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Generalist versus Abdominal Subspecialist Radiologist Interpretations of Abdominopelvic Computed Tomography Performed on Patients with Abdominal Pain and its Impact on the Therapeutic Approach

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Abstract

Introduction: Abdominal pain is one of the most common patient complaints in the emergency department (ED) and abdominopelvic computed tomography (ACT) scan plays an important role in evaluation of these patients.

Objective: The aim of this study was to determine the differences between interpretations by generalist radiologists and abdominal subspecialist radiologists regarding the abdominopelvic computed tomography (ACT) of patients who were admitted to the Emergency Department (ED) and to investigate its effect on the patients' therapeutic approach.

Methods: The records of 16452 patients who were admitted to the emergency department with complaint of abdominal pain between January 2015 and April 2017 were reviewed, retrospectively. Out of these patients, 245 (1.5%) underwent ACT for differential diagnosis and among them, 137 (0.8%) patients had their ACT reports evaluated by generalist radiologists in 45 minutes and by abdominal subspecialist radiologist 8–12 hours later and were included in the study. Patients were divided into three groups according to the effect of ACT reports on the performed treatment. Group 1: no effect on planned treatment, group 2: minor effect on planned treatment, which did not result in a change in the treatment process and group 3: major effect on planned treatment approach, which resulted in a change in the treatment process. These changes included at least one of the two criteria: changing the indication of surgery from emergency surgery to elective surgery and/or discharge of the patient from the ED, when actually hospitalization was required.

Results: Out of the 137 patients, 87 (63.5%) were male, 50 (36.5%) were female and the patients' mean age was 56 (27-93) years. There were 117 (85.4%) patients in group 1, 15 (10.9%) patients in group 2, and 5 (3.7%) patients in group 3. We determined minor inconsistency between the reports in group 2 and major inconsistency in group 3. Patients in group 3 suffered from delayed surgical intervention due to inconsistency of the CT reports resulting in prolonged hospital stay and increased morbidity. In 17 patients (four patients in Group 1 and 13 patients in Group 2) treatment plan was changed due to CT results; and while surgical treatment was planned for them prior to CT scan, they were discharged with medical treatment after that and overtreatment was prevented.

Conclusion: Contribution of abdominal radiologists to evaluation of ACT images in the ED would reduce the inconsistency in ACT reports and prevent the patients from receiving insufficient treatment or overtreatment.

Key words: Abdominal Pain; Emergency Service, Hospital; Radiologists; Tomography, X-Ray Computed

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INTRODUCTION

Abdominal pain is one of the most common patient complaints in the emergency department (ED) and abdominopelvic computed tomography (ACT) scan plays an important role in evaluation of these patients (1-3). It is often used in complicated situations, such as elderly patients with severe co-morbidities and difficulties in differential diagnosis.

Although ACT has high accuracy in differential diagnosis of acute abdominal pain, evaluation of ACT in emergency conditions can result in inaccurate reports due to systematic and/or individual mistakes. In our center (Adana, Turkey), all radiologists, regardless of their subspecialty, work in the ED, alternately. When they are working in the

ED they are responsible for interpreting ACTs within 45 minutes on daily shifts and via online imaging systems from home during off hours. Abdominal CTs are initially reported by a generalist radiologist and then re-evaluated by an abdominal radiologist (EK) 8-12 hours later. This study aimed to determine the differences between interpretations of ACT by generalist radiologists and abdominal subspecialist radiologists and assess its effect on the treatment process of patients with abdominal pain.

Methods

Study setting and design

This diagnostic accuracy study was conducted in Baskent University, Adana, Turkey. The hospital records of the patients between January 2015 until April 2017 were reviewed, retrospectively. All clinical decisions, including choosing the radiological imaging, were made by the in-charge physician. This study was approved by Baskent University Institutional Review Board (Project No: KA18/132). This manuscript has been prepared according to STROBE guidelines.

Selection of Participants

Patients aged >18 years who were admitted to the ED with abdominal pain and were hospitalized for at least 72 hours and underwent ACT scan with initial and final reports recorded in the hospital management system were eligible. Patients who were initially examined by an emergency physician (EP) then received consultation from a general surgery physician, and had an ACT examination were included. Patients who had undergone abdominal surgery in the previous 7 days, pregnant patients, patients who underwent repeated or multiple radiological screening and patients with ACTs initially reported by an abdominal subspecialist radiologist were excluded.

