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Technique and Value of Staging Laparoscopy

U. Giger M. Schäfer L. Krähenbühl

Department of Visceral and Transplantation Surgery, University of Zürich, Switzerland

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Abstract
Despite significant improvements in preoperative tumor staging due to sophisticated new imaging and interventional techniques, peritoneal tumor spread and occult liver and lymph node metastases are only detected during surgery in some patients. Newer treatment modalities using neoadjuvant regimens are only given if occult tumor spread is excluded. Diagnostic laparoscopy has therefore been introduced to prevent patients with advanced tumor disease from unnecessary laparotomy and as a diagnostic tool in neoadjuvant treatment protocols. Laparoscopic ultrasound represents an important technical improvement in diagnostic laparoscopy. The main indication for diagnostic laparoscopy is therefore exact tumor staging, especially in terms of peritoneal, liver, and lymphatic tumor spread, whereas determination of local tumor resectability is not the main issue. The aim of the current review is to summarize the technique of staging laparoscopy and to discuss its clinical value for a variety of gastrointestinal malignancies.

Introduction

Current treatment modalities for gastrointestinal tumors are focused on a precise tumor staging that determines the location and extent of the primary disease (T stage), involvement of regional lymph nodes (N stage), and the presence of distant metastases (M stage). In addition to anamnestic, clinical and laboratory findings, different radiological imaging techniques provide the most important information on the individual tumor stage. Transabdominal ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI) and, more recently, positron emission tomography (PET) are widely used. Nevertheless, the detection of peritoneal carcinomatosis and small liver metastases remains difficult. Such small lesions are best detected by direct visualization during surgical (open or laparoscopic) exploration of the abdominal cavity.

In the modern era of laparoscopy, diagnostic laparoscopy was introduced as a minimally invasive approach for the assessment of peritoneal carcinomatosis and liver metastases to prevent unnecessary laparotomy in patients with advanced tumor stage [1]. In addition, prior to the application of neoadjuvant treatment regimens, peritoneal carcinomatosis and occult liver metastasis need to be excluded. In some series, laparoscopy has been shown to decrease the incidence of unnecessary laparotomy in up to

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L. Krähenbühl, MD
Department of General Surgery
Hôpital Cantonal Fribourg
CH–1708 Fribourg (Switzerland)
Tel. +41 26 426 7200, Fax +41 26 426 7314, E-Mail kraehenbuehll@hopcantfr.ch

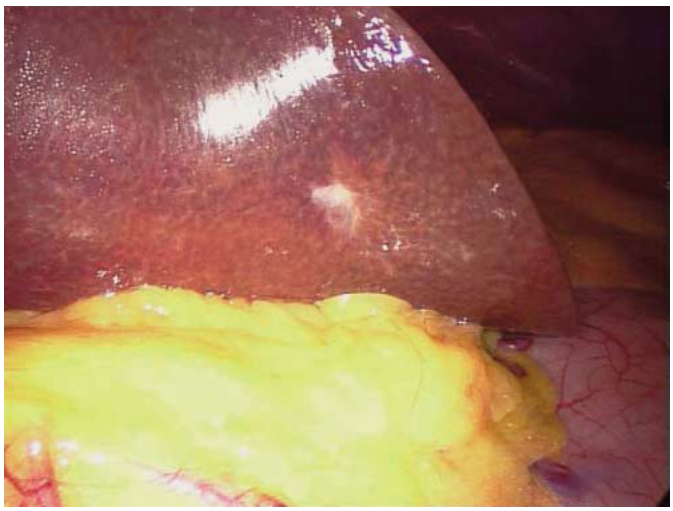

Fig. 1. Intraoperative finding of a solitary liver metastasis of the liver during staging laparoscopy.

67% of patients with intra-abdominal malignancies [2]. The sensitivity of laparoscopic tumor staging has markedly improved since endoscopic US probes have become available [3–7]. Diagnostic laparoscopy has also been used to determine the resectability of gastrointestinal tumors, in particular to assess the involvement of lymph nodes and the extent of vascular and organ infiltration. However, local tumor invasion and subsequent resectability cannot be fully determined by laparoscopic means and it is therefore not the primary goal for diagnostic laparoscopy.

The main aims of the current review are to present the technical aspects of staging laparoscopy (SL) and to assess its clinical value for a variety of gastrointestinal malignancies.

