

Rate of Unnecessary CT-Scans and Related Factors in Pediatric Head Trauma

Mahyar Mohammadifard¹, Ashkan Mehrkish¹, Bita Bijari², Alireza Mirgholami¹, Abtin Ariyan³

¹Department of Radiology, Faculty of Medicine, Birjand University of Medical Sciences, Birjand, Iran.

²Department of Social Medicine, Faculty of Medicine, Birjand University of Medical Sciences, Birjand, Iran

³Radiologist, Iranmehr Hospital, Tehran, Iran

Abstract

Introduction: Trauma is one of the most common reasons for patients to be referred to the emergency room, which is one of the most important diagnostic methods for trauma patients upon arrival. According to the many requests of doctors to perform CT scans of patients, the researchers consider the reasons for this to be the lack of clarity of the existing instructions or the lack of knowledge and concern of doctors regarding the mandatory cases of imaging. Regarding the lack of specific guidelines for obtaining CT scans in children in Birjand hospitals, the aim of this study was to investigate the rate of unnecessary CT scans and related factors in children with head trauma referred to the emergency department of Imam Reza Hospital.

Materials and methods: In this cross-sectional study, 250 children with Trauma complaint were included in the study. After entering the emergency room and being examined by an emergency medicine specialist, the patients were referred to the radiology department for a brain CT scan if necessary. The CT scan taken from the patients was reviewed by the radiology assistant and the CT scan findings were recorded in the study checklist. Indications for CT scan were reviewed based on NEXUS II guideline. SPSS version 22 software was used. Chi-square statistical test was used to compare the differences. P value ≤ 0.05 was considered statistically significant.

Results: The average age of children was 7.19 ± 3.38 years. The most common clinical symptom of children was headache. The most common indication based on the NEXUS II guideline was scalp hematoma followed by decreased consciousness. The most common CT scan finding was a fracture. 38.4% of the obtained CT scans were unnecessary. The frequency distribution of necessary CT scan did not differ significantly in terms of gender, age group of children and the symptoms of headache, nausea, vomiting, diplopia, raccoon sign and ettore ($P > 0.05$), but the frequency distribution of necessary CT scan showed a significant difference in terms of Mechanism of trauma, GCS level, final outcome of patients, amnesia, battle sign and rhinorrhea ($P < 0.05$).

Conclusion: Based on the data presented herein, the rate of brain CT scans of children with unnecessary head trauma in Imam Reza Hospital was 38.4%. The frequency distribution of necessary CT scan showed significant differences from each other in terms of trauma mechanism, GCS level, patients' final outcome, amnesia, battle sign, rhinorrhea, neurological deficit, decreased consciousness, abnormal behavior and persistent nausea.

Key Words: CT scan, head trauma, trauma medicine, patients.

Address for correspondence

Mahyar Mohammadifard, Department of Radiology, Faculty of Medicine, Birjand University of Medical Sciences, Birjand, Iran, Email: mahyarmohammadifard22@yahoo.com

Word count: 4191 **Tables:** 05 **Figures:** 00 **References:** 20

Received: -28 October, 2023, Manuscript No. OAR-23-123134

Editor assigned: - 01 November, 2023, Pre-QC No. OAR-23-123134 (PQ)

Reviewed: - 08 November, 2023, QC No. OAR-23-123134 (Q)

Revised: - 21 November, 2023, Manuscript No. OAR-23-123134 (R)

Published: - 29 November, 2023, Invoice No. J-123134

INTRODUCTION

Trauma is one of the most common reasons for referring patients to the emergency room, which is one of the most important causes of death or disability (1). Trauma and posttraumatic complication impose a heavy socio-economic burden on the society and healthcare system. Timely treatment and appropriate treatments are very important in trauma patients (2). In head trauma, especially severe traumas, injuries such as subdural hematoma, epidural hematoma, subarachnoid hemorrhages, and intraparenchymal hemorrhages can be expected (3). Skull base fracture is related to the severity of the head trauma and its incidence increases with the severity of the trauma. Bones such as orbital, frontal, ethmoid, sphenoid, occipital and temporal are involved in skull base fracture (4). Diagnosing skull base fracture is very important due to showing the severity of the initial blow to the head, the risk of developing meningitis and other complications such as cranial nerve palsy, pneumocephalus, rhinorrhea, ettore, dizziness, cerebrospinal fluid fistula (5).

