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Medical Science

Comparing the Compliance of Brain CT Scan Interpretations of Emergency Medicine Physicians with Radiologists Reports

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Introduction: **Since access to radiologists at any time of a day is not possible in all health centers, the ability to evaluate and interpret brain CT scans is necessary for emergency medicine physicians. The aim of this study is to compare the efficacy and functionality of brain CT scan interpretation of the emergency medicine team.** ***Methods:*** **In this observational, analytical and sectional study, brain CT scans of 150 patients with head trauma were examined and compared during six months in Hashemi Nejad hospital. Emergency physicians have recorded their interpretations of the disease after that Radiologist recorded their diagnosis by using PACS system simultaneously or after a short time. To specify the degree of compliance of these CT scans interpretations, the kappa coefficient used.** ***Results:*** **Reports of Brain CT scan by Emergency physicians consistent with the radiologist findings in 131 reports out of 150 reports (87.3%). In 19 cases (12.6%), the results were inconsistent; in 11 cases (7.3%) the findings were false negative, and in 8 (5.3%) findings were false positive. The obtained kappa coefficient was 0.7 (P <0.001), which indicates that the agreement was acceptable.** ***Conclusion:*** **The results indicate the acceptable skill of emergency physicians in the interpretation of brain CT scans. However, due to its high sensitivity and to minimize errors in clinical interpretation, teaching basic concepts of radiology to emergency physicians by professors of medicine or radiologist seems necessary.**

INTRODUCTION

Head trauma and Traumatic brain injury (TBI) is a health problem that cause major mortality and morbidity in young adults (1). Life Expectancy (LE) after TBI is related to severity of trauma and patients with mild TBI have similar LE to general population (2). Studies show that brain CT scans in patients with mild brain injury have an important role in identifying damage. Certainly, in moderate and severe brain injuries, CT scan is also the best way to diagnose the complications of intracranial head injury (3).

In one of the hospitals of Mashhad, 373 CT scans of 312 trauma patients were studied. Among patients with mild head injury, 42% (75 patients) of CT scans were normal, and 46% (n = 82) had a cerebral edema. The cerebral edema is the most common findings in patients with mild brain injury. The most common finding in patients with severe brain injury was intracranial hematoma (with a prevalence of 75%), particularly Extra-axial hematomas (4). In patients with head trauma, observing and interpreting brain CT scan has a great importance. In fact, the correct interpretation of CT scans will be decisive in saving the lives of patients.

Since in most large medical and emergency centers, there are no full-time radiologists, so emergency interpretation of brain CT scans must be done by the emergency physicians (5). Therefore, physicians working in the emergency department should be able to interpret brain CT scans correctly, because these are the basis of most subsequent decisions, and in many cases, correct interpretation will be decisive in saving the lives of patients.

Several studies have shown the lack of adequate skill of emergency residents to interpret CT scans and these interpretations are suboptimal (6, 7). Based on many Brain CT scans requested in ED, importance of education and improving skills of emergency physicians' interpretation in needed (8). Some studies suggested more educational program in Brain CT scan interpretation for residency curriculum. (9).

The aim of this study is to compare the performance and capabilities of emergency medicine team in interpreting brain CT scans, and to prove or disprove their correct interpretation in the target population.

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Table 1 Distribution and frequency of each of the positive findings in the interpretation of CT scans in emergency medicine and radiology teams

	Report of radiologist (n = 150)		Report of Emergency Medicine (n = 150)	
	No.	Percent	No.	Percent
Epidural	22	14.7	16	10.7
Subdural	38	25.3	29	19.3
Subarachnoid	58	38.7	41	27.3
Intracerebral	24	16	19	12.7
Intraventricular	0	0	0	0
Extra-axial	100	66.7	95	63.3
Pneumocephalus	70	46.7	65	43.3
Contusion	17	12	11	7.3
Fracture	80	53.3	67	44.7
Total CT scans with positive findings	106	70.7	103	68.7

METHODOLOGY AND ETHICAL CONSIDERATION

In this observational, analytical and sectional study, brain CT scans of 150 patients with head trauma was examined and compared during six months in Hashemi Nejad hospital. This study approved by Mashhad University of Medical Sciences (920697) and Ethical Committee of Mashhad university of Medical Sciences (97/447943). The research explained for patents and written informed consent completed by them.

