Staging Laparoscopy in Intra-Abdominal Cancers

Sudhir Kumar Singh, Farhanul Huda,
Rajkumar Kottayasamy Seenivasagam,
and Somprakas Basu

Introduction

The treatment modalities for intra-abdominal malignancies are decided by precise tumour staging i.e. location and extent of the primary tumour, regional lymph node involvement and the presence of distant metastasis. Preoperative staging of intra-abdominal malignancy is important to assess its resectability and possibility of curative resection. The clinical stage of the tumour is determined by clinical examination along with laboratory investigations and radiological imaging. Imaging modalities like transabdominal ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI) and newer modalities like endoscopic ultrasonography (EUS) and Positron emission tomography (PET)/Hybrid PET-CT are being widely used in the assessment of intra-abdominal malignancy.

Although, the use of sophisticated imaging and interventional techniques has increased the sensitivity of tumour detection, it is still a challenge to detect peritoneal carcinomatosis and small liver metastasis. Various abdominal malignancies such as pancreatic, oesophageal and gastric cancer are prone to disseminate intraperitoneally, which remains undetected by radiological imaging. Such lesions can only be detected by direct visualization [1]. Open surgical exploration for detection of peritoneal spread cannot be justified as it unnecessarily increases the morbidity in patients with unresectable or noncurative disease.

Minimal invasive surgery has changed the face of modern surgery and is increasingly being used for diagnostic as well as therapeutic purposes. Its utility has been extended recently to the staging of intra-abdominal malignancies. In addition to

S. K. Singh · F. Huda · R. K. Seenivasagam · S. Basu (✉)
Departments of General Surgery & Surgical Oncology, All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India

D. Sharma, P. Hazrah (eds.), *Recent Concepts in Minimal Access Surgery*,
https://doi.org/10.1007/978-981-16-5473-2_10

Table 1 Advantages of staging laparoscopy

Improve accuracy of staging
Assess resectability
Decrease unnecessary exploratory laparotomy in unresectable/metastatic disease
Decrease length of hospital stay in unresectable/metastatic disease
Obtain biopsy samples
Offer palliative treatments in unresectable/metastatic disease

direct visualisation of peritoneal cavity with the laparoscope, laparoscopic ultrasound (LUS) has improved the sensitivity of staging laparoscopy (SL). It is beneficial in patients with an advanced disease as it avoids unnecessary laparotomies [2].

The main advantage of SL, therefore, is tumour staging, especially in terms of peritoneal, liver, and lymphatic tumour spread. This affects the treatment plan as peritoneal carcinomatosis and occult liver metastasis need to be excluded prior to the application of neoadjuvant treatment regimens [3]. In addition, it may be utilized as a method of obtaining tissue from solid organs like liver and lymph nodes, directed biopsy and in obtaining cytological specimens from peritoneal lavage or by fine needle aspiration technique. It is also helpful in assessment of specific lymph nodes, involvement and infiltration of adjacent organs and named vessels [4]. SL is reported to increase the rate of resectability while simultaneously decreasing non-therapeutic laparotomies and length of post-operative hospital stay in unresectable diseases [4]. However, the other view point states that laparoscopic staging, though not accurate, may only guide about resectability of the tumors [5]. In general, peritoneal carcinomatosis, liver metastasis, direct extension of tumor to adjacent structures and vascular invasion are the criteria of unresectibilty on SL [1, 3]. The avoidance of unnecessary laparotomy in intra-abdominal malignancy is the main advantage of SL as its findings may upgrade the stage of disease (Table 1).

Technique of Staging Laparoscopy

After pre-operative clinical and radiological evaluation, SL is performed under general anaesthesia. The patient is placed in supine position on the operation table which can be converted to Trendelenburg or reverse Trendelenburg position during the course of examination. This position is advisable, if subsequent laparotomy is needed. An angled (30 to 45 degree) 10 mm laparoscope is preferred with a high resolution camera while the use of two video monitors is optional. The laparoscope is introduced through midline infra-umbilical port. Access to the abdominal cavity via Hasson's technique is preferred for infra-umbilical trocar placement. Additional trocar placement depends on the area to be examined i.e. whether it is an upper or lower abdominal malignancy. These may include two or three (10 mm or 5 mm) trocars depending on the need i.e., for liver retraction or dissection of the lesser sac. These ports may also be used for the introduction of grasping forceps, palpating

probes and biopsy forceps (Fig. 1). Patients with previous abdominal surgeries may require selective port placement to prevent intra-abdominal injuries.

After creating the pneumoperitoneum using carbon dioxide insufflation and maintaining the intra-abdominal pressure at 10–12 mm of Hg, sufficient time should be given for thorough inspection of the whole abdomen before any manipulation is commenced. If ascites is present, the fluid must be collected for cytological examination (Fig. 2). Alternatively, in the absence of ascites, peritoneal lavage with 500 mL saline should routinely be performed to obtain fluid for cytological investigation. To ensure that each site of the peritoneal cavity has been appropriately

Fig. 1 Port position for staging laparoscopy

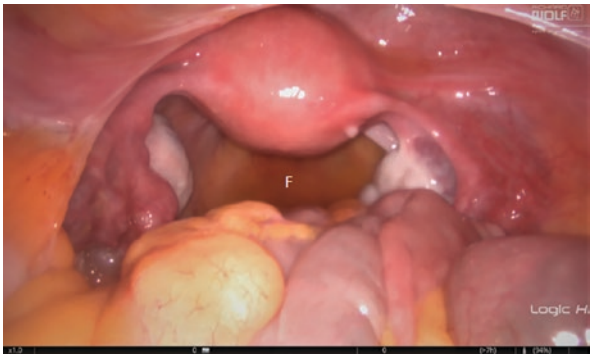

Fig. 2 Ascitic Fluid (F) in Pelvis

Fig. 3 Laparoscopic USG scanning of right lobe of liver. (Image courtesy: Dr. Deborshi Sharma)

cleaned, the operating table should be tilted to every side so that lavage fluid can reach every part of the peritoneal cavity prior to reaspiration.