One of the most important diagnostic methods used in trauma patients upon arrival is imaging methods, which differ based on the type of trauma, damage to body parts, and the type of imaging, including simple x-ray, ultrasound, MRI, and CT-Scans (6). Among the types of imaging methods, X-rays are used in CT scan and simple x-rays, which even in low doses are associated with the risk of causing problems such as increasing the risk of malignancy (7). The use of imaging in trauma patients is important and unavoidable in most cases due to its great help in timely diagnosis and treatment, therefore, the use of imaging methods with potential damage and loss such as CT scan and X-ray is of great importance based on the indications (2).

CT scan should be used to achieve the goal of the strategy in necessary cases (8). Computed tomography scanning is a valuable tool for diagnosing normal cases in the brain or spinal cord, because it is highly accurate in displaying these tissues. Brain CT scan is recommended in head trauma, intracranial hemorrhage, intracranial calcification, brain tumor, diagnosis and follow-up of brain abscess and seizures. In this method, the time necessary to diagnose brain lesions is reduced and the early diagnosis of brain lesions in CT scan allows the doctor to start treatment as soon as possible, resulting in an increase in the life expectancy and quality of life of patients with brain lesions (9). CT is a waste of time and money for the patient, hospital, and society in cases where the result does not help much in the diagnosis and treatment of patients, and the request for it should be made in necessary cases (10).

Researchers have mentioned several reasons for the increase in the request of doctors to perform CT scan of patients, including the lack of clarity and transparency of the existing instructions, or the lack of knowledge and concern of some doctors regarding the mandatory cases, leading to Doctors' use of diagnostic tests such as CT scan (11). Due to the lack of specific guidelines for obtaining CT scans in children, the aim of this study was to investigate the rate of unnecessary CT scans and related factors in head injuries in children referred to the emergency room.

MATERIALS AND METHODS

This descriptive-analytical study was conducted on children with a complaint of minor head trauma who were referred to the emergency room of Imam Reza hospital in Birjand, Iran either electively or by ambulance. Patients who met the inclusion and exclusion criteria were included in the study. The inclusion criteria included: age less than 15 years, having informed consent to enter the study. Exclusion criteria: unstable vital signs, having contraindications for CT scan (pregnancy, not receiving a lot of radiation during the last few months), previous history of head trauma, multiple trauma, history of taking anticoagulant drugs, brain tumors.

SAMPLE SIZE

250 patients who visited the emergency department of the hospital from April to September 2022 were enrolled in the study.

PROCEDURE

First, the implementation method and objectives of the study were explained to the parents of the child referred to the radiology department for a brain CT scan by the study manager, and informed consent was obtained from them. Then a checklist based on the objectives including: age, sex, reason for referral, mechanism of trauma, clinical symptoms, and final outcome of the child was recorded by the study manager. Also, the GCS level of the patients was checked by the study leader for each child. The CT scan taken from the patients was reviewed by the radiology assistant and the CT scan findings were recorded in the study checklist. Indications for CT scan are based on NEXUS II guideline (12).

DATA ANALYSIS

Descriptive data were reported using descriptive statistical indices (central and dispersion indices). Chi-square test or Fisher's exact test was used to analyze the data. The data was entered into SPSS software version 22. A P value of < 0.05 was statistically considered significant.

ETHICAL DECLARATIONS

The present study was approved by the Ethics Committee of the Vice-Chancellor of Research and Technology of Birjand University of Medical Sciences, IR.BUMS.REC.1401.022. All patient information was kept confidential. And data

analysis was done without patients' names. Informed consent was obtained from parents/legal guardians of all patients.

RESULTS

A total of 250 children were included in the study. Out of a total of 250 children, 152 (60.8%) were male and 98 (39.2%) were female. Out of a total of 250 children, 54 children (21.6%) were under 5 years old, 140 children (56%) were between 5 and 10 years old, and 56 children (22.4%) were more than or equal to 10 years old. In terms of trauma mechanism, 100 patients (40%) had a car accident, followed by a fall from a height (73 children, 29.2%), a motorcycle accident (49 children, 19.6%), a bicycle accident (22 children, 8.8%) and Quarrels (6 children, 2.4%).

Furthermore, 158 children (62.8%) were discharged, 83 (33.2%) were hospitalized, and 9 (3.6%) underwent surgery. The average age of the children was 7.19 ± 3.38 years with a minimum age of 3 months and a maximum age of 15 years.

