



Araştırma/Research

Comparison of abdominal computerized tomography interpretation levels of emergency physicians and radiologists

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Abstract

Aim: Computerized tomography (CT) is a frequently used diagnostic tool in the emergency department. In order to provide early and appropriate intervention for the patients, emergency physicians should be able to accurately interpret CT images at least to a certain degree. In this study, we aimed to determine the accuracy of emergency physicians in evaluating an abdominal CT.

Methods: In 2018, the images of 234 patients who underwent an abdominal CT due to trauma were interpreted by emergency physicians (EP). The level of agreement between emergency physicians and radiologists on these abdominal CT was determined by comparing their evaluations. This comparison was made using the kappa statistics.

Results: The rate of concordance in CT interpretations between the EPs and radiologists was 52.1%. The accuracy rate of EP on interpretation CT images was 59.22% (95% CI: 52.18-66) and the kappa value was 0.24. For the CT interpretation of emergency physicians, the sensitivity, specificity, positive predictive value and negative predictive value were calculated as 40.98% (95% CI: 32.17-50.25), 85.71% (95% CI: 76.38-92.39), 80.65% (95% CI: 70.30-88.00) and 50% (95% CI: 45.72-54.28), respectively.

Conclusion: Emergency physicians' accuracy in interpreting CT images is not at an adequate level. The institutions in emergency medicine should organize educative programs to increase this level.

Key words: Abdomen; computerized tomography; sensitivity; emergency physician

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Acil hekimlerinin ve radyoloji uzmanlarının abdomen BT yorumlama düzeylerinin karşılaştırılması

Özet

Amaç: BT acil serviste sıklıkla kullanılan bir tanı aracıdır. Hastalara erken ve doğru müdahale yapabilmek için acil hekimlerinin çekilen BT leri belli düzeyde yorumlayabilmeleri gerekmektedir. Bu çalışmada acil hekimlerinin abdomen BT yorumlayabilme düzeylerini belirlemeyi amaçladık.

Yöntem: 2018 yılı içerisinde travma nedeniyle acilde abdomen BT çekilen 234 hastanın görüntüleri acil hekimleri tarafından yorumlandı. Bu yorumlar önceden yazılmış olan radyoloji doktoru raporlarıyla karşılaştırılarak uyum düzeyi belirlendi. Bu karşılaştırma kapa istatistiği kullanılarak yapıldı.

Bulgular: Acil hekimlerinin abdomen bilgisayarlı tomografiyi değerlendirmede radyologlarla uyum oranı 52.1% olarak belirlendi. Acil hekimlerinin abdomen bilgisayarlı tomografiyi doğru değerlendirme oranı ise 59.22% (95% CI: 52.18-66) ve kapa değeri 0.24 olarak tespit edildi. Acil hekimlerinin BT yorumlama ile ilgili sensitivite, spesifite, pozitif prediktif değer ve negatif prediktif değeri sırasıyla 40.98%(95% CI: 32.17-50.25), 85.71%(95% CI: 76.38-92.39), 80.65%(95% CI: 70.30-88.00) ve 50%(95% CI: 45.72-54.28) olarak belirlendi.

Sonuç: Acil hekimlerinin travma hastalarında abdomen BT değerlendirme düzeyleri yetersizdir. Bu düzeyi yükseltmek için ilgili kuruluşların eğitim programları düzenlemesi gerekir.

Anahtar sözcükler: Abdomen; bilgisayarlı tomografi; sensitivite; acil hekimi

INTRODUCTION

Emergency services are critical centers of referral in the health system, and they are often overloaded. Furthermore, rapid diagnosis and intervention are required due to the urgent nature of referrals. Computerized tomography (CT) imaging modality, which has become increasingly more widespread in the world in the last few decades, is an important assisting method for doctors in the diagnosis process (1). With its easy accessibility and high diagnostic accuracy, CT has become popular and widely adopted in emergency departments. Despite the high radiation dose and cost involved, the rate of CT use in emergency departments has increased in recent years. In a study conducted in the United States, the rate of emergency CT was reported to have increased six-fold from 1995 to 2007 (2,3).

Despite the extensive cooperation between the radiology department and emergency physicians (EPs) in the diagnosis of patients, in many health centers, the limited number of radiologists

and their unavailability outside working hours leave EPs to manage some of the urgent cases alone. Therefore, in order to intervene or discharge the patient early, the EPs need to have knowledge of how to interpret CT images. However, studies have shown that the EPs' ability to interpret CT images is not generally at an adequate level (4-6). In the literature, there are studies concerning the EPs' interpretation of cranial CT, thorax CT, and abdomen CT, taking the reports from radiologists as reference(1,5-11).

