ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Evaluation of The Relationship Between Minor Head Trauma and Attention Deficit and Hyperactivity Disorder in Children

Çocuklarda Dikkat Eksikliği ve Hiperaktivite Bozukluğu ile Minör Kafa Travmasının İlişkisi

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ABSTRACT

Aim: Multiple injuries, such as poisoning, limb and tooth injuries, increase in children with attention-deficit and hyperactivity disorder (ADHD). Our study aimed to investigate the possible relationship between ADHD and head trauma in children.

Material and Methods: 200 children (Group 1) and 131 healthy children (control group) who presented with minor head injury were included in the study. After the initial evaluation and examination phase of the patients, the risk level of ADHD was determined by filling in the Conner's Parent Rating Scale (CPRS) with a descriptive form containing trauma mechanism, information about the child, and primary complaints.

Results: Of the 200 pediatric patients who were evaluated with minor head trauma, 125 were male (62.5%) and 75 were girls (37.5%). The average age was 7, and the most common occurrence mechanism was np: 79 patients (39.5%) falling from the same level. Subdural hematoma in 2 (1%) patients and linear cranial fracture in 8 (4%) patients were detected as a result of the imaging performed by patients with minor head trauma. ADHD rates were found as 15% according to the Conner's Parent Rating Scale. According to the ADHD subgroup analysis in our study population 59 (28.5%) attention deficit, 21 (% 10.5) antagonism, 63 (%31.5) hyperactivity and 62 (%31) behavioral disorder were detected.

Conclusion: Pediatric head trauma, as a significant public health problem all over the world, is usually due to preventable causes. A detailed evaluation of ADHD cases as they are evaluated due to trauma can initiate the diagnostic processes and enable follow-up and treatment.

Keywords: Minor head trauma, pediatric trauma, attention deficit and hyperactivity disorder

ÖZ

Amaç: Dikkat eksikliği ve hiperaktivite bozukluğu (DEHB) olan çocuklarda zehirlenme, ekstremite ve dental yaralanmaları gibi çoklu yaralanmaları artar. Çalışmamız, çocuklarda DEHB ile kafa travması arasındaki olası ilişkiyi araştırmayı amaçlamaktadır.

Gereç ve Yöntemler: Çalışmaya hafif kafa travması ile başvuran 200 çocuk (Grup 1) ve 131 sağlıklı çocuk (kontrol grubu) dâhil edildi. Hastaların ilk değerlendirme ve muayene aşamasından sonra, travma mekanizması, çocuk hakkında bilgiler ve birincil şikayetleri içeren tanımlayıcı bir form ile DEHB risk düzeyini belirlemek için Conner Ebeveyn Derecelendirme Ölçeği (CPRS) dolduruldu.

Bulgular: Minör kafa travması ile değerlendirilen 200 pediatrik hastanın 125'i erkek (% 62,5), 75'i kızdı (% 37,5). Ortalama yaş 7 idi ve en yaygın oluşum mekanizması n: 79 (% 39,5) hasta ile aynı seviyeden düşmeydi. Minör kafa travmalı hastalarda yapılan görüntüleme sonucunda 2 (% 1) hastada subdural hematom ve 8 (% 4) hastada lineer fraktür tespit edildi. Conner Ebeveyn Değerlendirme Ölçeği'ne göre DEHB oranları % 15 olarak bulundu. DEHB alt grup analizine göre çalışma popülasyonumuzda 59 (% 28,5) dikkat eksikliği, 21 (% 10,5) antagonizm, 63 (% 31,5) hiperaktivite ve 62 (% 31) davranış bozukluğu saptandı.

Sonuç: Tüm dünyada önemli bir halk sağlığı sorunu olan pediatrik kafa travması genellikle önlenebilir nedenlere bağlıdır. DEHB vakalarının travma nedeniyle olan başvurularında detaylı bir şekilde değerlendirilmesi, tanısal süreçleri başlatabilir, takip ve tedaviye olanak sağlayabilir.

Anahtar Kelimeler: Minör kafa travması, pediatrik travma, dikkat eksikliği ve hiperaktivite bozukluğu

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Introduction

Head trauma is one of the essential socio-economic problems that are common today with forensic and medical aspects. Despite efforts to reduce the incidence, it is still a significant problem in the pediatric population. Approximately 634,000 head traumas are reported each year in the United States, and most of them are children under the age of 15 (1). Head trauma is a frequent referral cause to emergency services in childhood, although clinically serious injuries are rare. On the other hand, delayed or missed diagnoses can lead to a fatal outcome. Routine physical examination at the initial evaluation does not always provide information about the severity of the injury. In the pediatric age group, the assessment may be inaccurate due to lack of communication and inadequacy of cognitive functions. A careful history should be taken from the parents about the mechanism of injury and the psychological condition of the child due to the underlying attention deficit and hyperactivity disorder. The use of criteria as PECARN (pediatric head injury/trauma algorithm) including the presence of an injury mechanism or accompanying symptoms can determine the need for imaging in the pediatric age group. According to the trauma mechanism falls from 0.9 m (3 feet) level is essential for the severe mechanism of injury and evaluated as a limit of fall from high. In this respect, clinically significant injuries can be detected, and also unnecessary exposure to radiation can be avoided (2).

