Trends in Clinical and Medical Sciences

PSR Press

Article

Prospective study: Role of 64-slice MDCT in pre-operative diagnosis of acute abdominal pain

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Received: 5 April 2023; Accepted: 10 May 2023; Published: 14 May 2023.

Abstract: Patients presenting with acute abdominal pain can benefit greatly from the additional diagnostic information provided by multidetector CT (MDCT). Correctly interpreting the patient's unique clinical data and test results is necessary for establishing a diagnosis. The patient's hemodynamic status has been stabilized, MDCT is the preferred imaging test for acute, severe, and widespread abdominal pain. The primary objective of our investigation is to determine whether 64-slice Multi-detector Computer Tomography (MDCT) is useful for diagnosing and evaluating patients with acute abdominal pain before surgery. This prospective study at Sri Aurobindo Medical College and Post Graduate Institute, Indore, randomly selected 200 participants. MDCTs were performed on all patients. Initially, pre-contrast images were obtained. Blood samples were drawn at 25 seconds, 45 seconds, and 7 minutes after contrast administration using bolus tracking and automated triggering. Contrast was administered intravenously or orally, depending on the patient's condition. Each patient's pre-CT and post-CT diagnoses were contrasted with intraoperative findings and discharge diagnosis. In total, 200 individuals participated in the study. Most of our patients (26%) were between the ages of 41 and 50, followed by those between the ages of 21 and 30 (21.5%). The majority of patients who participated in the study were males. In addition to severe abdominal pain, nausea and vomiting were the most frequently reported side effects. According to our research, the most common causes of acute abdomen are pancreatitis, small intestinal obstruction, appendicitis, and cholecystitis. We conclude that MDCT accurately detects a broad spectrum of acute abdominal diseases, including some that are uncommon, such as liver abscess, splenic abscess, pyelonephritis, epiploic appendagitis, ovarian torsion, omental infarct, and aortic dissection. CT is a useful diagnostic tool for determining the cause of non-traumatic acute abdominal discomfort.

Keywords: Acute abdominal pain; multidetector CT; MDCT; diagnosis; evaluation; surgery; 64-slice Multi-detector Computer Tomography; prospective study; intraoperative findings; discharge diagnosis; pancreatitis; small intestinal obstruction; appendicitis; cholecystitis; liver abscess; splenic abscess; pyelonephritis; epiploic appendagitis; ovarian torsion; omental infarct; aortic dissection; diagnostic tool.

1. Introduction

The term "acute abdomen" refers to an abnormal condition marked by the abrupt onset of severe abdominal discomfort that requires rapid examination, diagnosis, and maybe even urgent surgery [1]. It is one of the frequent reasons, accounting for 4-5% of all hospital admissions for emergencies. Acute abdominal disorders can range from self-resolving problems to life-threatening situations requiring immediate surgical, medicinal, or radiological procedures. Acute appendicitis, acute diverticulitis, nephrolithiasis, cholelithiasis, acute pancreatitis, intestinal perforation, rupture abdominal aneurysm, and acute mesenteric ischemia is the most common causes of severe and widespread abdominal pain in individuals [2,3].

Clinical diagnosis is difficult since many diseases have similar clinical signs and symptoms, yet treatment techniques and urgency might vary substantially depending on the underlying reasons. Finding the urgent problems necessitating surgical intervention is the clinician's main duty. A prompt and precise diagnosis is required for each person suffering from an acute abdomen to ensure effective therapy and prevent negative

effects. A physician needs accurate clinical information, a thorough physical exam, and laboratory test findings to make a "working clinical diagnosis." However, clinical and laboratory evaluation frequently produce conflicting results, especially if the abdominal pain is diffuse rather than localised to one area. Therefore, in this situation, abdominal imaging is crucial to the diagnostic process and aids in patient triage. The most significant imaging modalities are plain X-rays, computed tomography (CT), ultrasonography (US), and magnetic resonance imaging (MRI).

Widely accessible abdominal radiography is particularly helpful for individuals with minor intestinal blockage and pneumoperitoneum. Most of the time, radiography is insufficient for a conclusive diagnosis, and further imaging is necessary.

Another popular imaging technique for individuals with sudden onset of stomach discomfort is the ultrasonogram (USG). USG provides additional information because it aids in the real-time visualisation of the abdominal organs and the measurement of peristalsis and blood flow using a Doppler device. However, USG is not always conclusive, particularly when intra-abdominal fat and significant bowel gas exist.