Technique of Staging Laparoscopy

SL is performed under general anesthesia and single-shot antibiotic cover. The patient is usually placed in the 'French' position where the surgeon is placed between the patient's legs. A supine position is preferred if subsequent laparotomy is planned. An angled (30- to 45-degree) camera with high resolution is preferred, and the use of two video monitors is optional. Most commonly, three trocars (one 12 mm, two 10 mm) are used and an additional 5-mm trocar may be needed for retracting the liver lobes or dissecting the lesser sac. Trocar placement predominantly depends on the intra-abdominal tumor location. Open access to the abdominal cavity is preferred using the Hasson technique, in which the first trocar is placed below the umbilicus. The two further 10-mm trocars are then placed under direct vision in the left and right upper quadrant. Patients who have had previous abdominal operations may need adapted port placement to prevent intra-abdominal injuries.

Prior to any manipulations, the entire abdomen is inspected and possible ascites should be removed for cytological assessment. Irrigation of the abdominal cavity may also be helpful. Instrumental exploration starts in the left upper quadrant. Parietal and visceral peritoneum, the greater and lesser omentum, the left liver lobe, the anterior wall of the stomach, and the spleen are carefully inspected. Visualization of the lesser curvature, lesser omentum, and cardia can easily be achieved using a retractor to lift up the left liver lobe. Inspection of the right upper quadrant includes the peritoneal surface and the right liver lobe. The inferior part of the right liver, the falciforme ligament and the gallbladder must also be visualized (fig. 1).

After exploration of the upper quadrants, the patient is brought into the Trendelenburg position, while the lower abdomen is explored. As a next step, laparoscopic US using a flexible 7.5-MHz US probe is performed assessing the target organ and liver to evaluate the extent of the primary tumor and possible liver metastasis. After complete examination of the peritoneal cavity and the liver parenchyma, the lesser sac is opened through the gastrocolic or gastrohepatic ligament and is evaluated for tumor spread. The lesser curvature of the stomach is retracted laterally to the patient's left. Retroperitoneal lymph nodes are then fully exposed.

Laparoscopic staging of distal adenocarcinoma of the esophagus or cardia requires further evaluation of the hiatus. To this end, the esophagocardial peritoneal fold is incised and afterwards bluntly dissected. Exploration of the posterior part of the hiatus can be achieved by retracting the stomach on the patient's right side.

SL of pancreatic cancer requires careful visual evaluation of the hepatic, peripancreatic, and celiac lymph nodes as well as laparoscopic US. The duodenum is assessed for tumor invasion. Masses in the pancreatic head require complete mobilization of the duodenum and pancreatic head (Kocher maneuver). The laparoscopic approach may be helpful in determining tumor proximity and tumor compression and invasion of the portal and superior mesenteric vein. US of the body and tail of the pancreas is performed after opening the lesser sac.

Table 1. Staging laparoscopy for cancer of the esophagus or cardia

	Stein et al. [10]	Molloy et al. [11]	Anderson et al. [12]	Rau et al. [13]
Patients	127	244	44	73
Found unresectable	64	92	10	39
Potentially resectable	63	152	34	34
Actually resected	58	85	33	NR
Correctly predicted resectability, %	92	56	97	NR
Avoided laparotomy	64/127 (63%)	103/244 (42%)	10/44 (22%)	39/73 (53%)

NR = Not reported.

Table 2. Staging laparoscopy for gastric cancer

	D'Ugo et al. [19]	Lowy et al. [20]	Burke et al. [21]	Possik et al. [22]	Asencio et al. [23]	Hünerbein et al. [24]
Patients	70	71	104	352	71	389
Found unresectable	18	16	32	123	29	141
Potentially resectable	52	53	71	222	42	248
Actually resected	52	38	65	111	41	233
Correctly predicted resectability, %	100	71	91	50	98	94
Avoided laparotomy	18/70 (25%)	15/71 (2 %)	24/104 (23%)	123/352 (34%)	29/71 (40%)	141/389 (36%)

Whether peritoneal, liver or lymphatic tumors should be biopsied laparoscopically is, to the best of our knowledge, not clear. Due to the increased risk of intraperitoneal tumor spread during laparoscopic tumor biopsy, our policy is not to perform any biopsy if a curative resection can be achieved. However, if chemotherapy is planned (neoadjuvant or palliative), a biopsy is needed.

Clinical Value of Staging Laparoscopy

Cancer of the Esophagus and Cardia

The presence of liver metastases, peritoneal carcinomatosis or malignant ascites in patients with esophageal and gastric cancer is considered as a strict contraindication for major resectional procedures [8, 9]. Currently used imaging techniques often fail to detect peritoneal carcinomatosis or small amounts of malignant ascites. Only direct visualization by SL can reliably close this diagnostic gap. Since the successful introduction of laparoscopic US, previously unknown hepatic metastasis or peritoneal tumor dissemination can be detected in 20–30% of patients with potentially resectable adenocarcinoma of the distal esophagus or cardia. In contrast, the diagnostic gain in patients with squamous cell esophageal cancer is lower and SL has no proven oncological benefit [10]. The addition of SL to the preoperative evaluation in patients suffering from distal adenocarcinoma of the esophagus is reported to increase the rate of curative resections, whereas the number of diagnostic laparotomies can be lowered to a rate of 20–63% [10–13] (table 1).