ADHD, characterized by problems in attention, concentration, mobility and impulse control, is the most common psychiatric disorder of childhood. The onset is usually around the age of three, but the diagnosis is made during the school years required for regular attention and the development of concentration (3).

It has been reported that ADHD is seen in 3-10% of childhood (3,4). If it is not diagnosed on time, and appropriate treatment and education services are not arranged, it is observed to turn into a critical problem that causes many dysfunctions in school, at home and other social environments, which makes the life of the individual and family difficult. In many studies, ADHD is associated with poisonings, limb and tooth injuries, and penetration of foreign bodies into the nose and the ear (5-7).Some researchers noted a significant association between the incidence of untreated ADHD and the severity of injuries associated with traffic accidents and head traumas during adolescence (8).

Our study aims to evaluate the possible relationship between ADHD and head trauma by assessing children's ADHD scores concurrently with the trauma mechanism in children with minor head injuries admitted to the emergency department.

Material and Methods

Sampling:

Our study was carried out within one month from August 15th to September 15th. Ethical committee approval was obtained from Yüksek İhtisas Research and Education Hospital Clinical Research Ethics Committee (2011-KAEK- 25 2015/15-10) during the study planning phase. A total of 200 children aged five years and older who were evaluated for minor head trauma were included in the study. Patients with mild or moderate head trauma, children under five years old and patients who have not received a written consent form excluded from the study. The families of the cases involved have signed an informed consent form. A descriptive form included trauma mechanism, child information, and parents filled primary complaints in the monitoring process after the initial assessment and screening of the patients, and also ADHD risk status was evaluated by filling CPRS. Intracranial injury, hospitalization follow-up or operation necessity were prospectively recorded after initial treatment.

Simultaneously, the CPRS was filled in for 131 school children aged >5 years who had no history of head trauma, as a control group for establishing the frequency of ADHD in individuals without head trauma.

Evaluation of ADHD:

Multiple approaches are used in the evaluation of ADHD. Diagnosis is based on standard diagnostic criteria such as a diagnostic and statistical manual of mental disorders fifth edition (DSM-V) (9).In addition to DSM-V, other methods such as interview, observation, and rating scales are often used to help diagnose. When the clinical evaluation is insufficient, rating scales are handy tools to identify individuals who need treatment and education. Rating scales can provide valuable information about the individual from different sources of information, such as parents, teachers, peers, and the individual himself. Conner's rating scales are one of the most recognized and most used tools among them. Conner has developed a set of measurement tools to help clinical diagnoses and to determine the effects of treatment and/or training in children and adolescents primarily in ADHD (10).

CPRS was used in our study. The scale consists of forty-eight questions and has four subscales. The questions are answered on the quartile Likert scale (0: Never, 1: Rarely, 2: Frequently, 3: Always). Eleven items are scanning the behavioral disorder, five items attention deficit, four items the hyperactivity, and five items the antagonism.

When the total scores on the attention deficit subscale are 5, the scores on the hyperactivity subscale are 6, the scores on the antagonism subscale are 7, and the score on the subscale of the behavioral disorder is 18, it means that the child has ADHD or subgroup pathologies (10,11).

Statistical analysis:

Recording of all data for the study was recorded using IBM SPSS for windows 21.0 (Armonk, NY). In continuous variables ± standard deviation calculated as descriptive values and in categorical variables n and % values were given. Kolmogorov-Smirnov test was used to analyze whether the data were in a normal distribution. Student's t-test was used for parametric data, and Mann Whitney U test was used for non-parametric data. Categorical data were compared with the chi-square test. P<0.05 was considered statistically significant.

With an alpha = .05 and power = 0.95, the projected sample size needed with this effect size (G Power 3.1 or other software) is approximately N = 88 for group 1 and N:88 for group 2 for this most straightforward between-group comparison. Thus, our proposed sample size will be more than adequate for the main objective of this study and should also allow for expected attrition and our additional purposes of controlling for possible subgroup analysis.

