"128 MULTISLICE COMPUTED TOMOGRAPHY EVALUATION OF NON-TRAUMATIC BOWEL EMERGENCIES - ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY"

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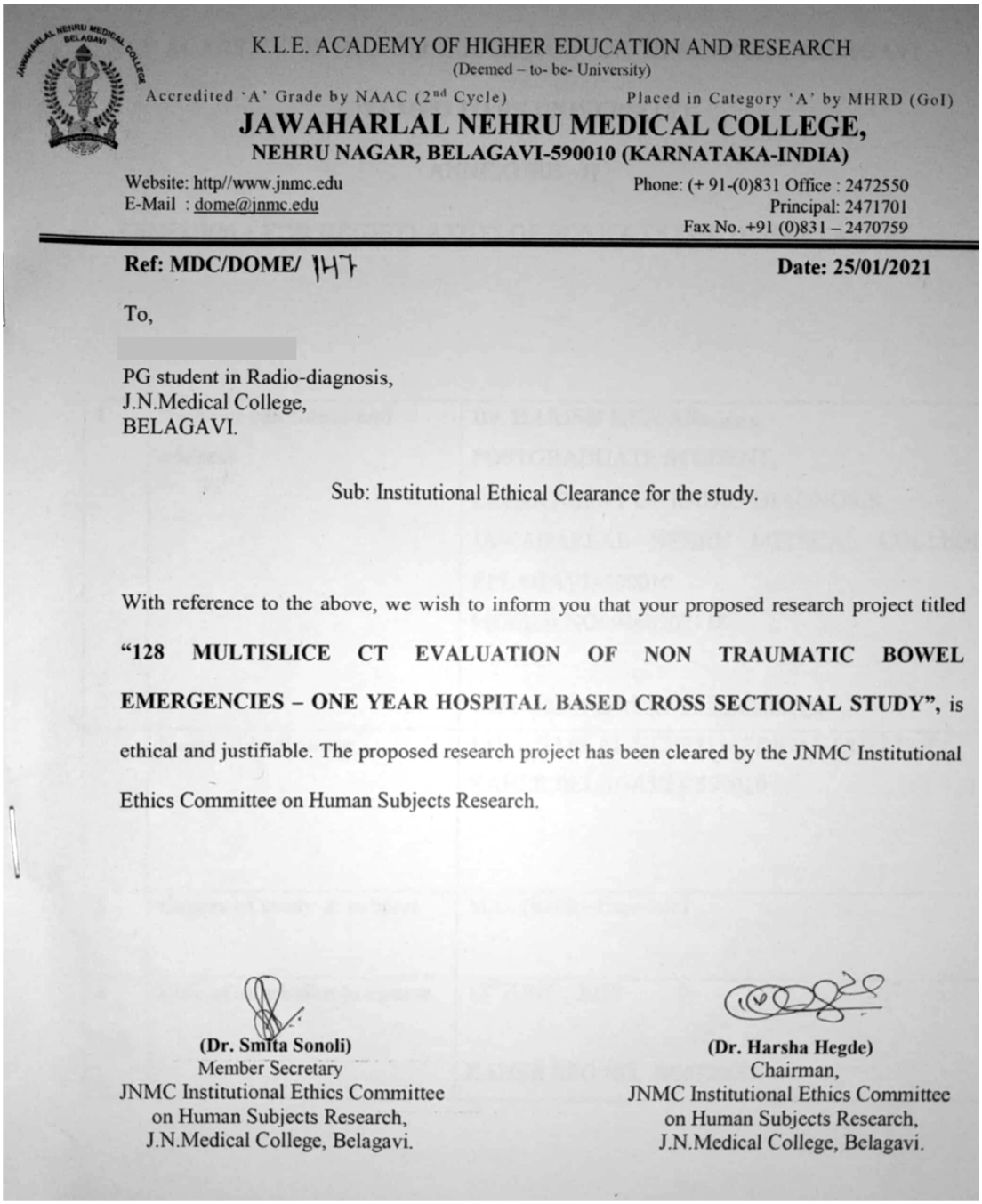

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"128 MULTISLICE CT EVALUATION OF NON TRAUMATIC BOWEL EMERGENCIES – ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

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ABBREVIATIONS

AA	Acute appendicitis
AAA	Abdominal aortic aneurysm
ABD	Abdomen
AGIH	Acute gastrointestinal hemorrhage
ANOVA	Analysis of variance
BAT	Blunt abdominal trauma
BMI	Body mass index
CD	Colonic diverticulitis
CECT	Contrast enhanced computed tomography
CT	Computed tomography
CTSI	Computed tomography severity index
ED	Emergency Department
EXP.	Exploratory
FAST	Focussed Assessment with Sonography in Trauma
GB	Gall bladder
GI	Gastrointestinal
HIDA	Hepatobiliary iminodiacetic acid
ICRP	International x-ray and radium protection committee
IV	Intravenous

LAP.	Laparoscopic
LBI	Large bowel ischemia
LBO	Large bowel obstruction
MDCT	Multidetector computed tomography
MRI	Magnetic resonance imaging
MSv	Millisievert
NCCT	Non-contrast enhanced computed tomography
NECT	Non-enhanced computed tomography
NMR	Nuclear magnetic resonance
PACS	Picture archiving and communication system
RLQ	Right lower quadrant
SBI	Small bowel ischemia
SBO	Small bowel obstruction
SD	Standard deviation
SMV	Superior mesentric vein
TAO	Thromboangitis obliterans
TB	Tuberculosis
US	Ultrasound
USG	Ultrasonography
VRT	Volume rendering technique

ABSTRACT

Background: Acute abdomen is one of the most common emergencies presenting to the casualty. Bowel pathologies are the most common cause of acute abdomen which can be both traumatic and non-traumatic. Few of the common non-traumatic bowel pathologies are acute appendicitis, acute gastrointestinal hemorrhage, colonic diverticulitis, large bowel ischemia, large bowel obstruction, small bowel ischemia, and small bowel obstruction. Computed tomography has revolutionized the management of acute abdomen by providing swift and effective diagnosis of these pathologies. The present study was done to evaluate the role of computed tomography in non-traumatic bowel emergencies in adults.

Materials and methods: A hospital-based cross-sectional observational study was done on 77 subjects, with age more than 18 years, presenting with acute abdomen to the casualty and then referred to the Department of Radio-Diagnosis at the KLE's Dr. Prabhakar Kore Hospital & MRC, Belagavi. Patients underwent 128 multislice computed tomography scan to diagnose the cause of acute abdomen. All patients were given oral and intravenous contrast agents. For all the tests, the value of p less than 5% (0.05) was considered significant.

Results: In the present study, males outnumbered females. According to this study, small bowel obstruction had the highest prevalence (37.66%) followed by acute appendicitis (27.27%). In SBO, CT imaging shows transition point in 89.66% subjects and small bowel feces sign in 34.48% subjects. Transition point was most commonly seen in distal ileum. In acute appendicitis, the common radiological features are dilated appendix, peri-appendiceal fat stranding and wall hyper-enhancement.

Conclusion: Computed tomography can be used as a reliable diagnostic imaging modality for the detection of non-traumatic bowel emergencies.

Keywords: Computed tomography, acute appendicitis, acute gastrointestinal hemorrhage, colonic diverticulitis, large bowel ischemia, large bowel obstruction, small bowel ischemia, and small bowel obstruction

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INTRODUCTION

Acute abdomen is one of the most common emergencies presenting to the casualty department of the hospital in adult population. Patients present with symptoms like abdominal pain, nausea, vomiting, diarrhoea and abdominal distension with abdominal pain being the foremost common symptom.

There are numerous medical and surgical causes of acute abdomen, among which bowel pathologies are the foremost common.

The abrupt onset of severe abdominal pain is known as “acute abdomen” necessitates prompt pathology identification that is life-threatening in order to give early treatment. In patients with acute abdominal pain, the role of traditional radiography has been exceeded, and this approach is only useful in patients with obstructed intestines. (1)

Imaging is crucial in the diagnosis because it helps the doctors to differentiate among the various causes of acute abdominal pain, which is necessary for effective therapy. As there’s tremendous advancement in scientific fields, more and more diagnostic facilities like ultrasonography, endoscopy, MRI, CT scan, radio nucleotide scan and other sophisticated investigations have developed which can give more information, than the plain radiograph. The diagnosis of abdominal pain, therefore, needs a radical and logical approach.

Computed tomography (CT) has revolutionized the management of abdominal pain by providing swift & effective diagnosis and treatment of abdominal pathologies by enabling early surgical interventions.(2) CT scan is usually considered as the investigation of choice for diagnosis of numerous abdominal pathologies. As a result,

its utilization has dramatically increased over the past decade, particularly in emergencies. Early diagnosis of bowel emergencies with CT can help in decreasing morbidity and mortality. CT Scanning due to its excellent soft tissue contrast, spatial resolution and operator independence is advantageous within the emergency setting for diagnosis and management. The disadvantage of CT is exposure to ionizing radiation. Approximately 10 mSv is the effective radiation dose for abdominal CT. The radiation risk and the direct diagnostic benefit must be weighed before getting into for CT examination of acute abdomen.(3)

In view of high sensitivity and specificity of CT over plain radiographs, CT is preferred over radiographs routinely round the world.

CT also has many advantages over magnetic resonance imaging, as MRI is time consuming and has limited accessibility & affordability, particularly in Indian scenarios.

Non-traumatic bowel emergencies include:

1. Acute appendicitis
2. Acute gastrointestinal tract hemorrhage
3. Colonic diverticulitis
4. Large bowel ischemia
5. Large bowel obstruction
6. Small bowel ischemia (also referred to as Acute mesenteric ischemia)
7. Small bowel obstruction

AIMS & OBJECTIVES

1. To determine the diagnostic role of computed tomography in patients with acute abdomen suspected of non-traumatic bowel emergencies.

2. To determine the pattern of bowel emergencies on computed tomography.

REVIEW OF LITERATURE

Acute abdominal discomfort can have a wide range of causes, from benign, self-limiting ailments to serious illnesses. USG and abdominal radiography are the first imaging modalities. In certain cases where ultrasonography is unable to provide a definitive diagnosis, CT has emerged as the imaging modality of choice.

DEVELOPMENTAL ANATOMY(4,5)

The normal structure of the abdominal cavity and its viscera is determined by their developmental anatomy, which also affects the pathogenesis and clinical symptoms of the majority of abdominal disorders. For the assessment of acute abdominal illness, peritoneal attachments and visceral sensory innervations are particularly crucial. The primitive gut differentiates into the foregut, midgut, and hindgut after the third week of fetal development. The midgut is supplied by the superior mesenteric artery (from lower half of the duodenum to the right two-thirds of the transverse colon). The esophagus, the stomach, and the upper half of the duodenum (up to the entry of the common bile duct) are parts of the foregut, whereas the left third of the transverse colon, the descending colon, the sigmoid colon, and the rectum are parts of the hindgut. Sensory innervation to the bowel and associated visceral peritoneum is supplied by the afferent fibers accompanying the vascular supply.

Therefore, celiac axis afferents are stimulated by diseases in the proximal duodenum (foregut) to cause epigastric pain. Afferent nerves which accompany superior mesenteric artery are activated by stimuli in the cecum or appendix (middle gut) to produce periumbilical pain, while the afferent nerves which accompany the

inferior mesenteric artery are stimulated by distal colon diseases, to cause suprapubic pain. The diaphragmatic muscles and the peritoneum on its undersurface are innervated by the phrenic nerve and afferent fibres in the C3, C4, and C5 dermatomes, which accompany the phrenic arteries. As a result, stimuli to the diaphragm result in referred shoulder pain. The abdominal wall, retroperitoneal soft tissue, and parietal peritoneum, all receive somatic innervation corresponding to segmental nerve roots.

The parietal peritoneum, which is richly innervated, is particularly sensitive. Painful stimuli are strongly localized to the stimulus site by parietal peritoneal surfaces. Pain becomes localized when the parietal peritoneal membrane is irritated by visceral inflammation. Maneuvers that aggravate this irritation, then make the pain worse. This is how the "peritoneal signs" that are useful in the clinical diagnosis of the acute abdomen are created. Clinical pain patterns are produced by the abdominal cavity's dual-sensory innervation by somatic and visceral afferents, which aid in diagnosis.

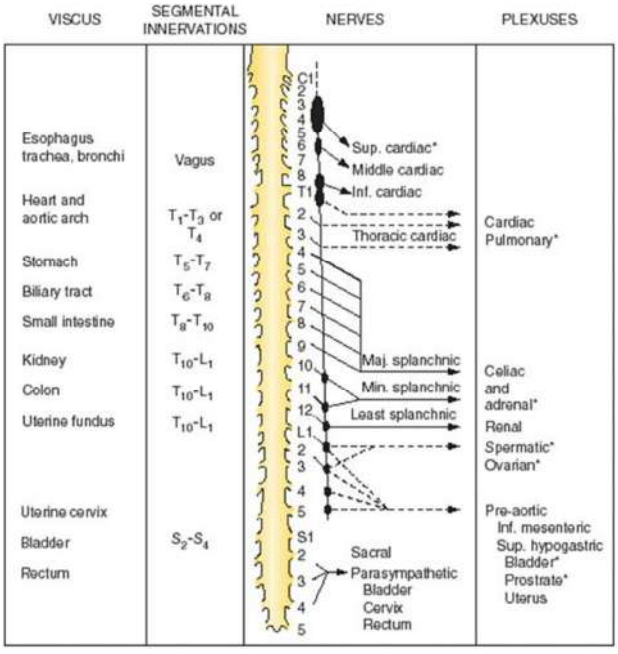

Figure 1: Sensory innervations of the viscera (5,6)

Sharp, sudden, and well-localized pain is mediated through peripheral nerves. Sensory afferents that are involved in intraperitoneal abdominal pain transmit a dull, poorly-localized, painful signal that develops gradually and lasts for a long time. The vagus nerve does not carry pain from the intestines. Small, unidentified sympathetic afferent neurons transmit pain from the esophagus to the spinal cord. From C3 to C5, afferent nerves from the pericardium, liver capsule, hepatic ligaments, central diaphragm, and splenic capsule enter the central nervous system. Pain fibers are sent from the diaphragm, gallbladder, stomach, pancreas, and small intestine to the spinal cord from T6 to T9. The 10th and 11th thoracic segments of the central nervous system receive pain fibers from the colon, appendix, and viscera of the pelvis. Pain fibers from the rectum, sigmoid colon, ureter, renal pelvis, and testicles reach the central nervous system at T11 and L1. Afferent nerves from the bladder and recto-sigmoid colon enter the spinal cord from S2 to S4.

The abdominal viscera often do not experience pain from cutting, ripping, crushing, or burning. However, pain is experienced when the peritoneum is stretched or distended. Visceral pain is caused by ischemia as well as peritoneal inflammation brought on by bacteria or chemicals. Sensory nerve invasion by cancer can result in intra-abdominal pain. The abdominal pain may be parietal, visceral or referred. The epigastrium, periumbilical area, or suprapubic region are the most common sites for visceral pain. It is dull and poorly localized, and it typically does not lateralize well. Sweating, restlessness, and nausea are other symptoms, that patients with visceral pain may encounter. With intra-abdominal diseases, parietal or somatic pain may be more severe and precisely localized. Referred pain is felt at a location far from the source of stimulus. For instance, shoulder pain may result from irritated diaphragm.

Shoulder pain might be caused by gallbladder or bile duct disease. Referred pain from the small intestinal obstruction to the back is possible.

The bowel outgrows the peritoneal cavity, emerges through the umbilical cord, and turns 180 degrees counterclockwise during the fifth week of fetal development. The colon does not enter the peritoneal cavity until the tenth week, after which it spins another 90 degrees counterclockwise and returns to the abdomen. The viscera are positioned in their adult positions as a result of this embryologic rotation, and the colonic and duodenal mesenteries merge with the posterior abdominal mesothelium to establish the final peritoneal attachments. When assessing patients with acute abdomen, it is vital from a clinical standpoint to be aware of these attachments since the exact positions of the viscera (such as the pelvic or retrocecal appendix) and the compartmentalization of the abdomen by the mesenteric attachments differ.

PERITONEAL PATHOPHYSIOLOGY(7)

Mesothelial cells line the parietal and visceral peritoneal surfaces. Openings into radially organized lymphatics pierce the diaphragmatic peritoneal surface. If germs are introduced into the peritoneal cavity, there may be a leaking of fluid from the peritoneal membrane. Tachycardia, resting or orthostatic hypotension, and dehydration are among clinical signs that might result from this fluid loss from the circulation. Through the diaphragmatic lymphatics, the abdominal cavity is mostly cleared of pathogens and cellular debris. The fluid in the intraperitoneal space circulates toward both subdiaphragmatic areas as a result of this mechanism. The fluid often gets accumulated within pelvis if it is not removed in this manner. Visceral perforation can thus be accompanied by fluid accumulation in the subhepatic,

subdiaphragmatic, paracolic, or pelvic regions. Bacteria and inflammatory byproducts get localized on the peritoneal surfaces. Inflammation causes the peritoneum to become more permeable, produce more blood flow, and produce a fibrinous exudate on its surface. Inflammation in the bowel can also cause localized or generalized paralysis. A disseminated process, such as a perforated ulcer, causes broad abdominal pain with a quiet abdomen, but an abscess may cause sharply localized pain with normal bowel sounds and gastrointestinal function. The visceral or parietal peritoneum may be affected in its entirety or in part by peritoneal peritonitis. The peritoneal fluid, which is rich in protein and leukocytes and promotes the development of fibrin on peritoneal surfaces, might rise as a result of transudation. Peritonitis is a general term for peritoneal inflammation. A widespread bacterial infection without a specific intra-abdominal source of contamination might cause primary or spontaneous peritonitis. Primary peritonitis is more prevalent in children than in adults, and it is typically brought on by hemolytic streptococci or pneumococci. However, adults with cirrhosis and ascites are vulnerable to spontaneous peritonitis brought on by Klebsiella and Escherichia bacteria.

A perforation, infection, or gangrene of an intra-abdominal organ, usually of the gastrointestinal system, causes the more common secondary peritonitis (8). When they come into contact with the peritoneum, gastrointestinal secretions, pancreatic secretions, bile, blood, urine, and meconium cause chemical peritonitis. The rupture of a peptic ulcer is followed by a common form of chemical peritonitis. Gallbladder perforation or bile duct leakage, both can cause bile peritonitis. Normally, slow bleeding into the abdominal cavity causes few signs of inflammation; when bacteria are added to blood, suppuration results. Tertiary peritonitis, which causes 30% to 64% mortality in affected patients, may affect postoperative patients. Tertiary peritonitis is

characterized by a state of poorly localized intra-abdominal infection, altered microbial flora, progressive organ failure, and increased mortality.

