Mild Traumatic Brain Injury: Epidemiology, Management, Outcome

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Abstract

Introduction: Mild traumatic brain injuries represent 80% of the total traumatic brain injuries. Their management is conducted as recommended by EBIC (European Brain Injury Consortium) or WFNS (World Federation of Neurosurgical Societies).

The aim of the study is to analyze the management of patients with mild traumatic brain injuries who present at the Emergency Department (ED), of the admitted ones, the paraclinical investigations used and the cerebral lesions which these identify.

Material and methods: During a 3 months period, 533 patients with mild traumatic brain injuries presented at the ED. We have followed these patients regarding the demographic data, the causes that led to the mild traumatic brain injuries and the paraclinical investigations used.

Regarding the admitted patients, we have taken into consideration risk factors, neurological symptoms, the need to repeat a paraclinical investigation, their management and outcome.

Results: Out of the 533 patients who presented at the ED, 248 (65%) were adults and 158 (29.64%) were third age patients. The remaining 27 (5%) were aged between 0-18 years old.

Male patients (359; 67%) were more frequently affected than female patients (174; 32.6%).

The top three causes were aggressions (57%), car accidents (27%) and same level falls (6.3%).

The patients were investigated by skull X-rays (47.8%) and cerebral CT (computed tomography) scans (52.35%).

Out of the total number of patients, 198 were admitted; these had the following risk factors: age > 65 years old (31%), alcohol use (18.6%), seizures (7.57%) and the following clinical symptoms: headaches (71%), vomiting (9.6%), dizziness (36.8%), loss of consciousness (31.8%).

Out of the admitted patients, only 12 presented cerebral lesions: hemorrhagic brain contusions (n=5), small subdural blood collections (n=3), traumatic subarachnoid hemorrhages (n=2), acute subdural hematoma (n=1) and intraventricular hemorrhage (n=1).

The patient with acute subdural hematoma was operated on and had a favorable outcome.

The patient with intraventricular hemorrhage, who was 90 years old and presented with coagulopathy, has deceased.

All the other patients were discharged after a mean hospitalization period of 3 days.

Conclusions: Out of the patients with mild traumatic brain injuries, only a small number present cerebral lesions.

For their diagnosis, expensive paraclinical investigations are used in both the ED and the neurosurgical department.

Careful monitoring of the evolution of the neurological status and performing a cerebral CT scan only in case of neurological deterioration would save resources that could be targeted for the therapeutic stage.

Abbreviations: ED = Emergency Department, EBIC = European Brain Injury Consortium, WFNS = World Federation of Neurosurgical Societies, GCS = Glasgow Coma Scale, CT = Computed Tomography.

Introduction

A mild traumatic brain injury is defined as a maximum 20 minutes consciousness loss or as a short period of retrograde amnesia, GCS (Glasgow Coma Scale) score of 13-15, without focal neurological deficits, without seizures and with normal CT scan. Mild traumatic brain injuries represent 80% of the total traumatic brain injuries.

Their management is conducted according to EBIC or WFNS regulations, between which there are minor approach differences.

Through their multitude, mild traumatic brain injuries consume an important part of the budget allocated to ED or neurosurgical departments from the emergency hospitals.

The aim of this study is to analyse the evolution of patients with mild traumatic brain injuries and their management in ED as well as in the neurosurgical department.

Material and methods

We identified patients with mild traumatic brain injuries between April and June of 2013, taking into consideration some epidemiological data (age, sex, living environment – urban/rural), causes and investigation methods in the ED (cerebral CT scan, skull X-ray).

For patients hospitalized in the neurosurgical departments we noted: risk factors, reasons of hospitalization, signs of neurological worsening, necessity of paraclinical investigations, treatment and outcome.

Results

During the three months period of study, 533 patients presented at the ED with mild traumatic brain injuries. Two thirds were men and one third were women; 72.8% were from an urban environment and 27.2% were from a rural environment.

Middle aged patients were twice as many as elderly ones (patients over 65 years). These represent a third of the total of patients admitted with mild traumatic brain injuries.

Causes of traumatic brain injuries are presented in Table 1; the top three causes are aggressions (57.03%), followed by car accidents (27.01%) and same level falls (6.38%).

