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Research

Epidemiology of severe head injury

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Abstract

Introduction: Severe traumatic brain injury (STBI) is a major public health problem, with a high incidence rate and a high morbidity and mortality rate. It is the 4th leading cause of death in all age groups and the 1st cause of death in people under 40. It is responsible for numerous serious cognitive and neurological sequelae. The aim of this study is to determine the epidemiological characteristics and predictive factors of mortality in severe head trauma.

Material and methods: Prospective study of STBI admitted to the Salim Zemirli health hospital, started in February 2017 over a period of three years.We collected epidemiological data, circumstances of the trauma, clinical and paraclinical evaluation, treatment instituted, occurrence of infectious complications and mortality. The results were expressed as mean, standard deviation, percentage and confidence interval; the statistical study was carried out using a $\chi 2$ test for the univariate analysis of mortality risk factors and the odds ratio for the multivariate analysis.

Results: 150 STBI were collected, with an average age of 34±15.6 years, in the presence of medical history in 25% of cases, the average GS was 6.73 ± 2.8. Anisocoria was observed in 29.33% of cases, mydriasis in 8%, haemodynamic distress in 36% and respiratory distress in 39%, and the CT classification of cerebral lesions according to the Marshall classification was greater than three in 64% of cases. Neurosurgery was indicated in 24% of cases, and the mortality rate was 54%. Univariate analysis of the different prognostic factors for mortality showed that : age (P=0.004) , haemodynamic and respiratory instability (P=0.04) , GLASGOW score ≤ 5 (P=0.03), MARSHALL classification > 3 (P=0.003) , presence of pupillary anomaly (P=0.02), infectious complications (P=0.04) were significantly associated with mortality , multivariate analysis of mortality risk factors showed that age (OR =1.O45) ; GLASGOW score ≤ 5 (OR =3.88) ; MARSHALL classification > 3 (OR =3.25).

Conclusion: severe head trauma is a major cause of mortality in adults, secondary to a number of factors, which may be either directly related to the trauma or to the conditions in which these patients are cared for.

Keywords: Severe head injury, GLASGOW score, MARSHALL classification, pupillary anomalies.

INTRODUCTION

Severe traumatic brain injury (STBI) is defined by a Glasgow score of less than or equal to 8. It is a major public health problem, affecting mainly young adults who are generally in good health [1], with a clear male predominance [2] [3], and is a high-incidence condition. Although the mortality rate in STBI varies from one study to another [4], it is still responsible for significant morbidity [5]. It is the leading cause of death in traumatology, ahead of haemorrhage. Traumatic brain injury generally occurs as part of a polytrauma, with 80% of head trauma patients suffering from at least one associated injury [6]. The lesions associated with head trauma are most often orthopaedic (50%), thoracic (35%) and abdominal (15%) [6]. Cervical spine involvement is found in 7% of head trauma patients [7]. The causes of this pathology are still dominated by road accidents (50-60%) and falls (20-30%), sports and leisure accidents (10-20%) and violence and aggression (10%) [8]. The outcome of STBI depends on the quality of their care, which must begin at the scene of the accident and be codified in regularly updated "GUIDELINES".The aim of our study was to determine the epidemiological characteristics and factors predictive of mortality in severe head injuries.

Patients and methods

This was a prospective study of STBI admitted to the intensive care unit of the Salim Zemirli health hospital over a period of 3 years and included 150 patients. We collected the following data age, sex, medical and surgical history, drug habits, lesion mechanism, lesion association, GLASGOW score on admission, search for signs of localisation by assessing the state of the pupils, presence of a sensory-motor deficit and convulsions, the presence of haemodynamic and respiratory distress, the time taken for treatment, the time taken for the scan to be performed, the classification of lesions found on the brain scan according to the MARSHALL classification, the search for indications for neurosurgical operation, the length of hospitalisation, the occurrence of complications and the outcome of patients. The data were entered into an EXCEL file, and the statistical analysis was carried out using SPSS version 20 software and Epi info Version 7.1.5.0 software.The results were expressed as mean, standard deviation, percentage and confidence interval. $p<0.05$. The statistical study was carried out using a $\chi 2$ test for the univariate analysis of mortality risk factors and the odds ratio for the multivariate analysis.