Abdominal exploration needs manipulation of the viscera and it should be started from the left upper quadrant in reverse Trendelenburg position. Careful inspection of the parietal and visceral peritoneum, the greater and lesser omentum, left lobe of the liver, anterior wall of the stomach and spleen should be done. Inspection of lesser omentum and cardia can be achieved by retraction of the left lobe of liver. Sequential exploration of the right upper quadrant includes inspection of the peritoneal surfaces, right lobe of the liver (especially inferior surface of the right liver), the falciform ligament and the gallbladder. For lower abdominal exploration, the patient is positioned in Trendelenburg position and rest of the abdominal and pelvic viscera are examined subsequently.

Specific visceral exploration requires instrumentation and special manoeuvres. To evaluate peritoneal metastasis in the lesser sac, it is preferably approached by dividing the gastro colic ligament. Alternatively, it can be approached through division of the gastro hepatic ligament. For detection of deep solid visceral lesions, laparoscopic ultrasound is used with the help of a flexible ultrasound probe (7.5 MHz) which is highly sensitive as compared to other radiological imaging (Figs. 3 and 4). It is also helpful in evaluation of retroperitoneal lymph nodes and tumour invasion or its proximity to the vessels.

Clinical Applications of Staging Laparoscopy

Cancer of the Oesophagus

Even after R0 resection of oesophageal cancer, the 5-year survival is very low (range: 10–20%) [6]. However, combined modality therapy may improve the outcome of patients with operable disease [7, 8]. Accurate staging is also essential for

Fig. 4 Laparoscopic USG scanning of left lobe of liver (Image courtesy: Dr. Deborshi Sharma)

inclusion of patients in clinical trials. Choice of therapy depends upon the tumour stage e.g. T1/T2 tumour without lymphatic involvement can undergo upfront surgical resection while higher stages may require pre-operative chemo-radiotherapy followed by surgery. Patients with metastatic disease require palliative treatment [6, 8].

Imaging techniques that are being used currently have a limitation in detection of peritoneal carcinomatosis, small amount of malignant ascites and lesions smaller than 1 cm in diameter [7]. Direct visualization by SL can bridge this diagnostic gap. Thus staging laparoscopy can help detect disseminated disease and assess intra-abdominal lymph nodes. Approximately in 20–30% of potentially resectable adenocarcinoma of distaloesophagus based on imaging, upfrontsurgery can be avoided by laparoscopic staging with ultrasound as it leads to upstaging of the disease [9, 10]. SL, however, has no proven oncological benefit in squamous cell carcinoma of the oesophagus as peritoneal carcinomatosis is rare [11].

After exploration of peritoneal, visceral surface metastasis and ascitic fluid sampling, a 5 mm trocar is placed in the epigastric region for retraction of the left lobe of liver which helps in further examination of the infra-hepatic space, esophagogastric junction and hepato-duodenal ligament. For lesser sac exploration, two additional ports are needed along the anterior axillary line in mid or upper abdomen. After examination of the lower abdomen and pelvis, if there is no evidence of peritoneal spread, assessment of intra-parenchymal liver lesions and suspicious lymph nodes in the hepatoduodenal ligament and para-aortic region is done by laparoscopic ultrasound. Biopsy is performed from the suspicious lesions. The lymph nodal status in carcinoma oesophagus has a prognostic value on the outcome of the disease, so laparoscopy and LUS should focus on the celiac axis lymph nodes which is regional LN for the lower third of oesophagus while distant metastasis for upper and mid oesophageal carcinomas. Assessment of para-aortic and hepatoduodenal ligament lymph nodes must be done as their involvement is considered as distant metastasis.

Only tumours of lower third of oesophagus canbe approached by laparoscopy whereas for the assessment of upper and mid third oesophageal tumours, thoracoscopy and endoluminal ultrasonography is required. Infiltration of the diaphragm in lower oesophageal malignancy can be visualized and biopsied by laparoscopic approach. Laparoscopy improves the accuracy of clinical staging and is an integral part of the decision-making process in oesophageal cancer.

Gastric Cancer

In most patients with gastric cancer, curative resection is not possible due to detection of the cancer in advanced stage. Resection with tumour free margin i.e. R0 resection in early stage is the most important prognostic factor in gastric cancer [12]. Preoperative staging of gastric cancer consists of various modalities including clinical examination, liver function tests, CECT abdomen and endoscopic ultrasound (EUS). For T and N staging, EUS is superior to CT scan [13]. Because of limitation of imaging, the role of laparoscopy combined with LUS is of utmost importance for its staging. The reason behind this is the biology of gastric cancer which is prone to trans-peritoneal metastasis and palliative resection, leaving small peritoneal/omental metastasis and/or liver metastasis, does not improve the overall survival when compared to patients under observation alone [14] (Fig. 5). Laparoscopy plays a major role in identifying and distinguishing the patients with early disease, who can undergo upfront gastric resection and lymph node dissection from patients with a locally advanced disease who may benefit from neo-adjuvant chemotherapy or palliation.

During SL for gastric cancer, two 5 mm ports are placed in the left and right upper quadrants for ascitic fluid aspiration and saline lavage from bilateral subphrenic spaces and the pelvis. Peritoneal adhesions, if any, should be divided and thorough examination of peritoneal cavity must be carried out including both the anterior and inferior surfaces of bilateral lobes of liver, parietal peritoneum of

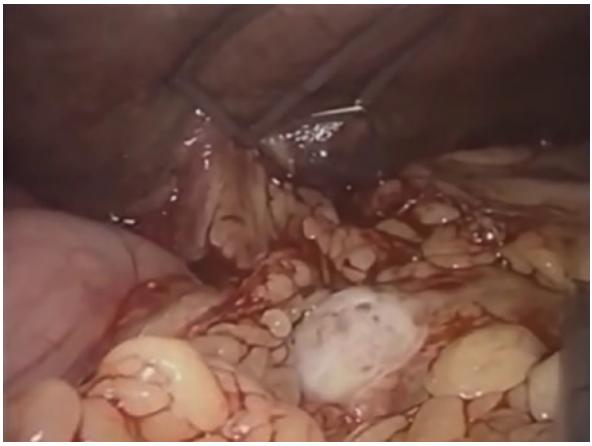

Fig. 5 Large omental deposit missed in CECT (Image courtesy: Dr. Deborshi Sharma)

diaphragm, anterior abdominal wall, pelvis, transverse mesocolon (both anterior and posterior surfaces), small bowel and the mesentery. Further assessment of deep-seated liver lesions and nodal disease along the root of the mesentery and the ligament of Treitz is carried out with the help of LUS through a 10 mm port in the right hypochondrium (Fig. 6).

