THE ATLANTIC Journal of Medical Science and Research

Atlantic J Med Sci Res 2025;5(3):75-84
DOI: 10.5455/atjmed.2025.06.012

Original Article

Evaluation of emergency medicine residents compatibility with radiology reports in whole-body CT of multiple trauma patients

Mehmet Burak Cilli[1], Ali Karakus[2], Mustafa Polat[2], Pinar Baydar Yucel[3], Salih Denis Simsek[4]

[1]Arsuz Goverment Hospital, Emergency Service, Hatay, Türkiye
[2]Hatay Mustafa Kemal University, Medical Faculty, Department of Emergency Medicine, Hatay, Türkiye
[3]Gülnar Goverment Hospital, Emergency Service , Mersin, Türkiye
[4]Nevşehir Goverment Hospital , Emergency Service , Nevşehir, Türkiye

Received: 05 June, 2025
Accepted: 13 September, 2025
Published: 26 September, 2025

Corresponding Author: Ali Karakus, Hatay Mustafa Kemal University, Medical Faculty, Department of Emergency Medicine, Hatay, Türkiye
Email: drkarakus@yahoo.com

CITATION
Cilli MB, Karakus A, Polat M,et al. Evaluation of emergency medicine residents compatibility with radiology reports in whole-body CT of multiple trauma patients Atlantic J Med Sci Res. 2025;5(3):75-84. DOI: 10.5455/atjmed.2025.06.012

Abstract

Aim: This study aimed to compare the compatibility of radiology reports and image interpretations performed by emergency medicine residents (EMR) for whole-body computed tomography (WBCT) scans—including brain, cervical, thoracic, and abdominal regions— requested for patients with multiple traumas admitted to the emergency department in our hospital.
Materials and Methods: This study included 150 multiple trauma patients admitted to the Emergency Department of Mustafa Kemal University Hospital over a one-year. Official radiology interpretations and EMR interpretations of brain, cervical, thoracic, and abdominal computed tomography (CT) scans were compared. Accuracy rates, Cohen's kappa coefficient, specificity, sensitivity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. Data were recorded and analyzed in SPSS version 22.
Results: The accuracy rate for brain CT was 96% (kappa: 0.920), cervical CT 96.7% (kappa: 0.882), thoracic CT 96.6% (kappa: 0.926) , and abdominal CT 96.6% (kappa: 0.919). Overall accuracy across all CT scans was 96% with a kappa value of 0.764 (specificity: 97.1%, sensitivity: 84.6%, PPV: 98.5%, NPV: 73.3%). The agreement between EMR and radiologists for all CT regions was statistically significant ($p < 0.05$).
Conclusion: There is a high level of agreement between the interpretations of EMR and radiologists in CT scans performed in emergency departments. This concordance may help expedite the clinical evaluation, diagnosis, and treatment process for patients.

Keywords: Multiple trauma, emergency department, computed tomography, emergency medicine residents

INTRODUCTION

Trauma refers to structural damage caused by kinetic, chemical, and/or thermal energy to tissues. It is the leading cause of death among individuals aged 1–44 worldwide and in our country, and ranks as the fourth leading cause of death across all age groups. Every year, 31.7 million patients are treated in emergency departments, 2.8 million are hospitalized, and more than 180,000 deaths occur due to trauma. These numbers continue to increase annually (1–4). According to the latest national data, 16,015 of the 435,941 deaths recorded in 2019 were due to accidents and poisonings (5).

Multiple trauma, also known as multitrauma, refers to simultaneous injuries involving more than one body cavity or region. Trauma is recognized as a public health problem because of its high frequency, impact on the young population, and significant mortality and morbidity (6,7). Most trauma-related deaths occur at the scene. For patients who reach the hospital, interventions performed within the first minutes and hours after admission are life-saving. The outcome depends not only on the severity of the injury but also on the interventions performed (8). Determining the severity of trauma and the extent of tissue damage enables rapid and appropriate treatment. Early recognition of a severely injured patient reduces disability rates and increases the likelihood of survival (9).

Current trauma imaging principles have changed with the rapid development of computed tomography (CT) technology and the increased accessibility of CT in recent years (4). These developments in CT have enabled clinicians to obtain more detailed information about traumatic injuries and other conditions. The rate of referral to CT in crowded emergency departments has increased approximately 20-fold due to its easy accessibility, shorter follow-up period, and rapid acquisition (1). Studies have reported that CT is performed in an average of 3% of all emergency department patients (10).

CT, which is widely used in the diagnosis of immobilized patients who present to the emergency department due to trauma, for whom direct radiographs are inadequate and appropriate positioning cannot be performed, has become increasingly adopted as whole-body CT (WBCT) in patients with multiple trauma. WBCT is the evaluation of brain, cervical, thoracic, and abdominal CT scans for the rapid and reliable assessment of patients with severe and multiple injuries, a practice that became widespread with the increased use of CT in the early 2000s (11).

CT is of great importance in making emergency intervention decisions in patients with multiple trauma. Although this technology is highly useful, it should be utilized selectively by physicians, considering the implications of cost, efficiency, and radiation dose (1).