The frequency distribution of the clinical symptoms of the studied children showed that 140 children (56%) had headache, followed by nausea (67 patients, 26.8%), vomiting (57 patients, 22.8%), amnesia (48 patients, 19.2%), diplopia (24 patients, 9.6%), raccoon sign (21 patients, 8.4%), battle sign (21 patients, 8.4%), ettore (18 patients, 7.2%) and rhinorrhea (17 patients, 6.8%).

The frequency distribution of the GCS level of the studied children showed that 13 patients (5.2%) had a GCS level below 10, followed by 10-14 (29 patients, 11.6%) and normal GCS levels (208 patients, 83.2%). The average GCS of the examined children was 14.38 ± 1.81 .

The most common indication according to the NEXUS guideline was scalp hematoma (60 cases, 24%) followed by decreased consciousness (42 cases, 16.8%), (Table 1).

Tab.1. Frequency distribution of NEXUS guideline indications in the studied children.

Statistical index parameter		Frequency
fracture	does not have	211 (84.4%)
	has it	39 (15.6%)
Scalp hematoma	does not have	161 (76%)
	has it	60 (24%)

Neurological defect	does not have	223 (89.2%)
	has it	27 (10.8%)
Decreased consciousness	does not have	191 (83.2%)
	has it	42 (16.8%)
Abnormal behavior	does not have	223 (89.2%)
	has it	27 (10.8%)
persistent nausea	does not have	223 (89.2%)
	has it	27 (10.8%)
Coagulopathy	does not have	249 (99.6%)
	has it	1 (0.4%)

The most common CT scan finding of children was fracture (37 cases, 14.8%), followed by subdural hematoma (11 cases, 4.4%), (Table 2).

Tab.2. Frequency distribution of CT scan findings in children.

Statistical index parameter		Frequency
Subdural hematoma	does not have	239 (95.6%)
	has it	11 (4.4%)
Epidural hematoma	does not have	240 (96%)
	has it	10 (4%)
contogen	does not have	235 (96.4%)
	has it	9 (3.6%)
Subarachnoid hemorrhage	does not have	243 (97.2%)
	has it	7 (2.8%)
Intraventricular hemorrhage	does not have	239 (97.6%)
	has it	6 (2.4%)
fracture	does not have	213 (85.2%)
	has it	37 (14.8%)

Based on the results presented in Table 3, the amount of unnecessary CT scan was higher in girls than boys ($P=0.425$). The rate of unnecessary CT scan in the age group under 5 years was higher than other age groups, but this difference was not found to be statistically significant ($P=0.423$). The

amount of unnecessary CT scan in children with bicycle accidents and fights was more (P=0.010) than other mechanisms and significantly more than other GCS in individuals with normal GCS, which was statistically significant (P<0.001).

Tab.3. Comparison of the frequency distribution of necessary CT scans according to the investigated parameters in children.

Necessary CT scan parameter		Yes frequency (percentage)	No frequency (percentage)	Chi-square statistical test result
gender	male	97 (63.8%)	55 (36.2%)	X ² =0.805 P=0.425
	female	57 (58.2%)	41 (41.8%)	
Age group (years)	Below 5	30 (55.6%)	24 (44.4%)	X ² =1.763 P=0.423
	05-Oct	86 (61.4%)	54 (38.6%)	
	10 years and more	38 (67.8%)	18 (32.2%)	
Mechanism of trauma	Fall	50 (68.5%)	23 (31.5%)	X ² =13.003 P=0.010
	Motorcycle accident	30 (61.2%)	19 (38.8%)	
	Bicycle accident	8 (36.4%)	14 (63.6%)	
	Car accident	65 (65%)	35 (35%)	
	quarrel	1 (1.7%)	5 (83.3%)	
GCS level	Below 10	13 (100%)	-	X ² =31.469 P<0.001
	Oct-14	29 (100%)	-	
	15 (natural)	112 (53.8%)	96 (46.2%)	
The final result	discharge	62 (39.2%)	96 (60.8%)	X ² =90.745 P<0.001
	Hospitalization	83 (100%)	-	
	Surgical intervention	9 (100%)	-	

The frequency distribution of necessary CT scan according to clinical symptoms in children was shown in Table 4, which was found to be statistically significant for forgetfulness, battle sign and rhinorrhea (P<0.05).

Tab.4. Comparison of the frequency distribution of necessary CT scans according to clinical symptoms investigated in children.

