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Original research article

Abdominal Computed Tomography Findings in Adults with Acute Right Lower Quadrant Pain

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ABSTRACT

Acute right lower quadrant (RLQ) abdominal pain is a common symptom in patients suffering from conditions such as appendicitis, diverticulitis, or enterocolitis. Some of these are emergency conditions and often require further investigation using abdominal computed tomography (CT). The objective of this study was to evaluate CT data from adult patients with acute RLQ pain coming from various causes. Data were collected from the electronic medical records of patients aged over 15 years, who presented acute RLQ pain, at the emergency department or outpatient department, and who were then sent to receive abdominal CT scans; the data were then reviewed independently by two experienced radiologists. The final diagnosis for each patient was retrieved from surgical findings, pathological results, and medical records. Abdominal CT diagnoses were considered along with the final diagnosis and calculated as a percent. A total of 240 patients were eligible for this study. Appendicitis and related complications was the most common CT diagnoses, consisting of 160 patients (66.67%). A normal CT finding was the second most common CT diagnosis, consisting of 18 patients (7.50%). Enterocolitis was the third most common CT diagnosis, consisting of 16 patients (6.67%). Gastrointestinal (GI) cancer was the sixth most common CT diagnosis, consisting of six patients (2.50%). Fifteen cases had discordance between the CT and final diagnoses. The most common diagnoses in discordant cases was normal in CT diagnosis with enterocolitis in final diagnosis, occurring in eight patients (53.33%). The most common abdominal CT finding in adults with acute RLQ pain was appendicitis and related complications. The second most common CT finding was normal CT findings. The third most common CT finding was enterocolitis. However, acute RLQ pain can present in cases of GI cancer, the sixth most common final diagnosis. CT scans are considered useful in inconclusive clinical presentations and it must be noted that the disease may be something other than appendicitis.

Keywords: Abdominal CT; Acute RLQ pain; Appendicitis; Enterocolitis; Normal CT finding

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1. Introduction

Acute right lower quadrant (RLQ) pain is defined as the sudden onset of RLQ pain lasting less than seven days, and is a common problem in patients. There are a number of possible diagnoses that can come from this symptom, such as appendicitis with or without complication, diverticulitis, enterocolitis, urinary tract infection, and pelvic inflammatory disease (PID). The treatments for acute RLQ pain are categorized into surgical and non-surgical groups. The surgical group includes diseases such as acute appendicitis, ovarian torsion or ruptured diverticulitis, and others. The non-surgical group includes diseases such as acute pyelonephritis or acute PID, and others. Delayed diagnosis and treatment can lead to prolonged hospital stays as well as increased morbidity and mortality. Computed tomography (CT) is the modality of choice for imaging techniques in cases of acute RLQ pain, due to it being readily available, effective, noninvasive, as well as having high sensitivity and high specificity, which contributes to its excellent performance in identifying gastrointestinal, genitourinary, and gynecological causes of acute RLQ pain [1-2]. The current study aimed to evaluate the CT findings in cases of acute RLQ pain originating from various causes, in adult patients.

2. Materials and Methods

2.1 Data collection

This study was a retrospective descriptive study conducted at Thammasat University Hospital, Pathum Thani, Thailand. The ethics board committee approved the study protocol prior to commencement.

Data were collected from patients, aged more than 15 years, who presented at the emergency department or outpatient department with acute RLQ pain. The data were gathered from their electronic medical records during the period of January 1, 2012, to September 30, 2017, by searching the Radiology Information System (RIS) using the search terms “RLQ pain”, “right lower quadrant pain”, and “rule out appendicitis”. Two hundred ninety-five patients were found in the RIS who received abdominal CT scans. Fifty-five of them were excluded from the study due to incomplete medical records. A total of 240 patients were included in this study.

Two experienced radiologists independently reviewed the abdominal CT scans. Both radiologists were blind to the clinical history and final diagnosis. Any discordant findings were discussed between the two radiologists in order to reach a final consensus. Patients’ final diagnoses were retrieved from surgical findings, pathological results, and final clinical diagnoses from medical records.

The imaging criteria in the diagnosis of appendicitis consists of main and additional imaging characteristics. The main imaging characteristics are dilated non-opacified appendix (>6mm) (Fig. 1) and appendicolith (Fig. 2). The additional imaging characteristics are fat stranding, fluid collection, abscess, extra-luminal air, and adenopathy [3-6].

