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Impact of psychiatric and neuropsychological sequelae of traumatic brain injury on the duration of legal time periods

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Introduction. In the forensic setting, diagnosis of sequels and determination of the legal periods are central to the assessment of traumatic brain injury (TBI). The analysis of the relationship between descriptors of TBI and legal periods is undertaken.

Method. Retrospective study of 50 TBI. Demographic information, severity and characteristics of the TBI, neuroimaging data, treatments, legal periods and sequels were gathered. Descriptive statistics and correlational analysis were performed.

Results. Glasgow Comma Scale was available in 47 cases but coma duration and posttraumatic amnesia only in 21. There was information on early TAC in 48 cases and follow-up neuroimaging (after three months) was available in 46. 26 patients received the diagnosis organic personality disorder and this correlated with longer legal periods. Affective disorder (N=6), anxiety disorder (N=5) and postconcussional syndrome (N=5) were less prevalent. Average "time in hospital" was longer than two months. "Healing time" and "disability time" were on average longer than a year. "Healing time" and "time in hospital" were longer with left sided lesions.

Conclusion. In the forensic assessment of TBI, availability of information regarding the duration of coma and posttraumatic amnesia should be improved. Left sided lesions and the presence of organic personality disorder predict longer legal periods. Understanding of these facts requires a more detailed analysis.

Key words:

Legal times. Survey. Traumatic brain injury. Psychiatric sequelae. Neuropsychological sequelae

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Impacto de las secuelas psiquiátricas y neuropsicológicas de los traumatismos craneoencefálicos sobre la duración de los tiempos legales

Introducción. En la peritación de los traumatismos craneoencefálicos (TCE), la determinación de las secuelas y de los tiempos legales (tiempo de hospitalización, de impedimento y de curación) son clave. Se analiza la relación de éstos con descriptores generales de los TCE y con las secuelas psíquicas.

Metodología. Estudio retrospectivo de 50 TCE. Se recogió información sociodemográfica, antecedentes, severidad y caracterización del traumatismo, neuroimagen, tratamientos, tiempos legales y secuelas. Las características de los 50 casos se describen utilizando estadística descriptiva, índices de correlación o chi cuadrado

Resultados. En 47 casos consta la escala de coma de Glasgow; sólo en 21 se dispone de la duración del coma o de la amnesia postraumática. En 48 casos consta la tomografía axial computarizada (TAC) temprana y en 46 hay neuroimagen después de los 3 meses. Se diagnosticó un trastorno orgánico de la personalidad en 26 casos y su presencia se correlaciona con tiempos de curación y de impedimento más dilatados. Los trastornos del ánimo (n = 6), los trastornos de ansiedad (n = 5) y los trastornos postconmocionales (n = 5) fueron menos frecuentes. La media del tiempo de hospitalización supera los dos meses. Tanto las medias del tiempo de impedimento como las de curación superan el año. Los tiempos de curación y de hospitalización son superiores si la lesión es izquierda.

Conclusiones. Aspectos a mejorar en la peritación de los TCE son la disponibilidad de información relativa a la duración de la amnesia postraumática y la duración del coma. La lesión cerebral izquierda y la presencia de trastorno orgánico de la personalidad predicen tiempos legales más dilatados. Su comprensión merece un estudio pormenorizado.

Palabras clave:

Tiempos legales. Peritación. Traumatismo craneoencefálico. Secuelas psiquiátricas. Secuelas neuropsicológicas

INTRODUCTION

The consequences of traumatic brain injury (TBI) that affect cognition, emotional control and behavior are the group of sequelae that have the greatest impact on the long-term social and occupational reintegration of patients.¹⁻³ This must be considered in any forensic assessment, and should be reflected in the diagnosis and any compensation for the injury.⁴⁻⁷ In the forensic evaluation of traumatic brain injury, the sequelae that affect mental health entail much more difficulty to objectively demonstrate their existence than neuromotor or sensory sequelae, which results in discrepancies between experts and makes the forensic doctor's work more challenging.⁸⁻¹⁰ The forensic physician is responsible for appraising the duration of the so-called "legal times:" healing time, disability time and hospitalization time. These three variables and the determination of sequelae are essential components in the calculation of compensations for injury.¹¹⁻¹²

The data discussed below were collected in the context of a doctoral thesis that was developed in the Forensic Medicine Clinic of Bilbao.¹³ The need to develop protocols to guide this type of medical and legal assessments was the inspiration for this investigation. The correction of underestimates of damages, reduction of fraud due to exaggeration of damages,¹⁴ and the reduction of litigation would be some of the practical consequences of using a protocol of this type. Another objective of the thesis included in this article was the identification of factors that influence appraisals of legal times in patients with TBI, in which mental disability is central to the clinical picture. This article centers on the relation between legal times, general descriptors of TBI, and mental sequelae. The data on the relation between legal times and neurological and neurosurgical variables will be addressed in another publication.