Depending on the disease, peritonitis can produce generalized or localized abdominal pain. The pain from an appendicitis is usually localized and a perforated peptic ulcer causes generalized abdominal pain. Right upper quadrant pain that radiates to the right scapula or shoulder is a symptom of acute cholecystitis. Abdominal tenderness, guarding, and rebound tenderness are physical signs of peritonitis.

ANATOMY OF ABDOMINAL CAVITY: (9)

The abdominal cavity extends from deep pelvis to just below the xiphisternum. It contains a variety of hollow and solid organs. Except for those organs/parts located under the lower ribs and in the pelvis, abdominal organs are solely anteriorly covered by muscles. The lateral boundary is formed by external, internal and transverse abdominis, and more inferiorly by iliac muscles. The vertebral column, psoas major & minor and quadrates lumborum, form the posterior boundary of the abdominal cavity. The anterior boundary is formed by the rectus abdominis. For descriptive reasons, two arbitrary horizontal and vertical lines split it into nine areas. The superior horizontal line cuts the costal margin at the ninth costal cartilages and is located at the level of the lower border of the L1 vertebra in the transpyloric plane. As a transtubercular line, the inferior horizontal line travels across the iliac crest tubercles and the body of vertebra L5 towards its upper border. Midclavicular downwards are the two vertical lines. The resultant quadrants are middle hypogastric, right and left iliac, middle umbilical, right and left lumbar, and middle epigastrium, right and left hypochondriac.

PERITONEAL CAVITY: (10)

The wall of abdominal cavity is lined by peritoneum. This is a serous membrane. During development, the peritoneum is carried into the abdominal cavity by the abdominal and pelvic viscera. The greater and lesser sacs are two different sections of the peritoneal cavity that are separated by the disappearance, fusion, shifting, and shortening of these peritoneal folds during development. The lesser sac is located behind the gastrocolic ligament, stomach, and lesser omentum. Through the foramen of Winslow, it connects with the greater sac on the right side. Retroperitoneal structures are those present in the abdominal cavity that are not attached to the body wall by ligaments or the mesentery. Males have a closed peritoneal cavity, whereas females have openings in the fimbrial end of their fallopian tubes through which they can connect with the exterior.

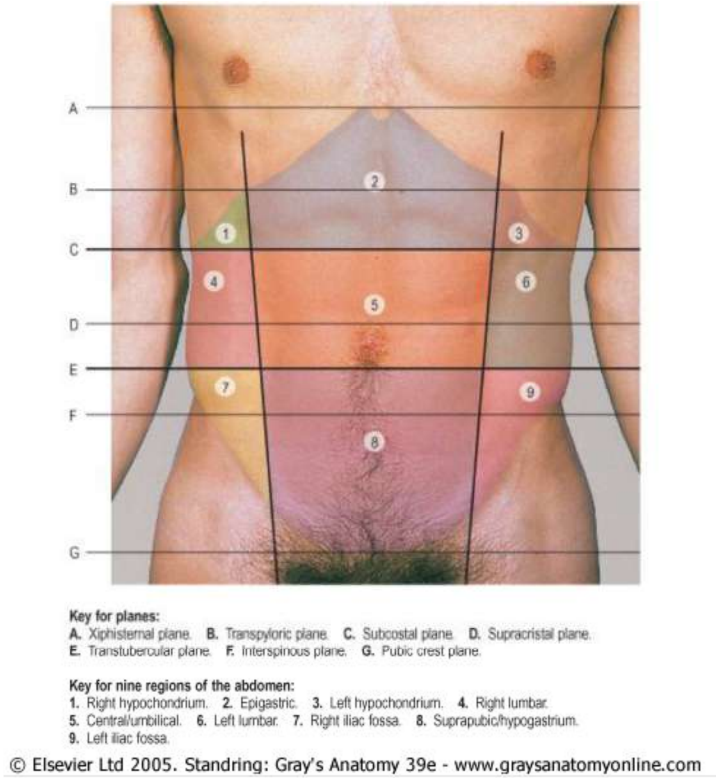

Figure 2: Different Quadrants of abdomen

SOLID ORGANS:

Liver: (11)

The liver is located in the right upper quadrant of the body. It has a wedge-like shape, with the its base directed to the right. It is the largest gland of the body. The xiphoid process and the diaphragm on either side are related to the triangular shaped anterior surface. The quadrilateral superior surface is marked by the cardiac impression in the middle. It is divided from the heart and pericardium in the middle by the diaphragm, and from the pleura and lungs on either side. Liver is made up of two lobes. The caudate and quadrate lobes are two extra lobes on the right lobe. The omental tuberosity is seen on the inferior surface of the left lobe. 20% of the blood that the liver receives comes from the hepatic artery and 80% comes from the portal vein. Hepatic artery and portal vein split into right and left branches before entering the liver. Hepatic veins form the venous drainage system, which empties into the inferior vena cava directly.

Spleen: (9)

The spleen is located in the left hypochondriac region of the abdomen, inferior to the diaphragm and with a long axis parallel to that of the tenth rib. It is a lymphatic organ connected with vascular system. It is covered by the peritoneum and is suspended by the following ligaments:

a) Gastrosplenic ligament- from splenic hilum to upper $1/3^{rd}$ of the greater curvature of stomach.
b) Lienorenal ligament- from splenic hilum to the anterior surface of left kidney.
c) Phrenicocolic ligament- supports anterior end of the spleen.

Splenic artery supplies spleen which is a branch of coeliac artery.

Pancreas:(9)

Pancreas is present on the upper part of the posterior abdominal wall. It extends from duodenal concavity to the splenic hilum at the level of L1 and L2 vertebral bodies. It is an elongated organ having both endocrine and exocrine functions. It is connected to the stomach and transverse colon anteriorly. It is related to the aorta, inferior vena cava, superior mesenteric artery and left diaphragmatic crus posteriorly.

Kidneys and suprarenal: (12)

The kidneys are pair of excretory organs that are located in the posterior abdominal wall, one on either side of the vertebral column behind the peritoneum. The left kidney is slightly closer to the median plane than the right, and it is slightly higher than the right kidney. There are two poles, two borders, and two surfaces of each kidney. The suprarenal gland is related to the upper pole, which is broad, while the lower pole is pointed. The medial border is concave with hilum in the middle and the lateral border is convex. Anterior surface is irregular and posterior surface is flat. The right suprarenal gland, the second part of the duodenum, the colonic hepatic flexure, and the small intestine are all related to the right kidney. Left suprarenal gland, spleen, stomach, pancreas, splenic vessels, splenic flexure, descending colon, and jejunum are related to the left kidney.

The diaphragm, medial and lateral arcuate ligaments, psoas major, Quadrates lumborum, transverse abdominis, subcostal vessels, and subcostal, iliohypogastric, and ilioinguinal nerves are related to the posterior surface of both kidneys. The left kidney corresponds to the 11th and 12th ribs, and the right kidney to the 12th rib. The fibro-areolar membrane that surrounds the kidney and perirenal fat is known as the

renal fascia (Gerota's fascia). Kidneys are supplied by the renal artery and vein. The renal vein drains directly into the inferior vena cava, while the renal artery is a direct branch of the aorta.

Adrenal gland (12)

Blunt abdominal trauma infrequently results in adrenal gland injury. They are shielded by the spine, ribs, and major organs and are located close to the middle of the upper abdomen. In 28% of patients with moderate abdominal injury who were autopsied, there was a report of an adrenal injury. Hematoma in adrenal gland is seen as a round or ovoid mass. In the perirenal fat, high density strands that represent hemorrhage may be seen. The hematoma in the adrenal may show an increased density initially. The density reduces over time as the blood clot lyses. The hematoma will often be reabsorbed in most cases, but rarely it can persist and turn into a seroma. It is the most common cause of adrenal pseudocysts. Adrenal injury usually has minimal clinical significance on patients. Before the patient experiences adrenal insufficiency, a significant amount of blood must be lost. But if there is a bilateral hematoma in the adrenal, Addison's disease must be taken into consideration.

NEUROLOGIC UNDERPINNINGS

A physician must be skilled in interpreting the location of pain since it is essential for making the correct diagnosis. (15,16) Understanding the three types of pain—referred, somatic, and visceral—basically is necessary for this.

Table 1: Possible causes of pain by location

Location of Pain	Associated Diseases
Right upper quadrant (Liver, kidney, gallbladder)	Acute hepatitis, acute cholecystitis, biliary colic, duodenal ulcer, right lower lobe pneumonia
Right lower quadrant (Ascending colon, appendix, ovary, fallopian tube)	Appendicitis, cecal diverticulitis, ectopic pregnancy, tubo-ovarian abscess, ruptured ovarian cyst, ovarian torsion
Left upper quadrant (Pancreas, spleen, kidney)	Acute pancreatitis, gastritis, splenic pathology, left lower lobe pneumonia
Left lower quadrant (Sigmoid and descending colon, ovary, fallopian tube)	Diverticulitis, ectopic pregnancy, tubo-ovarian abscess, ruptured ovarian cyst, ovarian torsion
Midline or periumbilical	Appendicitis (early), gastroenteritis, mesenteric Lymphadenitis, myocardial ischemia or infarction, pancreatitis
Flank	Abdominal aortic aneurysm, renal colic, pyelonephritis
Front to back	Acute pancreatitis, ruptured abdominal aortic aneurysm, retrocecal appendicitis, posterior duodenal ulcer
Suprapubic or lower abdominal	Ectopic pregnancy, Mittelschmerz, ruptured ovarian cyst, pelvic inflammatory disease, endometriosis, urinary tract infection

IMAGING MODALITIES

PLAIN RADIOGRAPHY:(17)

Abdominal radiography is typically the first step in an imaging workup. However, multiple studies have shown that plain abdominal radiography has low sensitivity and accuracy for the evaluation of acute abdominal pain as well as various specific conditions such as perforated viscus, bowel obstruction, ingested foreign body, and ureteral stones. Despite these limitations, erect chest X-ray has a significant role in the detection pneumo-peritoneum. It is possible to demonstrate up to 1cc of free air on upright chest radiograph.

ULTRASONOGRAPHY:(18)

US imaging is widely used in emergency care facilities, it is affordable, radiation-free, and easily accessible. Its effectiveness is directly related to the experience of the operator, who may be a surgeon, radiologist, or emergency room doctor. It is a dynamic, real-time examination that uses variations in posture. Endo-vaginal ultrasound probes may augment US examinations of women's pelvic cavities.

The uterus, pancreas, ovaries, and solid organs can all be evaluated by US, and it can also find intra-peritoneal effusions and collections. The technique of gradual compression permits evaluation of the gastrointestinal system, including wall thickness and motility, the absence of peristalsis, and the evidence of inflammatory or tumoral involvement, even though intestinal gas may reduce sensitivity. With sensitivity and diagnostic efficacy of 92% and 88%, respectively, it is superior than plain radiography in the hands of experienced radiologists for the detection of

pneumoperitoneum. US is the first-line examination for pregnant women because it avoids exposure to radiation.

COMPUTED TOMOGRAPHY:(18,19)

Acute abdominal and pelvic pain is usually non-specific, a diagnosis cannot always be made from clinical examination findings and laboratory tests, which is why the radiologist is so important to the patient's care. Despite the risk of radiation exposure, the availability of CT imaging has altered the methods to evaluate abdominal emergencies in adults. A shorter acquisition time on multi-detector systems of more recent generations minimises respiratory artefacts and shortens research times. There are several kinds of two- or three-dimensional reconstructions that may be done using high-resolution volumetric or isotropic data. The identification of anatomical structures such the mesenteric vasculature, biliary tract, or urinary tract is possible without raising the radiation dosage because of the capacity to simultaneously study a region in three spatial planes.

While axial cut analysis is the standard, studying slices in other planes increases the effectiveness of the diagnostic process. For less experienced practitioners, reconstructions seems even more important.

As multi-detector devices are accurate, there is no need to opacify the upper or lower gastrointestinal tract, which increases patient pain, costs, and examination time. Although not required, administering IV contrast normally is advised since it improves the study's diagnostic yield, particularly in lean individuals with little body fat. It is not advised to perform a CT with IV contrast as the initial investigation for flank pain. Serum creatinine should be assessed before any contrast injection if

urinary obstruction has not been ruled out, whenever patients have a history of renal or urological illness, are older than 60, or meet other criteria. The risks and advantages must always be assessed before contrast injection in situations of known allergy or renal insufficiency, and the advised precautions must be taken. Numerous studies highlight the importance of CT as a diagnostic tool and how it affects the treatment of abdominal emergencies. CT enables the confirmation of the diagnosis or the proposal of alternative diagnoses when the diagnosis is incorrect (unlike plain radiography). The findings help to improve management approaches, including surgical treatment, by providing further clarification and better differentiation, identifying not only the etiology but also the precise localization of bowel obstruction and the precise anatomical location of the appendix. Right lower quadrant (RLQ) pain, non-specific abdominal pain, and uncomplicated cholecystitis are less accurately diagnosed by CT. Due to its expense and radiation risk, CT is not generally recommended as the initial examination. Iatrogenic radiation exposure has alarmingly increased as a consequence of the increasing usage of CT. Multi-detector imaging devices, which enable rapid and more precise image acquisition with reduced radiation exposure per examination, are expected to help counter this trend. Depending on the type of study, the current estimated radiation dose for an abdominal CT ranges from 7 to 20 mSv; a 10 mSv exposure is equal to 500 chest X-rays or 4.5 years of typical natural radiation. Although "low-dose" CT techniques might produce almost identical diagnostic outcomes, they are not applicable for all indications or patients due to differences in muscle mass and body mass index (BMI).

MAGNETIC RESONANCE IMAGING:

MRI provides two- and three-dimensional images with various contrasts depending on the sequences used, and it is a non-invasive medical imaging technique without any known adverse effects.

The body's water protons are analysed by MRI machines using nuclear magnetic resonance (NMR). The amount of water present at the site, the longitudinal relaxation (T1) and transverse relaxation (T2) times of the nuclear spins, and the signal strength detected for a certain volume element (voxel) all affect each other. So, this method is extremely sensitive to the water content of tissues, which rises in a number of pathological processes, especially acute inflammation with edema as a result.

Similar to using iodinated contrast for CT scanning, gadolinium can be used as a contrast agent because it shortens the relaxation period, especially in the T1 sequences, which increases the signal strength in these sequences. Some IV contrast agents are contraindicated in patients with severe renal insufficiency or dialysis-dependent renal failure due to the risk of nephrogenic systemic fibrosis instead of nephrotoxicity; other agents can be used in these circumstances. Once again, the benefit-risk ratio needs to be considered. Additionally, due to the possible teratogenic risk, contrast agents should not be used in pregnant females.

For the examination of pelvic pain and biliary diseases, MRI appears to be superior than CT, or at least equivalent. This is similar to the situation for pregnant women in whom MRI is advised when US is not contributory. MRI may become a promising substitute at a time when radiation exposure from imaging

procedures has become a significant concern; further research to define its role in the assessment of abdominal pain is desired. Its limited availability remains a problem.

The causes of non-traumatic acute abdomen and their imaging findings in CT are described below.

1. **Acute appendicitis**: The cecal arrow head sign and cecal bar sign can be appreciated.(21) The Cecal arrow head sign refers to triangular configuration of oral contrast funneling into focally thickened cecum pointing towards appendiceal orifice. The cecal bar sign is due to the linear inflammatory soft tissue that separates contrast filled cecum from appendix.

2. **Small bowel obstruction:** Small bowel feces sign is seldomly seen in high grade obstruction in which particulate like material can be identified in dilated small bowel and is best appreciated at the point of transition. CT findings in closed loop obstruction include the presence of focally dilated bowel loop, with a C-shaped or U-shaped or radial configuration depending upon the plane of reconstruction.(22) When the closed loop is twisted, the twisting of mesenteric vessels give the appearances of Whirl's sign.(23) The serrated beak sign refers to the presence of mesenteric vascular engorgement and bowel wall thickening at obstructed site.

3. **Diverticulitis**: CT has important role in diagnosing diverticulitis.(24) The presence of peri-colic fat inflammation is the hall mark of acute diverticulitis, which is seen as fine linear strands, tiny bubbles of extra luminal air and engorgement of vasa-recta, tiny fluid collections can be seen. In severe cases, heterogeneous soft tissue densities representing phlegmon can present as Epiploic appendagitis; these are seen as pericolonic oval shaped lesions with peri-

appendageal fat stranding with surrounding parietal peritoneal thickening.(25) There can be a central high attenuation dot within it, that represents thrombosis of vessel. There can be mass effect on adjacent colon with adjacent focal wall thickening.

4. **Peritonitis**: The peritoneum thickens as a result of pathological conditions, and this thickening might have a smooth, regular pattern, an irregular pattern, or a nodular pattern.

5. **Intussusceptions:** It consists of a central intussusceptum and an external intussuscipiens, divided by mesenteric fat, which appears as a layer of low attenuation. Enhanced vessels are commonly seen within mesenteric fat. The pattern of the picture varies according to position, section axis, thickness of the bowel wall and patency of the lumen. The presence of an intussusception on CT images is similar to that of a "target" mass when the CT beam is perpendicular to the intussusception's longitudinal axis and to the sausage mass when the CT beam is parallel or oblique to the longitudinal axis. (26)

6. **Acute mesenteric ischemia:** Lack of enhancement and pneumatosis can be seen, and the ischemic bowel appears thickened.(27)

7. **Crohn's disease**: The "comb sign" refers to mesenteric findings that include distension of mesenteric vessels that extend toward the small bowel.(28,29) Fibrofatty proliferation is associated with increased fat along mesenteric border of the small bowel leading to bowel loop separation.

8. **Intra-abdominal abscess:** Abscesses may contain septations and have well-defined or irregular margins. The abscess has a fluid density, but because there is

blood, debris, and proteinaceous material present, the attenuation value may be higher. The abscess contains gas, which can be seen as air-fluid levels or as microbubbles. If there is gas within the abscess, the cause may be a gas-producing bacterium like Escherichia coli, Klebsiella, or Clostridium. A fistulous link to the digestive tract should be suspected when air fluid levels are present.

9. **Liver abscess:** CT helps in the identification of the various liver abscesses like pyogenic abscess, amoebic abscess, or fungal abscess. (30)

10. **Splenic infarct:** Infarcts often have a wedge shape; however, they can also have irregular contours. Splenic infarcts do not show enhancement, however the capsule may have peripheral enhancement.(31)

11. **Splenic abscess:** Bacterial abscesses can be solitary and multiloculated. The capsule may show enhancement and septations may be present. Fungal abscesses typically present as multiple, small micro abscesses. They usually measure about 5-10 mm in diameter. They often have low attenuation although a focus of high attenuation or a wheel within a wheel pattern is noticed.(32,33)

12. **Cholecystitis:** CT findings of acute cholecystitis are classified into two criteria: Major and minor. Major criteria include calculi, mural thickening of GB, pericholecystic fluid and sub-serosal edema. Minor criteria include gallbladder distension and sludge. GB wall thickening is a non-specific finding. Punctuate foci of contrast enhancement corresponding to enhancing vessels within GB wall is seen.