Direct extension of the disease into the duodenum, liver, colon and spleen should be ruled out. Posterior extension of tumour is evaluated after opening the lesser sac. For assessment of lymph nodal status, LUS is the most accurate as it defines the abnormal lymph nodes based on their size and echotexture (Fig. 7). Once the metastatic disease is ruled out by SL, curative resection can be undertaken in the same setting whereas on detection of a metastatic disease, the patient is planned for chemotherapy. Peritoneal lavage cytology may be additionally beneficial.

As far as resectability of the tumour is concerned, immobility and adherence of the tumour and direct invasion of the pancreas are the findings that can be confirmed on laparoscopy and LUS. Manoeuvres required for this assessment are

Fig. 6 Metastatic deposit in left lobe of liver (Image courtesy: Dr. Deborshi Sharma)

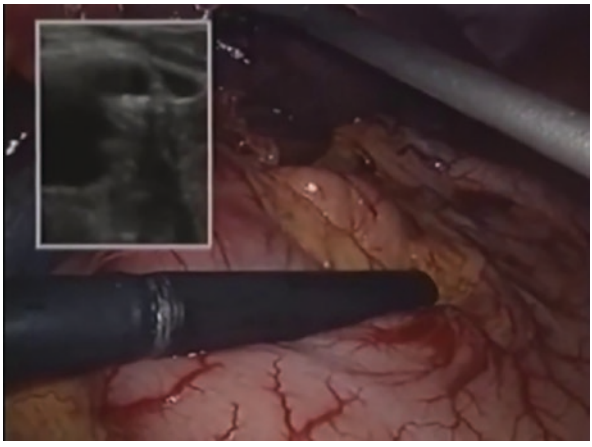

Fig. 7 Laparoscopic USG over stomach to look for retrogastric nodes (Image courtesy: Dr. Deborshi Sharma)

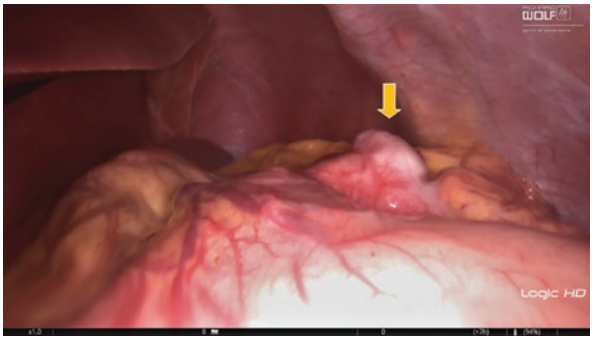

Fig. 8 Cancer deposits (Arrow) in lesser curvature of stomach

demonstration of gastric mobility with forceps, opening of lesser sac and elevation of posterior gastric wall off the surface of the pancreas. Sometimes laparoscopic staging may be compromised due to the presence of intra-abdominal adhesions and difficult manoeuvring during the assessment of transverse mesocolon and lesser sac (Fig. 8).

Pancreatic Cancer

Adenocarcinoma of pancreas is the most common histological subtype of pancreatic cancer (80% of all pancreatic cancers). It usually presents in the sixth and seventh decades [15]. Approximately 10–15% of the tumours are confined to the pancreas at the time of diagnosis where as 40% are locally advanced and 50% metastatic [16]. R0 resection is the only option for long term survival which mandates accurate staging before surgery.

Though, CT scan can fairly predict local un-resectability, approximately 40% of the patients predicted resectable on imaging are found to be unresectable during surgical exploration due to missed metastatic disease on the serosa [17]. With the help of a good quality dynamic contrast multidetector CT scan, it may be possible to differentiate between unresectable, potentially resectable and resectable tumors [18]. Findings of peritoneal, omental and hepatic metastasis, extra-pancreatic extension of tumour, invasion or encasement of the celiac axis, hepatic or superior mesenteric artery are acknowledged as criteria for unresectability. Whereas tumours with encroachment on portal and superior mesenteric veins are considered as potentially resectable [18]. Patients having potentially resectable disease or equivocal disease based on CT findings are candidates for laparoscopic staging.

The goal of laparoscopic staging is to select the patient in which curative resection will be beneficial. Sub-centimetric hepatic, peritoneal or omental deposits can be identified by laparoscopy. Additionally, peritoneal lavage fluid cytology at the time of laparoscopy can detect micrometastasis which has a poor prognosis. Apart from this, LUS can detect intra-parenchymal liver metastasis and vascular involvement. Findings of suspicious involvement of lymph nodes and vascular invasion, particularly celiac axis, superior mesenteric vessels and portal vein can be further

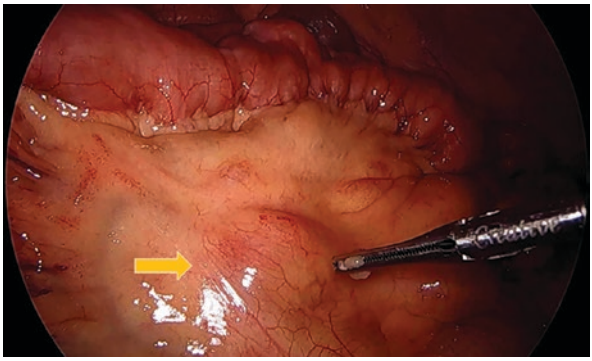

Fig. 9 Large lymph node (Arrow) at base of mesentery (Image courtesy: Dr. Deborshi Sharma)

