Section: Surgery

Original Research Article

COMPARATIVE EVALUATION OF CT-BASED PREOPERATIVE STAGING WITH AND WITHOUT DIAGNOSTIC LAPAROSCOPY IN GASTROINTESTINAL MALIGNANCIES

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ABSTRACT

Background: Accurate preoperative staging of gastrointestinal (GI) malignancies is crucial for optimal management. Although contrast-enhanced computed tomography (CECT) is widely used, it has limitations in detecting occult metastases. Diagnostic laparoscopy (DL) may improve staging accuracy. The objective is to compare CT-based staging of GI malignancies with and without diagnostic laparoscopy and assess its impact on detection of metastasis and resectability.

Materials and Methods: This prospective comparative study included 40 patients with GI malignancies. All underwent preoperative CT staging. Twenty patients underwent diagnostic laparoscopy (DL group), while 20 were evaluated without DL (non-DL group). Findings regarding metastasis, staging, and resectability were compared. Statistical analysis was performed using Z-test, with $p < 0.05$ considered significant.

Results: CT scan showed lymph node involvement in 45% of patients, with no distant metastasis detected, and all cases were deemed resectable. Most patients were classified as Stage II (72.5%) ($p < 0.0001$). In the DL group, occult metastases were identified, including liver metastasis (35%), peritoneal metastasis (15%), and serosal involvement (35%). Resectability decreased to 65%, and 35% of patients were upstaged to Stage IV ($p < 0.0001$). In the non-DL group, higher rates of advanced disease were observed intraoperatively, with liver metastasis (55%), peritoneal metastasis (20%), and serosal involvement (55%). Resectability was 45%, and 55% of patients had Stage IV disease.

Conclusion: Diagnostic laparoscopy enhances detection of occult metastasis and improves staging accuracy compared to CT alone. It aids in avoiding unnecessary laparotomies and optimizes surgical decision-making in GI malignancies.

Keywords: Gastrointestinal malignancy, CT scan, diagnostic laparoscopy, staging, metastasis.

INTRODUCTION

Gastrointestinal tumors are one of the most common malignancies causing significant morbidity and mortality. Therefore, the management of patients with a gastrointestinal (GI) malignancy requires a precise diagnosis and accurate staging information for necessary treatment. Treatment approach can be curative resection, palliative procedures like resection or bypass, neo adjuvant chemotherapy in advanced cases. Although a histological diagnosis of malignancy remain the gold standard, increasingly sophisticated endoscopic and radiological imaging may enable physicians to diagnose malignancy less invasively preoperatively.

With the advent of Computed topography, it has become possible to develop a fourth system for staging malignant neoplasm as CT offers superior density discrimination, true body topography with thin slices and excellent spatial resolution. Advances in recent century about the variety of diagnostic modalities have been made and have further redefined the management of patients with gastrointestinal malignancies as in both biliary tract and alimentary system. The detail of liver and biliary tract enables the surgeon to approach operative cases with a clear understanding of the anatomy and structures in the porta hepatitis.[1,2]

The superb anatomic discrimination CT offers and the great reliability of CT interpretations makes computed tomography an ideal basis on which to formulate a system of staging a variety of malignant neoplasm. The advantages of staging malignant neoplasm by CT are demonstrated particularly well in the alimentary tube because CT, unlike intra luminal radiographic studies with barium sulphate, demonstrates the wall of the bowel rather than just the mucosal surface.

However, despite the technical advances in CT scan/CECT, MRI and many other techniques, the diagnosis of small peritoneal deposits, small hepatic metastases, regional nodal metastases and local tumour in growth is frequently made during exploratory laparotomy.[3-6]

With the rapid advancement in the instrumentation and technique, laparoscopy has gained the wide acceptance as a new important modality, along with preoperative imaging studies like CT scan, in the evaluation of GI malignancy. Diagnostic laparoscopy has become an important tool in the evaluation of patients with certain gastrointestinal malignancies. Laparoscopy helps a surgeon to diagnose and obtain information about dissemination of a disease and to diagnose patients with equivocal radiological findings. This procedure enables direct inspection of the intra abdominal organs and facilitates obtaining biopsy specimens and aspiration cytology. Diagnostic laparoscopy helps in the staging of abdominal malignancies and also helps in avoiding unnecessary laparatomies, thereby corroborating with CT scan findings in reducing morbidity and mortality and can change the course of a management to a more palliative approach.[7-11]