13. **Acute pancreatitis:** On a CT scan, the pancreas might have a shaggy contour or appears enlarged with low or heterogeneous gland attenuation. (34) Inflammation

can be seen as haziness of the peripancreatic fat. Fat necrosis, hemorrhage, and extravasation of pancreatic fluid are the causes of low attenuation areas in the peripancreatic region. There are two morphological forms of acute pancreatitis: interstitial or edematous pancreatitis & necrotizing pancreatitis.

Interstitial pancreatitis - The pancreas shows normal enhancement with mild fatty infiltration with absent peripancreatic fluids, so there is no pancreatic parenchymal necrosis.

Necrotizing pancreatitis – occurs in 10-15% of patients. Three subtypes: i) Pancreatic parenchymal tissue and peripancreatic tissue necrosis, ii) Only extra-pancreatic tissue necrosis, iii) Pancreatic parenchymal necrosis without necrosis of surrounding peripancreatic tissue.

Pancreatic parenchymal necrosis can be diagnosed on a CECT $\geqslant$ 72 hours. Peripancreatic tissue necrosis can be very difficult to diagnose, but it is suspected when the collection is inhomogeneous, i.e. various densities on CT. The CT shows an acute necrotizing pancreatitis. The body and tail of the pancreas do not show enhancement. There is normal enhancement of the pancreatic head.

The CT severity index (CTSI) incorporates the Balthazar grade (0-4 points) with the pancreatic necrosis scale (0-6 points) on a 10-point grade scale.

14. **Renal and ureteric calculi:** On CT imaging, calculi differ considerably in density, around 99% of calculi are visible on CT. The radiolucent stones include indinavir stones and pure matrix stones. Most direct CT signs for urolithiasis include visible stone within the lumen of ureter with proximal ureteral dilatation and normal distal caliber ureter. Ureteral stones are commonly lodged in proximal ureter (37%), distal ureter (33%), mid ureter (7%) and uretero-vesical junction (18%) and impacted ureteric stone show soft tissue rim sign.(35) The

soft tissue rim represents edematous wall of ureter around calculus and has sensitivity of 50-77 % and specificity of 90- 100 %. The comet tail sign (36) is created by eccentric tapering of soft tissue area adjacent to the calcification and is a reliable feature in the diagnosis of phleboliths.

15. **Acute pyelonephritis:** Acute pyelonephritis manifests as enlarged kidneys, thickening renal fascia, and perinephric fat stranding. A striated nephrogram pattern is seen after the administration of contrast. (37) There may be delayed contrast excretion and decreased enhancement when the condition is diffuse. When complications develop, it is possible to identify hypodense lesions with areas of water attenuation and bulging renal surfaces with rounded borders and enhancing walls that indicate the existence of abscesses (38). The abscess also shows air pockets.

16. **Aortic aneurysm rupture:** The mural thrombus showing a hyperdense crescent, which is a warning sign that suggests impending rupture. (39) The draped aorta sign, which occurs when the aorta and spine are in close proximity and the aorta is no longer distinguishable from the vertebral body and psoas muscle owing to the lack of peri-aortic fat planes, is another indicator of imminent rupture.

In a study among 496 patients who presented with acute abdominal pain to ED (Emergency Department), the proportion of patients with a correct diagnosis after clinical evaluation increased from 70% to 83% after evaluation with US. (40)

In another study, the accuracy of the clinical diagnosis made before CT was performed, improved from 71% to 93% after CT was performed. The accompanying change in treatment management was 46%.(41)

A study was done among 300 patients who presented with acute abdominal pain, where US revealed a different diagnosis than the clinical impression in 69 (23%; 18.2-27.7%), and confirmed the diagnosis in 121 (40%; 34.4-45.5%) patients. The US changed the treatment plans in 47% (41.3-52.6%) of the patients. (42)

US and CT were compared in a cohort study of 1021 consecutive patients with acute abdominal pain to determine the most urgent diagnosis. Compared to US, CT was substantially more sensitive (89% vs. 70%, P<.001). The diagnostic approach using initial US followed by CT only in negative or inconclusive US cases had the best sensitivity (only 6% of urgent cases were missed). Because just 49% of the patients required a CT scan, using this approach also reduced radiation exposure.(43)

A study showed that abdominal CT was accurate in the diagnosis of surgical processes without and with clinico-biological findings (95.5% and 96.4%, p = 0.51). (19)

Rao PM et al.,(44) identified the signs of acute appendicitis in helical CT and statistically analyzed the sensitivity and specificity values in 200 cases (100 appendicitis and 100 normal appendix cases), demonstrating that CT had high sensitivities and specificities ranging from 91-99% and 91-100%, respectively, in the diagnosis of appendicitis. The enlarged (> 6 mm) unopacified appendix, which was one of the individual CT signs identified, has a high sensitivity and specificity of 93% and 100%, respectively, and is followed by surrounding fat stranding, which has a sensitivity and specificity of 100% and 80%. Over four-fifths of cases have accurate differential diagnoses that are identified by rectal and oral contrast.

Wong SK et al.,(45) with the help of thin-collimation helical CT, conducted a prospective study in 50 patients, , who were clinically diagnosed with appendicitis prior to surgery. This yielded results with 94% accuracy, 95% sensitivity, 92% specificity, 97% positive predictive value, and 86% negative predictive value. In 45 patients (90%) the appendix was identified; in the remaining five it was obscured by an inflammatory mass. The diagnosis of appendicitis may be made quickly, conveniently, and accurately using helical CT and rectal contrast agent. In individuals who would otherwise require a laparotomy, it may provide an alternate, potentially nonsurgical diagnosis. (45)

Bendeck SE et al.,(46) conducted a retrospective study to compare the sensitivity and positive predictive value of CT and Ultrasonography in 313 patients and stated that CT is more sensitive than ultrasound in patients with right iliac fossa pain. The sensitivity for USG and CT were 77% and 93% respectively.

Erik K. Paulson et al.,(47) found that though CT axial sections conducted with IV and oral contrast agents is sensitive and specific for acute appendicitis, In certain cases, the diagnosis may be difficult or ambiguous. For example, it may be difficult to identify the appendix in low peritoneal cavity fat content, posteriorly located appendix, incompletely opacified distal ileum, or the appendix near to the adnexa within the pelvic cavity. In these cases, coronal imaging can improve visibility of appendix and increase the chances of accurate diagnosis of acute appendicitis.

Peck et al.,(48) evaluated 55 cases for the possibility of small bowel obstruction using both CT and barium follow through. Compared to barium follow-through, CT had more sensitivity levels than barium meal follow through (90% and 50% respectively), and both had same specificity of about 57%. Computed

tomography was more accurate in identifying high-grade partial obstruction and complete bowel obstruction.

Durgesh Kumar Saini et al.,(49) 2013, conducted a prospective study in 40 patients of suspected small bowel obstruction for evaluation of the superiority of MDCT over the traditional clinical-radiographic findings. MDCT showed 85% sensitivity and 70% specificity in this study.

Mallo et al.,(50) (2005) studied the sensitivity and specificity of MDCT, which ranged from 81% to 100% and 68% to 100%, respectively, in the assessment of obstructed bowel. The sensitivity and specificity for the MDCT assessment of bowel obstruction were documented as 94% and 96%, respectively, in several other investigations. This discrepancy can result from selecting patients with a high-grade obstruction. The presence of mild and focal intestinal loop dilation may go unreported in cases of low-grade obstruction, which has a negative impact on the sensitivity and specificity of MDCT in detecting bowel obstruction. Therefore, in these situations, it is important to take into account these minute results, which might increase the accuracy rates for identifying bowel obstruction using MDCT. (15)

Ha HK et al.,(51) conducted a retrospective study on 84 patients for evaluation of the usefulness of CT for the differentiation of simple (n = 43) and strangulated (n = 41) small-bowel obstructions caused by adhesions, hernia, and volvulus. Surgery (n = 55) and clinical follow-up (n = 29) were used to make diagnoses. CT results demonstrated 100% specificity for the detection of strangulated blockages with no or minimal intestinal wall enhancement. (18) Sensitivity, specificity, and accuracy ratings for detecting more than 50% of pancreatic necrosis were 100%, 100%, and 87%, respectively. The sensitivity for small necrotic regions

during surgery was around 50%. For the diagnosis of acute pancreatitis, CT scans had no false-positive rates.(51)

Balthazar EJ et al.,(52) conducted his study based on the revised Atlanta classification. CECT serves as the initial imaging modality for accurately establishing the criteria based on the images in acutely ill patients. 80% of cases of acute pancreatitis are caused by gallstones and alcoholism. MDCT scanning with bolus IV contrast is carried out to assess the pancreas' morphology, analyse the necrosis of the pancreas, and identify any retroperitoneal complications. When considering the risk of death & the progression of both the systemic and local problems, the CT Severity Index (CTSI) is a useful indication of disease severity in this group. Additionally, MDCT is a helpful tool for monitoring these patients' progress toward clinical recovery.(52)

For patients which do not show symptoms of acute pancreatitis and for those whose clinical condition improves, CECT is not indicative. After 72 hours, it is best to assess the complications of acute pancreatitis. It is advised to repeat the CT scan in setting of fever, abnormal blood investigations, or septic shock. CT is a helpful interventional tool for placing catheters for drainage and assessing patients' level of recovery. If the patient has symptoms of acute pancreatitis, CECT also helps to determine whether there are any other causes of acute abdomen.(52)

MDCT is a decisive tool for determining the extent of the disease due to the use of post-processing techniques. VRT is an effective method for determining the severity of complications such as pseudo-cysts and their relationships to adjacent structures, venous thrombosis, pseudo aneurysms of the splenic artery and

collateralization. (52) Curved planar reconstructions are highly effective in defining the complex anatomical relationships of pancreatic ducts and vessels.(53)

Unenhanced (NECT) and post-contrast studies were performed during the "pancreatic phase" (40 seconds) , "portal phase" (70 seconds) and "late phase" (180 seconds) of the MDCT protocol. Calcified gallstones were detected using NECT scans. A contrast enhanced CT scan was routinely carried out to show vascular and loco regional complications as well as to determine the extent of necrosis (extension<30%, 30-50%, and > 50%). It is critical to recognize patients who are at a high risk for developing a life threatening conditions because they need to be monitored closely and may need intervention.(53)

The CT severity index is determined based on the imaging appearance of pancreatitis, which shows an enlarged pancreas with a thick fluid collection surrounding it. CT may not show any pathology in patients with mild forms. (54) In severe necrotizing cases, the presence and extent of collections are also well delineated, with distinct zones of normal and necrotic parenchyma. Peripancreatic exudates spread into the surrounding structures through the fascial planes.

Suri SG et al., conducted a prospective study on 32 patients to assess the plain film, US and CT in diagnosis of the intestinal obstruction. There were 32 patients, and 30 of them had intestinal obstructions (22 had small bowel obstruction and 8 had large bowel obstruction). The second patient had a mesenteric cyst, while the other had an adynamic ileus. CT exhibited strong blockage detection sensitivity (93%), specificity (100%), and accuracy (94%). On CT, US, and plain films, the amount of blockage was properly predicted in 93%, 70%, and 60% of the cases, respectively. When it came to identifying the cause of blockage, CT (87%) surpassed US (23%) and

conventional radiography (7%) by a wide margin. Study concluded that CT is a highly accurate method in the evaluation of intestinal obstruction especially for determining the level and cause of obstruction and should be the technique of choice when clinical or plain radiographic findings are equivocal.[2]

Macari M et al., conducted a retrospective study on 31 patients to assess the role of CT whirl sign in differentiating the sigmoid from cecal volvulus. CT whirl sign was present in all 31 patients with colonic volvulus. The CT whirl sign was not present in any of the kidney stone patients who underwent NCCT. Fisher's exact test revealed a highly significant correlation (p=0.0001) between the position of the colonic volvulus and the twist's direction (right versus mid-left) (cecal versus sigmoid). A total diagnostic accuracy of 96.8% (30/31) was achieved by using the position of the twist as a predictor of whether the volvulus was cecal or sigmoid. This method correctly identified 93.3% of patients with cecal volvulus and 100% of patients with sigmoid volvulus. Study concluded that the location of the mesenteric twist (CT whirl sign) is a highly accurate finding in discriminating the cecal volvulus from the sigmoid volvulus. (55)

Chuong AM et al., conducted a study for assessment of the bowel wall enhancement in diagnosis of intestinal ischemia and concluded on the basis of decreased bowel wall enhancement, that adding unenhanced CT to contrast-enhanced CT improved the sensitivity, diagnostic confidence, and interobserver agreement of the diagnosis of ischemia, which is a complication of mechanical small bowel obstruction. (56)

Kircher MF et al., conducted study to assess the frequency, sensitivity, specificity of diverticulitis on thin section helical CT. Study found that the most

frequent signs of diverticulitis were bowel wall thickening and fat stranding while the most specific signs were fascial thickening, free fluid and inflamed diverticula. Overall CT interpretation had a sensitivity of 99%, a specificity of 99%, a positive predictive value of 99%, a negative predictive value of 99%, and an overall accuracy of 99%.(57)

Kessner R et al., conducted a study to assess the CT for non-traumatic abdominal pain. There were 92 women and 82 males in each group. The two groups were 48 years of age on average. The primary clinical diagnoses were colitis (5.2%), diverticulitis (10.9%), and appendicitis (17.5%). 34.8% of the patients had a normal CT scan result. Most of the clinical indicators that were investigated showed no discernible difference between the groups. No patient required to undergo extra scans to confirm a diagnosis since none of the 174 patients in the research group's exams were judged to be technically deficient. The absence of oral contrast was not important in 96.6% of the instances and may have been helpful in just 6 of the 174 study group patients (3.4%). Of the 174 patients in the control group, the radiologists only identified 8 (4.6%) to benefit from oral contrast. Clinical and radiological diagnoses did not differ significantly between the two groups (study group, P = 0.261; control group, P = 0.075). According to research, most patients who visit the ED complaining of acute, nontraumatic abdominal discomfort do not require oral contrast to help with the radiographic diagnosis. Therefore, there will be no impact on the effectiveness of radiological diagnostic imaging if these patients receive abdominal CT scanning without oral contrast. (58)

Padidar AM et al., conducted a retrospective study to differentiate the sigmoid diverticulitis from carcinoma on CT scan. Patients with sigmoid diverticulitis

had the CT findings more often than those with cancer (p.001). The specificity, sensitivity, and positive predictive value of fluid at the base of the mesentery for diverticulitis were 90%, 36%, and 89%, respectively. The specificity, sensitivity, and positive predictive value of vascular engorgement were 56%, 29%, and 100%, respectively. According to the data, fluid at the root of the mesentery and vascular engorgement are CT features that can help distinguish between sigmoid diverticulitis and sigmoid cancer.(59)

MATERIAL & METHOD

Source of data: Patients presenting with acute abdomen clinically suspected of having non-traumatic bowel emergencies referred to the Department of Radio-Diagnosis at the KLE's Dr. Prabhakar Kore Hospital & MRC, Belagavi.

Method of collection of data:

Study design: Hospital based cross-sectional study

Sample size: Study comprises of 77 patients.

Sample size formula:

The minimum sample size formula based on prevalence rate is

$$n = \frac{z_\alpha{}^2 P(1-P)}{d^2}$$

where P is the percentage of prevalence and d is the percentage likely difference in the prevalence.

z_α is linked with the level of significance. For 5% level of the significance z_α = 1.96.

Ref:

With P = 56.6% and d = 20% of P = 11.3, the sample size is 75.

Sampling method: Universal sampling

Study duration: 1st January 2021- 31st December 2021 (12 months)

Inclusion criteria: Any case of acute abdomen in adult population with clinical suspicion of emergency bowel pathologies presenting with symptoms:

i. Pain abdomen

ii. Vomiting

iii. Nausea

iv. Diarrhoea

v. Fever

vi. Bloating

Exclusion criteria

i. Pregnant women (contraindication for radiation exposure).

ii. Paediatric population (<18 years).

iii. People having history of abdominal trauma.

iv. People diagnosed with extra-bowel cause of abdominal pain like pain of renal origin.

Methodology

Using a pre-designed and pre-tested questionnaire, data was collected in patients presenting with acute abdomen with clinical suspicion of having non traumatic bowel emergencies referred for computed tomography study to the Department of Radio-Diagnosis at the KLE's Dr. Prabhakar Kore Hospital & MRC, Belagavi. Written informed consent was obtained from all the study participants.

Patients underwent computed tomography scan (128 multislice GE Revolution) to diagnose the cause of acute abdomen. Standard scan protocol was followed for all the patients undergoing computed tomography. All patients were given intravenous contrast agents. The region of interest from the lower chest till the inguinal region was scanned four consecutive times to obtain images in arterial, porto-venous, venous and in delayed phases.

Once the computed tomography was done, data collection was done by personal interview, physical examination & CT scan by investigator. All the data collected were entered in to MS Excel sheet data and was tabulated in the form of tables, charts, and graphs.

Does the study require any investigations or interventions to be conducted on patients or other humans or animals? If so, please describe briefly:

Yes, computed tomography of patients with acute abdomen was done. Healthy humans or animals were not involved in this study.

Has ethical clearance been obtained from your institution in case of 7.3?

Yes. Clearance obtained from the Institute Ethics Committee for Human Subjects Research of Jawaharlal Nehru Medical College, Belagavi.

Statistical analysis

Since the study is of observational type, the plan of analysis as follows:

For the continuous quantitative variables, mean and standard deviation were calculated.

Discrete variables were represented by median. The categorical data was expressed in terms of rates, ratios and percentages.

Apart from the above, suitable tools like ANOVA, correlation, regression etc., was used according to the need.

Suitable graphs were used to depict the comparison.

For all the tests, the value of p less than 5% (0.05) was considered significant.

RESULTS

This study includes 77 subjects, whose age ranges from 18 to 93 years with mean age of 47.26 ± 20.41 years. The following table gives the distribution of subjects according to different variables.

Table 2: Distribution of subjects according to different variables.