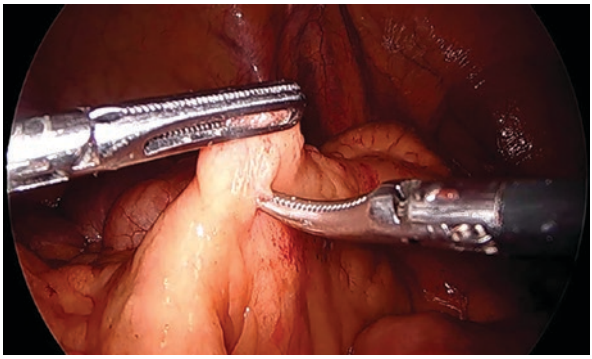

Fig. 10 Mesenteric node biopsy (Image courtesy: Dr. Deborshi Sharma)

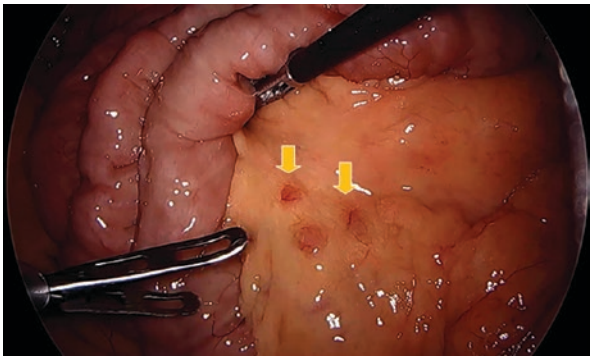

Fig. 11 Multiple lymph nodes (Arrows) near inferior border of pancreas (Image courtesy: Dr. Deborshi Sharma)

clarified on LUS (Figs. 9, 10, and 11). Combined staging with LUS is more valuable in patients with advanced cancer of the pancreatic head and body as compared to patients with peri-ampullary cancers. Adenocarcinoma of pancreatic tail is notorious for being metastatic and unresectable at presentation; thus, SL is beneficial

particularly for detection of distant metastasis in these tumours. Nevertheless, SL should not be considered as an alternative to high quality imaging.

SL for pancreatic cancer is done by using three ports; an umbilical port for telescope and two additional ports in the right and left upper quadrant. Positioning of the trocar should be in such a way that if laparotomy is required, these can be included in the incision line (rooftop incision). Specific manoeuvre for pancreatic tumours is done by placing the ultrasound probe along the pylorus and following the duodenal convexity. In addition, relationship of the adjacent vessels with the tumour can be identified. The only limitation of SL is difficulty in creation of a prophylactic bypass in the same setting for anticipated subsequent biliary or gastric outlet obstruction. Biliary obstruction can be dealt with non-operative intervention such as endoscopic stenting. Nowadays, technique of laparoscopic biliary bypass and gastroenterostomy is well established. Proponents of laparoscopic staging suggest that patients with unresectable disease should undergo non-operative palliative interventions only when necessary.

Hepatobiliary Cancer

Complete resection is the only potential curative management of primary hepatobiliary malignancy and is beneficial only if there is no distant metastasis and there is adequate functional hepatic reserve after hepatic resection [19]. The aim of preoperative staging is to identify the patients who can undergo curative resection and to rule out factors which preclude the resection like metastasis, concomitant hepatic disease and vascular invasion. The incidence of hepatocellular cancer has increased in recent times due to increasing incidence of chronic hepatitis [20]. In comparison to primary hepatocellular cancer, metastatic disease of liver remains a more common indication for SL. Most of the primary tumours involve the surface of the liver, hence laparoscopic assessment becomes important. A three-trocar technique i.e., an umbilical port for laparoscope and two additional ports in the left and right upper quadrantsare used for hepatic assessment. Sometimes division of triangular ligament may be required for proper examination of the superior surface of liver. The characteristics of hepatic lesions on laparoscopy are nodularity or a depressed/umbilicated lesion with hyperaemia due to increased vascularity, giving a volcano-like appearance (Fig. 6). The lesion may be biopsied using a core needle or cup forceps and haemostasis is achieved with the help of electrocautery along with pressure (Fig. 12). LUS and LUS-guided biopsy can facilitate the difference between benign and malignant hepatic lesions. Along with identification of features suggestive of unresectability like diffuse lesions in both lobes and presence of extrahepatic disease, laparoscopy can identify a cirrhotic liver which may be a contraindication for major hepatic resection.

Fig. 12 Punch Biopsy being taken from superficial liver metastasis using biopsy forceps (Image courtesy: Dr. Deborshi Sharma)

Gynaecologic Cancer

Most gynaecological cancers, except cervical and vaginal, are staged surgically. In the past, staging was performed by laparotomy but with the advent of minimal invasive surgery, laparoscopic staging of these cancers has gained popularity.

Carcinoma Cervix

Approximately 85% of cervical cancers occur in developing countries, where the resources are limited. As a result, its staging is mainly dependent on clinical examination while expensive investigations like CT, MRI and PET-CT are not considered mandatory. Even though lymph node metastasis is not included in the FIGO staging of Carcinoma cervix, being an independent prognostic factor, lymphadenectomy forms an integral part of the treatment of cervical cancer. The accuracy of CT, MRI or PET-CT in detecting lymph node metastases is variable and the decision of lymphadenectomy cannot be relied on these investigations. A systematic review showed that 4%–35% of histologically proven para-aortic lymph node metastasis was missed by CT, MRI or PET-CT. On the other hand, laparoscopic staging can allow direct assessment of the lymph nodes in patients presenting with an early disease. The mainstay of treatment in advanced cervical cancer is chemo-radiation. Thus, by staging laparoscopy, the knowledge of the extent of lymph node involvement can avoid unnecessary extended-field radiotherapy [21–23].