In this study, we aimed to determine the EPs' accuracy in interpreting CT images by comparing their abdominal CT evaluations with the radiologist reports of trauma patients.

METHODS

System Description and Setting

This study was performed in the adult emergency department of a tertiary hospital. The study was initiated after the approval of the clinical research ethics committee of the university (ethics committee no: 2019/2-13). Currently, 21 physicians are employed in our emergency department (ED), and our study was carried out with five of these physicians, who had at least one-year experience in the ED. The hospital administration have contracted with a teleradiology company for evaluating the CT images which were taken in ED. So, all of the images in our ED have been evaluated by radiologists who were provided by the teleradiology company. Normally, the CT images are evaluated by doctors on call and a preliminary report is written. After that, the specialist radiologists examined the images on a normal monitor in their home and write the definite final radiology report up to three days. There are radiologists in our hospital during working hours. But they do not evaluate any radiological images which was taken in our ED because of the lack numbers of radiologists.

In this study, the records of the patients who were referred to our ED in 2018 due to trauma and admitted to general surgery or pediatric surgery clinics were evaluated. The abdominal CT images of these patients were evenly distributed to the EPs for interpretation. The EPs were given clinical information about the patients considering that a radiologist also prepares the CT report after receiving preliminary information. Then, the reports presented by the EPs were compared with the definite reports presented by the radiologists to determine the rate of agreement. The presence of CT findings, such as free abdominal fluid, free abdominal air, solid organ (liver, spleen, kidney and pancreas) injuries, and impaired abdominal wall integrity due

to stab wounds was investigated. Non-traumatic pathologies such as acute appendicitis, acute cholecystitis and mesenteric ischemia were ignored. In addition to CT images evaluation, the age, gender and type of trauma of the patients were also examined. The patients who had missing data in records and those with preliminary teleradiology report were excluded from the study.

Statistical Analysis

After compiling the data, statistical analyses were performed using SPSS v. 17 (SPSS, Chicago, Illinois) to calculate the false positive, false negative, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the k coefficient for each group (EP and radiologist). $P < 0.05$ was regarded as statistically significant. 95% confidence intervals (CI) were calculated using an online calculator (https://www.medcalc.org/calc/diagnostic_test.php). The kappa values were interpreted according to those recommended by Fleiss, where 0.75 indicates excellent agreement, 0.40–0.75 intermediate agreement, and < 0.40 poor agreement (6).

RESULTS

The mean age of the 234 patients included in the study was 23.8 ± 18.5 years, and 182 of them (77.8%) were male. The majority of cases (34.2%) with abdominal CT had been referred to the emergency department due to a stab wound (Table 1).

Table 1. Demographic characteristics

	n	%
Total	234	100
Age distribution		
<18	94	40.2
18-45	110	47
46-65	24	10.3
>65	6	2.5
Gender		
Female	52	22.2
Male	182	77.8
Type of trauma		
Falls	78	33.3
Traffic accidents	72	30.8
Stabbing	80	34.2
other	4	1.7

The radiologists detected pathological findings in 150 (64.1%) of the CT images, and reported 84 (35.9%) to be normal. The EPs found pathological findings in 90 (38.5%) cases and evaluated 144 (61.5%) cases as normal. In 28 cases, both radiologists and EPs evaluated the CT images as indicating a pathology, but reported different findings. In those 28 cases, EPs misdiagnosed spleen laceration in 18 patients, spleen contusion in 4 patients, pancreas laceration in 2 patients, kidney laceration in 4 patients, liver laceration in 2 patients and intraabdominal free fluid in 6 patients. The concordance rate of CT interpretations between the EPs and radiologists about being any pathological findings or not was 52.1%(n:122 cases) (Table 2).

Table 2. Agreement between EP and radiologists

	n	%
Concordance	122	52.1
Normal findings	72	30.8
Abnormal findings	50	21.3
Discordance	112	47.9
EP normal, Radiologist abnormal	72	30.8
EP abnormal, Radiologist normal	12	5.1
Mismatching abnormalities(Both abnormal but different diagnosis)	28	12
Total	234	100

EP: emergency physician

After the exclusion of 28 cases with different pathological findings obtained from the EPs and radiologists, the analysis of the remaining 206 cases revealed poor agreement between the two parties evaluating the cases (κ : 0.24). The true positive, true negative, false positive and false positive rates were determined as 24.2%, 35%, 5.8% and 35%, respectively, with a statistically significant difference ($p < 0.001$) (Table 3).

