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COMPARISON OF THE EFFICIENCY OF THE PAEDIATRIC BRAIN CTS WITH TRAUMA AND NON-TRAUMA RELATED INDICATIONS IN THE PAEDIATRIC EMERGENCY DEPARTMENT

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ABSTRACT

BACKGROUND: This study aimed to determine the appropriateness of the examinations by evaluating the pre-diagnosis of the patients who underwent brain Computed Tomography (CT) in the paediatric emergency departments and the existing pathologies in the brain CTs. In addition, a comparison of the efficiency of the brain CT examinations performed for trauma and non-traumatic reasons was made.

MATERIAL AND METHODS: CT's were examined by dividing into 2 groups according to the indications as trauma (group 1) and non-trauma related (group 2). The 2 groups were compared statistically according to the number of pathologies, distribution of pathologies by gender and age.

RESULTS: Pathologies were detected in 9.3% (n = 30) of the patients in the first group and 21.2% (n = 14) of the patients in the second group. A statistically significant difference was found between the groups in terms of whether pathology was detected (p = 0.023). The rate of pathology detection in the group that underwent CT for non-traumatic reasons was statistically significantly higher than the other group.

CONCLUSION: Precautions should be taken especially with trauma patients to prevent unnecessary CT scans in the paediatric emergency department. In addition, if a CT scan is planned in the paediatric emergency department with the approval of the paediatrician and radiologist, the CT examinations can be made with more accurate indications.

KEY WORDS: Multi-detector Computed Tomography, paediatric, head trauma, radiation, emergency department

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INTRODUCTION

Emergency departments (EDs) are very busy departments in Turkey as well as in the whole world. Patients are admitted to the ED for many different reasons since the diagnostic tests and the treatments are applied faster than outpatient clinics for various type of diseases in these departments [1, 2]. Radiological diagnostic imaging methods are used frequently for the diagnosis of diseases in the EDs [2]. In recent years, among these imaging methods, especially Computed Tomography (CT) is the most frequently used diagnostic method due to its ability to provide very fast imaging, thanks to the increasing technology, and its easy accessibility [2]. The most common CT examination in the ED is the brain CT examination [3]. CT is an imaging method that

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uses cross-sectional imaging by using X-rays. The increase in the number of CT causes an increase in the total exposed radiation dose per patient [4]. It has been reported that 48% of the total radiation exposure in society is with medical CT scans [5]. The use of CT has many disadvantages related to radiation, especially in children. Children younger than 2 years old are much more sensitive to radiation than adults [6]. For this reason, the use of CT with the correct indication is very important in the ED, especially in the paediatric age group. In addition, unnecessary CT scans also increase diagnosis-related costs in the health expenditures [7]. Determining the appropriate examinations that will lead to the diagnosis in emergency departments and requesting the necessary diagnostic tests will prevent patients from unnecessary radiation exposure and reduce the costs to be paid for unnecessary examinations [1].

This study aimed to determine the appropriateness of the examinations by evaluating the pre-diagnosis of the patients who underwent brain CT in the paediatric ED and the existing pathologies in the brain CTs. In addition, a comparison of the efficiency of the brain CT examinations performed for trauma and non-traumatic reasons was made.

MATERIAL AND METHODS

The study was compiled with the guidelines of the Health Insurance Portability and Accountability Act. Local institutional ethics committee approval was obtained by the Ethics Committee of the Malatya Training and Research Hospital Ethics Committee as follows: ethics committee date and number: 25/02/2021 and E-23536505-604.02. Informed consent was taken from the parents of the patients.

In the 2 months between 1.01.2019–28.02.2019, the patients, who underwent brain CT in the paediatric emergency radiology department of the hospital were analysed retrospectively in terms of clinical pre-diagnosis and radiological results. Patients aged 0–17 years who underwent brain CT for non-traumatic or minor head trauma were included in the study. Patients with head trauma, Glascow Coma Score (GCS) of 14–15 and without loss of consciousness were accepted as minor head trauma. Preliminary diagnoses of brain CT examinations were obtained by detailed anamnesis and patient files in the hospital information management system. Patients who did not have sufficient clinical information or anamnesis in the hospital information management system and patient files were excluded from the study. Patients, whose diagnosis was previously known and who applied to the ED for follow-up were also excluded from the study.

Patients were grouped as traumatic (group 1) and non-traumatic (group 2). In addition, according to their age, they were grouped as under 2 years old (infant) and above.

