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Prognostic Factors for Mortality in Severe Traumatic Brain Injury at HGZ 46, Villahermosa, Tabasco, Period from March 1, 2021 to December 31, 2022

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Abstract

Introduction: A traumatic brain injury (TBI) is caused by a forceful bump, blow, or jolt to the head or body, or by an object that pierces the skull and interrupts the normal function of the brain. Severe TBI is estimated at 73 cases per 100,000 people. The mortality of severe TBI can be reduced if a timely diagnosis and treatment of the injuries are made through prognostic factors. Objective: To determine the prognostic factors related to mortality in severe traumatic brain injury at the Hospital General de Zona No. 46. Material and Methods: Retrospective, cross-sectional and descriptive study in beneficiaries admitted to the Hospital General de Zona (HGZ) No. 46 of the Mexican Institute of Social Security (IMSS by its acronym in Spanish), with a diagnosis of severe TBI; the possible prognostic factors related to mortality of severe TBI were obtained from their records. Measures of central tendency and chi square were used for data analysis. Results: The study sample consisted of 60 subjects diagnosed with severe traumatic brain injury, of which 5 (8%) were women and 55 (92%) were men, and all 60 (100%) patients died. The average age of the sample was 26 with a standard deviation of 9 years. The variables that had a p value less than or equal to 0.05 were: Mydriasis, seizures, Hyperglycemia, Normoglycemia, Hypothermia and Hypotension. This means that these variables were associated with mortality. Conclusion: Statistical significance is demonstrated in prognostic factors of mortality in severe traumatic brain injury with $p < 0.05$ in the case of mydriasis, sei-

zures, hyperglycemia, normoglycemia, hypothermia and hypotension.

Keywords

Traumatic Brain Injury, Prognostic Factors, Mortality, Severity

1. Introduction

The present research concerns the topic of traumatic brain injury (TBI) which is caused by a blow or jolt to the head, or by a penetrating wound to the head that disrupts the normal function of the brain [1].

The main characteristic of TBI is one of the greatest health problems worldwide, because it represents one of the main causes of mortality; its importance increases due to the health care costs associated and the permanent sequelaes that may arise, mainly in those traumas initially classified as severe [2].

To analyze this problem, it is necessary to mention that severe TBI is estimated at 73 cases per 100,000 people. Mortality from severe TBI can be decreased by timely diagnosis and treatment of the lesions through prognostic factors [3].

The investigation of this problem was carried out due to the academic and professional interest of determining the prognostic factors related to mortality in severe traumatic brain injury at the Hospital General de Zona (HGZ) No. 46.

During the research, a retrospective, cross-sectional and descriptive study was carried out in beneficiaries admitted to the Hospital General de Zona (HGZ) No. 46 of the Mexican Institute of Social Security (IMSS by its acronym in Spanish), with a diagnosis of severe TBI; the possible prognostic factors related to mortality of severe TBI were obtained from their records.

2. Objectives

2.1. General

To determine the prognostic factors related to mortality in severe traumatic brain injury at the Hospital General de Zona (HGZ) No. 46.

2.2. Specific

Identify the factors associated with the event that caused the trauma and their relationship with mortality.

To identify complications in patients with traumatic brain injury in the emergency room and intensive care unit.

To establish the epidemiological profile of patients with severe traumatic brain injury treated at the Hospital General de Zona (HGZ) No. 46.

3. Material and Methods

1) Type of study: Retrospective, cross-sectional and descriptive study between

the different prognostic factors of mortality in patients with severe TBI.

This type of study was selected to determine the impact of the previous variables mentioned had on the patient's prognosis. This observational study helped to analyze the data from the population subset at a specific time window and it was relatively easy and inexpensive to conduct compared to the experimental case.

2) Universe of study: Hospital General de Zona (HGZ) No. 46 of the IMSS, located in Villahermosa, Tabasco, Mexico.

3) Study population: All beneficiaries who have been admitted due to a diagnosis of severe traumatic brain injury to the emergency room and the intensive care unit, in the time period from March 1, 2021 to December 31, 2022.

4) Sample size and sampling: For convenience, non-probabilistic sampling was performed. Every patient who was admitted with a diagnosis of severe TBI during the time window mentioned above was included. Among the biases or limitations that the study may present is that it has only included those patients who were documented in the established period of time and who had the required variables for the study.

4. Selection Criteria

4.1. Inclusion Criteria

Patients of both sexes; diagnosis of severe TBI on admission (Glasgow Coma Scale < 8 points); patients over the age of 18; with a medical record that includes the necessary information for the study.