Table 3. Comparison of abdomen CT interpretations of EP with radiologists

		Radiologist				Total	κ	p value	
		abnormal		normal					
		n	%	n	%				n
Emergency physician	abnormal	50	24.2	12	5.8	62	30	0.24	<0.01
	normal	72	35	72	35	144	70		
		122	59.2	84	40.8	206	100		

κ : Kappa value (0.75 indicates excellent agreement, 0.40–0.75 intermediate agreement, and <0.40 poor agreement, by Fleiss.)

Furthermore, for the EPs' interpretation of abdominal CT, the sensitivity was 40.98% (95% CI: 32.17-50.25), the specificity was calculated as 85.71% (95% CI: 76.38-92.39), the positive predictive value as 80.65% (95% CI: 70.30-88.00) and the negative predictive value as 50% (95% CI: 45.72-54.28) (Table 4).

Table 4. Abdomen CT interpretation level of EP

	%	95% CI
Sensitivity	40.98	32.17-50.25
Specificity	85.71	76.38-92.39
Positive predictive value	80.65	70.30-88.00
Negative predictive value	50.00	45.72-54.28
Accuracy	59.22	52.18-66.00

DISCUSSION

In this study, we found that the EPs' accuracy in the evaluation of abdominal CT images of trauma patients was not at an adequate level, and the findings they reported had poor agreement with the radiologist reports.

Trauma care requires early detection and appropriate intervention of injuries. The non-invasive nature, and rapid and accurate diagnosis of CT plays a fundamental role in the evaluation of trauma patients (12,13). Undertaking proper intervention for patients requires accurate interpretation of the CT images. However, a previous study reported that 77% of hospitals in the United States did not provide radiology services outside working hours. The development of teleradiology has closed this gap and contributed significantly to emergency patient care. Nevertheless, EPs should still be able to evaluate CT images on their own in order not to overlook any diagnosis or delay treatment (11).

There are many studies in the literature investigating the ability of EPs to evaluate CT. A study comparing the interpretation of abdominal CT performed in non-trauma cases between EPs and radiologists showed that the EPs were insufficient in this regard (10). Bagheri-Hariri et al. (11) reported that EPs were able to accurately interpret 68.2% of abdominal CT images, which was not a percentage that could be underestimated. Similarly, in another study, EPs were found to evaluate abdominal CT performed at the emergency service due to renal colic at an acceptable level (6). However, other researchers suggested that general surgeons were not able to make such assessments at an adequately level compared to radiologists (14). In the current study, it

was determined that EPs accurately interpreted 59.22% of the abdominal CTs, and there was poor agreement between the EPs and radiologists. In addition, the EPs' level of accurately identifying pathological findings was found to be low.

In studies comparing the CT evaluation of EPs with that of radiologists, different results were obtained. For example, Dolatabadi et al.(1) and Alfaro et al.(15) reported that EPs had an inadequate accuracy in brain CT assessment whereas Ardic et al.(7) and Khan et al.(5) determined that the CT interpretation accuracy of EPs was similar to that of radiologists. Another study examining the evaluation of pulmonary embolism by EPs in thoracic CT angiography found that EPs overlooked some cases that had been detected by radiologists (9). In another research investigating the presence of plaque and stenosis in cardiac CTs, it was shown that EPs did not have a sufficient level of accuracy compared to radiologists (8). These results suggest that EPs can better evaluate brain CT than thoracic and abdominal CT.

Only hospitalized patients were included in this study, and therefore the CT images with pathological findings were predominant. The rate of agreement might have been different if all CT images taken had been included in the sample. Furthermore, each of the five EPs evaluated a similar number of CT images belonging to a total of 234 patients. Although each physician had at least one-year experience in the emergency service, it was not possible to measure or compare their personal level of knowledge concerning CT assessment. Therefore, we consider that evaluation of all images by a single physician or by all physicians and comparing the results with the reports of radiologists can provide more objective results.

In conclusion, it was determined that the EPs' accuracy in evaluating abdominal CT performed in trauma patients was not at an adequate level compared to the radiologists. Therefore, we consider it to be an appropriate approach for both EPs and the patients that EPs do not make a final decision about any case without first seeing the radiology reports. Furthermore, in order to increase the knowledge and skills of EPs concerning CT assessment, institutions in the field of radiology and emergency medicine need to organize physician training on the subject.

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