DOI: 10.37990/medr.1205918 Med Records 2023;5(2):290-4

MEDICAL RECORDS-International Medical Journal

Research Article

Comparison of the Interpretations of Brain Computed Tomography of Emergency Medicine Specialists and Neurosurgeons

Levent Aras[1], Levent Sahin[2], Murat Kayabas[2], Omer Canacik[3], Turkhun Cetin[4]

[1]Bakırköy Sadi Konuk Training and Research Hospital, University of Health Sciences, Department of Brain and Neurosurgery, İstanbul, Türkiye
[2]Kafkas University, Faculty of Medical, Departmant of Emergency Medicine, Kars, Türkiye
[3]Memorial Hospital, Department of Emergency Medicine, İstanbul, Türkiye
[4]Erzincan Binali Yıldırım University, Departmant of Radiology, Erzincan, Türkiye

Abstract

Aim: We aimed to examine the similarity in the brain computed tomography (CT) reports of emergency medicine and neurosurgery specialists.

Material and Methods: Patients who applied to the emergency department and underwent cranial CT in traumatic and non-traumatic conditions were analyzed retrospectively. The reports of emergency medicine and neurosurgeon specialists were reviewed. The radiologist's report was set as the gold standard. All CT examinations were performed independently of the radiologist by physicians with at least 5 years of experience.

Results: Emergency medicine and neurosurgery specialists were found to be highly compatible in detecting pathologies in CT reports. There was significant similarity in the diagnosis of bone defects and maxillofacial trauma in the CT reporting of emergency medicine specialists and neurosurgeons.

Conclusion: It was observed that emergency medicine specialists were as successful as neurosurgeons in the interpretation of brain CT pathologies of traumas. Since their knowledge and experience in non-traumatic pathologies are insufficient, they should receive support from radiology in residency training.

Keywords: Emergency medicine, neurosurgery, radiology, computed tomography

INTRODUCTION

Fast and accurate diagnosis is critical for patients who have applied to the emergency department with cranial problems. For this, imaging methods; Computed tomography (CT) is often needed. The correct interpretation of CT images is very important for the correct intervention in patients (1). CT is the most preferred and gold standard radiological imaging method in patients with head trauma (2,3). With its increasing popularity, brain CT has become increasingly common for neurologists and neurosurgeons (4). However, there is not yet a standard application about who will interpret it and how it will be interpreted (5). Although most emergency medicine specialists (EMS) express their opinions in the first stage interpretations of emergency services, consultation from radiology specialists may be requested in some cases. EMSs, who have to manage critically ill patients on their own, can sometimes make mistakes in their CT interpretation.

A study showed that there are inconsistencies in the interpretation of brain CTs between emergency physicians and radiologists in approximately 11% of cases (6). Studies done so far were mostly about CT interpretations of two different branches (7). When the brain CT interpretations of the three departments were examined in our study, it was

CITATION
Aras L, Sahin L, Kayabas M et al. Comparison of the Interpretations of Brain Computed Tomography of Emergency Medicine Specialists and Neurosurgeons. Med Records. 2023;5(2):290-4. DOI:1037990/medr.1205918

Received: 16.11.2022 **Accepted:** 12.12.2022 **Published:** 23.03.2023
Corresponding Author: Levent Sahin, Kafkas University, Faculty of Medical, Departmant of Emergency Medicine, Kars, Türkiye
E-mail: levsahin44@gmail.com

seen that the comments of neurosurgeons and RS were similar. Because of this similarity, brain CT interpretations of these two branches were not compared. In our study, the similarities and differences in the interpretations of EMS and neurosurgeons were examined. Among the patients who applied to the emergency department and had a brain CT scan, the comments of the cases evaluated by the EMS and then consulted with the neurosurgeon were examined.

MATERIAL AND METHOD

Ethical Approval

This study was carried out in the university hospital in Kars city. Patients included in the study were selected retrospectively during the one-year period between 2019-2020. The study was initiated after ethical approval was obtained from the ethics committee of the Faculty of Medicine of Kafkas University with the date of 06.05.2020 and number 80576354-050-99/136.

Study Plan

The examination notes of all these patients who applied to the emergency department were obtained from patient follow-up forms and computer epicrisis notes. The hospital PACS system was used to access the images of the patients. Brain CTs of the study were obtained using Siemens Somatom Emission 16-section tomography device. The records of EMS, neurosurgeons, and radiology specialists' physicians' comments on all brain CT images scanned in the emergency department during the study period were reviewed. As a reference for comparison, radiologist interpretation was considered the diagnostic gold standard in CT scanning. The comments made by the EMS and its neurosurgeons were compared with that of the radiology specialists. All CT examinations were performed independently of the radiologist by physicians with at least 5 years of experience.

