

The role of multi-detector CT (MDCT) in patients presented with non-traumatic acute abdominal conditions

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Abstract:

Background: Acute abdominal pain classically refers to pain within the abdomen that has been present for less than 7 days from the time of presentation. The use of CT scan in the evaluation of acute abdominal pain has increased to a large extent due to high accuracy of CT in the diagnosis of specific diseases like appendicitis and diverticulitis, especially with the use of multidetector CT scanners. It has been shown that the use of intravenous contrast media increases the diagnostic accuracy of CT scan examination, with a positive predictive value of 95% in the cases of acute appendicitis. The accuracy of CT scan imaging in patients with acute abdominal pain was not affected by the lack of entral contrast material.

Objectives: To evaluate the real usefulness of multi-detector CT(MDCT) in non-traumatic acute abdomen, to determine the cause of acute abdomen in those with uncertain pathological diagnosis.

Patients and methods: This prospective study had been conducted at Al-Sader medical city from the first of January to the first of September 2015. Our study includes all patients presented to the emergency department with non-traumatic acute abdominal conditions with uncertain underlying cause inspite of detailed history and physical examination with negative or non-conclusive U/S, plain abdominal XR finding and the surgeon failed to identify the exact underlying pathology. This study included (80) patients, (44 male and 36 female) . Non-enhanced CT scan was done first for all patients which was sufficient to reach the diagnosis in (22) patients, contrast material were not used because blood urea was elevated in (6) patients . In (8) patients, CT angiography protocol was performed for patients with suspected mesenteric vessels pathology. In the remaining (44) patients, intravenous contrast was given manually via a wide bore cannula (gauge 18) and post contrast scan done in the portal phase (delay time 45-50 second).

Results: In this study, which was performed on (80) patients with undiagnosed nontraumatic acute abdominal conditions. We found that acute pancreatitis (20 patients)(25%) was the most common cause of undiagnosed acute abdominal pain, followed by intestinal obstruction (12 patients)(15%). While acute cholecystitis (8 patients)(10%) , portal or mesenteric vein thrombosis (8 patients) (10%) , perforated viscus ,(6 patients) (7.5%), mesenteric arterial thrombosis (4 patients) (5%) ,left gastric artery aneurysm (2patient))(2.5%) , acute appendicitis(2 patient) (2.5%)diverticulitis (2patient) (2.5%) and ectopic pregnancy (2patient) (2.5%). In (14 patients) (17.5%), no specific pathology could be detected.

Conclusion: The role of multi-detector CT (MDCT) has an important role in the management undiagnosed acute abdominal conditions in the emergency department. Acute pancreatitis is one of the main cause of undiagnosed acute abdominal conditions.

Keywords: The role of multi-detector CT (MDCT), non-traumatic acute abdominal conditions.

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Introduction:

Acute abdominal pain classically refers to pain within the abdomen that has been present for less than 7 days from the time of presentation .1 In order to decrease the morbidity and mortality, it is of paramount importance to reach exact diagnosis rapidly. It is often difficult to reach the precise diagnosis depending on the clinical judgment solely. Moreover, both laboratory and conventional radiologic findings are often nonspecific, however; the development of cross-sectional imaging has had a tremendous impact on the diagnosis and treatment of acute abdomen . Computed

tomography (CT) has gained widespread acceptance as a reliable imaging technique to evaluate patients with acute abdominal pain .2 The use of CT scan in the evaluation of acute abdominal pain has increased to a large extent due to high accuracy of CT in the diagnosis of specific diseases like appendicitis and diverticulitis, especially with the use of multidetector CT scanners.3 It has been shown that the use of intravenous contrast media increasing the diagnostic accuracy of CT scan examination with a positive predictive value of 95% reported for the diagnosis of appendicitis and a high level of diagnostic confidence, especially in thin patients.4However, abdominal CT can be performed without contrast medium5. Oral or rectal contrast material

