Posttraumatic Seizure

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Abstract

Background: Posttraumatic seizures (PTS) occur because of brain damage. Repetition of these seizures indicates posttraumatic epilepsy (PTE). **Objectives:** To identify the risk factors for developing PTS and long term PTE. **Materials and methods:** In this prospective study, 1040 head injured patients including 746 males and 294 females admitted to Department of Neurosurgery - Hilla Teaching Hospital over 10 years period from 2008 to 2018 in Babylon – Iraq and successfully followed-up after discharge from hospital as outpatient. Only 95 cases complain from PTS including 68 males and 27 females. Several variables are studied including: sociodemographic characteristics, mechanism of head injury and the patient's prognosis. **Results:** The incidence of PTS is 9% and incidence long term PTE is 5.4%. Peak seizures happen during one-year post head damage 78%. The incidence of PTS in the 1st year after head injury is 7%. PTS patients have biphasic age specific distribution. Male was the predominant gender to be affected by PTS. RTA is the major causative mechanism for PTE followed by accidental falling from height. Brain contusion, especially with lobar involvement, prolonged loss of consciousness and late seizures are the most frequent risk factors for developing PTS and PTE. Lobar affection and late onset seizures are the only statistically significant parameters. Only 58.9% of PTS patients remain epileptic. Immediate seizure constitute 31.6%, early seizure 15.8% and late onset seizure 52.6%. Generalized tonic-clonic seizure found in 74.7% of patients. Associated extra cranial injuries are present in only 10.5% cases and most of them 7.4% have PTE. Surgical treatment is done for 33.7% of patients and 65.6% of them have PTE. Conservative treatment is done for 66.3% of patient and 55.6% of them having PTE. **Conclusion:** Subgroups with significantly higher risk for PTE include those with severe head injury, brain contusion especially with lobar involvement, prolonged loss of consciousness (more than 24 hours), early seizures especially delayed early seizures, late seizures, surgical evacuation of a subdural hematoma and intracerebral hematoma, depressed skull fracture that was not surgically elevated, dural penetration by injury and parietal lobe lesion on CT scan. Surgical treatment can possibly increase the risk of PTE by exacerbating the existing brain insult.

Key Words: Post Traumatic Seizures, Post Traumatic Epilepsy, Traumatic Brain Injury.

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Introduction

Posttraumatic seizures (PTS) happen occur because of brain damage. Reappearance of these seizures indicates posttraumatic epilepsy (PTE)[1]. Traumatic Injury of brain represented 20% of characteristic epilepsy in community and 5% of all patients with epilepsy, lead to showed symptomatic epilepsy [2]. After brain damage after 24 hours PTS occur and named abrupt PTS. While that happen during week called primary PTS and PTS occur after I week called late PTS[3]. Mild head injury (concussion) is defined as head injury without skull fracture and with less than 30 minutes of post-traumatic amnesia or brief period of impairment of consciousness.

Mild head injury is, in greatest studies, not related with any decidedly high danger of seizure. Modest head damage define as damage occur after posttraumatic forgetfulness for 30 min or more or skull fracture or consciousness loss [3].

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Severe head damage is head injury occur through post-traumatic forgetfulness 24 hours or more, intracranial hemorrhage, contusion of cerebellum and coma, so severe head damage represented 10-15% of total patients [4,5]. Unknown mechanism of seizures occur after trauma due to many types of seizures. Abrupt seizures (concussive convulsions) are probably the result of transient loss of cortical inhibition or due to brainstem activation[5].Several Factors might contribute to development of PTS and PTE, including iron deposition from extravasated blood, the accumulation of glutamate leading to damage by excitotoxicity, and disruption of blood brain barrier[6].New studies suggest that immune system plus inflammation may be causal to the progress of seizures and epilepsy. Recent literatures have found that several inflammatory mediators, including IL-1β and HMGB1, exhibit epileptogenic properties, acting on glia and neurons both directly and indirectly to influence neuronal excitability[7,8].