Study protocol

Demographic, clinical and radiological evaluations of the patients were recorded in a checklist. Picture Archiving and Communication System (PACS) for ACT scan was used in this regards. The hospital records confirmed that all patients were evaluated by the ED physician and were consulted by the general surgery physician at the time of admission. ACT scan reports were provided by generalist radiologist within 45 minutes and the final reports were provided by the abdominal subspecialist radiologist in 8–12 hours after the imaging was performed. Data regarding clinical management and the final status of patients were reviewed using hospital records. Differences between ACT scan reports of generalist radiologist and abdominal subspecialist radiologist were classified into three groups according to their effects on clinical treatment. Group 1: Patients with no difference between generalist radiologists and abdominal radiologist ACT reports; Group 2: Patients with a difference between generalist radiologist and abdominal radiologist reports of ACT, but not adversely affecting clinical treatment and/or recovery; Group 3: Patients with a difference between generalist radiologist and abdominal radiologist ACT reports that resulted in a negative impact on their clinical treatment and/or recovery. The effect of the differences between generalist radiologist and abdominal subspecialist radiologist reports on the clinical treatment plan, delayed treatment, surgical complications, morbidity and mortality were examined.

Statistical analysis

SPSS 17.0 package program was used for all statistical data analyses. Categorical variables are presented as number and percentage, and continuous variables as mean and standard deviation.

Results

Totally, 16452 patients who were admitted to the ED during the study period, were reviewed. Out of the 245 (1.5%) patients who underwent an ACT, 137 (0.8%) patients who had both a generalist radiologist as well as an abdominal radiologist ACT report were enrolled in the study. Out of the 137 patients, 87 (63.5) were male, 50 (36.5%) were female, and the patients' mean age was 56.6±14.4 (27-93) years. There were 106 (77.4%) patients with additional co-morbidities (diabetes mellitus, hypertension, coronary artery disease, etc). Fifty-five (40%) patients had previously undergone surgery for various reasons. For differential diagnosis, ACT scan was performed in 23 patients due to inefficient results of abdominal ultrasonography. A total of 8 (5.8%) patients had exitus during the treatment (2 patients had mesenteric vascular occlusion, 3 patients had ileus, 2 patients had acute organ cholelithiasis due to multiple calculi and no etiological cause was found in 1 patient).

There were 117 (85.4%) patients in group 1, 15 (10.9%) patients in group 2, and 5 (3.7%) patients in group 3. In our study, the 5 patients in group 3 had delay in emergency surgery, prolonged hospital stay and increased morbidity due to inconsistency between the ACT scan reports. However, the planned surgery was cancelled in 13 patients in group 1, and 4 patients in group 2 due to ACT scan evaluations. These patients did not undergo unnecessary surgery and were discharged

Table 1: The distribution of general radiologist and abdominal subspecialist radiologist ACT scan reports in the diagnostic categories

Diagnosis category	Radiologist			
	Abdominal subspecialist	Generalist		
	Positive based on final diagnosis (n)	True positive (n)	False negative (n)	Percentage of true positive
Non-specific abdominal pain	37	34	3	92
Gallbladder and biliary tract diseases	19	16	3	84.2
Acute appendicitis	16	13	3	81.2
Ischemic diseases	5	4	1	80
Ileus	18	15	3	83.3
Gastrointestinal perforation	8	6	2	75
Infectious causes	13	12	1	92.3
Obstetrics and gynecological diseases	5	3	2	60
Others	16	14	2	87.5

with medical treatment without any problem.

Patients were devided into 9 category according to their final diagnosis including non-specific abdominal pain, gallbladder and biliary tract diseases (acute cholecystitis, pancreatitis etc.), acute appendicitis, ischemic diseases (mesenteric artery embolism, etc.), Ileus, gastrointestinal perforation, infectious causes (intraabdominal abscess, diverticulitis, etc.), obstetrics and gynecological diseases (ovarian torsion, pelvic inflammatory disease (PID) etc.), other causes (mass, bleeding, etc.). The distribution of general radiologist and abdominal radiologist ACT reports in each diagnostic category is shown in Table 1. The frequency of diagnosis in the groups is demonstrated in figure 1.

