

ROLE OF IMAGING IN ONCOLOGICAL EMERGENCIES RELATED TO HEPATO-PANCREATO-BILIARY, GASTROINTESTINAL AND GENITO-URINARY SYSTEMS

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Abstract- An oncologic emergency is defined as acute onset, potentially life-threatening condition that has developed due to cancer or therapy for cancer, which can be directly or indirectly related to the cancer. Cancer emergencies can present as initial presenting symptom which leads to the first-time diagnosis of malignancy or it can present as the end-stage disease. Some of these conditions can be iatrogenic that is related to cancer treatment like surgery, radiation or chemotherapy. But these complications are not confined to the period of initial diagnosis or active treatment, instead it can occur at any stage of the course of malignancy. Patients can even present with complications several years after the cancer treatment has completed. Therefore, every primary care clinician including clinical radiologist should be aware of the possible emergencies that can occur in cancer patients. Timely diagnosis of these and early intervention in these emergent conditions can prolong survival and improve the quality of life, even in patients with end stage disease.

Aims & Objectives

- ▶ To assess the role of radiological imaging in oncological emergencies of the abdomen related to Hepato-pancreato-biliary, Gastrointestinal and Genito-urinary systems.
- ▶ List the structural oncologic emergent conditions involving the abdomen and to describe the patho-physiology and characteristic cross-sectional imaging findings.
- ▶ Discuss the role of the radiologist in the early diagnosis and management of life-threatening emergent conditions in cancer patients and to categorize the common oncological emergencies encountered in our institute based on different emergency situations.

Materials and Methods: Known cancer patients presenting to the Emergency Department with an abdominal emergent condition arising out of their disease or as a result of their treatment and also those already admitted in the wards developing an emergency condition were imaged with the most appropriate modality.

Detailed clinical history including presenting symptoms, location of primary malignancy, prior treatment history including chemotherapy, radiation therapy and surgery are noted. The initial investigations for most of the patients were plain radiograph or ultrasonogram. In cases where abdominal radiographs or ultrasonogram were inconclusive, further imaging was done with either plain or contrast enhanced CT or MRI depending on the suspected emergency condition and based on the patient's symptoms.

Percentage of different oncological emergency conditions commonly encountered in our institute is enumerated. Most common imaging modality used to diagnose these emergencies were ascertained and Salient imaging findings seen in these emergencies are noted.

Results: In our prospective study observational study with 88 cancer patients who were referred to radiology department for various imaging modalities, in view of abdominal emergencies, majority of patients had primary malignancy involving gastrointestinal system (47.7%), followed by genitourinary system (15.9%) and hepato-pancreato-biliary system (11.3%), 10% cases had primary tumor involving extra abdominal solid organs, and 9% cases had primary extra abdominal hematological malignancies. There was positive correlation between type of emergency and location of primary tumor, with majority of surgical type of emergencies (48.5%) occurring in patient with primary gastrointestinal tumor.

Majority of the patients had emergency condition involving gastrointestinal system (69.3%), followed by genitourinary (12.5%), hepato-pancreato-biliary (11.4%) and a few cases (6.8%) were miscellaneous systems which involve more than one organ system.

In our study, majority of patients had surgical emergencies of abdomen (79.5%). The percentages of various emergency conditions of the abdomen in cancer patients at our institute are infective / inflammatory conditions (23.9%), followed by obstruction (22.7%), post-surgical or procedural leak (21.6%), perforation (20.5%), ischemia (4.5%) and least are miscellaneous conditions like torsion, intussusceptions or volvulus (6.8%).

In our study, a positive correlation was found between prior history of abdominal surgery and the surgical type of emergency condition. 49 out of 70 i.e., 70% patients with surgical emergencies had prior history of abdominal surgery.

CT scans were most accurate in concluding the diagnosis of abdominal emergency in cancer patients (92.8% of cases where CT was performed). Plain radiograph was useful in 11.6% of cases.

Though MR imaging was selectively performed in a small percentage (6.8%) of the cases, it had a high diagnostic accuracy, mainly for emergencies related to hepato-pancreato-biliary systems.