Although radiographic interpretations are performed by a full-time radiologist in some hospital emergency departments, in many facilities without a radiologist, emergency physicians perform radiographic evaluations themselves and plan patient treatment according to their interpretations (12). This study aimed to compare the compatibility of radiology reports with the interpretations of brain, cervical, thoracic, and abdominal CT scans ordered for multiple trauma patients admitted to the emergency department of our hospital and interpreted by emergency medicine residents (EMR).

MATERIALS AND METHODS

The study was planned retrospectively, and the emergency department, which is the level 1 trauma centre of Mustafa Kemal University Research and Application Hospital, a tertiary care hospital where approximately 100,000 patients and 5,000 trauma patients are admitted annually, was accepted as the population. A total of 150 multiple trauma patients admitted to the hospital between 01.01.2018 and 31.12.2018 who underwent brain, thorax, abdomen, and cervical CT scans were included as the sample.

Inclusion criteria:

- Patients with trauma to at least two systems
- Patients over 16 years of age
- Patients who underwent brain, thorax, abdomen, and cervical CT
- EMR who gave consent to participate in the study

Exclusion criteria:

- Patients with injuries involving a single organ system
- Patients under 16 years of age
- Patients with incomplete or missing CT scans
- Patients without radiological interpretation
- EMR who did not give consent to participate in the study

Patient data were accessed through the Enlil automation system. CT scans were randomly selected from previously interpreted CTs. The CT scans of all patients were interpreted by EMR using a double-blind method (the resident interpreting the CT had no information about the patient's clinical condition). Each EMR was assigned CT scans of 15 patients, and their interpretations were obtained. These were compared with the previously interpreted radiological reports.

This study was approved by the local ethics committee of Hatay Mustafa Kemal University Faculty of Medicine on 17.01.2019 during the 2nd meeting, decision number 18.

All data obtained in the study were analyzed using IBM SPSS Statistics version 22. The Chi-square test was used to evaluate relationships between categorical variables. Sensitivity, specificity, concordance rate, concordance coefficient (kappa: <0.20 poor; 0.21–0.40 fair; 0.41–0.60 moderate; 0.61–0.80 good; 0.81–1.00 excellent), positive predictive value (PPV), and negative predictive value (NPV) were calculated. In this study, $p < 0.05$ was considered statistically significant.

RESULTS

The agreement rate for displaced cranial fractures was 96.7% (kappa: 0.926), for non-displaced cranial fractures 93.4% (kappa: 0.550), and for all cranial fractures 94% (kappa: 0.877). The concordance rate for subdural hematoma (SDH) was 99.3% (kappa: 0.968), for epidural hematoma (EDH) 100% (kappa: 1.000), for subarachnoid hemorrhage (SAH) 99.3% (kappa: 0.974), for intraparenchymal hematoma 100% (kappa: 1.000), and 99.3% for intracranial hematoma (ICH) (kappa: 0.983), 96% for shift (kappa: 0.778), 98% for edema (kappa: 0.946), 99.3% for contusion (kappa: 0.978), and 100% for herniation (kappa: 1.000).

In 67 (98.5%) of 68 cases in which radiologists detected pathology on brain CT, EMR detected cranial pathology, and in 5 (6.1%) of 82 cases in which radiologists detected normal findings, EMR considered cranial pathology. The agreement rate for cranial pathology was 96% (kappa: 0.920). The specificity, sensitivity, PPV, and NPV of these data are given in Table 1. The similarity in the evaluation of cranial pathologies between EMR and radiologists was statistically significant ($p < 0.05$) (Table 1).

In the cervical CT evaluation, the agreement rate for cervical vertebral fracture was 96.7% (kappa: 0.765), for free air 100% (kappa: 1.000), and for dislocation 100% (kappa: 1.000). Cervical pathology was detected by EMR in 23 (92%) of 25 cases in which radiologists detected pathology on cervical CT, and cervical pathology was considered by EMR in 3 (2.4%) of 125 cases in which radiologists detected normal cervical CT. The agreement rate for cervical pathology was 96.7% (kappa: 0.882). The specificity, sensitivity, PPV, and NPV values are presented in Table 2. The similarity in evaluation of cervical pathology between EMR and radiologists was statistically significant ($p < 0.05$) (Table 2).

In the thoracic CT evaluation, the agreement rate for rib fracture was 96.7% (kappa: 0.922), for sternum fracture (kappa: 0.759), for diaphragm rupture 100% (kappa: 1.000), for lung contusion 98% (kappa: 0.960), 96.7% for hemothorax (kappa: 0.897), 99.3% for pneumothorax (kappa: 0.982), 100% for pneumomediastinum (kappa: 1.000), 99.3% for foreign body (kappa: 0.973), and 96% for vertebral fracture (kappa: 0.681).

Thoracic pathology was detected by EMR in 96 (96%) of 100 cases in which radiologists detected pathology on thorax CT, and thoracic pathology was considered by ERM in 1 (2%) of 50 cases in which radiologists detected normal findings. The agreement rate for thoracic pathology was 96.7% (kappa: 0.926). The specificity, sensitivity, PPV, and NPV values are given in Table 3. The similarity in the assessment of thoracic pathology between EMR and radiologists was statistically significant ($p < 0.05$) (Table 3).