The researchers chose patients with head trauma who have CT scans, reports, interpretations of Emergency Medicine physicians, and also the PACS radiology examination. Emergency physicians have recorded their interpretations of the disease, after that radiologist were also recorded their diagnosis by using PACS system simultaneously or after a short time. Neither groups view the interpretation of the other group.

Collected Data analyzed by using SPSS version 23. Results were assessed through descriptive statistics methods (frequency, frequency percentage and graphs). Kappa coefficient (kappa) was also used to determine the amount of the interpretations compliance.

It should be noted that in interpreting kappa, the highest value is 1. So, values from 0.8 to 1 are known as an excellent agreement, from 0.6 to 0.8 are known as an acceptable agreement, from 0.4 to 0.6 average agreement and values below 0.4 is practically worthless. These values are considerable if the p-value is significant. The aim of this study is not to evaluate a particular person. So, we didn`t mention any specific physician`s name in the results.

RESULTS

The prevalence of traumatic brain lesions and their frequencies in radiologists and emergency medicine physician reports were shown in Table 1. Based on the radiologist reports, 106 CT scans out of 150 (70.7%) were positive. The most prevalence of these findings related to extra-axial hematomas observed in 66.7% of patients, and least prevalence was Intraventricular hemorrhage which was not observed in any of the patients. The findings of emergency medicine and radiologist reports were compared and evaluated. Data was shown in Table 2.

Accordingly, 131 interpretations of emergency medicine (87.3%) out of 150 CT scans were match with the radiologist findings. In 19 cases (12.6%), the results were inconsistent; in 11 cases (7.3%) the findings were false negative, and in 8 (5.3%) findings were false positive (Fig.1). The obtained kappa coefficient was 0.7 (P <0.001), which indicates that the agreement was acceptable.

In a specific evaluation of each lesion, kappa coefficient for epidural hemorrhage, subdural hemorrhage, subarachnoid hemorrhage, hematomas extra-axial, contusion and skull fractures were between 0.6 - 0.8, that is, the agreement was acceptable. But, in case of brain bleeding and pneumocephalus, the value was between 0.8 - 1, which indicated a great degree of agreement.

DISCUSSION

Patients with head trauma are subject to a range of injuries, complications, and risks that varies depending on each patient and the type and severity of injury. Brain CT scan in head trauma patients can separates high risk and low risk patients (10). TBI is one of the most important causes of mortality in traumatic patients and it becomes a public health burden (11). A common complication of blows to the head is intracranial hematomas that are divided into two main categories: epidural hematoma, and intradural hematoma which itself divided into two groups of subdural hematomas, intracranial hematomas. According to different sources, 58 % of all patients who underwent hematoma discharge and 21 % of patients who had a severe traumatic brain injury, suffered a subdural hematoma, and the ratio of male to female in these studies have been reported from 1 to 3 to 1: 6 (12, 13).

In head trauma, especially in severe trauma, cerebral contusion is one of the intracranial brain damage that is created by extravasation of blood and swelling of the affected area (14). In the case of trauma, the decision often has to be taken immediately. Interventions such as surgery performed by clinical findings which completed with imaging methods, especially CT scan, should be done. Therefore, the ability to interpret CT scans correctly is vital in the management of trauma patients. It is important that team members can detect threatening findings in CT scans (15).

In this study, the compliance between findings of emergency medicine reports and findings reported by radiologists were compared and evaluated. The results showed that in a total of 131 cases (87.3%) out of 150 interpreted CT scans, emergency medicine team reports were consistent with the radiologist findings and the kappa coefficient was 0.7 (P <0.001), indicating an acceptable agreement. In an exclusive review of each lesion, Kappa coefficient for epidural hemorrhage, subdural hemorrhage, subarachnoid hemorrhage, hematomas extra-axial, contusions and skull fractures were 0.6 to 0.8, this means that the agreement was acceptable. But in case of bleeding within the brain and pneumocephalus, this number was 0.8 to 1, which indicates the excellent degree of agreement.