Study Criterions

Two EMS and 2 neurosurgeons with at least 5 years of experience in the field took part in the study. Physicians performed CT examinations independently and unbeknownst to the radiologist. Doctors reported in their comments what they saw as important for their specialty. If there is pathology, they describe what it is and its localization. Brain CT interpretations of EMSs and neurosurgeons were accepted as compatible if they matched with the reports of radiologists, and inconsistent if they did not. The report of sinusitis was also considered insignificant, as CT was performed to look for evidence of intracranial lesions rather than sinuses. Any intracranial bleeding was considered significant if patients were using anticoagulants. In such studies, the report of the radiologist is accepted as the gold standard (7,8). Since neurosurgeon and radiologist reports were similar in this study, both departments were accepted as the gold standard with equal strength.

All traumatic and non-traumatic patients over the age of 18 who underwent brain CT and for whom neurosurgery consultation was requested were included in the study. As exclusion criteria; Patients under the age of 18, patients with no or incomplete radiologist comments, and patients who left the hospital without approval were determined. All cases considered normal by the RS and neurosurgeons after the examinations were excluded from the study.

Statistical Analysis

After compiling all data, statistical analyzes were performed using SPSS 22 (SPSS, Chicago) to calculate sensitivity and specificity. The obtained data were given as mean ± standard deviation (SD), number (n), mean, and percent (%). Chi-square and t-tests were used for comparisons between groups. Cohen's Kappa test was used to show the similar status of the groups. In all statistical analysis results, $p<0.005$ was considered significant.

RESULTS

After reviewing cranial CT scans of a total of 572 patients, we completed the study with 269 patients who met the inclusion criteria. Of these patients, 169 (57.8%) were male and 100 (42.2%) were female. The mean age of all patients was 47.06 years. The mean age of men was 44.21(±20.10) years. The mean age of the women was 51.88(±22.32) years.

In the CT reports of our study, it was observed that most of the pathological results were higher in the male gender, while the masses were more common in the female gender. Among all diagnoses, 14 (5.2%) of the intracranial masses belonged to the female gender (Table 1).

Table 1. Gender relationship with brain CT reports

CT Diagnoses	Gender		Total
	Man	Woman	
Epidural Bleeding	14 5.2%	5 1.9%	19 7.1%
Subarachnoid Bleeding	17 6.3%	10 3.7%	27 10.0%
Ischemia	17 6.3%	14 5.2%	31 11.5%
Cysts	16 5.9%	4 1.5%	20 7.4%
MFT	35 13.0%	14 5.2%	49 18.2%
Masses	8 3.0%	14 5.2%	22 8.2%
Bone Defects	17 6.3%	4 1.5%	21 7.8%
Parenchymal Bleeding	24 8.9%	21 7.8%	45 16.7%
Subdural Bleeding	21 7.8%	14 5.2%	35 13.0%
Total	169 62.8%	100 37.2%	269 100.0%

In CT reports, 18.2% (n=49) maxillofacial trauma (MFT) at most, followed by 16.7% (n=45) parenchymal bleeding, 13% (n=35) subdural bleeding, 11.5% (n=31) ischemia, respectively. 10% (n=27) subarachnoid bleeding, 8.2% (n=22) mass, 7.8% (n=21) bone defects, 7.4% (n=20) cyst, and 7.1% (n=19) epidural bleeding was detected. Considering the age distribution, ischemia and subdural hemorrhage occurred in the elderly group (Table 2). In CT reports, ischemia and subdural hemorrhages were seen in advanced ages. On the other hand, cysts, MFT, and epidural hemorrhages were observed at younger ages (Table 2).

Table 2. Age relationship with brain CT reports

CT Diagnoses	Mean	n	SD
Epidural Bleeding	35.47	19	14.88
Subarachnoid Bleeding	56.40	27	16.20
Ischemia	68.77	31	15.36
Cysts	27.10	20	7.39
MFT	34.10	49	15.63
Masses	49.27	22	23.62
Bone Defects	47.23	21	20.41
Parenchymal Bleeding	39.28	45	17.75
Subdural Bleeding	65.00	35	13.84
Total	47.06	269	21.24

In the results of brain CT reports in our study, it was observed that the age range was in a normal distribution (Figure 1).

