

Rational use of CT- scanner Considering its Diagnostic Accuracy for the Management of Acute Abdomen: A single-Center Study

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Abstract

Aim: We aimed to put forward the efficacy of abdominal CT performed for patients diagnosed with acute abdomen and to share our clinical findings in that regard.

Methods: 216 patients who had been hospitalized in General Surgery Department due to acute abdomen had been analyzed retrospectively between October 2018- January 2019. Abdominal computerized tomography (CT) results had been discussed in terms of diagnostic accuracy and clinical outcomes.

Results: 171 (79.2%) patients (M/F:95/76 (55.6% / 44.4%)) had been evaluated by computerized tomography (CT) due to various causes of acute abdomen. Patients who had been scanned more than once (n=13 (7.6%)) during their hospitalization period had longer average length of stays compared to those whom had been scanned for only once (n=158 (92.4%)) (multiple scanned:17 days vs single scanned:3 days; p=0.000). Besides, single-scanned patients had showed higher clinical accuracy compared to those with multi-scans (80.4% vs 61.5%, p=0.126). 28 ileus (84.8%) patients had been scanned by non-enteral computerized tomography (CT), and 12 (36.4%) of them had been given false radiological reviews.

Conclusion: Improper and redundant use of computerized tomography (CT) may cause prolongation of stays at the hospital, besides performing unnecessary scans do not improve diagnostic accuracy.

Keywords: Acute abdomen, radiology, computerized tomography (CT), oral/iv/rectal contrast

Introduction

Acute abdomen constitute one of the major complaints for Emergency Department (ED) visits. It could hinder many different underlying disorders varying from a self-limiting benign disorder to some which may necessitate urgent surgical intervention and could end up with serious sequelae unless treated [1, 3]. In achieving accurate diagnosis, radiological modalities for imagining compromise a crucial part in this manner. Advances in technology had let the way for improvements in radiological imagining from low-

quality, undetailed processing to multi-slice, high-resolution scans.

Computerized tomography (CT) is the preferred imagining modality for the evaluation of different causes of acute abdomen due to its high diagnostic accuracy compared to the limited efficiency of plain abdominal graph and abdominal ultrasonography (USG); such that, relevant literature recommend use of CT for evaluation of patients being admitted to EDs due to acute abdomen. [4-6]

Although it bounders significant contributions in leading the diagnosis, some factors that came out in time had become as drawbacks that had brought the clinicians in debate for its frequent use. Scanning performed by CT exposes the patients to a definite amount of ionizing radiation that may increase the frequency of malignancy in the future [7, 8]. Considering pediatric population and pregnant patients, this issue had become a great concern in near time⁹. Another concern is about contrast nephropathy. There are multiple randomized studies conducted on clinical consequences of contrast-induced nephropathy. Yet, there is still ongoing debate about its impact on clinical outcome. Third subject is about the use of enteral (oral/ rectal) contrast in performing CT scan. Some authors advocate the use

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of enteral contrast for certain cases like acute mechanical intestinal obstruction (AMIO), on the other hand others argue against for prolonging stays in EDs and so find it redundant. [10-14]

Related to recent discussions about the use of CT scan for the management of acute abdomen, we had conducted a single center retrospective study discussing clinical outcomes of patients with CT scan results accordingly and aimed to make a clinical suggestion for the proper use of CT scan based upon our clinical findings.

Methods

The present study is a retrospective analysis of patients whom were hospitalized due to different causes of acute abdomen in General Surgery Department of a university hospital. Institute's medical database had been evaluated to obtain clinical results considering patient follow-ups.

Patients who were hospitalized with the pre-diagnosis of acute abdomen were included in the study. For those having clinical features of acute abdomen (abdominal tenderness, rebound sign etc.), first had been evaluated during admission at ED by physical examination and simple laboratory tests, and then had been scanned by abdominal CT (contrast-enhanced or non-contrast) and/or ultrasonography (USG) depending on the clinician's decision.

