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REPEATED CRANIAL COMPUTED TOMOGRAPHY FINDINGS IN CHILDREN WITH HEAD TRAUMA

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Abstract

Introduction: The previous studies reported that in case of normal or improving neurologic findings there is no need to repeated CT. We investigated the value of repeated tomography for head trauma in children.

Materials: We retrospectively investigated the files and computer records of the children who admitted to our emergency department between February 2009 to January 2015 in the Emergency Department of Ankara Diskapi Education and Research Hospital. We included 561 patients under the age of 18 who was admitted to ER with head trauma and also repeated CT examination was performed in the first four hours.

Results: The mean age of the patients was 6.6 ± 4.9 years, male frequency was 66.5%. In both of the genders the most of the patients was between the age of 1-5. The mortality rate under the age of 5 was 5.5% (n=16) besides, mortality rate was 7.8% (n=21) between the ages of 6-15. The most frequently detected pathology in cranial CT was skull fracture (79.3%); following with subarachnoid hemorrhage (28.7%). In 9.4% of the patients we detected new pathology by the repeated tomography. The mortality was higher and also new pathology was more frequent if the initial GCS score of the patient was under 14.

Conclusion: In case of worsening mental or clinical state or initial GCS is under 14, repeated cranial CT is necessary.

Keywords: head trauma, children, repeated computed tomography.

Резюме

ПОВТОРНЫЕ РЕЗУЛЬТАТЫ ЧЕРЕПНОЙ КОМПЬЮТЕРНОЙ ТОМОГРАФИИ У ДЕТЕЙ С ТРАВМОЙ ГОЛОВЫ

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Введение: в предыдущих исследованиях сообщалось, что в случае нормальных или улучшающихся неврологических показателей нет необходимости в повторной компьютерной томографии. Мы исследовали значение повторной томографии при травмах головы у детей.

Материалы: Мы ретроспективно исследовали файлы и компьютерные записи по детям, поступившим в наше отделение неотложной помощи с февраля 2009 года по январь 2015 года в отделении неотложной помощи Образовательной и исследовательской больницы Анкары Diskapi. Мы включили 561 пациента в возрасте до 18 лет, поступивших в отделение неотложной помощи с травмой головы, а также повторное КТ-исследование было выполнено в первые четыре часа.

Результаты. Средний возраст пациентов составил $6,6 \pm 4,9$ года, частота встречаемости у мужчин - 66,5%. Большинство пациентов обоих полов было в возрасте от 1 до 5 лет. Смертность в возрасте до 5 лет составила 5,5% (n = 16), а в возрасте от 6 до 15 лет - 7,8% (n = 21). Наиболее частой патологией при КТ черепа был перелом черепа (79,3%); после субарахноидального кровоизлияния (28,7%). У 9,4% пациентов при повторной томографии выявлена новая патология. Смертность была выше, а также чаще возникала новая патология, если исходная оценка пациента по шкале GCS была ниже 14.

Заключение: в случае ухудшения психического или клинического состояния или начального уровня GCS до 14 лет необходима повторная краниальная КТ.

Ключевые слова: травма головы, дети, повторная компьютерная томография.

Түйіндеме

БАЛАЛАРДАҒЫ БАС ЖАРАҚАТЫМЕН БАСТЫҢ ҚАЙТАЛАМА КОМПЬЮТЕРЛІК ТОМОГРАФИЯСЫНЫҢ НӘТИЖЕЛЕРІ

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Кіріспе: алдыңғы зерттеулерде қалыпты немесе жақсарған неврологиялық көрсеткіштер жағдайында қайта компьютерлік томографияның қажеті жоқ екендігі айтылды. Біз балалардағы бас жарақаттарына қайталама томографияның маңыздылығын зерттедік.

