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Comparison of Emergency Medicine Physician's Decision and Pecarn Scale Suggestions On Pediatric Head Trauma Patients

Pediatrik Kafa Travmalı Hastalarda Acil Tıp Hekimlerinin Kararları İle Pecarn Skalasının Önerilerinin Karşılaştırılması

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ABSTRACT

Objectives: To determine head CT scan necessity in pediatric head trauma patients and to compare decisions of Emergency medicine physicians (EMP) and Pediatric Emergency Care Applied Research Network (PECARN) scale suggestions on head CT scan necessity.
Materials and Methods: Our study was conducted retrospectively in our third stage hospital between January 2014 and December 2014. Patients under the age of 13 with head injury because of fall were included. Registry of all patients was analyzed and PECARN scale was applied to each patient's data retrospectively. Suggestions of PECARN scale were noted. Head CT scans were reported by radiologist. EMP's decision and PECARN scale suggestions were compared. Patients whom should had CT scan by PECARN scale suggestions but had no imaging were contacted and questioned about any other reasons to seek medical care.
Results: PECARN suggestion and EMP's decisions of CT necessity compared. Concordance analysis of two results are determined as 76.6% (Kappa coefficient: 0.766). EMP's decisions had 88.76% sensitivity, 91.09% specificity, 78.22% positive predictive value, 95.74% negative predictive value and 90.48% accuracy.
Conclusions: In assessment of children with minor head injury EMP decision and PECARN scale were found coherent and sufficient. Instead of early decision of CT scan, observation of patient can reduce radiation exposure, but cost effectivity of this approach should be evaluated by further studies.

Key Words: Pediatric head trauma; PECARN; Emergency Medicine

ÖZET

Giriş: Pediyatrik kafa travma hastalarında Beyin Bilgisayarlı Tomografi (BT) tarama gerekliliğini belirlemek ve Acil Tıp Hekimleri (ATU) ile PECARN skalasının Beyin BT gereksinimi hakkındaki önerilerini karşılaştırmak.
Gereçler ve Yöntem: Çalışmamız retrospektif olarak üçüncü seviye hastanemizde, Ocak 2014-Aralık 2014 tarihleri arasında gerçekleştirildi. Düşme nedeniyle 13 yaşın altında kafa travması geçiren hastalar çalışmaya alındı. Tüm hastaların kayıtları analiz edildi ve her hastanın verilerine retrospektif olarak PECARN ölçeği uygulandı. PECARN ölçeği önerileri not edildi. Beyin BT taramaları radyolog tarafından değerlendirildi. ATU'nun kararı ve PECARN skalasının önerileri karşılaştırıldı. PECARN skalası önerileri ile BT taraması yapılması gereken ancak görüntüleme yapılmamış hastalar ile temasa geçilmiş ve herhangi bir nedenle sağlık kuruluşuna başvuruları olup olmadığı sorgulandı.
Bulgular: PECARN önerisi ve ATU'nın BT gerekliliği kararları karşılaştırıldı; İki sonucun uyum analizi % 76.6 olarak belirlenmiştir (Kappa katsayısı: 0.766). ATU'nın kararları% 88,76 duyarlılık,% 91,09 özgüllük,% 78,22 pozitif tahmin değeri,% 95,74 negatif tahmin değeri ve% 90,48 doğruluk düzeyindeydi.
Tartışma: Hafif kafa travması geçiren çocukların değerlendirilmesinde ATU kararı ve PECARN ölçeği uyumlu ve yeterli bulunmuştur. Erken BT taramasının kararı yerine, hastanın gözlemlenmesi radyasyon maruziyetini azaltabilir, ancak bu yaklaşımın maliyet etkinliği daha ileri çalışmalarla değerlendirilmelidir.

Anahtar Kelimeler: Pediatrik Kafa Travma, PECARN, Acil Tıp Uzmanı

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Introduction

Fall injuries are the most common cause of trauma and important healthcare issue in pediatric age. According to World Health Organization (WHO); annually, 830.000 children had traumatic injuries and 2300 children died because of falls (1). Most common location of injury is head, thus evaluation of head trauma injuries in pediatric patients in emergency department is become important. In patients with head trauma, imaging studies are frequently used in addition to physical examination and Computerized Tomography (CT) scan is the gold standard method for evaluating head injuries (2).