Variables	Sub Category	Number of subjects (%)
Age (years)	Mean ± SD	47.26 ± 20.41
	Median (Min, Max)	46 (18, 93)
Gender	Female	27 (35.06%)
	Male	50 (64.94%)
Chief complaints	Pain abdomen	75 (97.4%)
	Blood in stools	3 (3.9%)
	Loose stools	2 (2.6%)
	Abdominal distension	1 (1.3%)
	Bloating	3 (3.9%)
	Diarrhoea	1 (1.3%)
	Distension	4 (5.19%)
	Fever	19 (24.68%)
	Vomiting	38 (49.35%)
	Nausea	1 (1.3%)

	Constipation	1 (1.3%)
Duration (days)	Mean ± SD	2.49 ± 1.5
	Median (Min, Max)	2 (1, 8)
Diagnosis	Acute appendicitis	21 (27.27%)
	Acute GI hemorrhage	4 (5.19%)
	Colonic diverticulitis	2 (2.6%)
	LBI	2 (2.6%)
	LBO	12 (15.58%)
	SBI	7 (9.09%)
	SBO	29 (37.66%)
Management	Conservative	12 (15.58%)
	EXP. Laparotomy	47 (61.04%)
	LAP. Appendicectomy	18 (23.38%)
Outcome	Expired	13 (16.88%)
	Improved	64 (83.12%)

Out of 77 subjects, 50 (64.94%) were males and 27 (35.06%) were females with gender ratio of 1.85:1. Majority subjects had pain abdomen as chief complaint. Health condition of 64 (83.12%) subjects improved while 13 (16.88%) subjects expired.

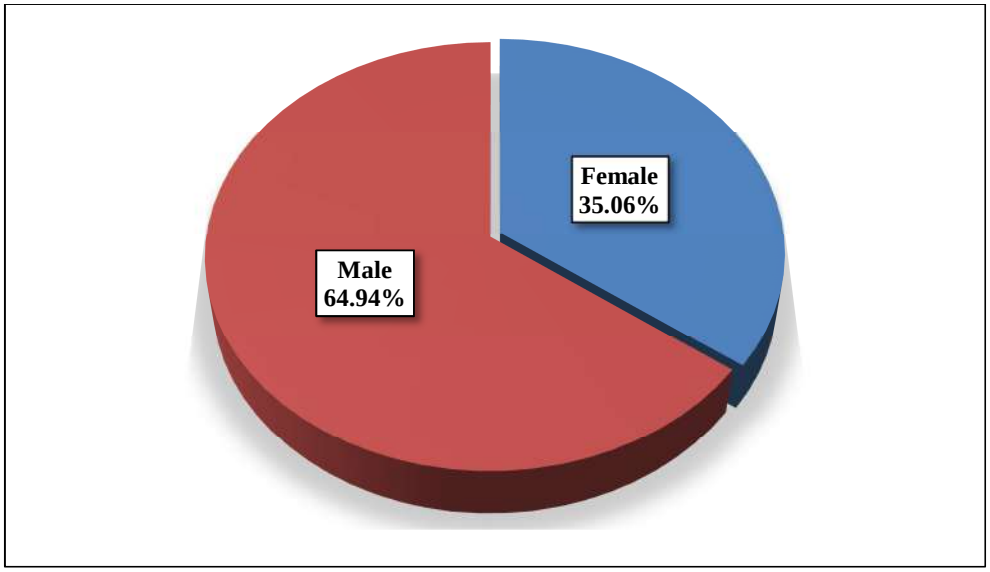

Figure 3: Graphical representation of subjects according to sex.

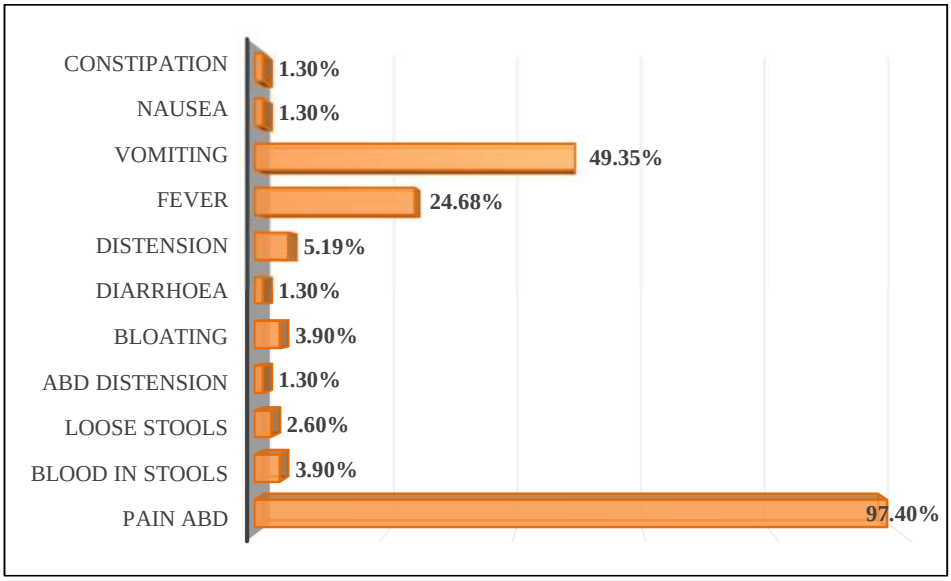

Figure 4: Graphical representation of subjects according to chief complaints.

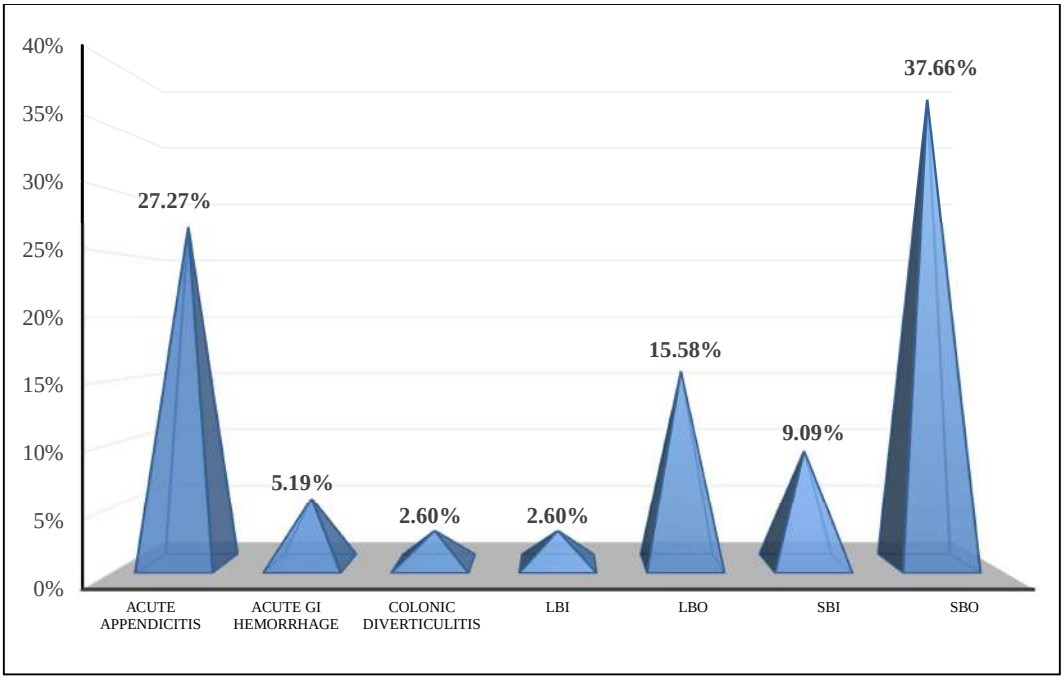

Figure 5: Graphical representation of subjects according to diagnosis.

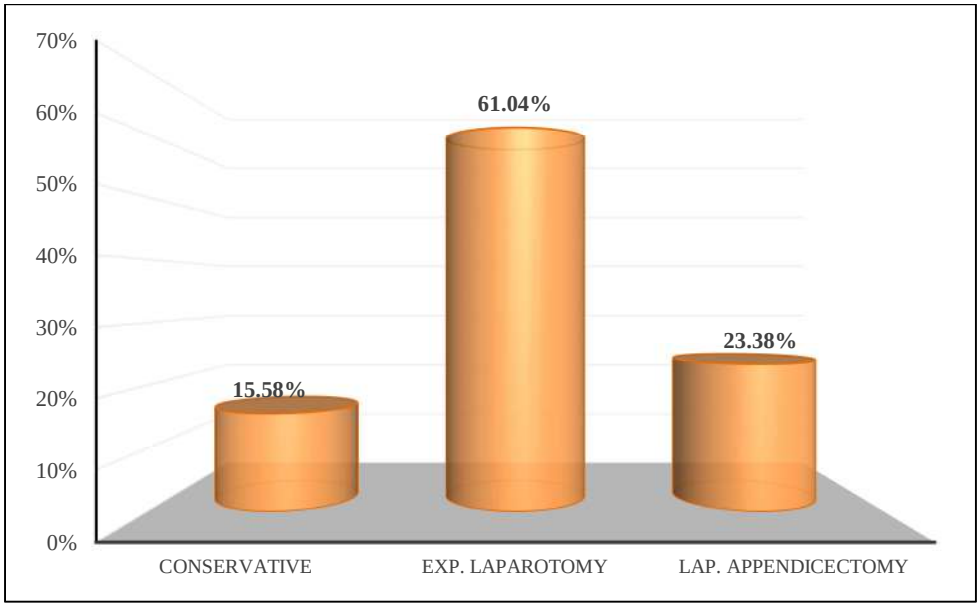

Figure 6: Graphical representation of subjects according to management.

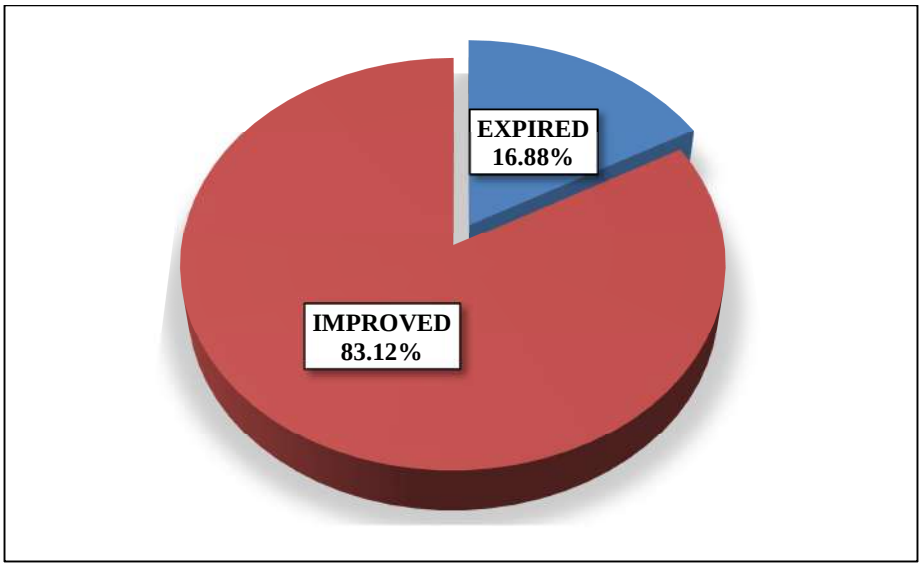

Figure 7: Graphical representation of subjects according to outcome.

The following table gives distribution of different diseases in subjects with acute appendicitis.

Table 3: Descriptive analysis of radiological features in subjects with acute appendicitis.

Features	Sub Category	Number of subjects (%)
Pneumoperitoneum	Absent	20 (95.24%)
	Present	1 (4.76%)
Dilated appendix	Present	21 (100%)
Peri appendiceal collection	Absent	14 (66.67%)
	Present	7 (33.33%)
Wall enhancement	Absent	2 (9.52%)
	Present	19 (90.48%)
Appendicolith	Absent	17 (80.95%)
	Present	4 (19.05%)
Fat stranding	Absent	2 (9.52%)
	Present	19 (90.48%)
Lymphadenopathy	Absent	1 (4.76%)
	Present	20 (95.24%)
Ascites	Absent	18 (85.71%)
	Present	3 (14.29%)

Out of 21 subjects with acute appendicitis, 1 (4.76%) had pneumoperitoneum, 7 (33.33%) had peri-appendiceal collection, 19 (90.48%) had wall enhancement, 4 (19.05%) had appendicolith, 19 (90.48%) had fat stranding, 20 (95.24%) had lymphadenopathy, 3 (14.29%) had ascites and all (100%) had dilated appendix.

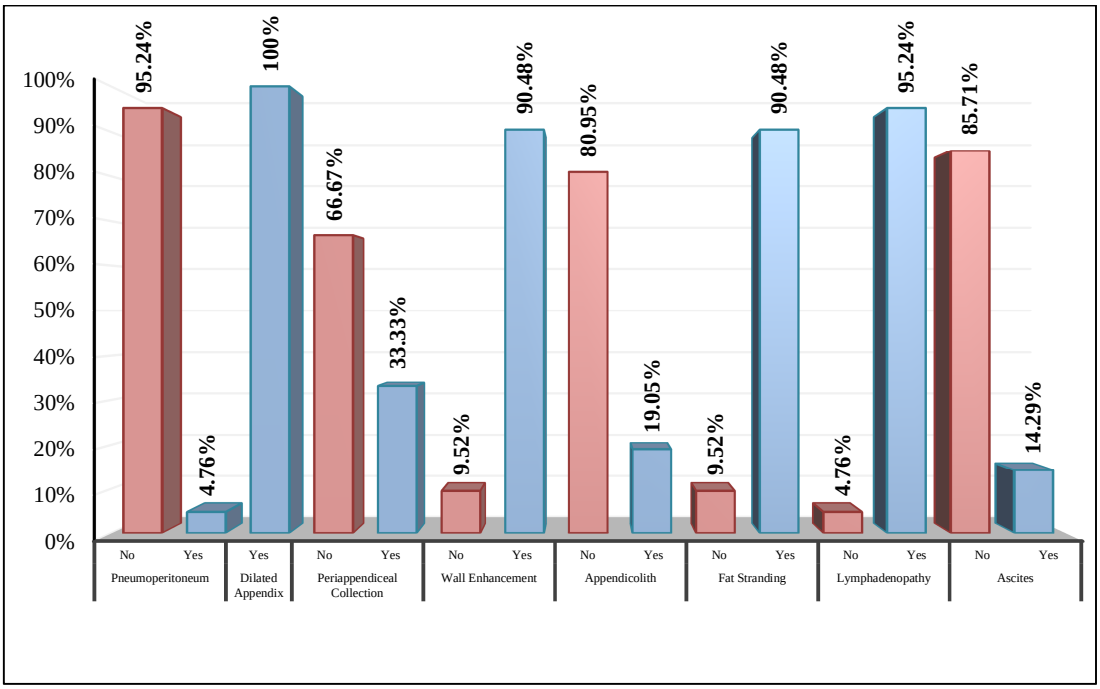

Figure 8: Graphical representation of radiological features in subjects with acute appendicitis.

The following table gives the distribution of different diseases in subjects with acute gastrointestinal hemorrhage.

Table 4: Descriptive analysis of radiological features in subjects with acute GI hemorrhage.

Features	Sub Category	Number of subjects (%)
Pneumoperitoneum	Absent	1 (25%)
	Present	3 (75%)
Pneumatosis Intestinalis	Absent	2 (50%)
	Present	2 (50%)
Submucosal Hemorrhage	Absent	2 (50%)
	Present	2 (50%)
Wall Enhancement	Absent	2 (50%)
	Present	2 (50%)
Fat Stranding	Absent	1 (25%)
	Present	3 (75%)
Lymphadenopathy	Present	4 (100%)
Ascites	Present	4 (100%)

Out of 4 subjects with acute GI hemorrhage, 3 (75%) had pneumoperitoneum, 2 (50%) had pneumatosis intestinalis, 2 (50%) had submucosal hemorrhage, 2 (50%) had wall enhancement, 3 (75%) had fat stranding and all had lymphadenopathy and ascites.

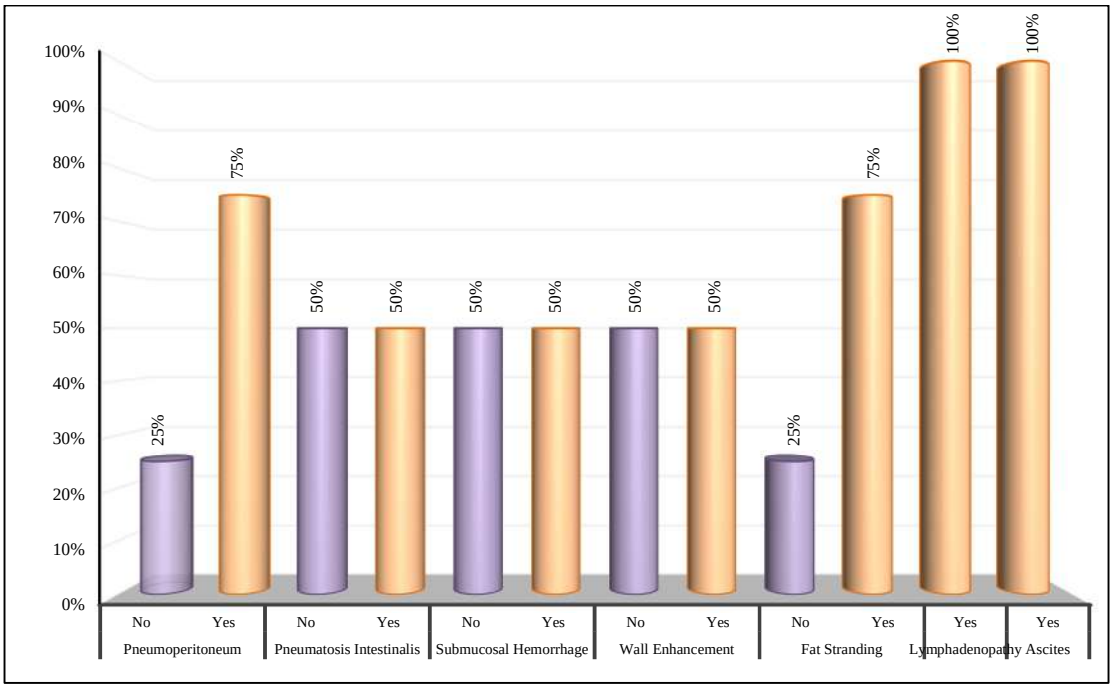

Figure 9: Graphical representation of radiological features in subjects with acute GI hemorrhage.

The distribution of subjects according to site of acute GI hemorrhage.

Table 5: Distribution of subjects according to site of acute GI hemorrhage.

Site	Number of subjects (%)
Ascending Colon	1 (25%)
Jejunum	1 (25%)
Proximal Ileum	1 (25%)
Sigmoid Colon	1 (25%)

Out of 4 subjects with acute GI hemorrhage, 1 (25%) subject had hemorrhage in ascending colon, 1 (25%) in jejunum, 1 (25%) in proximal ileum and 1 (25%) in sigmoid colon.

