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Medico-legal study of post-traumatic seizures and epilepsy in patients with traumatic brain injury in El Demerdash and Ain Shams Specialized Hospitals (2017 -2018)

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Abstract **Background:** Traumatic brain injury (TBI) is one of the most leading causes of deaths and disability among youth worldwide. Post-traumatic seizures (PTS) and post-traumatic epilepsy (PTE) are important catastrophic complications of TBI. Epilepsy has important medico-legal aspects for both the patient and the physician. **Aim of the study:** to identify forms of post traumatic seizures (generalized, focal, or focal followed by secondary generalized), site of epileptic focus, nature of brain injury that caused their occurrence, risk factors for epilepsy occurrence and medico-legal importance of PTS. **Methods:** A prospective cross-sectional study was conducted including patients with PTS and PTE who presented to El Demerdash and Ain shams Specialized Hospitals during the study period. Data were collected from patients by a questionnaire and from clinical sheets. Patients were classified into three groups according to time of occurrence of PTS. **Results:** A total of 77 patients were included. Cases were mostly in the age group less than 45 years old. Male patients were more represented in the study (64.9%). Transportation injuries were the most prominent pattern of TBI followed by blunt trauma (29.9%), open head injuries (13%), fall from height (13%) and polytrauma (1.3%). The most common affected site was frontal area of the brain (51.9%) followed by temporal region (45.5%). Associated complications included intra-cranial hemorrhage (87%) and skull fracture (35.1%). Immediate seizures were recorded in 9.1 % of the studied patients compared to 26% with early PTS. Patients with late PTS were the majority accounting for 64.9% of study patients of whom 50% with late PTS from the start. Most cases experienced generalized seizures attacks (59.7%) followed by focal with secondary generalization seizures attacks in (27.3%) and the least were with focal seizures attacks (13.0%). EEG showed abnormal activity in (62.3%) of patients and normal activity in (37.7%). **Conclusion:** Post-traumatic seizures and epilepsy are an important well-known sequel of traumatic brain injury with important medico-legal aspects. Pattern of head injury and site of traumatic area are important risk factors in occurrence of PTS and EEG abnormal activity is an important predictor for occurrence of PTS as well.

Key words Traumatic brain injury, post-traumatic seizures, post-traumatic epilepsy, medico-legal

Introduction

Traumatic brain injury (TBI)is known to be one of the most common and important causes of acquired epilepsy. Studies have demonstrated a direct relationship between the severity of brain injury and appearance of epilepsy specially with direct trauma to the brain parenchyma (Daniel, 2009).

Post-traumatic seizures (PTS) have been identified as, "seizure occurring after head trauma which is causally related to the trauma itself" as identified by Hippocrates as early as 460 BC. Post-traumatic epilepsy (PTE) is defined as recurrent spontaneous seizures following traumatic brain injury, even if the patient experienced one unprovoked seizure after PTS (Thapa et al., 2010).

Post-traumatic seizures can be classified according to the time of occurrence after trauma as; immediate post-traumatic seizures that occur within 24 hours from injury, early seizures that occur in the first week of trauma and late PTS that occur after more than week (Frey, 2003).

Studies have found that traumatic brain injury is the cause of epilepsy in almost 30% of individuals developing epilepsy between the ages of 15 and 34 years, about 14% in children younger than 14 years and 8% in adults older than 65 years (Daniel, 2009).

As it is a disabling chronic disorder, epilepsy and its treatment as well have undesirable impacts on patients, their families, and all society. It is considered a major problem from the medical, legal, and social point of view. Epilepsy is associated with increased risk of trauma and mortality. Moreover, patients with epilepsy are at higher risk for developing psychiatric disorders increasing the negative impact of this disorder. Accordingly, legal implications must be considered while dealing with these patients (Robert, 2005).

Subjects and Methods

The current study is a cross-sectional study for the factors affecting the occurrence of seizures and epilepsy after traumatic brain injury (TBI) to be applied in the forensic practice for these cases. This study was held in El Demerdash and Ain shams Specialized Hospitals in the period from October 2017 to October 2018 based on the data collected from the selected patients for the study.

Patient selection: 77 patients were included who presented to the outpatient neurological clinics (diagnosed with PTE) and the ER (diagnosed with immediate PTS). Sample size was calculated using PASS program, setting alpha error 5% and power 80%, according to (Thapa et al, 2010) cases with PTS, male sex was represented by 71.3% of cases, according to this value the needed sample was 77 cases.

Inclusion criteria: Included patients were adult patients aged from 18 to 60 years old with seizures after TBI without a history of epilepsy before head trauma.

Exclusion criteria: Patients with past or family history of epilepsy before TBI were excluded.
Data were also collected from clinical sheets in addition to an informed questionnaire (constructed in Arabic language to be fully understood) filled by each selected patient.