Table 1. Comparison of radiologists and EMR in brain CT

			Radiologist							
			Yes n(%)	No n(%)	Specificity (%)	Sensitivity (%)	PPD (%)	NPD (%)	Kappa	Compliance rate (%)
ATA	Displaced cranium fracture	Yes	49 (94.2)	2 (2)	94.2	98.0	96.1	97	0.926	96.7
		No	3 (5.8)	96 (98)						
	Non-Displaced cranium fracture	Yes	7 (77.8)	8 (5.7)	77.8	94.3	46.7	98.5	0.550	93.4
		No	2 (22.2)	133 (94.3)						
	Fracture	Yes	59 (95.2)	6 (6.8)	95.2	93.2	90.8	96.5	0.877	94.0
		No	3 (4.8)	82 (93.2)						
	SDH	Yes	17 (94.4)	0	94.4	100	100	99.2	0.968	99.3
		No	1 (5.6)	132 (100)						
	EDH	Yes	7 (100)	0	100	100	100	100	1.000	100
		No	0	143 (100)						
	SAH	Yes	22 (100)	1 (0.8)	100	99.2	95.7	100	0.974	99.3
		No	0	127 (99.2)						
	ICH	Yes	24 (100)	0	100	100	100	100	1.000	100
		No	0	126 (100)						
	All intracranial haemorrhage	Yes	39 (100)	1 (0.9)	100	99.1	97.5	100	0.983	99.3
		No	0	110 (99.1)						
	Shift	Yes	12 (75)	2 (1.5)	75.0	98.5	85.7	97.1	0.778	96
		No	4 (25)	132 (98.5)						
	Edema	Yes	35 (92.1)	0	92.1	100	100	97.4	0.946	98
		No	3 (7.9)	112 (100)						
	Contusion	Yes	28 (96.6)	0	96.6	100	100	99.2	0.978	99.3
		No	1 (3.4)	121 (100)						
	Herniation	Yes	0	0						100
		No	150 (100)	150 (100)						
	Cranial pathology	Yes	67 (98.5)	5 (6.1)	98.5	93.9	93.1	98.7	0.920	96
		No	1 (1.5)	77 (93.9)						
	Total		**100.0**	**100.0**						

EMR:Emergency medicine residents, PPV: Positive predictive value, NPV: Negative predictive value, SDH:Subdural hematoma, EDH:Epidural hemetoma, SAH:Subarachnoid hemorrhage, ICH:Intracranial hematoma

In the evaluation of abdominal CT by radiologists and EMR, the agreement rate for liver laceration was 99.3% (kappa: 0.956), for splenic laceration 98.7% (kappa: 0.793), for free air 98% (kappa: 0.922), for Douglas fluid 96.7% (kappa: 0.889), for Morrison fluid 97.3% (kappa: 0.912), for subsplenic fluid 97.3% (kappa: 0.804), for suprahepatic fluid 98.7% (kappa: 0.921), for abdominal fluid 96.7% (kappa: 0.918), for kidney laceration 98.7% (kappa: 0.826), for foreign body in the abdomen 98.7% (kappa: 0.942), for lumbar vertebral fracture 98.7% (kappa: 0.930), and 100% for pelvic fracture (kappa: 1.000).

Table 2. Comparison of radiologists and EMR in cervical CT

			Radiologists							
			Yes n (%)	No n (%)	Specificity (%)	Sensitivity (%)	PPV (%)	NPV (%)	Kappa	Compliance rate (%)
EMR	Cervical fracture	Yes	9 (81.8)	3 (2.2)	81.8	97.8	75.0	98.6	0.765	96.7
		No	2 (18.2)	136 (97.8)						
	Cervical air	Yes	17(100)	0	100	100	100	100	1000	100
		No	0	133 (100)						
	Cervical dislocation	Yes	0	0						100
		No	150 (100)	150 (100)						
	Cervical pathology	Yes	23 (92.0)	3 (2.4)	92.0	97.6	88.5	98.4	0.882	96.7
		No	2 (8.0)	122 (97.6)						
	Total		**100.0**	**100.0**						

EMR:Emergency medicine residents, PPV: Positive predictive value, NPV: Negative predictive value