RESULTS AND DISCUSSIONS

Descriptive analysis of the characteristics of the sample: In our sample (Table 1), the average age of our patients was 34±15.6 years, with a sex ratio of seven men to one woman, in the presence of a medical history in 25% of cases, toxic habits in 22% of cases, road traffic accidents were the most frequent mechanism found in 64% of cases, followed by falls in 31% of cases. In 52% of cases, our patients were admitted secondarily after having been admitted to another hospital. Serious head injuries were only transported by a doctor in 34% of cases, with an average delay of 2.49 ± 0.56 hours with 95% CI [1.88- 3.10h] (Table 2).

Clinical and paraclinical assessment

The evaluation of the three distresses on admission of our patients (Table 3) showed that, in addition to neurological distress, respiratory distress was present in 39% of patients, followed by haemodynamic distress in 36% of cases. Concerning the evaluation of the state of consciousness, the mean Glasgow score was 6.73 ± 0.34 with 95% CI [6.46 -7], in 80% of cases the STBI had a Glasgow score between 6 and 8, the search for signs of localisation found the presence of a pupillary anomaly in 37, 33% of cases with anisocoria in 29.33% of cases and mydriasis in 8% of cases, convulsions in 31% of cases, for signs of brain stem damage, the photomotor reflex was present in 92% of cases.

Brain scans were performed in all our patients, within a mean time of 3.12 ±0.56 hours with 95% CI [2.76 - 3.27 hours]. The distribution of brain lesions according to the Marshall classification concluded that 64% of patients were classified in categories higher than the third class. The rest of the radiological work-up showed that severe head trauma occurred as part of a polytrauma in 75% of cases, and the most frequent associated injury was thoracic damage in 69% of cases, followed by locomotor damage in 23% of cases.

Outcome of patients in intensive care

All our patients were intubated, ventilated and sedated, the average length of hospital stay was 12.51 ±2.86 days with 95% CI [10.55 - 14.47 days], hospitalization in the intensive care unit was marked by the occurrence of infectious complications in 61% of cases, the evolution of severe head injuries was marked by a mortality rate in 54% of cases.

Table 1: Epidemiological characteristics of STBI

Characteristics	N(number of employees)	results
Middle age	150	34±15,6 ans
Age peak	150	[15- 35 [
Sex ratio (M/W)		7M/1W
-Men	131	
-Women	19	
ATCDS		
-Medical	37	25%
-Surgcal	12	8%
- Toxic habits	33	22%
Mechanism		
- Traffic accident	58	39%
- Road accident	37	25%
-Drop	46	31%
- Others	7	5%
Mode of transport		
-Medical	51	34%
-No medical	99	66%
The provenance		
-First hand	72	48%
-Second hand	78	52%

Table 2: Time taken for management and CT scan in STBI

Average time to care = 2,49±0,56h avec IC95% [1,88- 3,10h]
Average time taken to complete a scan = 3 ,12 ±0,56h avec IC95% [2,76 - 3,27h]

Table 3: Clinical evaluation of STBI

Characteristics	N(number of employees)	results
Assessment of the three types of distress		
-Neurological distress	150	100%
-Respiratory distress	58	39%
-Haemodynamic distress	54	36%
Assessment of neurological distress		
- state of consciousness		
• average glasgow score	150	6,73 ± 0 ,34 avec IC95% [6,46 -7]
•GS [3 - 5]	30	20%
•GS [6 - 8]	120	80%
- Signs of location		
•pupillary anomalies	56	37 , 33%
°anisocoria	44	29,33%
°mydriasis	12	8%
•convulsion	4	3%
•sensory-motor deficit	34	23%
-Signs of brain stem damage		
•photomotor reflex	138	92%