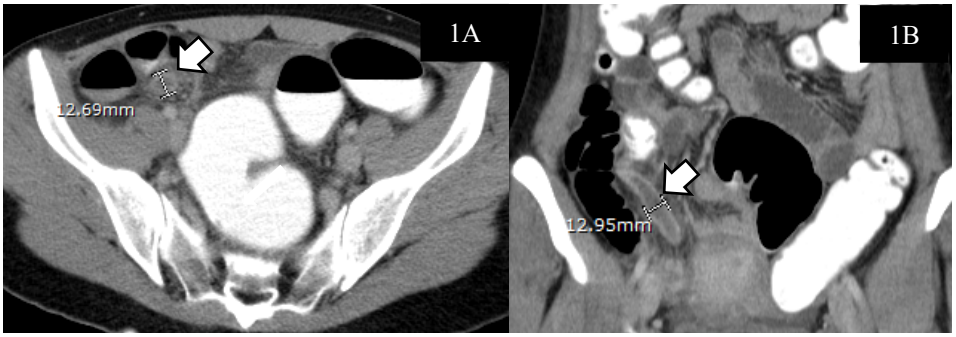

Fig.1. Axial (A) and coronal (B) contrast-enhanced CT images of acute appendicitis show dilated non-opacified appendix (>6mm) (arrow).

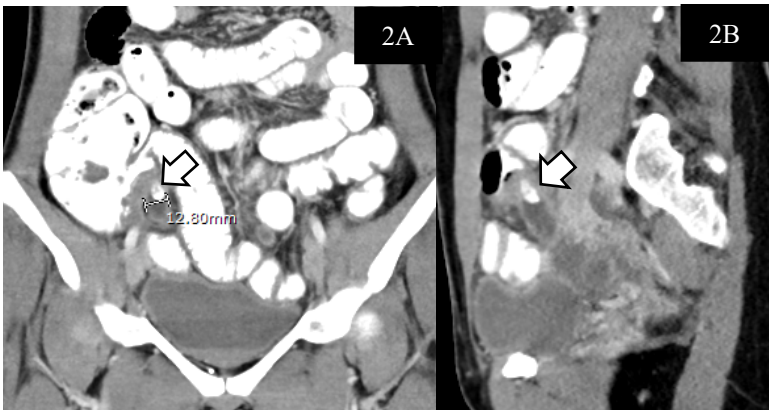

Fig.2. Coronal (A) and sagittal (B) contrast-enhanced CT images of appendicitis with appendicolith (arrow).

Major CT findings that indicate enterocolitis are nonspecific findings, such as circumferential mural thickening of the terminal ileum and cecum with homogeneous enhancement (Fig. 3), and adjacent adenopathy, seen in CT imaging. Fat stranding in the pericolic and mesenteric regions, as well as small amounts of ascites may or may not be associated [2].

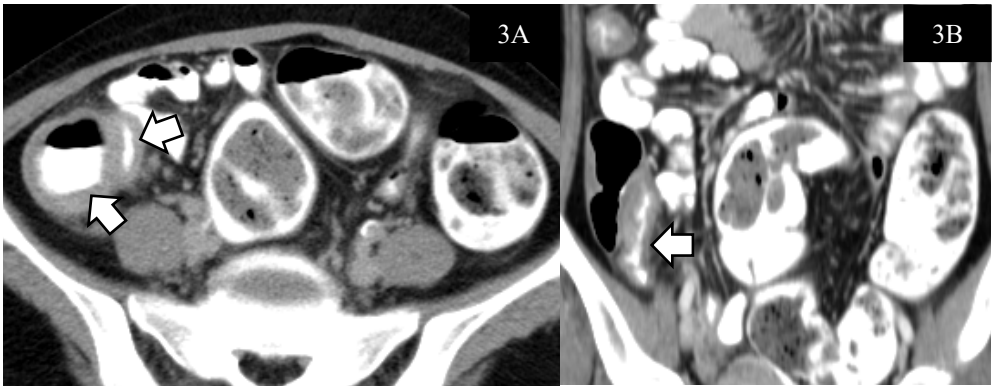

Fig. 3. Axial (A) and coronal (B) contrast-enhanced CT images of enterocolitis show circumferential mural thickening of the terminal ileum and cecum (arrow).

Furthermore, other causes of acute RLQ pain include mesenteric adenitis, epiploic appendagitis, diverticulitis, gastrointestinal (GI) cancer, ureteric calculi, pyelonephritis, cystitis, complicated ovarian disease, and issues of the musculoskeletal system, and can also present in patients with CT findings categorized as normal or other groups.