MRI is performed when there is a radiation risk, such as in cases of nephrotoxicity brought on by iodinated contrast agents or in patients who are pregnant or young children. However, there are several reasons why MR imaging is not yet frequently used in the diagnostic work-up of patients who present with acute abdominal pain, including its cost, availability issues, incompatibility with other MR imaging systems, such as equipment used for intensive care, and monitoring of patient status.

For most patients, CT has become the go-to triage method [4]. It has shown to be an effective aid in the differential diagnosis of acute abdominal discomfort, offering precise illustrations of abdominal anatomy and pathology within examination periods. The gut, mesenteries, omenta, peritoneum, retroperitoneum, sub-peritoneum, and extra-peritoneum may be seen broadly. In helical CT, thin sections can be taken without increasing radiation exposure or causing respiratory artefacts, enabling multiple acquisitions throughout various phases of a single IV contrast bolus. If the patient is unsteady, MDCT scans are taken after the patient is made stable.

A further advantage of CT over MRI is that it may be completed more rapidly, at a lower cost, with more accessibility, and with fewer errors. As a result, despite the low radiation risk and somewhat higher cost, early CT utilisation in the case of investigation due to its excellent accuracy has significantly boosted the use of MDCT for identifying acute abdominal diseases in recent years [5–7].

This study investigates the diagnostic value and preoperative evaluation of participants presenting with acute abdominal discomfort using 64 slice Multi-detector Computer Tomography (MDCT).

2. Material and methods

The study was carried out in the department of radiodiagnosis at Sri Aurobindo Medical College & Post Graduate Institute, Indore, from November 2017 to May 2019 with written permission, certification, and approval from the Ethical Committee.

200 randomly selected patients who were sent to the radiology department for a multidetector CT scan and had evidence of an acute abdomen from the emergency, surgery, medical, and gynaecology departments were the subjects of this prospective observational study. All patients participating in the trial provided their informed written permission on the prescribed format for the current study.

2.1. Inclusion criteria

Patients of all age groups, regardless of their gender, who showed up with acute abdominal discomfort and had MDCT were included in the study.

2.2. Exclusion criteria

- Patients who present with an acute abdomen from blunt trauma.
- Patients refusing to sign a written informed consent form.
- Patients with conditions that make them contraindicated for contrast (such as pregnancy, renal insufficiency, or a history of allergic responses).

2.3. Procedure

A SIEMENS 64 slice multidetector scanner (Somatom Definition AS) was used to perform MDCT on patients to analyse the patterns of different disorders.

2.3.1. MDCT Technique

At our institution, reconstruction was done at 1.25- and 5-mm-thick axial sections for primary viewing using detector configurations of 16 x 1.25mm or 64 x 0.625mm. Then a reconstruction in three dimensions was made. First, the pre-contrast phase was used to acquire the images. A power injector infused 1-2ml per kg of a water-soluble, non-ionic IV contrast medium with an iodine value of 275 to 370 mg. Then, using automated triggering and bolus tracking technology, post-contrast arterial, venous, and delayed phases were recorded at 25 seconds, 45 seconds, and 7 minutes, respectively. If oral contrast was required, it was administered an hour before the operation in 30ml of ionic contrast medium containing 250mg I/ml in 1 litre of water. All individuals receiving a contrast scan had their kidney function and iodine contrast allergy checked.

2.4. Data Collection and statistical analysis

Results from the scan analysis were documented on a pre-structured proforma for the study. Using the SPSS 20 programme, the entire statistical analysis was carried out. Descriptive statistical analysis was used to describe the qualities and traits of the gathered samples. The master charts were prepared with Microsoft Excel. The data was represented as Mean and Percentage. The Chi Square test was used to determine the relationship between the variables. A p value of 0.001 or less was regarded as statistically significant.

3. Results

The Table 1 shows the distribution of 200 patients by age group. The largest age group was 41 to 50 years (26%), followed by 21 to 30 years (21.5%), and 31 to 40 years (17.5%). The smallest age groups were 81 to 90 years and 0 to 10 years (2% each). The majority of patients were in the middle-aged category.

