Laparoscopy with laparoscopic ultrasound for pretreatment staging of hepatic focal lesions: A prospective study

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Abstract Introduction: The need for accurate intrahepatic staging is crucial for patients with primary or secondary hepatic malignancies. Currently available data indicate that laparoscopy with laparoscopic ultrasound provides information similar to that obtained by intraoperative ultrasound and that it is able to identify small intrahepatic lesions not diagnosed by preoperative conventional imaging techniques.

Objective: To determine the role of preoperative laparoscopy and laparoscopic ultrasonography in patients with potentially resectable hepatic focal lesion or candidate for radiofrequency ablation based on preoperative imaging.

Material and methods: From March 2004 to March 2007, 55 patients with potentially resectable hepatic focal lesions were candidates for exploratory laparotomy based on preoperative abdominal ultrasonography and triphasic spiral CT. All cases were then reevaluated prior to surgery using laparoscopy and laparoscopic ultrasound. All these procedures were performed within a time period of
no more than 4 weeks. The data obtained were compared to those obtained by the preoperative conventional imaging studies as regards the presence of satellites, subcentimeter lesions, newly discovered deep parynchymatous lesions, liver condition, portal vein thrombosis, nodal metastases, ascites, peritoneal implants, size and site of the primary lesion.

Results: After performing ultrasound-guided laparoscopy, fourteen patients proved to be unfit for surgical resection or ablation, seven patients showed newly discovered focal lesions, five patients proved to have satellites around the tumor and peritoneal deposits, one patient had ascites and one patient had been falsely diagnosed as HCC, proved to have had a liver abscess.

Conclusion: Preoperative laparoscopy and laparoscopic ultrasonography as an adjunct to preoperative imaging techniques provide more accurate staging for patients with potentially resectable hepatic focal lesions.

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Introduction

The use of laparoscopy in staging of cancer was first described in 1911, when Bernheim used laparoscopy on a patient with cancer of the pancreas. In 1975, Cuschieri of Scotland described the use of laparoscopy to diagnose liver metastases and ascites. As video capability and better technology for illumination, insufflation, and visualization have been developed, experience with videoscopic techniques for the staging of malignancy has been gained. Laparoscopy has been reported to decrease the incidence of unnecessary or non therapeutic laparotomy for malignancy in as many as 67% of patients as well as minimizing the under staging of malignancy [1].

Unfortunately, traditional radiologic staging techniques have recognized limitations. As many as 30–40% of patients with hepatobiliary and pancreatic malignancies harbors occult metastasis that cannot be imaged radiologically [2].

The first report of a technique combining laparoscopy with ultrasonography dates to 1963, when Yamakawa and co-workers performed A-mode scanning of a gallbladder cancer under laparoscopic guidance [3]; however, it was not until much later (1980–1981) when it was introduced into clinical practice in the early 1980s in Japan, and rapidly became routine practice [4]. Intraoperative ultrasound overcomes the two-dimensional capability of laparoscopy and provides a third arm and so frequently alters the course of the operation by identifying deep parynchymatous additional hepatic tumors not seen on laparoscopic inspection. It also provides more precise delineation of the relationship between tumors and major vascular and biliary structures [5].

In addition, Doppler flow capability allows accurate vessel identification and facilitates assessment of the tumor–vessel interface [2].

Patients and methods

From March 2004 to March 2007, 55 patients with potentially resectable hepatic focal lesions based on preoperative ultrasonography (3.5 MHz curvilinear probe with Color Doppler mode) and triphasic spiral CT (with IV sodium diatrizoate or meglumine diatrizoate iodinated contrast media) were candidates for exploratory laparotomy. All 55 cases were reevaluated prior to surgery using laparoscopy and laparoscopic ultrasound. The data obtained from laparoscopy and laparoscopic ultrasound were compared to those obtained by the pre-
Laparoscopic ultrasound

rior mesenteric veins was identified, and the splenic vein was followed to the left. Doppler flow capability was used to assess the relationship between the tumors and the vessels in order to assess resectability. It was also used to exclude the presence of portal vein thrombosis.

In all cases, laparoscopy and laparoscopic ultrasound were preformed and the findings were interpreted, documented by the surgeon and compared with the preoperative imaging data. In cases where the findings agreed with the preoperative imaging data, the planned surgical procedure was carried out; but when laparoscopy and laparoscopic ultrasound disagreed in staging, the management was accordingly altered. Inoperability was decided in patients demonstrating extra hepatic tumor spread, bilobar or multiple and multifocal tumor deposits. In all cases laparoscopy and laparoscopic ultrasound staging procedure were completed within a time range of 30 min to 1 h.

Results

Our study was carried out on 55 patients (32 males and 23 females), their ages ranged between 27 and 69 years (median age 56). All patients were scheduled for hepatic resection; however the decision was altered in 14 patients (25.45%), who were understaged by the conventional preoperative imaging techniques, thus would not benefit from the surgical resection (see Tables 1 and 2).

Laparoscopic ultrasound detected all the lesions identified by the preoperative imaging techniques, and in addition 26 more lesions, which were missed by the abdominal ultrasound and the CT scan in 7 out of these 14 patients (50%).

In 5 out of the 14 patients (36%), satellites around the tumor and peritoneal deposits were identified by laparoscopy and missed by the preoperative imaging techniques Fig. 1.

One patient developed ascites during the time period that lapsed between the preoperative imaging studies and the laparoscopic assessment, and one patient who was falsely diagnosed as hepatic malignant tumor, proved to have an abscess, which was aspirated through ultrasound guidance (Fig. 2). The undetected lesions ranged in size from 4 to 38 mm in diameter (median 18 mm). Fifty percent (13 out of 26) were less than 1 cm, 34.6% (9 out of 26) were from 1 to 2 cm and 15.4% (4 out of 26) ranged from 2 to 3 cm. The majority of these missed lesions were subcentimetric. The minimal diameter detected by abdominal ultrasound was 19 mm, and by CT was 15 mm, however laparoscopic ultrasound detected lesions as small as 4 mm in diameter.