Patient's investigations in the ED were carried out by skull X-rays and CT scans in approximately equal proportions, with a slightly higher incidence of CT scans. These investigations pointed out extracranial, facial and intracranial lesions (table 1). Following the paraclinical investigations we established that 12 patients had intracranial lesions, 5 of which were hemorrhagic brain contusions, 3 small subdural blood collections, 2 cases of traumatic subarachnoid hemorrhages, 1 acute subdural hematoma and 1 intraventricular hemorrhage.

Among the 533 patients who presented

at the ED, 198 were admitted in the neurosurgical department, out of which 195 (98.48%) performed cerebral CT scan in the ED and 3 had skull X-rays. 252 patients were sent home and 83 refused admission.

Out of the 252 patients who were sent home, 82 (32.54%) had normal cerebral CT scans and the rest presented with normal skull X-rays.

Out of the 83 patients who refused admission, 2 (2.4%) presented diffuse cerebral edema (Marshall type II lesion) on the CT scans and the rest had normal skull X-rays.

Admission was motivated by the presence of the risk factors, clinical symptoms, as well as the presence of traumatic intracranial lesions revealed by the cerebral CT scan (table 2).

The characteristics of admitted patients are presented in table 2.

Out of the admitted patients, 194 presented with GCS score of 15 points, 3 with GCS score of 14 points and one patient with GCS score of 13 points. The GCS score of patients who presented at the ED and of adimtted patients is presented in table 3.

All patients with GCS score of 14 and 13 points were investigated by cerebral CT scan. They were admitted and the CT scan was repeated on the neurosurgical department.

Among the patients with GCS score of 15 points at admission, 275 (51.98%) out of 529 were investigated by cerebral CT scan. 191 patients (69.45%) were admitted with CT scan and 3 with skull X-rays.

Out of the 279 patients who were investigated by cerebral CT scan in the ED, 195 (69.89%) were admitted and one patient (0.51%) was operated on for an acute subdural hematoma.

TABLE 1

Characteristics of patients who presented at the ED

		No.	**%**
Age	0-18 years old	27	5.07
	19-64 years old	248	65.29
	>65 years old	158	29.64
	Total	**533**	**100**
Sex	M	359	67.35
	W	174	32.65
Cause	Aggressions	304	57.03
	Car accidents	144	27.01
	Same level fall	34	6.38
	Unspecified conditions	20	3.75
	Bike fall	13	2.44
	Other level fall	10	1.88
	Accident at work	6	1.13
	Sports accident	2	0.38
Investigations	Skull X-ray	255	47.84
	Cerebral CT scan	279	52.35
Revealed lesions	Skull fractures	5	0.94
	Intracranial lesions	12	2.25
	Scalp abrasions	75	14.07
	Scalp plagues	127	23.83
	Epicranian hematoma	36	6.75
	Facial lesions	287	53.84

TABLE 2

Characteristics of admitted patients

		No.	%
Age	0-18 years old	0	0
	19-64 years old	136	68.69
	>65 years old	62	31.31
	Total	198	100
Risk Factors	Age >65 years	62	31.31
	Alcoholism	37	18.68
	Epilepsy	15	7.57
	Previous neurosurgical interventions	1	0.5
	Coagulopathy	6	3.03
Clinical symptoms	Headache	142	71.72
	Vomiting	19	9.6
	Dizziness	73	36.87
	Loss of consciousness	63	31.82
	Retrograde amnesia	4	2.02
	Scalp plagues	71	35.86
Neurological signs	Motor deficit	1	0.5
Skull lesions revealed by X-ray or CT scan	Cranial fissures	0	0
	Skull fractures withoutclogging	5	2.52
Cerebral lesions revealed by the CT scan	Hemorrhagic contusions	5	2.52
	Traumatic subarachnoid hemorrhage	2	1.01
	Acute subdural hematoma	1	0.5
	Small subdural blood collections	3	1.51
	Intraventricular hemorrhage	1	0.5
Hospitalization Period	<24 hours	9	4.55
	24-48 hours	80	40.4
	48-72 hours	60	30.3
	>72 hours	49	24.75
	Mean Hospitalization Period		3.03 days

TABLE 3

The relationship between the GCS score and the CT scan investigation

GCS		**Patients**		**CT**	
		No.	**%**	**No.**	**%**
Patients in ED	15	529	99.25	275	51.98
	14	3	0.56	3	100
	13	1	0.19	1	100
Admitted patients	15	194	97.97	191	98.45
	14	3	1.52	3	100
	13	1	0.51	1	100

TABLE 4
The results of the cerebral CT scan performed in the ED

		Number of patients	Observations
Positive results	Intracranial lesions	12	Admitted
	Cerebral edema	2	Refused admission
	Total	14	
Negative results	Normal CT scan	82	Sent home
	Normal CT scan	183	Admitted
	Total	265	

In the neurosurgical department, 3 patients (1.51%) presented neurological deterioration, one of each group of patients with GCS score of 15, 14 and 13 points.