Table 3. Comparison of radiologists and EMR in thorax CT

			Radiologist							
			Yes n(%)	No n (%)	Specificity (%)	Sensitivity (%)	PPV (%)	NPV (%)	Kappa	Compliance rate (%)
EMR	Rib fracture	Yes	44 (89.8)	0	89.8	100	100	95.3	0.922	96.7
		No	5 (10.2)	101 (100)						
	Sternum fracture	Yes	7 (77.8)	5 (62.5)	77.8	62.5	100	100	0.759	98
		No	2 (22.2)	3 (37.5)						
	Diaphragm rupture	Yes	0	0						100
		No	150 (100)	150 (100)						
	Contusion	Yes	77 (98.7)	2 (2.8)	98.7	97.2	97.5	98.6	0.960	98
		No	1 (1.3)	70 (97.2)						
	Haemothorax	Yes	28 (100)	5 (4.1)	100	95.9	84.8	100	0.897	96.7
		No	0	117 (95.9)						
	Pneumothorax	Yes	36 (97.3)	0	97.3	100	100	99.1	0.982	99.3
		No	1 (2.7)	113 (100)						
	Pneumomediastinum	Yes	5 (100)	0	100	100	100	100	1.000	100
		No	0	145 (100)						
	Foreign body	Yes	21 (95.5)	0	95.5	100	100	99.2	0.973	99.3
		No	1 (4.5)	128 (100)						
	Thoracic vertebral fracture	Yes	7 (53.8)	0	53.8	100	100	95.8	0.681	96
		No	6 (46.2)	137 (100)						
	Thoracic pathology	Yes	96 (96)	1 (2)	96.0	98.0	99.0	92.5	0.926	96.7
		No	4 (4)	49 (98)						
	Total		**100.0**	**100.0**						

EMR:Emergency medicine residents, PPV: Positive predictive value, NPV: Negative predictive value

DOI: 10.5455/atjmed.2025.06.012

In abdominal CT scans, EMR detected abdominal pathology in 63(92.6%) of 68 cases in which radiologists detected pathology, and in 1 (1.2%) of 82 cases where radiologists reported normal findings, EMR considered abdominal pathology. The agreement rate for intra-abdominal pathology was 96% (kappa: 0.919). The specificity, sensitivity, PPV, and NPV of these data are given in Table 4. The similarity in the evaluation of abdominal pathology between EMR and radiologists was statistically significant ($p < 0.05$) (Table 4).

Overall, in 133 (97.1%) of 137 cases in which radiologists detected pathology on WBCT, EMR detected pathology, and in 2 (15.4%) of 13 cases in which radiologists detected normal WBCT, EMR considered pathology. The agreement rate for any pathology detected was 96% (kappa: 0.764). The similarity in the evaluation of EMR and radiologists for the presence of pathology was statistically significant ($p < 0.05$) (Table 5).

Table 4. Comparison of radiologists and EMR in abdominal CT

			Radiologist							
			Yes n(%)	**No n(%)**	**Specificity (%)**	**Sensitivity (%)**	**PPV (%)**	**NPV (%)**	**Kappa**	**Compliance rate (%)**
EMR	**Liver laceration**	Yes	12 (100)	1 (0.7)	100	99.3	92.3	100	0.956	99.3
		No	0	137 (99.3)						
	Spleen laceration	Yes	4 (80)	1 (0.7)	80.0	99.3	80.0	99.3	0.793	98.7
		No	1 (20)	144 (99.3)						
	Free air	Yes	21 (91.3)	1 (0.8)	91.3	99.2	95.5	98.4	0.922	98
		No	2 (8.7)	126 (99.2)						
	Fluid in Douglas	Yes	25 (83.3)	0	83.3	100	100	96	0.889	96.7
		No	5 (16.7)	120 (100)						
	Fluid in Morison	Yes	26 (89.7)	1 (0.8)	89.7	99.2	96.3	97.6	0.912	97.3
		No	3 (10.3)	120 (99.2)						
	Subsplenic fluid	Yes	9 (81.8)	2 (1.4)	81.8	98.6	81.8	98.6	0.804	97.3
		No	2 (18.2)	137 (98.6)						
	Suprahepatic fluid	Yes	13 (92.9)	1 (0.7)	92.9	99.3	92.9	99.3	0.921	98.7
		No	1 (7.1)	135 (99.3)						
	Fluid in abdominal	Yes	40 (90.9)	1 (0.9)	90.9	99.1	97.6	96.3	0.918	96.7
		No	4 (9.1)	105 (99.1)						
	Kidney laceration	Yes	5 (83.3)	1 (0.7)	83.3	99.3	83.3	99.3	0.826	98.7
		No	1 (16.7)	143 (99.3)						
	Foreign body in the abdomen	Yes	19 (95)	1 (0.8)	95.0	99.2	95.0	99.2	0.942	98.7
		No	1 (5)	129 (99.2)						
	Lumbar vertebral fracture	Yes	15 (88.2)	0	88.2	100	100	98.5	0.930	98.7
		No	2 (11.8)	133 (100)						
	Pelvic fracture	Yes	13 (100)	0	100	100	100	100	1.000	100
		No	0	137 (100)						
	Intra-abdominal pathology	Yes	63 (92.6)	1 (1.2)	92.6	98.8	98.4	94.2	0.919	96
		No	5 (7.4)	81 (98.8)						
	Total		**100.0**	**100.0**						

EMR:Emergency medicine residents, PPV: Positive predictive value, NPV: Negative predictive value

Atlantic J Med Sci Res 2025;5(3):75-84
DOI: 10.5455/atjmed.2025.06.012

Table 5. Comparison of radiologists and EMR in WBCT

			Radiologists							
EMR			Yes n (%)	No n (%)	Specificity (%)	Sensitivity (%)	PPV (%)	NPV (%)	Kappa	Compliance rate (%)
	All pathologies	Yes	133 (97.1)	2 (15.4)	97.1	84.6	98.5	73.3	0.764	96
		No	4 (2.9)	11 (84.6)						
	Total		100.0	100.0						

EMR:Emergency medicine residents, PPV: Positive predictive value, NPV: Negative predictive value

DISCUSSION

In many hospitals, physicians working in the emergency department interpret CT scans independently, without waiting for the radiologist's report, to initiate patient management as promptly as possible. Furthermore, in many centers, interpretations are delayed due to the unavailability of radiologists outside regular working hours. This results in a delay in the so-called "golden hour," which is critical for reducing morbidity and mortality in critical care (13).