Materials and Methods

This prospective study is achieved in Hilla Teaching Hospital - Department of Neurosurgery in Babylon – Iraq over 10 years period from 2008 to 2018, in which1040 head injured patients (746 males and 294 females)who can successfully followed-up after discharge from hospital as outpatient included in this study. All of these cases have complete medical records during hospital admission and after discharge from hospital during follow up period. Brain CT scan is done for all cases and some of cases brain MRI is done. Only 95 cases complain from PTS including 68 males and 27 females. Each case has documented history of head injury before having seizure with no history of seizure before head trauma. Electroencephalogram (EEG) examinations is done for all patients with suspicious seizure. The patients are classified into 5 groups according to their ages (less than 5, 5-10, 10-20, 20-30 and more than 30 years). Several variables are studied including: sociodemographic characteristics, mechanism of head injuryand the patient's prognosis.Statistical analysis is carried out using SPSS version 20. Categorical variables were presented in form of frequencies, percentages, Pearson's chi square (X^2), Fisher-exact test and the association between these categorical variables are studied. A *p*-value of ≤ 0.05 was considered as significant.

Results

In this prospective study, the incidence of PTS is 9% (*n*=95) and incidence of long term PTE is 5.4% (*n*=56). Most seizures in our study occur within one year after head injury 78% (*n*=74).The incidence of PTS in the 1st year after head injury is 7%. In this study, PTS patients have biphasic age specific distribution, the first phase is at 10-20 years and the second is more than 30 years. Male was the predominant gender to be affected by PTS. RTA is the major mechanism of head injury causing PTS in our patients, followed by accidental falling from height. Brain contusion, especially with lobar involvement, prolonged loss of consciousness (more than 24 hours) and late seizures (more than 1 week) are the most frequent risk factors for developing PTS and PTE in our patients. Lobar liking and late start seizures (one week or more afterward trauma) are the lone statistically significant parameters. Parietal lobe affection is most frequent for developing PTS 27.4% (*n*=26) followed by frontal lobe 23.2% (*n*=22).

In current study, more than half of our patients 52.6% (n=50) having late onset seizure, 31.6% (n=30) having immediate seizure and 15.8% (n=15) having early seizure.In this study 74.7% (*n*=71) of patients having generalized tonic clonic seizures while 25.3% (*n*=24) of patients having partial seizures according to EEG records. Associated extracranial injuries are present in only 10.5% (n=10) cases and most of them 7.4% (n=7) have PTS. Surgical treatment either by craniotomy or craniectomy or bur hole aspiration is done for 33.7% (n=32) of patients and 65.6% (n=21) of them have PTS. More than one surgery are done for 7.4% (n=7) of patients in which 57% (n=4) of them having PTS. Conservative treatment is done for 66.3% (n=63) of patient, of which 55.6% (n=35) having PTS. Prognosis of PTS patients are divided into poor prognosis by developing long term epilepsy (58.9%) or having good prognosis by being seizure free (41.1%) Figure (2).

The sociodemographic characteristics are shown in Table (1). The clinical manifestations of the patients are shown in Table (2).The clinical characteristics of the patients and related prognosis are shown in Table (3).The clinical manifestations of the patients and related prognosis are shown in Table (4).The distribution of patients according to mechanism of head injuryare shown in Figure (1).The prognosis of PTS either developing long term epilepsy or being

seizure free are shown in Figure (2).

Table 1. Sociodemographic characteristics

Socio demographic variables	N	(%)
Age (years)		
below 5	18	18.9
5-10	13	13.7
10-20	26	27.4
20-30	15	15.8
More than 30	23	24.2
Total	95	100.0
Gender		
Male	68	71.6
Female	27	28.4
Total	95	100.0

Table 2. Clinical manifestations of the patients

Variables	N	(%)
Skull fracture		
Depressed	22	23.2
Linear	26	27.4
No fracture	47	49.5
Brain injuries		
Contusion	34	35.8
Concussion	18	18.9
Subdural hematoma	5	5.3
Epidural hematoma	9	9.5
Subarachnoid hemorrhage	3	3.2
Intracerebral hemorrhage	9	9.5
Multiple brain injury	8	8.4
No brain injury	9	9.5
Lobe affected		
Parietal	26	27.4
Frontal	22	23.2
Occipital	2	2.1
Temporal	17	17.9
Left hemisphere (all lobes)	1	1.1
No lobe affected	27	28.4
Cerebrospinal fluid leak		
Otorrhoea	14	14.7
Rhinorrhea	6	6.3
Duration of loss of consciousness		
Less than 30 minutes	0	0.0
30 minutes to 24 hours	31	32.6
More than 24 hours	36	37.9
No loss of consciousness	28	29.5
Focal Neurological deficit		
Amnesia	14	14.7
Aphasia	2	2.1
Ataxia	1	1.1
Facial nerve palsy	9	9.5
Hemiplegia	18	18.9
No neurological deficit	74	77.9
Onset of seizures		
Immediate (within 1st 24 hours)	30	31.6
Early (2nd – 7th day)	15	15.8
Late (more than a week)	50	52.6
Type of seizures		
Generalize tonic clonic (GTC)	71	74.7
Partial	24	25.3
Associated extracranial injuries		
Present	10	10.5
Absent	85	89.5