Материалдар: Біз 2009 жылдың ақпанынан 2015 жылдың қаңтарына дейін Анкара Diskapi білім беру және зерттеу ауруханасының жедел жәрдем бөлімінде біздің жедел жәрдем бөліміне түскен балалардың файлдары мен компьютерлік жазбаларын ретроспективті түрде зерттедік. Біз 18 жасқа дейінгі 561 пациентті бас жарақатымен жедел жәрдем бөліміне қабылдадық, сондай-ақ алғашқы төрт сағат ішінде КТ-ны қайта тексеру жүргізілді.

Нәтижелер. Пациенттердің орташа жасы $6,6 \pm 4,9$ жасты құрады, ерлерде кездесу жиілігі - 66,5%. Екі жыныстағы пациенттердің көпшілігі 1 жастан 5 жасқа дейін болды. 5 жасқа дейінгі өлім - жітім 5,5% ($n = 16$), ал 6 жастан 15 жасқа дейін-7,8% ($n = 21$) құрады. Бас сүйегінің КТ-да жиі кездесетін патология бас сүйегінің сынуы болды (79,3%); субарахноидты қан кетуден кейін (28,7%). Қайта томография кезінде пациенттердің 9,4% - ында жаңа патология анықталды. Егер пациенттің GCS шкаласы бойынша бастапқы бағасы 14-тен төмен болса, өлім деңгейі жоғары болды, сонымен қатар жаңа патология жиі пайда болады.

Қорытынды: психикалық немесе клиникалық жағдайдың нашарлауы немесе 14 жасқа дейінгі GCS бастапқы деңгейі жағдайында қайталама краниалды КТ қажет.

Негізгі сөздер: бас жарақаты, балалар, қайталама компьютерлік томография.

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Introduction

Head trauma of the children is a frequent cause of emergency service admissions. Children tolerate the increase in intracranial pressure better due to incomplete closing of the cranial sutures so intracranial bleeding and space-occupying lesions can reach to big masses without giving any neurological finding [21].

The computed tomography (CT) frequently used for diagnoses of cranial pathologies and also it is the gold standart method in radiologic examination of head injury [16]. CT has advantages on any other methods because it is a non-invasive method, gives results immediately, shows acute traumatic lesions and shows intracranial shifts, mass-effect, hydrocephalia, fractures, sinuses, soft tissues, intracranial foreign substances and pneumocephalia.

Radiation affects especially the rapidly proliferating cells. So children in childhood and adolescence in which the cell proliferation is fast have to be protected against radiation. The CT has 1.72 risk of leukemia for children under the age of 15, also it increases the central nervous

system tumors with 1.35 fold [17, 10]. This risk increases with the other sources of radiation lifelong [1]. The head of the children are exposed to radiation lesser than the other parts of the body but still it is affected significantly [22].

The previous studies reported that in case of normal or improving neurologic findings there is no need to repeated CT [18]. Besides, late stage intracranial bleeding could be seen with a frequency of 2.5% in case of using medication that increases bleeding like clopidogrel and warfarin [19].

In this study, we reported the frequency of intracranial pathologies due to head trauma in children and also we investigated the value of repeated tomography for head trauma in children.

Material and Methods

This study is performed in the Emergency Department (ER) of Ankara Diskapi Training and Research Hospital. We retrospectively investigated the files and computer records of the children who admitted to our emergency department between February 2009 to January 2015.

We included 561 patients under the age of 18 who was admitted to ER with head trauma and also repeated CT examination was performed in the first four hours. The age, gender, hospitalization and intensive care unit durations, the initial glasgow coma scale (GCS), the first and the second CT findings are recorded.

The statistical analyses is performed by SPSS 17.0 for Windows package program. The continuous variables are expressed as mean±sd for normally distributed data and median (min-max) for data that are not normally distributed; categorical variables expressed as n (%). The normal distribution is determined by Kolmogorov Smirnov test. The differences of continuous variables between groups were comparison by the Mann Whitney U-test and Kruskal Wallis Test for variables that are not normally distributed; Student's T-test is used for normally distributed data; Pearson Chi-Square and Fisher's exact test test is used for

categorical variables. $p \leq 0.05$ was regarded as significant with 95% confidence interval.