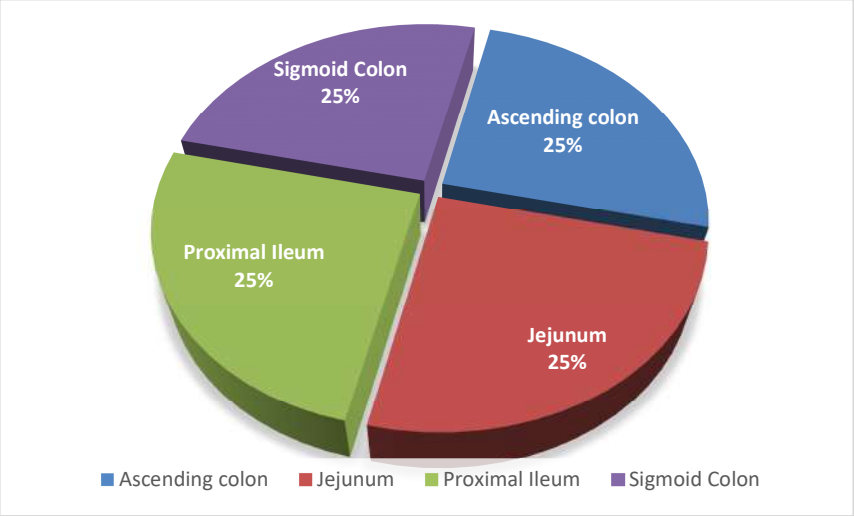

Figure 10: Graphical representation of distribution of site of acute GI hemorrhage.

The following table gives the distribution of different diseases in subjects with colonic diverticulitis.

Table 6: Descriptive analysis of radiological features in subjects with colonic diverticulitis.

Features	Sub Category	Number of subjects (%)
Pneumoperitoneum	Present	2 (100%)
Wall Enhancement	Present	2 (100%)
Fat Stranding	Present	2 (100%)
Lymphadenopathy	Present	2 (100%)
Ascites	Absent	1 (50%)
	Present	1 (50%)

Out of 2 subjects with colonic diverticulitis, ascites was observed in 1 (50%) subject. Pneumoperitoneum, wall enhancement, fat stranding and lymphadenopathy were observed in both (100%) the subjects. The site of disease is sigmoid colon.

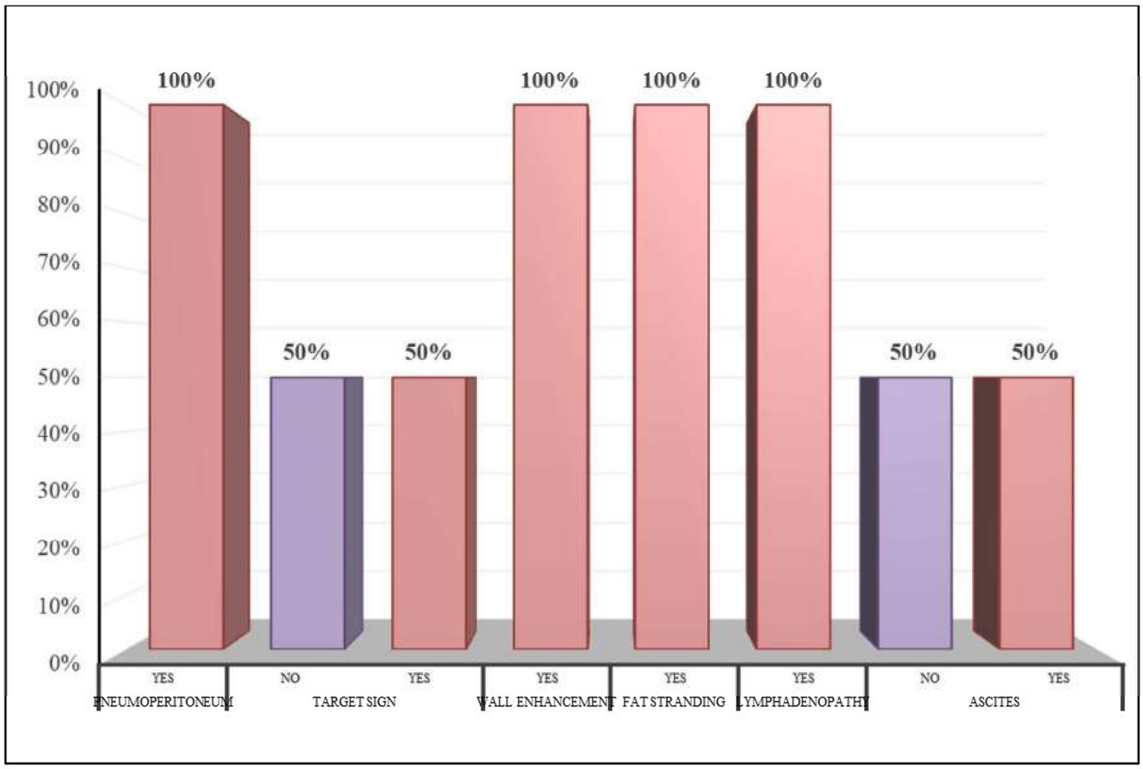

Figure 11: Graphical representation of radiological features in subjects with Colonic diverticulitis.

The following table gives the distribution of different diseases in subjects with LBI.

Table 7: Descriptive analysis of radiological features in subjects with LBI.

Features	Sub Category	Number of subjects (%)
Pneumoperitoneum	Absent	1 (50%)
	Present	1 (50%)
Wall hypo-enhancement	Present	2 (100%)
Target sign	Present	2 (100%)
Pneumatosis intestinalis	Present	2 (100%)
Submucosal hemorrhage	Absent	1 (50%)
	Present	1 (50%)
Fat stranding	Present	2 (100%)
Lymphadenopathy	Present	2 (100%)
Ascites	Present	2 (100%)

Out of 2 subjects with LBI, 1 (50%) subject had pneumoperitoneum and submucosal hemorrhage in ascending colon. Wall hypo-enhancement, target sign, pneumatosis intestinalis, fat stranding, lymphadenopathy and ascites were observed in both (100%) the subjects.

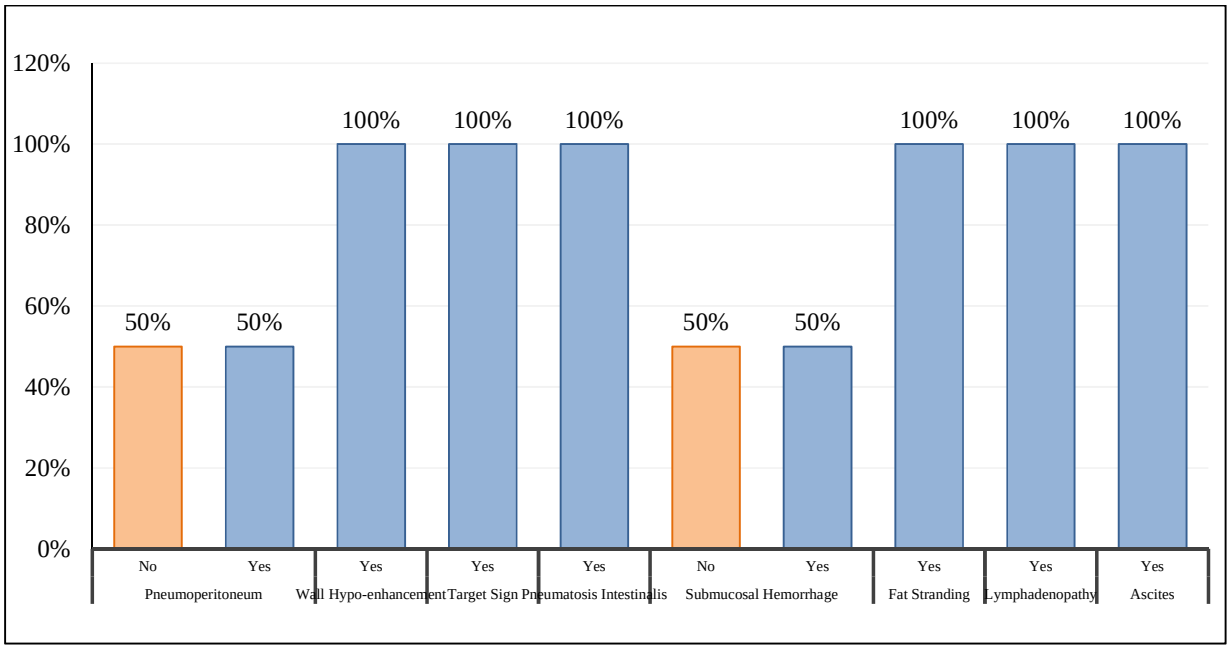

Figure 12: Graphical representation of radiological features in subjects with LBI.

The distribution of subjects according to site in LBI.

Table 8: Distribution of subjects according to site in LBI.

Site	Number of subjects (%)
Ascending colon	1 (50%)
Sigmoid Colon	1 (50%)

Out of 2 subjects with LBI, 1 (50%) subject had ischemia in ascending colon and 1 (50%) in sigmoid colon.

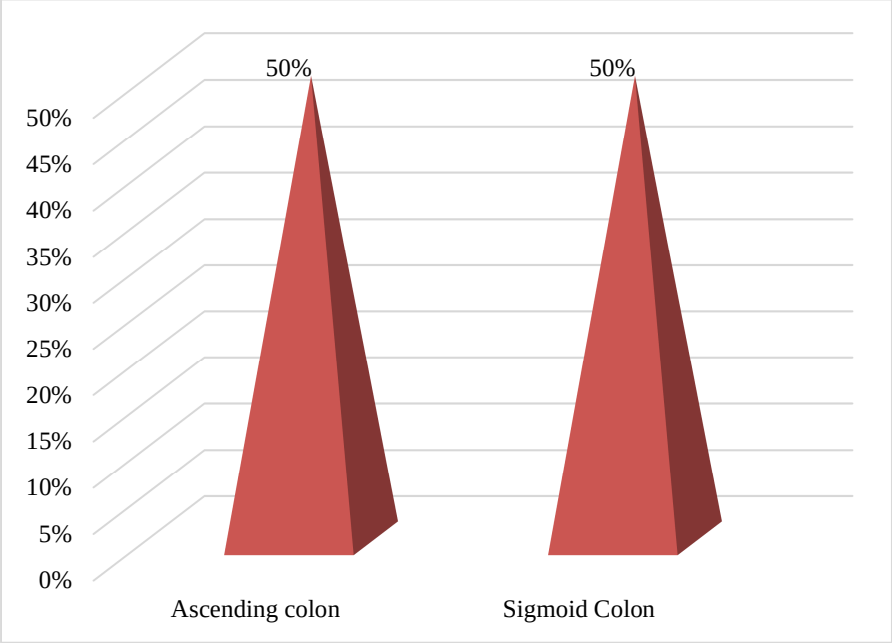

Figure 13: Graphical representation of distribution of site of LBI.

The following table gives the distribution of different diseases in subjects with LBO.

Table 9: Descriptive analysis of radiological features in subjects with LBO.

Features	Sub Category	Number of subjects (%)
Transition Point	Absent	1 (8.33%)
	Present	11 (91.67%)
Pneumoperitoneum	Absent	6 (50%)
	Present	6 (50%)
Target Sign	Absent	9 (75%)
	Present	3 (25%)
Wall Enhancement	Absent	11 (91.67%)
	Present	1 (8.33%)
Fat Stranding	Absent	5 (41.67%)
	Present	7 (58.33%)
Lymphadenopathy	Absent	3 (25%)
	Present	9 (75%)
Ascites	Absent	5 (41.67%)
	Present	7 (58.33%)

Out of 12 subjects with LBO, 11 (91.67%) subjects had transition point. 2 (16.67%) had small bowel feces sign, 6(50%) had pneumoperitoneum, 3 (25%) had target sign, 1 (8.33%) had wall enhancement, 7 (58.33%) had fat stranding, 9 (75%) had lymphadenopathy and 7 (58.33%) had ascites.

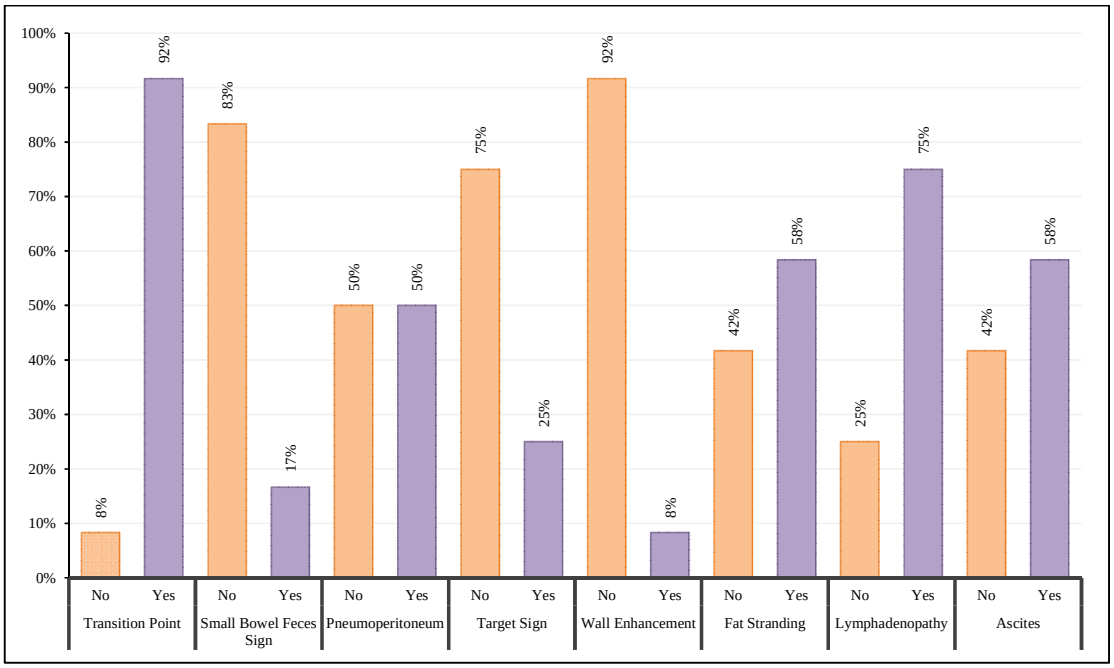

Figure 14: Graphical representation of radiological features in subjects with LBO.

The distribution of subjects according to site in LBO.

Table 10: Distribution of subjects according to site in LBO.

Site	Number of subjects (%)
Ascending colon	2 (16.67%)
Descending Colon	5 (41.67%)
Sigmoid Colon	3 (25%)
Transverse Colon	2 (16.67%)

Out of 12 subjects with LBO, 2 (16.67%) subjects had obstruction in ascending colon, 5 (41.67%) in descending colon, 3 (25%) in sigmoid colon and 2 (16.67%) in transverse colon.

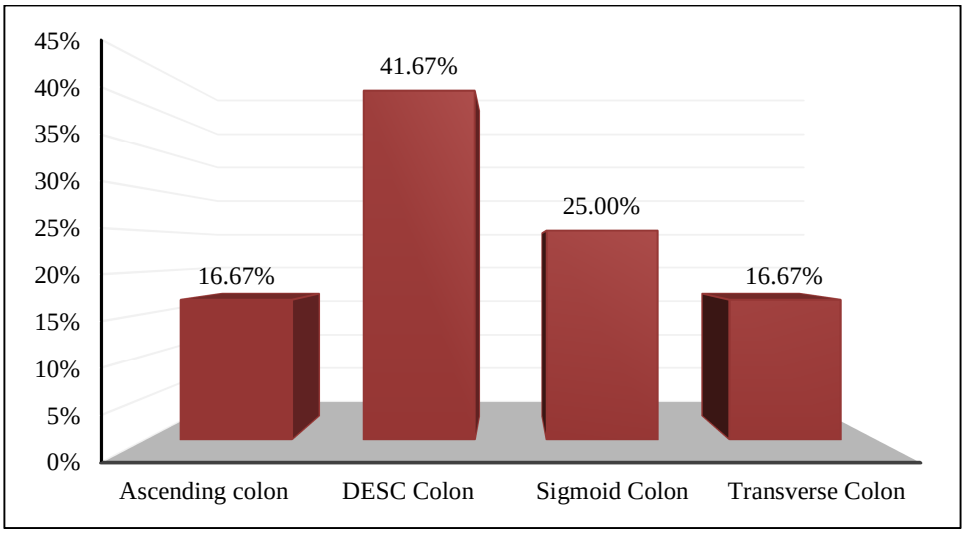

Figure 15: Graphical representation of distribution of site of LBO.

The following table gives the distribution of different diseases in subjects with SBI.

Table 11: Descriptive analysis of radiological features in subjects with SBI.

Features	Sub Category	Number of subjects (%)
Pneumoperitoneum	Absent	3 (42.86%)
	Present	4 (57.14%)
Wall Hypo-enhancement	Present	7 (100%)
Target Sign	Absent	1 (14.29%)
	Present	6 (85.71%)
Pneumatosis Intestinalis	Absent	1 (14.29%)
	Present	6 (85.71%)
Submucosal Hemorrhage	Absent	3 (42.86%)
	Present	4 (57.14%)
Wall Enhancement	Absent	6 (85.71%)
	Present	1 (14.29%)
Fat Stranding	Absent	3 (42.86%)
	Present	4 (57.14%)
Lymphadenopathy	Absent	2 (28.57%)
	Present	5 (71.43%)
Ascites	Absent	2 (28.57%)
	Present	5 (71.43%)

Out of 7 subjects with SBI, 4 (57.14%) had pneumoperitoneum, 6 (85.71%) had target sign, 6 (85.71%) had pneumatosis intestinalis, 4 (57.14%) had submucosal hemorrhage, 1 (14.29%) had wall enhancement, 4 (57.14%) had fat stranding, 5 (71.43%) had lymphadenopathy, 5 (71.43%) had ascites and all 7 (100%) had wall hypo-enhancement.