Results

A total of 200 minor head trauma patients (group 1) and 131 healthy controls (control group) were included in the study. The mean age in group 1 was 7.2 (min: 5-max: 13 standard giant 2.15) and 8.4 (min: 6-max 11 giant: 1.312) in the control group. N: 125 male and n: 75 girls were in group 1 while n: 86 male and n: 45 girls were in the control group. The mechanisms of head trauma are summarized in Table 1. The most common cause was falling from the same level 79 (%39, 5), was followed by collision with hard objects 43 (% 21.5). Injuries occurred in 110 (%55) cases at the playground and the street outside the home, and 79 (%39.5) occurred at home (Table: 2). 28 (%14) children had a previous head trauma history. After the initial evaluation by an emergency physician, 180 (% 90) patient needs further imaging studies. 96 (%48) patients had cranial X-ray, and 74 patients (%18.5) had cranial computed tomography. Ten patients (%5) underwent computed tomography (CT) scanning after initial cranial X-ray, because of the need for detailed examination. According to the mechanisms of trauma, the examination requests are summarized in Table 3.

	Frequency (N)	Percent (%)
Fall from the same level	79	39,5
Toy-induced injury	27	13,5
Fall from high	23	11,5
Collision with a fixed object	43	21,5
Fall from the bike	28	14,0
Total	200	100,0

Table 1: The mechanisms of head trauma

Ten (%5) pathologies were detected, with 2 (%1) subdural haemorrhage and 8 (%4) linear fracture. The distribution of the pathologies determined by imaging methods is summarized in Table 4. After the initial assessment, 10 (%5) patients admitted to hospital, 8 (%4) to neurosurgery clinic and 2 (%1) to pediatric intensive care unit respectively. None of them needs a surgical procedure. The whole cases were followed by an average four hour in emergency department observation room.

	Frequency (N)	Percent (%)
Home	79	39,5
School	8	4,0
Garden	26	13.0
Street	84	42,0
Other	3	1,5
TOTAL	200	100,0

Table 2: Distribution of the places where the trauma has occurred

CPRS scale was calculated across all cases and control group, and subgroup analyzes as attention deficit, antagonism, hyperactivity, and behavioral disorder subgroups calculated. Conner's scale evaluation of patients is summarized in Table 5.

Analysis of sub-parameters according to CPRS showed that 59 (%28.5) attention deficit was detected in 200 patients evaluated with head trauma; antagonism, hyperactivity and behavioral disorder rates were 21 (%10.5), 63 (%31.5) and 62 (%31) respectively. There was a statistically significant difference in hyperactivity and behavioral disorder groups in terms of head trauma (p= 0.026, p=0.006) (Table 5).

Discussion

Pediatric head trauma is a significant public health problem all over the world and usually occur due to preventable causes. Therefore, the education of families and child care providers can prevent such accidents as indoor and outdoor. Thus the frequency of trauma reduce.

Brain CT in head trauma is the "gold standard" imaging method (12,13).Indications for withdrawal of CT in patients presenting with emergency trauma are controversial[14]. Haydell et al. reported that %8 of 175 patients with mild head trauma had had an intracranial injury or depressed skull fracture detected in CT (15). In our study, 106 (%53) of the patients were required for CT, whereas only 10 (%5) of them have pathologies on imaging modalities. These rates show that the rate of requesting CT from patients who present with head trauma is quite high in our emergency service.

Overuse of imaging methods may be in question in children who are evaluated for head trauma due to the intense

patient admissions of emergency services. The lack of team and material to meet this intensity, the follow-up times of

		Imaging studies				
Trauma mechanism		**X-ray**	**Cranial CT**	**None**	**X-ray+CT**	**Total**
Fall from the same level	*Frequency(n)*	44	27	7	1	79
	Percentage (%)	45,80%	36,50%	35,00%	10,00%	39,50%
Toy-induced injury	*Frequency (n)*	11	8	6	2	27
	Percentage (%)	11,50%	10,80%	30,00%	20,00%	13,50%
Fall from high	*Frequency (n)*	3	17	1	2	23
	Percentage (%)	3,10%	23,00%	5,00%	20,00%	11,50%
Collision with a fixed object	*Frequency (n)*	24	11	5	3	43
	Percentage (%)	25,00%	14,90%	25,00%	30,00%	21,50%
Fall from bike	*Frequency (n)*	14	11	1	2	28
	Percentage (%)	14,60%	14,90%	5,00%	20,00%	14,00%
Total	*Frequency (n)*	96	74	20	10	200
	Percentage (%)	100,00%	100,00%	100,00%	100,00%	100,00%

CT: Computed tomography

Table 3. Trauma mechanisms and imaging studies

the patients are being shortened. And this increases the demand for unnecessary head CT. The limited time allocated to patients, the anxiety of encountering medicolegal events related to the patient, the desire to reduce the suspicion of skipping diagnoses or being late may lead the physician to use imaging methods. In our study, few pathologies were determined compared to the number of views required. In conclusion, it is useful for physicians to observe the indications of head CT again.