Studies examining the agreement between EMR and radiology assistants in CT interpretations report varying compatibility rates (15-18).

In studies comparing the interpretations of radiologists and emergency physicians in brain CT scans of patients with traumatic head injury, agreement rates ranged from 61.3% to 98.9%, with kappa values between 0.59 and 0.78 (14,19-25). Alfaro et al. evaluated brain CT interpretations by emergency physicians and radiologists in 555 patients, most of whom had trauma, and reported a discordance rate of 38.2% (19). Wyoski et al. assessed brain CT interpretations of radiologists and EMR in posttraumatic patients, finding a major discordance rate of 1.2% and a minor discordance rate of 2.6% (22). In a study conducted in Tehran, brain CT scans of 544 patients with head trauma were interpreted by emergency physicians, with 35 false negatives and 53 false positives reported (23). Arendts et al. reported that emergency physicians missed 14.8% of brain CT pathologies, of which 41.1% had potentially acute consequences (26). Another study evaluating 2,150 brain CT scans with minimal head trauma interpreted by emergency physicians classified 1,788 as negative, 217 as positive, and 119 as suspicious; one case requiring craniotomy was missed (27). Inan et al. compared emergency medicine specialists and radiologists in brain CT interpretation, reporting that emergency medicine specialists incompletely interpreted cases of EDH (specificity 100%) and SAH, while all subdural hematoma cases were correctly interpreted. The study found that although emergency medicine specialists misinterpreted or incompletely interpreted brain CTs in 42.1% of cases, 31.1% of these discrepancies were clinically significant. Specifically, 36.8% of major findings (sensitivity: 63.2%, specificity: 73.8%) and 58.9% of minor findings were discordant. Difficulties in differentiating lesions in cases with multiple findings were noted and reported to have led to treatment disruptions in 0.4% of cases (11).

Mucci et al. investigated the concordance between brain CT reports of expert radiologists and EMR and observed that the pathologies missed by EMR were not critical for the patients (28). Levitt et al. reported that the rate of major false-negative brain CT interpretations decreased from 11.4% to 2.8% after brief training was provided to emergency physicians (29). In his thesis, Sır noted that the margin of error among EMR in brain CT interpretation decreased over time (14). Another study reported that the accuracy of emergency physicians in interpreting brain CTs increased from 60% to 78% following three months of training (30). A radiology study found that the most frequently missed findings in brain CTs requested from the emergency department were chronic infarcts and fractures (31). Additionally, higher concordance rates were reported for intracranial hemorrhage (ICH) cases (20). In our study, the most frequently missed lesions were non-displaced fractures and shifts, while the highest accuracy rates were observed for herniation and ICH. Our accuracy rates were consistent with the literature and generally high. We believe that physicians have improved, particularly in brain CT interpretation, due to ongoing training, the frequent presentation of head trauma cases in emergency departments, and pressure from patients' relatives to provide timely assessments before official radiology reports are available. The primary reason for missing non-displaced fractures may be their resemblance to suture lines, and linear fractures might be overlooked because they are thin. Additionally, physicians' focus on more serious lesions may contribute to overlooking simple fractures. Missed shifts could be related to the physician's positional assessment of the images. The high accuracy in hemorrhage detection likely reflects the increased density of hemorrhagic lesions. Missed cases may be due to the isodense appearance of hemorrhages in the subacute phase.

Although cervical CT is the gold standard for detecting pathology in blunt trauma patients, there remain hesitations regarding its use due to concerns about radiation exposure and cost (32). Güven et al. reported that the accuracy rate of emergency physicians in cervical CT interpretation was 98.7%. Gratton et al. evaluated multiple imaging modalities and found the agreement rate between emergency physicians and radiologists in cervical radiography to be 96.1% (33). Aydın et al. assessed CT and direct radiographs of 100 trauma patients and reported high agreement in cervical imaging (kappa: 0.789) (34). In our study, the accuracy rate for cervical fractures was 96.7%, while the accuracy rate for free air detection was 100%. We attribute the high accuracy in cervical fractures to the clear visualization of vertebral lines on CT and the ability to compare vertebral height loss. Because air appears very hypodense and is easily distinguishable from other tissues, we believe all free air cases were correctly identified.

