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The Influence of the COVID-19 Pandemic on Pediatric Head Trauma

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Abstract

Background: We compared the pre-COVID-19 (2019–2020) and COVID-19 (2020–2021) periods in terms of the incidence of pediatric head trauma (PHT) cases. The incidence of PHT during the pre- COVID-19 pandemic (PCP) and COVID-19 pandemic (CP) periods was investigated.

Materials and Methods: A total of 6,158 patients with PHT seen in a tertiary emergency department between March 15, 2019 and March 15, 2021 were retrospectively reviewed. 1,198 patients for whom were included in the study. The age, gender, type of trauma, Glasgow Coma Scale score, computerized brain tomography findings, and consultation results of the patients were recorded.

Results: The records of 729 and 469 PHT cases in the PCP and CP periods were analyzed, respectively. The number of patients with PHT was significantly lower in the CP period ($p < 0.001$). While the incidence rates of falls, traffic accidents, and bicycle accidents were higher in the PCP period ($p > 0.05$), trauma rates were lower in the CP period ($p < 0.001$). The incidence of falling from a height was highest in the 7–12 years age group ($p < 0.05$). Cranial fracture, and epidural, subdural, and intracranial bleeding rates, were higher ($p > 0.05$) in the PCP period. While the mortality rate was higher in the PCP period, the treatment refusal rate was higher in the CP period ($p < 0.001$).

Conclusion: The rate of PHT decreased, while treatment refusal rates increased during the CP period. However, mortality rates due to PHTs were higher before the CP.

Key words: COVID-19, emergency department, pediatric head trauma, pre-pandemic, pandemic

Introduction

Coronavirus disease 2019 (COVID-19), a novel disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in China in December 2019 and quickly spread worldwide[1]. Various restrictions have been implemented by governments, including a national curfew in many countries[2]. To reduce the spread of the virus, businesses, schools, and childcare facilities closed worldwide. Social distancing measures were helpful and necessary for slowing down the transmission of the virus[3]. Similarly, social restrictions were imposed in many countries. The effect of those regulations on rates of hospitalization for head trauma (HT) injuries, especially pediatric HT (PHT), is still unknown.

PHT is one of the most important medical problems worldwide, and one of the most common causes of morbidity and mortality in the pediatric population[4].Studies have shown that more than 500,000 children present to emergency rooms due to HT; 60,000 receive inpatient treatment and 7,000 die each year in the United States[5]. Many of the injuries that cause PHTs are preventable, and with appropriate precautions the number of injuries and adverse consequences could be reduced[6].

This study evaluated PHT cases presenting to a tertiary emergency department during the pre-COVID-19 pandemic (PCP) and COVID-19 pandemic (CP) periods. We also obtained demographic and injury profiles of PHT cases and compared them between the two periods. To the best of our knowledge, this is the first study to focus on PHT during the CP.

Materials and Methods

In total, 6,158 patients with HT under the age of 18 years, who presented to the emergency department of the tertiary-level University of Health Sciences, Bursa Yüksek Ihtisas

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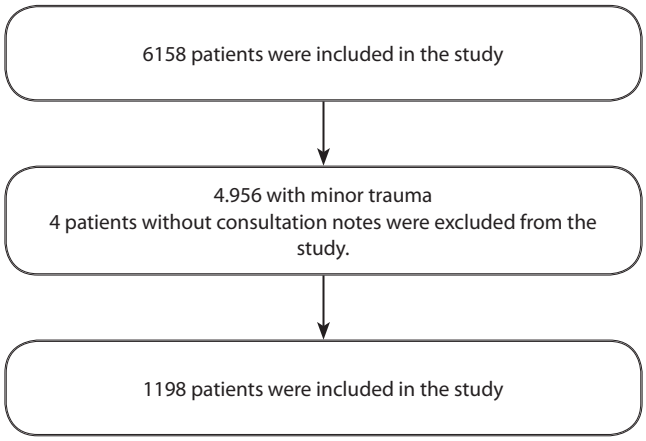

Figure 1: Flowchart on the study

Training & Research Hospital (Bursa, Turkey) between 15 March 2019 and 15 March 2021, were retrospectively reviewed. In total, 4,956 patients who had minor HT (Patients without loss of consciousness, amnesia, vomiting, diffuse headache) but did not require a consultation, and 4 who did not have a consultation note, were excluded from the study. Ultimately 1,198 patients for whom a neurosurgery consultation was requested and information was available were included (Figure 1). Written approval was obtained from the ethics committee of the hospital during the planning phase of our study (2011-KAEK-25 2021/04-15).