METHODS

For this part of the investigation, a retrospective study was made of the files of 50 patients with TBI assessed at the Forensic Medicine Clinic of Bilbao over a period of five years. In every case, a criminal complaint had been filed that required clarification of the criminal responsibility. Cases of traumatic brain injury with evidence of altered levels of consciousness were included. Cases with previous TBI were excluded.

A data collection form was completed that contained sociodemographic information, medical-surgical history, variables describing the etiology and severity of the traumatism, neuroimaging (cranial computed axial tomography [CAT] and magnetic resonance [MR]), the characteristics of the cranial and cerebral damage, hos-

pital treatment and outpatient rehabilitation, legal times and sequelae. Sequelae included post-traumatic epilepsy, motor, sensitive and sensory deficits, and diverse neuropsychological deficits and neuropsychiatric diagnoses (ICD-10).¹⁵ The categories of neuropsychological deficit used were orientation, attention, memory, language, reasoning, executive function, intelligence and behavior. Data derived from standardized neuropsychological tests and qualitative descriptions of the patient's deficit were considered. All this information was obtained from the medical reports on hospital treatment and rehabilitation, and from expert reports available in the files. The medical record and follow-up reports of the forensic doctor responsible for the case, who determined the legal times and issued the final health report, were also available for the investigation.

The characteristics of the 50 cases were described using descriptive statistics. The association between legal times and the rest of the variables was studied using correlation indices, or chi square analysis in the case of categorical variables. Analyses were made with the STATA program.

RESULTS

Description of the sample

In the 50 cases studied, 34 men and 16 women were involved. In relation to the causal circumstances of TBI, 44 were the result of traffic accidents: 13 collisions with pedestrians, 9 motorcycle accidents and the rest were passengers in vehicular accidents. Only 2 occupational accidents, 1 victim of assault and 3 casual accidents were entered.

The data on the severity of the TBI are shown in Table 1, classified according to the 3 most widely accepted variables: the Glasgow coma scale (GCS) score, duration of the coma, and duration of the post-traumatic amnesia. There was a notably high percentage of cases (58%) in which data on the duration of coma and amnesia were not recorded. According to the GCS score, more than half of the sample (28 patients) experienced severe TBI. Early (before 48 hours) neuroimaging (CAT or MR) results were available in 48 cases and neuroimaging after three months was also available in 46 cases.

The characteristics of the brain injuries are summarized in Table 2: skull fracture, bleeding, and injury side. Closed TBI (41) was predominant, cranial fracture was often absent²⁹ and meningeal bleeding (epidural, subdural or subarachnoid bleeding in 34 cases) predominated over parenchymal bleeding. Injuries were distributed equally between sides (18 right and 17 left), with 11 cases of bilateral or diffuse brain damage

Table 1		Severity of TBI	
		N	%
Glasgow coma scale	Mild: 12–15 points	8	16
	Moderate: 9–12	11	22
	Severe ≤ 8	28	56
	Not recorded	3	6
Duration of the coma	0 days	8	16
	1–7 days	3	6
	8–14 days		36
	15–21 days	4	8
	22–30 days	3	6
	Not recorded	29	58
Duration of post-traumatic amnesia	< 8 days	8	16
	8–28 days	4	8
	29–60 days	4	8
	More than 60 days	5	10
	Not recorded	29	58
n = 50			

Table 2		Description of injuries in TBI	
		N	%
Scalp wounds		9	18
Skull fractures	Fractures absent	29	58
	Skull vault	8	16
	Skull base	9	18
	Depressed fractures	4	8
Intracranial bleeding	Epidural	5	10
	Subdural	18	36
	Subarachnoid	11	22
	Parenchyma	11	22
	Bleeding absent	5	10
Brain damage	Not observed	4	8
	Right predominance	18	36
	Left predominance	17	34
	Bilateral or diffuse	11	22
n = 50			

Psychiatric and neuropsychological sequelae

The distribution of psychiatric diagnoses and the presence of major types of neuropsychological deficit are shown in figures 1 and 2 (the "change of behavior" category was added to the classic cognitive functions, including language).