This study is to compare the Computed topography staging and Diagnostic Laparoscopy findings in Gastrointestinal Malignancies to identify and to prove or disprove the presence of local, regional or metastatic diseases, for curative resection or any other possible interventions

Aims and Objectives

The study aims to evaluate the role of diagnostic laparoscopy in assessing the gastrointestinal malignancies corroborating with the CT scan diagnosed non metastatic cases for getting accurate diagnosis, accurately defining the extent of the disease complementary to imaging modalities and in staging for GI Malignancies and to plan appropriate therapy and avoid unnecessary interventions.

1. To evaluate the role of diagnostic laparoscopy for staging in GI malignancies.
2. To evaluate the role of CT scan in preoperative staging of GI malignancies.
3. To assess the ability of diagnostic laparoscopy in corroborating CT scan diagnosed non metastatic cases to avoid unnecessary laparatomies.
4. To compare the outcome of intra operative findings with or without diagnostic laparoscopy in a CT guided staging of GI malignancies

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery, R.G Kar Medical College and Hospital, Kolkata, West Bengal for a period of one year. The study was carried out after obtaining approval from the Research Ethics Board, R.G Kar Medical College and Hospital. Strict confidentiality and privacy were maintained.

All patients admitted in department of General Surgery, R.G Kar Medical College and Hospital with clinical and radiological diagnosis of primary GI malignancy without distant metastasis were included in the study. Patients below 12 years of age, malignancy with radiologically proved distant metastasis (inoperable cases), non-GIT cancers like primary reproductive cancer, patients unfit for general anesthesia with associated co morbidities and unwillingness to participate and follow study protocol were excluded from the study.

As few cases were posted for diagnostic laparoscopy in the surgical OT, a total of 40 patients with preoperative CT scan without distant metastasis were included in the study of which 20 patients each were chosen randomly for diagnostic laparoscopy and without diagnostic laparoscopy.

All patients were assessed through detailed history taking, thorough clinical examination, and appropriate laboratory investigations. Radiological evaluation, particularly contrast-enhanced computed tomography (CT), was used to establish a provisional diagnosis. After obtaining informed consent, explaining the procedure and possible complications, and ensuring fitness for anesthesia, patients underwent diagnostic laparoscopy under strict aseptic precautions in the operating theatre. Pneumoperitoneum was created using carbon dioxide (8–12 mmHg), and a standard multiport technique was employed, typically with a 10 mm camera port placed infra- or supra-umbilically using the open Hasson technique, along with two or three 5 mm working ports as required.

A systematic and sequential laparoscopic examination of the entire abdomen and pelvis was performed. Peritoneal fluid or ascitic fluid, when present, was aspirated prior to manipulation; otherwise, peritoneal lavage was performed, and samples were sent for cytological examination using

Giemsa and Papanicolaou staining. The inspection included evaluation of the liver surfaces, gallbladder, diaphragm, spleen, bowel surfaces, paracolic gutters, mesentery, ligament of Treitz, lesser sac, and pelvic organs. The examination followed a structured approach involving Trendelenburg and reverse Trendelenburg positioning to ensure optimal visualization. Suspicious lesions were biopsied using laparoscopic instruments such as cupped forceps or core needle, and laparoscopic ultrasound was utilized when indicated. In selected cases, the gastrocolic omentum was divided, and the esophageal hiatus was explored, particularly in upper gastrointestinal malignancies.

Findings from diagnostic laparoscopy were documented and compared with preoperative CT findings. In the absence of unresectable or metastatic disease, patients proceeded to definitive surgical intervention (laparotomy). Postoperative assessment included evaluation of perioperative complications, recovery period, and histopathological confirmation. A meticulous and sequential evaluation of the entire abdominal cavity, with special attention to areas identified on preoperative imaging, was essential for improving diagnostic accuracy and staging.