2.2 Computed tomographic techniques

CT examinations were performed using a Philips Brilliance iCT 256 slices helical scanner (Philips Healthcare Medical System) or a SOMATOM Definite AS 128 slices helical scanner (Siemens Healthineers) at the Thammasat University Hospital in Pathum Thani. Standard CT protocol for abdominal pain included a non-contrast phase, late arterial phase, and portal-venous phase (40 seconds and 80 seconds post-injection start, respectively) using positive oral or rectal contrast administration, or no positive oral or rectal contrast administration. However, each abdominal CT scan was individually tailored depending on clinical information and discussion between the referring physicians and on-duty residents or radiologists.

2.3 Statistical analysis

Abdominal CT diagnoses were considered together with their corresponding final diagnosis; the findings are presented as percentages.

3. Results

Clinical data of the patients are shown in Table 1. A total of 240 patients were eligible for this study. The ages in the study population range from 16-94 years (mean; 47.73 years). Durations of symptom presentations range from 1-7 days (mean; 2.27 days). One hundred thirty-one patients (54.60%) had a fever, while 109 patients (45.40%) had no fever. White blood cell (WBC) counts in this study ranged from 2,500-30,000 cells/uL (mean; 13,158.25). Of the study population, 170 patients (70.83%) had a WBC count >10,000 cells/uL; 70 patients (29.16%) had a WBC count <10,000 cells/uL.

CT scans were done on 100, 135, and 5 patients as whole abdominal CT, lower abdominal CT, and CT KUB, respectively. CT scans were performed on 14, 27, 44, 46, 58, and 51 patients in 2012, 2013, 2014, 2015, 2016, and 2017, respectively.

Two hundred forty patients had a diagnosis from an abdominal CT, which are displayed in Table 2. Appendicitis and related complications was the most common CT diagnosis, accounting for 160 patients (66.67%). Normal CT findings was the second most common CT diagnosis, accounting for 18 patients (7.50%). Enterocolitis was the third most common CT diagnosis, accounting for 16 patients (6.67%). GI cancer was the sixth most common CT diagnosis, accounting for 6 patients (2.50%).

Diseases of other groups in CT findings were myoma uteri with complications, acute cholecystitis, lymphoma, closed-loop obstruction, internal hernia (retrocecal hernia), parasitic infestation along with small bowel loops, transitional cell carcinoma, hemorrhagic polycystic kidney disease, and pancreatitis.

All final clinical diagnoses are displayed in Table 3. Appendicitis and related complications were the most common final diagnosis, accounting for 160 patients (66.67%). Enterocolitis was the second most common final diagnosis, accounting for 24 patients (10.00%). Disease of another group was the third most common final diagnosis, accounting for 9 patients (3.75%). GI cancer was the sixth most common final diagnosis, accounting for 6 patients (2.50%).

Diseases of other groups in final diagnosis were abdominal pain and all the same CT findings, except for pancreatitis misdiagnosed as diverticulitis.

Fifteen cases had discordance between the CT and final diagnosis. The most

common combination of diagnoses in cases of discordant diagnosis was normal CT diagnosis with enterocolitis in the final diagnosis, accounting for 8 patients (53.33%). Discordant cases are listed in Table 4.

Table 1. Clinical data of the patients.

Variable	n	Percentage (%)
Age (years), mean	47.73	
Gender, male/female	103/137	43/57
Durations of presenting symptoms (days), mean	2.27	
Fever	109	45.4
WBC counts (cells/uL), mean	13,158.25	
WBC counts > 10,000 cells/uL	170	70.83
WBC counts < 10,000 cells/uL	70	29.16

Table 2. Lists of abdominal CT diagnoses.

CT Diagnoses	No. of patients	Percentage (%)
Appendicitis and related complications	160	66.67
Mesenteric adenitis	4	1.67
Enterocolitis	16	6.67
Epiploic appendagitis	1	0.42
Diverticulitis	2	0.83
GI Cancer	6	2.50
Ureteric calculi	4	1.67
Pyelonephritis	4	1.67
Cystitis	2	0.83
Complicated ovarian disease	5	2.08
Pelvic inflammatory disease	7	2.92
Musculoskeletal system	2	0.83
Normal	18	7.50
Other group	9	3.75

Table 3. Lists of final diagnoses.