Results

The mean age of the patients was 6.6 ± 4.9 years, median age was 5 years (range 0-17). The male frequency was 66.5% (n=373). In both of the genders the most of the patients was between the age of 1-5. The mortality rate equal and under the age of 5 was 5.5% (n=16) besides, mortality rate was 7.8% (n=21) between the ages of 6-15. The mortality rate was similar in both of the genders ($p=0.267$).

The most frequently detected pathology in cranial CT was skull fracture (79.3%, n=445); following with subarachnoid hemorrhage (28.7%, n=161). The skull fracture was more frequently detected in females than males but other pathologies were similarly detected in both of genders (Table 1).

Table 1.

The frequency of the pathologies detected by cranial CT according to gender.

	Female n (%)	Male n (%)	p
Skull fracture	140 (74.5%)	305 (81.8%)	0.044
Cerebral contusion	21 (11.2%)	35 (9.4%)	0.505
Intraparenchymal bleeding	-	2 (0.5%)	0.554
Subarachnoid bleeding	57 (30.3%)	104 (27.9%)	0.547
Epidural bleeding	23 (12.2%)	46 (12.3%)	0.973
Subdural bleeding	62 (33%)	119 (31.9%)	0.797

There was at least one of the intracranial pathologies in 96.4% (n=541) of the patients in the first cranial CT, but by the repeated CT, there was at least one pathology in all of the patients. It means we detected new pathology in 3.6% (n=20) of the patients by the second tomography;

additionally in 6.1% (n=33) of the patients who has any pathology in the first CT. Totally, in 9.4% (n=53) of the patients we detected new pathology by the repeated tomography. The most frequently detected new pathology by the second CT was subdural hematoma (Table 2).

Table 2.

Frequency of the cranial pathologies detected by the initial and repeated CT with the new findings.

	Initial CT n (%)	Repeated CT n (%)	New Finding n (%)
Skull fracture	445 (79.3%)	445 (79.3%)	-
Cerebral contusion	56 (9.9%)	56 (9.9%)	-
Intraparenchymal bleeding	2 (0.3%)	2 (0.3%)	-
Subarachnoid bleeding	143 (25.5%)	161 (28.7%)	18 (4.3%)*
Epidural bleeding	57 (10.2%)	69 (12.3%)	12 (2.4%)*
Subdural bleeding	155 (27.6%)	181 (32.3%)	26 (6.4%)*

* The pathology was not present in the first CT but detected by the repeated CT

When we evaluate the new findings with GCS, we detected new pathology by the repeated CT in 6,8% (n=21) of the patients whose GCS were 14 or 15; but we detected new pathology with a frequency of 12,7% (n=32) in patients with GCS under 14. We detected new pathology more frequently if the initial GCS score of the patient was under 14 ($p=0.017$).

The relationship of mortality with new findings calculated. We did not detected mortality if the repeated CT revealed new contusion or epidural hematoma but two patients (10,5%) with new subarachnoid bleeding were resulted with mortality. The mortality in newly detected

subdural hematoma was 3,8% (n=1). Only one of the patients who has no pathology in the first cranial CT but we detected new pathology by the second cranial CT, died. But the GCS of this patient was under 14. If the initial GCS was 14 or 15, there was no mortality even we detect new pathology.

The total mortality rate was 6,6% (n=37). The mortality rate was 1,3% (n=4) in patients whose GCS score was 14 or 15; the mortality was 13,1% (n=33) if the initial GCS was under 14. The mortality was significantly higher in subarachnoid and subdural bleeding (Table 3).

Table 3.

The frequency of hospitalization, intensive care unit admission and mortality according to the pathologic finding.