Patient data were obtained from patient cards and epicrisis reports, obtained from the hospital's patient information management system. The age, gender, type of trauma, Glasgow Coma Scale (GCS) score, computerized brain tomography (CBT) findings, and consultation results were recorded. On CBT scans, intracranial hemorrhage, skull fractures, epidural hematomas, and subdural hematomas were considered as severe traumatic brain injury. Patients under the age of 18 without HT were excluded. The patients were divided into two groups as PCP and CP period.

The chi-square test was performed to compare the PCP and CP periods in terms of patient gender, GCS severity, trauma type, injury type, and outcome; only outcome showed significance ($p < 0.001$).

Statistical Analysis

IBM SPSS Statistics for Windows (version 21.0; IBM Corp., Armonk, NY, USA) was used for the statistical analyses. As descriptive statistics, continuous variables are expressed as median (interquartile range, IQR), while categorical variables are expressed as number (%). The Kolmogorov-Smirnov test was used to test the normality of the data distribution. Chi-squared and Fisher's exact tests were used to analyze categorical variables. P-values < 0.05 were considered statistically significant.

Results

A total of 1,198 patients were included in this study. The median age of the patients was 5 (IQR: 3–9) years; 759 (63.4%) were in the 0–6 age group and 779 (65%) were male. In total, 709 patients (60.9%) presented to the emergency department during the PCP period. The GCS classifies traumatic brain injuries as mild (score of 14–15), moderate (score of 9–13), or severe (score of 3–8). The classifies traumatic brain injuries as mild grade 1, moderate grade 2 and severe grade 3. The GCS grade of 1,163 patients (97.1%) was 1. Falling from a height was the most common cause of trauma (n = 1,060; 88.5%); 503 (42.0%) of these patients were hospitalized (Table 1).

Table 1: Clinical and Demographic data

		n	%
		Frequency	Percent
Age group	0-6	759	63.4
	7-12	288	24.0
	13-17	151	12.6
Gender	Female	419	35.0
	Male	779	65.0
Period	Pre-Covid-19	729	60.9
	Covid-19	469	39.1
GCS	Grade 1	1163	97.1
	Grade 2	13	1.1
	Grade 3	22	1.8
Trauma type	Falling from height	1060	88.5
	Traffic accident	92	7.7
	Bicycle accident	46	3.8
	ICB	12	1.0
Injury type	Fracture	321	26.8
	Epidural	36	3.0
	Subdural	63	5.3
	Fracture + Bleeding	34	2.8
	No	732	61.1
Other traumas	No	1115	93.1
	Extremity	30	2.5
	Chest	14	1.2
	Abdomen	14	1.2
	Vertebra	25	2.1
Outcome	Hospitalized	503	42.0
	Discharged	675	56.3
	Ex	6	.5
	Treatment refusal	11	.9
	Referral	3	.3
	Total	1198	100.0

The GCS classifies traumatic brain injuries as mild (score of 14–15) (grade 1), moderate (score of 9–13), (grade 2) or severe (score of 3–8) (grade 3).

During the PCP period, the mortality rate in the emergency department was higher than in the CP period, while the treatment refusal rate was higher in the latter period (Table 2).

Table 2: Analysis of pre-Covid 19 and Covid 19 periods and some variables

			Period		Total	Chi-square Test
			Pre-Covid	Covid		
Gender	Female	n	262	157	419	χ^2=0.762, p>0.05
		%	62.5%	37.5%	100.0%	
	Male	n	467	312	779	
		%	59.9%	40.1%	100.0%	
GCS	Grade 1	n	709	454	1163	χ^2=0.303, p>0.05
		%	61.0%	39.0%	100.0%	
	Grade 2	n	7	6	13	
		%	53.8%	46.2%	100.0%	
	Grade 3	n	13	9	22	
		%	59.1%	40.9%	100.0%	
Trauma type	Falling from height	n	653	407	1060	χ^2=3.416, p>0.05
		%	61.6%	38.4%	100.0%	
	Traffic accident	n	52	40	92	
		%	56.5%	43.5%	100.0%	
	Bicycle accident	n	24	22	46	
		%	64.8%	59.5%	100.0%	
Injury type	ICB	n	8	4	12	χ^2=3.734, p>0.05
		%	66.7%	33.3%	100.0%	
	Fractures	n	203	118	321	
		%	63.2%	36.8%	100.0%	
	Epidural	n	21	15	36	
		%	58.3%	41.7%	100.0%	
	Subdural	n	32	31	63	
		%	50.8%	49.2%	100.0%	
	Fracture + Bleeding	n	21	13	34	
		%	61.8%	38.2%	100.0%	
Outcome	No	n	444	288	732	χ^2=24.151, p<0.001
		%	60.7%	39.3%	100.0%	
	Hospitalization	n	276	227	503	
		%	54.9%	45.1%	100.0%	
	Discharge	n	444	231	675	
		%	65.8%	34.2%	100.0%	
	Ex	n	5	1	6	
		%	83.3%	16.7%	100.0%	
	Treatment refusal	n	2	9	11	
		%	18.2%	81.8%	100.0%	
	Referral	n	2	1	3	
		%	66.7%	33.3%	100.0%	
Total		n	729	469	1198	
%			60.9%	39.1%	100.0%	