Conclusion: Patients with abdominal and non-abdominal primary malignancies can present with structural emergencies of abdomen. During evaluation of acute abdomen in cancer patients, Radiograph and USG can be performed as initial investigations, which sometimes yields diagnostic outcomes, however a normal radiograph or USG cannot rule out an abdominal emergency. CT scan is the preferred modality to diagnose abdominal emergencies. If CT scan is inconclusive, MR imaging can serve as a problem-solving tool in patients having the emergencies of hepato-pancreato-biliary and genitourinary systems.

INTRODUCTION

All over the world, cancer has become one of the leading causes of death. Due to the high incidence of cancer, medical care of complications in cancer treatment has increased in recent years. Complications in cancers can present in many ways from an acute life-threatening event or can be developing insidiously, which may take weeks or months to diagnose. It is not uncommon for the acute emergency to be the first manifestation of the disease (1).

Emergency in oncology can be of acute onset potentially life-threatening condition, which may have developed due to the cancer or during therapy for cancer (1). But these complications are not always confined to the period of initial diagnosis or active treatment and can occur at any stage of the course of malignancy. Patients can even present with complications many years after the cancer treatment has completed, which may be due to recurrence or post treatment events. Therefore, every primary care clinician including the attending radiologist should be aware of possible complications of different cancers. Timely diagnosis of these and timely intervention in these emergencies can prolong survival and improve quality of life, even in patients with end stage disease.

Sometimes the cancer can present initially with an acute symptom like severe abdominal pain or breathlessness. In such cases the radiological investigations are done based on the symptoms and the primary malignancy will be diagnosed for the first time. Oncological emergencies occurring in the patient may bring attention to the tumor for the first time, and can lead to early diagnosis, which may be surgically resectable. In the cases of acute complications resulting from invasion of adjacent viscera, the patient usually has a poor prognosis due to inoperability.

The cause of acute symptoms can be due to the tumor response or progression, metabolic or hematologic complications of chemotherapy or due to sepsis in immunosuppressed patients. Immediate post-operative complications can also present as emergency.

For evaluating of the cause of emergency in cancer care, it requires detailed analysis of the case history, clinical data and treatment history. Decisions regarding appropriate imaging study are based usually on the presenting symptoms (2). The radiologist's role is crucial for quick and accurate diagnosis, which increases the likelihood of a positive outcome.

The most common oncologic emergencies are related to gastrointestinal system and have a high association with mortality. One of the many ways to classify them are as tumor related, diagnosis related, treatment related or non-oncological (3).

(INSERT TABLE 1)

Owing to the critical nature of acute complications of abdomino-pelvic malignancies, it is often described as individual entities. A broad classification can be done, based on the complications relating to each anatomical organ system and sub classified according to the etiology.

(INSERT TABLE 2)

EMERGENCY CONDITIONS OF ABDOMEN

Oncologic emergencies are divided into metabolic, hematologic and structural conditions (4). Metabolic and hematologic emergencies are diagnosed clinically by laboratory investigations. Structural emergencies are diagnosed by radiologic investigations, so radiologist has an important role in early diagnosis and timely management of these patients (5). Our study on oncologic emergencies of the abdomen is limited to the three systems identifying the most common and serious complications including gastrointestinal, hepato-pancreato-biliary and genitourinary systems.

STRUCTURAL EMERGENCIES OF GASTROINTESTINAL SYSTEM

Structural oncologic emergencies can be broadly classified depending on the basic etiology and can be sub classified based on the system involved (copied and modified from **Katrina Mc Ginty et al (2020)** (6) :

- A. Obstruction.
- Gastric outlet obstruction.
 - Small bowel obstruction.
 - Large bowel obstruction.
 - Biliary obstruction.
 - Urinary obstruction.

- B. Perforation.
- C. Inflammatory or infective conditions.
 - Gastritis
 - Enterocolitis.
 - Appendicitis.
 - Abscess.
 - Cholangitis.
 - Cholecystitis.
 - Pancreatitis.
 - Pyelitis.
 - Pyelonephritis.
 - Prostatitis.
 - Cystitis.
- D. Ischemia or infarct.
 - Mesenteric/bowel/gastric ischemia.
 - Renal infarct.
- E. Post procedural anastomotic leak/ dehiscence.
- F. Miscellaneous conditions
 - Torsion,
 - Volvulus,
 - Intussusception.