Final Diagnoses	No. of patients	Percentage (%)
Appendicitis and related complications	160	66.67
Mesenteric adenitis	5	2.08
Enterocolitis	24	10.00
Epiploic appendagitis	1	0.42
Diverticulitis	3	1.25
GI Cancer	6	2.50
Ureteric calculi	4	1.67
Pyelonephritis	4	1.67
Cystitis	3	1.25
Complicated ovarian disease	4	1.67
Pelvic inflammatory disease	8	3.33
Musculoskeletal system	2	0.83
Normal	7	2.92
Other group	9	3.75

Table 4. Lists of discordance between CT and final diagnoses.

CT Diagnoses	Final Diagnoses	No. of patients
Normal CT finding	Appendicitis and related complications	1
	Mesenteric adenitis	1
	Enterocolitis	8
	Pelvic inflammatory disease	1
	Other group (Abdominal pain)	1
Appendicitis and related complications	Cystitis	1
Complicated ovarian disease	Normal final diagnosis	1
Other group (Pancreatitis)	Diverticulitis	1

4. Discussion

Abdominal CT has been used to diagnose adult patients presenting with acute RLQ pain; as an area of research, it has been receiving more attention, being featured in an increasing number of studies each year.

The most common disease diagnosis to come from abdominal CT findings in adults with acute RLQ pain was appendicitis and related complications, accounting for 160 patients (66.67%). Normal CT findings was the second most common CT diagnosis, accounting for 18 patients (7.50%). Enterocolitis was the third most common CT diagnosis, accounting for 16 patients (6.67%). These results are similar to findings of prior studies, including Balthazar EJ, et al. [3], Rao PM et al. [4], and Kamel IR et al. [5], wherein appendicitis and related complications was the most common CT diagnosis.

Balthazar EJ et al. [3] found that a normal CT finding was the second, and complicated ovarian disease the third, most common disease. Rao PM et al. [4] found that a normal CT finding was the second, and PID the third, common disease. Kamel IR et al. [5] found PID was the second, and diverticulitis the third, most common disease.

The most common combination of diagnoses in cases of discordance between CT and final diagnoses was a normal CT finding and enterocolitis in final diagnosis, seen in 8 patients (53.33%). Enterocolitis can present with normal findings in CT scans, it depends on a clinical diagnosis. Patients with enterocolitis from any cause typically have bowel wall thickening [11], representing a degree of disease severity not found in this study's patients due to the mild severity. One of the cases with normal CT findings resulted in a final diagnosis of appendicitis; this particular patient had an instance of partial antibiotic drug treatment in their history (Fig. 5). Previous antibiotic drug treatment can mimic normal CT findings of appendicitis [12].

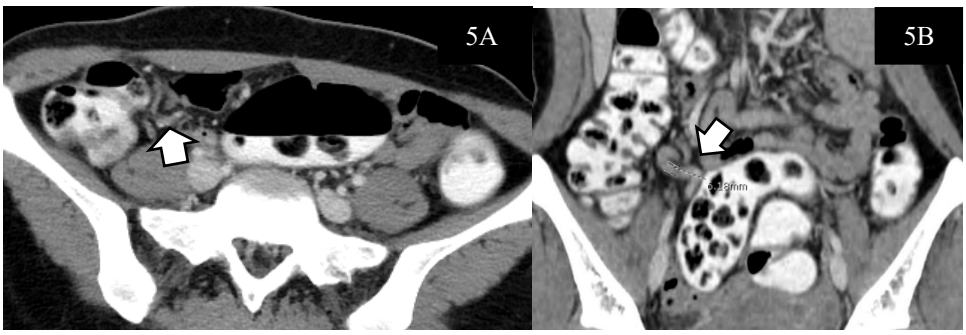

Fig. 5. A 31-year-old female presented with RLQ pain and partial antibiotic drug treatment for 3 days. Axial (A) and coronal (B) contrast-enhanced CT images with positive rectal contrast administration show normal diameter of the appendix (arrow) without definite enhancement or fat stranding, the diameter is

about 0.6 cm. The patient was sent to undergo an appendectomy. Final pathology report was acute appendicitis.

In one case, there was a diagnosis of complicated ovarian disease in the CT findings. The final diagnosis was left ruptured corpus luteal cyst, seen in the CT finding (Fig. 6.). The results of the gynecological examination were unremarkable. This patient received no treatment due to self-limiting with conservative management. A ruptured ovarian cyst is a frequent cause of acute pelvic pain in women of reproductive age. The disease course can range from asymptomatic to severe peritoneal irritations and even life-threatening shock [13].