Pathologies diagnosed in patients presenting with trauma were epidural and subdural bleeding, subarachnoid haemorrhage, intraparenchymal contusion-haemorrhage, cerebral oedema, and skull fracture. In non-traumatic patients, mass, abscess, meningitis, hydrocephalus, brain oedema, Posterior Reversible Encephalopathy Syndrome (PRES), and intraparenchymal haemorrhage were the diagnosed pathologies.

The images of the brain CT scans were re-evaluated via Image Storage and Communication Systems (PACS) by one paediatric radiologist and all were reported again. Brain CTs of the patients were obtained with a multi-slice device (16-slice multidetector CT, Philips Medical System MX-16) without intravenous contrast agent administration and in the axial plane. Each area to be examined by the device was obtained by observing the principles of ALARA with shooting protocols at the appropriate dose according to the size (age and weight) of the children [8]. All sections were applied parallel to the orbito-meatal line, 5 mm for the posterior fossa, 10 mm for the supratentorial region and 1 mm intervals. All CTs were examined in the bone and parenchyma windows.

The 2 groups were statistically compared according to the number of pathologies, distribution of pathologies by gender and age, and the relationship between pre-diagnosis and the detected pathologies.

Statistical Analysis

SPSS-17 program was used to evaluate the data. Data were given as numbers and percentages. Chi-square or, when appropriate, fisher-exact test was used in the evaluation of categorical data. In the results, a value of $p < 0.05$ was considered statistically significant.

RESULTS

A total of 389 brain CT scans were examined in this study, 323 (83%) of them were performed for trau-

ma-related and 66 (16.9%) of them were performed for non-trauma related reasons. Demographic characteristics and distribution of pathologies of all patients are shown in Table 1.

While 152 of the patients (39%) were female, 237 (61%) of them were male in this study. There was no statistically significant difference between the two groups in terms of gender (p = 0.490).

The average age of the patients was 8.18. 118 (30.3%) patients were under 2 years old and 271 (69.7%) patients were between 3–17 years old. While 76.2% of the patients in the first group were older than 2 years, this rate was 53% in the second group. There was a significant difference between the two groups in terms of age (p = 0.001).

The distribution of patients and pathologies among the groups are shown in Table 2.

Pathologies were observed in 44 (11.3%) of 389 patients. While pathologies were observed in 9.3% (n = 30) of the patients in the first group, pathologies were found in 21.2% (n = 14) of the patients in the second group. There was a significant difference between the two groups in terms of detection of pathology. The pathological findings were found to be significantly higher in the non-trauma patients (group 2) in the present study (p = 0.023). While 16.7% (n = 5) of the patients with pathology in the first group were in the 0–2 age group, 57.1% (n = 8) of the patients with pathology in the second group were in the 0–2 age group. A statistically significant difference was found between the two groups in terms of positive pathology in the 0–2 age group (p = 0.001).

One (3.3%) of the traumatic patients had an epidural haemorrhage, 5 (16.6%) of them had a subdural haemorrhage, 2 (6.6%) of them had a subarachnoid haemorrhage, 1 (3.3%) of them had intraparenchymal contusion, 1 (3.3%) of them had cerebral oedema, and 24 (80%) of them had skull fractures.

Four (28.5%) nontraumatic patients had mass, 1 (7.1%) had abscess, 2 (14.2%) had hydrocephalus 3 (21.3%) had cerebral oedema, 1 (7.1%) had PRES, and 2 (14.2%) of them had an intraparenchymal haemorrhage.

The clinical preliminary diagnoses of patients with non-traumatic reasons and the number of pathologies in that group are shown in Table 3.

DISCUSSION

Advances in CT technology in recent years has caused CT to be used as a method of triage, especially in the EDs. This has increased the use of CTs with unnecessary indications like some other radiological methods.

Patients with minor head trauma constitute 83% of the present study group and the demographic

Table 1. Demographic characteristics and distribution of pathologies of all patients

		(n)	(%)
Age	0–2 years 3–17 years	118 271	30.3 69.7
Gender	Female Male	152 237	39 61
Age with pathology	0–2 years 3–17 years	13 31	29.5 70.5
Gender with pathology	Female Male	14 30	31.8 68.2

Table 3. Preliminary diagnoses of patients who underwent brain CT for non-traumatic reasons and the number of pathologies in these pre-diagnoses

	(n)	Pathology (n)	Pathology (%)
Headache	22	4	18.1
Seizure	16	3	18.7
Fewer	10	2	20
Confusion	8	2	25
Haematoma	4	1	20
Infarct	2	0	0
Optic neuritis	3	1	33.3
Arrest	1	1	100