One patient was operated on for an acute subdural hematoma. The rest of the patients with intracranial lesions were clinically monitored and also, the cerebral CT scan was repeated when needed, the patients being discharged in an improved condition.

Discussions

Over 10 million traumatic brain injuries are produced annually worldwide (1).

Following the statement of Hippocrates, no trauma „is too trivial to ignore". The patients with mild traumatic brain injuries, who are the majority, represent 80% of the admitted patients with traumatic brain injuries (2). Both EBIC and WFNS developed classifications of traumatic brain injury, as well as recommendations for management (table 5, table 6).

Epidemiological data of our study is consistent with the literature. Mild traumatic brain injuries prevail among male patients. Since we only refer to mild traumatic brain injuries, their main cause is represented by aggressions (57%), followed by car accidents (27%). In other studies, car accidents represent the main cause both regarding the mild traumatic brain injuries as well as brain traumas overall (3, 4, 5). Figures show a tendency to aggression among our poor educated population.

Older patients represent almost a third of the patients with mild traumatic brain injuries. These patients with multiple comorbidities requiring investigations and prolonged hospital admission are resource consumers.

Our survey data on patients with craniocerebral traumas reveal that CT scan examination was widely used in the ED, on 52% of the patients who were examined. 48% of the patients were examined using the skull X-ray. Skull lesions were identified among 5 patients (0.94%) and intracranial lesions were identified among 12 patients (2.25%).

CT scan examination identified 5 cases of hemorrhagic brain contusions, 2 cases of traumatic subarachnoid hemorrhages, 3 cases of small subdural blood collections and one case of acute subdural hematoma which was operated.

TABLE 5
EBIC classification of mild traumatic brain injuries

Degree	GCS score	Observations
	13-15	Does not include cases with: -focal neurological deficits -fractures with clogging -CSF fistula
0	-without loss of consciousness -without amnesia	-sent home
0 with risk of late deterioration	- alcoholism -drugs -age (both limits) -epilepsy -history of neurosurgical interventions	-cerebral CT scan -24 hours hospitalization
1	-loss of consciousness < 5 minutes -retrograde amnesia -headache, vomiting -large scalp plagues	-cerebral CT scan in the first 6 hours -24 hours hospitalization
2	-sleepy patients -GCS score of 14-13 points for 30 minutes after the trauma	-cerebral CT scan -hospitalization until improvement

TABLE 6
Neurotrauma Committee of the WFNS Model for Mild Head Injury

	Low risk	Medium risk	High risk
GCS score	15	15 with clinical findings	14 or 15 with: -neurological deficits or -skull fracture or -risk factors with/ without clinical findings
Clinical findings	No	Amnesia Diffuse headache Vomiting Loss of consciousness	Amnesia Diffuse headache Vomiting Loss of consciousness
Neurological deficits	No	No	Yes
Cranial fracture	No	No	Yes
Risk factors	No	No	Yes: coagulopathy, age > 60 years, previous neurosurgical interventions, epilepsy, misuse of alcohol, drugs
Imaging	No	CT scan/ skull X-ray	CT scan
Disposition	Sent home	Hospitalization: -3-6 h after the CT scan examination -24 h after skull X-ray followed by home observation	Hospitalization (24-48h) fallowed by home observation

One patient with thrombocytopenia, diabetes and chronic renal failure presented intraventricular hemorrhage. This patient, aged 90 years old, with GCS 13 points at admission died after 9 days.

Except for 3 patients, all the other patients who were hospitalized benefited from CT scan examination in the ED.

Out of the 533 patients who presented at the ED, 279 benefited from CT scan examination, but only 195 were hospitalized. 84 patients were not admitted. Out of these patients, 82 presented a normal cerebral CT scan and were sent home and 2 refused admission even though the CT scan showed diffuse cerebral edema. The remaining 81 patients who refused admission were investigated by skull X-ray.

Among the patients who presented at the ED and were investigated by CT scan, 275 presented with GCS score of 15 points.

According to the WFNS classification, 118 patients (42.9%) presented medium risk and 157 (57.1%) presented high risk of neurological deterioration.