Head CT is frequently used in pediatric patients due to reasons like; lack of history, challenges in physical examination and concern of malpractice. Emergency medicine physicians (EMP) decide with their training and clinical experience for the necessity of radiological imaging for head injuries. Various scales are made to make easy to decide for EMPs and to increase accurate percentage of diagnosis. Other advantages of using these scales are reducing the costs and the radiation exposure of patient by decreasing the number of radiological imaging. Different scales are available to decide head CT scan necessity in pediatric patients. *Pediatric Emergency Care Applied Research Network* (PECARN) scale can be used to decide head CT scan necessity in low risk group of pediatric patients with head injury (3). It recommends head CT scan according to history and physical examination findings.

In our study, head CT scan necessity was compared between EMP's decision with PECARN scale in pediatric patients with head injury.

Material and Method

Our study was conducted retrospectively in our third stage Hospital between January 2014 and December 2014. The study was approved by the Local Ethics Committee (89513307/1009/387). All patients under the age of 13 with head injury because of fall were included.

Registries of all patients were analyzed and PECARN scale was applied to each patient's data retrospectively. Suggestions of PECARN scale were noted. Each registry was checked for performed Head CT scans by the decision of EMP. In our hospital head CT scans were evaluated and reported by radiologist, routinely. EMP's decision and PECARN scale suggestions were compared (Figure 1). Patients whom should had CT scan by PECARN scale suggestion but had no imaging were contacted and questioned whether they have received additional medical care regarding their condition.

Patients with inadequate data, age older than 13, history of falling from a moving vehicle, Glasgow Coma Scale (GCS) 13 and under, diseases which cause altered mental status and in use of anti-coagulant drugs were excluded.

Statistics: Statistical analyses of PECARN scale of patients, PECARN suggestions and EMP's decisions, CT scan reports are assessed with Number Cruncher Statistical System (NCSS) 2007 (Kaysville, Utah, USA) software. While assessing the study data; correlation between PE-CARN suggestions and EMP's decisions were analyzed with McNemar test. And Kappa statistic was used to determine reliability and classification function (Sensitivity and Specificity) as well as desciptive statistics as; Mean, Standard Deviation, Median, Frequency, Percentages, Minimum, Maximum.

Results

A total of 336 patients included in these study whom 40.5% of are female. Parents were the most common eyewitness of the falls. Vast majority of the emergency department (ED) applications were in 1 hour after the incidents which 68.8% of them happened at home. Various classifications of these patients are shown in Table 1. Most of the injuries (75.6%) were cause of head trauma and body location of injuries is shown in Table 1.

There were 164 patients who were under 2 years old and 172 who were 2 years old and more. Cranial CT scans according to PECARN scale and decision per age groups and distribution of patients accordingly are shown in Table 2.

Only 9 patients had cranial pathology but none of them had any surgical procedures or neurological damage related to head trauma. Treatment and progress of patients with pathological findings in head CT scans are shown in Table 3.

PECARN scale suggestions and EMP's decisions of head CT scans compared in Table 4.

PECARN suggestion and EMP's decisions of CT necessity compared; two applications showed compatibility. Concordance analysis of two results are determined as 76.6% (Kappa coefficient: 0.766).