Gastric Cancer

In most Western countries, the majority of gastric cancers is only diagnosed at an advanced tumor stage, and thus, the curative resection rate remains low. But it is widely accepted that radical resection with tumor-free margins (R0 resection) is one of the most important prognostic factors determining long-term survival [14].

The best preoperative radiological assessment of the primary tumor and regional lymph node staging is achieved by endoscopic US (EUS). The T-stage overall accuracy for EUS is about 80% compared to 25% in CT

Table 3. Staging laparoscopy for pancreatic cancer

	Bemelman et al. [30]	John et al. [5][a]	Andren et al. [31]	Conlon et al. [32][a]
Patients	73	40	60	110
Found unresectable	12	24[b]	36	41
Potentially resectable	58	14	24	67
Actually resected	29	12	8	61
Correctly predicted resectability, %	50	86	33	91
Avoided laparotomy	13/73 (17 %)	18/40 (45%)	28/60 (46%)	141/110 (37%)

[a] Includes a small number of patients with nonpancreatic periampullary malignacies.
[b] One patient found to be unresectable at laparoscopy was found to be resectable at laparotomy.

Table 4. Staging laparoscopy for hepatobiliary disease

	Vollmer et al. [27]	John et al. [4]	Babineau et al. [33]	Barbot et al. [34]
Type of cancer	GB[a]/EHB	Liver	Liver	Liver
Patients	11[a]/23	52	29	24
Found unresectable	7[a]/4	32	14	6
Potentially resectable	4[a]/19	18	15	18
Actually resected	3[a]/16	13	11	16
Correctly predicted resectability, %	75[a]/84	72	73	89
Avoided laparotomy	7/11 (63%)[a] 4/23 (17%)	35/52 (67%)	12/29 (41%)	6/24 (25%)

GB[a] = Gallbladder; EHB = extrahepatic bile duct.

scan. The sensitivity and specificity of EUS in detecting lymph node metastases is 80 and 70% for EUS compared to 25 and 40% by CT scan, respectively [15, 16]. Liver metastases assessed with US and CT reveal a low accuracy of 65% [17]. In a recent study using diagnostic laparoscopy combined with laparoscopic US to detect peritoneal, hepatic, and nodal metastases, the overall accuracy was 94, 99, and 65%, respectively [18]. The clinical value for SL in gastric carcinoma is summarized in table 2 [19–24].

Pancreatic Cancer

Following the initial work by Cuschieri et al. [25] in 1979, laparoscopy has emerged as a new method of detecting extrapancreatic metastases in patients presumed to have localized pancreatic cancer. Favorable preliminary experience with SL in the identification of subclinical metastatic disease led to a liberal policy of performing routine laparoscopy for the staging of patients with pancreatic cancer. CT is nearly 100% accurate in predicting local nonresectability. However, multiple studies have shown that up to 40% of patients predicted resectable by high quality CT are found to be unresectable during surgical exploration. In most instances, missed lesions are beyond the resolution of current radiological imaging. The usefulness of SL in identifying occult metastases excluding resection is reported to be up to 30%, when a detailed laparoscopic examination including inspection of the lesser sac with selective biopsies is performed [26]. Although laparoscopic US can provide further information regarding vascular invasion and lymph node involvement, particularly with respect to the celiac axis, superior mesenteric vessels, and portal vein, we do not advocate the use of laparoscopic US routinely. If the anatomic site of the tumor is situated well away from important vascular structures on CT scan, we do not routinely perform laparoscopic US. Recent data indicate that SL combined with laparoscopic US is most valuable in advanced cancer

of the pancreas head and body, and it is of little or no value in ampullary or duodenal cancer [27]. Adenocarcinoma of the pancreatic tail is notorious for often being metastatic and unresectable at the time of exploratory laparotomy, and SL has been shown to be valuable in detecting distant tumor spread [26]. The resection rate after careful SL is increased compared to conventional staging. Resection rates are reported to be as high as 75–92% [28]. The experience of SL combined with ultrasonography in the staging of pancreatic cancer is summarized in table 3 [5, 29–31].