4.2. Exclusion Criteria

Diagnosis of mild to moderate TBI; patients under the age of 18; patients who have received cardiopulmonary resuscitation maneuvers prior to admission (In patients with severe TBI, the primary goal is to maintain adequate blood flow to the brain. CPR can increase intracranial pressure and further compromise cerebral perfusion as well as increase the risk of complications, making the prognosis bleaker, which is why it would not be part of the study since the variables to be studied would be altered); incomplete medical record.

4.3. Elimination

Patient who has been transferred to another hospital unit.

5. Systematization of Variables

The next table describes the variables that were analyzed in this study. For each variable, we provide its conceptual and operational definitions, as well as the main aspects and indicators that we used to measure it. The multiclass variables were encoded using label encoding in order to perform their statistical analysis and determine the prognosis factors.

Variable	Conceptual definition	Operational definition	Source
Mortality	Death of the patient during a stay in the emergency department or intensive care unit	Death of the patient during a hospital stay	Instrument
Sex	A set of biological conditions that characterize each person as either male or female.	Biological sex obtained from the medical record	Instrument Clinical record
Age	How long a person has lived since birth in whole years	Age obtained from the medical record	Instrument Clinical record
Cause of Trauma	Event That Causes Traumatic Brain Injury	Cause obtained from the medical record	Instrument Clinical record
Anisocoria	Asymmetry in pupillary size	Asymmetrical pupillary size	Instrument Clinical record
Midriasis	Bilateral reactive pupillary dilation greater than 4 mm	Recorded reactive pupillary dilation	Instrument Clinical record
Seizures	Transient and involuntary episodes of impaired consciousness, behavior, or motor activity	Episode of seizures on admission recorded	Instrument Clinical record
Hyperglycaemia	Blood glucose greater than 180 mg/dL on admission	Baseline hyperglycemia recording	Instrument Clinical record
Hypoglycemia	Glucemia less than 80 mg/dL on admission	Baseline hypoglycemia recording	Instrument Clinical record
Hemoglobin	Optimal hemoglobin levels 7 - 9 g/dL	Basal hemoglobin recording	Instrument Clinical record
Hypernatremia	Plasma sodium levels greater than 155 mEq/L	Recording of sodium levels above reference values	Instrument Clinical record
Hyponatremia	Plasma sodium levels less than 135 mEq/L	Recording of sodium levels above reference values	Instrument Clinical record
Hyperthermia	Body temperature greater than 38˚C	Recording of sodium levels above reference values	Instrument Clinical record
Hypotension	Systolic blood pressure less than 90 mmHg on admission	Baseline hypotension recording	Instrument Clinical record

6. Ethical Considerations

The present study was carried out under the approval and corresponding authorization of the Local Committee for Research and Ethics in Health Research of the Mexican Institute of Social Security of the Tabasco state delegation. Since this is a non-invasive study but descriptive and data collection, the ethical implications are minimal. This research proposal adheres to the basic principles of section I of the Declaration of Helsinki. This investigation is in accordance with the provisions of the Political Constitution of the United Mexican States, in accordance with Article 4. In addition, it is in accordance with the provisions of Article 100 of the General Health Law and its Regulations of the General Health Law on Health Research, in its Second Title "On the Ethical Aspects of Research on Human Beings" in Chapter I:

Article 17. Research risk is considered to be the probability that the research subject will suffer harm as an immediate or delayed consequence of the study.

For the purposes of this Regulation, investigations are classified into the following categories:

Section I. Risk-free research: These are studies that use retrospective documentary research techniques and methods and those in which no intervention or intentional modification is made in the physiological, psychological, and social variables of the individuals participating in the study, including: questionnaires, interviews, review of clinical records, and others, in which it is not identified or discussed sensitive aspects of their conduct.

In accordance with the above, the present work does not require informed consent to obtain the information.

The data used is anonymized before being analyzed. This data does not contain information that can be directly linked to patients (such as names, addresses, or identification numbers), and the risk to patient privacy and well-being is minimal. In this study, the protection of data privacy and confidentiality was carried out.

Based on the Integral Privacy Statement of Medical Consultation in External Units of High Medical Specialties in IMSS Hospitals, which patients and relatives have access and knowledge of, it is stipulated that clinical information from medical records will be used in statistical reports as well as in research studies that help improve the quality of service. Therefore, no explicit consent from the patient or their relative is required, since they have already accepted the privacy terms when receiving hospital care, that includes the use of the medical records for this study.

7. Results

The study sample consisted of 60 subjects diagnosed with severe traumatic brain injury, of which 5 (8%) were women and 55 (92%) were men, all 60 (100%) patients died (Figure 1).