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may be helpful in differentiating fluid-filled bowel loops from abscesses in some cases, however; its use can markedly increase the time these patients spend in the emergency department.⁶ The accuracy of CT scan imaging in patients with acute abdominal pain does not affected by the lack of entral contrast material as it does in postoperative patients.⁷ Prospective studies showed that CT scan imaging findings improve the diagnostic accuracy of the clinical diagnosis made before CT from 71% to 93% after CT was performed.⁸ Multi-detector row CT angiography (CTA) allows clinicians to view nearly perfect three-dimensional images of the abdominal vasculature utilizing a non-invasive radiological imaging study. CTA is being utilized in the diagnosis of acute abdominal vascular conditions like ruptured abdominal aortic aneurysm, aortic dissection, intra-abdominal organ hemorrhage, graft fistulas, and mesenteric ischemia.⁹ As there is usually a significant time reduction for diagnosing acute abdominal vascular emergencies with CTA as compared to traditional catheter angiography, CTA is rapidly becoming the emergency vascular imaging modality of choice in patients with emergency abdominal conditions.⁹ Abdominal CT scan can accurately detect pneumatosis intestinalis and hepatic portal venous gas, and has the ability to reveal their underlying cause. Therefore, CT should be used as the primary diagnostic tool.¹⁰ Recently the application of CTA as the ideal first-step imaging approach in patients with acute bowel ischemia has been advocated with a specificity of 94% with a sensitivity of 96%.¹¹ CT is the preferred imaging technique for the diagnosis and assessment of appendicitis.¹² Studies evaluating the efficacy of high-resolution CT show sensitivities of 90-100%, specificities of 83-97%, and accuracies of 93-98% for the diagnosis of acute appendicitis.¹³ However ;CT has limitations in the detection of appendiceal perforation.¹⁴ CT scan is a useful tool in the diagnosis and staging of suspected complicated conditions of colonic diverticulitis as well as aids in therapeutic decisions and in the detection of alternative diseases.¹⁵ The sensitivity of CT in the assessment and diagnosis of diverticulitis is 94% and specificity is 99%.³ CT scan is an accurate modality to identify an emphysematous or gangrenous gallbladder as it can visualize gas in the wall or lumen of the gallbladder, lack of wall enhancement, and pericholecystic fluid .These findings highly specific for the diagnosis of gangrenous cholecystitis and have good accuracy, with a sensitivity of 92% and a specificity of 99%.¹⁶ Bowel obstruction is a relatively common condition presents with acute abdominal pain. It is proved that CT scan can differentiate between high and low level obstruction.¹⁷ However; it is

very useful in cases of high-level small bowel obstruction, with a sensitivity of 90%–96%, a specificity of 96%, and an accuracy of 95%.² CT scan can shows a clear change in bowel diameter. With SBO, loops proximal to the transition point are distended, whereas loops distal to the transition point are collapsed. A helpful sign for identifying the point of obstruction is the small-bowel feces sign—that is, feces-like material in the distended small bowel.¹⁸ Moreover, CT scan can identify the cause, the level of obstruction, as well as can differentiate between complicated obstruction (eg, strangulation) from simple conditions.¹² However, its accuracy in the diagnosis of large bowel obstruction is shown by Frager et al study with sensitivity of 96% and a specificity of 93%.¹⁹ Gastrointestinal perforation represents an important cause of acute abdominal conditions. It is proved that perforated peptic ulcer is the most common cause while perforated carcinoma and bowel ischemia are less frequent causes. Previously, suspected free intraperitoneal air was always an indication to perform surgery. However; recently, with the increased use of CT, contained perforations are more commonly diagnosed, and the initial treatment for these may be conservative.¹⁴ moreover ,it can correctly depict the actual site of perforation in 86% of cases.²⁰ Pancreatitis usually presents with nausea, vomiting, and upper or diffuse abdominal pain & CT scan is the imaging modality of first choice for uncomplicated conditions. In cases where the patient has a fever, elevated serum markers, elevated white cell count, hypotension, severe pain, or evidence of early sepsis, CT is a better choice as it provides more information.CT will show extension of the disease to adjacent soft tissue, hemorrhage within the pancreas, and pancreatic necrosis. It can also identify and localize fluid collections and pseudocysts.²¹

Patients and methods:

This prospective study had been conducted at Al-Sader medical city from the first of January to the first of September 2015.Our study includes all patients presented to the emergency department with non-traumatic acute abdominal conditions with uncertain underlying cause inspite of detailed history and physical examination with negative or non-conclusive U/S, plain abdominal XR finding and the surgeon failed to identify the exact underlying pathology. Patients with history of recent abdominal trauma were excluded from the study. This study included (80) patients , (44 male while 36 female) .U/S of the abdomen and plain X-ray of abdomen and chest were performed for all patients .Helical CT scan was performed for all those patients .The patients were told about the advantage and disadvantage of

the CT scan examination & then consent agreement was taken from them.