Table 3. Clinical characteristics of the patients and related prognosis

Variables	Prognosis of patients		χ^2	P-value
	Epileptic	Free		
Age (years)				
20 or more	26 (46.4%)	12 (30.8%)		
10-20	15 (26.8%)	11 (28.2%)	2.855	0.24
Below 10	15 (26.8%)	16 (41.0%)		
Total	56 (100.0%)	39 (100.0%)		
Sex				
Male	41 (73.2%)	27 (69.2%)		
Female	15 (26.8%)	12 (30.8%)	0.179	0.672
Total	56 (100.0%)	39 (100.0%)		
Mechanism of injury				
RTA	17 (30.4%)	15 (38.4%)		
Penetrating	2 (3.6%)	2 (5.1%)		
FFH	18 (32.1%)	12 (30.8%)		0.404 f
Bullet	6 (10.7%)	0 (0.0%)		
Blunt	8 (14.3%)	6 (15.4%)		
Blast	5 (8.9%)	4 (10.3%)		
Total	56 (100.0%)	39 (100.0%)		
Onset of epilepsy				
Immediate (within 1st 24 hours)	8 (14.3%)	22 (56.4%)		
Early (2nd – 7th day)	9 (16.1%)	6 (15.4%)	20.425	<0.001*
Late (more than a week)	39 (69.6%)	11 (28.2%)		
Total	56 (100.0%)	39 (100.0%)		
Type of epilepsy				
Generalize tonic clonic (GTC)	40 (71.4%)	31 (79.5%)	0.791	0.374
Partial	16 (28.6%)	8 (20.5%)		
Total	56 (100.0%)	39 (100.0%)		
Type of treatment				
Surgical treatment	21 (37.5)	11 (28.2)	0.889	0.346
Conservative treatment	35 (62.5)	28 (71.8)		
Total	56 (100.0)	39 (100.0)		

*p value ≤ 0.05 was significant. f: Fisher- exact test.

Table 4. Clinical manifestations of the patients and related prognosis

Variables	Prognosis of patients		χ^2	P-value
	Epileptic	Free		
Neurological deficit				
Present	15 (26.8%)	6 (15.4%)	1.735	0.188
Absent	41 (73.2%)	33 (84.6%)		
Total	56 (100.0%)	39 (100.0%)		
Loss of consciousness				
Present	43 (76.8%)	24 (61.5%)	2.571	0.109
Absent	13 (23.2%)	15 (38.5%)		
Total	56 (100.0%)	39 (100.0%)		
History of amnesia				
Present	11 (19.6%)	3 (7.7%)	2.613	0.106
Absent	45 (80.4%)	36 (92.3%)		
Total	56 (100.0%)	39 (100.0%)		
Cranial nerve deficit				
Present (facial nerve)	5 (8.9%)	4 (10.3%)		1.000 f
Absent	51 (91.1%)	35 (89.7%)		
Total	56 (100.0%)	39 (100.0%)		
History of rhinorrhea				
Present	5 (8.9%)	1 (2.6%)		0.395 f
Absent	51 (91.1%)	38 (97.4%)		
Total	56 (100.0%)	39 (100.0%)		
History of otorrhoea				
Present	6 (10.7%)	8 (20.5%)	1.757	0.185
Absent	50 (89.3%)	31 (79.5%)		
Total	56 (100.0%)	39 (100.0%)		
Skull fracture				
Present	29 (51.8%)	19 (48.7%)	0.087	0.769
Absent	27 (48.2%)	20 (51.3%)		
Total	56 (100.0%)	39 (100.0%)		
Brain injury				
Present	53 (94.6%)	33 (84.6%)		0.154 f
Absent	3 (5.4%)	6 (15.4%)		
Total	56 (100.0%)	39 (100.0%)		
Lobe affected				
Present	48 (85.7%)	20 (51.3%)		
Absent	8 (14.3%)	19 (48.7%)	13.39	<0.001*
Total	56 (100.0%)	39 (100.0%)		
Associated extracranial injuries				
Present	7 (12.5%)	3 (7.7%)		0.518 f
Absent	49 (87.5%)	36 (92.3%)		
Total	56 (100.0%)	39 (100.0%)		

*p value ≤ 0.05 was significant. f: Fisher- exact test.

