VICTIMS WITH TRAUMATIC BRAIN INJURY IN THE EMERGENCY ROOM AND FACTOR ASSOCIATED WITH PERMANENCE IN THE SECTOR

VÍTIMAS COM TRAUMATISMO CRANIOENCEFÁLICO NA SALA DE EMERGÊNCIA E FATOR ASSOCIADO À PERMANÊNCIA NO SETOR

VÍCTIMAS CON TRAUMATISMO CRANEOENCEFÁLICO EN URGENCIAS Y FACTOR ASOCIADO A PERMANENCIA EN EL SECTOR

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Objective: analyzing the evolution of victims of blunt traumatic brain injury in the emergency room and identifying independent factors for length of stay in this service. Method: a prospective cohort that included all victims who met the eligibility criteria and were admitted between July and December 2017 in a reference hospital for trauma. The Rapid Emergency Medicine Score was applied to identify the evolution of the victims up to 6 hours after admission and descriptive statistics and bivariate analysis were applied. Results: between admission and 2 hours, unfavorable changes were observed in 35.1% of the victims, between 2-4 hours in 13.6% and between 4-6 hours, in 42.8%; improvement was observed between 27% and 28.6% of the sample. Hemodynamic support was an independent factor for length of stay. Conclusion: unfavorable evolution was more frequent between admission and 2 hours and after 4 hours. The longest stay in the emergency room occurred in victims with hemodynamic support.

Descriptors: Craniocerebral Trauma. Closed Head Trauma. Emergency Hospital Service. Emergency Nursing. Treatment Result.

Objetivo: analisar a evolução das vítimas de traumatismo cranioencefálico contundente na sala de emergência e identificar fatores independentes para tempo de permanência nesse serviço. Método: coorte prospectiva que incluiu todas as vítimas que atenderam aos critérios de elegibilidade e foram admitidas entre julho e dezembro de 2017 em hospital referência para trauma. Foi aplicado o Rapid Emergency Medicine Score para identificar a evolução das vítimas até 6 horas após admissão e aplicadas estatísticas descritivas e análise bivariada. Resultados: entre a admissão e 2 horas, foram observadas mudanças desfavoráveis em 35,1% das vítimas, entre 2-4 horas em 13,6% e entre 4-6 horas, em 42,8%; foi observada melhora entre 27% e 28,6% da casuística. Suporte hemodinâmico foi fator

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independente para tempo de permanência. Conclusão: a evolução desfavorável foi mais frequente entre a admissão e 2 horas e após 4 horas. A maior permanência na sala de emergência ocorreu em vítimas com suporte hemodinâmico.

Descritores: Traumatismos Craniocerebrais. Traumatismos Cranianos Fechados. Serviço Hospitalar de Emergência. Enfermagem em Emergência. Resultado do Tratamento.

Objetivo: analizar la evolución de las víctimas de traumatismo craneoencefálico contundente en la sala de urgencias e identificar factores independientes para la duración de la estancia en este servicio. Método: cohorte prospectiva que incluyó a todas las víctimas que cumplieron con los criterios de elegibilidad y estuvieron ingresadas entre julio y diciembre de 2017 en un hospital de referencia por traumatismo. Se aplicó el Rapid Emergency Medicine Score para identificar la evolución de las víctimas hasta 6 horas después del ingreso y se aplicó estadística descriptiva y análisis bivariado. Resultados: entre el ingreso y 2 horas, se observaron cambios desfavorables en 35,1% de las víctimas, entre 2-4 horas en 13,6% y entre 4-6 horas, en 42,8%; se observó mejoría entre el 27% y el 28,6% de la muestra. El soporte hemodinámico fue un factor independiente para la duración de la estancia. Conclusión: la evolución desfavorable fue más frecuente entre el ingreso y 2 horas y después de 4 horas. La estancia más larga en la sala de urgencias ocurrió en víctimas con soporte hemodinámico.

Descriptores: Traumatismo Craneoencefálico. Traumatismo Craneoencefálico Cerrado. Servicio de Urgencias Hospitalarias. Enfermería de Emergencia. Resultado del Tratamiento.

Introduction

Traumatic brain injury (TBI) is one of the most devastating causes of death and persistent disabilities in the world, especially in Western societies[1-3]. In TBI, the total damage resulting from trauma is caused by the combination of initial involvement and secondary injuries, which result from the progression of the primary injury that occurs during trauma. However, secondary injuries are potentially preventable or treatable, which makes the initial treatment of victims of great importance in their prognosis[4-5]. A study conducted with 174 victims of severe TBI showed that, in the first 6 hours of trauma, monitoring vital signs such as heart rate (HR) and mean arterial pressure (MAP), together with intracranial pressure, helps in the identification of those requiring more intensive neurological treatment in the early stages after brain injury[6].