ACT scan reports of 11 patients in group 2, and 5 patients in group 3 were interpreted by generalist radiologists who did not work specifically on ACT examinations. Although there were minor disruptions in treatment in group 2, no adverse effects on clinical treatment and/or recovery were observed. One patient in group 3 was suspected with inguinal hernia preoperatively, while strangulated femoral hernia and bowel necrosis were detected during surgery. One patient underwent surgery with diagnosis of ileus with suspicion to a malignant mass in the transverse colon but ileus was observed due to compression of the incarcerated small bowel segment within the left inguinal canal. One patient had subacute cholecystitis in the emergency ACT scan report but after abdominal subspecialist radiologist evaluation, the patient underwent surgery because of the presence of perforated cholecystitis. Corpus luteum cyst was the diagnosis made via generalist radiologist evaluation in one patient and conservative treatment was planned. After

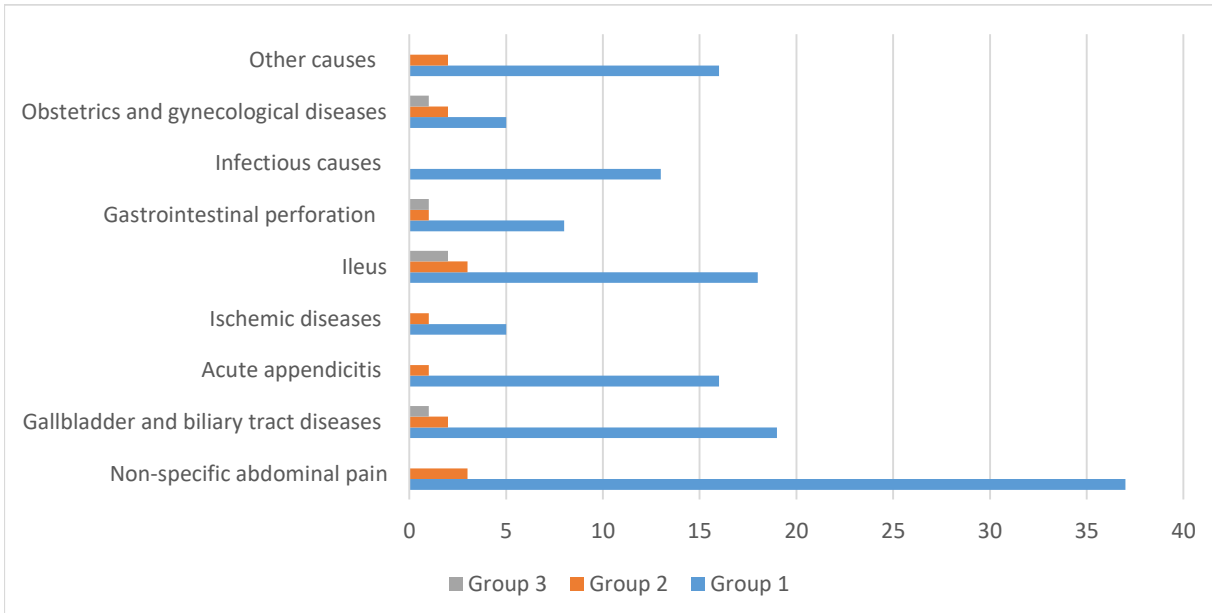

Figure 1: Distribution of diagnoses in 3 groups

abdominal subspecialist radiologist evaluation, the patient underwent surgery due to suspicion of ovarian torsion and partial torsion was detected in the right ovary during the surgery. In a patient who

Table 2: The demographic, clinical, and surgery data of patients with temporary and final Abdominopelvic computed tomography scan reports in groups 2 and 3