Hepatobiliary Cancer

Several studies have shown that laparotomy can be avoided in a significant number of patients with hepatobiliary cancer when laparoscopy reveals either metastatic or nonresectable disease [4, 26, 32, 33]. SL combined with laparoscopic US and laparoscopic-guided biopsy facilitates the differentiation between benign and malignant hepatic lesions. Identification of extrahepatic tumor spread and peritoneal carcinomatosis are best detected at SL [34]. Laparoscopic US is recommended for such cases to determine local resectability (table 4).

Conclusions

The value of SL predominantly depends on the underlying diagnosis. SL is a simple and safe diagnostic tool to find or exclude peritoneal carcinomatosis and metastatic disease. The addition of laparoscopic US further increases the clinical value of SL. However, determination of local resectability is either achieved by modern imaging techniques (e.g. multi-slice CT, MRI and PET) or by open surgical exploration. SL should never be used to determine local resectability if intraoperative US is also added. A possible exception to this rule may be advanced hepatobiliary cancer. Before a neoadjuvant treatment regimen can start, any kind of metastatic disease must be excluded and a tissue specimen for histological tumor confirmation may be obtained. This process is best achieved laparoscopically.

To date, the use of SL to change treatment plans has been best applied to patients with hepatobiliary tumors, tumors of the pancreas, and stomach. There is less proven benefit for treating distal esophageal tumors and periampullary malignancies. We only perform SL selectively as an additional diagnostic tool in patients with advanced tumors who are still being considered for possible curative resection after conventional tumor staging or in cases of a neoadjuvant treatment protocol (esophagus, pancreas). If SL is performed, laparoscopic US should be used selectively to screen for occult metastases. These lesions may be biopsied under laparoscopic guidance but with the risk of increased intra-abdominal tumor spread. We believe that SL in combination with laparoscopic US is a powerful diagnostic tool for detecting those patients suffering from surgically incurable disease, but it has strong limitations in determining local resectability.

References

1 Zucker KA, Pitcher DE, Ford RS: Laparoscopic-assisted colon resection. Surg Endosc 1994; 8:8–12.
2 Ramshaw BJ, Esartia P, Mason EM, Wilson R, Duncan T, White J: Laparoscopy for diagnosis and staging of malignancy. Semin Surg Oncol 1999;16:279–283.
3 Greene FL: Laparoscopy in malignant disease. Surg Clin North Am 1992;72:1125–1137.
4 John TG, Greig JD, Crosbie JL, Miles WF, Garden OJ: Superior staging of liver tumors with laparoscopy and laparoscopic ultrasound. Ann Surg 1994;220:711–719.
5 John TG, Greig JD, Carter DC, Garden OJ: Carcinoma of the pancreatic head and periampullary region: Tumor staging with laparoscopy and laparoscopic ultrasonography. Ann Surg 1995;221:156–164.
6 Bremelman WA, van Delden OM, van Lanschott JJ, de Wit LT, Smits NJ, Fockens P, Gouma DJ, Obertop H: Laparoscopy and laparoscopic ultrasonography in staging of carcinoma of the esophagus and gastric cardia. J Am Coll Surg 1995;181:421–425.
7 Callery MP, Strasberg SM, Doherty GM, Soper NJ, Norton JA: Staging laparoscopy with laparoscopic ultrasonography: Optimizing resectability in hepatobiliary and pancreatic malignancy. J Am Coll Surg 1997;185:12–14.
8 Fink U, Stein HJ, Wilke HJ, Roder JD, Siewert JR: Multimodal treatment for squamous cell esophageal cancer. World J Surg 1995;19:198–204.
9 Siewert JR, Stein HJ: Adenocarcinoma of the gastroesophageal junction. Definition, classification and extent of resection. Dis Esophagus 1996;9:173–182.
10 Stein HJ, Kraemer SM, Feussner H, Siewert JR: Clinical value of diagnostic laparoscopy with laparoscopic ultrasound in patients with cancer of the esophagus or cardia. J Gastrointest Surg 1997;1:167–173.
11 Molloy RG, McCourtney JS, Anderson JR: Laparoscopy in the management of patients with cancer of the gastric cardia and esophagus. Br J Surg 1995;82:352–354.
12 Anderson DN, Campbell S, Park KG: Accuracy of laparoscopic ultrasonography in the staging of upper gastrointestinal malignancy. Br J Surg 1996;10:1424–1428.
13 Rau B, Hünerbein M, Reingruber B, Hohenberger P, Schlag PM: Laparoscopic lymph node assessment in pretherapeutic staging of gastric and esophageal cancer. Recent Results Cancer Res 1996;142:209–215.