CT protocol: We use multidetector CT (TOSHIBA 64 AQUILION) in Al-Sader medical city. CT protocol was applied according to the clinical presentation of the patient. Non-enhanced CT scan (from the xyphisternum to the inguinal region) was done first for all patients. The patient lies supine on the couch with the head first. We use KVp(120) Mass change automatically according to the soft tissue thickness. This study showed that Non-enhanced CT scan was sufficient to reach the diagnosis in (22) patients. contrast material were not used because blood urea was elevated in (6) patients.

In (8) patients, CT angiography protocol was performed for patients with suspected mesenteric vessels pathology. The contrast agent used is iohexol (omnipaque 350mg/ml given by automatic injector via wide bore cannula, at a rate of 4 cc/second with bullous tracking placed on the thoracic aorta, followed by normal saline infusion (half the volume of the consumed contrast) by another syringe in the same injector (dual injector), the scanning start at density threshold of 120HU and patient asked to hold breathing. In the remaining (44) patients, intravenous contrast was given manually via a wide bore cannula (gauge 18) and post contrast scan done in the portal phase (delay time 45-50 second). Then the results of the CT scan were interpreted by specialist radiologist taking in consideration the U/S and plain XR findings with the clinical data. The patients then followed up clinically to see if they are operated on or treated conservatively. The result then was calculate & arranged bio-statistically into tables according to the EXCELL 2010.

Results:

This study includes (80) patients with nontraumatic acute abdominal pain. Of them, we found that (44) patients (55%) were male and (36) patients (45%) were female. The commonest age group was found between 31-50years (32) patients (40%). The second most common age group affected was those between 61-70 years (14) patients (17.5%). The least were those between 1-20 years, and those between 71-80 years (18) patients as shown in table 1. In this study, we found that (70) patients did not have free fluid on abdominal U/S while only (10) patients had free fluid. Twenty five percent of the patients who presented with undiagnosed acute abdominal pain were found to have acute pancreatitis (20) patients. In (14) patients (17.5%), no specific pathology could be detected. Table (2) showed the detail of different clinical conditions and their percentages

in our patients.

Twenty-four patients were treated surgically while (56) patients were treated conservatively as shown in table (2).

Table 1 shows the age distribution of patients

Age of patients in years	Number Of patients	%
1 - 10	6	7.5 %
11 - 20	6	7.5 %
21 - 30	8	10 %
31 - 40	16	20 %
41 - 50	16	20 %
51 - 60	8	10 %
61 - 70	14	17.5 %
71 - 80	6	7.5 %
total	80	100%

Table 2 shows CT scan diagnostic findings

C T diagnosis	Patients	%	management
Acute pancreatitis	20	25%	Conservative
No specific pathology detected	14	17.5%	Conservative
Intestinal obstruction	12	15%	10 Surgical , 2 conservative
Acute cholecystitis	8	10%	Conservative
Portal or mesenteric v. thrombosis	8	10%	6 Conservative , 2 surgical
Perforated viscus	6	7.5%	Surgical
Mesenteric arterial thrombosis	4	5%	2 Surgical , 2 conservative
Lt epigastric artery hematoma (ruptured artery)	2	2.5%	Conservative
Acute appendicitis	2	2.5%	Surgical
Diverticulitis	2	2.5%	Conservative
Ectopic pregnancy	2	2.5%	Surgical

Discussion:

In this cross sectional study which was done to evaluate 80 patients of undiagnosed nontraumatic acute abdominal pain by multi detector CT, the diagnosis was reached for most cases without the need of oral contrast media, because there was no time for such patients to take oral contrast and some patients were unable to take oral fluid due to repeated vomiting or the presence of naso gastric tube. There are several studies state that no contrast of any kind is needed for the majority of acute non traumatic abdominal CT scans