Carcinoma Endometrium

Laparoscopy in endometrial malignancies helps in collecting peritoneal washings for cytology which has a prognostic significance in this malignancy along with detection of lymph node involvement and need for lymphadenectomy. The need of omentectomy can also be decided by laparoscopy [24, 25].

Table 2 Staging Laparoscopy Recommendations

• SL is done to identify any local, regional or distant spread of the disease that would adversely affect the plan of curative resection.
• SL should be performed in an orderly manner. Biopsy should be taken from suspicious lesions and cytology of ascitic fluid, if present, should also be done.
• According to the National Comprehensive Cancer Network (NCCN) Guidelines, SL is useful in patients with adenocarcinoma of the intra-abdominal part of oesophagus.
• According to the consensus based guidelines from the NCCN, preoperative SL for gastric cancer can be done in a medically fit patient who appears to have more than a T1 lesion on EUS, no histologic confirmation of stage IV disease, and who would otherwise not require a palliative gastrectomy because of symptoms.
• In pancreatic adenocarcinoma, SL to rule out metastases not detected by imaging (especially of body and tail regions) is used in some institutions prior to surgery or chemo-radiation or selectively in patients with high risk of disseminated disease (borderline resectable disease, markedly elevated CA19-9, larger primary tumours or large regional lymph nodes). Intraoperative Ultrasound can be used as an adjunct to SL. Positive cytology obtained from peritoneal washings is considered as M1 disease.
• In retrospective and prospective studies, the overall yield of detecting unresectable biliary tract cancer using SL ranges from 24 to 48 percent. The yield is greater for gall bladder cancer (48 percent) as compared to cholangiocarcinoma (24 percent). SL is recommended for patients with gall bladder cancers and proximal cholangiocarcinoma but not for distal biliary cancers.
• SL in colorectal cancers is used very infrequently as resection of primary lesion is necessary in most patients to control or avoid bleeding and/or obstruction. The role of SL is in limited metastatic disease to the liver, which can be resected with curative intent.
• The role of laparoscopic staging in stage III-IV ovarian carcinoma is uncertain. Laparoscopic scoring based upon parameters such as omental cake, peritoneal and diaphragmatic carcinomatosis, mesenteric retraction, bowel and stomach infiltration and superficial metastasis in spleen and/or liver has been proven to be accurate in predicting resectability in advanced ovarian cancers and it could avoid unnecessary up front laparotomy.

Carcinoma Ovary

Laparoscopic staging in ovarian malignancy is important as 16–39.5% of apparently early-stage ovarian cancers are upstaged after a staging procedure. Laparoscopic scoring using parameters such as omental caking, peritoneal and diaphragmatic carcinomatosis, mesenteric retraction, bowel and stomach infiltration and spleen and/or liver superficial metastasis has proved accurate in predicting resectability in advanced ovarian cancers.

It could also avoid unnecessary up front laparotomies, which might otherwise result in suboptimal debulking [26, 27] (Table 2).

Conclusion

Staging laparoscopy is a simple and safe diagnostic tool to exclude metastatic disease. With laparoscopic ultrasound, the clinical value of SL has further increased. It increases the resectability rates, decreases non-therapeutic laparotomies and

decreases the length of post-operative hospital stay in patients with advanced disease. Staging laparoscopy can help select those patients who would actually benefit from neoadjuvant treatment, by upstaging the disease identified as early stage on clinical and radiological staging. Another great advantage of SL is the palliative laparoscopic procedures in patients with unresectable disease. Its disadvantages include requirement of general anaesthesia and limited role in assessment of vascular invasion.

Key Clinical Points

1. Main indication for SL is to improve accurate staging by helping in detecting peritoneal, omental, liver and lymphatic spread.
2. SL per se in esophageal cancers is primarily beneficial for adenocarcinomas particularly of the lower third esophagus, and its role in squamous cell carcinoma is limited.
3. Thoracoscopy in addition to laparoscopy is of additional benefit in staging esophageal malignancies.
4. SL along with LUS and peritoneal lavage cytology is beneficial in gastric cancers to detect metastatic disease.
5. Presence of dense adhesions can limit assessment in SL, particularly of the lesser sac region.
6. SL along with laparoscopic sonography is useful for the detection of sub centimetric tumor deposits on liver, peritoneum and omentum.
7. Detection of vascular involvement particularly of the coeliac axis, superior mesenteric and portal venous system with SL can determine unresectability in pancreatic adenocarcinoma.
8. SL is more useful in pancreatic head cancers as compared to periampullary cancers.
9. SL should not be considered as an alternative to high quality imaging in pancreatic cancers.
10. SL is beneficial in determining the resectability of hepatocellular cancers.
11. SL facilitates identification of extrahepatic disease, bilobar involvement and cirrhosis.
12. Metastatic liver disease is the most common indication for hepatic assessment in staging laparoscopy.
13. SL useful in assessment of para-aortic lymph node status in cervical cancer.

Editor's Note[1]

Clinical staging of malignancies has been traditionally limited to non-operative techniques viz: history, physical examination, imaging and endoscopy. Staging laparoscopy until lately was not a recommended modality of clinical staging in malignancies, however recently its incorporation has been envisaged in selective patient subgroups.

Objective of staging laparoscopy: The main objective of staging laparoscopy is to assess resectability and rule out peritoneal, omental, superficial visceral and other intrabdominal metastasis which often eludes detection by current imaging modalities. In addition, it provides an opportunity to obtain tissue diagnosis from primary and metastatic lesions as also lymph node sampling particularly in situations where previous core biopsy was not possible or inconclusive. It also aids in evaluation of ascites in patients with malignancy. Any consequent upstaging of the disease can help avoid unnecessary laparotomy in borderline resectable cases or high-risk patients and procedures, thus minimizing morbidity and mortality. The relatively painless quick recovery after staging laparoscopy aids in early initiation of adjuvant/neoadjuvant treatment when compared with conventional laparotomy. Additionally, other surgical procedures like splenectomy and oopheropexy in lymphoma and insertion of an enteral tube for feeding or palliative procedures can be done when indicated. With the availability of adjuncts like laparoscopic ultrasound the diagnostic accuracy of detection of liver lesions has improved over and above other imaging techniques. Staging laparoscopy should be considered as an additional tool to help staging and not an alternative to high quality imaging.