Table 1. Distribution of patients according to age

S. No.	AGE GROUPS (Years)	No. OF PATIENTS	PERCENT %
1	0 to 10	4	**2**
2	11 to 20	7	**3.5**
3	21 to 30	43	**21.5**
4	31 to 40	35	**17.5**
5	41 to 50	52	**26**
6	51 to 60	22	**11**
7	61 to 70	27	**13.5**
8	71 to 80	6	**3**
9	81 to 90	4	**2**
	Total	200	**100**

Table 2 shows that out of 200 patients, 70.5% were male, and 29.5% were female. The male to female ratio was approximately 2.4:1.

Table 2. Distribution of patients on the basis of gender

S No.	GENDER	No. OF PATIENTS	PERCENT %
1	**Female**	59	**29.5**
2	**Male**	141	**70.5**
3	**Total**	**200**	**100**

Table 3 shows the distribution of 200 patients based on their CT diagnosis. The table lists 17 different CT diagnoses and the number of patients diagnosed with each condition. The most common diagnosis was acute

pancreatitis (24%), followed by small bowel obstruction (20%), and urolithiasis (17%). The table further breaks down the subtypes of small bowel obstruction, with small bowel obstruction due to bowel ischemia being the most common subtype (5%). The remaining diagnoses made up less than 5% of the total patient population each. Acute pancreatitis, small bowel obstruction, and urolithiasis were the most common CT diagnoses in this patient sample.

Table 3. Distribution of patients based on ct diagnosis

S No.	CT-DIAGNOSIS	**No. OF PATIENTS**	PERCENT %
1	Acute Pancreatitis	48	**24**
2	Small bowel obstruction	40	**20**
2a	Small bowel obstruction due to bowel ischemia	10	**5**
2b	Small bowel obstruction due to inflammatory bowel pathology	6	**3**
2c	Small bowel obstruction due to Intussusception	5	**2.5**
2d	Small bowel obstruction due to Volvulus	3	**1.5**
2e	Small bowel obstruction due to band/Adhesion	9	**4.5**
2f	Small bowel obstruction due to bowel Stricture	7	**3.5**
3	Urolithiasis	34	**17**
4	Acute Appendicitis	29	**14.5**
5	Acute Cholecystitis	20	**10**
6	Liver abscess	8	**4**
7	Perforation	6	**3**
8	Splenic Abscess	2	**1**
9	Acute Pyelonephritis	2	**1**
10	Emphysematous pyelonephritis	2	**1**
11	Epiploic Appendicitis	2	**1**
12	Aortic Dissection/ Aneurysm	2	**1**
13	Diverticulitis	1	**0.5**
14	Omental Infarction / Torsion	1	**0.5**
15	Splenic Infarct	1	**0.5**
16	Ovarian Torsion	1	**0.5**
17	Rupture ectopic pregnancy	1	**0.5**
	Total	200	**100**

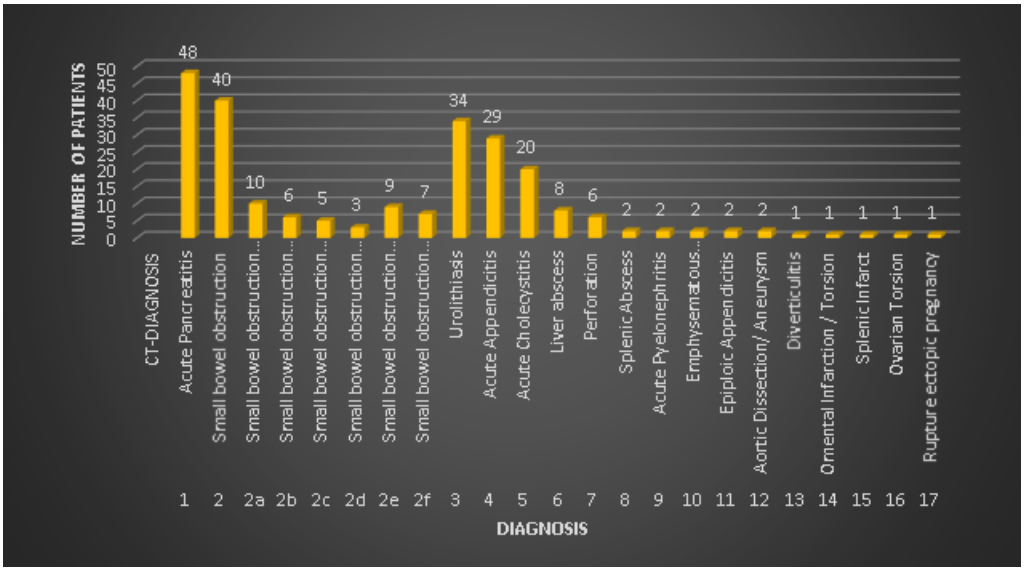

Figure 1. Distribution of patients based on CT diagnosis

Table 4 shows the distribution of 200 patients on the basis of their presenting associated symptoms and signs. The most common symptom was nausea/vomiting (68.5%), followed by distension (31.5%),