Patient grading: Selected 77 patients were divided into three main groups according to timing of seizures:
Group (1): included 7 patients with immediate seizures only (within 24 hours of TBI).

Group (2): included 20 patients with early seizures only (within the first 7 days of TBI).

Group (3): included 50 patients with late seizures (after 7 days from TBI). Group (3) patients were further classified to:

Subgroup (3A): included 25 patients with late seizures without being preceded by the occurrence immediate nor early seizures.

Subgroup (3B): included 15 patients with late seizures preceded by early seizures.

Subgroup (3C): included 10 patients with late seizures preceded by immediate seizures.

Ethical considerations: Data were collected after approval of the Research Ethics Committee of Faculty of Medicine Ain Shams University (Code?). Oral informed consent was taken from the selected patients before filling the questionnaire. Confidentiality as well as dignity of the patients was ensured.

Results

Regarding gender distribution, 64.9% patients were males (n=50). Ages ranged from 18 to 60 years with a mean of 36.1 ± 12.4 years. Cases were mostly in the age group less than 45 years old (table 1).

Transportation injuries were the most prominent type of accidents (42.9%), followed by blunt trauma to the head (29.9%), open head injuries (13%), fall from a height accident (13.0%) and only one patient had polytrauma (1.3%) (table 1).

Regarding the site of brain injury among the study patients, frontal area of the brain was the most common affected site (51.9%) followed by temporal region whether right or left (45.5%). head injury on the back (the occipital area) and polytrauma in the brain each were only recorded in (1.3%) (table 1).

Associated complications included intra-cranial hemorrhage recorded in 67 patients (87%) and skull fracture recorded in 27patients (35.1%) (table 1).

Immediate seizures were recorded in 9.1 % (n=7) of the studied patients compared to 26% (n=20) with early PTS. Patients with late PTS were the majority accounting for 64.9% of study patients half of them with late PTS from the start while late seizures preceded by early seizures were recorded in 30% and late seizures preceded by immediate seizures in 20% (table 1).

Generalized seizures attacks were experienced by most cases (59.7%) followed by focal with secondary generalization seizures attacks in 27.3% and focal seizures attacks in 13.0 % (table 1).

EEG showed abnormal activity in (62.3%) of patients and normal activity in (37.7%) (table 1).

There was highly statistically significance between the groups of different timing of seizures as regard the pattern of head trauma (P-value= 0.009) while there was no statistically significant difference between timing of seizures and the site of the affected area in the brain by the injury as shown in table (2).

There was a significant difference between the late seizures group as regard EEG results P-value = 0.05 while there was no statistically significant difference between immediate and early seizures groups and the result of EEG as shown in table (2).

Table (1): Variables recorded among studied patients (including gender, age, types of accidents, site of injury in the brain, associated complications, timing of seizures, type of seizures and EEG changes)

Variables			Number Total=77 patients	%
Gender	**Male**		50	64.9%
	Female		27	35.1%
Age	**Less than 25 years**		17	22.07%
	25-<35 years		19	24.67%
	35-<45 years		19	24.67%
	45 years or more		22	28.6%
	Range		(18.00 – 60.00)	
	Mean + SD		36.12 + 12.41	
Type of accidents	**Transportation injuries**		33	42.9%
	Blunt trauma		23	29.9%
	Open head injury		10	13.0%
	Fall from height		10	13.0%
	Polytrauma		1	1.3%
Site of Injury *	**Frontal (Front)**		40	51.9%
	Temporal (Side)		35	45.5%
	Occipital (Back)		1	1.3%
	Polytrauma		1	1.3%
Associated Complications*	**Hemorrhage**	**No**	10	13.0%
		Yes	67	87.0%
	Skull Fracture	**No**	50	64.9%
		Yes	27	35.1%
Timing of seizures	**Immediate**		7	9.1%
	Early		20	26.0%
	Late		50	64.9%
	- Immediate then late seizures		10	20.0%
	- Early then late seizures		15	30.0%
	- Late seizures only		25	50.0%
Type of seizures	**Generalized**		46	59.7%
	Focal		10	13.0%
	Focal then generalized		21	27.3%
ECG results	**Abnormal**		48	62.3%
	Normal		29	37.7%

**(CT and MRI guided)*

Table (2): Chi square statistical analysis test of timing of seizure in relation to type of accident, site of injury and EEG results among the studied patients.