In many studies, there has been an increased risk in the frequency of multiple injuries, including head trauma in ADHD. In the Komurcu et all reported that extremity fractures were found in the ADHD group, and diagnostic measurements were made using the Wender Utah Rating Scale (WURS) and the Adult Self-Report Scale (ASRS) (6). In another study, Avsar et al. examined the relationship between ADHD and dental injuries (16). Discala and colleagues have identified an increased risk of head trauma and different body parts. In particular, ADHD has increased risk for the presence of hyperactivity, inattention, and behavioral impairment (17,18). In our study, hyperactivity and behavioral disorder rates were found high, especially in head trauma group. In our study, hyperactivity and behavioral disorder rates were found high, especially in head trauma group.

		Pathology			
Imaging Modality		**Linear fracture**	**Subdural hematoma**	**None**	**Total**
X-ray	*Frequency(n)*	2	0	94	96
	Percentage (%)	25,00%	0,00%	49,50%	48,00%
Cranial CT	*Frequency (n)*	6	2	66	74
	Percentage (%)	75,00%	100,00%	34,70%	37,00%
None	*Frequency (n)*	0	0	20	20
	Percentage (%)	0,00%	0,00%	10,50%	10,00%
X-ray+ CT	*Frequency (n)*	0	0	10	10
	Percentage (%)	0,00%	0,00%	5,30%	5,00%
Total	*Frequency (n)*	8	2	190	200
	Percentage (%)	100,00%	100,00%	100,00%	100,00%

CT: Computed tomography

Table 4: The imaging and detecting pathologies

Score received		Head trauma		Total (N)	X^2 and p value
		Have(N)	*No(N)*		
Attention deficit	0-4	141	95	236	X^2 :0.158
	5-15	59	36	95	p=0.691
Antagosim	0-6	179	121	300	X^2 :0.766
	7-15	21	10	31	p=0.381
Hyperactivity	0-6	137	74	211	X^2 :4.491
	7-12	63	58	120	**p= 0.026**
Behavioral	0-7	138	108	246	X^2 :7.495
Disorder	8-33	62	23	85	**p= 0.006**
Total		200	131	331	

Table 5: Conner's rating scale subgroup analyzes

In our study, the 48 items Likert type CPRS was used in the evaluation of ADHD. Dereboy et al. examine the validity of the Conners Short Form Teacher and Parent Rating Scales and found that the construct validity of the scales and the factor analysis of the children with healthy development for CPRS-48 data, the scales support the validity of the structure (19).

The paediatrician or emergency physician often assesses ADHD associated with high-risk behaviours for different reasons before child psychiatrists. With careful evaluation, it can provide proper follow-up and appropriate orientation for the patient. According to Culpepper, the primary care physician should be aware of ADHD and should be able to guide the patient while solving the referral problem[20]. Faber et al. studied the frequency of ADHD in children and adolescents under 16 years of age, and initial diagnosis and treatment unit found that diagnosis by the paediatrician was 32% and the rate of determination by the primary care physician was 61%, with 51% of the patients being followed by the child psychiatrists (21).

The American Academy of Pediatrics and the American Academy of Emergency Specialists have emphasized that early detection of ADHD in emergency services has a significant impact on this group with a high risk of trauma (22). When a pediatric patient is admitted with head trauma, initial assessment and imaging are followed by observation and monitoring during the observation period in emergency service. During this period taking a more detailed history from the child and parents may indicate an underlying psychological problem in the current injury, as well as the appropriate orientation, may prevent future injuries.

In many studies, the relationship between ADHD and increased use of health facilities and multiple hospital applications has shown as most of them can be solved in the first step health unit instead of emergency services (23,24). Early diagnosis of ADHD in children can help to eliminate additional problems that may arise during adulthood, and can help to recognize comorbid conditions such as bipolar disorder and major depression (25).

Limitations

This study has potential limitations. First, the low number of patients and the fact that the study was performed in a single department. Second, all patient information was obtained from their parents since the patients were in childhood, and parents may have acted incorrectly while filling out the form. However, we think that these limitations can be overcome since there may be a relationship between minor head trauma and ADHD. We believe that this issue can be better elucidated by other multicenter studies to be conducted with a higher number of patients

Conclusion

Pediatric trauma is an essential reason for referral to emergency services. ADHD is one of the most common psychiatric disorders of childhood. Many studies show that children with ADHD have a higher risk of trauma than the healthy population. Detailed evaluation during admission to emergency services due to trauma can initiate the diagnostic processes of these cases and enable follow-up and treatment. We think that evaluating pediatric trauma patients among this aspect and informing parents can prevent both future injuries and prevent recurrent emergency department visits.

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Authors' Contribution: Conceptualization, Data curation, Project administration, Resources, Supervision, Roles/Writing - original draft, Writing - review & editing (SE, SA, YN, IT) Formal analysis, Methodology, Validation, Visualization (MY,HK,EA) Funding acquisition, Investigation, Methodology, Project administration, Software (SE, SA, YN, EA)

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All authors declared that they follow the rules of Research and Publication Ethics.

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