Table 4: Outcome of patients in intensive care

Characteristics	N(number of employees)	Results
Indication for neurosurgical surgery	36	24%
Average length of hospital stay	150	12,51 ±2 ,86J avec IC95% [10,55J - 14,47 J]
Infectious complications	91	61%
Mortality	81	54%

Table 5: Distribution of severe head injuries according to the MARSHALL classification

Categories	N(number of employees)	Results
Diffuse lesion I	3	2%
Diffuse lesion II	51	34%
Diffuse lesion III	6	4%
Diffuse lesion IV	28	18,66%
Surgical mass lesions	36	24%
Non-surgical mass lesions	26	17,33%

Descriptive analysis of the characteristics of the sample

In our sample, the average age of our patients was 34±16.4 years, with a sex ratio of seven men to one woman, and a medical history in 21% of cases. Road traffic accidents were the most frequent cause of injury in 64% of cases, followed by falls in 31% of cases. In 52% of cases, our patients were admitted second-hand after having been admitted to another hospital. Serious head injuries were only transported by a doctor in 34% of cases, with an average delay of 2.49 ± 0.56 hours.

Clinical and paraclinical assessment

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Cerebral scans were performed in all our patients, with an average delay of 3.12 ±0.56 hours. The distribution of cerebral lesions according to Marshall's classification concluded that 64% of patients were classified in categories higher than the third class. The rest of the radiological work-up showed that the severe head injury had occurred as part of a polytrauma in 75% of cases. The most frequent associated injury was thoracic damage in 69% of cases, followed by locomotor damage in 23% of cases.

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Univariate analysis of different factors in relation to mortality

Analysis of the impact of seven factors (age, medical history, Glasgow score, pupillary anomalies, haemodynamic and/or respiratory instability, Marshall classification > 3, infectious complications) (Table 4) on mortality showed that there was a strong and significant correlation between these factors, with the exception of medical history, and mortality.

Table 6: Univariate analysis of different factors in relation to mortality

	Dead	NOT dead	P	Significantly
Age (year) IC 95%	37,91 [33,15-42,67[	28,72 [24,72-32,72]	0,004	DS
ATCDS medical	25%	23%	0,74	DNS
Glasgow score≤5	28%	11%	0,03	DS
Pupillary anomalies	43%	30%	0,02	DS
haemodynamic and respiratory instability	61%	43%	0,04	DS
MARSHALL classification>3	72%	46%	0,002	DS
Infectious complications	72%	52%	0,04	DS

Table 7: Multivariate analysis of mortality risk factors

	P	OR	IC95%	OR
Age	0,05	1,045	1,013	1,078
Glasgow score≤5	0,036	3,888	1,094	13,825
MARSHALL classification>3	0,018	3,257	1,219	8,702
haemodynamic and respiratory instability	0,038	2,089	1,067	12,478

DISCUSSION

STBI is a major public health problem, a worldwide scourge that affects young adults, a fact that has been confirmed in numerous studies [9][10][11][12]. In our study, the demographics of our patients were comparable to those reported in the literature [13][14][15]. STBI mainly affected young adults; the mean age of our patients was 34±15.6 years, with a clear male predominance (sex ratio 7 M/1F). The causes of STBI are unanimously accepted in the majority of studies, with road accidents at the top of the list, followed by falls [16][17]. In our study, the majority of STBI patients were victims of road accidents in 64% of cases. The number of people killed in road accidents is rising sharply, and this burden will fall more heavily on low-income countries. If appropriate measures are not taken, road accidents cost countries between 1% and 2% of their gross national product, or US$518 billion a year [18].