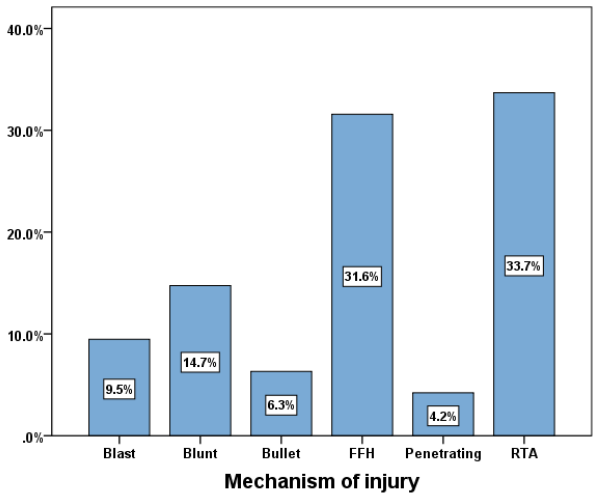

Figure 1. The distribution of patients according to mechanism of head injury

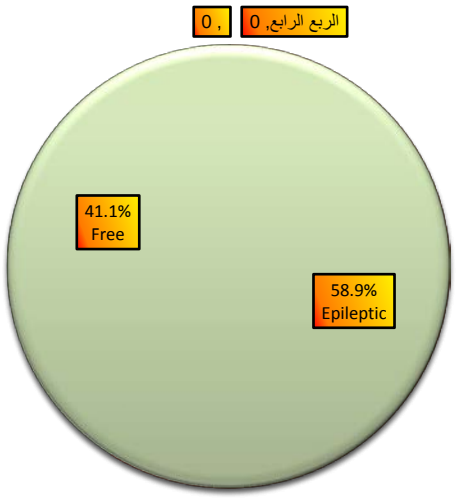

Figure 2. The prognosis of PTS either developing long term epilepsy or being seizure free

Discussion

Head injury is an important health problem. It is the first cause of neurological disabilities, especially in young age group. In TBI patients, epileptic seizures can exacerbate pathological brain injury and cause neural biochemical changes, which lead to increase the complication of management and extremely affect the patient's prognosis and their service abilities. PTE is one of the common complications of TBI. In this study, the incidence of PTS is 9% (*n*=95)and the incidence long term PTE is 5.4% (*n*=56). PTE incidence varies in published reports from 1.8% to 53% due to differences in the research circumstances. The incidence of PTE in battle injuries was 34%. PTS can obvious numerous years post trauma although numerous cases of seizures in our study happed within one year's posttraumatic 78% (*n*=74) which is comparable with other study [9].The incidence of PTS in the 1st year after head injury is 7% (*n*=74). One research article in China shows that incidence rate of PTE was 5% within first three years post traumatic in 2826 patients with TBI[10]. Another study showed that 2.5–14% of cases progressed to PTE after 36 months after TBI [11].

In this study, PTS patients have biphasic age specific distribution Table (1). The first phase is at 10-20 years and the second at ages more than 30 years. In contrast to our study, a study in China reports only one peak of PTE incidence rate 50–69 years age group [12]. This can explained by long life expectancy in China population as compared to Iraq population. Male was the predominant gender to be affected by PTS Table (1). These finding are expected, as violence and RTA are more common in young age group, especially in males. RTA is the major mechanism of head injury (33.7%) causing PTE in our patients, followed by accidental falling from height (31.6%) Figure (1).Head injury study in Vietnam suggested that patients with penetrating head injuries are at high risk of PTS and PTE [12]. In addition, Temkin also added penetrating head injury as a risk for long-term epilepsy [13].This variation may be a matter of social and traffic laws variations. Current study shows that, Brain contusion, especially with lobar involvement, prolonged loss of consciousness (more than 24 hours) and late seizures (more than 1 week) are the most frequent risk factors for developing PTS and PTE in our patients. Findings supported by other studies [10, 14]. These parameters might increase the chance of development of epileptogenic foci in the brain and hence epilepsy[1, 13, 15].Brain contusions lead to damage to cortical neurons and lead to hemorrhage to subarachnoid space, lead to activate it directly. Vessels contraction occur due to subarachnoid bleeding lead to clot formation and deposition products can encourage neuronal releases [10]. One of the main goals in this study is to find predictive parameters for long term PTE. Lobar affection (especially parietal and frontal lobes) and late beginning seizures (additional than one week post trauma) are the only statistically significant parameters Table (3-4). This indicates that these patients are likely to be long term epileptic. Most of the patients with early seizures have paroxysmal EEG discharges found in EEG examinations, which is mostly performed in outpatient follow up. These