Statistical Analysis was performed with help of Epi Info (TM) 7.2.2.2 EPI INFO is a trademark of the Centers for Disease Control and Prevention (CDC). Using this software, basic cross-tabulation, inferences and associations were performed. Chi-square test was used to test the association of different study variables. Z-test (Standard Normal Deviate) was used to test the significant difference between two proportions. T-test was used to compare the means. Diagnostic accuracy was calculated to compare the findings of different diagnostic tools. $p<0.05$ was considered to be statistically significant.

RESULTS

CT scan was performed preoperatively in all the 40 patients without distant metastasis, of which 20 patients were posted for diagnostic laparoscopy and the rest 20 had undergone operative procedure directly without diagnostic laparoscopy.

The mean age (mean ± S.D.) of the patients was 52.22±6.41 years with range 38 – 64 years and the median age was 53.5 years.

Most of the patients (87.5%) were with age ≥45 years which was significantly higher than other age group ($Z=10.60$; $p<0.0001$). Thus, gastrointestinal malignancies were mostly prevalent among the patients with age≥45 years.

The ratio of male and female (Male:Female) was 1.5:1.0. Test of proportion showed that proportion of males (60.0%) was significantly higher than that of females (40.0%) ($Z=2.82$;$p<0.0001$).

Table 1: Distribution of age and gender of the patients

Age Group (in years)	Male	Female	Total
35 - 44	2	3	5
45-54	10	8	18
55-64	12	5	17
Mean±s.d.	53.33±5.52	50.56±7.43	
Median	54.5	50.0	
Range	42 - 64	38 - 62	

x2 =1.77; p=0.41 NS-Not Significant

Corrected Chi-square (x2) test showed that there was no significant association between age and gender of the patients (p=0.41).

Though the mean of the females was lower than that of male patients, t-test showed that there was no significant difference between the mean age of male and female patients ($t38=1.35$;$p=0.17$).

Table 2: Distribution of site of gastrointestinal malignancies of the patients

Site	Number	%
Stomach	13	32.5%
GB	12	30.0%
Colon	11	27.5%
Pancreas	3	7.5%
GEJ	1	2.5%
Total	40	100.0%

Cancer in stomach (32.5%) followed by gall bladder (30.0%) and colon (27.5%) which were significantly higher than that of other Test of proportion showed that proportion of males (60.0%) was significantly higher than that of females (40.0%) ($Z=2.82$; $p<0.0001$). Thus gastrointestinal malignancies were mostly prevalent among males.

Table 3: Comparison of CT Findings, Diagnostic Laparoscopy, and Non-Diagnostic Laparoscopy Groups

Variable	CT Scan (n=40)	DL Group (n=20)	Non-DL Group (n=20)	Z value	p-value
Lymph Nodes	18 (45.0%)	—	—	1.41	0.22 (NS)
Distant Metastasis	0 (0.0%)	—	—	—	—
Liver Metastasis	—	7 (35.0%)	11 (55.0%)	1.41	0.22 (NS)
Peritoneal/Pelvic Metastasis	—	3 (15.0%)	4 (20.0%)	—	—

Serosal Involvement	—	7 (35.0%)	11 (55.0%)	1.41	0.22 (NS)
Adjacent Structure Involvement	—	—	11 (55.0%)	1.41	0.22 (NS)
Resectability	40 (100.0%)	13 (65.0%)	9 (45.0%)	4.24	<0.0001 (HS)
Stage I	11 (27.5%)	3 (15.0%)	3 (15.0%)	—	—
Stage II	29 (72.5%)	10 (50.0%)	6 (30.0%)	6.36	<0.0001 (HS)
Stage IV	0 (0.0%)	7 (35.0%)	11 (55.0%)	4.24	<0.0001 (HS)

A total of 40 patients were evaluated using contrast-enhanced CT, of which 45% demonstrated lymph node involvement; however, this was not statistically significant ($Z = 1.41$, $p = 0.22$). Notably, CT failed to detect any cases of distant metastasis, and all patients (100%) were deemed resectable based on preoperative imaging ($Z = 14.14$, $p < 0.0001$). The majority of patients were classified as Stage II (72.5%), which was significantly higher compared to Stage I disease (27.5%) ($Z = 6.36$, $p < 0.0001$).

