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Post-Traumatic Epilepsy: A Review of This Pathology in Childhood

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Abstract: Introduction: Traumatic brain injury has been related to the 20% of symptomatic epilepsy in the general population; In children, information about the magnitude of this condition is few, because the occurrence can develop in immediate periods or even years after the injury. Objective: To evaluate the epidemiological and clinical characteristics in pediatric patients diagnosed with Post-Traumatic Epilepsy. Methods: Children's Records diagnosed with post-traumatic epilepsy from the Pediatric Neurology Service. The clinical-epidemiological characteristics of the trauma, the convulsive crisis and the latency period in its presentation were identified. The difference of quantitative variables was estimated to evaluate their association, according to the intensity of the Head Traumatism (TBI). Results: 72 children with an average age of 8.7 years and males predominance of with 65.3% were included. The most frequent traumatic brain injury site (TBI) was occipital with 35.6% and the classification was 47.6% for mild. 93.1% presented simple partial crisis and 73.6% of children had neurological sequelae. The median onset for the epileptic seizure was 2.9 years, this period being shorter in relation to the intensity of the trauma and the age group in which it occurs. Conclusions: There is a clinical correlation between the intensity of TBI with the acute presence of epilepsy. It is necessary for the community of neurologists to develop follow-up protocols focused on informing and providing adequate care to patients at high risk of presenting post-traumatic epilepsy, including providing information to parents in a timely manner of this risk considering the intensity of the TBI and without ruling out those who suffered mild TBI.

Keywords: Post-Traumatic Epilepsy, Head Injury, Convulsive Crisis, Pediatric Neurology

1. Introduction

Post-traumatic epilepsy is characterized by the appearance of secondary recurrent seizures, due to brain injuries produced after a traumatic brain injury (TBI), having ruled out other causes, it is diagnosed when spontaneous seizures are observed at least one week after a brain injury, [1] however, it can appear several years after the injury. [2]

At any age epilepsy can develop, however the child is more susceptible because he is unprotected at early stages of life; myelination, closure of the fontanelles and sutures, in addition to the development of the compartments of the brain spaces, for protection. [3]

Head injury in children is an important risk factor for serious sequelae, including epilepsy, [4, 5] which is defined as a brain disorder characterized by a long-lasting or chronic predisposition to epileptic seizures, with neurobiological, cognitive, psychosocial and social sequelae. The epileptic

seizure is the transient presence of signs and/or symptoms caused by excessive, abnormal and synchronized neuronal activity in the brain" which have been divided into: convulsive and non-convulsive seizures. In turn, seizures are divided into generalized and partial, and according to the patient's alert status into simple and complex. [6, 7]

Epileptic seizures observed during and after TBI have been classified according to the time of onset into early seizures (first week) and late seizures (after the first week). As the term epilepsy implies recurrence, the use of post-traumatic epilepsy is considered more appropriate for late-onset and recurrent seizures. [8-10]

The TBI, it is classified according to its intensity as severe, moderate and mild according to the Anneger criteria and modified Glasgow Coma Scale (ECG), for children under 2 years of age, [3, 8, 11] which is a factor decisive in determining the treatment of pediatric patients with TBI and influences decision-making and the application of algorithms established in pediatric services and in prognostic evaluation. [12, 13]

About the incidence, post-traumatic epilepsy (PTS) has been observed a correlate with the trauma severity the more severe, the more frequent the appearance of epilepsy during the first year. In severe and moderate TBI, the risk of developing EPT is 2.6 times higher in the first year; 4.4 for the next 4 years and 1.4 for next years. [8]

There is a latency period between the trauma and the development of epilepsy. It has been observed that the first seizure after TBI will occur in 23% of children during the following two years and 40% may have seizures for up to 10 years. years later. Approximately 70-82% of seizures are partial and 18-30% are generalized. [14]

The duration of the EPT seems to be related to the frequency of the crises: for a high frequency, a greater persistence. The number of crises during the first year has a predictive value in relation to subsequent severity, it has also been related to greater recurrence and persistence if they are partial crises. About the type of crisis, 75% are partial (the majority are complex), of which 50% are generalized and the remaining 30-35% are generalized. [8]

The purpose of this study is to determine the evaluation of the epidemiological and clinical characteristics in pediatric patients diagnosed with Epilepsy Secondary to Head Trauma (TBI).