Necessary CT scan parameter	Yes frequency (percentage)	No frequency (percentage)	Chi-square statistical test result
Headache	64 (58.2%)	46 (41.8%)	X ² =0.970 P=0.360
nausea	108 (59%)	75 (41%)	X ² =1.927 P=0.188
Vomit	116 (60.1%)	77 (39.9%)	X ² =0.801 P=0.439
forgetfulness	115 (56.9%)	87 (43.1%)	X ² =9.697 P=0.003
diplopia	137 (60.6%)	89 (39.4%)	X ² =0.957 P=0.383
Raccoon sign	138 (60.3%)	91 (39.7%)	X ² =2.063 P=0.168
Battle Sign	135 (59%)	94 (41%)	X ² =8.081 P=0.004
Author	139 (59.9%)	93 (40.1%)	X ² =4.048 P=0.076
Rainure	138 (59.2%)	95 (40.8%)	X ² =8.154 P=0.004

Headache	does not have	64 (58.2%)	46 (41.8%)	X ² =0.970
	has it	90 (64.3%)	50 (35.7%)	P=0.360
nausea	does not have	108 (59%)	75 (41%)	X ² =1.927
	has it	46 (68.7%)	21 (31.3%)	P=0.188
Vomit	does not have	116 (60.1%)	77 (39.9%)	X ² =0.801
	has it	38 (66.7%)	19 (33.3%)	P=0.439
forgetfulness	does not have	115 (56.9%)	87 (43.1%)	X ² =9.697
	has it	39 (81.3%)	9 (18.8%)	P=0.003
diplopia	does not have	137 (60.6%)	89 (39.4%)	X ² =0.957
	has it	17 (70.8%)	7 (29.2%)	P=0.383
Raccoon sign	does not have	138 (60.3%)	91 (39.7%)	X ² =2.063
	has it	16 (76.2%)	5 (23.8%)	P=0.168
Battle Sign	does not have	135 (59%)	94 (41%)	X ² =8.081
	has it	19 (90.5%)	2 (9.5%)	P=0.004
Author	does not have	139 (59.9%)	93 (40.1%)	X ² =4.048
	has it	16 (83.3%)	3 (16.7%)	P=0.076
Rainure	does not have	138 (59.2%)	95 (40.8%)	X ² =8.154
	has it	16 (94.1%)	1 (5.9%)	P=0.004

In Table 5, the frequency distribution of necessary CT scan was compared according to CT scan findings. a statistically significant difference was found for the use of necessary CT scan used for subdural hematoma, epidural hematoma, contusion and fracture (P<0.05).

Tab.5. Comparison of the frequency distribution of necessary CT scan in the examined children.

Necessary CT scan parameter		Yes frequency (percentage)	No frequency (percentage)	Chi-square statistical test result
Subdural hematoma	does not have	143 (59.8%)	96 (40.2%)	X ² =7.173 P=0.008
	has it	11 (100%)	-	
Epidural hematoma	does not have	144 (60%)	96 (40%)	X ² =6.494 P=0.015
	has it	10 (100%)	-	
contogen	does not have	145 (60.2%)	96 (39.8%)	X ² =5.820 P=0.029
	has it	9 (100%)	-	
Subarachnoid hemorrhage	does not have	148 (60.9%)	95 (39.1%)	X ² =1.770 P=0.255*
	has it	6 (85.7%)	1 (14.3%)	
Intraventricular hemorrhage	does not have	148 (60.7%)	96 (39.3%)	X ² =3.832 P=0.085*
	has it	6 (100%)	-	
fracture	does not have	119 (55.9%)	94 (44.1%)	X ² =19.986 P<0.001
	has it	35 (94.6%)	2 (5.4%)	

* Fisher exact test

DISCUSSION

Trauma is one of the most common reasons for patients to be admitted to the emergency room, and the most important diagnostic methods in trauma patients are various imaging methods. Many requests of doctors to perform CT scan are due to the lack of clarity of existing instructions or the lack of knowledge and concern of doctors regarding the mandatory cases of imaging (5). Due to the lack of a specific guideline for obtaining CT scans in children in Birjand hospitals, the aim of this study was to investigate the rate of unnecessary CT scans and related factors in children with head trauma

referred to the emergency department of Imam Reza Hospital, Birjand.

