THE VALUE OF INTRAOPERATIVE LIVER ULTRASOUND ASSESSMENT USING AN INTRAABDOMINAL PROBE DURING LAPAROTOMY PERFORMED FOR ONCOLOGICAL REASONS

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The quality of liver assessment in an oncological patient plays an important role in the selection of a proper type of medical intervention. Diagnostic techniques commonly used in liver imaging are still far from perfect. Intraoperative liver evaluation using an intraabdominal ultrasound probe remains an important tool for proper assessment of this organ.

The aim of the study was to evaluate suitability of this intraoperative diagnostic method for detection of primary and secondary neoplastic pathologies of the liver.

Material and methods. Between March 2010 and the end of December 2011, we performed intraoperative ultrasound examinations of the liver during 220 of 461 laparotomies carried out for oncological reasons.

Results. In 72 patients (33%), intraoperative ultrasonography using an intraabdominal probe revealed neoplastic pathologies in the liver. In 16 patients (7%), the pathologies had not been observed in the preoperative imaging examinations. In 7 cases (3%), the detected tumors were impalpable and invisible in macroscopic examination routinely performed during laparotomy. The time of performing preoperative liver examinations did not affect the detection of previously unrecognized liver tumors (p > 0.05). We found progression in the number of liver tumors in 28 patients (39%). In 20 patients (9%), the primary surgical plans were changed intraoperatively.

Conclusions. Liver examination using an intraabdominal ultrasound probe is a useful tool for assessment of neoplastic disease progression. The procedure allows proper choice of an optimal treatment regime and decreases the risk of performing an unnecessary oncological invasive procedure.

Key words: intraoperative ultrasound, liver surgery

Primary and secondary liver tumors still pose a diagnostic and therapeutic challenge for modern oncology. The quality of imaging affects the efficiency of liver assessment, also as regards the presence of neoplastic processes in the hepatic parenchyma (1, 2). This is reflected in methods of patient management and oncological treatment outcomes (3). Everyday practice indicates imperfection of liver imaging techniques routinely used in preoperative diagnostics, including computer tomography (CT), magnetic resonance imaging (MRI) or ultrasonography (USG). Imaging techniques characterized by high detection efficiency and the use of advanced features of CT, MRI or USG are still not universally available in Poland (4, 5). A way to decrease the risk of diagnostic errors in hepatic parenchyma assessment is a method popularized in the late ‘90s, namely intraoperative ultrasound using an intraabdominal probe. The examination can be performed during laparotomy or laparoscopy (5, 6). We decided to evaluate suitability of intraoperative ultrasound examination using an abdominal probe for detection of primary and secondary neo-
plastic pathologies of the liver, based on our own experience.

MATERIAL AND METHODS

Between March 2010 and the end of December 2011, we performed intraoperative intraabdominal ultrasound examinations of the liver during 220 of 461 laparotomies carried out because of gastrointestinal cancer and genital cancer. The examinations were performed using a 5-12 MHz probe of the BK Focus pro system. The results were assessed by surgeons of the surgical team. In individual cases, a radiologist participated in the assessment. The biggest group of patients examined using intraabdominal ultrasound were those with colon cancer, n = 175 (79.5%). Twenty-two (10%) laparotomies were performed in stomach cancer patients, 6 (2.7%) in pancreatic cancer patients, 5 (2.2%) in esophageal patients cancer and 5 in patients with primary liver tumor. In 7 (3.4%) cases, tumors were located in the female genital tract. Three of 220 laparotomies using intraabdominal ultrasound assessment were performed in an emergency setting. In the analyzed group of patients, there were more men (n = 132, 60%) than women (n = 88, 40%); median age: 68.5 years (20–91). Before the surgery, all patients underwent at least one of the three following liver imaging tests: USG (n = 59, 82%), CT (n = 67, 93%) or MRI (n = 5, 7%), and in addition, every patient who underwent an ultrasound examination was examined using CT and/or MRI. Liver tumors were detected preoperatively in 56 patients (25%). Among patients with tumors diagnosed de novo or confirmed during the intraabdominal ultrasound (n = 72), we distinguished a group A, n = 53 (74%), in which liver imaging was performed within 6 weeks before the surgery, and a group B, n = 19 (26%), in which liver assessment was performed earlier than 6 weeks prior to the procedure.