2. Patients and Methods

Retrospective cohort study carried out in the Pediatric Neurology Service of the Regional General Hospital No. 17 at Cancun City Mexico. Children registered with a Epilepsy diagnosis and in treatment by the Neuropediatric doctor. The pediatric population was considered to all children under 15 years of age at the moment to be diagnosed with post-traumatic epilepsy.

For the inclusion of children in the study, the diagnosis confirmed by the neuropediatric was considered and children with a neonatal history hypoxia, use of forceps at birth, history of obstetric trauma and preterm newborns were ruled out.

The data was concentrated in a certificate prepared by the doctor from the beginning of the operation of the neuropediatrics service for the internal control of the patients, some of these data was obtained through an interview with the family member who came to the medical consultation with the child and others were collected from the clinical file.

The neurological symptoms immediately after the trauma, affected cerebral lobe(s), time elapsed between the trauma and the definitive diagnosis of post-traumatic epilepsy, type of seizure, the presence of neurological sequelae caused by the trauma were identified. and if it required surgical management derived from it. The origin of the trauma was classified according to the International Statistical Classification of Diseases and Related Health Problems in its Tenth Revision (ICD 10) [15]

For the classification of TBI, the Anneger criteria and Glasgow Coma Scale (ECG) were used, for children under 2 years of age the modified scale is used: – Mild TBI: no fracture, post-traumatic amnesia or loss of consciousness and score ECG from 13 to 15. – Moderate TCE: amnesia or loss of consciousness for a period greater than 30 minutes and less than 24 hours; there is fracture and ECG score 9-12. – Severe TBI: existence of intracranial hematoma and cerebral contusion, absence of consciousness for more than 24 hours and ECG score less than 8. [3, 8, 11]

Descriptive statistics were performed for the categorical variables with relative frequencies, for the quantitative data, the measures of central tendency and dispersion were estimated. A Spearman correlation was obtained to determine their association.

The study was accepted by the local research and ethics committee in health research and the care of the children in the medical consultation with the pediatric neurologist was not modified by the completion of this research.

3. Results

The study population was 72 children of pediatric age assigned to the Regional General Hospital No. 17 of Cancún, Quintana Roo in control by the Neuropediatrics service with an established diagnosis of Post-traumatic Epilepsy.

The average age was 8.7 ± 4.0 years; with a predominance of the male sex with 65.3%. The classification of the traumatism corresponded to mild with 47.6%, Moderate with 20.6% and severe with 31.7%. In relation to the ICD 10 classification, it was found that falls were the most frequent cause of trauma with 61.9% and those that were from the hammock occupied 9.5% of the injuries, however transport accidents caused severe trauma more frequently. Table 1.

Table 1. Classification of traumatic brain injury in relation to intensity.

	INTENSITY OF TRUMATISM			
	Mild n (%)	Moderate n (%)	Severe n (%)	Total n (%)
Transportation accidents	2 13,3%	3 20,0%	10 66,7%	15 23,8%
Falls	22 56.4%	9 23.1%	8 20.5%	45 61.9%
Hammock drop	4 66.7%	1 16.7%	1 16.7%	6 9.5%
Hits with structures	2 66,7%	- -	1 33,3%	3 4,8%
Total	30 47,6%	13 20,6%	20 31,7%	63 100,0%

Chi suare p < 0.05.