Discussion

In this study, consistency of EMP's decision and PECARN scale suggestions on CT scan in patients with minor head injury was assessed. Gold standard

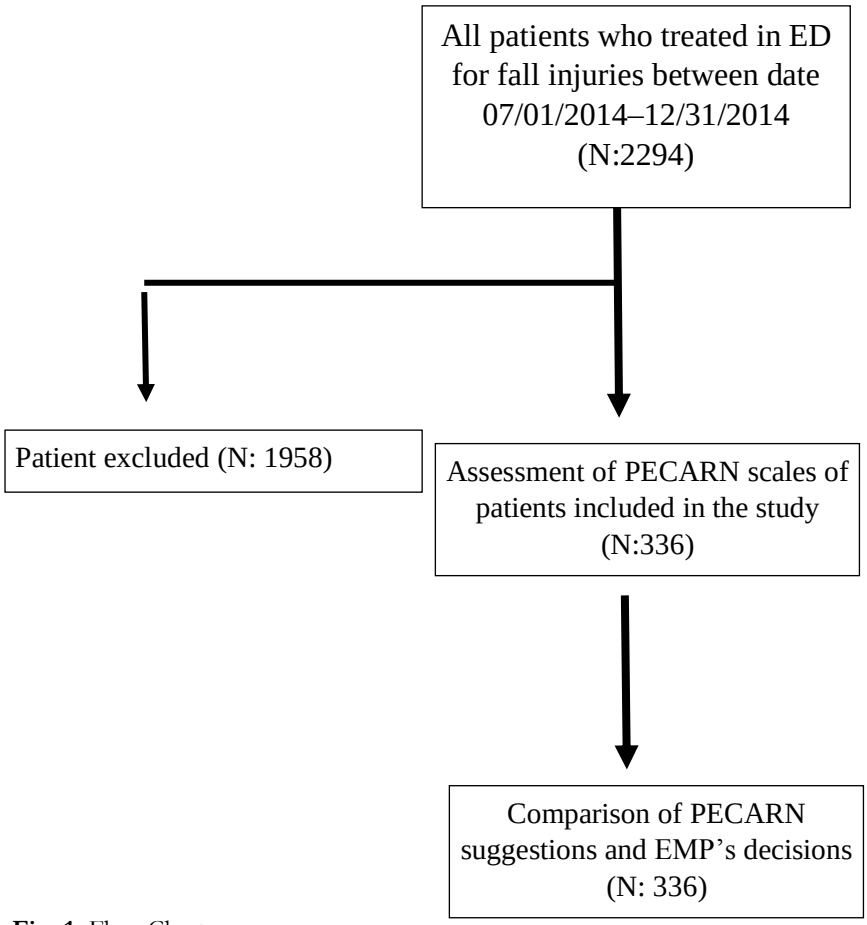

Fig. 1. Flow Chart
ED: Emergency Department. PECARN: Pediatric Emergency Care Applied Research Network. EMP: Emergency Medicine Physician

imaging technique for head trauma is still CT scan [4]. Thus, scales like PECARN were built up to reduce unnecessary radiological imaging for protecting children from radiation[3]. In this study, ıt was detected that while making decisions in pediatric patients with head trauma; EMP's decisions were coherent with PECARN scale suggestion.

PECARN is a scale recommended by the reference books to be used to make a decision in pediatric head injuries. [5]. It is easier to use in comparison to similar scales because it is based on history and physical examination and does not require any additional laboratory test or studies. In some situations; scales can be insufficient, and physicians may decide independently without any scale. As in our study EMP decisions and PECARN scale suggestions are concordant (Kappa coefficient: 0.766). First step of PECARN scale is based upon examination and second step is based upon history. In our study, it was detected that doctors decided to perform CT scan based on neurological findings on physical examination, but they disregarded the trauma history of patients with head trauma. Thus, they did not perform CT scan 10 patients who marked positive at second step of PECARN scale. These patients were called for the study and they informed that any of them had any neurological symptoms due to head trauma. EMP decided to perform CT scans in 22 patients who had negative PECARN scale results. When these scans were examined, there are not any pathological findings except only one patient had a scalp hematoma. The reasons behind the decisions of these imaging studies are unknown. Intracranial pathologies were identified in 10% of scans which were positive for PECARN scale and in 8% of scans which decided by EMP. None of the patients were operated or had any neurological sequela. Approximately one-third of the patients (either chosen by PECARN suggestion or EMP decision) scanned and exposed to the radiation.