findings can worse the prognosis for developing PTE. More than half of PTS patients 58.9% remain epileptic while the rest became seizure free. Numerous kinds of seizures can happen afterward TBI, generalized tonic-clonic seizure are found in in most of our patient 74.7%, while partial seizures with or without secondary generalization are the major manifestation in other study [10]. Associated extra cranial injuries like long bone fractures, rib fractures, pneumothorax and hem thorax are present in only 10.5% cases and most of them 7.4%have PTE, Table (4), this can be explained by the fact that blood loss caused by these injury might causing secondary brain insult and exacerbating the present TBI. In this study 33.7%of patient have undergo surgical treatment by craniotomy or craniectomy or bur hole aspiration and 65.6% of them have PTE, Table (3). More than one surgery are done for 7.4% of patients in which 57% of them having PTE. This comparable with Englander et al. showed that numerous craniotomies increase incidence rate of PTE to (36.5%) [16]. Conservative treatment is done for 66.3% of patient and55.6% of them having PTE, which is less incidence than patients treated by surgery, Table (3), these results are comparable with other study[10].

Conclusion

Subgroups with significantly higher risk for PTE include those with severe head injury, brain contusion especially with lobar involvement, prolonged loss of consciousness (more than 24 hours), early seizures especially delayed early seizures, late seizures, surgical evacuation of a subdural hematoma and intracerebral hematoma, depressed skull fracture that was not surgically elevated, dural penetration by injury and parietal lobe lesion on CT scan. Surgical treatment can possibly increase the risk of PTE by exacerbating the existing brain insult.

References

Lucke-Wold BP, Nguyen L, Turner RC, Logsdon AF, Chen YW, Smith KE, et al. Traumatic brain injury and epilepsy: Underlying mechanisms leading to seizure. Seizure 2015; 33: 13-23.

Shorvon SD. Historical introduction: the causes of epilepsy in the pre-molecular era (1860–1960). In Shorvon SD, Andermann F, Guerrini R. (eds). Te Causes of Epilepsy. Common and Uncommon Causes in Adults and Children. Cambridge: Cambridge University Press 2011; 1–20.

Verellen RM, Cavazos JE. Post-traumatic epilepsy: An overview. Therapy 2010; 7: 527–531.

Simon S. Etalepilepsy and related disorders. Neurology, Aqueen Square Textbook 2016; 235-236.

Oxford Textbook of Epilepsy and Epileptic Seizures. Oxford Textbook of Epilepsy and Epileptic Seizures (Oxford University Press, 2013).

Hunt RF, Boychuk JA, Smith BN. Neural circuit mechanisms of post-traumatic epilepsy. Front Cell Neurosci., 2013; 7.

Webster K. Inflammation in epileptogenesis after traumatic brain injury. Journal of Neuroinflammation 2017; 13: 14(10).

Lucke-Wold B. Traumatic brain injury and epilepsy: Underlying mechanisms leading to seizure. Seizure 2015; 33: 13-23.

Frey LC. Epidemiology of posttraumatic epilepsy: a critical review [J]. Epilepsia 2003; 44: 11–17.

Yongqing Z, Huili W, Xueling W, Jianguo L, Sai Z. Clinical Epidemiology Of Posttraumatic Epilepsy In A Group Of Chinese patients. Seizure 2012; 21: 322–326.

Schutze M, Dauch WA, Guttinger M, Risk factors for posttraumatic fits and epilepsy. Zentralbl Neurochir 1999; 60: 163–167.

Raymont V, Salazar AM, Lipsky R. Correlates of posttraumatic epilepsy 35 years following combat brain injury. Neurology 2010; 75: 224–229.

Temkin R. Risk Factors for Posttraumatic Seizures in Adults. Epilepsia 2003; 44: 18–20.

Petridis AK., Doukas, A., Maslehaty, H. & Mehdorn, H. M. Predictors and incidence of posttraumatic seizures in children and adolescents after brain injury. Clinics and Practice2, (2012).

Torbic H, Forni AA, Anger KE, Degrado JR, Greenwood BC. Use of antiepileptics for seizure prophylaxis after traumatic brain injury. American Journal of Health-System Pharmacy 2013; 70: 759–766.

Englander J, Bushnik T, Duong TT. Analyzing risk factors for late posttraumatic seizures: a prospective, multicenter investigation. Arch Phys Med Rehabil., 2003; 84: 365–373.