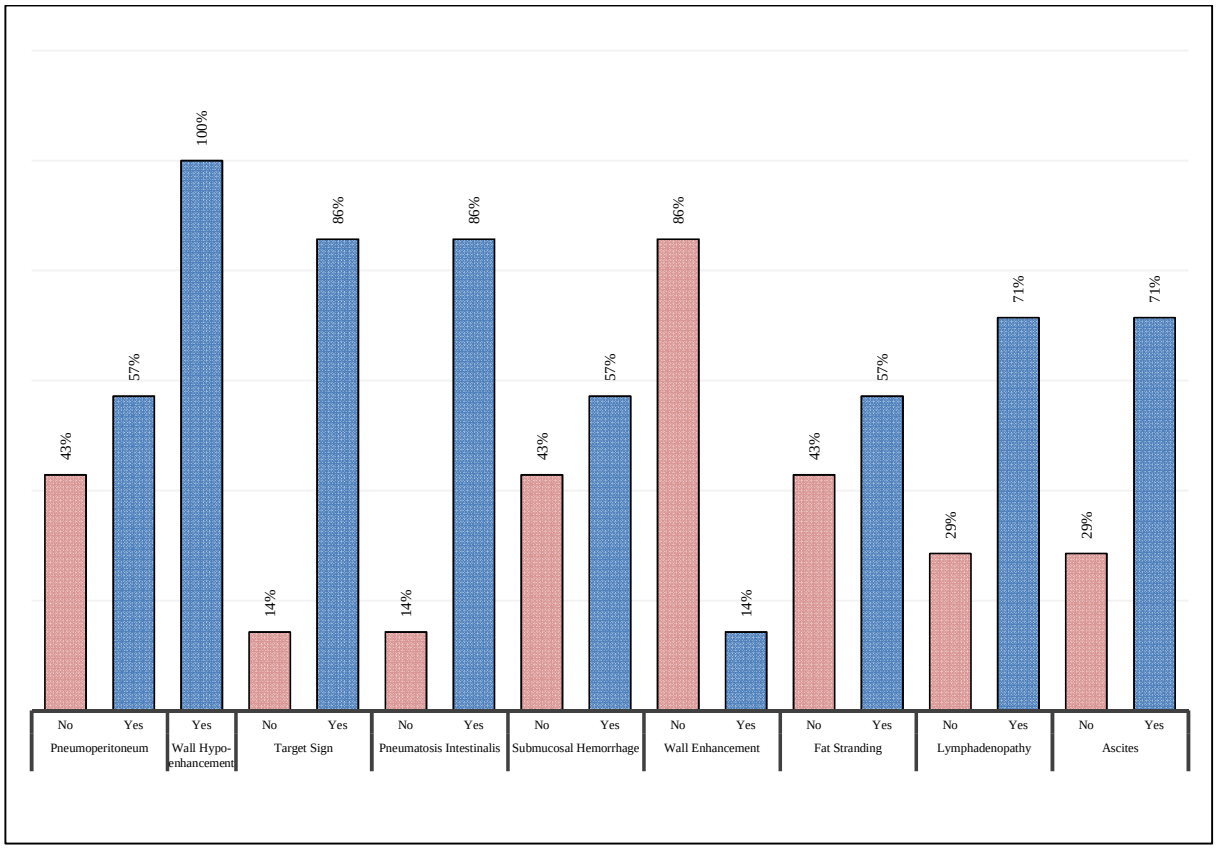

Figure 16: Graphical representation of radiological features in subjects with SBI.

The distribution of subjects according to site of SBI.

Table 12: Distribution of subjects according to site of SBI.

Site	Number of subjects (%)
Ileum	2 (28.57%)
Jejunum	3 (42.86%)
Jejunum & Ileum	2 (28.57%)

Out of 7 subjects with SBI, 2 (28.57%) subjects had ischemia in ileum, 3 (42.86%) in jejunum and 2 (28.57%) in both jejunum & ileum.

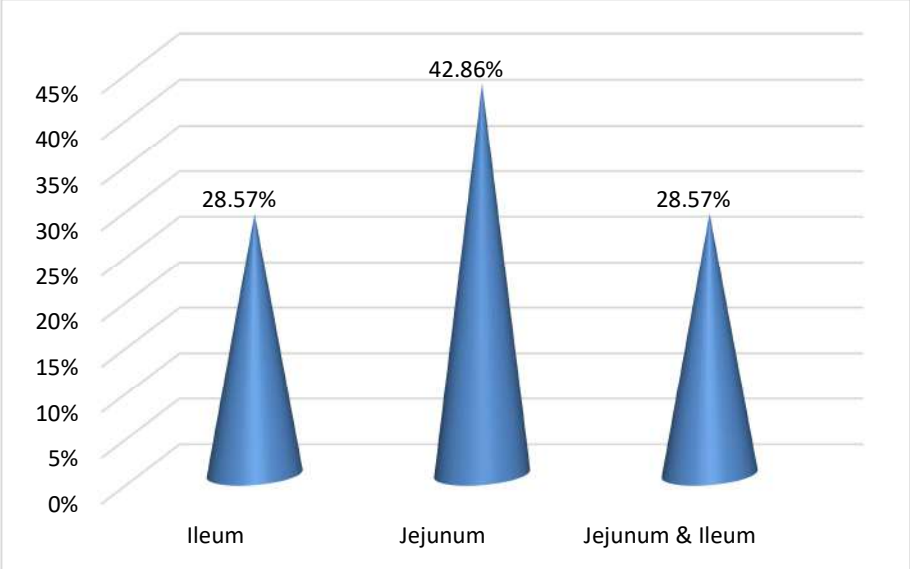

Figure 17: Graphical representation of distribution of site of SBI.

The following table gives the distribution of different diseases in subjects with SBO.

Table 13: Descriptive analysis of radiological features in subjects with SBO.

Features	Sub Category	Number of subjects (%)
Transition Point	Absent	3 (10.34%)
	Present	26 (89.66%)
Small Bowel Feces Sign	Absent	19 (65.52%)
	Present	10 (34.48%)
Pneumoperitoneum	Absent	23 (79.31%)
	Present	6 (20.69%)
Target Sign	Absent	26 (89.66%)
	Present	3 (10.34%)
Wall Enhancement	Absent	23 (79.31%)
	Present	6 (20.69%)
Fat Stranding	Absent	15 (51.72%)
	Present	14 (48.28%)
Lymphadenopathy	Absent	14 (48.28%)
	Present	15 (51.72%)
Ascites	Absent	10 (34.48%)
	Present	19 (65.52%)

Out of 29 subjects with SBO, 26 (89.66%) had transition point, 10 (34.48%) had small bowel feces sign, 6 (20.69%) had pneumoperitoneum, 3 (10.34%) had target sign, 6 (20.69%) had wall enhancement, 1 (3.45%) had appendicolith, 14 (48.28%) had fat stranding, 15 (51.72%) had lymphadenopathy and 19 (65.52%) had ascites.

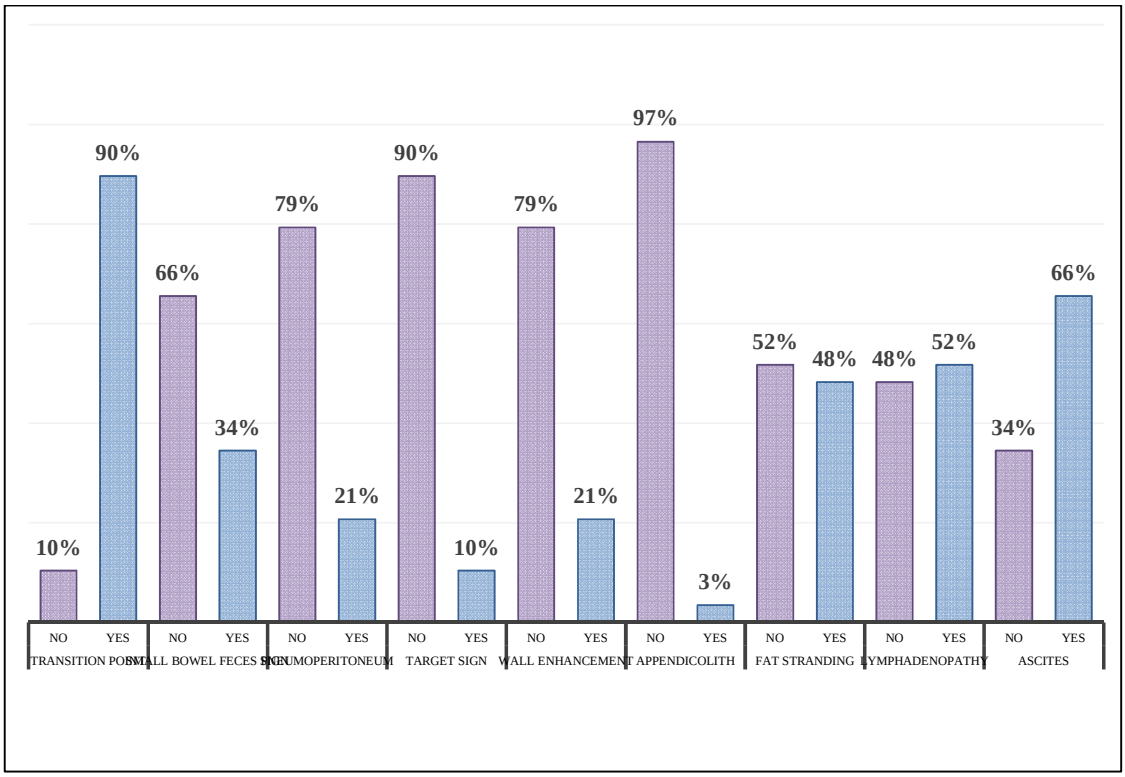

Figure 18: Graphical representation of radiological features in subjects with SBO.

The distribution of subjects according to site of SBO.

Table 14: Distribution of subjects according to site of SBO.

Site	Number of subjects (%)
Distal ileum	12 (41.38%)
Distal Jejunum	4 (13.79%)
Mid Ileum	6 (20.69%)
Mid Jejunum	1 (3.45%)
Proximal Ileum	3 (10.34%)
Terminal Ileum	3 (10.34%)

Out of 29 subjects with SBO, 12 (41.38%) subjects had obstruction in distal ileum, 4 (13.79%) in distal jejunum, 6 (20.69%) in mid ileum, 1 (3.45%) in mid jejunum, 3 (10.34%) in proximal ileum and 3 (10.34%) in terminal ileum.

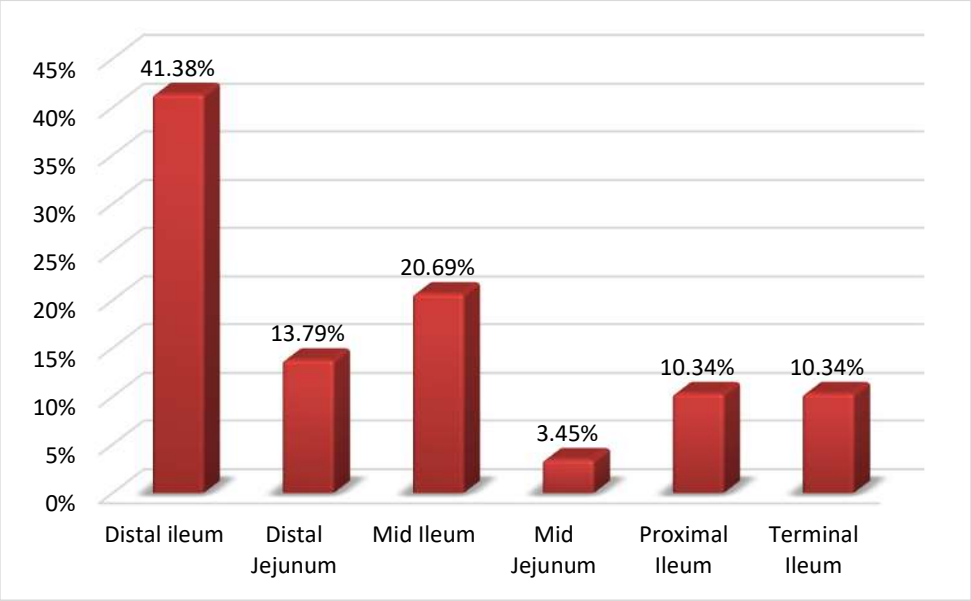

Figure 19: Graphical representation of distribution of site of SBO.

DISCUSSION

Acute abdomen is one of the most common emergencies presenting to the casualty in adult population. Imaging is crucial in the diagnosis because it helps to differentiate among the various causes of acute abdominal pain.

Computed tomography (CT) has revolutionized the management of abdominal pain by providing swift and effective diagnosis & treatment of abdominal pathologies by enabling early therapeutic interventions. CT scan is usually considered as the investigation of choice for diagnosis of numerous abdominal pathologies. Early diagnosis of bowel emergencies with CT can help in decreasing morbidity and mortality.

The present cross-sectional study explores the role of CT in 7 most common non-traumatic bowel emergencies that include acute appendicitis, acute GI hemorrhage, colonic diverticulitis, small bowel obstruction, small bowel ischemia, large bowel obstruction and large bowel ischemia.

Sample size in the present study was 77. Other studies have a sample size ranging from 40-462. For instance, Ha HK et al. took a sample size of 84 and PM Rao et al. conducted his study on 200 patients.

In the present study, the age ranges from 18 to 93 years with mean age of 47.26 ± 20.41 years. In another studies, patient age ranges from 25-90. For example, in a study conducted by Chuong AM et al., the mean age of the patients was 71.2 years.

In the present study, females constitute 35.06% of the sample size while the males constitute 64.94%. However, in the study by Yoshito Tsushima et al., females constitute 40.8% of the cases while the rest 59.2% were males.

In the present study, the most common presenting complaint was abdominal pain (97.4%) and the second most common was vomiting (49.35%). The other complaints were fever, abdominal distension, blood in stools, bloating, loose stools, diarrhoea, nausea and constipation. According to the prospective study done by Durgesh Kumar Saini et al. on 40 patients, 100% complained of abdominal pain while vomiting, abdominal distension and constipation were complained by 67.5%, 82.5% and 60% respectively.

According to this study, acute appendicitis, acute GI hemorrhage, colonic diverticulitis, large bowel ischemia, large bowel obstruction, small bowel ischemia and small bowel obstruction had prevalence of 27.27%, 5.19%, 2.6%, 2.6%, 15.58%, 9.09% and 37.66% respectively.

The duration of presenting complaints ranges from 1 to 8 days with mean duration being 2.49 ± 1.5 days.

In this study, out of 21 subjects with acute appendicitis, 1 (4.76%) had pneumoperitoneum, 7 (33.33%) had peri appendiceal collection, 19 (90.48%) had wall hyper-enhancement, 4 (19.05%) had appendicolith, 19 (90.48%) had peri-appendiceal fat stranding, 20 (95.24%) had lymphadenopathy, 3 (14.29%) had ascites and all (100%) had dilated appendix. According to study done by PM Rao et al., out of 100 patients with acute appendicitis 100% showed fat stranding, 6% showed wall

hyper-enhancement, 44% showed appendicolith, and 93% showed enlarged unopacified appendix.

In this study, 4 patients had acute GI hemorrhage, out of which, 3 (75%) had pneumoperitoneum, 2 (50%) had pneumatosis intestinalis, 2 (50%) had submucosal hemorrhage, 2 (50%) had wall enhancement, 3 (75%) had fat stranding and all had lymphadenopathy and ascites. Out of these 4 subjects, site of hemorrhage was jejunum in 1 (25%) subject, proximal ileum in 1 (25%) subject, ascending colon 1 (25%) subject and sigmoid colon in 1 (25%) subject.

Out of 2 subjects with colonic diverticulitis, ascites was observed in 1 (50%) subject. Both (100%) subjects showed wall hyper-enhancement of diverticuli, fat stranding, lymphadenopathy and pneumoperitoneum. The site of disease in both subjects was sigmoid colon. In study done by Kircher MF et al., out of 114 patients of colonic diverticulitis, 96% cases had bowel wall thickening, and 91% cases showed fat stranding.

In this study, there were 2 subjects with LBI, out of which 1 (50%) subject had pneumoperitoneum and 1 (50%) subject had submucosal hemorrhage. Wall hypo-enhancement, target sign, pneumatosis intestinalis, fat stranding, lymphadenopathy and ascites were observed in both (100%) subjects. The site of ischemia in 1 (50%) subject was ascending colon and sigmoid colon in 1 (50%) subject.

Out of 12 subjects with LBO, 11 (91.67%) subjects had transition Point, 6(50%) had pneumoperitoneum, 3 (25%) had target sign, 1 (8.33%) had wall enhancement, 7 (58.33%) had fat stranding, 9 (75%) had lymphadenopathy and 7 (58.33%) had ascites. Transition point is seen in the descending colon in 4 (36.36%)

subjects, in sigmoid colon in 3 (27.27%) subjects, in transverse colon in 2 (18.18%) subjects and in ascending colon in 2 (18.18%) subjects. A study conducted by Tracy Jaffe et al. showed that site of large bowel obstruction due to intra-luminal contents is sigmoid colon in 20% cases.

Out of 7 subjects with SBI, 4 (57.14%) had pneumoperitoneum, 6 (85.71%) had target sign, 6 (85.71%) had pneumatosis intestinalis, 4 (57.14%) had submucosal hemorrhage, 4 (57.14%) had fat stranding, 5 (71.43%) had lymphadenopathy, 5 (71.43%) had ascites and all 7 (100%) had wall hypo-enhancement. The site of ischemia was jejunum in 3 (42.86%) subjects, ileum in 2 (28.57%) subjects and both ileum and jejunum in 2 (28.57%) subjects. According to the study conducted by Akira Furukawa et al., wall hypo-enhancement and pneumatosis intestinalis were showed by 42% of the cases.

In this study, out of 29 subjects with SBO, 26 (89.66%) had transition point, 10 (34.48%) had small bowel feces sign, 6 (20.69%) had pneumoperitoneum, 3 (10.34%) had target sign, 6 (20.69%) had wall enhancement, 14 (48.28%) had fat stranding, 15 (51.72%) had lymphadenopathy and 19 (65.52%) had ascites. Transition point was seen in distal ileum in 9 (34.62%) subjects, mid ileum in 6 (23.07%) subjects, distal jejunum in 4 (15.39%) subjects, proximal ileum in 3 (11.54%) subjects, terminal ileum in 3 (11.54%) subjects and mid jejunum in 1 (3.85%) subject. According to Charles P Mullan et al., accuracy of CT for high-grade SBO is 95% and sensitivity of 90-94% and specificity is 96%. In a retrospective study conducted by Modesto Colon et al. on 200 patients, 75% showed radiographic transition zone.

Out of 77 patients in the present study, 47 (61.04%) were taken for exploratory laparotomy, 18 (23.38%) patients were taken for laparoscopic appendicectomy and 12 (15.58%) were managed conservatively.

Out of 21 patients with acute appendicitis, 18 patients were taken for laparoscopic appendicectomy and 3 patients were managed conservatively. Out of 29 patients suffering from SBO, 23 were taken for exploratory laparotomy and 6 were managed conservatively. According to Durgesh Kumar Saini et al. out of 40 total patients, 30 were taken for exploratory laparotomy and 10 were managed conservatively. All 7 patients of SBI were taken for exploratory laparotomy. Out of 12 patients suffering from LBO, 9 were taken for exploratory laparotomy and 3 were managed conservatively. Both the patients of LBI were taken for exploratory laparotomy. Both the patients of colonic diverticulitis were also taken for exploratory laparotomy. All 4 patients of acute GI hemorrhage were also managed by exploratory laparotomy.

Health condition of 64 (83.12%) subjects improved while 13(16.88%) subjects died.