SUBJECTS AND METHODS

This is a prospective observational study including all patients with an abdominal oncological emergency referred for radiological imaging to the Department of Radiology at Apollo Speciality Hospital, Anna Salai, Chennai-600035, for further evaluation.

IMAGING TECHNIQUE

Known cancer patients presenting to the Emergency Department with an abdominal emergent condition arising out of their disease or as a result of their treatment and also those already admitted in the wards developing an emergency condition were imaged with the most appropriate modality. Clinical details including primary malignancy, treatments taken like prior abdominal surgery, chemotherapy and radiation therapy, duration since treatment, presenting complaints, and suspected acute condition are noted. For most cases patients were referred first for abdominal radiograph, which is taken in Antero-Posterior Erect or supine position of the patient. Ultrasonogram is done using 5 MHz curvilinear probe. The initial investigations for most of the patients were plain radiograph or ultrasonogram. In cases where abdominal radiographs or ultrasonogram were inconclusive, further imaging was done with either plain or contrast enhanced CT, very few cases underwent MRI, depending on the suspected emergency condition and based on patient's symptoms. CT scan was done using Siemens Go Sim 64 slice MDCT scanner with multiplanar reconstructions of the images. The decision to administer IV contrast was taken based on the values of Renal Function Test and eGFR for every patient and also considering the safety of contrast administration in individual patients with other comorbidities.

The result of the study was immediately informed to the concerned treating physician without further delay in order to continue the appropriate further management (critical case report).

Whenever CT scan of the patients were inconclusive and there was clinical suspicion for an abdominal emergency, further investigation was performed with MRI. 6 patients were inconclusive on CT scan, and was proceeded with MR Imaging using Philips Achieva 1.5. Routine sequences including T2WI, T2 Fat saturated, T1WI, DWI, ADC and post contrast T1W imaging were performed.

INCLUSION CRITERIA:

- Oncological patients presenting with an abdominal emergency condition, referred for radiological imaging.

EXCLUSION CRITERIA:

- Oncological patients presenting with an emergency condition not relating to abdominal organs.
- Oncological patients coming under pediatric age group.
- Emergency patients with metabolic complications or having no imaging findings.
- Emergency patients not referred for radiological imaging studies.
- Patients not willing to give consent.

IMAGE ANALYSIS

The patients with abdominal emergencies presenting to the emergency and referred for radiological imaging were imaged with most appropriate imaging modalities. Their clinical or surgical diagnoses are then correlated with imaging findings. The Oncological emergency conditions related to the abdomen were then categorized based on the type of emergency and the salient imaging findings are then tabulated. Imaging findings in each modality are classified as normal, inconclusive or diagnostic. The imaging findings are categorized in each modality as:

Normal: No abnormalities are seen on imaging.

Inconclusive: Abnormal findings detected, with inability to conclude the diagnosis. **Diagnostic:** Abnormal findings which adequately explains and confirms the diagnosis and is correlated with clinical or surgical diagnosis.

Not performed: when the corresponding imaging study is not done.

Each emergency condition is further categorized as surgical, when surgical intervention is required and as medical, when only medical management was required.

Percentage of various emergency condition involving abdomen related to hepato-pancreato- biliary, gastrointestinal and genito urinary systems were calculated. The location of primary malignancy in these patients were also noted. Imaging features in each condition were tabulated. Diagnostic accuracy of different radiological imaging in these conditions were assessed.

All the cases in this study were immediately interpreted soon after the scan performed and the results reported to the primary clinician for further management. All these cases were included in critical care reporting module for emergency medical attention, as per NABH protocol in our institution, which is a NABH accredited hospital.

(INSERT FIGURE 1)

(INSERT FIGURE 2)

(INSERT FIGURE 3)

RESULTS

At our center, during our study period, 88 cancer patients with abdominal emergencies were studied to assess the role of imaging in oncologic emergencies of abdomen related to hepato-pancreato-biliary, gastrointestinal and urinary systems. Among them, the maximum number of patients were within 51 -65 years of age, which accounts for 40 out of 88 patients with a mean age of 56.59 years (Figure 4).