Studies have reported agreement rates between EMR and radiologists in thorax CT lesion detection ranging from 86.6% to 99.6% (1,21,35). These studies indicate that the most commonly missed thorax CT pathology by EMR is lung contusion; however, these missed pathologies did not affect the patients' clinical courses. Lung contusions were often radiologically confused with pneumonia and other lung parenchymal diseases (1,35). Kartal et al. found a compliance rate of 91-93% for emergency physicians in thorax CT interpretation, reporting excellent agreement (21). In our study, the highest accuracy rates were observed for diaphragm rupture and pneumomediastinum, while the lowest accuracy rate was found for thoracic vertebral fractures. We believe diagnostic accuracy has improved due to advances in CT technology, which allows separate contrast evaluation of both parenchymal and musculoskeletal systems. Since thoracic vertebrae are closely associated with the ribs, small fractures, especially of the lateral processes, may be overlooked.

Although some studies indicate general agreement between emergency physicians and radiologists in abdominal CT interpretations, others report poor concordance. Agreement rates between the two departments have been reported to range from 59% to 97% (21,36-38). Regarding abdominopelvic CTs, Kartal et al. reported a 97% agreement rate for emergency physicians, with kappa values ranging from 0.40 to 0.75. They found that agreement was moderate for solid organs (liver, spleen, kidney) and hemorrhages but became excellent for pelvic fractures, with kappa values exceeding 0.75 (21). Kang et al. reported an 83.3% agreement between EMR and radiologists in patients with nontraumatic abdominal pain, while agreement between radiology assistants and specialists was 87.8% (16).

Vaziri et al. evaluated 183 abdominal CT scans interpreted as abnormal by radiologists; emergency physicians identified 170 true positives and 13 false positives. Of 516 CT scans interpreted as negative by radiologists, emergency physicians classified 494 as negative and 22 as positive. The overall agreement rate was reported as high (95%). The study concluded that emergency physicians could independently interpret abdominopelvic CTs, although accuracy could improve with systematic training (39). Bagheri-Hariri et al. reported an agreement rate of 68.2% and a kappa value of 0.77 between radiologists and emergency medicine specialists in abdominopelvic CT interpretations. In this context, eight patients received undertreatment and three received overtreatment. While no differences in mortality were found between concordant and discordant groups, hospital stay duration and frequency of clinic transfers were higher in the discordant group (36).

In a study conducted in our country, the agreement between radiologists and emergency physicians in 234 abdominal CT scans performed due to trauma was reported as 59.2%, with a kappa value of 0.24; this indicated that the level of abdominal CT evaluation by emergency physicians in trauma patients was insufficient, and training was recommended (38). In another domestic study, the agreement rate between EMR and radiologists was found to be 73%, with a kappa value of 0.46 (4). Despite this relatively high rate, only 6% of discrepancies were deemed clinically significant (4).

In our study, the accuracy rate for abdominal CT interpretation was 96.6%. While accuracy was higher for pelvic fractures and solid organ injuries, it was lower for detecting hemorrhages and free air. This lower accuracy may be due to the larger anatomical area of the abdomen compared to other regions, the presence of multiple organs, and the variable densities of these organs.

We believe diagnosis is facilitated by the clear visualization of solid organ contours and bone structures, as well as the density differences between organs. However, edema in the intestines, gallbladder, and stomach may have led to fluid being overlooked in patients with minimal amounts. It should also be noted that failure to detect fluid in one abdominal cavity does not imply fluid was absent in other cavities.

Chung et al. compared the interpretations of 4,768 thorax and abdominopelvic CT scans by radiology assistants and specialists, reporting a major discordance rate of 2% (40). Among these patients, 13 required additional investigations, and 3 were recalled to the emergency department by telephone (40). Aydın et al. found that, of 100 trauma patients who underwent CT, the agreement between EMR and senior radiology assistants was high (kappa: 0.773), with specificity of 96%, sensitivity of 86.8%, PPV of 82.8%, and NPV of 97.1% (34).

Gratton et al. evaluated various imaging modalities and found an overall agreement rate of 96.8% between emergency physicians and radiologists (33). Kartal et al. reported agreement rates between emergency physicians and radiologists as 94% for brain CT, 91% for thorax CT, and 97% for abdominopelvic CT. Kartal classified the agreement for brain and thorax CT as excellent (kappa > 0.75), while the agreement for abdominopelvic CT was moderate (kappa = 0.40–0.75) (21). Güven et al. reported excellent agreement (>95%) between emergency physicians and radiologists in CT interpretation of cranial, thoracic, and vertebral injuries, whereas agreement in abdominal CT was moderate. The study also noted moderate agreement rates for imaging in non-traumatic patients (20). Similarly, another emergency department study reported accuracy rates exceeding 95% with high kappa values (>0.75) for CT interpretation in cranial, thoracic, and vertebral injuries, while non-traumatic cases showed lower kappa values and moderate agreement (20). According to the literature, abdominal CT images are more frequently misinterpreted by radiology assistants (4,41).

In a thesis study by Tieng et al. and Uğurlu, the discrepancy between radiology residents and specialists in interpreting CT images obtained in the emergency department was reported to be approximately 30% (35,42). In our study, the overall CT accuracy rate was 96%. We attribute the low frequency of missed cases to advancements in CT technology, the inclusion of CT training in the emergency medicine residency curriculum, a dedicated one-month radiology rotation during residency, and accumulated clinical experience over time.