Incidence of falling from a height was highest in the PCP than CP period in the 7–12 years age group (Table 3).

Table 3: Analysis of pre- Covid-19 and Covid-19 periods and age

	Variable	n	median (IQR: 25-75)	p value
Age	Pre-Covid	729	5(3-10)	<0.001
	Covid	469	4(2-8)	
	Total	1198	5(3-9)	

In our study neurosurgery consultation was requested for 729 patients during the PCP period and 469 during the CP period. In the former period, the frequency of consultations, number of patients hospitalized in the neurosurgery department, and mortality rate of patients with HT due to falling from a height, being involved in a traffic accident, or falling off a bicycle all decreased. However, the rate of treatment refusal increased during the CP period.

Discussion

In this study, we retrospectively compared the incidence of PHTs between the PCP and CP periods. To the best of our knowledge, this is the first retrospective study to evaluate the impact of the CP on the incidence of PHTs in a tertiary hospital setting.

The literature indicates that the number of admissions to the emergency department decreased during the CP[7]. Similarly, the number of patients presenting to the emergency department decreased during the SARS epidemic[8]. Oseran *et al*. reported a 33.7% decrease in emergency department admissions in 2020 compared to 2019[9]. There have also been some reports of a decrease in emergency department admissions for life-threatening myocardial infarctions, hyperglycemic crisis, surgical emergencies, and acute orthopedic trauma during the CP[10-12]. In our study, the number of patients who presented to the emergency department with PHT during the CP period decreased by 44.8% compared to the PCP period. This may be related to a decrease in falls in children due to quarantine restrictions.

HT is an important cause of morbidity and mortality in the pediatric population. Sanford *et al*. reported a change in pediatric injury and trauma types during the CP period[13]. Many authors have reported an overall decrease in blunt injuries due to the severe restrictions imposed in various countries[14]. Similarly, we found that the rate of HT, which was 60.9% in the PCP period, significantly decreased to 39.1% in the CP period. GCS is frequently used to measure the extent of brain damage in patients with head injury[15]. The GCS classifies traumatic brain injuries as mild (score of 14–15), moderate (score of 9–13), or severe (score of 3–8). In our study, 97.1% of patients had a grade of 1, 1.1% a

Table 1: Analysis of pre- Covid-19 and Covid-19 periods and age group and trauma type

Age group				Period		Total	Chi-square Test
				Pre-Covid	Covid		
0-6	Trauma type	Falling from height	n	418	303	721	χ^2=0.827, p>0.05
			%	58.0%	42.0%	100.0%	
		Traffic accident	n	15	15	30	
			%	50.0%	50.0%	100.0%	
		Bicycle accident	n	5	3	8	
			%	62.5%	37.5%	100.0%	
	Total		n	438	321	759	
			%	57.7%	42.3%	100.0%	
7-12	Trauma type	Falling from height	n	163	63	226	χ^2=6.715, p<0.05
			%	72.1%	27.9%	100.0%	
		Traffic accident	n	25	16	41	
			%	61.0%	39.0%	100.0%	
		Bicycle accident	n	10	11	21	
			%	47.6%	52.4%	100.0%	
	Total		n	198	90	288	
			%	68.8%	31.3%	100.0%	
13-17	Trauma type	Falling from height	n	72	41	113	χ^2=0.929, p>0.05
			%	63.7%	36.3%	100.0%	
		Traffic accident	n	12	9	21	
			%	57.1%	42.9%	100.0%	
		Bicycle accident	n	9	8	17	
			%	52.9%	47.1%	100.0%	
	Total		n	93	58	151	
			%	61.6%	38.4%	100.0%	

grade of 2, and 1.8% a grade of 3. The rate of grade 1 cases, which was 61% in the PCP period, decreased to 39% in the CP period; the incidence of grade 2 cases changed from 53.8% to 46.2% and the incidence of grade 3 cases decreased to 40.9% from 59.1%. The number of admissions to the emergency department due to PHT decreased during the CP period, especially cases with a GCS grade of 1. Parents may have been more likely to ignore mild traumas during the CP. Males suffer more PHTs than females[16,17]. In our study, the trauma rates during both the PCP and CP periods were higher in boys than girls. Boys are more active than girls, and play "harder", such that PHTs are more common than in girls; this would not have changed during the pandemic.