Among the 88 patients, 42 patients had primary malignancy involving gastrointestinal system, 14 had genitourinary system, 10 patients had malignancy related to hepato-pancreato-biliary system, 17 had extra abdominal primary malignancy of which 9 were extra abdominal solid tumors(like carcinoma breast, carcinoma tongue, basal cell carcinoma of lower limb) and 8 were extra abdominal hematological malignancies (like multiple myeloma, leukemia) and 5 cases were miscellaneous including perianal synovial sarcoma, peritoneal carcinomatosis, retroperitoneal sarcoma (Figure 5).

Among 88 patients, majority of patients had surgical emergencies (79.5%) (Figure 6). Majority of patients had emergencies involving gastrointestinal system(69.3%), followed by genito-urinary system (12.5 %) and hepato-pancreato-biliary system (11.4%) (Figure 7).

Majority of patients had infectious or inflammatory conditions of abdomen as emergency condition (23.9 %), followed by obstruction (22.7%) and post procedural / post-surgical complications like anastomotic leak or fistula (21.6 %)(Figure 8).

Among 88 patients with oncological emergencies of abdomen, majority of patients (64.8 %) had history of prior abdominal surgery related to malignancy; where as 35.2 % had no prior history of surgery in abdomen (Figure 9).

In our study, majority of patients had past history of chemotherapy or radiotherapy (62.5 %). 37.5% had no history of chemotherapy or radiation therapy.

Majority of the patients in our study recovered (87.5 %), and a small percentage of patients expired due to complication arising from the emergent condition (Figure 10).

In our study with 88 patients, radiograph was performed in 77 patients. Diagnostic findings were seen in radiography in 9 patients (11.6 % of study population) with oncologic emergency and all these patients had emergencies involving gastrointestinal system. In the majority of patients abdominal radiograph was normal (60%). Inconclusive findings which were not diagnostic were seen in 17% patients (Figure 11).

Almost half of the patients in our study showed inconclusive findings on ultrasonogram(47.7%). Least number of patients showed diagnostic findings (9.1 %) (Figure 12).

CT scan of the abdomen was diagnostic in majority of patients (88.6%). Inconclusive findings which were not diagnostic were seen in 6.8 % cases, whereas CT scan was not performed in 4.5% cases (Figure 13).

Among 88 patients who presented with oncologic emergencies of abdomen, only 6 patients had MRI done. In rest of the patients, adequate information was obtained from other imaging modalities. Among 6 patients, adequate information was obtained from MRI which helped in diagnosis of the emergency condition (Figure 14).

Cases

(INSERT FIGURES 15, 16, 17, 18, 19, 20 and 21)

DISCUSSION

In our study of 88 cancer patients, the locations of the various primary tumors were:

- 1) Gastrointestinal malignancies (47.7%): Carcinoma gastro-esophageal junction, Carcinoma stomach, Carcinoma colon, Carcinoma stomach, Lymphoma, Malignant GIST, Carcinoma appendix.
- 2) Hepato-pancreato-biliary (11.4%): Carcinoma pancreas, Peri ampullary carcinoma, Hepatocellular carcinoma, Cholangiocarcinoma, Carcinoma gall bladder.
- 3) Genitourinary (15.9%): Endometrial carcinoma, Carcinoma ovary, Carcinomacervix, Carcinoma ovary, Carcinoma urinary bladder, Uterine leiomyosarcoma.
- 4) Extra abdominal solid tumors (10.2%): Carcinoma breast, Carcinoma lung, Lymphoma, Carcinoma tongue
- 5) Extra abdominal hematologic malignancies (9.1%): Multiple myeloma, Leukemia
- 6) Miscellaneous (5.7%): Perianal synovial sarcoma, Peritoneal carcinomatosis, Retroperitoneal sarcoma.

In our study, the most common primary tumor which resulted in surgical emergency was carcinoma colon (12 out of 70 surgical emergencies). Most common emergency conditions infectious / inflammatory conditions (23.8%) followed by obstruction (22.7%) and post-surgical /post procedural leaks (21.5%).

There is statistically significant association seen between prior history of abdominal surgery and type of emergency. Most of the patients with surgical emergencies (49 out of 70 cases, 70%) had history of prior surgery and most of the patients with medical emergencies (10 out of 18 cases, 55.5%) did not have any history of previous abdominal surgery.