Imaging Analysis

Preference of CT scanning (contrast-enhanced or non-contrast) had been decided according to the patients' chief complaints, test results and also to clinician's decision whom were authorized that day. Some of the patients had undergone more than one scans during hospitalization period according to their clinical status.

All CT scans had been examined by using 'Picture Archiving and Communication Systems (PACS)' of the institute, and reviews done by the radiologists had been obtained for future evaluation.

CT reviews given by the radiologists had been discussed in terms of compliance of CT scan results with our observations. Main objective of the present study was to reach to a conclusion that defines proper use of CT for the diagnosis of acute abdomen that will give the most accurate results.

Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 21.0 (SPSS, Inc). Categorical variables were described using frequency and percentage. Regarding the comparison between the groups; student's t-test had been used for comparison of continuous variables, and categorical variables were compared by Pearson chi-square test or the Fisher exact test. A P value less than 0.05 was considered statistically significant.

Results

Between October 2018- January 2019, 216 (M/F= 124/92 (57.4% / 42.6%)) consecutive patients whom were hospitalized in General Surgery Department due to differing causes of acute abdomen had been included in the study. Calculated average age had been found as 48,7 years (range= 18-95). Average length of stay was 4,3 days. 55 (25.5%) patients had record of previous abdominal surgery.

Most frequent cause of acute abdomen had been found as acute appendicitis (n=70 (32.4%)). Rest of the study group had been consisted of the ones diagnosed with acute cholecystitis (n=50 (23.1%)), acute mechanical intestinal obstruction (AMIO) (n=33 (15.3%)), acute diverticulitis (n=14 (6.5%)), acute biliary pancreatitis (n=13 (6%)), gastrointestinal system (GIS) perforation (n=5 (2.3%)), acute mesenteric ischemia (AMI) (n=4 (1.9%)) and incarcerated hernia (n=4 (1.9%)) consecutively. 10 (4.6%) patients had non-specific findings of acute abdomen whom could not be specified under a marked diagnosis, and 13 (6%) patients had been evaluated as 'normal' after further evaluations had been done (Table 1-2.).

Final diagnosis	USG (n=)	CT (n=)	Total (n=)
Acuteappendicitis	28 (40%)	54 (77.1%)	70 (32.4%)
Acutecholecystitis	28 (56%)	29 (58%)	50 (23.1%)
AMIO	-	32 (97%)	33 (15.3%)
Acutediverticulitis	2 (14.3%)	14 (100%)	14 (6.5%)
Acutebiliarypancreatitis	7 (53.8%)	10 (76.9%)	13 (6%)
GIS perforation	2 (40%)	5 (100%)	5 (2.3%)
AMI	-	4 (100%)	4 (1.9%)
İncarceratedhernia	1 (25%)	2 (50%)	4 (1.9%)
Non-specificfindings	8 (80%)	9 (90%)	10 (4.6%)
Normal	4 (30.8%)	12 (92.3%)	13 (6%)
Total	80	171	216

AMIO; Acute mechanical intestinal obstruction, GIS; Gastrointestinal system, AMI; Acute mesenteric ischemia

Table 1: Number of USG and CT scans performed for each diagnosis

Within all study group; 171 (79.2%) patients (M/F:95/76 (55.6% / 44.4%)) been scanned by CT. 13 (7.6%) of them had multi-scans during their hospitalization period. Those multi scans were mostly due to uncertainty in achieving definite diagnosis, and also to perform control scans in situations of clinical deteriorations during stay. Whereas; remaining 45 (20.8%) (M/F:29/16 (64.4% / 35.6%)) patients had been evaluated without CT scan of which vast majority of the group had consisted of the ones whom were diagnosed with acute cholecystitis (n=21 (46.6%)) and