Within the focal lesion after trauma, it was found a 43.1% of the children did not have complementary diagnostic studies. Epidural hematoma was present in 11.1%, subdural hematoma in 6.9%, parenchymal hemorrhage in 6.9%, no lesion due to studies carried out in 31.9%, highlighting that all children with epidural hematoma and subdural, presented a severe trauma. It was also found that 80.6% of these patients did not require surgical management was found a 69.4% had closed trauma and 30.6% open.

The presence of immediate neurological symptoms occurred in 69.4%, with a frequency of 42.0% in children who presented severe trauma. The neurological sequelae after trauma were observed in 73.6%. About the cerebral lobe affected by the trauma, it was observed that 35.6% occurred in the occipital, followed by the frontal with 20.3%; however, within the severe trauma, the highest frequencies were observed for the lesion in the parietal lobe with 40.0% and temporal with 20.0%

The type of convulsive crisis that they present at the moment, 93.1% are simple partial and 6.9% complex partial; in both groups the highest frequency was observed in mild trauma. Table 2.

Table 2. Clinical characteristics and intensity of TBI.

	MILD n (%)	MODERATE n (%)	SEVERE n (%)	TOTAL n (%)	p
Crisis Type					
Simple partial	32 (47,8)	14 (20,9)	21 (31,3)	67 (93,1)	N/A
Complex partial	4 (80,0)	1 (20,0)	-	5 (6,9)	
Focal brain injury					
Epidural Hematoma	-	-	8 (100,0)	8 (11,1)	
Subdural Hematoma	-	-	5 (100,0)	5 (6,9)	
Parenchymal hemorrhage	1 (20,0)	-	4 (80,0)	5 (6,9)	N/A
None	17 (73,9)	5 (21,7)	1 (4,3)	23 (31,9)	
Without complementary diagnostic studies	18 (58,1)	10 (32,3)	3 (9,7)	31 (43,1)	
Type of trauma					
Close	35 (70,0)	7 (14,0)	8 (16,0)	50 (69,4)	.001
Open	1 (4,5)	8 (36,4)	13 (59,1)	22 (30,6)	
Surgical Management					
Yes	-	1 (7,1)	13 (92,9)	14 (19,4)	N/A
No	36 (62,1)	14 (24,1)	8 (13,8)	54 (80,6)	
Immediate neurological symptomatology					
Yes	16 (32,0)	13 (26,0)	21 (42,0)	50 (69,4)	N/A
No	20 (90,9)	2 (9,1)	-	22 (30,6)	
Neurological sequelae					
Yes	28 (52,8)	10 (18,9)	15 (28,3)	53 (73,6)	0.689
No	8 (42,1)	5 (26,3)	6 (31,6)	19 (26,4)	
Diffuse Axonal Injury					
Yes	-	-	4 (100,0)	4 (5,6)	N/A
No	36 (52,9)	15 (22,1)	17 (25,0)	68 (94,4)	
Site of trauma					
Frontal	8 (66,7)	2 (16,7)	2 (16,7)	12 (20,3)	
Parietal	1 (20,0)	2 (40,0)	2 (40,0)	5 (8,5)	
Temporal	5 (50,0)	3 (30,0)	2 (20,0)	10 (16,9)	
Occipital	12 (57,1)	5 (23,8)	4 (19,0)	21 (35,6)	
Fronto – Temporal	2 (50,0)	-	2 (50,0)	4 (6,8)	N/A
Occipito – Parietal	-	-	2 (100,0)	2 (3,4)	
Parieto – Temporal	-	-	1 (100,0)	1 (1,7)	
Occipito – Temporal	-	-	3 (100,0)	3 (5,1)	
Fronto – Parietal	-	1 (100,0)	-	1 (1,7)	

Chi square p < 0.05.