14 Roder JD, Bottcher K, Siewert JR, Busch R, Hermanek P, Meyer HJ: Prognostic factors in gastric carcinoma. Results of the German Gastric Carcinoma Group Study 1992. Cancer 1993;72:2089–2097.
15 Feuerbach S: Computertomographie und Kernspintomographie; in Classen M, Siewert JR (Hrsg): Gastroenterologische Diagnostik. Stuttgart, Schattauer, 1993.
16 Nattermann C, Galbenu-Grunwald R, Nier H, Dancygier H: Endoscopic ultrasound in TN staging of stomach cancer. A comparison with computerized tomography and conventional ultrasound. Z Gesamte Inn Med 1993;48:60–64.
17 Krestin GP: Präoperative Diagnostik des Pankreaskarzinoms: Was ist notwendig und wo sind die Grenzen der Bildgebung? Swiss Surg 1996(suppl 4):21–24.
18 Stell DA, Carter CR, Stewart I, Anderson JR: Prospective comparison of laparoscopy, ultrasonography and computer tomography in the staging of gastric cancer. Br J Surg 1996;83:1260–1262.
19 D'Ugo DM, Coppola R, Persiani R, Ronconi P, Caracciolo F, Picciochi A: Immediately preoperative laparoscopic staging for gastric cancer. Surg Endosc 1996;10:996–999.
20 Lowy AM, Mansfield PF, Leach SD, Ajani J: Laparoscopic staging for gastric cancer. Surgery 1996;119:611–614.
21 Burke EC, Karpeh MS, Conlon KC, Brennan MF: Laparoscopy in the management of gastric adenocarcinoma. Ann Surg 1997;225:262–267.
22 Possik RA, Franco EL, Pires DR, Wohnrath DR, Ferreira EB: Sensitivity, specifity, and predictive value of laparoscopy for the staging of gastric cancer and for the detection of liver metastases. Cancer 1986;58:1–6.
23 Asencio F, Aguilo J, Salvador JL, Villar A, De la Morena E, Ahmad M, Escrig J, Puche J, Viciano V, Sanmiguel G, Ruiz J: Video-laparoscopic staging of gastric cancer. A prospective multicenter comparison with noninvasive techniques. Surg Endosc 1997;11:1153–1158.
24 Hünerbein M, Rau B, Hohenberger P, Schlag PM: The role of staging laparoscopy for multimodal therapy of gastrointestinal cancer. Surg Endosc 1998;12:921–925.
25 Cuschieri A, Hall AW, Clark J: Value of laparoscopy in the diagnosis and management of pancreatic carcinoma. Gut 1978;19:672–677.
26 Jimenez RE, Warshaw AL, Rattner DW, Willett CG, McGrath D, Fernandez-del Castillo C: Impact of laparoscopic staging in the treatment of pancreatic cancer. Arch Surg 2000;135:409–415.
27 Vollmer CM, Drebin JA, Middleton WD, Teefey SA, Linehan DL, Soper NJ, Eagon CJ, Strasberg SM: Utility of staging laparoscopy in subsets of peripancreatic and biliary malignancies. Ann Surg 2002;235:1–7.
28 Jimenez RE, Warshaw AL, Fernandez del Castillo C: Laparoscopy and peritoneal cytology in the staging of pancreatic cancer. J Hepatobiliary Pancreat Surg 2000;7:15–20.
29 Bemelman WA, De Wit LT, van Delten OM, Smits NJ, Obertop H, Rauws EJ, Gouma DJ: Diagnostic laparoscopy combined with laparoscopic ultrasonography in staging of cancer of the pancreatic head region. Br J Surg 1995;82:820–824.
30 Andren-Sandberg A, Lindberg CG, Lundstedt C, Ihse I: Computed tomography and laparoscopy in the assessment of the patient with pancreatic cancer. J Am Coll Surg 1998;186:35–40.
31 Conlon KC, Dougherty E, Klimstra DS, Coit DG, Turnbull AD, Brennan MF: The value of minimal access surgery in the staging of patients with potentially resectable peripancreatic malignancy. Ann Surg 1996;223:134–140.
32 Babineau TJ, Lewis WD, Jenkins RL, Bleday R, Steele GD Jr, Forse RA: Role of staging laparoscopy in the treatment of hepatic malignancy. Am J Surg 1994;167:151–155.
33 Barbot DJ, Marks JH, Feld RI, Liu JB, Rosato FEl: Improved staging of liver tumors using laparoscopic intraoperative ultrasound. J Surg Oncol 1997;64:63–67.
34 Hemming AW, Nagy AG, Scudamore CH, Edelmann K: Laparoscopic staging of intra-abdominal malignancy. Surg Endosc 1995;9:325–328.