Although some cases appeared to be missed, it is notable that many of the overlooked lesions were of no clinical significance. We also believe that certain discrepancies (e.g., interpreting a non-displaced cranial fracture as displaced) may reflect differences in interpretation rather than true misses. It is important to consider that radiologists interpret CT scans based solely on limited trauma information provided by the emergency physician, whereas emergency physicians have access to detailed patient examinations and ongoing clinical follow-up during interpretation. This contextual knowledge may confer an advantage to emergency physicians in CT interpretation.

There are limitations inherent to the retrospective design of our study. Clinical information available for patients was limited, and both EMR and radiologists made interpretations based solely on brief clinical data, including the indication for the scan.

Because patient management was guided by the radiologists' interpretations, the clinical impact of pathologies missed by EMR on CT scans could not be assessed.

Additionally, information regarding any cases missed by radiologists and the subsequent treatments provided by the relevant departments is lacking. Furthermore, data on whether follow-up CT scans were performed during patient monitoring are unavailable.

CONCLUSION

Overall, the accuracy rate of CT interpretation in our study was 96%, with a kappa value of 0.764.

In conclusion, there was a high level of agreement between EMR' interpretations of CT scans performed in the emergency department and those of radiologists. However, this agreement is expected to improve further with additional training for EMR.

Although some critical diagnoses with potential morbidity and mortality (e.g., SAH, SDH) are rarely missed on imaging, we believe these patients can be identified through clinical examination, follow-up, and laboratory support.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
This study was approved by the local ethics committee of Hatay Mustafa Kemal University Faculty of Medicine on 17.01.2019 with the 2nd meeting 18th decision number.

REFERENCES

1. Karpuz Ç. Investigation of the degree of accuracy and reliability of emergency medicine speciality students in the interpretation of tomographs in the evaluation of thoracic computed tomographs taken to patients admitted to the emergency department. (Speciality Thesis) Bursa 2018.
2. Akturan S, Gümüş B, Özer Ö,et al. Mortality Rates and Causes Between 2009 and 2016 in Turkey According to TURKSTAT Data. Konuralp Medical Journal. 2019;11:9-16.
3. Center for Disease Control and Prevention: National Vital Statistics System. Mortality Rates. [Internet]. [cited 2019 February 28]. Available from: https://www.cdc.gov/nchs/nvss/deaths.htm.
4. Çelenk N. Evaluation of the compatibility of emergency medicine speciality students with the radiology report in the interpretation of abdominal computed tomography in trauma patients (Expertise Thesis) Izmir 2014.
5. Turkish Statistical Institute. Regional Statistics: Table Generation Application https://biruni.tuik.gov.tr/bolgeselistatistik/tabloOlustur.do# access date 20.10.2020.
6. Karakuş A, Kekeç Z, Akçan R, Seydaoğlu G. The relationship of trauma severity and mortality with cardiac enzymes and cytokines in multiple trauma patients. TJTES. 2012;18:289-95.
7. Haagsma JA, Graetz N, Bolliger I,et al. The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. Injury Prevention. 2016;22:3-18.
8. Rahmani F, Bakhtavar HE, Vahdati SS,et al. Evaluation of MGAP and GAP trauma scores to predict prognosis of multiple trauma patients. Trauma Monthly. 2016;22:e33249.
9. Llompart-Pou J, Chico-Fernández M, Sánchez-Casado M,et al. Severity scoring in trauma: comparison of prehospital scoring systems in trauma ICU patients. Eur J Trauma Emerg Surg. 2017;43:351-7.
10. Kocher KE, Meurer WJ, Fazel R,et al. National trends in the use of computed tomography in the emergency department. Ann Emerg Med. 2011;58:452-62.
11. Oyar O. The Initial evaluation of multiple blunt trauma patients Pan BT: should be included in whole-body. Turkiye Klinikleri J Orthop & Traumatol -Special Topics. 2012;5:14-8.
12. Inan F. Investigation of the degree of accuracy of emergency medicine specialists in interpreting computerised brain tomography. (Expertise Thesis) Izmir 2001 H
13. Sır ZN. Evaluation of emergency medicine specialists and assistants' interpretations of computed cranial tomography scans in pediatric patients with head trauma (Expertise Thesis) Bursa-2018.

14. Ardiç Ş, Guneysel Ö. Emergency medicine residents can evaluate cranial computed tomography scans consistently with radiologists. Journal of Acute Medicine. 2015;5:92-5.

15. Aydın SA, Bulut M, Topal NB,et al. Performance of emergency medicine residents in the interpretation of radiographs in traumatised patients. Emerg Med J. 2008;25:482-5.

16. Kang MJ, Sim MS, Shin TG,et al. Evaluation of the accuracy of abdominal CT interpretation by emergency medicine residents in patients with non-traumatic abdominal pain. J Korean Med Sci. 2012 Oct;27:1255-60.

17. Espinosa JA, Nolan TW. Reducing emergency physicians' errors in interpreting radiographs: a longitudinal study. Bmj. 2000;320:737-40.