Based on this last classification, the frequency was estimated in relation to the number of brain lobes affected by the trauma and the type of seizure, in which the highest frequencies were observed in those who presented a simple partial seizure with 93.8 % and 90.9% (p > 0.05) for one and two lobes, respectively. Similarly, it was found that all children with a complex partial seizure type presented a closed TBI, however, the largest number of children was in simple partial seizure with 90.1% for closed TBI and 100.0% for for the open (p >0.05). This same behavior was observed for the TCE classification. Table 3.
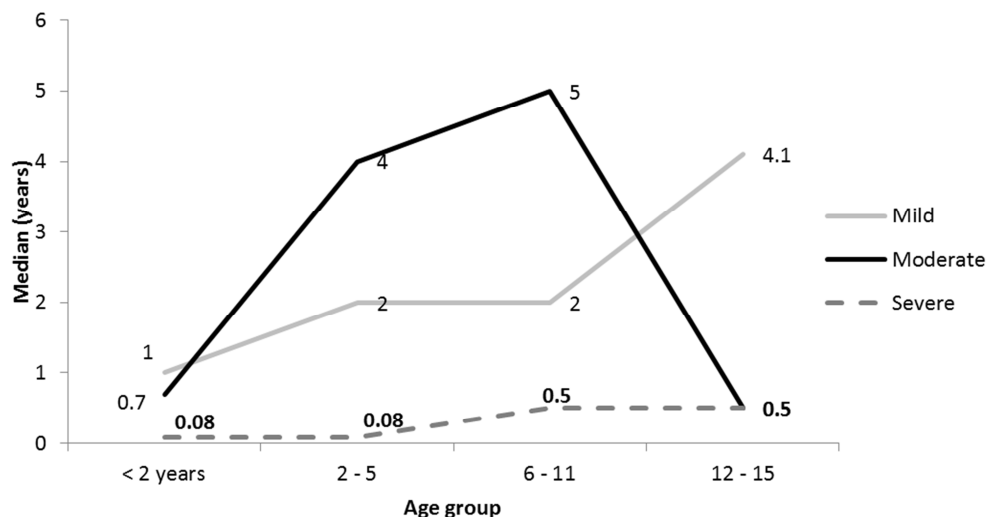
Table 3. Type of seizure in relation to the number of affected lobes and type of trauma.

	Type of seizure			
	Simple Partial n = 97 (93.1%)	Partial Complex n = 5 (6.9%)	Total	P +
Number of affected lobes				
One	45 (93,8)	3 (6,3)	48 (81,4)	0,735
Two	10 (90,9)	1 (9,1)	11 (18,6)	
Total	55 (93,2)	4 (9,1)	59 (100,0)	
Type of head injury				
Close	45 (90,0)	5 (10,0)	50 (69,4)	
Open	22 (100,0)	-	22 (30,6)	0,124
Total	67 (93,1)	5 (6,9)	72 (100,0)	
Classification of head injury				
MIld / Moderate	46 (90,2)	5 (9,8)	51 (70,8)	
Severe	21 (100,0)	-	21 (29,2)	0,137
Total	67 (93,1)	5 (6,9)	72 (100,0)	
Age				
< 2 years	4 (100.0)	-	4 (5.6)	
2 – 6 years	13 (86.7)	2 (13.3)	15 (20.8)	0.355
6 – 12 years	28 (90.3)	3 (9.7)	31 (43.1)	
> 12 years	22 (32.8)	-	22 (30.6)	
Total	67 (93.1	5 (6.9)	72 (100.0)	

+ Chi square.

Due to the non-normality with the Kolmogorov Smirnov test in the distribution of the data of the variables (p<0.05), the medians were estimated to compare the latency period between the intensity of the TBI and the presence of convulsive crisis in relation to the age group and it was observed that the latency time was less than one year for those who presented severe trauma and regardless of age. Figure 1.

Figure 1. Time of appearance of the convulsive crisis according to the intensity of the trauma and the age of the child.