(INSERT TABLE 3)

In our study, it was observed that majority patients had the organ system involving emergent condition same as the location of primary tumor. 32 out of 42 patients with primary gastrointestinal malignancies had emergency involving gastrointestinal system. Similarly, 5 out of 10 patients with primary hepato-pancreato-biliary malignancies had emergencies related to hepato-pancreato-biliary systems. However no similar correlation was seen in our study in Genito-urinary system, this may be due to small sample size.

In our study with 88 patients, **plain abdominal radiographs** were performed in 77 patients (87.5%), in which conclusive findings were seen in 9 patients only (11.7%) and all of those emergencies were related to the gastrointestinal system.

Overall **ultrasound** imaging as an initial modality for abdominal emergencies in cancer patients, did not show a good diagnostic accuracy. In our study, 63 patients (71.6%) underwent emergency USG scans. Of these USG findings were inconclusive in 42 patients (66.6%) and these patients had to undergo MDCT or MRI for further evaluation. Ultrasonography has the benefit of close contact with patient, which enables the radiologist to assess the spot of maximum tenderness and the severity of illness, without using ionizing radiation. Though USG scans are widely available at the emergency department, the lowered diagnostic accuracy is probably due to operator dependency, patient habitus, presence of pain and bowel gas preventing an optimal USG evaluation.

Of the 88 patients in our study, 84 patients (95.4%) underwent **CT scans**, in which 78 patients (92.8%) had conclusive findings; most of these cases were related to gastrointestinal system (61 cases, 78.2%). Hence, MDCT is most accurate in detecting abdominal emergencies in cancer patients. This correlates well with the study by Anuradha et al, 2019 (4).

(INSERT TABLE 4)

MR imaging was performed in a limited number of cases (6 out of 88), whenever MDCT is inconclusive or emergency related to hepato-pancreato-biliary system is suspected.

(INSERT TABLE 5)

(INSERT Figure 22)

CONCLUSIONS

In our prospective study observational study, we included 88 cancer patients who were referred to radiology department for various imaging modalities, in view of abdominal emergencies. Majority of patients had primary malignancy involving gastrointestinal system, followed by genitourinary system and hepato-pancreato-biliary system; few cases were primary tumor involving extra abdominal solid organs and had primary extra abdominal hematological malignancies. There was positive correlation between type of emergency and location of primary tumor, with majority of surgical type of emergencies occurring in patients with primary gastrointestinal tumor.

Majority of the patients had emergency condition involving gastrointestinal system, followed by genitourinary, hepato-pancreato-biliary and a few cases were miscellaneous systems which involve more than one organ system.

In our study, majority of patients had emergencies which lead to surgical interventions. The percentages of various emergency

conditions of the abdomen in cancer patients at our institute are infection/ inflammatory conditions (23.9%), followed by obstruction (22.7%), post-surgical or procedural leak (21.6%), perforation (20.5%), ischemia (4.5%) and least are miscellaneous conditions like torsion, intussusceptions or volvulus (6.8%).

In our study, a positive correlation was found between prior history of abdominal surgery and the surgical type of emergency condition. Majority of patients with surgical emergencies had prior history of abdominal surgery. CT scans were most accurate in concluding the diagnosis of abdominal emergency in cancer patients. Plain radiograph was diagnostic in least number of cases. Though MR imaging was selectively performed in a small percentage of the cases, it had a high diagnostic accuracy, mainly for emergencies related to hepato-pancreato-biliary systems.

Considering all factors, it is concluded from our study that CT scan is the preferred modality to diagnose abdominal emergencies. If CT scan is inconclusive, MR imaging can serve as a problem-solving tool in patients having the emergencies involving the hepato-pancreato-biliary and genitourinary systems.

LIMITATIONS

1. This is a short duration cross sectional, prospective, observational study for a period of 1.5 years and included a relatively small number of patients.
2. There is a noticeable differential distribution of the organ systems causing emergency condition in this study, where majority were related to gastrointestinal systems (Centre Bias).
3. MR imaging was performed selectively in a very less number of patients.

RECOMMENDATIONS

1. Radiograph and USG can be performed as initial investigations, which sometimes yield diagnostic outcomes, however a normal radiograph or USG cannot rule out an abdominal emergency.
2. CT scan is the best imaging modality in evaluating emergency conditions involving the gastrointestinal system.
3. MR imaging helps as a problem-solving tool, especially in hepato-pancreato-biliary and genitourinary systems and whenever CT is inconclusive.

Financial support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

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