for staging rectal carcinoma because of inability to image the individual layers of the rectal wall (1,2). Endoscopic and nonoptical sonography, generally known as endosonography, were developed to improve the diagnostic value of ultrasound by directly approaching the target lesion via the gastrointestinal lumen with a high frequency ultrasonic beam (3-8). This technique has been reported to be accurate for clinical TNM (tumour, nodes, metasizes) staging of gastrointestinal carcinoma (9-13).

Recently, there has been a revision of the T categories and stage grouping of the TNM classification, which now permits a direct translation to Duke's classification (0-4) (14-17). The N classification has been revised to account for the lymph nodes as well as their location. These changes were made based on data from the Erlangen Tumor Registry (16). The aim of this study was to assess the accuracy and limitations of transrectal endosonography in clinical TNM staging of rectal carcinoma according to the new (1987) TNM classification.

MATERIALS AND METHODS

Between March 1984 and April 1989 endosonography was performed...
preoperatively in 58 patients with rectal carcinoma proven by endoscopic biopsy. There were 40 males and 18 females with ages ranging from 26 to 90 years (average 66). These examinations were performed within four weeks before surgery. The results of endoscopic images and histology of resected specimens were staged according to the new (1987) TNM classification.

**Instruments:** The author has been routinely using the rigid Aloka ASU-59 and a flexible Aloka prototype ASU-57 to examine the rectal carcinomas (Figure 1). For rectosigmoid colon, the author has been using the side-viewing 10 MHz echoendoscope (EUM2) or the forward-viewing echoscope (AXF-EUM2). The latter can be more readily maneuvered endoscopically because of its forward-viewing optics (Figure 2). This radial scanner has a sector of approximately 300° because the biopsy channel adjacent to the transducer hampers the transmission of ultrasound. The area under the biopsy channel cannot be seen due to the total reflection of the ultrasonic beam. The recently available Olympus echoendoscope can be attached with a water-filled balloon at the transducer (Figure 3). This makes imaging of colorectal abnormalities much easier. The specifications of these instruments are summarized in Table 1.

**Investigation technique:** The technique of investigation is compatible with rectosigmoidoscopy in patients lying in the left lateral decubitus position after phosphate enema. Rectal digital examination is obligatory to assess the local anatomy and to dilate the sphincter and muscle prior to insertion of the instrument. The nonoptic instrument is blindly inserted as deeply as possible. Thereafter, the instrument should carefully be withdrawn until abnormalities are imaged sonographically. By filling the balloon with water the polypoid or exophytic configuration of tumours can be clearly visualized. The method of investigation with the echoendoscope is similar to the examination of the stomach for gastric carcinomas.

The tumour should be visualized endoscopically. The echoprobe is positioned adjacent to the tumour. Thereafter, the balloon or the colorectal lumen is filled with water to produce adequate transmission for ultrasound. Whenever possible, the instrument should be passed beyond the lesion into the proximal colonic segments to visualize lymph node abnormalities and to determine the proximal noninvaded area. This is important to give accurate information for localization of resection margins. The interpretation of normal and pathological structures is based on the results of previous studies. Endosonographic criteria for new TNM staging are given in Table 2.

Criteria for assessing lymph node metastases are as follows. Lymph nodes with a hypoechoic pattern and clearly delineated boundaries are suspicious of malignancy. Direct extension of mural abnormalities into adjacent lymph nodes is highly suspicious of malignancy. Lymph nodes with a hyperechoic pattern and indistinctly demarcated boundaries are indicative of benignancy.

Staging of distant metastasis with endosonography was excluded because
**TABLE 1**

Technical data of various colorectal echoendoscopes

<table>
<thead>
<tr>
<th>Echoendoscope</th>
<th>Olympus EU-M2</th>
<th>Olympus AXF-EUM2 flexible</th>
<th>Aloka ASU-57 rigid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endoscope</td>
<td>Side-viewing duodenoscope</td>
<td>Forward-viewing colonoscope</td>
<td>Nonoptic</td>
</tr>
<tr>
<td>Length</td>
<td>120 cm</td>
<td>130 cm</td>
<td>65 cm</td>
</tr>
<tr>
<td>Echoprobe length</td>
<td>42 mm</td>
<td>42 mm</td>
<td>10 mm</td>
</tr>
<tr>
<td>Diameter</td>
<td>13 mm</td>
<td>15 mm</td>
<td>10 mm</td>
</tr>
<tr>
<td>Frequency</td>
<td>10 MHz</td>
<td>7.5 MHz</td>
<td>7.5 MHz</td>
</tr>
<tr>
<td>Depth of penetration</td>
<td>5 cm</td>
<td>10 cm</td>
<td>10 cm</td>
</tr>
<tr>
<td>Axial resolution</td>
<td>0.15 mm</td>
<td>0.2 mm</td>
<td>0.2 mm</td>
</tr>
</tbody>
</table>

All echoprobe are mechanical sector or radial scanning (180° or 360°). Only the Olympus AXF-EUM2 has capability for endoscopically guided puncture or biopsy.

**TABLE 2**

Endosonographic criteria for 1987 TNM staging of rectal carcinoma

Assessment of rectal carcinoma

- **T1**: Hypoechoic tumour localized in the mucosa and/or submucosa
- **T2**: Hypoechoic tumour invades the muscularis propria
- **T3**: Hypoechoic tumour invades through the muscularis propria into the subserosa or nonperitonealized pericolic or perirectal tissues
- **T4**: Hypoechoic tumour penetrates the visceral peritoneum or directly invades other organs or structures.

Assessment of lymph node metastasis of rectal carcinoma

- **N0**: No regional lymph nodes
- **N1**: Metastasis in one or three perirectal or pericolic lymph nodes
- **N2**: Metastasis in four or more perirectal or pericolic lymph nodes
- **N3**: Metastasis along the course of a named vascular trunk.