and few literatures favour its use. 22 Lee et al²² compared CT of the abdomen and pelvis with and without contrast. Scans were read by different radiologists at different times. There was 79% agreement between the non contrasted CT and the contrasted CT. Analysis suggested that the difference was due more to intra-observer variation rather than bowel opacification. In current study, intravenous contrast material were given in (52) patients. Most published studies advocate the use of IV contrast alone for vascular disease, hepatobiliary disease, and pancreatic disease unless ruptured aneurysm or abscess is suspected. 9Huynh LN et al⁶ found that the use of oral contrast material can markedly increase the time these patients spend in the emergency department. The lack of enteral contrast medium does not seem to hamper the accurate reading of CT images obtained in patients with acute abdominal pain. 12 In a series of 1021 consecutive patients with acute abdominal pain in whom only intravenous contrast medium was administered, there were no inconclusive CT scans due to the lack of enteral contrast medium 7 Hill BC et al²³ did a retrospective review of 661 hospital in patients who underwent urgent abdominal/pelvic CT with any combination of contrast, intravenous (IV), oral, rectal, or unenhanced for a suspected acute abdominal process. Accuracy of CT was compared between enhanced and unenhanced imaging using Fisher's exact test. Use of IV contrast alone was found to be correct in 92.5% of cases. IV and oral contrast was correct in 94.6%. Unenhanced imaging was correct in 92.5%. Oral contrast alone was 93.5% correct. They found that there was no significant difference in the ability to correctly diagnose a suspected acute abdominal process when enhanced CT imaging was compared to unenhanced. They conclude that CT contrast administration in critically ill-hospitalized patients is not necessary to accurately diagnose an acute abdominal process. Eliminating the use of contrast may improve patient comfort, decrease patient risk, and minimize financial cost. For patients with bowel obstruction, scans are best obtained without oral contrast material because intraluminal fluid and gas serve as natural contrast agents. IV contrast material is important in assessing intestinal perfusion and ischemia and delineating the size, configuration, and patency of the mesenteric vessels 24 Jonathan W. Berlin et al²⁵. prefer to give 800-1000 ml of a 2% solution of oral diluted water-soluble contrast material at least 1 hour before scanning. Oral contrast material may obscure the diagnosis of bowel hemorrhage or ischemia and limit the detection of ureteral stones, appendicoliths, or bile duct stones. Practical difficulties of oral contrast material include the time it takes to opacify the gut, the randomness

of contrast opacification, and the inability of sick patients to consume and retain sufficient quantities of oral contrast material. Hershko DD, Awad N, Fischer D, et al²⁶ did a prospective study with 232 patients which showed that non contrast enhanced CT (sensitivity, 90%; specificity, 86%) was inferior to rectal-only contrast (sensitivity, 93%; specificity, 95%) and IV and oral contrast (sensitivity, 100%; specificity, 89%) Dearing DD, Recabaren JA and Alexander M²⁷ stated that High accuracy has been reported for both techniques however the few direct comparisons available in the literature suggest higher accuracy when IV contrast is used.

In this study, which was performed on (80) patients with undiagnosed nontraumatic acute abdominal conditions, we found that acute pancreatitis (20 patients)(25%) was the most common cause of undiagnosed acute abdominal pain. In (14 patients) (17.5%), no specific pathology could be detected, while other conditions explained in detail in the table (3). In a review of approximately 30,000 patients with acute abdomen, de Bombal²⁸ observed that 28% of patients had appendicitis, 9.7% had acute cholecystitis, 4.1% had small-bowel obstruction, 4% had acute gynecologic disease, 2.9% had acute pancreatitis, 2.9% had acute renal colic, 2.5% had perforated peptic ulcer, and 1.5% had diverticulitis. In one third of patients, no cause could be determined. In this study, 20 patients (25%) were found to have acute pancreatitis. The incidence of acute pancreatitis has been rising in the western world during the last 20 years (Whitcomb 2006) 29. But the incidence, varying widely depending on the country, is partly explained by the difference in alcohol consumption in the various countries (Yadav and Lowenfels 2006). 30 Gallstone pancreatitis is more common in women, and alcoholic pancreatitis is more common in men. However, in the last 20 years, the incidence of gallstone pancreatitis has increased in all counties (Nøjgaard et al. 2010). 31 In the current study, acute appendicitis was found in (2 patient) (2.5%) of cases only. Valenovich V, Satava R³². were found that acute appendicitis is the most common abdominal surgical emergency, affecting approximately 250,000 people annually in the United States. They said that although the correct diagnosis can be made in most patients on the basis of history, physical examination, and laboratory tests, diagnosis is uncertain in 20-33% of patients who present with atypical symptoms. Currently, diagnosing acute appendicitis remains challenging when relying only on clinical and laboratory findings. Indeed, the rate of histologically normal appendix is 20% (Raman et al³³. 2008; Poortman et al³⁴. 2009). However, during the past 20 years, ultrasonography and computed tomography