CONCLUSION

- Sample size in the present study was 77.
- The age ranges from 18 to 93 years with mean age of 47.26 ± 20.41 years.
- In the present study, males outnumbered females (64.94% vs 35.06% respectively).
- The most common presenting complaint was abdominal pain (97.4%) and the second most common was vomiting (49.35%).
- The mean duration of the presenting complaints was 2.49 ± 1.5 days.
- According to this study, small bowel obstruction had the highest prevalence (37.66%).
- In this study, out of 21 subjects with acute appendicitis, 1 (4.76%) had pneumoperitoneum, 7 (33.33%) had peri appendiceal collection, 19 (90.48%) had wall hyper-enhancement, 4 (19.05%) had appendicolith, 19 (90.48%) had fat stranding, 20 (95.24%) had lymphadenopathy, 3 (14.29%) had ascites and all (100%) had dilated appendix.
- Out of 21 patients with acute appendicitis, 18 patients were taken for laparoscopic appendicectomy and 3 patients were managed conservatively.
- In this study, 4 patients had acute GI hemorrhage, out of which, 3 (75%) had pneumoperitoneum, 2 (50%) had pneumatosis intestinalis, 2 (50%) had submucosal hemorrhage, 2 (50%) had wall enhancement, 3 (75%) had fat stranding and all had lymphadenopathy and ascites. Out of these 4 subjects, site of hemorrhage was jejunum in 1 (25%) subject, proximal ileum in 1 (25%) subject, ascending colon 1 (25%) subject and sigmoid colon in 1 (25%) subject.

- All 4 patients of acute GI hemorrhage were managed by exploratory laparotomy.
- Out of 2 subjects with colonic diverticulitis, ascites was observed in 1 (50%) subject. Both (100%) subjects showed wall hyper-enhancement of diverticuli, fat stranding, lymphadenopathy and pneumoperitoneum. The site of disease in both subjects was sigmoid colon.
- Both the patients of colonic diverticulitis were taken for exploratory laparotomy.
- In this study, there were 2 subjects with LBI, out of which 1 (50%) subject had pneumoperitoneum and 1 (50%) subject had submucosal hemorrhage. Wall hypo-enhancement, target sign, pneumatosis intestinalis, fat stranding, lymphadenopathy and ascites were observed in both (100%) subjects. The site of ischemia in 1 (50%) subject was ascending colon and sigmoid colon in 1 (50%) subject.
- Both the patients of LBI were taken for exploratory laparotomy.
- Out of 12 subjects with LBO, 11 (91.67%) subjects had transition point, 6 (50%) had pneumoperitoneum, 3 (25%) had target sign, 1 (8.33%) had wall hyper-enhancement, 7 (58.33%) had fat stranding, 9 (75%) had lymphadenopathy and 7 (58.33%) had ascites. Transition point was seen in the descending colon in 4 (36.36%) subjects, in sigmoid colon in 3 (27.27%) subjects, in transverse colon in 2 (18.18%) subjects and in ascending colon in 2 (18.18%) subjects.
- Out of these 12 patients, 9 were taken for exploratory laparotomy and 3 were managed conservatively.

- Out of 7 subjects with SBI, 4 (57.14%) had pneumoperitoneum, 6 (85.71%) had target sign, 6 (85.71%) had pneumatosis intestinalis, 4 (57.14%) had submucosal hemorrhage, 1 (14.29%) had wall enhancement, 4 (57.14%) had fat stranding, 5 (71.43%) had lymphadenopathy, 5 (71.43%) had ascites and all 7 (100%) had wall hypo-enhancement. The site of ischemia was jejunum in 3 (42.86%) subjects, ileum in 2 (28.57%) subjects and both ileum and jejunum in 2 (28.57%) subjects.
- All 7 patients of SBI were taken for exploratory laparotomy.
- In this study, out of 29 subjects with SBO, 26 (89.66%) had transition point, 10 (34.48%) had small bowel feces sign, 6 (20.69%) had pneumoperitoneum, 3 (10.34%) had target sign, 6 (20.69%) had wall hyper-enhancement, 14 (48.28%) had fat stranding, 15 (51.72%) had lymphadenopathy and 19 (65.52%) had ascites. Transition point was seen in distal ileum in 9 (34.62%) subjects, mid ileum in 6 (23.07%) subjects, distal jejunum in 4 (15.39%) subjects, proximal ileum in 3 (11.54%) subjects, terminal ileum in 3 (11.54%) subjects and mid jejunum in 1 (3.85%) subject.
- Out of 29 patients suffering from SBO, 23 were taken for exploratory laparotomy and 6 were managed conservatively.
- Among all 77 patients with non-traumatic acute abdomen, clinical condition of 64 (83.12%) subjects improved with therapeutic interventions while 13 (16.88%) subjects expired.

LIMITATIONS AND RECOMMENDATIONS

The cross-sectional nature of the study and the single centre sample recruitment affects the validity of the present study findings and its generalizability. The use of non-probability sampling technique is also a limitation.

Some other limitations that were encountered in this study included the wide varieties of pathologies that cause bowel-related pain like inflammatory, ischemic, neoplastic, and miscellaneous lesions. This variation affected the sample size in each pathological category.

Further study on a large number of patients may be of value in retrieving better results with more understanding of the bowel pathologies causing abdominal pain.

SUMMARY

Acute abdominal and pelvic pain is usually non-specific. A diagnosis cannot always be made from clinical examination findings and laboratory tests, which is why the radiologist is so important to the patient's care. Despite the risk of radiation exposure, the availability of CT imaging has altered the methods to evaluate abdominal emergencies in adults. It is considered as the investigation of choice for diagnosis of numerous abdominal pathologies. It has revolutionized the management of abdominal pain by providing swift and effective diagnosis & treatment of abdominal pathologies by enabling early surgical interventions. Early diagnosis of bowel emergencies with CT can help in decreasing morbidity and mortality. A shorter acquisition time on multi-detector systems of more recent generations minimises respiratory artefacts and shortens research times. There are several kinds of 2-D and 3-D reconstructions that may be done using high-resolution volumetric or isotropic data. The identification of anatomical structures such as the mesenteric vasculature, biliary tract, or urinary tract is possible without raising the radiation dosage because of its capacity to simultaneously study a region in three spatial planes. Administering IV contrast with non-enhanced CT improves the diagnostic yield of study, particularly in lean individuals with little body fat.

The present cross-sectional study was conducted on 77 patients with mean age of 47.26 ± 20.41 years for evaluation of role of CT in 7 common non-traumatic bowel emergencies that include acute appendicitis, acute GI hemorrhage, colonic diverticulitis, small bowel obstruction, small bowel ischemia, large bowel obstruction and large bowel ischemia. The most common presenting complaint was abdominal pain with mean duration of 2.49 ± 1.5 days.

According to this study, small bowel obstruction had the highest prevalence (37.66%) followed by acute appendicitis (27.27%). In this study, out of 29 subjects with SBO, 89.66% had transition point and 34.48% had small bowel feces sign. Transition point was most commonly seen in distal ileum followed by mid ileum, distal jejunum, proximal ileum, terminal ileum and mid jejunum. 79.31% patients were taken for exploratory laparotomy and rest were managed conservatively.

In this study, out of 21 subjects with acute appendicitis, 90.48% had peri-appendiceal fat stranding and wall hyper-enhancement, 33.33% had peri-appendiceal collection, and 19.05% had appendicolith. 85.71% patients were managed by laparoscopic appendicectomy and others were managed conservatively.

Out of 12 subjects with LBO, 91.67% had transition point. Most common site of transition point was in the descending colon, followed by sigmoid colon, transverse colon and ascending colon. 75% patients were taken for exploratory laparotomy and others were managed conservatively.

Out of 7 subjects with SBI, 100% had wall hypo-enhancement, 85.71% had target sign and pneumatosis intestinalis and 57.14% had submucosal hemorrhage. The most common site of ischemia was in jejunum followed by ileum and both ileum and jejunum. All patients were taken for exploratory laparotomy.

In this study, 4 patients had acute GI hemorrhage, out of which, 75% had pneumoperitoneum and 50% had pneumatosis intestinalis and submucosal hemorrhage. The site of hemorrhage was jejunum, proximal ileum, ascending colon and sigmoid colon. All the patients were managed by exploratory laparotomy.

Out of 2 subjects with colonic diverticulitis, 100% subjects showed wall hyper-enhancement of diverticuli, fat stranding, and pneumoperitoneum. The site of disease in both subjects was sigmoid colon. The management was done by explorative laparotomy.

In this study, there were 2 subjects with LBI, out of which 100% subjects showed wall hypo-enhancement, target sign, pneumatosis intestinalis and 50% showed pneumoperitoneum. The site of ischemia was ascending colon and sigmoid colon. Both the patients were managed by exploratory laparotomy.

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ANNEXURE I – INFORMED CONSENT

KAHER

JAWAHARLAL NEHRU MEDICAL COLLEGE, BELAGAVI

DEPARTMENT OF RADIO-DIAGNOSIS

TITLE OF THE STUDY: "128 MULTISLICE COMPUTED TOMOGRAPHY EVALUATION OF NON TRAUMATIC BOWEL EMERGENCIES-ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY"

INVESTIGATOR: DR.

GUIDE: DR.

INTRODUCTION AND PURPOSE: The purpose of this study is to determine the role of computed tomography in detection of patients with acute abdomen suspected of non-traumatic bowel emergencies in the study population. 128 Multislice computed tomography provides accurate parameters and information in detection of bowel pathologies and helps in improving the quality of treatment towards patients suffering from it.

PROCEDURE: I request you to kindly participate in the study titled **"128 MULTISLICE COMPUTED TOMOGRAPHY EVALUATION OF NON TRAUMATIC BOWEL EMERGENCIES - ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY"** at Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi is being conducted by: **DR. _____** Post graduate in Radio-diagnosis at J.N. Medical College, Belagavi, Karnataka, under the guidance of **DR. _____** Professor, Dept. of Radio-diagnosis, J. N. Medical College, Belagavi.

We request you to participate in this study as you are eligible to be included. During the study, you will be asked questions regarding your present and past medical history and you will be required to answer to the best of your knowledge. You will also be clinically examined as per the protocol drawn.

If you agree to participate in the study, please furnish the details pertaining to the study.

BENEFITS: No use of surgical equipments/risk associated with it.

COMPLICATIONS: Minimal exposure to radiation. A single exposure to radiation during CT scan usually does not cause any adverse effects. Some rare events that can occur are skin reddening, induction of cancer.

ALTERNATIVES: If you are not willing to take part in the study, your treatment or any other further investigations you want to undergo, in future, in KLE Hospital will not be affected by your decision.

VOLUNTARY PARTICIPATION / WITHDRAWAL: Taking part in this study is voluntary. You may choose not to take part in this study, or if you decide to take part, you can later change your mind and withdraw from the study. Your decision will not change the present or future health care or other services that you receive. The study doctor or the sponsor may stop your participation in this study. You will tell if any important new findings that may change your willingness to continue to take part. If you choose not to take part in the study, you will receive the standard treatment for patients with your condition.

COSTS: NIL (The study is to be conducted on the participants who are advised computed tomography as an investigation by the referring consultant and the participants will bear the charges for it.)

Payment for Participation: No incentive will be paid to you for participating in this study.

COMPENSATION: In the event that you become injured as a result of taking part in this study, treatment whatever available at KLE Charitable hospital, Belagavi, will be offered to you. No reimbursement, compensation or free medical care is given.

CONFIDENTIALITY: All information collected about you during the course of the study will be kept confidential to the extent permitted by the law. The code numbers will identify you in this research record. Information from this study may be published but your identity will be kept confidential in any publication/ presentation.

QUESTION: If you have any enquiries in the future or in case of research related injury illness, you may contact following persons:

Dr. ROOPA BELLAD
Professor, Chairman, J.N. Medical College Institutional Ethical Committee for Human Subjects Research.
Ph. No: 0831-2473777, Ext. 1529

CONSENT TO PARTICIPATE IN RESEARCH STUDY:

1. "I understand that I am participating in the study, which includes computed tomography of abdomen and pelvis.

2. I confirm that I have read and understood the information in the patient information sheet. Procedure is explained to me in detail along with information about the advantages and disadvantages of taking part in the study. I have been given the opportunity to discuss all aspects of the trial, to ask questions and hereby consent to participation in the trial outlined above.

3. I understand that the decision to take part in this study is completely voluntary and I am aware that I can choose to withdraw from the study at any point of time.

4. I consent to the photographing or recording of the procedure to be performed including appropriate portions of my body, for medical, scientific or educational purposes provided my identity is not revealed in the pictures or by the descriptive texts accompanying them.

5. I understand that there is no significant risk involved in the test that would be done in this study.

6. No guarantee or assurance has been given by anyone as to the results that may be obtained.

7. My signature on this form signifies that I have willingly decided to participate after understanding the above information".

Participant's Name/ legally authorized representative_____

Signature _____

Name and signature of witness _____

Name and signature of interviewer _____

Date:

Place:

ANNEXURE II – PROFORMA

KAHER

JAWAHARLAL NEHRU MEDICAL COLLEGE, BELAGAVI.

DEPARTMENT OF RADIO-DIAGNOSIS

TITLE: "128 MULTISLICE COMPUTED TOMOGRAPHY EVALUATION OF NON-TRAUMATIC BOWEL EMERGENCIES - ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY"

RESEARCH INVESTIGATOR: DR.

GUIDE: DR.

PROFORMA FOR DATA COLLECTION

DATE OF INTERVIEW: ___-___-_____

NAME OF THE PATIENT: _____

SEX: M / F

AGE (IN YEARS) _____

OP/IP NO _____

MOBILE NUMBER: _____

ADDRESS:_____

CT NUMBER: _____

CHIEF COMPLAINTS: **Duration**

1. _____ _____

2. _____ _____

3. _____ _____

HISTORY OF PRESENTING ILLNESS:

PAST HISTORY:

VITALS:

CLINICAL EXAMINATION:

- **CARDIOVASCULAR SYSTEM:**
- **RESPIRATORY SYSTEM:**
- **CENTRAL NERVOUS SYSTEM:**
- **PER ABDOMINAL EXAMINATION:**

PROVISIONAL DIAGNOSIS: _____

CT SCAN ABDOMEN AND PELVIS FINDINGS:

LIVER:

GALL BLADDER:

SPLEEN:

PANCREAS:

KIDNEYS:

URINARY BLADDER:

SMALL BOWEL:

LARGE BOWEL:

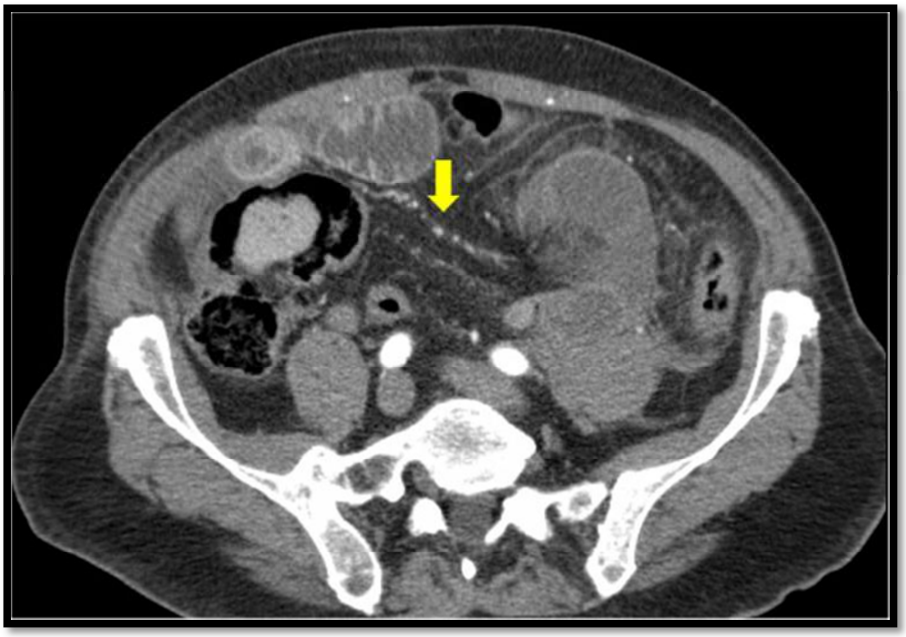
UTERUS/ PROSTATE:

IMPRESSION:

ANNEXURE III - PHOTOGRAPHS

Figure 20: Description and radiological images of a case of closed loop small bowel obstruction.

Case 1: A 45 year old male patient presented with abdominal pain and vomiting since 3 days. Laboratory investigations were normal. CT examination showed radial array of dilated hypo-enhancing small bowel loops on the left with the mesenteric vessels converging to a central point. Mesenteric veins were dilated (yellow arrow). At the point of strangulation the afferent loop was dilated (blue arrow) and efferent loop was collapsed (red arrow). The distal small bowel was collapsed (green arrows). The proximal small bowel is dilated (white arrow).



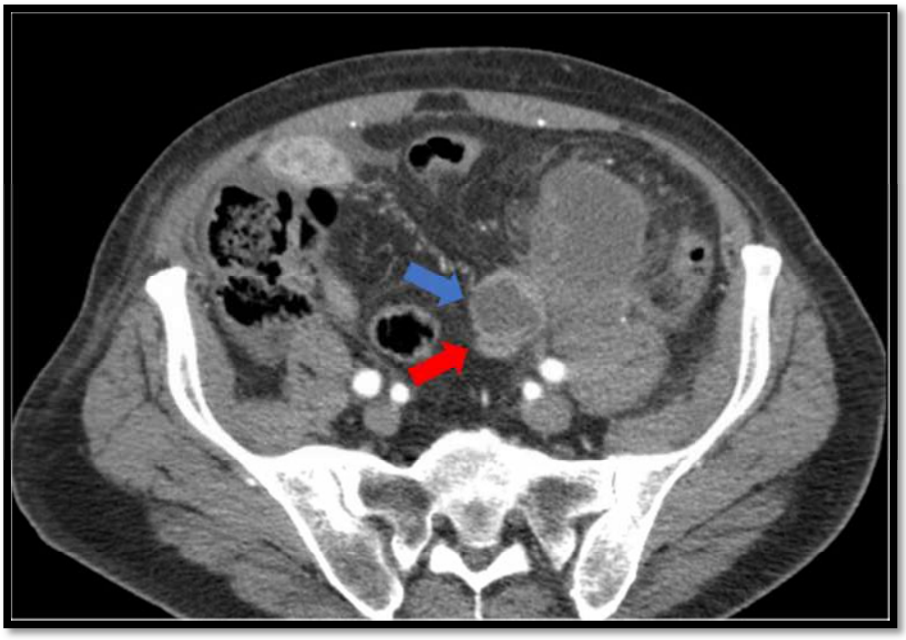
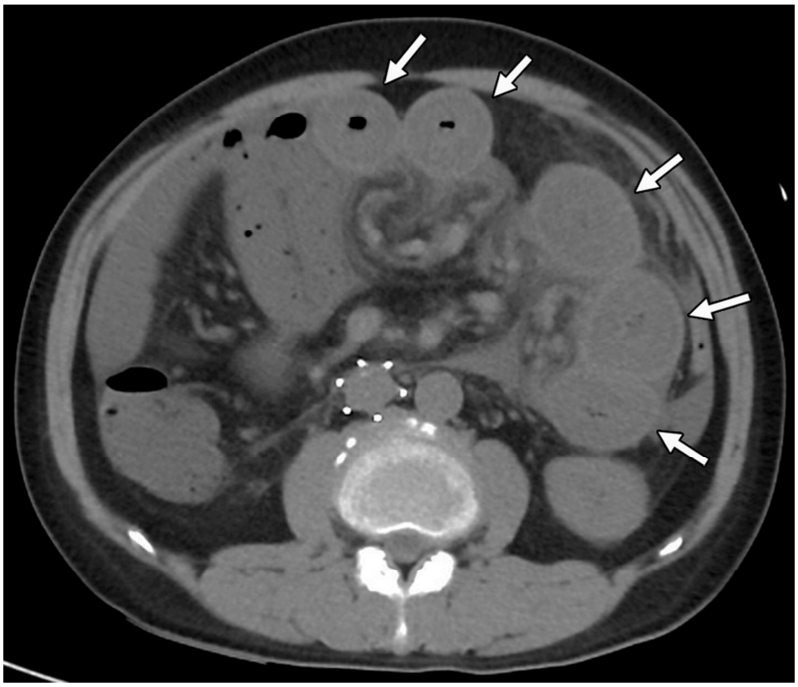


Figure 21: Description and radiological images of a case of acute appendicitis.