Contraindication: Strong contraindications to use of staging laparoscopy are:

1. Patients unfit for general anaesthesia
2. Distant metastasis has been confirmed by imaging techniques and biopsy not necessary/available.
3. Dense intrabdominal adhesions

Other relative contraindications are patients in whom a laparotomy is indicated viz: Patients with early-stage malignancy or in advanced disease where a surgical palliation is essential (for example in intestinal obstruction or gastrointestinal haemorrhage), due to its lack of perceived benefits and non-metastatic borderline resectable tumours where upfront neoadjuvant chemotherapy is planned.

Disadvantages: The noted disadvantages are:

1. The inherent risks of laparoscopic access and pneumoperitoneum
2. Procedure- and anaesthesia-related complication
3. False negative results may lead to unnecessary laparotomy
4. When staging laparoscopy is planned in separate sitting then there may be a delay in definitive treatment
5. In situations where the yield is low it can add to unnecessary cost

[1] References: Main chapter references are included after the "References Editor's Note" section.

6. Potential adverse oncologic effects of the procedure viz: peritoneal dissemination, port site inoculation, cyst rupture etc.

Opposition: Detractors of the procedure have put forth that with the availability of recent imaging techniques a high accuracy has been achieved in detection of distant metastasis and additional staging laparoscopy may be of limited benefit [1].

Adjuncts: Different Adjunctive techniques have been used to detect peritoneal hepatic and lymphnode metastasis as well as vascular invasion [2–6].

Adjuncts used in staging laparoscopy to increase yield

1. Laparoscopic USG
2. Lavage Cytology + RTPCR (e.g., for carcinoembryonic antigen)
3. Near Infra-red Fluorescence Laparoscopy/Indocyanine Green Fluorescence
4. Five aminolevulinic acid Fluorescence
5. Fluorescent antibody imaging

Though most studies on fluorescence laparoscopy reported are in experimental models' literature in clinical scenariosare emerging.

Results of meta-analysis of trials evaluating staging laparoscopy in various abdominal malignancies have been tabulated in Table EN1 [7–16].

Table EN1 The results of trials evaluating staging laparoscopy in gastrointestinal and hepatobiliary and gynaecological malignancies [7–16]

Authors/year Type of data	Type of malignancy	Outcome of SL
Convie L/2015 Prospective collected data [7]	Esophagogastric cancer	Macroscopic metastasis detected in esophageal adenocarcinoma (11.8%) & gastric adenocarcinoma (22.6%). Positive peritoneal cytology is similar in both types of malignancy
Ramos RF, 2016 Meta-analysis [8]	Gastric cancer	Sensitivity 84.6%, specificity 100% for detection of peritoneal metastasis
Hariharan D, 2010 Meta-analysis [9]	Hepatobiliary malignancy	Sensitivity in detection of metastasis in 1. Pancreatic cancer: Liver metastasis 88%, peritoneal metastasis 92% 2. Proximal biliary cancer: Liver metastasis 83%, peritoneal metastasis 93%
Coelen R JS, 2016 Meta-analysis [10]	Perihilar cholangiocarcinoma	Diagnostic accuracy of staging laparoscopy with reference to sensitivity for detection of unresectable disease 52.2%

(continued)

Table EN1 (continued)

Authors/year Type of data	Type of malignancy	Outcome of SL
Tian Y, 2017 Metaanalysis [11]	Gall bladder and hilar cholangiocarcinoma	Detection of unresectable disease in: Gall bladder cancer: 27.6%, 0.642 (95% CI: 0.579–0.701) Hilarcholangiocarcinoma: 32.4%, 0.556 (95% CI: 0.495–0.616) Pooled specificity for the SL was 100% (95% CI: 0.993–1.000) for all studies
Ta R, 2019 Metaanalysis [12]	Pancreatic cancer	Of patients deemed resectable in imaging 20% (range:14%–38%) had unresectable disease. Among patients with locally advanced disease in imaging 36% were detected to have metastasis. Failure rate to detect non resectable disease was 5%
Bastiaenen VP, 2019 COLOPEC 2 multicentre randomized trial [13]	Colonic cancer pT4 second look/third look laparoscopy	Peritoneal metastasis detected in second look: 10% & third look: 10%
Park HJ, 2013 Meta-analysis [14]	Early-stage ovarian cancer	Reported lower blood loss, upstaging in 22.6% and conversion in 3.7%
Lu Y, 2015 Meta-analysis [15]	Comprehensive staging for early-stage ovarian cancer	Less blood loss, shorter hospital stay, lower recurrence in laparoscopic group. One study showed lower incidence of tumor rupture in laparoscopy group
Bogani G, 2017 Meta-analysis [16]	Surgical staging in early-stage ovarian cancer	In laparoscopy a longer operative time (weighted mean difference [WMD] = 28.3 min; 95% [CI], −2.59 to 59.2), a lower blood loss (WMD = −156.5 mL; 95% CI, −216.4 to −96.5), a shorter hospital stay (WMD = −3.7 days; 95% CI, −5.2 to −2.1), and a lower postoperative complication (odds ratio [OR] = 0.48; 95% CI, 0.29–0.81), shorter time to chemotherapy (WMD = −5.16 days; 95% CI, −8.68 to −1.64) than laparotomic procedures. Upstaging (OR = 0.81; 95% CI, 0.55–1.20) and cyst rupture (OR = 1.32; 95% CI, 0.52–3.38) were similar