(CT) have progressively changed the practices. Where it found that these new imaging technologies, in particular CT, allow preoperative diagnosis of appendicitis to be more reliable, related complications to be evaluated, the negative appendectomy rate and costs of caring to be lowered, and differential diagnosis to be sought.³⁴ Computer aided diagnosis may reduce negative laparotomies and negative appendectomies as that shown by Adams, I.D., et al³⁵, who said that CT has been shown to reduce the appendicular perforation rates from 23 to 11% by early identification. This difference in the results is because in these studies, CT scan was performed for all patients with acute abdominal pain while in our hospital, the diagnosis of acute appendicitis, acute cholecystitis and renal stones relies solely on the basis of detailed history, physical examination, laboratory test results and ultrasound findings while CT scan examination is preserved for cases with inconclusive ultrasound findings. In this study, only two patients were found to have perforated diverticulitis which is sealed by omentum and he was treated conservatively. However; these findings were in agreement with the findings of Jacobs DO³⁶ who reported that among patients who are evaluated for possible acute diverticulitis, only 1%–2% have free perforation and most perforated diverticula are contained perforations and they said that the major advantage of CT, as compared with radiography and US, is that it can correctly depict the actual site of perforation in 86% of cases. Jacobs DO³⁶ also found that acute colonic diverticulitis is the second most common cause of acute abdominal pain and leads to 130000 hospitalizations in the United States annually. Jaap Stoker, MD et al¹² found that the prevalence—and thus the incidence—of diverticulosis increases with age. In a study done by Ferzoco LB et al³⁷, found that ten percent of the general population younger than 40 years and more than 60% of people older than 80 years are affected by diverticulosis. In current study, six patients (7.5%) were found to have perforated peptic ulcer and were treated surgically. Acute abdominal pain as a result of gastrointestinal tract perforation is most commonly caused by a perforated gastroduodenal peptic ulcer or diverticulitis. Less frequent causes include carcinoma and bowel ischemia. Perforated viscus is a generally recognized diagnosis, although the incidence of this abnormality with free perforation is low. Jaap Stoker, MD et al¹² found that perforation of a peptic ulcer is now less frequent because of the availability of adequate medical therapy for peptic ulcer disease. Isabel B. Oliva, MD et al³⁸ found that acute mesenteric ischemia is most commonly secondary to acute embolism to the superior mesenteric artery (SMA), which accounts for approximately 40%-50%

of all episodes. Hagspiel KD³⁹ found that acute mesenteric artery thrombosis is the second most common cause of acute mesenteric ischemia (20%-30%) followed by non occlusive mesenteric ischemia (25%) and less commonly mesenteric and portal venous thrombosis (5%-15%). Mesenteric and portal venous thrombosis is the least common cause of acute mesenteric ischemia and may be idiopathic^{38,39} However the last 2 studies disagree with the current study where we found that 8 patients (10% of all) had portal or mesenteric vein thrombosis and 4 patients (5%) had mesenteric arterial thrombosis. In this study we also found that only (8 patients) (10%) had acute cholecystitis. As the diagnosis is usually made by history, clinical examination and ultrasound findings. Jaap Stoker, MD et al¹² said that the prevalence of acute cholecystitis is approximately 5% in patients who present with acute abdominal pain to the ED and traditionally, the diagnosis has been based on the clinical triad of right upper quadrant tenderness, elevated body temperature, and elevated white blood cell count. In a prospective series of patients with acute cholecystitis (done by Lameris W et al⁴⁰) however, this triad was present in only 8% of patients. In a highly select study sample done by Bennett GL, Rusinek H, Lisi V, et al¹⁶, CT also showed good accuracy, with a sensitivity of 92% and a specificity of 99%. In this study, however; we found that no patient with renal problem was present as undiagnosed acute abdominal pain which means that the diagnosis is usually made on the base of history, physical examination, laboratory tests results with the help of ultrasound examination.

Conclusion:

The role of multi-detector CT (MDCT) has an important role in the management undiagnosed acute abdominal conditions in the emergency department. Acute pancreatitis is one of the main cause of undiagnosed acute abdominal conditions.

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