Patient	Age	Gender	First Diagnosis	Temporary Report	Final Report	Findings in Surgery	Hospitalization (Days)	Post-operative Complication
Group 2								
1	82	F	Trauma	Parenchymal hematoma and laceration in segments 6 and 7 of the right lobe of the liver	Normal	-	4	-
2	80	F	Ileus	Normal	Narrowing in the sigmoid colon calibration	-	2	-
3	78	F	Trauma	Subcutaneous hematoma in right hip	Retroperitoneal hematoma	-	2	-
4	77	M	İleus	Asymmetric thickening of the rectum wall (tumor?)	Distention by fecal content in colon loops and ileus	-	5	-
5	77	M	Acute abdomen	Mesenteric volvulus	Acute thromboembolism in superior mesenteric artery branches	Dilatation, edema and necrosis in small intestine	12	Acute Renal Failure
6	74	M	Acute calculous cholecystitis	Acute calculous cholecystitis	Acute calculous cholecystitis, stone in the bile duct and dilatation of intrahepatic biliary tract	-	2	-
7	73	M	Ileus	Small bowel obstruction due to bezoar (?)	Jejuno-jejunal intussusception, Ileus	-	2	-
8	69	F	Acute appendicitis	Hepatosplenomegaly, Acute appendicitis	Diverticulosis coli, Splenomegaly	-	1	-
9	67	M	Acute calculous cholecystitis? Infectious colitis?	Mesenteric ischemia	Cholelithiasis, Intestinal intramural hematoma	-	3	-
10	64	M	Mesenteric ischemia	Cholelithiasis, Ascites	Diverticulosis coli, Free abdominal air, Hollow organ perforation?	-	10	
11	49	F	Non-spesific abdominal pain	Retroperitoneal hematoma	Hepatosplenomegaly, Ruptured ovarian cyst	-	3	-
12	42	F	Urinary tract infection	Bilateral ovarian cyst	Peritonitis or Pelvic inflammatory disease?	-	4	-
13	35	F	Cholelithiasis	Cholelithiasis, left adnexial mass	Colon mass, cholelithiasis, left adnexial mass	-	2	-
14	29	M	Acute appendicitis	Terminal ileitis,inflammatory bowel disease?	Acute appendicitis	Acute appendicitis	1	-
15	29	F	Hollow organ perforation?	Dilatation in the stomach, gastric outlet obstruction	Wilkie's syndrome	-	3	-
Group 3								
1	30	M	Normal	Acute Abdomen	Free Abdominal Air, Hollow Organ Perforation	Stomach Perforation, Pancreatic Injury	9	_
2	31	F	Corpus Luteum Cyst	Corpus Luteum Cyst + Acute Appendicitis	Suspicion to Torsion	Ovarian Torsion	3	_
3	77	M	Incarcerated Inguinal Hernia without Ileus	Inguinal Hernia	Ileus +, Strangulate Inguinal Hernia	Strangulated Femoral Hernia	8	Pneumonia
4	64	M	Cholelithiasis, Subacute Cholecystitis	AcuteCholecystitis	Perforated Cholecystitis	Open cholecystectomy	6	_
5	81	F	Segmental Mass on Transverse Colon with Ileus, Cholelithiasis	Ileus	Left Inguinal Hernia with Ileus, Segmental Mass on Transverse Colon, Cholelithiasis	Incarcerated InguinalHernia	3	_

underwent emergency operation due to sharp object injury, stomach perforation and pancreatic tail injury were observed during the operation although the generalist radiological evaluation was normal. The demographics, clinical findings, surgical findings, and generalist radiologist and abdominal subspecialist radiologist ACT scan reports of patients in group 2 and 3 are shown in table 2.

Discussion

Abdominal pain is one of the most commonly encountered complaints in the ED. In differential diagnosis of acute abdominal pain, a spectrum of diseases, ranging from self-limiting benign cases to those with high morbidity and mortality, need to be considered. Although abdominal pain is frequently observed in association with diseases that limit themselves, which are often treated with conservative and medical treatment, problems encountered during diagnosis of diseases requiring emergency surgical treatment can lead to serious morbidity and mortality. Therefore, the period between the admission of patients to ED and the transition time from diagnosis to treatment should be kept as short as possible. Emergency patients range from patients requiring outpatient treatment and follow-up to patients requiring emergency surgery. In order to make a differential diagnosis and to determine the treatment process in a shorter time, physical examination, laboratory examination and radiological evaluations are used as complementary investigations. Abdominal CT is one of the imaging methods frequently used by clinicians to narrow this broad spectrum of disease. Recent technical developments (multi-detector row CT) have led to an increase in the use of CT in emergency departments (4). Technical development of CT has improved its performance in determining the etiologic causes of abdominal pain (5). Patients with abdominal and pelvic pain are the major reason that the use of CT has increased increase in ED (6). However, along with this positive effect on diagnosis, it also causes an increase in health costs (7, 8). When evaluating the cost increase due to CT scans, the financial burdens and medical outcomes that may occur due to delay in diagnosis and treatment of patients should be taken into consideration. In particular, the problems experienced during the diagnosis and treatment of patients requiring surgical treatment may lead to an increase in morbidity and mortality, and increase in cost. When these advantages and disadvantages of CT use are considered carefully, it is observed that hospitalizations are reduced, patients are operated on time and unnecessary surgeries can be avoided (1). In our study, 5 patients in group 3 experienced delay in diagnosis and treatment. As a result, prolonged hospital stay and increased morbidity were observed. In 13 patients in group 1 and 4 patients in group 2 for whom surgical treatment was planned, the treatment plan was changed after CT scan results. These patients in both group 1 and group 2 were discharged with medical treatment without any problem. Abdominal CT shortens the duration of hospital stay and prevents unnecessary surgical interventions (1). In a study conducted on 57 patients, it was shown that CT increased the confidence of the physician in diagnosis and decreased hospitalization rates for patients presenting to ED with abdominal pain (3). However, this study showed that incorrect interpretation and possible discrepancies in reports result in malpractice or delay in surgical treatment.