Statistical analysis was performed using the tools of STATISTICA 10 software. For comparisons, Pearson’s chi-square test was used. For calculations, a significance level of <0.05 was adopted.

RESULTS

In 72 patients (33%), intraabdominal ultrasound examination revealed neoplastic pathologies in the liver. In 16 patients (7%), whose liver was preoperatively assessed as free from neoplastic pathologies, the presence of metastases was detected. Metastatic nature of the newly discovered tumors was confirmed microscopically. In case of numerous metastatic foci, a tissue sample from a single tumor was used for histopathological assessment. Table 1 lists locations of the primary tumor in newly discovered metastatic liver tumors. In 7 cases (3%), the detected tumors were immeasurable and invisible in macroscopic examination routinely performed during laparotomy. The time of performing preoperative liver imaging tests (A vs. B) did not affect the detection of previously unrecognized liver tumors (Pearson’s chi-square test, p > 0.05).

Table 2 presents the agreement between the preoperative assessment and the intraoperative intraabdominal ultrasound examination as regards the presence, number and size of liver tumors depending on the imaging technique used. In case of numerous metastases detected through intraabdominal ultrasound, those detected earlier were always bigger than reported before the surgery.

The intraabdominal ultrasound examination performed intraoperatively revealed progression in the number of liver tumors compared with the state before the surgery in 28
of analyzed patients (39%). This was the case with 19 of 37 (51%) patients with hepatic metastases of colon cancer, 5 of 6 patients with metastases of stomach cancer (83%), 1 of 2 patient with pancreatic cancer, 1 of 4 patients with primary liver cancer and 2 of 7 patients with genital cancer.

Table 3 list cases where intraabdominal ultrasound assessment contributed to a change in the scope of preoperatively planned surgical intervention during laparotomy. This group did not include patients where the intervention was extended only by taking a sample/bioplate from liver tumors. In one of such cases, a preoperative imaging diagnosis of primary liver cancer was rejected intraoperatively. In 20 of 220 patients (9%), the initial surgical plans were changed during the laparotomy. All such cases of patients with stomach cancer involved locally advanced neoplasm, which was, however, eligible for potentially palliative resection, in combination with newly discovered hepatic metastases. The intraabdominal ultrasound assessment eventually contributed to a decision of not performing stomach resection. In case of patients with pancreatic cancer, the newly discovered hepatic metastases disqualified them from resection of the pancreas, which was assessed intraoperatively, also using intraabdominal ultrasound, as potentially resectable. In one case, plans to perform laparoscopic thermal ablation of liver cancer were rejected due to the tumor size and location assessed intraoperatively using an intraabdominal ultrasound probe. In case of neoplastic diseases originating from colon tumors, changes of surgical plans during laparotomy usually involved expansion of the scope of resection by excision and/or thermal ablation of metastatic tumor or rejection of metastasis resection in favor of thermal ablation.

**DISCUSSION**

Imaging of the liver plays an important role in diagnosing patients with neoplastic disease, since it allows assessment of viable treatment options and proper treatment planning (3). Macroscopic assessment of this organ during laparotomy or laparoscopy has lower efficiency than imaging tests. The tests, for instance with addition of tools making it possible to trace the dynamics of changes at the cellular level, not only make it easier to detect the presence of neoplastic foci in a given organ, but also may provide information on susceptibility of these foci to the planned treatment options, e.g. thermal ablation or chemotherapy (2, 4).