Assessment of distant metastasis of rectal carcinoma

- **M0**: No distant metastasis
- **M1**: Distant metastasis such as hepatic and/or peritoneal dissemination

**RESULTS**

Table 3 summarizes the results of endosonography and histology in assessing the depth of tumour infiltration. The depth of tumour infiltration was assessed in 58 patients.

**TABLE 3**

Results of histology and endosonography in assessing depth of tumour infiltration of colorectal carcinoma

<table>
<thead>
<tr>
<th>Stage</th>
<th>Histology</th>
<th>Endosonography</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>T2</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>T3</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>T4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Values given are numbers of patients. There were two and eight patients overstaged in the T1 and T2 classes, respectively, and one patient understaged in the T3 class. (For explanations of T categories, see Table 3)

**TABLE 4**

Results of histology and endosonography in assessing regional lymph nodes of colorectal carcinoma

<table>
<thead>
<tr>
<th>Stage</th>
<th>Histology</th>
<th>Endosonography</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0</td>
<td>36</td>
<td>22</td>
</tr>
<tr>
<td>N1</td>
<td>13</td>
<td>8 (4*)</td>
</tr>
<tr>
<td>N2</td>
<td>9</td>
<td>7 (2*)</td>
</tr>
<tr>
<td>N3</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

There were 14 false positives in the N0 class and one false negative in the N1 class. *Patients with inaccurate staging according to the separate N1 and N2 definitions of metastasis. Values given are numbers of patients. (For explanations of N categories, see Table 2)

lymph node metastasis along the suprapetral blood vessels, liver metastasis and peritoneal dissemination could be imaged. This was explained by the limited penetration depth of ultrasound and the difficult anatomical route to reach the target of interest.

**RESULTS**

Table 3 summarizes the results of endosonography and histology in assessing the depth of tumour infiltration. The depth of tumour infiltration was assessed in 58 patients.

T1 carcinoma was correctly diagnosed in five of seven patients. Overstaging occurred in two patients due to peritumoral infiltration.

T2 carcinoma was correctly diagnosed in seven of 15 patients (Figure 4). Overstaging occurred in eight patients due to perirectal abscesses (three patients), peritumoral inflammation (four patients) or preoperative irradiation with destruction of peritumoral structures (one patient).
Figure 4) A Endosonogram of a hypoechoic rectal carcinoma (t) with penetration into the muscularis propria (mp) localized ventrally adjacent to the prostate gland (pr). B Corresponding endoscopy showing a polypoid tumour.

Figure 5) A Endosonogram of a hypoechoic tumour (t) with penetration through the muscularis propria (mp) into the submucosal layer (s). B Corresponding histology of carcinoma penetrated through the muscularis propria (mp).

T3 carcinoma was correctly diagnosed in all 34 patients (Figure 5). T4 carcinoma was correctly diagnosed in one of two patients. Understaging occurred in one patient because penetration into the dorsal wall of the vagina was not imaged.

The overall accuracy was 81%. Overstaging occurred in 17% and understaging in 2%.

Table 4 summarizes the results of endosonography and histology in assessing regional lymph nodes. The number of lymph nodes in one resected specimen varies from one to 17 with a total of 337 (average per resected specimen six). Metastases (N1 and N2) were found in 114 lymph nodes (34%). Nonmetastatic tumours (diameter range 2 to 18 mm) were correctly diagnosed in 22 of 36 patients. Incorrect diagnoses were made in the remaining 14 patients. Lymph node metastases (diameter range 6 to 22 mm) were correctly diagnosed in 21 of 22 patients. False negative diagnoses were made in the remaining patient due to granulomatous inflammation. However, accurate staging according to the separate N1 and N2 definitions of metastasis was done in only 15 patients: N1 metastasis was correctly staged in eight of 13 patients and N2 in seven of nine patients. N1 metastasis was erroneously classified as N2 in four patients and N2 as N1 in two. The overall accuracy of endosonography was 74%, sensitivity 95% and specificity 61%. The positive predictive value was 60% and negative was 96%.

DISCUSSION

Endosonography is accurate in the assessment of tumour category because of the ability to image the depth of tumour infiltration and transition between normal and pathological wall structure. A close correlation between endosonography findings and histology can be demonstrated. Various sections of endosonography images are crucial for the assessment of maximum depth and extent of carcinomatous infiltration. This is essential for comparing the clinical T category with the pathological T category. Overstaging may occur because of peritumoral inflammation, which cannot be distinguished from carcinomatous infiltration on ultrasound. Understaging may occur due to severe stenosis, which cannot be passed with the instrument.

Endosonography is more accurate for determining metastatic involvement than for identifying nonmetastatic lymph nodes. Distinction between a micrometastatic and a benign lymph node or between an inflammatory enlarged lymph node and lymph node metastasis cannot be made based on ultrasound alone. Therefore, false positive and false negative diagnoses may occur.
Stage grouping is a combination of T, N and M categories. Therefore, stage grouping can be assessed if additional transcutaneous ultrasound or computed tomography is incorporated. Incorrect diagnosis of each category, however, may lead to erroneous stage grouping. This has also been reported in the staging of upper gastrointestinal carcinomas (9-13).

In conclusion, the author believes that endosonography will become the standard procedure for staging rectal carcinomas. The important information for the surgeon is the delineation of the tumour free region, both proximal and distal to the primary site. Moreover, lymph nodes adjacent to and distant from the edge of tumour should be carefully examined. With this information, radical tumour resection and lymph node dissection can be planned. In cases of nonsurgical treatment with laser photocoagulation or irradiation, the depth of tumour infiltration before and after treatment should be carefully measured. In this manner, documentation after therapy can be done.

REFERENCES