Mean age in CHALICE (Children's Head injury Algorithm for the prediction of Important Clinical Events), CATCH (Canadian Assessment of Tomography for Childhood Head İnjury) and PECARN studies are 10, 5.7 and 7.1 respectively. Upper age limit is 16 in CATCH and CHALICE and

Table 1. Classification of Patients

		Total (n=336)	< 2 age (n=164; %48.8)	≥ 2 age (n=172; %51.2)
Age (year)	Min-Max (Median)	0,08-13,5	0,08-1,9	2-13,5
	Mean ± SD	3,17±3,21	0,80±0,44	5,43±3,06
Gender	Female	136 (40,5)	79 (48,2)	57 (33,1)
	Male	200 (59,5)	85 (51,8)	115 (66,9)
Eyewitness of fall	Parent	275 (81,8)	143 (87,2)	132 (76,7)
	Grandparents, aunt etc.	20 (6,0)	13 (7,9)	7 (4,1)
	Nanny	3 (0,9)	2 (1,2)	1 (0,6)
	Other	38 (11,3)	6 (3,7)	32 (18,6)
Parent's education (n=275)	Illiterate	6 (2,2)	1 (0,7)	5 (3,8)
	Elementary/Junior high	127 (46,2)	59 (41,3)	68 (51,5)
	High School	98 (35,6)	55 (38,5)	43 (32,6)
	College graduate/Postgraduate	44 (16,0)	28 (19,6)	16 (12,1)
Time period	00:00 - 08:00	42 (12,5)	31 (18,9)	11 (6,4)
	08:00 - 16:00	135 (40,2)	63 (38,4)	72 (41,9)
	16:00 - 24:00	159 (47,3)	70 (42,7)	89 (51,7)
ED application time after incident	Just now	169 (50,3)	80 (48,8)	89 (51,7)
	1 hour before	88 (26,2)	43 (26,2)	45 (26,2)
	1-2 hours	27 (8,0)	18 (11,0)	9 (5,2)
	> 2 hours	52 (15,5)	23 (14,0)	29 (16,9)
Scene	Home	231 (68,8)	139 (84,8)	92 (53,5)
	School/ Day-care	11 (3,3)	1 (0,6)	10 (5,8)
	Playground	44 (13,1)	8 (4,9)	36 (20,9)
	Other	50 (14,9)	16 (9,8)	34 (19,8)
Fall type	While walking	60 (17,9)	16 (9,8)	44 (25,6)
	Height	244 (72,6)	135 (82,3)	109 (63,4)
	Stairs	32 (9,5)	13 (7,9)	19 (11)
Fall from height	0-50 cm	139 (57,0)	97 (71,9)	42 (38,5)

(n=244)	50-200 cm	79 (32,4)	35 (25,9)	44 (40,4)
	>200 cm	26 (10,7)	3 (2,2)	23 (21,1)
Fall from stairs (n=32)	1-5 stairs	13 (40,6)	5 (38,5)	8 (42,1)
	5-10 stairs	11 (34,4)	3 (23,1)	8 (42,1)
	> 10 stairs	8 (25,0)	5 (38,5)	3 (15,8)
Location (n=221)	Head	167 (75,6)	76 (93,8)	91 (65)
	Head and extremity	19 (8,6)	3 (3,7)	16 (11,4)
	Torso	16 (7,2)	0 (0)	16 (11,4)
	Extremity	11 (5)	2 (2,5)	9 (6,4)
	Head and torso	5 (2,3)	0 (0)	5 (3,6)
	Torso and extremity	3 (1,4)	0 (0)	3 (2,1)

Table 2. PECARN scale decision per age groups

< 2 age (n=164)			≥ 2 age (n=172)		
	YES	NO		YES	NO
1. Step GKS<14 Palpable skull fracture or agitation, somnolence, slow response	8 (4,9%)	156 (95,1%)	1. Step GKS<14 Signs of basilar skull fracture, agitation, somnolence, slow response	8 (4,7%)	164 (95,3%)
2. Step Scalp hematoma (excluding frontal), loss of consciousness >5 seconds, not acting normally per parent, fall >1 meter	26 (15,9%)	138 (84,1%)	2. Step Fall >1.5 meters, projectile vomiting, severe headache, loss of consciousness	56 (32,6%)	116 (67,4%)

18 in PECARN studies [3, 6, 7]. In our study, mean age was 3.17 ± 3.21 and our upper limit was 14. Difference between mean age values could be related with these limits. In addition, excessive number of patients who were 6-9 months old could be effective in low mean age values. Reason of most ED visits were fall of 6-9 months old patients and this could be a sign of lack of parental care.