In any similar studies for brain damages, the agreement has not been evaluated individually but the general agreement has been reported. The general agreement was 86.6% in Mucci et al. (16), 84.4% in Talebian et al. (17), and 87.14 % in Khan et al. (18) studies. These findings are similar to our study. On the other hand, other studies reported more

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Table 2 Frequency distribution of the same, different, false positive and false negative interpretations results of CT scans by emergency medicine physicians and radiologist

	Same findings	Different findings	false negative	false positive	p.value	kappa coefficient
Epidural	140	10	8	2	<0.001	0.7
Subdural	137	13	11	2	<0.001	0.751
Subarachnoid	131	19	18	1	<0.001	0.718
Intracerebral	143	7	6	1	<0.001	0.81
Intraventricular	133	17	11	6	<0.001	0.751
Extra-axial	139	11	8	3	<0.001	0.852
Pneumocephalus	141	9	8	1	<0.001	0.659
Contusion	131	19	16	3	<0.001	0.748
Total	131	19	11	8	<0.001	0.7

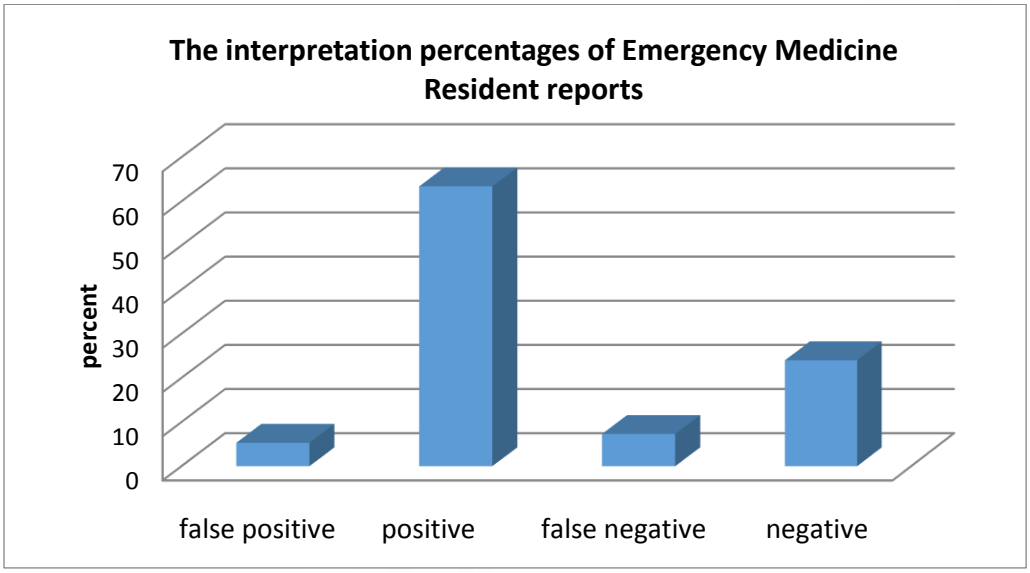

Figure 1 The interpretation percentage of emergency medicine reports

educational needs for emergency staff, for example the study of Nee chenkhoo et al., reported correct interpretation in two-third of cases (7). Several studies have shown the lack of adequate skills of emergency medicine residents in the interpretation of head CT scans (6, 7). However, emergency medicine specialists, in many cases have to interpret CT scans without the help of scholars from other disciplines. Unfortunately, despite the need for skilled emergency medicine physicians in interpreting CT scans, there is no clear plan for training (19).

However, it seems a systemic, practical and principled educational program can partly, cover this gap, as it was shown in the study by Perron et al. In this study, the ability to interpret the head CT scans in 83 emergency team at the five hospitals in the United States before and 3 months after the two-hour training course has been investigated. In this study, emergency medicine residents were interpreted correctly 60% of CT scans of the head before training. After their training, the diagnostic accuracy increased to 78%. The authors have stated that emergency medical assistance is weak in the interpretation of head CT and designing new training courses can increase their ability (19).

Limitation

In this study small sample size is one of our limitations and study with more patients can be more helpful.

CONCLUSION

Brain Ct interpretation is one of the necessary skills that emergency physicians must learn. In this study the results indicate the acceptable skill of emergency physicians in the interpretation of brain CT scans after training courses in the residency program. This training program must be in curriculum of Emergency Medicine Residency program and performed by radiologist or emergency professors.

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Conflict of interest
The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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