CT — Computed Tomography

Table 2. Comparison of patients who underwent brain CT for trauma and non-traumatic reasons

		Traumatic (n)	Traumatic (%)	Nontraumatic (n)	Nontraumatic (%)
Age	0–2 years 3–17 years	87 236	23.8 76.2	31 35	47 53
Gender	Female Male	129 194	39.9 60.1	23 43	34.8 65.2

CT — Computed Tomography

distribution of patients in this group is compatible with the literature [9–11]. In the study of Guneş et al. [10], 58% of the patients were male and 80.3% were above 2 years old, while these results were found 60.1% and 83.3% in this study. Skull fractures constituted most of the pathologies seen in trauma patients (80%) in this study, following the literature. This rate was found to be 82% in the study of Guneş et al. [10], and 57.8% in the study of Er et al. [9].

In the study of Kuppermann et al., it was reported that most of the patients with head trauma admitted to the ED were patients with mild head trauma, and traumatic brain injury was detected in less than 10% of these patients, which is similar to the present study [12]. The 9.3% of the patients with minor head trauma had pathology in this study. Pathology was observed in 6–6.5% of the patients with minor head trauma in the studies of Gunes et al., Er et al. And Mannix et al. [9, 10, 13].

In recent years, as a result of increased accessibility to CT and shortening of examination times due to technological developments, the number of CT examinations has increased significantly in paediatric patients as well as in adult patients. It is difficult to evaluate the history and examination findings in young children. In addition, medicolegal reasons cause this increase in the number of CT examinations [13]. On the other hand, the number of patients applying to ED is very high and the physician of the ED has to make an optimum evaluation in a very short time. This may be a possible reason for the high numbers of radiological imaging in the EDs in Turkey. However, since the children are more sensitive to ionizing radiation, the indications of the CT should be considered very carefully especially in this age group.

Brain CT examinations were found to be normal in 88.7% of all patients included in this study. Although there are many studies on this subject in the literature, these studies are generally related to patients with head trauma [9, 10]. Studies related to the CT examinations of nontraumatic patients are usually done in adult patients [14–16]. The number of studies on the CT of nontraumatic patients in the paediatric ED is few [17, 18]. Although the study of Akca et al. [17] was similar to the present study, there have been serious differences between the presented findings and their results. The percentage of the normal CT scans performed for trauma was 90.7% in this study and 70.4% in the study of Akca et al. One of the reasons for higher normal results in the trauma group may be the consideration of the non-emergency radiopathologies and chronic changes (arachnoid cyst, mega cisterna magna, etc.) not as pathology in the presented reports. The number of normal CTs was found to be significantly higher in the patients with trauma in this study, while the number of normal CTs was significantly higher in the patients with nontrauma in the study of Akca et al.

The most important result of this study was the number of CTs and the radiologically normal rate of examinations in the trauma-related patient group were significantly higher than non-traumatic patients. Paediatric trauma patients are first evaluated not only by paediatricians but also by the practitioner doctors in the hospital. The first request for the radiological imaging of these patients is also made by these doctors. But all nontraumatic patients are evaluated by paediatricians. Because paediatricians are more familiar with the paediatric patient population, they can ask for a more detailed history and make a more accurate physical examination. Thus, the number of CTs and radiology reports without pathology can be significantly low in the non-traumatic patients' group. In addition, paediatricians cooperate with the paediatric radiologists in the hospital, and this contributes to CT scans with the right indication. Some of the nontraumatic patients are applied a brain MRI instead of the brain CT with the recommendation of the paediatric radiologist, which can show the pathology more accurately and so the number of CTs reduces in the paediatric EDs. More detailed studies are needed on this subject, which is very limited in the literature. New studies may be a guide for defining the correct indication and may lead to a reduction in the number of CT scans in the emergency departments.

The study had some limitations. It was a retrospective study and the number of patients in the nontraumatic patient group was lower than the trauma patients.

CONCLUSION

Many studies aim to protect the patients from radiation as much as possible by performing CT scans with more accurate indications, especially in paediatric patients.

Unfortunately, there is still no consensus on the indications of CT imaging. In this study, both the number of patients who underwent CT and the

number of CTs reported as normal in the trauma group were higher than the nontraumatic group. Precautions should be taken especially in patients with trauma to prevent unnecessary CT applications in the paediatric EDs. In addition, if the indications of the brain CT scans are planned with the approval of the paediatrician and radiologist, CT examinations can be made with the correct indication and, if possible, other diagnostic methods can be used instead of CT.

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