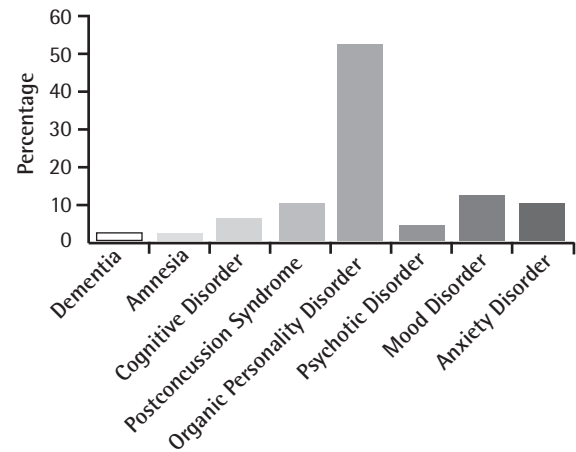


Figure 1 Neuropsychiatric sequelae.

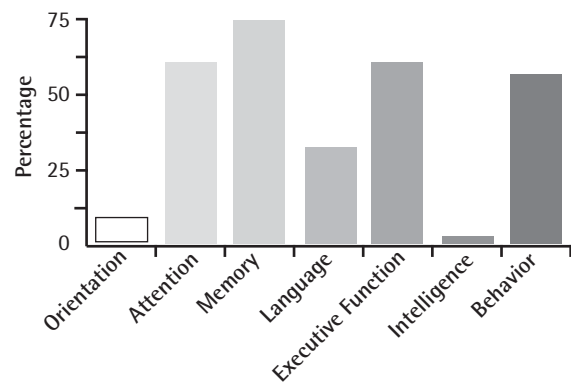


Figure 2 Neuropsychological sequelae.

A psychiatric diagnosis was available in 49 cases, which gives an idea of the high prevalence of this type of complications in severe TBI. Organic personality disorder was diagnosed in more than half of the cases (n = 26). The diagnosis of psychiatric disorders was followed in frequency by mood disorders (n = 6), anxiety disorders (n = 5) and postconcussion syndrome (n = 5). Psychotic disorders were very infrequent (n = 2) and the diagnosis of dementia (n = 1) seems to be disappearing as the cognitive disorder is being more precisely characterized by neuropsychological evaluations.

Neuropsychological sequelae are extraordinarily frequent. In this study, we collected information derived from quantitative tests as well as from the qualitative description of cognitive function obtained in the clinical interview. Despite the difficulty in defining subtypes of cognitive dysfunction, the high prevalence of memory (n = 37), attention (n = 30) and executive function (n = 30) disorders was noteworthy.

Times	Legal times (days)			
	Mean	Standard deviation	Minimum	Maximum
Hospitalization	64.38	74.71	0	331
Disability	397.00	173.66	48	807
Healing	436.00	157.85	157	807

Legal times

The means and intervals of the three legal times are shown in Table 3. The mean hospitalization time was more than two months; cases with hospitalization in excess of three months corresponded to treatment in specialized brain damage rehabilitation units. Both the mean disability time and healing time were longer than a year, with an extremely wide interval, including 9 patients who required more than 600 days for healing.

The correlation between the disability time and healing time was high (0.75; $p = 0.0001$; $n = 50$); these values coincided in 37 cases, whereas the disability time was shorter than healing time in 13 cases. The relation between hospitalization time and disability time was less significant (0.37; $p = 0.007$; $n = 50$) and there was no significant relation between hospitalization time and disability time (0.27; $p = 0.057$; $n = 50$).

Relation between the duration of legal times and the severity of traumatic brain injury, injury location, and psychiatric and neuropsychological variables

Although the correlation between the three legal periods and coma duration was clearly significant, the value of this correlation was undermined by the small sample size, n

$= 13$. For the study of the correlation between legal times and the Glasgow coma scale, the sample size was $n = 47$. Only the correlation between hospitalization time and the Glasgow coma scale attained statistical significance (0.35; $p = 0.0158$). The healing and hospitalization times correlated significantly with the injury location. In both cases, healing and hospitalization times were longer for injuries in the left hemisphere (Table 4).

In view of the distribution of psychiatric diagnoses (with a preponderance of organic personality disorder), the analyses in the study of the relation between legal times and the presence or absence of organic personality disorder clustered around psychiatric diagnoses (Table 5). For the rest of the diagnoses, the samples (" n ") were very small. The diagnosis of personality disorder correlated with significantly longer healing and disability times. The hospitalization times pointed in the same direction without attaining statistical significance. The presence of mood disorders was also related to longer legal times, whereas the relation was inverted in postconcussion syndrome; the diagnosis of postconcussion syndrome was related to short legal times, although not in a statistically significant way, as in the case of mood disorders.