From the total number of subjects diagnosed with severe traumatic brain injury in this study, 45 patients (75%) arrived at the emergency room with advanced airway management and 15 patients (25%) were not intubated by prehospital means or referral medical unit.

With measures of central tendency: The mean age of the sample was 26 with a

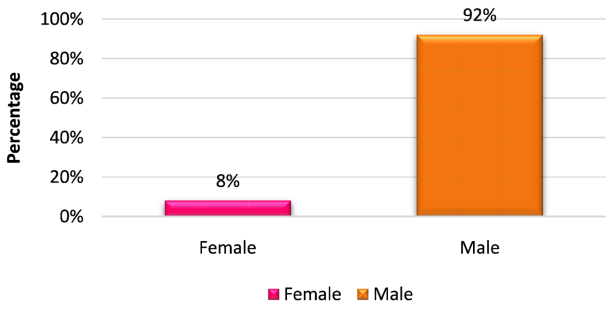

Figure 1. Male-female ratio. Source: Data obtained from the medical record.

standard deviation of 9 years, while men had a mean age of 26 with a standard deviation of 9 and women had a mean age of 32 with a standard deviation of 1 year (Table 1).

In terms of etiologies, 58 (96.7%) were due to traffic accidents, 1 (1.7%) due to falls, and 1 (1.7%) due to aggression (Figure 2).

Regarding the Glasgow Coma Scale score at the time of admission to the emergency room, 8 (13%) patients had 5 points, 9 (15%) patients had 6 points, 7 (12%) patients had 7 points and 36 (60%) patients had 8 points (Figure 3).

Table 1. Mean and standard deviation of men and women.

Patient Gender		N	Minimal	Maximum	Media	Standard deviation
Female	Age	5	30	35	32.4	1.949
Male	Age	55	20	86	26.15	9.472

Source: Data obtained from the medical records.

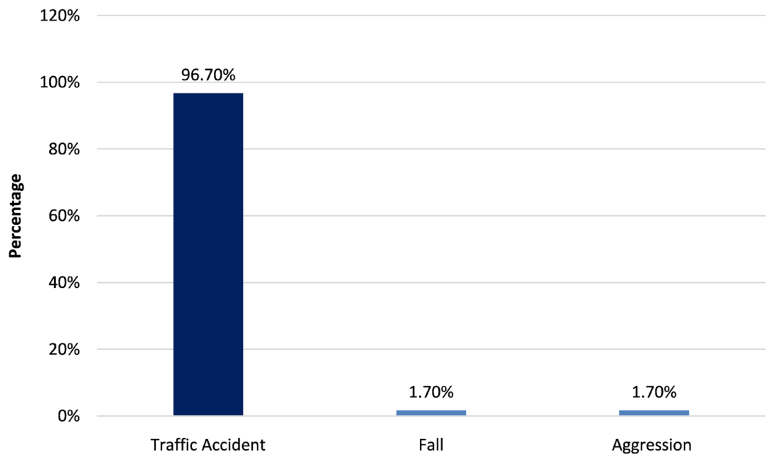

Figure 2. Causes of Trauma. Source: Data obtained from the medical record.

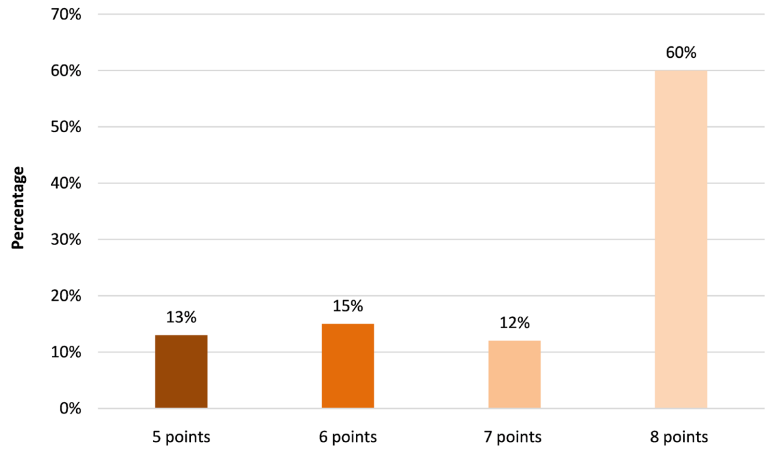

Figure 3. Glasgow coma scale score on admission. Source: Data obtained from the medical record.