Differences and inconsistencies between emergency and late radiological reports are complex and often related to each other. The radiologist-related causes include misinterpretation, perception failure, and lack of knowledge (especially due to the radiologists having a different subspecialty). In addition, factors related to the system (shortage of personnel, work overload, inadequacy of radiological imaging and information transfer systems) play a role in the emergence of these inconsistencies. However, in various studies it has been shown that this difference is not solely caused by radiologist and/or systemic reasons. Differences in sample size and differences of the definition of "inconsistency" in radiological reports lead to a broad spectrum of such problems. In the literature, inconsistency between emergency/elective, cranial, traumatic and abdominal CT reports has been evaluated in many studies and factors that have negative effects on these processes have been identified. However, the term "inconsistency" and its impact on the clinical and treatment processes of the patients was not completely defined or classified in any of the studies. In this study, in addition to revealing the negative factors affecting the process, we tried to determine the effects of radiological inconsistencies on the groups by defining a classification system. In abdominal and pelvic CT reports, inconsistency rates that have been reported in previous studies range from 0.1% to 18% (9-11). In our study, this rate was found to be 14.6% (10.9% in group 2 and 3.7% in group 3). However, the effect of these "inconsistency rates"

on management of the patients and treatment approach has not been clearly demonstrated in the literature, as all of the patients have been generally evaluated in the same group. In this study, we divided our patients into 3 groups to investigate the effect of the differences between the initial and final ACT reports on clinical treatment. We allocated patients with minor inconsistency (10.9%) to group 2 and those with major inconsistency (3.7%) to group 3. Major differences in the final ACT interpretations changed the treatment process and indicated the need for emergency surgery. This could happen due to the radiologist's interpretation and/or technical problems of imaging and system used. Inadequacy of machines, online imaging transfer system used and inappropriate imaging quality may affect the interpretations. Failure of the radiologist in differential diagnosis could happen due to not being a subspecialist in abdominal radiology and a fast-paced workload.

In one study, the inconsistency between the immediate and late reports of abdominopelvic CT and the rate of this condition leading to clinically significant treatment changes was found to be 14% (12). In our study, in accordance with the mentioned study, surgical treatment was initially planned for 17 patients (12.4%) (4 in group 2, 13 in group 1) and the treatment plan was changed following the CT scans results.

The evaluation of ACTs by specialist radiologists is one of the factors decreasing the inconsistency rates in the reports. In our study, 5 (3.7%) patients were included in group 3. All of these patients were evaluated by radiologists who did not specifically work in the field of abdominal and pelvic CT examinations. In addition, 11 of the 15 (10.9%) patients in group 2 were evaluated by non-specialist radiologists. Although there were minor disruptions in treatment management in group 2, there were no negative effects on the patients' clinical treatment and/or recovery. However, emergency surgery was not planned for 5 patients in group 3 in the initial evaluation, but the decision of emergency surgery was made with late reports. Mortality was not seen in any of the patients in group 3 who underwent surgery, but morbidity was observed due to prolonged hospital stay and delayed treatment (table 1).

Computed tomography is effective in diagnosis and planning a treatment for patients in the emergency department. There are many factors that influence the assessment process. The most important factor is that the initial clinical evaluation of the patient is usually performed by residents or non-specialist doctors. In the studied center also the initial assessment is carried out by residents or non-specialist experts; therefore, in our study, this might have led to errors in collection of records and interpretation of data. In cases where the assessment is inadequate, CT has a greater role in determining the diagnosis and treatment plan. The close cooperation between the radiologist and the surgical team is the way to provide the most accurate treatment approach.

Limitations

The limitation of this study is its retrospective design; thus, findings were only based on the availability and accuracy of relevant documentation.

Conclusions

Increasing the employment of specialist radiologists, consultation with other radiologists in case of doubt, and reducing system equipment problems will reduce the inconsistency of clinical radiological reports. Prospective randomized trials involving larger numbers of patients are needed to clearly demonstrate the effectiveness of CT reports in diagnosis and treatment of patients.

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Authors' contribution

All the authors met the standards of authorship based on the recommendations of the International Committee of Medical Journal Editors.

Conflict of interest

None declared.

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