The time taken to treat severe head injuries is of major importance, in terms of morbidity and mortality [16]. Improving the prognosis of this condition depends on optimal pre-hospital medical care and an appropriate referral strategy, because any delay or inadequacy in treatment has serious clinical consequences [16] [19]. This delay is responsible for a significant proportion of post-traumatic deaths, which can be avoided by organising the management of severe trauma patients [20]. In fact, 80% of deaths in severe trauma patients during the first 24 hours post-trauma are secondary to either haemorrhagic shock or cranial trauma [20]. In the literature concerning the time taken to treat STBI, we find in developed countries and particularly in France, the study by Bouhours G [16] which records a time (accident-hospital) for STBI of 1 h 55± 48 min. This time is close to that of the study by Tentillier E et al [21] which is 1h41min. The average delay in the management of our patients was 2.49 ± 0.56 h, which is close to that found in Morocco by Sadeq I [22]. In addition to the delay in caring for these patients, there was also a failure in the quality of their transfer: only 34% of our patients were transferred by medical transport.

In our study, serious trauma patients are generally admitted to the local hospital, which is always the closest to the scene of the accident. As a result, more than half of our patients (78patients) are transferred to us after an initial stay in another hospital. However, the initial management of severe head trauma patients in a specialised neuro-resuscitation centre improves their prognosis [23]. This finding was confirmed in the work of Patel et al [24], in a retrospective study comparing two periods before and after the creation of a neuro-resuscitation service specialising in the management of STBI , showed an improvement in the neurological prognosis of these patients of 59.6% with a good prognosis compared with 40.4%, p=0.036. It is common for STBI to be associated with polytrauma [16], and a seemingly isolated head injury should be considered polytraumatic until proven otherwise. This observation has been found in several studies [25] [26]; in our study, STBI occurred as part of a polytrauma in 75% of cases.

An analysis of the impact of seven factors (age, medical history, GLASGOW score, pupillary anomalies, haemodynamic and/or respiratory instability, Marshall classification > 3, infectious complications) on mortality revealed the following:

- There was a strong and significant correlation between increasing age and mortality. This correlation was also observed by Van Haverbeke L et al [27].

- That medical history is not a poor prognostic factor in the management of STBI.
- That a Glasgow score ≤5 was correlated with a significant increase in mortality. Van Haverbeke L et al [27] also found that for a GS ≤5 the mortality rate was 65% compared with 25% for patients with a Glasgow score >5.
- That there is a significant correlation between the presence of a pupillary anomaly and the mortality rate; in the literature we find the work of Jaeger M et al [28] who found that the presence of pupillary asymmetry was a negative factor at 6 months after a severe head injury.
- That the presence of haemodynamic and/or respiratory instability was correlated with a significant increase in mortality, Erra et al [29] in their study also found that the mortality rate of patients admitted in an unstable haemodynamic state was 54.71%.
- Cerebral lesions in the Marshall classification > 3 were significantly correlated with a higher mortality rate. This analysis showed that six of the seven factors studied were correlated with a significant increase in mortality. Apart from age, these factors are linked to the conditions under which MCTs are managed. Improvements in the conditions for the collection, pre-hospital medical management and management on admission of STBI have a direct impact on control:
- Haemodynamic and respiratory stability.
- Pupillary anomalies, by introducing rapid treatment based on osmotherapy.
- Secondary cerebral attacks of systemic origin, so as not to worsen the post-traumatic neurological score.
- Cerebral scans to check cerebral haemodynamics by monitoring intracranial pressure and cerebral blood flow. During hospitalisation, in addition to controlling the above factors, infection prevention helps to improve the outcome of STBI.

Multivariate analysis using the logistic regression method for the 7 factors (age, medical history, pupillary anomaly, presence of haemodynamic and respiratory distress, GLASGOW score, Marshall classification and infectious complications). According to the model best suited to this type of data, we retained the following as risk factors: age, GS, haemodynamic and respiratory instability and Marshall classification. These factors can be controlled from the pre-hospital management of the STBI.

CONCLUSION

Improving the prognosis of STBI is based on urgent and effective care at the scene of the accident, hence the need to develop genuine pre-hospital medicine, but also the management of these patients in specialised centres with the necessary technical facilities and a specialised intensive care unit equipped with specific monitoring of cerebral haemodynamics.

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