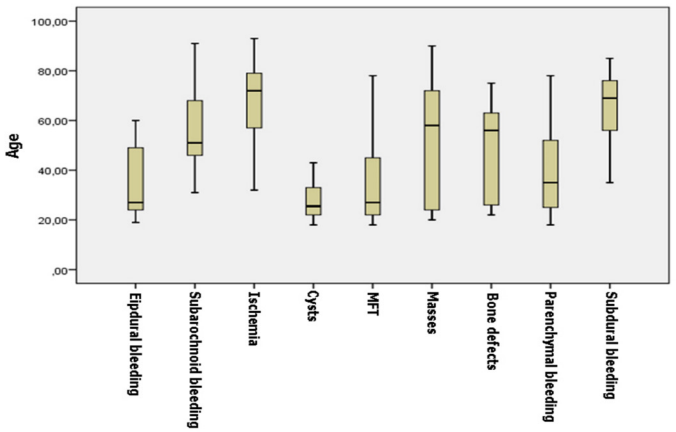

Figure 1. Age distribution graph with brain CT findings

As a result of the evaluation of EMS and neurosurgeons to detect pathologies in CT reports, it was seen that their evaluations were highly compatible with each other (k=.273, p=.000) according to Cohen's kappa test result applied to determine the compatibility between them (Table 3).

The similarity compatibility of EMS and neurosurgeons in CT reporting was found to be statistically significant, especially in bone defects and MFTs (p=0.002; 0.005). Although there were similarities in other diagnoses, there was no statistical significance (p>0.05) (Table 4).

Table 3. Compatibility of evaluations of neurosurgeons and emergency medicine specialists

		Neurosurgery Specialist Evaluation			
		Compatible	Incompatible	Total	Cohen's Kappa
Emergency Medicine Specialist Evaluation	Compatible	175	6	181	k=.273 p=.000
	Incompatible	68	20	88	
	Total	243	26	269	
Cohen's Kappa test					

Table 4. Compatibility of CT reports of emergency medicine and neurosurgeon specialists

CT Diagnoses	Specialist Doctors	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Epidural Bleeding	EMS	.174	.157	1.345	.179
	Neurosurgeons	19			
Subarachnoid Bleeding	EMS	.158	.091	1.523	.128
	Neurosurgeons	27			
Ischemia	EMS	-.054	.045	-.391	.696
	Neurosurgeons	31			
Cysts	EMS	.091	.069	.976	.329
	Neurosurgeons	20			
MFT	EMS	.324	.102	2.835	.005
	Neurosurgeons	49			
Masses	EMS	-.078	.066	-.482	.629
	Neurosurgeons	22			
Bone Defetcs	EMS	.644	.325	3.158	.002
	Neurosurgeons	21			
Parenchymal Bleeding	EMS	-.068	.036	-.511	.609
	Neurosurgeons	45			
Subdural Bleeding	EMS	.146	.180	1.092	.275
	Neurosurgeons	35			
Total	EMS	.237	.055	5.055	.000
	Neurosurgeons	269			

DISCUSSION

The use of CT has become one of the most frequently preferred diagnostic methods in emergency services because it is fast, effective, and noninvasive. Unfortunately, there are many studies in the literature regarding the request for large amounts of unnecessary tests for out-of-indication patients (9). Diagnostic and clinical decision-making algorithms should be used for the use of diagnostic tests in the emergency room. In cases of head trauma, the CT request should be evaluated in the presence of clinical findings. However, doctors want more CT, especially due to malpractice cases in emergency services. The increase in the use of CT in the emergency department by more than 80% causes emergency departments to become

diagnostic centers (10).

The key element of our study is to demonstrate whether there is an agreement between the examiner and the consultant in the interpretation analysis of brain CTs and in determining normal or abnormal results. Many studies have been conducted comparing CT interpretations between radiologists and emergency physicians (11,6). However, studies comparing the compatibility of neurosurgeons and radiology specialists in interpreting CT imaging examinations are few (12). A gold standard is required to make observational research on radiological studies and to compare the compliance rate. To improve the quality of this type of research, it is recommended to use a panel of radiologist (13,14). In this study, we considered radiologists comments as a definitive diagnosis. In line with the data we obtained, there was a general agreement between the departments, except for a negligible rate.

In the study of Al-Reesi et al., acute findings were detected in 82 of them in brain CT examinations. While 17 of them were clinically significant, insignificant findings were observed in 65 of them (8). In our study, 269 of 572 patients had pathological findings in their reports, while the results of 303 were found to be normal.

The interpretations of EMSs in CT interpretation of the head, thorax, extremity, and abdomen in traumatized cases admitted to the emergency department were mostly consistent with the radiology specialists' reports. When abdominal CT interpretations made in non-traumatic cases between EMS and radiology specialists were compared, it was found that EMSs were insufficient in this regard, and their power to accurately define pathological findings was low (15). In our study, only brain CT interpretations were examined. Among the EMSs and neurosurgeons' assessments of detecting different pathologies in their reports, their assessments of MFT and bone defects were found to be highly concordant. On the other hand, EMSs in the detection of ischemia, cyst, parenchymal hemorrhage, and masses had a higher rate of discordance with radiologist reports. In some studies, it has been reported that EMSs have insufficient accuracy in brain CT evaluation (15,16). However, different studies have shown that the accuracy of EMSs in CT interpretation is similar to that of radiologists (17-19). Although every EMS working in the emergency department is experienced, it is not possible to measure their level of personal knowledge regarding IT assessments. It has been observed that EMS training is insufficient for CT interpretation training, especially brain CT (8). Pieces of trainings or organizations can be organized to increase the knowledge and skills of emergency physicians (20).