In the relation between legal times and neuropsychological sequelae (Table 6), the correlation between the duration of disability time and four of the neuropsychological variables was noteworthy: attention, memory, executive functions, and behavior disorders. The hospitalization time also correlated significantly with memory and executive function disorders.

DISCUSSION

Classification of TBI always includes an evaluation of severity and a description of the cerebral and cranial injuries.^{16,17} Three variables used to evaluate severity are repeatedly mentioned in the bibliography: the Glasgow coma scale,¹⁸ duration of the coma,¹⁹ and the duration of post-traumatic amnesia.²⁰⁻²²

Brain damage	Relation between legal times and the location of brain damage									
	n	Times								
		Hospitalization (days)			Disability (days)			Healing (days)		
50	Mean	Standard deviation	p	Mean	Standard deviation	p	Mean	Standard deviation	p	
None	4	18.75	19.50							
Right	18	71.39	79.99		344.78	158.16		367.83	147.03	
Diffuse	11	45.09	24.94	0.000	405.00	122.23	0.273	422.73	129.76	0.016
Left	17	80.17	93.49		441.59	218.65		519.23	163.93	

Brain damage	n	Times								
		Hospitalization (days)			Disability (days)			Healing (days)		
		50	Mean	Standard deviation	p	Mean	Standard deviation	p	Mean	Standard deviation
Postconcussion syndrome	No 45	69.73	76.76	0.13	403.40	173.37	0.470	441.16	159.92	0.490
	Si 5	16.20	18.96		343.40	186.47		389.60	144.70	
Post-traumatic personality change	No 24	47.96	58.45	0.14	315.92	151.44	0.001	382.00	148.92	0.018
	Si 26	79.54	85.46		472.62	160.48		485.85	151.83	
Mood disorder	No 44	62.38	67.23	0.61	380.61	161.25	0.060	424.48	145.95	0.160
	Si 6	79.00	124.68		520.50	226.39		520.50	226.39	
Anxiety disorder	No 45	68.38	77.53	0.26	396.11	182.03	0.870	434.67	164.30	0.860
	Si 5	28.40	21.80		409.00	69.13		448.00	89.96	

Brain damage	n	Times								
		Hospitalization (days)			Disability (days)			Healing (days)		
		50	Mean	Standard deviation	p	Mean	Standard deviation	p	Mean	Standard deviation
Attention disorder	No 20	46.75	64.83	0.170	318.60	165.13	0.007	397.90	157.48	0.170
	Si 30	76.13	79.62		449.93	161.10		461.40	155.51	
Memory disorder	No 13	29.00	46.29	0.040	286.00	158.75	0.005	398.23	154.04	0.320
	Si 37	76.81	79.21		436.54	163.07		449.27	159.09	
Thought and executive function disorder	No 20	30.70	38.61	0.008	329.50	156.62	0.020	407.55	152.59	0.300
	Si 30	86.83	84.57		442.67	172.00		454.97	160.98	
Behavior disorder	No 21	57.38	77.41	0.540	321.52	141.80	0.008	384.86	139.66	0.054
	Si 28	70.82	74.67		451.75	179.18		473.17	165.11	
Language disorder	No 34	50.76	67.29	0.060	362.50	162.75	0.036	419.26	147.39	0.280
	Si 16	93.31	83.44		471.56	177.81		471.56	177.81	

Injury classification is usually done with neuroimaging techniques: CAT and MR are the most widely used. A preliminary aspect of this study was to check the availability of data in the files, which would make it possible to accurately classify the type of TBI that was being evaluated. Whereas GCS was recorded in 47 of the cases, the duration of coma and post-traumatic amnesia were recorded in only 21 cases. In the case of description of the injuries by means of neuroimaging, 48 patients underwent a CT scan before 48 hours and 46 had MR after 3 months. The data reflect a strength of the health care system—the extensive availability and use of neuroimaging techniques. They also reveal a weakness—scant attention was given to documenting the variables that have to be evaluated by direct observation of the patients for days or weeks after TBI. The intervention of health care professionals in the acute phase is guided by protocols, with the ambulance personnel beginning

the ECG evaluation, which is then repeated when the patient reaches the hospital center. The duration of the coma, which is clearly observed, and the duration of post-traumatic amnesia, which in most cases is easily determined, are not evaluated and recorded as consistently as the ECG. This is a point that could be improved, as shown by the findings of this study. In the case of post-traumatic amnesia or confusion, it is possible that the very existence of these conditions may be overlooked in many cases. This has implications for decision-making, such as when the patient should be discharged, the treatment of agitation as a permanent problem, and the lack of explanations to the family regarding the probable outcome.