Variables		Timing of seizures						Chi square	P-value
		Immediate		Early		Late			
		Number	%	No.	%	No.	%		
Type of accident	**Transport Injuries**	5	15.2	2	6.1	26	78.8	17.456 FE (#)	0.009**
	Blunt Trauma	1	4.3	8	34.8	14	60.9		
	Open Head Injury	1	10.0	4	40.0	5	50.0		
	Fall from Height	0	0.0	6	60.0	4	40.0		
	Polytrauma	0	0.0	0	0.0	1	100.0		
Site of injury	**Frontal**	3	5.5	16	29.1	36	65.5	8.725 FE (#)	0.172
	Temporal	4	20	3	15	13	65.5		
	Occipital	0	0	1	100	0	0		
	Polytrauma	0	0	0	0	1	100		
EEG Result	**Abnormal**	6	12.5	8	16.7	34	70.8	6.151 FE (#)	0.050*
	Normal	1	3.4	12	41.4	16	55.2		

(**) P is highly significant at 0.01, (*) P is significant at 0.05, (#) Fisher Exact (FE) test was used as (20.0%) of the cells or more have expected count less than 5

Discussion

In the current study, males had a higher incidence of developing PTE (64.9 %) compared to females (35.1%) with mean age of 36.12 ± 12.41 years. Most cases were in the age groups less than 45 years old. Similar age and gender distribution of PTE cases was obtained from the retrospective follow-up study by Zhao et al. (2012), males constituted (73.0%) of. On the contrary, Christensen et al. (2009) noted that the relative risk of post-traumatic epilepsy was slightly higher in women (RR= 2·49) than in men (RR= 2·01). The increased percent of males at risk for TBI and developing PTS and PTE may be attributed to the hard nature of their work.

Transportation injuries were the most prominent type of accidents in the current study (42.9%), followed by blunt trauma to the head (29.9%), open head injuries, and fall from a height accident (13% each). Previous studies pointed that road traffic accidents (RTA) were the leading cause of TBI, however some reported higher incidence of fall from heights (Thapa et al. 2010; Khiari et al.,2011; Peeters et al., 2015).

Frontal lobe injuries were reported in 51.9% of study population, followed by injuries to the temporal lobe (45.5 %). Conversely, Gupta et al. (2014) evaluated PTE patients and noted that most of them had localization-related epilepsy: 57% had temporal lobe epilepsy, 35% had frontal lobe epilepsy, and 3% each had parietal and occipital lobe epilepsy.

Immediate seizures after TBI were recorded in 9.1 % of the studied patients compared to 26% with early PTS. Patients with late PTS were the majority accounting for 64.9% of study patients. Regarding patients with late PTS, half of them were diagnosed as late PTS from the start while late seizures preceded by early seizures were recorded in 30% and late seizures preceded by immediate seizures in 20%. Similar results were obtained from a study done by Ritter et al. (2016) who found that among TBI cases, 8.9% developed immediate seizures, 1.9% had early seizures and 20% developed late seizures. Also, Zhao et al. (2012) found that among PTE late seizures were the commonest (88.7%) followed by early seizures (66.7%) and immediate PTS (0.8%). While in a study of Thapa et al. (2010), they found that PTS occurred in (11.4%) in TBI patients, immediate seizures occurred in 6.5% of cases, early seizures occurred in 2.1% of cases and late PTE occurred in 2.7% of cases.

Generalized seizures were the most common type of seizures (59.7%) followed by focal with secondary generalization seizures attacks in 27.3% and focal seizures attacks in 13 %.

These results are in accordance with Daniel (2009). On the other hand, a study done by Chen et al. (2017) recorded that focal seizures with secondary generalization were more common compared to complex partial seizures and focal seizures.

In the current study, 62.3% of patients had abnormal epileptogenic changes in EEG while 37.7% had normal EEG for further follow up. Similarly, Pollandt et al. (2017) studied the relation between seizures and epileptiform activity after subdural hemorrhage, the majority had abnormal epileptogenic activity on EEG. Also, in a study done by Chen et al. (2017), all cases showed abnormal changes on EEG except for one case who showed normal EEG during interictal period.

This study shows that there is a strong relationship between the type of trauma and the development of post-traumatic seizures. Our results suggest that transportation injuries are strongly related to occurrence of immediate post-traumatic seizures. Falling from heights is an important risk factor for occurrence of early post-traumatic seizures while polytrauma is a risk factor for occurrence of late post-traumatic seizures.

So, the type of traumatic accident is an independent risk factor for occurrence of seizures. This result agrees with that obtained by Thapa et al. (2010) that also stated that type of TBI is an independent risk factor for the occurrence of seizures especially due to falling from heights. While in a study done by Frey (2003) it was stated that young age, intra-cranial hemorrhage, and increased injury severity were significant risk factors for early and late post-traumatic seizures. In a study done by Mahler, et al. (2015) they found that an isolated intra-cranial hemorrhage or brain contusion is a strong risk factors for developing early PTS as it leads to five to six-fold increase of the risk for developing PTS.

Conclusion

PTS forms a great burden on the affected person and the whole society. Epilepsy has important medicolegal aspects that must be well understood by forensic experts. Males have a higher risk for developing TBI and consequently PTS especially adults ≤ 45 years old. The most common cause of TBI followed by PTS was RTA followed by blunt trauma then fall from height. The most affected brain area was the frontal lobe followed by the temporal lobe.