References for Editor's notes

1. Guidelines for diagnostic laparoscopy. https://www.sages.org/publications/guidelines/guidelines-for-diagnostic-laparoscopy/.
2. Handgraaf HJM, Sibinga Mulder BG, ShahbaziFeshtali S, Boogerd LSF, van der Valk MJM, FariñaSarasqueta A, Swijnenburg RJ, Bonsing BA, Vahrmeijer AL, Mieog JSD. Staging laparoscopy with ultrasound and near-infrared fluorescence imaging to detect occult metastases of pancreatic and periampullary cancer. PLoS One. 2018;13(11):e0205960. https://doi.org/10.1371/journal.pone.0205960.
3. Murayama Y, Ichikawa D, Koizumi N, Komatsu S, Shiozaki A, Kuriu Y, Ikoma H, Kubota T, Nakanishi M, Harada Y, Fujiwara H, Okamoto K, Ochiai T, Kokuba Y, Takamatsu T, Otsuji E. Staging fluorescence laparoscopy for gastric cancer by using 5-aminolevulinic acid. Anticancer Res. 2012;32(12):5421–7.
4. Jamel S, Markar SR, Malietzis G, Acharya A, Athanasiou T, Hanna GB. Prognostic significance of peritoneal lavage cytology in staging gastric cancer: systematic review and meta-analysis. Gastric Cancer. 2018;21(1):10–8. https://doi.org/10.1007/s10120-017-0749-y.
5. Yoon H, Lee DH. New approaches to gastric cancer staging: beyond endoscopic ultrasound, computed tomography and positron emission tomography. World J Gastroenterol. 2014;20(38):13783–90. https://doi.org/10.3748/wjg.v20.i38.13783.
6. Shirakawa S, Toyama H, Kido M, Fukumoto T. A prospective single-center protocol for using near-infrared fluorescence imaging with indocyanine green during staging laparoscopy to detect small metastasis from pancreatic cancer. BMC Surg. 2019;19(1):165. https://doi.org/10.1186/s12893-019-0635-0.
7. Convie L, Thompson RJ, Kennedy R, Clements WD, Carey PD, Kennedy JA. The current role of staging laparoscopy in oesophagogastric cancer. Ann R Coll Surg Engl. 2015;97(2):146–50. https://doi.org/10.1308/003588414X14055925061270.
8. Ramos RF, Scalon FM, Scalon MM, Dias DI. Staging laparoscopy in gastric cancer to detect peritoneal metastases: a systematic review and meta-analysis. Eur J Surg Oncol. 2016;42(9):1315–21. https://doi.org/10.1016/j.ejso.2016.06.401.
9. Hariharan D, Constantinides VA, Froeling FE, Tekkis PP, Kocher HM. The role of laparoscopy and laparoscopic ultrasound in the preoperative staging of pancreatico-biliary cancers--a meta-analysis. Eur J Surg Oncol. 2010;36(10):941–8. https://doi.org/10.1016/j.ejso.2010.05.015.
10. Coelen RJ, Ruys AT, Besselink MG, Busch OR, van Gulik TM. Diagnostic accuracy of staging laparoscopy for detecting metastasized or locally advanced perihilar cholangiocarcinoma: a systematic review and meta-analysis. Surg Endosc. 2016;30(10):4163–73. https://doi.org/10.1007/s00464-016-4788-y.
11. Tian Y, Liu L, Yeolkar NV, Shen F, Li J, He Z. Diagnostic role of staging laparoscopy in a subset of biliary cancers: a meta-analysis. ANZ J Surg. 2017;87(1–2):22–7. https://doi.org/10.1111/ans.13762.

12. Ta R, O'Connor DB, Sulistijo A, Chung B, Conlon KC. The role of staging laparoscopy in resectable and borderline resectable pancreatic cancer: a systematic review and meta-analysis. Dig Surg. 2019;36(3):251–60. https://doi.org/10.1159/000488372.
13. Bastiaenen VP, Klaver CEL, Kok NFM, de Wilt JHW, de Hingh IHJT, Aalbers AGJ, Boerma D, Bremers AJA, Burger JWA, van Duyn EB, Evers P, van Grevenstein WMU, Hemmer PHJ, Madsen EVE, Snaebjornsson P, Tuynman JB, Wiezer MJ, Dijkgraaf MGW, van der Bilt JDW, Tanis PJ. Second and third look laparoscopy in pT4 colon cancer patients for early detection of peritoneal metastases; the COLOPEC 2 randomized multicentre trial. BMC Cancer. 2019;19(1):254. https://doi.org/10.1186/s12885-019-5408-8.
14. Park HJ, Kim DW, Yim GW, Nam EJ, Kim S, Kim YT. Staging laparoscopy for the management of early-stage ovarian cancer: a metaanalysis. Am J Obstet Gynecol. 2013;209(1):58.e1–8. https://doi.org/10.1016/j.ajog.2013.04.013.
15. Lu Y, Yao DS, Xu JH. Systematic review of laparoscopic comprehensive staging surgery in early stage ovarian cancer: a meta-analysis. Taiwan J Obstet Gynecol. 2015;54(1):29–38. https://doi.org/10.1016/j.tjog.2014.10.003.
16. Bogani G, Borghi C, Leone Roberti Maggiore U, Ditto A, Signorelli M, Martinelli F, Chiappa V, Lopez C, Sabatucci I, Scaffa C, Indini A, Ferrero S, Lorusso D, Raspagliesi F. Minimally invasive surgical staging in early-stage ovarian carcinoma: a systematic review and meta-analysis. J Minim Invasive Gynecol. 2017;24(4):552–62. https://doi.org/10.1016/j.jmig.2017.02.013.