18. Kim SJ, Lee SW, Hong YS, Kim DH. Radiological misinterpretations by emergency physicians in discharged minor trauma patients. Emerg Med J. 2012;29:635-9.

19. Alfaro D, Levitt MA, English DK,et al. Accuracy of interpretation of cranial computed tomography scans in an emergency medicine residency programme. Ann Emerg Med. 1995;25:169-74.

20. Güven R, Akça AH, Çaltılı Ç,et al. Comparison of emergency department computed tomography interpretation between emergency department physicians and specialist radiologists: a multicentre study. Niger J Clin Pract. 2018;21:1323-9.

21. Kartal ZA, Kozacı N, Çekiç B,et al. CT interpretations in patients with multiple injuries: comparison of emergency department physicians and on-call radiologists. Am J Emerg Med. 2016;34:2331-5.

22. Wysoki MG, Nassar CJ, Koenigsberg RA,et al. Head trauma: CT scan interpretation by radiology residents and staff radiologists. Radiology. 1998;208:125-8.

23. Arhami Dolatabadi A, Baratloo A, Rouhipour A,et al. Interpretation of Computed Tomography of the Head: Radiologists versus Emergency Physicians. Trauma Mon. 2013;18:86-9.

24. Jamal K, Mandel L, Jamal L, Gilani S. ‘Out-of-hours’ adult CT head interpretation by senior emergency department staff following an intensive training session: A prospective blinded pilot study of 405 patients. J Emerg Med. 2014;31:467-70.

25. Khan A, Qashqari S, Al-Ali AA. Accuracy of non-contrast CT brain interpretation by emergency department physicians: a cohort study. Pak J Med Sci. 2013;29:549-53.

26. Arendts G, Manovel A, Chai A. Cranial CT interpretation by senior emergency department staff. Australas Radiol. 2003;47:368-74.

27. Livingston DH, Lavery RF, Passannante MR,et al. Emergency department discharge of patients with negative cranial computed tomography scans after minimal head injury. Ann Surg. 2000;232:126-32.

28. Mucci B, Brett C, Huntley LS, Greene MK. Cranial computed tomography in trauma: accuracy of interpretation by emergency department staff. J Emerg Med. 2005;22:538-40.

29. Levitt MA, Davvkins R, Williams V, Bullock S. Abbreviated Training Session Improves Emergency Physicians' Interpretation of Cranial Computed Tomography Scans! Ann Emerg Med. 1997;30:616-21.

30. Perron AD, Huff JS, Ullrich CG,et al. A multicentre study to improve emergency medicine residents' recognition of intracranial emergencies on computed tomography. Ann Emerg Med. 1998;32:554-62.

31. Erly WK, Berger WG, Krupinski E,et al. Evaluation of head CT scan orders in the emergency department by radiology residents. AJNR Am J Neuroradiol. 2002;23:103-7.

32. Duane TM, Young A, Mayglothling J,et al. CT for all or selective approach? Who really needs CT of the cervical spine after blunt trauma?J Trauma Acute Care Surg. 2013;74:1098-101.

33. Gratton MC, Salomone JA, 3rd, Watson WA. Clinically significant radiography misinterpretations in an emergency medicine residency programme. Ann Emerg Med. 1990;19:497-502.

34. Aydın S, Bulut M, Topal N, Akgöz S,et al. Performance of emergency medicine residents in the interpretation of radiographs in trauma patients. J Emerg Med. 2008;25:482-5.

35. Uğurlu T. Comparison of emergency medicine assistants and radiology specialist interpretations in the evaluation of thorax computed tomography in trauma patients. (Expertise Thesis) İzmir 2016.

36. Bagheri-Hariri S, Ayoobi-Yazdi N, Afkar M,et al. Comparison of emergency medicine physicians‘ interpretations of abdominal and pelvic CT scans with radiologists’ reports and its effect on patient outcomes. Emerg Radiol. 2017;24:675-80.

37. Lim TK, Yu BC, Ma DS,et al. Correlation between optic nerve sheath diameter measured by computed tomography and elevated intracranial pressure in patients with traumatic brain injury. J Trauma Inj. 2017;30:140-4.

38. Turgut K. Comparison of abdominal CT interpretation levels of emergency physicians and radiologists. Adıyaman Üni. Sağlık Bilimleri Derg.5:1483-91.

39. Vaziri S, Mosaddegh R, Rezai M,et al. Emergency medicine service can interpret abdomino-pelvic CT scans with close to the same accuracy as radiology service. JCR. 2020;7:709-13.

40. Chung JH, Strigel RM, Chew AR,et al. Torso CT interpretation by night residents at a level one trauma centre, an analysis and literature review. Acad Radiol. 2009;16:1155-60.

41. Ruchman RB, Jaeger J, Wiggins EF,et al. Preliminary radiology resident interpretations versus final radiologist interpretations in a community hospital and the impact on patient care. AJR Am J Roentgenol. 2007;189:5.23-6.
42. Tieng N, Grinberg D, Li SF. Inconsistencies in interpretation of emergency department body computed tomography scans by radiology residents. Am J Emerg Med. 2007;25:45-8.