Although the WFNS classification regarding patients with mild traumatic brain injuries provides their investigation via CT scan or skull X-ray and hospitalization for 3-6 hours or 24 hours if those are negative, the patients included in this study were investigated using the CT scan in 52.34% of the cases and the admitted ones were hospitalized for a longer period, of 3 days in average. Considering the same group of patients, the EBIC classification recommends CT scan examination during the first 6 hours and 24 hours hospitalization.

Regarding these classifications which are not a hundred percent concordant, having different recommendations for management, ED doctors and neurosurgeons chose over- investigation and longer hospitalization period in order to avoid accusations of malpractice. This was achieved by increasing the costs of medical services.

Among the admitted patients, 3 presented neurological deterioration from the moment of admission, one case out of each group of patients with GCS score of 15, 14 and 13 points. They represent 1.51% of the total number of admissions.

Our study provides contradicting evidence. On one hand, even patients with mild traumatic brain injuries may have intracranial lesions, supporting the need for paraclinical investigations via CT scan and hospital admission. On the other hand, the number of patients with neurological deterioration who require surgery is small.

Regarding the patients with medium risk based on WFNS classification, it is preferred a consuming fund exploration and a longer period of hospital observation.

The media attack on the health system determines the doctors to inefficiently spend public money and, regarding the alternative – skull X-ray and 24 hours hospitalization – they prefer examination via CT scan and 48 hours hospitalization.

Regarding the small number of patients with mild traumatic brain injuries with a positive cerebral CT scan, the National Institute of Clinical Excellence of England and Wales (NICE) established in 2009 the following criteria for requesting a CT scan examination for this group of patients:GCS score < 13 points at any moment after the trauma, GCS score > 13-14 points 2 hours after the trauma, suspecting open or clogged skull fracture, signs of skull base fracture, at least one vomiting episode, retrograde amnesia > 30 minutes;

regarding the patients with loss of consciousness or posttraumatic amnesia, the CT scan will be done immediately even if the patient: is aged ≥ 65 years, presents coagulopathy or presents dangerous lesion mechanism (car accident, more than 1 meter fall).

Miller and Jeret stated that CT scan examination in case of mild traumatic brain injuries is indicated in patients with GCS score < 15 points, when there are skull fractures, clinical signs for skull base fracture, seizures, focal neurological signs or persistent headache (6, 7).

In the USA, annually, 800000 patients with mild traumatic brain injuries are examined in various medical facilities and 1200000 are examined in the ED.

In the ED, the evaluation of patients with concussions is often done through the CT scan. Currently in the USA there is a consensus to reserve cerebral CT scan and MRI when there are suspicions of intracerebral structural lesions: prolonged loss of consciousness (> 1 minute), focal neurological deficit, worsening of clinical symptoms.

Unlike USA, in Romania, all patients with mild traumatic brain injuries are examined in the ED and, even though the vast majority presents with GCS score of 15 points, 52% of them were investigated using the CT scan.

In Moore's study only 1% of patients with mild traumatic brain injury underwent surgical intervention (8). We only operated on one patient with acute subdural hematoma out of the 195 patients hospitalized with CT scan performed in the ED (0.51%).

Because of patients' high expectations of having top imagistic procedures, of financial incentives for doctors (in case the CT scan was requested) and of practicing a defensive medicine style, this imagistic method is highly used. However, some consider that 20-50% of top imagistic procedures are not necessary and don't bring useful clinical information (9).

Information received from the patient's history and from the neurological examination is neglected and there is a high emphasis on cerebral CT scan examination.

Because the health system is confronting with budgetary restrictions, a rational and efficient use of resources with an aim to sustain not only the diagnostic stage but the therapeutic one is needed.

Minimizing resources on investigation and treatment of patients with mild traumatic brain injuries can be performed thorough methods of preventing the occurrence of traumatic brain injuries by reducing aggressions and car accidents and also by reducing the prevalence of risk factors.

Conclusions

Mild traumatic brain injuries affect people of all ages and, among the traumatic brain injuries in general, they are the most frequent.

Their management is conducted according to the recommendations of EBIC or WFNS, among which there are certain differences.

The paraclinical investigations, skull X-ray and cerebral CT scan, are used in similar proportions. The imagistic investigations, which are used in an increasingly large percentage because of the fear of malpractice, detect cerebral lesions in a small number of cases.

A thorough neurological monitoring can avoid expensive imagistic over-investigation.

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