Based on the results of the present study, it can be stated that most of the examined children (60.8%) were male. In the studies conducted by Saeedi Borujeni (13) and Salimi et al. (14), most of the examined patients were men, which is in line with the study, the reason for the high prevalence of trauma in males compared to females can be attributed to cultural considerations in the society and less presence of females in high-risk places, more activity of boys in social fields, and high-risk behaviors in males.

According to the results of the present study, the most common mechanism of trauma in the examined patients was accident. Yousufzadeh et al. (15) reported that the most common cause of trauma in children was car accidents, which was consistent with the present study. In various studies conducted by Salimi et al. (14), Byun et al. (16), the most common cause of head trauma in children was a fall, which was not consistent with the present study. Among the reasons for this inconsistency, we can mention the difference in the type of study, geographical area and culture of people in different societies.

The most common indication according to NEXUS guideline II was scalp hematoma (24%), followed by decreased consciousness (16.8%), abnormal behavior and neurological deficit (10.8%). DeAngelis et al reported that 21.3% of patients had scalp hematoma, which was consistent with the study. It was also stated in aforementioned study that 1.3% of patients had neurological deficits and 2.7% had abnormal behavior, which was not consistent with the study conducted (18), the reasons for this inconsistency can be attributed to the difference in the studied population, the time Study and entry and exit criteria mentioned.

The most common CT scan finding of the examined children was skull fracture with a frequency of 14.8%. The study of Saeedi Borojni et al. (13) and Salimi et al. (14) stated that the most common finding in the CT scan of the examined patients was skull fracture, which was consistent with the study. Based on the results of the present study, CT scan was necessary for 61.6% of the patients and CT scan was unnecessary for 38.4% of the patients. The study conducted by Fallah et al. reported that 39% of the CT scans obtained were necessary

based on the radiologist's report, which was consistent with the study conducted (19).

The study conducted by DeAngelis et al demonstrated that 40.5% of CT scans performed by doctors were not necessary based on the NEXUSII guideline, which was consistent with the study conducted (18).

The frequency distribution of necessary CT scan was not significantly different in terms of gender and age group of children ($P>0.05$), but the frequency distribution of necessary CT scan was significantly different in terms of trauma mechanism, GCS level and final outcome of patients ($P<0.05$). The study conducted by DeAngelis et al stated that the frequency distribution of CT scan indications (based on the NEXUSII guideline) was not significantly related to the age group of patients, which was consistent with the study conducted (18). Furthermore, the distribution of the frequency of necessary CT scan (according to NEXUSII guideline) was significantly different from each other in terms of the gender, which was not consistent with the study conducted (18).

Among the reasons for this inconsistency, we can mention the difference in the studied society, the time of the study and the experts' experience-based interpretation. The study conducted by Fallah et al stated a relationship between the frequency distribution of normal CT scans and the age, where the frequency distribution of abnormal CT scans in children under one year old was significantly higher than people over one year old, such findings was inconsistent with our result (19). The reasons for the inconsistency can be pointed to the difference in the studied society and the studied sections.

The study conducted by Ahsaei et al. reported a significant correlation between CT scan findings and the GCS level of the examined patients, which is consistent with the study conducted (17). Salimi et al stated a correlation between CT scan findings and GCS level of patients, which was consistent with the study conducted (14).

Based on the results of the present study and other studies, it can be stated that patients with a lower GCS level had more CT scan findings and, accordingly, more reasons and indications for CT scan than patients with a higher GCS level.

Also, if the mechanism of trauma includes a motor vehicle accident or fall, or the children's GCS level was low, CT scan was

necessary for patients. According to the results of the present study, the symptoms of amnesia, Battle sign and rhinorrhea, decreased consciousness, abnormal behavior and persistent nausea were related to the necessary CT scan. The study conducted by Sadegh et al. reported that vomiting twice or more, loss of consciousness, rhinorrhea, battle sign was associated with abnormal CT scan in patients, which was consistent with the study conducted (20). Furthermore, headache was not a risk symptom for abnormal CT scan, which was consistent with the present study.

CONCLUSION

Based on the data presented herein, the rate of brain CT scans of children with unnecessary head trauma in Imam Reza Hospital was 38.4%. The frequency distribution of necessary CT scan showed significant differences from each other in terms of trauma mechanism, GCS level, patients' final outcome, amnesia, battle sign, rhinorrhea, neurological deficit, decreased consciousness, abnormal behavior and persistent nausea. In other words, children with the above symptoms have an abnormal CT scan that was in need of a brain CT scan.

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