tenderness (39%), and constipation (24.5%).Fever was reported in 17% of patients, and guarding/rigidity was seen in 14.5% of patients. Hematuria was reported by 6% of patients, while dysuria/pyuria and bleeding stool/malena were each reported by 10% and 4% of patients, respectively.Only 0.5% of patients presented with jaundice, amenorrhea, or bleeding from the vagina.

Table 4. Generated by Spread-LaTeX

S. No.	Signs & Symptoms	No. Of Patients	PERCENT %
1	Nausea/Vomiting	137	68.5
2	Constipation	49	24.5
3	Fever	34	17
4	Guarding/Rigidity	29	14.5
5	Distension	63	31.5
6	Tenderness	78	39
7	Hematuria	12	6%
8	Dysuria/Pyuria	20	10%
9	Bleeding Stool/ Malena	8	4%
10	Jaundice	1	0.50%
11	Amenorrhea/ Bleeding PV	1	0.50%

Table 5 shows the correlation between CT diagnosis and discharge diagnosis. Out of 200 patients, there were 190 true positive cases, 10 false positive cases, and no false negatives for CT diagnosis. The highest false positive rates were seen in small bowel obstruction and acute appendicitis diagnoses.

Table 5. Correlation between CT diagnosis and discharge diagnosis

S No.	CT Diagnosis	No of PATIENTS	Discharge Diagnosis	FN	FP	TP
1	Acute Pancreatitis	48	53	5	0	48
2	Small Bowel Obstruction	40	40	4	4	36
2a	Bowel ischemia	10	12	2	0	10
2b	Inflammatory Bowel pathology	7	5	0	2	5
2c	Intussusception	5	5	0	0	5
2d	Volvulus	3	3	0	0	3
2e	Band/Adhesion	9	8	0	1	8
2f	Neoplastic Bowel pathology	6	7	2	1	5
3	Urolithiasis	34	34	0	0	34
4	Acute Appendicitis	29	27	1	3	26
5	Acute Cholecystitis	20	18	0	2	18
6	Liver abscess	8	7	0	1	7
7	Perforation	6	6	0	0	6
8	Splenic Abscess	2	2	0	0	2
9	Acute Pyelonephritis	2	2	0	0	2
10	Emphysematous pyelonephritis	2	2	0	0	2
11	Epiploic Appendagitis	2	2	0	0	2
12	Aortic Dissection/ Aneurysm	2	2	0	0	2
13	Diverticulitis	1	1	0	0	1
14	Omental/Infarction Torsion	1	1	0	0	1
15	Splenic Infarction	1	1	0	0	1
16	Ovarian Torsion	1	1	0	0	1
17	Rupture ectopic pregnancy	1	1	0	0	1
	Total	200	200	10	10	190