Table 3. Causes of changes in treatment plan resulting from intraabdominal ultrasound examination findings (n = 20)

<table>
<thead>
<tr>
<th>Primary tumor location</th>
<th>Progression of previously known liver tumors</th>
<th>Newly discovered liver tumors</th>
<th>Progression – observed locally and in the liver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>–</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>TPancreas</td>
<td>–</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Cervix</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Liver</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Colon</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sigmoid-rectal junction</td>
<td>–</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Rectum</td>
<td>–</td>
<td>–</td>
<td>2</td>
</tr>
</tbody>
</table>
Intraoperative liver ultrasound during laparotomy for oncological reasons

The arsenal of tools used in imaging of the liver includes different options of magnetic resonance tomography, computer tomography, positron emission tomography combined with CT (PET-CT), angiography and USG, including ultrasound with contrast and other methods (1). Ultrasound without contrast remains the least invasive and cheapest method of liver imaging examination (5). At the same time, it is characterized by a satisfactory efficiency in hepatic metastases detection of as much as 96% (7). This efficiency can be increased even to 99%, and according to some sources to 100%, by using an intraabdominal probe placed by the operator directly at the liver surface (3, 8, 11). This leads to more frequent detection of neoplastic foci in the liver during preoperative diagnostic CT (even up to 30% of cases). This might eventually change the plan established before the surgery.

Sietses et al., based on material of 117 laparotomies in 100 patients with hepatic metastases of colon cancer, observed disagreement between the results of CT scans performed 4 weeks prior to surgery and of intraabdominal ultrasound examinations in as many as 32% of cases, where in 20% of cases, a higher number of metastatic foci was observed, and in 9% of cases, disagreement was seen in assessment of their location within the hepatic parenchyma (3). In a paper by different authors, including material of 213 patients with colorectal cancer, intraabdominal ultrasound made it possible to detect previously unknown hepatic metastases in as many as 10% of cases. The authors claim that the results of MRI, PET or PET-CT scans performed before the surgery did not affect the ratio of metastatic tumors detected using intraabdominal ultrasound (9). These observations seem to confirm the findings of our study: In 17% of patients, intraoperative ultrasound assessment revealed the presence of tumors in the liver, which was diagnosed during preoperative examination as free from metastatic changes, and in as many as 39%, new metastatic foci were discovered, in addition to those diagnosed earlier. In case of computer tomography, these differences amounted to 18% and 19%, respectively. Progression in the number of metastases was accompanied by enlargement of previously diagnosed foci. Overall, in 7% of patients, intraabdominal ultrasound assessment allowed us to detect changes that had not been recognized in preoperative diagnostic imaging. In 7 cases (3%), the detected tumors were metastases impalpable and invisible in macroscopic examination.

A small number of patients with MRI liver assessment in our material (n = 5) made it impossible to compare the value of this method with other imaging techniques. It is believed that in preoperative diagnostics, MRI is characterized by the highest efficiency in detecting neoplastic pathologies in the liver compared with CT, USG and PET-CT (1). There are reports indicating slightly greater value of assessing the neoplastic status of the liver using technologically advanced features of CT and MRI compared with intraabdominal ultrasound (2). Everyday practice suggests that in Poland diagnostic imaging using these tools is still rather incidental (in our material, MRI was used in 5% of patients).

The condition of the hepatic parenchyma, especially the location, number and size of hepatic metastases, has a significant impact on the course of treatment and follow-up in patients with gastrointestinal cancer. Proper diagnosis using intraabdominal ultrasound might change the extent of intended surgical treatment of colon cancer in as many as 18% of patients, and in as many as 47% cases, this technique is a source of useful data unknown before the surgery (10, 11). In our study, better knowledge of the actual state of neoplastic foci in the liver, gained through intraoperative intraabdominal ultrasound assessment, significantly changed the scope of intended surgical treatment in 20 patients (9%). Only in one case, neoplastic disease originated from outside of the gastrointestinal tract. The information obtained through intraabdominal ultrasound examinations has no doubt positively affected the regimen of follow-up and further oncological treatment in many other patients.

CONCLUSIONS

Ultrasound examination of the hepatic parenchyma using an intraabdominal probe during a surgery performed on a neoplastic patient is a useful tool for assessment of neoplastic disease progression. It allows proper choice of an optimal treatment regime and decreases the risk of performing an unnecessary oncological invasive procedure.

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