Final diagnosis	Contrast-enhanced CT (IV)	Contrast-enhanced CT (Enteral)	False review	Total (n=)
Acute appendicitis	43 (61.4%)	-	11 (15.7%)	70 (32.4%)
Acute cholecystitis	26 (52%)	-	-	50 (23.1%)
AMIO	28 (84.8%)	5 (15.2%)	12 (36.4%)	33 (15.3%)
Acute diverticulitis	10 (71.4%)	-	1 (7.1%)	14 (6.5%)
Acute biliary pancreatitis	10 (76.9%)	-	2 (15.4%)	13 (6%)
GIS perforation	3 (60%)	1 (20%)	4 (80%)	5 (2.3%)
AMI	4 (100%)	-	2 (50%)	4 (1.9%)
Incarcerated hernia	1 (25%)	-	-	4 (1.9%)
Non-specific findings	8 (80%)	1 (10%)	-	10 (4.6%)
Normal	9 (69.2%)	-	-	13 (6%)
Total				216

AMIO; Acute mechanical intestinal obstruction, GIS; Gastrointestinal system, AMI; Acute mesenteric ischemia

Table 2: Distribution of CT scans according to each diagnosis and demonstration of false reviews

acute appendicitis (n=16 (35.5%)) respectively according to their USG evaluations.

28 (84.8%) ileus patients had been evaluated by non-enteral CT scans. 12 (36.4%) patients within this group (8 of them had previous history of abdominal surgery) had been given false CT reviews such as one patient had been missed for bile stone ileus, another patient's right diagnosis was ileus instead of AMI, etc. On the contrary; considering other 5 (15.2%) ileus patients whom had been scanned by enteral contrast-enhanced CT, all were given correct radiological reviews which were correlated with their clinical diagnosis ($p=0.375$) (Table 3.).

CT-scanned patients	N (%)	Average Length of Stay (days)	Clinical Correlation (%)
Single time	158 (92.4%)	3 (range = 1-24)	80.4
Multiple times	13 (7.6%)	17 (range = 1-38)	61.5
		P = 0.000	P = 0.126

Table 3: Statistical analysis of CT-scans according to length of stay and clinical correlation

Abdominal ultrasonography (USG) had been performed for 28 (40%) patients diagnosed with acute appendicitis. 5 (7.1%) of them had been scanned with CT later on, since appendix could not be visualized clearly by USG. Findings of USG were sufficient for 16 (22.9%) patients to confirm the diagnosis for acute appendicitis that no further radiological assessments were needed. On the other hand, 11 (15.7%) patients who had undergone CT scan had been missed for acute appendicitis even though future re-evaluations of the CT scan views had revealed findings for perforations and/or plastrone appendicitis.

31 (62%) acute cholecystitis patients' diagnosis had been confirmed by abdominal USG, with 13 (26%) of

them had been scanned by CT later on due to insufficient evaluation of extrahepatic biliary anatomy.

Discussion

According to relevant literature; use of CT scan may have significant benefits like improving diagnostic certainty, reducing hospital readmissions, and decreasing morbidity and mortality [15-17]. However; as they had begun to be performed more often especially in EDs, some undesirable effects came along with it.

Major limitations are contrast-induced nephropathy, exposure to ionizing-radiation and uncertainty about the clinical usefulness of enteral (oral/ rectal) contrast. Considering all these uncertainties and also lack of a definite protocol had let American College of Radiology (ACR) to establish evidence-based guidelines called 'Appropriateness Criteria' to help clinicians in making decisions for most suitable diagnostic imaging modality based on patients' physical complaints [18].

Although contrast-induced nephropathy has been declared as a certain risk factor especially among 'high-risk' patients (those with co-existing renal and/or cardiac problems etc.) by ACRs, contrast-enhanced CT is superior in diagnostic accuracy with respect to non-contrast scanning in terms of giving more detailed information about the vascular anatomy, proximity of bowel wall to adjacent pathologies (like perforation, wall thickening etc.) and also presence of fluid collections within abdominal cavity [19]. Relevant studies recommend in favor of contrast use by taking preventive measures like pre-hydration, and taking control creatinine measurements that will likely decrease the risk of contrast-induced nephropathy [20].