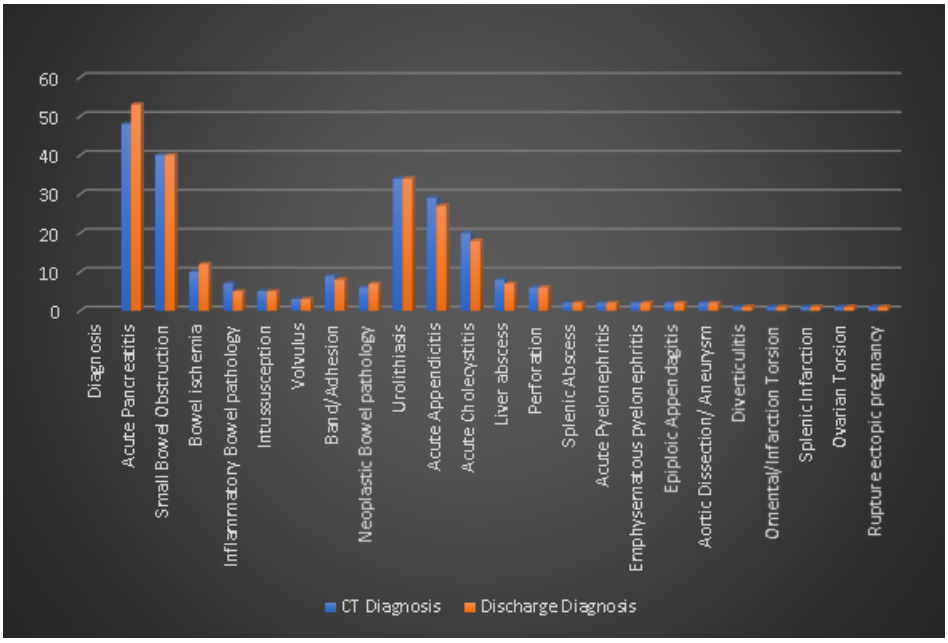

Figure 2. Correlation between CT diagnosis and discharge diagnosis

4. Discussion

The acute abdomen includes a variety of disease processes. Therefore any diagnosis made based only on clinical signs is often inappropriate. As a result, imaging is essential to the medical management of individuals with acute abdomen. The scanning duration is greatly decreased because of the availability of MDCT and modern reconstruction procedures, making it appropriate even for critically ill patients. With the capture of sub-millimetre-thin slices in the axial plane and the large volumetric data, reformations into the needed plane are possible without compromising picture resolution. Besides financial limitations and radiation exposure, MDCT is an excellent tool for assessing patients with acute abdomen.

In our region worldwide, patients with acute abdomen undergo ultrasonography following a thorough clinical examination and necessary laboratory tests. The MDCT examination, however, becomes necessary in many patients since the ultrasonography is operator-dependent, requires patient cooperation, and occasionally produces a poor study due to patient body habits. Therefore, the purpose of the current study was to "study the utility of MDCT in the nontraumatic acute abdomen."

Only patients with acute abdomen who underwent an MDCT test between November 2017 and May 2019 were included in this research. There were 200 acute abdominal patients in our research. According to Table 1, the average patient age in our research population was 43 years old. Most cases (26% of all cases) belonged to the 41–50 age range, while 21.5% belonged to the 21–30 age range. Only 5.5% of the study population, or very few patients, fell into the 0 to 20-year-old age range, possibly because many of these patients underwent ultrasonographic exams instead of MDCT exams. Table 2 reveals that there were 70.5% male individuals in our study sample; this higher male inclination may be attributable to the bias in study population selection.

In our study, 137 patients (68.5%) had nausea and vomiting in addition to acute abdominal pain, while 63 patients (31%) experienced abdominal distension. In 78 patients (39%) we found abdominal discomfort to be the most prevalent symptom, followed by guarding and stiffness in 29 patients (14.5%) (Table 3).

The distribution of patients into different aetiologies of acute abdomen is shown in Table 4 and 5 based on the CT diagnosis, and the CT diagnosis was associated with the ultimate discharge diagnosis. With sensitivity and positive predictive value of 95%, 190 patients with 10 false-positive and 10 false-negative cases of CT diagnosis were found to have accurate results. Our results align with research by Udayshankar UK et al. [8], which found that MDCT had a positive predictive value of 92% to 95% for various causes of acute abdominal pain, while Monica Mangini et al. [9] indicated that MDCT had a sensitivity of 82.4% for acute abdomen.

We examined the CT patterns of common acute abdominal diseases such as acute pancreatitis, small intestinal obstruction, urolithiasis, acute appendicitis, and acute cholecystitis in the past.

Acute pancreatitis heavily strains the patient's morbidity, and it occasionally has a lifelong effect. In our study, this was the most frequent cause of acute abdomen in the study population. According to the final discharge diagnosis, there were 53 instances of acute pancreatitis in total.

We recommended an acute pancreatitis diagnosis in 48 instances based on CT characteristics. In five cases, we misdiagnosed the patient, one of which was groove pancreatitis, which later revealed a tiny, localised region of peripancreatic inflammation close to the duodenum. In a retrospective study, the rest of the patients revealed no noticeable variations in pancreatic size, variability in the pattern of pancreatic enhancement, and observable peripancreatic inflammatory alterations. These individuals underwent a CT scan either extremely early in the course of the illness process or six to seven days after the beginning of symptoms.

Busireddy KK et al. [10] suggested that the best time for a CECT study to assess the full extent of morphologic changes in cases of pancreatitis would be 72 hours after the onset of symptoms because studies conducted immediately and more than 5 days after the onset of symptoms may underestimate the disease process. A CT scan conducted within the first two days after the beginning of symptoms may be normal, according to Turkvatana A. et al.'s research [11].