Subsequent evaluation with diagnostic laparoscopy (DL) in 20 patients revealed a substantial proportion of occult metastatic disease not identified on CT. Liver metastasis was detected in 35% of cases, while peritoneal/pelvic metastasis and serosal involvement were observed in 15% and 35% of patients, respectively. Following DL, only 65% of patients were considered resectable, indicating a significant reduction compared to CT-based assessment ($Z = 4.24$, $p < 0.0001$). Furthermore, disease upstaging was evident, with 35% of patients categorized as Stage IV.

In contrast, among patients not undergoing diagnostic laparoscopy ($n = 20$), a higher incidence of advanced disease was observed intraoperatively, with liver metastasis present in 55%, peritoneal metastasis in 20%, and serosal involvement in 55% of cases, although these findings were not statistically significant ($Z = 1.41$, $p = 0.22$). Resectability in this group was further reduced to 45%, and a greater proportion of patients were found to have Stage IV disease (55%) compared to Stage I–II disease (45%). Overall, diagnostic laparoscopy demonstrated superior sensitivity in detecting occult metastasis and accurately assessing tumor spread compared to CT imaging. This resulted in significant stage migration and more precise determination of resectability, thereby preventing unnecessary laparotomies and optimizing patient selection for definitive surgical intervention.

Figure 1: Serosal Involvement in a Case of Carcinoma Stomach

Figure 2: Peritoneal carcinomatosis in case of stomach cancer

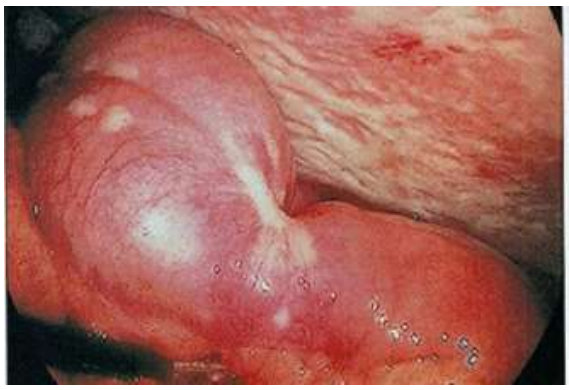

Figure 3: Jejunal stricture from a metastatic implant secondary to adenocarcinoma OE GE junction

Figure 4: CT image showing gastrointestinal tumor (marked arrows)

Figure 5: Pancreatic Cancer

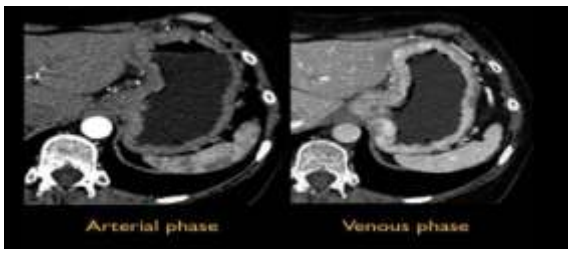

Figure 6: Gastric Carcinoma

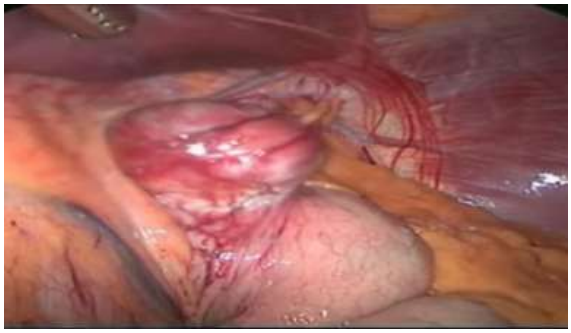
Figure 7: Gist of Stomach

DISCUSSION

This study was conducted in patients of gastrointestinal malignancies with preoperative CT scan staging and findings suggestive of a non metastatic disease and to compare it with the findings of diagnostic laparoscopy and also, when DL is not performed before surgery.

Primary locations so studied were: stomach, colon, gall bladder, gastro esophageal junction and pancreas. The patients with preoperative CT suggestive of a non metastatic disease and planned for curative treatment were considered. After receiving detailed information of the procedure and study protocols, 40 patients who had agreed for study were enrolled.

The objective of accurate staging in cases of gastrointestinal malignancies is to provide an accurate assessment of the size and extent of the primary tumor as well as identifying local and distant metastasis. In view of the increasing alternatives for neoadjuvant therapy and palliative procedures, it has increasingly become important to distinguish patients who have a potentially resectable localized tumor from those with advanced disease or distant metastasis, so to ensure that each patient receives the most appropriate treatment with minimal morbidity and in a cost effective manner.