Falls were the most common etiology of the PHTs in this study, especially in the 0–6 years age group. Other studies also showed that falls in childhood were the most common cause of HT[18]. In our study, falls accounted for 61.6% of the PHTs among all age groups. During the CP period, this rate decreased to 38.4%. Falling from a height during the PCP period was most common in the 7–12 years age group. We speculate that the closure of community playgrounds and traffic restrictions during the CP may have reduced the rate of such falls, along with closer supervision and control by families.

Traffic accident was the second most common etiology of PHT during the PCP period[2-4]. In our study, traffic accident was the second most common cause of PHT, accounting for 56.5% of cases during the CP period. Bicycles are widely used for transportation and recreation in many countries, and studies have been published on associated traumatic accidents. The literature shows a male predominance in bicycle accidents, and 33–70% of traumatic accidents involve HTs[17,19]. In our study, the proportion of patients who had a PHT due to a bicycle accident was 52.2% in the PCP period and 47.8% in the CP period. The fact that children can ride bicycles alone may have increased the rate of bicycle accidents during the pandemic period, given that community playgrounds were closed.

In one studies, epidural hematoma was the most common type of intraparenchymal lesion[20]. However, Klevian *et al*.

reported that subdural hematoma was the most common type, accounting for 46% of all intraparenchymal lesions[21]. In our study, computed tomography (CT) was performed in all patients; the CT results of 732 patients were normal (60.7% in the PCP period and 39.3% in the CP period). Parents may have been hesitant to being their child to the emergency department for mild traumas due to a fear of COVID-19 infection.

While 285 (61.1%) patients had a pathology during the PCP period, 181 (38.8%) had one during the CP period. The most common pathology detected in both periods was skull fracture (PCP: n = 203 (63.2%), CP: n = 118 (36.8%)). The most common type of intraparenchymal lesion was subdural hematoma, which was detected in 32 cases (50.8%) in the PCP period and 31 (49.2%) in the CP period. This was followed by epidural hematoma, fracture with hemorrhage, and intracranial hemorrhage. Güzel *et al*. detected intracranial hemorrhage in 34.7% of patients with skull fractures, and reported that all of them were epidural hematomas[20]. In their study on 193 pediatric fall cases, Park *et al*. found the rate of intracranial hemorrhage was 75% among cases with skull fractures[22]. In our study, intracranial hemorrhage was found in 21 (61.8%) of the patients in the PCP period and 13 (38.2%) in the CP period. Additionally, we observed epidural hematoma in 21 (58.3%) patients during the PCP period and 15 (41.7%) during the CP period; these rates are lower than those in the literature.

Of the patients included in this study, 276 (54.9%) were hospitalized during the PCP period and 227 (45.1%) during the CP period. Güzel *et al*. reported a hospitalization rate of 18.6% in their study of patients who presented due to falls[20]. In a US study, the rate was 28%[23]. The lower hospitalization rates in our study compared to the literature may be due to the fact that most of our patients suffered from mild head traumas.

Conclusion

We found an increase in the treatment refusal rate during the CP period due to social distancing and self-isolation rules. This may have been because, due to the restrictions, parents were always with their children while working from home. In addition, we found that 83.3% of the mortalities occurred during the PCP period. This suggests that the number and severity of traumas, and the mortality rate, decrease when children are constantly under the supervision of their parents.

During the CP period, there was a significant decrease in pediatric head injuries, which we infer was due to the national quarantine regulations. Also, parents were likely hesitant to visit healthcare facilities. This study provides information that could inform future public health policies pertaining to the CP, and also provides a basis for research into alternative strategies to address non-emergency pediatric traumas and relieve the burden on emergency departments.

Limitations

Our study had several limitations. A large number of patients with minor head trauma who did not want consultation were excluded from the study. We could not evaluate the effect of factors such as family structure, socioeconomic status, access to and use of health services. It was also a single-center and retrospective analysis; We think that multinational studies are needed.

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