According to timing of seizures, late PTS was the most recorded while a minority of the studied cases had immediate PTS. The most common form of PTS was generalized tonic-clonic seizures followed by focal seizures with secondary generalization. The type of traumatic accident and the site of trauma are important and independent risk factors for developing PTS.

Recommendations

- Collaboration of neurologists and forensic experts in diagnosis and management of cases with PTS is recommended.
- Detailed history about the traumatic event must be well documented for forensic application.
- Proper documentation of clinical data, diagnostic measures, complications, and management is very important for follow up of TBI and PTS/PTE.
- Neurologists must understand the important medicolegal aspects of PTE.
- Modification and addition of specific Egyptian civil and criminal laws for dealing with epileptic patients are recommended.

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دراسة طبية شرعية للصرع ونوبات التشنج عقب إصابات الدماغ الرضية بمستشفى الدمرداش ومستشفى عين شمس التخصصي (٢٠١٨ – ٢٠١٧)

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الملخص العربي

المقدمة: تعد إصابات الدماغ الرضية من أكثر الأسباب الرئيسية للوفاة والإعاقة بين في جميع أنحاء العالم. تعتبر نوبات ما بعد الإصابة الدماغية والصرع اللاحق للإصابة الدماغية من المضاعفات الكارثية الهامة للإصابات الدماغية الرضية. الصرع له جوانب طبية قانونية مهمة لكل من المريض والطبيب.

الهدف من الدراسة: تحديد أشكال نوبات ما بعد الإصابة الدماغية (معممة، بؤرية، أو بؤرية متبوعة بالثانوية المعممة)، موقع بؤرة الصرع، طبيعة إصابة الدماغ التي تسببت في حدوثها ، عوامل الخطر لحدوث الصرع والأهمية الطبية والقانونية للصرع.

الطريقة: تم إجراء دراسة مستعرضة مستقبلية شملت المرضى الذين يعانون من نوبات ما بعد الإصابة الدماغية والصرع اللاحق للإصابة الدماغية الذين قدموا إلى مستشفيات الدمرداش وعين شمس التخصصي خلال فترة الدراسة. تم جمع البيانات من المرضى عن طريق استبيان ومن الملفات الطبية. تم تصنيف المرضى إلى ثلاث مجموعات وفقًا لوقت حدوث الصرع اللاحق للإصابة الدماغية.

النتائج: تم تضمين ما مجموعه ٧٧ مريضاًو كانت معظم الحالات في الفئة العمرية الأقل من ٤٥ عامًا. كان المرضى الذكور أكثر تمثيلاً في الدراسة (٦٤.٩٪) وكانت إصابات حوادث المرور هي النمط الأبرز للإصابات الدماغية الرضية تليها الإصابات الحادة (٢٩.٩٪) ، وإصابات الرأس المفتوحة (١٣٪) ، والسقوط من الارتفاع (١٣٪) والصدمات المتعددة (١.٣٪). كان المكان الأكثر

إصابة هو المنطقة الجبهية للمخ (٥١.٩٪) تليها المنطقة الصدغية (٤٥.٥٪). تضمنت المضاعفات المصاحبة النزف داخل الجمجمة (٨٧٪) وكسر الجمجمة (٣٥.١٪). تم تسجيل نوبات فورية في ٩.١٪ من المرضى الخاضعين للدراسة مقارنة بـ ٢٦٪ أُصيبوا بتشنجات مبكرة. كان المرضى الذين يعانون من التشنجات المتأخرة يمثلون الأغلبية بنسبة ٦٤.٩٪ من مرضى الدراسة ، منهم ٥٠٪ يعانون من التشنجات المتأخرة من البداية. تعرضت معظم الحالات لنوبات معممة (٥٩.٧٪) تليها نوبات صرع بؤرية ثانوية في (٢٧.٣٪) وأقلها كانت هجمات نوبات صرع بؤرية (١٣.٠٪). كما أظهر مخطط كهربية الدماغ نشاط غير طبيعي لدى (٦٢.٣٪) من المرضى ونشاط طبيعي لدى (٣٧.٧٪).

الخلاصة: نوبات ما بعد الإصابة الدماغية والصرع اللاحق للإصابة الدماغية هي نتائج مهمة ومعروفة لإصابات الدماغ الرضحة ذات جوانب طبية وقانونية هامة. يعد نمط إصابة الرأس ومكان المنطقة المصابة من عوامل الخطر المهمة في نوبات ما بعد الإصابة الدماغية، كما أن النشاط غير الطبيعي لتخطيط كهربية الدماغ هو مؤشر مهم لحدوث نوبات ما بعد الإصابة الدماغية.

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