We had determined our threshold as 1,4 mg/dl for creatinine value in decision for IV-contrast enhanced CT scan. Despite 6 (4.4%) patients had creatinine values above

the threshold value, they had been scanned by IV-contrast due to their highly suspicious clinical findings that had features of AMI. Eventually, 3 (50%) patients' CT scans had been reviewed as AMI as the final diagnosis. Moreover, we had not observed any contrast-induced nephropathy during follow-up period of these patients. Although there are insufficient number of cases for AMI in the present study to achieve a statistical significance, we still suggest use of IV-contrast in case of clinical suspicion of bowel ischemia even if the creatinine values are above the threshold value despite adequate hydration. We think that burden of bowel ischemia outweighs risk of contrast nephropathy, especially for high-risk patients.

Preference of enteral contrast (oral/rectal) for CT scan is an ongoing debate considering evaluation of abdominal pathologies since there is not a certain, established guideline relevant with its optimal use. Of course, this uncertainty leads to variances in daily clinical practice mostly in emergency departments [21, 22]. Most claim that oral/rectal contrast-enhanced CT scans prolong hospital stay which eventually cause delay in diagnosis that may be fatal for a patient who is in need of emergent intervention [23]. According to some, use of only IV-contrast is highly sufficient for differential diagnosis of bowel pathologies. ACR appropriateness criteria currently do not recommend absolute use of enteral contrast even for evaluation of bowel obstructions.

12 (36.4%) patients of the present study had been given false CT reviews that had been missed for ileus, and considering 8 of them with previous history of abdominal surgery is highly worth mentioning. Common features of these patients were that none of them had been scanned by enteral contrast. Whereas, 5 (15.2%) ileus patients whom were scanned by enteral contrast-enhanced CT scan had all been given accurate diagnosis. Though, due to lack of adequate number of subjects it could not reach to a statistical significance ($p=0.375$).

Accurate interpretation of unenhanced CT scans mainly depends on the experience of the clinician. An adequately reviewed non-enteral CT scan by a radiologist, could easily be mistaken in diagnosis by another less experienced colleague. Besides, giving inadequate information about clinical status of the patient may lead to false or missed reports as well. According to our institutional results, enteral contrast for CT scans is highly efficient and beneficial in management for certain cases of acute abdomen such as bowel obstructions with previous history of abdominal surgery, and suspicious bowel leakage etc.

Vast majority ($n=158$ (92.4%)) of CT scans had been performed for once. Remaining 13 (7.6%) patients' scans

had been performed more than once due to inadequacy in achieving definite diagnosis, and also in need of control evaluations considering cases having clinical deteriorations during follow-up. After all, performing multi-scans did not improve the diagnostic accuracy of CTs rather than prolonging length of stays at the hospital (multiple scanned: 17 days vs single scanned: 3 days; $p=0.000$). In that regard; clinician should be rational in use of CT scan, and should not apply on redundant multi-scans in cases of uncertainty unless emergent. That will probably lead to prolongation of stays, and also occurrence of possible undesirable effects like contrast-induced nephropathy, radiation exposure, etc.

One limitation of the present study is the small number of patient population for some of the subgroups in particular that is not enough in count to achieve statistical significance. Another drawback is heterogenous distribution of physicians that were in charge which had led to dissimilar choices of imaging modalities with different protocols.

Conclusions

CTs are highly efficient diagnostic tools for the management of acute abdomen unless performed properly and reviewed accurately as well. Choice of contrast use whether IV and/or enteral mainly depends on clinical status of the patient. Especially when used for certain cases with previous history of abdominal surgery, enteral contrast may be beneficial considering differential diagnosis. On the other hand; reliance on redundant, multiscans as well as with inappropriate scanning protocols do not improve diagnostic accuracy other than prolonging length of stays and putting the patient in risk of exposure of undesirable effects of CT scan. After all, the one should always keep in mind that clinician's experience and intuition comes above all.

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