The crux of an evaluation of any technique is in its power to produce a beneficial effect. With reference to both CT and Diagnostic laparoscopy, efficacy must be measured in terms of diagnostic contribution and the influence which this contribution has on patient management.

Since its inception, computed tomography (CT) has become a prolific diagnostic imaging tool, the speed and accuracy with which CT can be obtained to diagnose many conditions largely account for the desirability of this modality. Another advantage of CT as a tool for diagnosing malignancy is in its ability to perform CT guided biopsies accurately and safely. Diagnostic, histological and cytological specimens may be obtained in over 85% of tumours.[12,13]

In a study reported by Wittenberg et al the efficacy of body CT was measured in 623 patients. In 43, CT improved diagnostic understanding in 52% of patients, improved precision of previously planned treatment in 23%, and contributed to a change in management of 14% and 19% of previously planned surgery was avoided.[14]

Robbins et al in their study found that CT helped avoided surgery in 5% of 687 examinations.[14] In another study specifically related to patients with cancer, Male et al reported that CT provided unique diagnostic information in half of 1030 examinations of which 45 % of scans led to a change in patient management.[15]

However, there are drawbacks and limitations of CT, notably the exposure to ionizing radiation and the potential for misdiagnosis of certain diseases.[16] The lack of tissue specificity and the inability to resolve tumours below a certain size are the major constraints of CT.[17]

In this study, we have preoperative CT scan of 40 patients of different sites of GI malignancies with resectable tumours but failure in detection of distant metastasis resulted in unnecessary laparotomies.

Despite current technological sophistication, preoperative imaging methods shows significant disparity and often the results of preoperative investigations and findings at exploratory laparotomy differs. Preoperative under staging may result in the termination of a planned curative resection. With the resurgence and improvement of laparoscopy over the past the last years, this technology is evolving as an ideal tool for staging intra abdominal malignancies. Laparoscopy may be useful not only in procuring tissue for the definitive diagnosis of malignancy but also in determining the extent of the disease. Although laparoscopy is more invasive than other imaging techniques, it has more specificity and sensitivity. With the advent of LUS, the accuracy has further increased.[18]

As like other invasive diagnostic procedures, SL should be performed only when there are no available non invasive staging methods with similar or equivalent information and diagnostic yield and SL so performed provides information that is necessary and capable of changing the treatment plan. (86, 87) Staging laparoscopy is contradicted in patients with complications which should be treated with open surgery. However, since DL is an invasive procedure, chances of complications are always there. In an Indian study, Nair C K et al. reported complication rate of 25% diagnostic laparoscopy in gastrointestinal malignancies.[19]

As each of the diagnostic modalities have its own pros and cons, in this study DL and without the use of it, is evaluated as a tool for diagnosing, staging, assessment of gastrointestinal malignancies in terms of primary tumor resectabiltity, distant metastasis and

to corroborate with preoperative CT scan findings and to compare them.

All cancers combined, the age specific incidence rate rises steeply from around age 55-90 with the highest incidence in older people.[20] In present study, the mean age of the patients was 52.22±6.41 years with range 38 – 64 years and the median age was 53.5 years with gastrointestinal malignancies mostly prevalent among the patients with age≥45 years.

In studies, the incidence rates are significantly lower in males than the females in the younger age groups and higher in males in the older age groups.[21] Studies have also shown slight male preponderance for gastrointestinal malignancies.[22]

In our study, the ratio of male and female (male: female) was 1.5:1.0. Test of proportion showed that proportion of males (60.0%) was significantly higher than that of females (40.0%) and the females were in higher risk of having gastrointestinal malignancies at a younger age than that of the males.