The legal times can be organized by mean duration from the shortest to the longest: hospitalization time, disability time, and healing time. Disability time refers

to the time that passes until the person is able to resume his or her prior occupational activity. On occasions, a health-related aspect that does not affect performance may remain unresolved, which explains why healing time was longer than disability time in 13 cases; in the rest of the cases, disability time and healing time coincided. The correlation between these two variables was very high, indicating a close relation between disability and healing. Hospitalization time only showed a significant relation with disability time. Hospitalization time tended to lose its predictive value as legal times became longer. The progressive generalization of rehabilitation care in Brain Injury Units may modify these hospitalization times and thus change the criteria for continuing hospital treatment. As this is a relevant variable in the compensation process, a health care scenario with two different types of hospitalization times must be contemplated: admission to a critical care unit and a stay in a dedicated multidisciplinary rehabilitation unit.

Psychiatric diagnoses describe a clinical problem that is clearly different from those of the general psychiatry practice.²³ Quantitatively, the psychoses are practically nonexistent; personality disorders with their respective changes in behavior affect almost one half of patients,²⁴ and affective and anxiety disorders have an intermediate frequency.²⁵ A new category, postconcussion syndrome, has emerged.²⁶ The relation between postconcussion syndrome and legal times indicates that the presence of this diagnosis was related to much shorter legal time periods, which contrasts with patients with organic personality disorder. The healing and disability times of the group with organic personality disorder was associated with significantly longer legal times than in patients without personality disorder. Postconcussion syndrome is a psychiatric diagnosis related to less severe TBI and more rapid recovery and stabilization. Personality disorder, in contrast, is predictive of longer hospitalization, disability and healing times than in patients without personality disorder.

In relation to cognitive disorders or neuropsychological sequelae, the distribution of psychiatric diagnoses may give the false impression that such disorders are uncommon: dementia, 1 case; amnesia, 1 case; cognitive disorder, 5 cases. Consultation of the table of neuropsychological sequelae reveals that these problems are very frequent.²⁷⁻²⁹ Consequently, the question of why these findings are not reflected in the psychiatric diagnoses must be asked. In our opinion, the response to this question lies in the diagnostic algorithms that psychiatrists have been trained to use, which are highly sensitive for detecting alterations in perception (hallucinations), in the content and course of thought, and in affective symptoms, and are less sensitive for diverse types of cognitive dysfunction. In the area of cognitive dysfunction, it is important for a psychiatrist to differentiate between dementia, confusional condition,

and affective disorder. Similarly, the symptoms and signs that are paradigmatic of major psychiatric disorders have enjoyed diagnostic priority and have relegated the study of other comorbid symptoms. Thus, the presence of a marked and permanent change in behavior entails a diagnosis of organic personality disorder without cognitive deterioration receiving more diagnostic attention.

An unexpected and very interesting finding was the relation between the side of the injury and legal times. The group of people with bilateral or diffuse damage had much fewer mean hospitalization days than the two other groups. It is possible that inclusion in the first group of some relatively mild diffuse axonal damage has contributed to lowering the mean. Nevertheless, when the disability and healing times were analyzed, the group of patients with left-sided injury maintained and increased their position as the subgroup with the longest legal times; the patients with right-sided injuries had the shortest legal times and the patients with bilateral or diffuse damage had intermediate times. These differences were statistically significant for hospitalization time and healing time. Stated otherwise, injury of the dominant hemisphere predicts more extended legal times. Whereas problems of language, praxia and gnosia can help to explain the longer disability and healing times, the hospitalization times should have been less affected by these problems, unless several of the patients treated in rehabilitation units prolonged their stay due to the need for speech rehabilitation. Since an integral cure or complete restitution is rare in these cases, it can only be concluded that the sequelae of patients with injury of the nondominant hemisphere stabilize more quickly, or therapists complete the full range of rehabilitation possibilities more rapidly than in the case of left-sided injuries.

CONCLUSIONS

In the forensic medicine valuation of TBIs, GCS data are usually available in the first 48 hours, together with information on early neuroimaging and follow-up. Information on the duration of post-traumatic amnesia and coma is lacking.

All the patients except one had some psychiatric diagnosis, organic personality disorder being diagnosed in more than half of the cases. At least 30 of the 50 patients also had attention, memory, and executive function disorders.

The mean hospitalization time was longer than two months; the mean disability and healing times were more than a year and, in 9 patients, lasted longer than 600 days.

Injury of the left hemisphere and presence of organic personality disorder correlated with longer legal times. In other words, the presence of communication disorders and

behavioral disorders were predictive of longer healing and disability times.

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