	Hospitalization n (%)	Intensive Care Unit n (%)	Mortality n (%)	p (pathology & mortality)
Skull fracture	383 (86.1%)	62 (13.9%)	29 (6.5%)	0.883
Cerebral contusion	43 (76.8%)	13 (23.2%)	5 (8.9%)	0.305
Intraparenchymal bleeding	2 (100%)	-	-	0.872
Subarachnoid bleeding	116 (72.0%)	45 (28.0%)	28 (17.4%)	<0.001
Epidural bleeding	63 (91.3%)	6 (8.7%)	3 (4.3%)	0.308
Subdural bleeding	147 (81.2%)	34 (18.8%)	18 (9.9%)	0.027

Discussion

Head trauma is frequently occurs under the age of five in children [4]. The prognosis is worse under the age of five than between the ages of 5 to 15 [14,5]. Our study results were similar with previous studies which revealed the most frequent admission was under the age of five and also the mortality was higher in under five years of age. Male gender was dominant in our study with a frequency of 66.5% which is similar with the previous studies [5,9, 15].

According to GCS, mortality is close to zero in minor head trauma, in moderate head trauma it is 7-10% and in severe trauma it is around 30% [21]. In our study mortality rate was 6,6%; in patients whose GCS are 14 or 15, mortality rate was 1.3% but the mortality rate in GCS under 14 is 13.1%.

The intracranial pathologic findings differ according to studies and population, some of the studies report epidural bleeding is the most frequent bleeding type but some others report as subdural bleeding [6, 7, 11, 3]; besides the most frequent cranial CT finding is always skull fracture as we reported in our study. Our study revealed the most frequent bleeding type was subdural hematoma followed by subarachnoid bleeding.

According to Children’s Head Injury Algorithm for the Prediction of Important Clinical Events (CHALICE) algorithm, mental alterations, skull fracture, vomiting, neurological deficiencies, amnesia and dizziness are not certain indications for repeated cranial CT [12]. Another multicentre study Pediatric Emergency Care Applied Research Network (PECARN) reported that under the age of 18, even in lack of vomiting, amnesia and dizziness in children with minor or moderate head trauma, cranial CT is needed if there is any other criteria indicated in CHALICE [12]. Additionally, this study reported that repeated CT do not effect the prognosis significantly in minor and moderate head trauma [12].

We reported that there is at least one pathologic finding in cranial CT of 96,4% of the patients, all of the other patients had new pathologies in repeated CT. Additionally, 33 of the patients who has any pathology in CT revealed new pathologies in repeated CT. Totally 9.4% (n=53) of the patients had new pathologies in repeated CT. The most frequent new finding which is detected in the repeated tomography was subdural bleeding. We detected new pathology by the repeated CT in 6.8% of the patients whose GCS were 14 or 15; but we detected new pathology with a frequency of 12.7% in patients with GCS under 14. We detected new pathology more frequently if the initial GCS

score of the patient was under 14. Previous studies suggest repeated CT in patients with low GCS because in these patients the injury progression continues [8, 2,13, 20]. Similarly, Kim et al. [8] advised repeated CT in patients with GCS under 9 or the present bleeding is over 10 cc, even there is no clinical worsening or new symptom.

In our study, according to the new finding in repeated CT, the mortality rate was 10.5% in new subarachnoid bleeding, 3.8% in new subdural bleeding; besides there was not any mortal cases in new epidural hematoma or cerebral contusion. There was only one patient whose first cranial CT was completely normal but the repeated tomography revealed new pathology. But the initial GCS of this patient was under 14. There was not any mortality in patients with initial GCS 14 or 15 even there was a pathology in new CT.

Conclusion

We already know that in case of worsening mental or clinical state requires repeated cranial CT but it have to be kept in mind that even there is not any worsening of the clinical condition, if the initial GCS is under 14 repeated CT is required. On the other hand, if the initial GCS is 14 or 15, there is not any worsening of clinical condition, there is no need to repeat the cranial CT.

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Contribution of the authors to the study:

Ceritli S. – literature search, writing a review, developing ideas and concepts;

Dibek K. – methodologically assessing the quality of the articles included, writing a review;

Çavuş UY. – writing a review, developing ideas and concepts

Kavak N. - literature search, writing;

Altun S. - literature search, writing a review

Kavalci C. - literature search, writing a review. counseling correspondence with the editorial office;

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