The patient with newly discovered lesions in Fig. 3 had 2 hepatic focal lesions shown in the left lobe by the CT while after application of laparoscopic ultrasound up to 7 new lesions were detected, which would have been missed (see Fig. 4).

Discussion

Laparoscopy and laparoscopic ultrasonography are ideally suited for staging and assessment of potentially resectable hepatic lesions; they are more accurate than conventional preoperative radiological modalities.

Transabdominal ultrasonography is highly operator dependent and technical difficulties presented by obesity, bowel gas, and concealment of the liver beneath the rib cage may further restrict the ability of the ultrasonographer to detect small hepatic lesions. The overall experience in defining small hepatic focal lesions has been variable, with sensitivities ranging from 20% to 76% in the detection of colorectal liver metastases [6]. In laparoscopic ultrasonography, avoidance of the acoustic attenuation caused by interposed tissues may be achieved by placing the ultrasound probe directly in contact with the liver capsule, thus permitting the use of higher frequency ultrasound probes that provide images of correspondingly higher resolution [7].

In their prospective study comparing intraoperative hepatic ultrasound with conventional preoperative imaging modalities in patients undergoing resection of colorectal liver metastases, Clarke and colleagues reported that not only in laparoscopic ultrasound had 25% to 35% additional lesions been detected compared with trans-abdominal ultrasound and CT, respectively, but also that 40% of liver tumors defined by operative ultrasound had not been visible or palpable at surgery [8].

However, the principal imaging methods used in the assessment of liver tumors are based on CT scanning, the sensitivity of which varies with the type of contrast enhancement used and its method of administration. Bolus dynamic CT, delayed CT, and iodized oil emulsion-enhanced CT have all shown fallacies in the evaluation of colorectal liver metastases with overall sensitivities ranging from 38% to 94%, falling to 0% to 61% when identifying lesions measuring less than 10 mm [6]. Despite its apparent sensitivity, CTAP has been associated with false-positive findings because of intraperitoneal perfusion defects in 15–40% of cases [9].

Laparoscopic needle biopsy is not routinely attempted in patients considered to have potentially resectable lesions, because needle-track seeding of liver malignancies to the parietals is a well-documented and probably under-reported phenomenon [10]. Laparoscopic ultrasound with guided biopsy may be useful in establishing the benign nature of small regenerating cirrhotic nodules in patients, avoiding the need for operative assessment [11].

Table 1 Causes of inoperability in the 14 patients with hepatic focal lesions, who were understaged by the conventional preoperative imaging techniques, and thus did not undergo surgical resection.

<table>
<thead>
<tr>
<th>Reason for inoperability</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellites &amp; Peritoneal deposits (S &amp; PD)</td>
<td>5</td>
</tr>
<tr>
<td>Newly discovered parynchematous lesions (NDPL)</td>
<td>7</td>
</tr>
<tr>
<td>Ascites</td>
<td>1</td>
</tr>
<tr>
<td>Liver abscess</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2 Number of lesions detected by each device in the previous 7 patients that were missed by the abdominal ultrasound and the CT scan.

<table>
<thead>
<tr>
<th>Patient device</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>P7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abd U/S</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CT</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lap U/S</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Common lesions</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
In our study which was carried on 55 patients initially scheduled for hepatic resection, the decision for surgical resection was altered in 14 patients (25.45%), which were understaged by the preoperative imaging techniques and therefore would not benefit from surgical resection. This technique has spared these patients unnecessary laparotomies and allowed more appropriate lines of treatment to be carried out without the need for unnecessary surgery with a non curative outcome.

Our results match the work done by Bismuth and colleagues on 210 patients with primary and secondary hepatic malignancies [12]. They reported that intraoperative ultrasound provided additional information in 35% of cases and changed the operative plan in 20%.

In our study preoperative conventional radiological investigations failed to detect 26 lesions in 7 out of the 14 patients to whom laparotomy was avoided and this agrees with the study by Foroutani and colleagues on 55 patients with a total number of 222 lesions, including primary and metastatic liver tumors. The laparoscopic ultrasound detected all 201 tumors seen on preoperative CT and detected 21 additional tumors (9.5%) in 11 patients (20.0%). These tumors missed by CT ranged in size from 0.3 to 2.7 cm. Smaller tumors tended to be missed by CT scan (28.6% of the lesions less than 1 cm,
15.8% of those 1–2 cm, 4% of those 2–3 cm, and 0% of those more than 3 cm), as did those in segments III and IV [13]. In another study conducted by Timothy et al. [14] analyzing a cohort of 50 consecutive patients who were diagnosed as having potentially resectable liver tumors in 43 patients. Laparoscopy demonstrated factors precluding curative resection in 23 patients (46%). Laparoscopic ultrasonography identified liver tumors not visible during laparoscopy in 14 patients (33%), and provided staging information in addition to that derived from laparoscopy alone in 18 of 43 patients (42%) [14].

Conclusion

Laparoscopic inspection combined with a meticulously performed laparoscopic ultrasound (LUS) shows great promise as an acceptable staging procedure for potentially resectable primary and metastatic liver tumors. All visible lesions can be subjected to biopsy under real-time ultrasound imaging, making the false-positive rate low. Patients whose disease is clearly not resectable, as determined by laparoscopic inspection and LUS, will be spared the laparotomy and possible morbidity.

References


Figure 4  Two hepatic focal lesions referred to by the preoperative imaging techniques.