Case 2: A 33-year old male presented with abdominal pain in the right iliac fossa, fever and loose stools since 2 days. USG was inconclusive. CT examination showed dilated (9.5 mm) fluid filled appendix (red arrow) with hyperenhancing walls and peri-appendiceal fat stranding (red cross). Coronal CT reconstruction showed an appendicolith within the appendix in its proximal portion (yellow arrow).

Figure 22: Description and radiological images of a case of small bowel ischemia.

Case 3: In a 37-year-old male patient who presented with pain abdomen and vomiting since 3 days, Nonenhanced axial CT image showed significant bowel wall thickening (arrows). Axial contrast-enhanced CT image showed thickened bowel wall with a target or halo appearance (arrowheads). Mesenteric stranding and vascular engorgement were also seen. (c) Coronal contrast-enhanced CT image shows thrombus (arrows) in the SMV and portal vein.



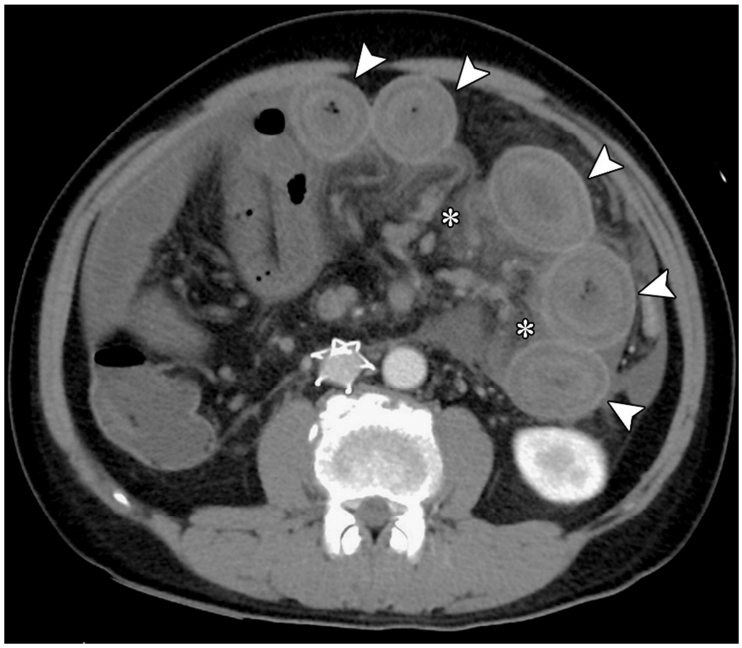
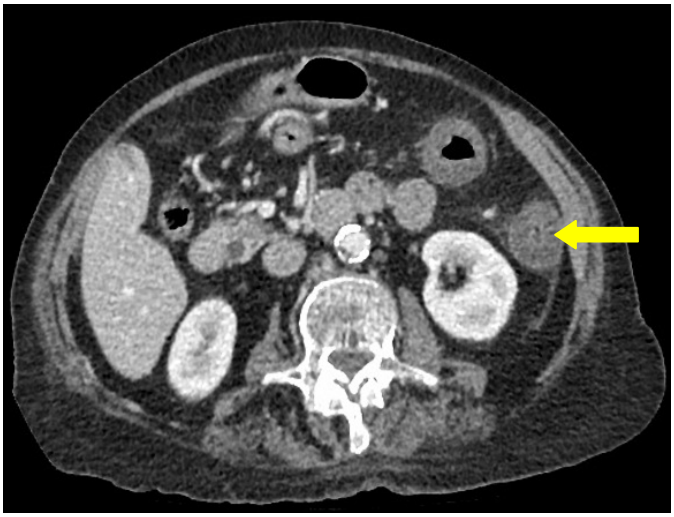


Figure 23: Description and radiological images of a case of large bowel obstruction.

Case 4: In a 50-year-old female patient who presented with pain abdomen since 3 days, contrast enhanced coronal CT image showed large bowel obstruction caused by a colocolonic intussusception (red arrow showing short segment telescoping of proximal transverse colon into distal transverse colon).

Figure 24: Description and radiological images of a case of large bowel ischemia.

Case 5: A 83-year old male patient presented with abdominal pain and diarrhoea tinged with blood since 4 days. Axial and coronal contrast enhanced CT images showed circumferential hypo-enchancing wall thickening of the large bowel from the mid transverse to the mid descending colon.



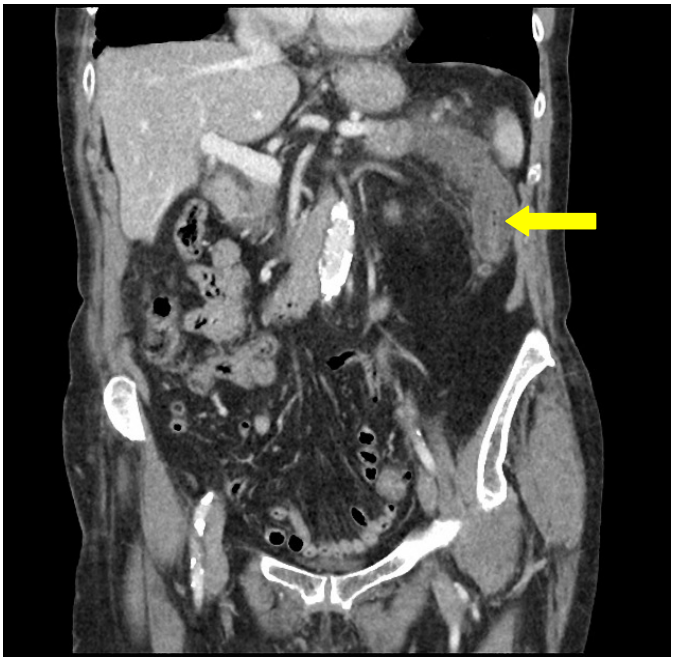


Figure 25: Description and radiological images of a case of acute gastrointestinal hemorrhage.

Case 6: A 86-year old female presented with pain abdomen, fever and blood in stools since 4 days. CT scan demonstrated an extravasation arising from a diverticulum of the sigmoid (yellow arrow).

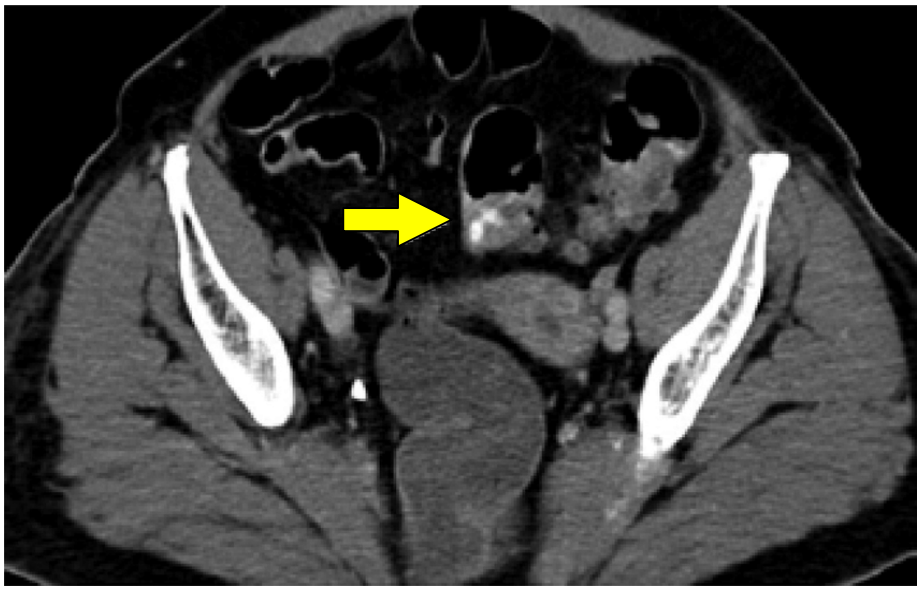


Figure 26: Description and radiological images of a case of colonic diverticulitis.

Case 7: This 60 year old male patient presented with pain in left iliac fossa and blood in stools since 3 days. Contrast-enhanced axial CT image showed multiple air-filled outpouchings from the sigmoid colon, indicating diverticular disease. There was fat stranding adjacent to the sigmoid colon (yellow arrow), which indicates an inflammatory process suggestive of acute colonic diverticulitis.

ANNEXURE IV - KEY TO MASTERCHART

KEY	SEX	CHIEF COMPLAINTS	FEATURES	DIAGNOSIS	MANAGEMENT	OUTCOME
0			Absent			Expired
1	Male	Pain in abdomen	Present	Acute appendicitis	Conservative	Improved
2	Female	Blood in stools		Acute GI hemorrhage	Exploratory laparotomy	
3		Loose stools		Colonic diverticulitis	Laparoscopic appendicectomy	
4		Abdominal distension		Large bowel ischemia		
5		Bloating		Large bowel obstruction		
6		Diarrhea		Small bowel ischemia		
7		Fever		Small bowel obstruction		
8		Vomiting				
9		Nausea				
10		Constipation				

ANNEXURE V – MASTERCHART

SR NO.	SCAN NO.	AGE (YEARS)	SEX	CHIEF COMPLAINTS	DURATION (DAYS)	SITE	TRANSITION POINT	SMALL BOWEL FECES SIGN	PNEUMOPERITONEUM	WALL HYPO-ENHANCEMENT	TARGET SIGN	PNEUMATOSIS INTESTINALIS	SUBMUCOSAL HEMORRHAGE	DILATED APPENDIX	PERIAPPENDICEAL COLLECTION	WALL ENHANCEMENT	APPENDICOLITH	FAT STRANDING	LYMPHADENOPATHY	PLEURAL EFFUSION	ASCITES	DIAGNOSIS	MANAGEMENT	OUTCOME
1	C 20959	24	1	1,8	2	DISTAL ILEUM	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	7	2	1
2	C 23011	81	1	1,4	2	DESC COLON	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	5	2	1
3	C 24081	55	2	1 ,5	3	DISTAL ILEUM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	7	1	1
4	C 24767	25	2	1,7,8	1	DISTAL ILEUM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	7	2	1
5	C 24971	32	1	1,8	1	PROX ILEUM	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	7	2	1
6	C 25951	38	1	1,8	3	ILEUM	0	0	0	1	1	1	1	0	0	0	0	1	1	0	0	6	2	1
7	C 26225	27	2	1,8	2	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	1	1
8	C 26379	29	2	1	2	APPENDIX	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	1	3	1
9	C 26812	24	1	1,7,8	1	APPENDIX	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	3	1
10	C 26845	37	1	1,8	3	JEJUNUM	0	0	1	1	1	1	0	0	0	0	0	1	1	0	0	6	2	0

11	C 29453	45	1	1,5	3	PROX ILEUM	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	7	2	1
12	C 30132	70	2	1,8	2	APPENDIX	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	1	3	1
13	C 30270	75	1	1,8	2	PROX ILEUM	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	1	1
14	C 30286	92	2	1	3	DISTAL JEJUNUM	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	7	2	0
15	C 39319	58	1	1,9,7	3	APPENDIX	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	2	1
16	C 676521	45	1	1,6	2	ASC COLON	0	0	1	1	1	1	1	0	0	0	0	1	1	1	1	4	2	1
17	C 39156	50	2	1	3	TRANS COLON	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	5	1	1
18	C 39138	50	2	1,8	2	DISTAL ILEUM	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	7	2	1
19	C 39110	20	2	1,4,8	4	JEJUNUM	0	0	1	1	1	0	1	0	0	1	0	1	1	0	1	6	2	0
20	C 39055	46	2	1	1	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	1	1	1	1
21	C 38694	50	2	1	3	JEJUNUM, ILEUM	0	0	0	1	1	1	0	0	0	0	0	1	1	0	1	6	2	1
22	C 38892	65	1	1,8	4	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
23	C 38652	43	1	1	2	APPENDIX	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	3	1
24	C 38501	61	1	1,8	4	ILEUM	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	6	2	1
25	C 38384	60	1	1,8	1	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
26	C 38313	43	1	1,8	1	DESC COLON	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	5	2	0
27	C 38307	93	1	1,7,8	1	DESC COLON	1	0	0	0	1	0	0	0	0	0	0	1	1	0	0	5	2	1
28	C 38269	35	1	1,5	2	TERMINAL ILEUM	1	0	0	0	0	0	0	0	0	1	0	1	1	0	1	7	2	1

29	C 38734	70	2	1	2	DISTAL ILEUM	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0
30	C 39330	83	1	1,8	4	DESC COLON	0	0	0	0	1	0	0	0	0	0	0	1	0	1	1	5	2	1
31	C 39411	64	2	1,4	8	APPENDIX	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	3	1
32	C 40070	60	2	1,8	2	MID ILEUM	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	7	2	1
33	C 40184	18	2	1	5	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
34	C 39467	38	1	1,8	2	DISTAL JEJUNUM	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7	2	1
35	C 39584	71	1	1,8	1	MID ILEUM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	7	2	1
36	C 39756	65	1	3, 4	2	ASC COLON	1	0	1	0	0	0	0	0	0	0	0	1	1	1	0	5	2	1
37	C 39841	52	1	1,7	2	SIGMOID COLON	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	5	1	1
38	C 39833	60	1	1,2	3	SIGMOID COLON	0	0	1	0	0	0	0	0	0	1	0	1	1	0	0	3	2	1
39	C 40025	33	1	1,7,3	2	APPENDIX	0	0	1	0	0	0	0	1	1	1	1	1	1	0	0	1	3	1
40	C 40065	32	1	1,8	1	APPENDIX	0	0	0	0	0	0	0	1	1	1	0	1	1	0	1	1	3	1
41	C 40345	68	2	1,8	2	MID ILEUM	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	7	1	1
42	C 40907	75	1	2	1	JEJUNUM	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	1
43	C 41015	66	1	1	1	TERMINAL ILEUM	1	1	1	0	0	0	0	0	0	0	0	1	0	1	1	7	2	1
44	C 41121	50	1	1,8	2	TRANS COLON	1	0	1	0	0	0	0	0	0	0	0	1	0	1	1	5	2	1
45	C 41099	71	1	1,8	8	SIGMOID COLON	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	3	1	0

46	C 41795	44	1	1	2	ASC COLON	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	5	1	1
47	C 6765565	83	1	1	4	SIGMOID COLON	0	0	0	1	1	1	0	0	0	0	0	1	1	0	1	4	2	1
48	C 12253735	47	1	1,7	3	MID JEJUNUM	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0	7	2	1
49	C 11983501	21	1	1,7	3	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
50	C 12134845	46	1	1,3	3	MID ILEUM	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0	7	2	0
51	C 12549441	24	1	1,7,8	3	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
52	C 12056313	26	1	1,8	3	APPENDIX	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	3	1
53	C 12474015	23	1	1,7	4	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
54	C 12534006	23	1	1	1	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
55	C 12526426	56	2	1,7,8	1	TERMINAL ILEUM	1	1	1	0	0	0	0	0	0	0	0	1	0	1	1	7	2	0
56	C 11919179	40	2	1,8	2	DISTAL ILEUM	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	7	2	1
57	C 12560922	45	2	1,7	2	SIGMOID COLON	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	5	2	0
58	C 12573073	22	1	1,7,8	1	DISTAL ILEUM	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	7	1	1
59	C 12167854	40	2	1	3	SIGMOID COLON	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	5	2	1

60	C 12091568	25	1	1,7,8	2	MID ILEUM	1	0	0	0	0	0	0	0	0	0	0	0	0	1	7	2	1
61	C 12109099	18	2	1,8	1	DISTAL ILEUM	1	1	0	0	0	0	0	0	0	1	0	0	0	1	1	7	1	1
62	C 12254466	48	1	1,8	4	DISTAL ILEUM	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	7	2	1
63	C 11903754	40	1	1,8	1	DISTAL ILEUM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	1
64	C 12482056	24	1	1	3	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	3	1
65	C 12464811	19	2	1	3	APPENDIX	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	3	1
66	C 12583028	67	1	1,4	2	MID ILEUM	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	7	2	0
67	C 12031577	24	1	1,7	1	ASC COLON	0	0	0	0	0	0	0	0	0	D	0	0	1	0	1	2	2	0
68	C 1144641	19	1	1,8	4	APPENDIX	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	3	1
69	C 1143742	59	2	1,7,8	1	DISTAL JEJUNUM	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	1
70	C 1143900	23	2	1,7	2	DISTAL ILEUM	1	0	0	0	0	0	0	0	0	1	0	1	1	0	1	7	2	1
71	C 200394	52	2	1,10	8	DISTAL ILEUM	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	7	2	1
72	C12560967	61	1	1,7	2	JEJUNUM	0	0	0	1	0	1	1	0	0	0	0	0	0	1	1	6	2	1
73	C 1143284	80	2	1	3	DESC COLON	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	5	2	1
74	C 6764740	21	1	1,2	2	PROX ILEUM	0	0	1	0	0	1	1	0	0	1	0	1	1	1	1	2	2	0

75	C 1145950	86	2	1,7	4	SIGMOID COLON	0	0	1	0	0	1	1	0	0	1	0	1	1	0	1	2	2	1
76	C 1144783	35	1	1,8	1	DISTAL JEJUNUM	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	7	1	1
77	C 1146779	49	1	1,8	2	JEJUNUM, ILEUM	0	0	1	1	1	1	0	0	0	0	0	0	1	1	1	6	2	0