References

1. Metcalfe MS, Maddern GJ. Laparoscopic staging of upper gastrointestinal malignancy. ANZ J Surg. 2003;73(10):782–3. https://doi.org/10.1046/j.1445-2197.2003.02788.x.
2. Zucker KA, Pitcher DE, Martin DT, Ford RS. Laparoscopic-assisted colon resection. Surg Endosc. 1994;8(1):12–8. https://doi.org/10.1007/BF02909486.
3. Giger U, Schäfer M, Krähenbühl L. Technique and value of staging laparoscopy. Dig Surg. 2002;19(6):473–8. https://doi.org/10.1159/000067599.
4. Velanovich V. Staging laparoscopy in the management of intra-abdominal malignancies. Surgery. 1998;124(4):773–81. https://doi.org/10.1067/msy.1998.91270.
5. Ramshaw BJ. Laparoscopic surgery for cancer patients. CA Cancer J Clin. 1997;47(6):327–50. https://doi.org/10.3322/canjclin.47.6.327.
6. Zheng Z, Cai J, Yin J, Zhang J, Zhang ZT, Wang KL. Transthoracic versus abdominal-transhiatal resection for treating Siewert type II/III adenocarcinoma of the esophagogastric junction: a meta-analysis. Int J Clin Exp Med. 2015;8(10):17167–82.
7. Tirumani H, Rosenthal MH, Tirumani SH, Shinagare AB, Krajewski KM, Ramaiya NH. Esophageal carcinoma: current concepts in the role of imaging in staging and management. Can Assoc Radiol J. 2015;66(2):130–9. https://doi.org/10.1016/j.carj.2014.08.006.
8. Napier KJ, Scheerer M, Misra S. Esophageal cancer: a review of epidemiology, pathogenesis, staging workup and treatment modalities. World J Gastrointest Oncol. 2014;6(5):112–20. https://doi.org/10.4251/wjgo.v6.i5.112.
9. Krasna MJ, Jiao X. Thoracoscopic and laparoscopic staging for esophageal cancer. Semin Thorac Cardiovasc Surg. 2000;12(3):186–94. https://doi.org/10.1053/stcs.2000.9669.
10. de Graaf GW, Ayantunde AA, Parsons SL, Duffy JP, Welch NT. The role of staging laparoscopy in oesophagogastric cancers. Eur J Surg Oncol. 2007;33(8):988–92. https://doi.org/10.1016/j.ejso.2007.01.007.
11. Stein HJ, Kraemer SJ, Feussner H, Fink U, Siewert JR. Clinical value of diagnostic laparoscopy with laparoscopic ultrasound in patients with cancer of the esophagus or cardia. J Gastrointest Surg. 1997;1(2):167–73. https://doi.org/10.1016/s1091-255x(97)80105-9.
12. Villafranca E, Aristu J, Meiriño R, Dueñas MT, Marcos M. Prognostic factors of gastric carcinoma. Anales del Sistema Sanitario de Navarra. 2001;24:111–20. https://doi.org/10.23938/ASSN.0438.
13. Hallinan JT, Venkatesh SK. Gastric carcinoma: imaging diagnosis, staging and assessment of treatment response. Cancer Imaging. 2013;13(2):212–27. https://doi.org/10.1102/1470-7330.2013.0023.
14. Li Z, Ji J. Application of laparoscopy in the diagnosis and treatment of gastric cancer. Ann Transl Med. 2015;3(9):126. https://doi.org/10.3978/j.issn.2305-5839.2015.03.29.
15. Ryan DP, Hong TS, Bardeesy N. Pancreatic adenocarcinoma. N Engl J Med. 2014;371(11):1039–49. https://doi.org/10.1056/NEJMra1404198.
16. Sener SF, Fremgen A, Menck HR, Winchester DP. Pancreatic cancer: a report of treatment and survival trends for 100,313 patients diagnosed from 1985-1995, using the National Cancer Database. J Am Coll Surg. 1999;189(1):1–7. https://doi.org/10.1016/s1072-7515(99)00075-7.
17. 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(2):156–64. https://doi.org/10.1097/00000658-199502000-00005.
18. Furukawa H, Uesaka K, Boku N. Treatment decision making in pancreatic adenocarcinoma: multidisciplinary team discussion with multidetector-row computed tomography. Arch Surg. 2008;143(3):275–81. https://doi.org/10.1001/archsurg.2007.78.
19. 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(1):33–9.

20. Ko S, Nakajima Y, Kanehiro H, et al. Significant influence of accompanying chronic hepatitis status on recurrence of hepatocellular carcinoma after hepatectomy. Result of multivariate analysis. Ann Surg. 1996;224(5):591–5. https://doi.org/10.1097/00000658-199611000-00001.
21. Scholz HS, Lax SF, Benedicic C, Tamussino K, Winter R. Accuracy of frozen section examination of pelvic lymph nodes in patients with FIGO stage IB1 to IIB cervical cancer. Gynecol Oncol. 2003;90(3):605–9. https://doi.org/10.1016/s0090-8258(03)00398-6.
22. Lv X, Chen L, Yu H, Zhang X, Yan D. Intra-operative frozen section analysis of common iliac lymph nodes in patients with stage IB1 and IIA1 cervical cancer. Arch Gynecol Obstet. 2012;285(3):811–6. https://doi.org/10.1007/s00404-011-2038-z.
23. Marnitz S, Köhler C, Affonso RJ, et al. Validity of laparoscopic staging to avoid adjuvant chemoradiation following radical surgery in patients with early cervical cancer. Oncology. 2012;83(6):346–53. https://doi.org/10.1159/000341659.
24. AlHilli MM, Mariani A. The role of Para-aortic lymphadenectomy in endometrial cancer. Int J Clin Oncol. 2013;18(2):193–9. https://doi.org/10.1007/s10147-013-0528-7.
25. Mariani A, Dowdy SC, Cliby WA, et al. Prospective assessment of lymphatic dissemination in endometrial cancer: a paradigm shift in surgical staging. Gynecol Oncol. 2008;109(1):11–8. https://doi.org/10.1016/j.ygyno.2008.01.023.
26. Brun JL, Rouzier R, Uzan S, Daraï E. External validation of a laparoscopic-based score to evaluate resectability of advanced ovarian cancers: clues for a simplified score. Gynecol Oncol. 2008;110(3):354–9. https://doi.org/10.1016/j.ygyno.2008.04.042.
27. Fagotti A, Vizzielli G, Fanfani F, et al. Introduction of staging laparoscopy in the management of advanced epithelial ovarian, tubal and peritoneal cancer: impact on prognosis in a single institution experience. Gynecol Oncol. 2013;131(2):341–6. https://doi.org/10.1016/j.ygyno.2013.08.005.