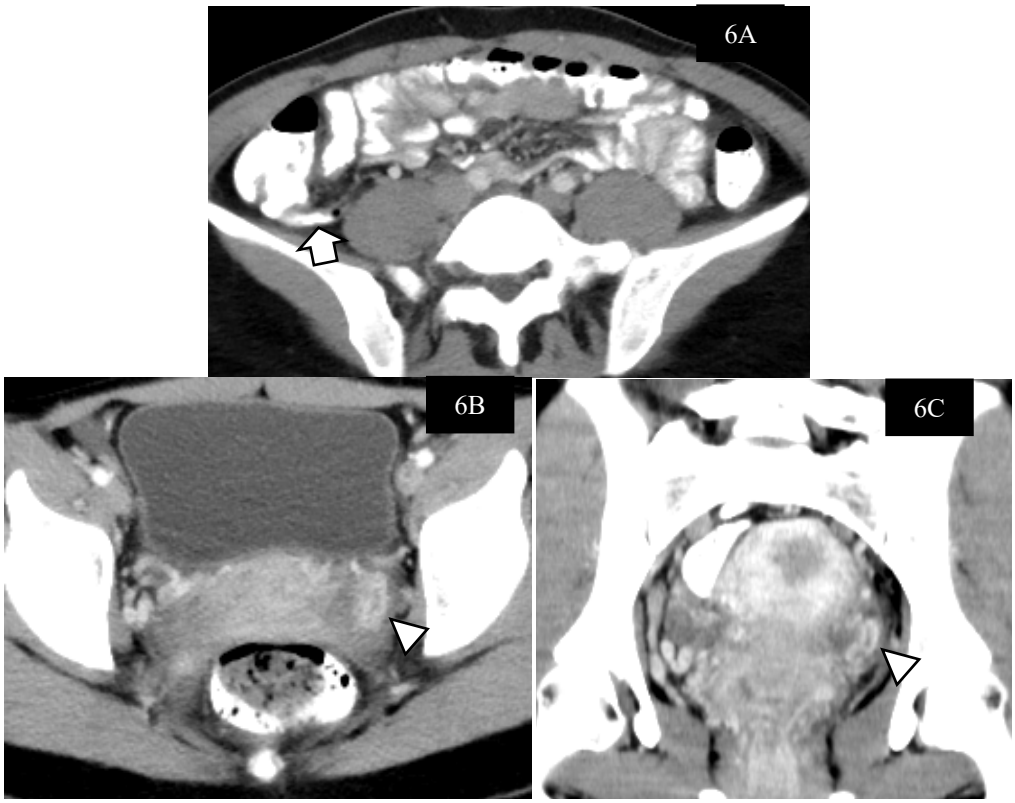

Fig. 6. A 29-year-old female presented with RLQ pain for 1day. Axial (A) contrast-enhanced CT image with positive rectal contrast administration shows normal size and enhancement of appendix (arrow) with contrast filling-in. Axial (B) and coronal (C) contrast-enhanced CT images show an irregular hyper-enhancing thick wall of left ovarian cyst (arrow head), measured about 1.5 cm, likely ruptured corpus luteal cyst. Gynecological examination finding is unremarkable. Final diagnosis is normal.

GI cancer was the sixth most common final diagnosis, accounting for 6 patients (2.50%). Not only cases of infection or inflammation can present with acute RLQ pain, cases of cancer can as well. Most patients underwent a preoperative abdominal CT scan, presumably due to advanced age and the possibility of a coexisting GI cancer [14].

CT scans can reduce the negative appendectomy rate in patients who present with acute RLQ pain [15]. CT findings show multiple diseases that present with acute

RLQ pain, leading to corrected treatment plans, decreased morbidity, and mortality.

There are limitations to this study. First of all, the study was a retrospective descriptive study. Second, the CT techniques used were variable depending on clinical information and discussion between the referring physician and the on-duty residents or radiologist. Finally, a cost-effectiveness analysis estimating the CT scan value and the associated potential long-term risks of radiation exposure was not performed [16].

5. Conclusion

The most common abdominal CT finding in adults with acute RLQ pain was appendicitis and related complications. The second most common CT finding was a normal CT finding. The third most common CT finding was enterocolitis. However, GI cancer can present with acute RLQ pain, the sixth most common final diagnosis. CT scans are considered useful in cases of inconclusive clinical presentation and it should be noted that in cases of controversial patient diagnoses, the cause of the problem can be things other than appendicitis.

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