Limitations

We think that comparing CT images with the same radiologist's report after being evaluated by the same physician may yield more objective results. EMSs and neurosurgeons are more in control of patients' clinical knowledge. However, the other limitation is that radiologists have only as much information as the image on the computer screen. Not being able to reach the required radiologist, not being able to read the CT on time even when reaching the radiologist, and not documenting the reports officially can be listed. Changed or newly added CT findings during the follow-up of the patients were not included in the study.

CONCLUSION

In our study, it was seen that EMS and neurosurgeons were highly compatible with each other in the assessment of detecting pathologies in CT reports. It was concluded that their knowledge and experience in non-traumatic (such as mass, cyst, and ischemia) pathologies were insufficient. We can recommend that emergency medicine residents receive more support from radiology in their specialization training.

Financial disclosures: *The authors declared that this study hasn't received no financial support.*

Conflict of Interest: *The authors declare that they have no competing interest.*

Ethical approval: *This retrospective study was approved by the ethics committee of Kafkas University (approval date/ number: 06.05.2020-80576354-050-99/136).*

REFERENCES

1. Turgut K. Comparison of abdominal ct interpretation levels of emergency physicians and radiologists. ADYÜ Sağlık Bilimleri Derg. 2019;5 :1482-91.
2. Berdahl CT, Vermeulen MJ, Larson DB, Schull MJ. Emergency department computed tomography utilization in the United States and Canada. Ann Emerg Med. 2013;62:486 94.
3. Freid VM, Bernstein AB. Health care utilization among adults aged 55-64 years: how has it changed over the past 10 years? NCHS Data Brief. 2010:1-8.
4. Berkseth TJ, Mathiason MA, Jafari ME, et al. Consequences of increased use of computed tomography imaging for trauma patients in rural referring hospitals prior to transfer to a regional trauma centre. Injury. 2014;45:835-9.
5. Howlett DC, Drinkwater K, Frost C, et al. The accuracy of interpretation of emergency abdominal CT in adult patients who present with non traumatic abdominal pain: Results of a UK national audit. Clin Radiol. 2017;72:41-5.
6. Mucci B, Brett C, Huntley LS, Greene MK. Cranial computed tomography in trauma: the accuracy of interpretation by staff in the emergency department. Emerg Med J Emj. 2005;22:538-40.
7. Dolatabadi AA, Baratloo A, Rouhipour A, et al. Interpretation of computed tomography of the head: emergency physicians versus radiologists. Trauma Mon. 2013;18:86.
8. Al-Reesi A, Stiell IG, Al-Zadjali N, Cwinn AA. Comparison of CT head interpretation between emergency physicians and neuroradiologists. Eur J Emerg Med. 2010;17:280-2.
9. Hodgson L. Cost containment in the emergency department. CAL/ACEP 1993 Source Guide. 1993:710.

10. Larson DB, Johnson LW, Schnell BM, et al. National trends in CT use in the emergency department: 1995 2007. Radiolog. 2011;258:164-73.

11. Gallagher FA, Tay KY, Vowler SL, et al. Comparing the accuracy of initial head CT reporting by radiologists, radiology trainees, neuroradiographers and emergency doctors. Br J Radiol. 2011;84:1040-5.

12. Mukerji N, Cahill J, Paluzzi A, et al. Emergency head CT scans: can neurosurgical registrars be relied upon to interpret them? Br J Neurosurg. 2009;23:158-61.

13. Nitowski LA, O'Connor RE, Reese CLth. The rate of clinically significant plain radiograph misinterpretation by faculty in an emergency medicine residency program. Acad Emerg Med. 1996;3:782–9.

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

15. Kang MJ, Sim MS, Shin TG, et al. Evaluating the Accuracy of Emergency Medicine Resident Interpretations of Abdominal CTs in Patients with Non-Traumatic Abdominal Pain. J Korean Med Sci. 2012;27:1255- 60.

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

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

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

19. Ardic S, Guneysel O. Emergency medicine residents can assess cranial computed tomography scans consistently with radiologists. Journal of Acute Medicine. 2015;5:92-5.

20. Turen CH, Mark JB, Bozman R. Comparative analysis of radiographic interpretation of orthopedic films: is there redundancy? J Trauma. 1995;39:720–1.