4. Discussion

Epilepsy can be present at any age; in the pediatric age there is greater susceptibility to the development of this due to exposure to trauma. It is twice more frequent in men, as referred by Bayir [16] and as observed in the study, where 2 out of 3 children were male. In our case, 86.1% presented between the ages of 6 and 12, this derived from the fact that this is precisely the most activity age in the life development, as has already been documented with a greater risk of the presence of TBI.

In relation to the intensity of the trauma, Chun-Chieh, et al. [17] mentions that post-traumatic epilepsy occurs more frequently in severe trauma, however in this study population mild trauma prevailed with almost half of the cases and the severe one only occurred in 3 out of 10 children with post-traumatic epilepsy.

When determining the cause of the trauma, it was shown that falls predominated in children with approximately 7 out of 10 events, this agrees with that reported by Deheza [18] who mentions that children under 10 years of age, falls are the main cause of head trauma, but differs for childrens over 15 years of age where vehicle accidents are the main causes of TBI, according to the Center for Disease Prevention and Control (CDC) [19].

It is important to mention that in southeastern Mexico and Probably in many tropical zones as a custom use an hammock for sleep and it´s has a greater relationship with the frequency of trauma coupled with the inherent risk of age. It is advisable to consider that among the population health education establishes a preventive culture in the areas where it is used hammocks.

Regarding the type of seizures present at the moment, a greater number of simple partial seizures (93%) were observed, which differs for reported by De la Peña P. [12] and Oliveros-Juste, [14] they refer that the majority are complex. These same authors mention that the most epileptogenic area for the development of post-traumatic epilepsy are the parietal, temporal, frontal and occipital areas consecutively and this increase if more than one affected area is found, however, in the present study the area with The highest frequency of presentation for post-traumatic epilepsy was the occipital and several children presented trauma in more than one area. Likewise, it is reported the risk for the development of post-traumatic epilepsy increased when the trauma is open and in the present study these events occurred more frequently when the trauma was severe.

In our study, almost 70% of the patients presented neurological symptoms at the time of the trauma. This can be contrasted with what De La Peña [8] mentions regarding the incidence of PTSD development of 25%, the presence of early crises and a 5% with loss of consciousness for more than 24 hours, focal deficit in 13% according to Oliveros-Juste. [14]

Regarding the type of trauma, the closed was the most reported in the children in this study, which coincides with the reported in the literature, where this type of trauma is the most frequent in patients with post-traumatic epilepsy and usually have a worse prognosis than open ones. [14, 20-23]

It is necessary for clinicians in the medical care process to consider establishing the use of this preventive diagnostic protocol in the follow-up of patients with TBI, as it is demonstrated that the presence of epilepsy is not an exclusive obviousness of severe intensity.

The seizure onset interval in the pediatric age contrast to the figures documented in adults because in children the onset interval is longer, according to Oliveros-Juste [14] 2 of 10 children present the first seizure during the first 2 years following trauma and 40% may have seizures 10 years later.

[20] However, the children in this study, seizures occurred before the first year of life and the median time to seizure onset depended on the intensity of the seizure trauma, as Chun-Chie [17] reported in his study, where he found a highest frequencies of crisis onset occurred during the first year after the trauma.

Therefore, based on these findings, it is advisable to consider every child suffering a TBI of any minimum severity has a neurological assessment the following year, which allows for an early diagnosis and improves the costs/effectiveness of care.

5. Conclusion

Post-traumatic epilepsy in children can be a late evolution disease and trauma is erroneously considered as something "normal" in childhood by the child's caregivers, even culturally accepted as a parameter of normal development within society.

However, it is necessary to implement cultural changes in the socially accepted constructs and the use of accessories in tropical areas such as the hammock so that the incidence of these accidents in the home is prevented, including all social actors in schools, home and public or private medical care units.

Timely follow-up is essential in children in whom a TBI has occurred and to have complementary diagnostic studies. However, the prevention of head trauma is the most effective way to prevent post-traumatic epilepsy.

Conflict of Interest

All the authors do not have any possible conflicts of interest.

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