In 40 out of 200 patients, small intestinal blockage from diverse sources was discovered to be the second most frequent cause of acute abdomen. All SBO cases were discovered via MDCT. It was also useful for quickly determining the underlying cause of the obstruction. Out of the 40 cases of SBO, 12 had bowel ischemia, 5 had inflammatory bowel disease, 8 had bands and adhesions, 7 had neoplastic aetiology, 5 had intussusception, and 3 had volvulus as their final diagnosis. Bowel ischemia was appropriately recognised in 10 of 12 instances.

Furthermore, two were incorrectly diagnosed as having inflammatory bowel disease. On final diagnosis, MDCT properly identified all 5 instances of inflammatory bowel disease, except two false-positive cases that were ultimately shown to have ischemic aetiology. In 8 instances, adhesions were shown to be the cause of SBO. One false positive instance that turned out to be neoplastic stricture helped MDCT identify them all. In 7 instances, neoplastic intestinal pathology was identified as the root cause of SBO, with MDCT being accurate in 6 cases. With MDCT, all five instances of intussusception and three instances of volvulus were appropriately detected. Urinary system-related aetiologies ranked third in frequency among the research population. 34 of the instances involved urolithiasis.

In our investigation, MDCT detected every instance of urolithiasis without a single missed occurrence. These results also agree with existing research. According to Smith RC et al. (1999), most calculi are visible on CT scans, except a small percentage of radiolucent calculi such as indinavir and pure matrix stones.[12] In our analysis, acute appendicitis ranked the fourth most frequent cause of acute abdomen. 29 individuals were identified as having acute appendicitis based on CT results, of which 26 instances had accurate final discharge diagnoses and were therefore regarded as real positive cases. Three false-positive patients had peri-appendiceal fat stranding and a diameter of more than 7 mm, but they were negative for acute appendicitis. In our investigation, one false-negative case had an appendiceal perforation and small bowel blockage. On final discharge diagnosis, 18 of 200 patients with acute abdomen had acute cholecystitis. We identified all instances of acute cholecystitis. After receiving a definitive diagnosis at discharge, acute pancreatitis was found to be the cause in both cases. At the time of the final diagnosis, there were 7 cases of liver abscess. One instance of a false-positive MDCT resulted in gangrenous cholecystitis with hepatic parenchymal rupture and abscess development.

MDCT correctly diagnosed 6 cases of bowel perforation, 2 cases of splenic abscess, 2 cases of acute pyelonephritis, 2 cases of emphysematous pyelonephritis, 2 cases of epiploic appendagitis, 2 cases of aortic aneurysm/dissection, 1 case of diverticulitis, 1 of omental infarction, 1 of splenic infarct, 1 of ovarian torsion and 1 case of ruptured ectopic pregnancy. Overall, MDCT demonstrates a high level of accuracy in diagnosing acute abdominal diseases and further aids in therapy.

The results of our investigation support previous research showing MDCT is the preferred imaging technique in patients with acute abdomen. It is rapid and dependable, with the only drawbacks being financial limitations and radiation-related concerns.

Modern low-radiation devices are widely used, and skilled radiologists may still learn a lot from abdominal CT scans that aren't enhanced. Use of MDCT can be recommended as the primary imaging modality in cases of the acute abdomen or at least whenever USG is ambiguous or provides the doctor or operating surgeon with only a few details due to its lack of operator dependency, fat and air-friendly modality, ability to assess the severity and grading of the disease, and ability to give exquisite and comprehensive

anatomical details.

5. Conclusion

In our research population, MDCT was also successful in correctly detecting a variety of less frequent acute abdominal diseases, including liver and splenic abscesses, pyelonephritis, epiploic appendagitis, ovarian torsion, omental infarct, and aortic dissection. When determining the causes of non-traumatic acute abdomen with certain characteristics as described in the literature and seen in our study, CT can be an effective diagnostic tool. The immediate use of CT in instances of acute abdominal investigation results in more accurate diagnosis and better patient care decisions, increasing outcomes despite the little radiation risk and somewhat higher cost.

Author Contributions: All authors contributed equally to the writing of this paper. All authors read and approved the final manuscript.

Conflicts of Interest: The authors declare that they do not have any conflict of interests.

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