Falls from heights are the most common type of falls with 72.6% occurrence in our study, consisted with the literature. Dolunay et al. stated in their study that falls from heights are the foremost (73%) reason of falls [8]. In our study; falls from moving vehicle excluded because hardships in calculating the velocity could be confusing. Fall heights were based upon patient's history. Twenty-six children were determined as fallen from 1.5 meters and above. Maximum height was determined as 10 meters in one case. To be the leading type of falls, fall from heights could be another sign of lack of parental care. Head-body proportion is in favor of head. Children's head-body proportion is 1/3 at birth, 1/4 at the age of 2 and 1/8 in an adult [9]. And this proportion is the biggest factor in head injuries due to falls.

In a shorter time than found in the literature most of the children (76.9%) were examined by EMP in the first hour after the fall. In a study by Güzel et al. 44.1% of children were examined in first hour. [10]. In CATCH study mean examination time after the fall is 4.3 hours [7]. Easy access of ED and evaluation of pediatric falls as triage category 1 are the main reasons of fast examination. At the same time, the reaction of

Table 3. Progress of patients with identified head CT pathology

	Mechanism of injury	Pathology	Treatment / Result	Neurological sequela
P1	Fall >250 cm	Frontal skull fracture	Discharge after 24 hours of observation	None
P2	Fall >200 cm	Frontal epidural hematoma	Discharge after 24 hours of observation	None
P3	Fall while walking	Frontal skull fracture	Discharge after 24 hours of observation	None
P4	Fall while walking	Frontal epidural hematoma	Admission / Follow up	None
P5	Fall >70 cm	Occipital skull fracture	Discharge after 24 hours of observation	None
P6	Fall >300 cm	Occipital skull fracture	Discharge after 24 hours of observation	None
P7	Fall >500 cm	Temporal skull fracture	Discharge after 24 hours of observation	None
P8	Fall 50 cm	Depressed cranial vertex fracture	Admission / Follow up	None
P9	Fall >200 cm	Frontoparietal Epidural hematoma	Admission / Follow up	None

Table 4. Comparison *PECARN* CT suggestions and EMP's CT decisions

		PECARN CT Suggestion		
		CT (-)	CT (+)	Total
		n (%)	n (%)	n (%)
EMP's CT decision	CT (-)	225 (67,0)	10 (3,0)	235 (69,9)
	CT (+)	22 (6,5)	79 (23,5)	101 (30,1)
	Total	247 (73,5)	89 (26,5)	336 (100)
Sensitivity		88,76		
Specificity		91,09		
Positive Predictive Value		78,22		
Negative Predictive Value		95,74		
Accuracy		90,48		

our society on the fall of their children can also have a role. Because of retrospective nature of the study; many cases were excluded from study due to insufficient data. The strongest part of the study is our hypothesis and patient selection criteria. This study is one of the few studies in knowing literature about comparing EMP decisions without PECARN scale and result of PECARN scale for planning

cranial CT at head traumas. Fall from heights were determined by patient's history given by parents; so, fall heights could be exaggerated by parents and this could lead increasing in PECARN scale scoring.

In assessment of children with minor head injury, EMP decision and PECARN scale were found consistent and sufficient. In patients with minor pediatric head injuries, majority of performed CT scans according to either PECARN scale suggestions or EMP decisions showed no intracranial pathology. There is a need for more specific methods to provide more accurate assessment. Instead of early decision of CT scan, observation of patient can reduce radiation exposure, but cost effectivity of this approach should be evaluated by further studies.

Conflict of Interest: None

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