According to site of lesion, gastric cancer is the fourth most leading cancer in India, and the third most common in men.[23] Though the incidence rectal cancer in India is lower than that in the western countries, and it is still the seventh leading cancer in India.[24] Esophageal cancer is the sixth most common cause of cancer-related deaths in India.[25]

In present study, stomach is the most common location of cancer closely followed by gall bladder and colon. Next in order are pancreas and GEJ junction. In this study size, gall bladder cancer is the 2nd most common. Maybe it is so because of high incidence of GB cancer in regions comprising Uttar Pradesh, Bihar, Orissa, West Bengal and Assam.[26]

In a study to compare between SL and CT in case of gastric cancer, 50 patients underwent a diagnostic laparoscopy after a preoperative CECT excluded any form of metastasis. At diagnostic laparoscopy, out of these 50 patients, 14 patients revealed metastasis (9 hepatic, 5 peritoneal), thus an unnecessary laparotomy was averted in 14 (28%) patients.[27]

In an effort to compare laparoscopic staging to improved CT technology, Lowy et al studied 69 patients with resectable gastric cancer who were determined by CT and found that laparoscopy identified metastatic disease in 16 (23%) of the 69 patients, only 1 of whom had required laparotomy for palliation. This approach, using CT and laparoscopy, resulted in a resectability rate of 93% in patients who underwent surgery with curative intent.[28]

In another study to evaluate the role of diagnostic laparoscopy in the management of gastro esophageal, pancreatic and colorectal cancers with operability in preoperative imaging modalities, out of the total of 70 new cases of gastro intestinal malignancies, stomach malignancies constituted 45 cases(64.3),colon malignancies 17cases(24.3) followed by pancreatic malignancies 8 cases(11.4). On staging laparoscopy, 14 cases (20%), had liver metastases, 16 cases (22.9%) had peritoneal metastases found on staging laparoscopy. Rest 54 cases had no peritoneal metastases on staging laparoscopy. In 16 cases (22.9%), ascites was found on staging laparoscopy. Out of 70, 54 were operable and 16 cases were inoperable on diagnostic laparoscopy.[29]

In the present study, 40 patients had preoperative CT with no distant metastasis (72.5% of the cases with Stage-II and 27.5% as Stage-I) and resectability of 100%. Of these, 20 patients who had undergone DL showed peritoneal metastasis in 3 patients (15%) and liver metastasis in 7 patients (65%). Staging was changed in 11 patients', of whom 7 were unresectable (35%) and 3 patients though showed a change in staging, were still resectable. The resectability was 65% instead of 100% when compared with CT findings. DL corroborated with CT findings of 9 patients'. DL had 35% with stage IV and 65% with stage I and II. Thus, unnecessary laparotomies were avoided in 7 patients (35%).

Rest 20 patients who had undergone operative procedures without DL, peritoneal metastasis were detected in 4 patients (20.0%) and liver metastasis in 11 patients (55.0%). Staging was changed in 14 patients, however 3 were still resectable. The resectability came down from 100% to 45%. 55% of the patients had stage IV diseases which were unresectable. Thus, 11 patients were subjected to unnecessary laparotomies.

Thus, my results showed the advantages of DL over preoperative CT imaging. However, in view of the small sample size and study period, it would be prudent to say that for accurate assessment of both the diagnostic modalities, much data is required.

CONCLUSION

Diagnostic Laparoscopy not only helps in the diagnosis of metastasis not detected by modern imaging techniques but by providing tissue diagnosis it helps to achieve the final diagnosis without any significant complication and less operative time, and thus, it can be safely concluded that diagnostic laparoscopy is a safe, quick, and effective adjunct to non-surgical diagnostic modalities.

In our study we have found that diagnostic laparoscopy when corroborating with pre operative imaging (CT) have detected metastasis not detected in CT thereby avoiding laparotomies not needed.

Though the routine application of diagnostic laparoscopy is not recommended by many, argue being increased chances of complications and financial risk, the morbidity of DL was acceptable. Maybe the best choice is in its selective performance based on specific indications. It can be performed just before a planned surgery to certify operability in cases of borderline resectable GI cancers and thereby, helping in avoiding unnecessary laparotomies.

In our study, CT and Diagnostic laparoscopy both served as an important tool for diagnosis but in some cases the staging was changed and the line of treatment too, thereby giving diagnostic laparoscopy a slight edge. However, the judicious and specific use

of both the diagnostic modalities have increased benefits as shown in the study.

Use of radio imaging techniques like CT and diagnostic Laparoscopy have not only revolutionized the way of approach of management of cancers but also has markedly improved research and patients quality of life.

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