Chi-square distribution tests were performed to determine categorical variables that could be considered as prognostic factors for mortality (Table 2).

The variables that have a p-value less than or equal to 0.05 are: Mydriasis, Presence of seizures, Hyperglycemia, Hypothermia and Hypotension. With values of $p < 0.005$, $p < 0.001$, $p < 0.039$, $p < 0.001$ and $p < 0.001$ respectively. This means that these variables are associated with mortality, and could be considered as risk factors.

The variables that have a p-value less than 0.05 are: Anisocoria, Hypernatremia, Normonatremia, Hyperthermia, Euthermia, Hypertension and Normotension. This means that these variables are not associated with mortality, and could be considered irrelevant or non-influential.

8. Discussion

This research demonstrates the importance of knowledge of mortality prognostic factors in the context of patients with severe traumatic brain injury, regardless of etiology. The general objective of the thesis, "To determine the prognostic factors related to mortality in severe traumatic brain injury in the Hospital General de Zona (HGZ) No. 46", was fulfilled by analyzing the data obtained from the medical records, resulting in the following:

These accidents were more frequent in men than in women, tripling their frequency, as described in the literature [3]. This study shows that the highest incidence and mortality of severe traumatic brain injury occurred in men, taking into account that the sample obtained was 60 (100%) patients, of which 5 (8%) were women and 55 (92%) were men.

With the application of measures of central tendency, the mean age of the

Table 2. Chi-square of prognostic factors.

Prognostic Factors	Chi Square	p-value
Anisocoria	3.267	0.071
Midriasis	**8.067**	**0.005**
Seizures	**35.267**	**<0.001**
Hyperglucemia	**4.267**	**0.039**
Hypernatremia	3.267	0.071
Normonatremia	3.267	0.071
Hyperthermia	2.400	0.121
Eutermia	3.267	0.071
Hypothermia	**56.067**	**<0.001**
Hypertension	0.067	0.796
Normotension	0.067	0.796
Hypotension	**52.267**	**<0.001**

Source: Data obtained from the medical record.

sample was 26 with a standard deviation of 9 years, while men had a mean age of 26 with a standard deviation of 9 and women a mean age of 32 with a standard deviation of 1 year.

The Glasgow Coma Scale score on admission is associated with clinical severity and mortality in patients with severe traumatic brain injury [2]. In this study of 60 patients studied, the following patients were admitted: 8 (13%) patients had 5 points, 9 (15%) patients had 6 points, 7 (12%) patients had 7 points, 36 (60%) patients had 8 points. This does not represent a relevant result in the research since all 60 patients died, representing 100% of the sample, regardless of the Glasgow Coma Scale score.

Statistically significant variables such as mydriasis, presence of seizures, hyperglycemia, hypothermia, and hypotension are associated with mortality in patients with severe traumatic brain injury, which has been described in other literature [4] [5] [6]. Obtaining a value of $p < 0.005$ in the case of mydriasis and $p < 0.001$ in the case of hyperglycemia, as mentioned in the study carried out by Frutos Bernal *et al.* [4].

Despite the above, this can be explained by the randomization of the sample, which is why it is not necessarily applicable in all cases in our population but only in the study group. There are weaknesses in the study that are derived from its design and justified in the same way.

One of the weaknesses is that the design is retrospective, so, it was not possible to directly analyze the patient's clinical symptoms or parameters with neurosurgical intervention, however, as it is a serious pathology that potentially causes death, it is completely understandable. The way in which this could be improved is through a prospective cohort protocol in which the evolution of the patients is monitored and the adequate recording of the relevant data for the research in the records is ensured.

Another weakness is the sample size, increasing it could improve the margins of error and thus increase the statistical significance of the parameters analyzed by their trend. Similarly, it would be prudent to use more parameters in terms of neurosurgical intervention: the time in which it is performed, the findings found, and the neurological evolution thereafter.

9. Conclusions

The objective of this study was to determine the prognostic factors related to mortality in severe traumatic brain injury at the General Hospital of Zone No. 46.

Through a statistical analysis, the mean age of the sample was 26 years with a standard deviation of 9 years, showing higher mortality in men than in women. This fact is related to traffic accidents and gender disparity in relation to them.

Statistical significance was found in the prognostic factors of mortality in severe traumatic brain injury with $p < 0.05$ in the case of mydriasis, presence of convulsions, hyperglycemia, normoglycemia, hypothermia and hypotension.

This research yields data from a small sample of the population, so it would be

important to apply it to a larger sample. It is considered essential to continue these studies on the same clinical entity and to include new variables that can improve the prognosis of patients.

Thanks

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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