In Brazil, the TBI is responsible for more than 125,000 admissions per year and 9,700 hospital deaths in recent years[7-8]. Trauma involving vehicles is the most common causes of TBI and the incidence of this injury is increasing worldwide, especially in developing countries, due to the increasing use of motorized transportation[3,7].

The increase in TBI victims is of particular importance for emergency departments, since 80% to 92% of these victims are treated in this type of unit[9]. Studies that conducted time analyses indicated an increase in the number of TBI victims in emergency departments, as they found significantly higher rates than those previously described in the literature[9] or compared TBI-related rates for a long follow-up period[2,10].

In 2016, an American study showed that, between 2001 and 2010, the number of visits in emergency departments due to TBI increased by 70% and the number of hospitalizations and deaths increased by 11% and 7%, respectively[10]. Research on the epidemiology of the TBI, published in 2020, emphasized the constant increase in these visits, considering data from 2006 to 2014. In 2014, U.S. records documented 2.53 million victims with TBI in emergency departments and approximately 57,000 deaths related to this injury[2]. The greatest burden of increasing cases of TBI is found in low- or middle-income countries, where, among many other problems in health care, there is overcrowding of emergency departments[11-14].

In Brazil, in 2014, the *Conselho Federal de Medicina* (CFM) recommended, in CFM Resolution nº 2,077/14, a maximum of 4 hours of patients' stay in the resuscitation room or advanced procedures room, aiming at improving outcomes[15]. However, it cannot be ruled out

that emergency departments are under great pressure due to the high demand of patients, lack of resources available to attend emergencies and lack of beds for the continuity of treatment, thus resulting in an increase in the length of stay in these services[11-14]. These structural problems are widely recognized by managers and health professionals, but it is likely that clinical conditions that hinder the stabilization of TBI victims also contribute to increasing the permanence of these patients in the emergency room.

In view of the importance of the TBI among external causes, the initial consequences of this injury, the problems of overcrowding of emergency departments and the absence of investigations on the evolution of patients with TBI in this sector in Brazil and in international studies, is it questioned what the evolution of these victims in the emergency room and what factors are associated with increased permanence in this sector?

The World Health Organization (WHO) has recognized the scarcity of good evidence in the literature on the treatment of TBI cases, especially in low and middle-income countries. According to the WHO, the lack of hospital data on the care provided to these victims results in a slow progress in meeting the health needs of this population[3].

The frequency of TBI victims in emergency departments has been increasing[2,9-10] and studies like this can help improve strategies to treat these patients and expand knowledge of the pathophysiology of TBI in the first hours after the traumatic event. Considering the above, the objectives of this investigation were: to analyze the evolution of victims of blunt TBI during their stay in the emergency room and to identify the independent factors for the length of stay in this service.

Methods

A prospective cohort study that analyzed data collected at admission of the patient victim of blunt TBI, in the emergency room and 2, 4 and 6 hours after admission. The participants were followed up to a maximum of 6 hours in the emergency room or for less time, that is, until the exit of the sector.

The study was carried out in the Emergency Department of a large university hospital located in the city of São Paulo (SP), Brazil. It is an emergency unit referred to care for trauma victims, specialized in neurosurgery treatment, which helps cases of high complexity.

For this study, all victims admitted to this emergency department from July to December 2017, with blunt TBI and age 15 years old or over, totaling 79 people, were included. Individuals who did not present TBI as the main traumatic injury, those admitted to the emergency department after one hour of the traumatic event and those who arrived at the hospital in cardiac arrest and died, without returning to spontaneous circulation after resuscitation maneuvers, were excluded.

The Abbreviated Injury Scale (AIS) was used to identify the victims who presented TBI as the main injury, this instrument is compose of a list of injuries presented in the AIS Manual, which provides, for each description of the injury, an identifier composed of seven numbers. The last digit of this identifier is the value referring to the severity, with scores ranging from one (lowest severity) to six points (maximum severity). The list presented in the AIS manual also classifies each injury resulting from trauma by body region considering nine regions: head, face, neck, thorax, abdomen, spine, upper limbs, lower limbs and external surface[16].

In this study, considering the body regions and the severity of the injuries, we identified the region that presented the most severe injury, that is, with the highest score in the AIS. TBI was considered a major injury when the victims had the most severe head injury. In cases where the highest score was present simultaneously in the head and in other regions, the region with the highest number of injuries prevailed, when establishing the location of the main injury.

In the analysis of the evolution of victims in the emergency room, the Rapid Emergency Medicine Score (REMS)[17] was used, a physiological severity indicator designed to be used in emergency departments, which includes,

for their calculation, age and physiological parameters: Glasgow Coma Scale (GCS), HR, MAP, respiratory rate (RR) and peripheral oxygen saturation (SpO_2). These five components receive values from zero to +4 in the REMS calculation, and the score assigned to age ranges from zero to six. The predictive capacity of mortality of this instrument has been evaluated against other indices that estimate the severity of trauma in patients in intensive care units and in the emergency room[18].

The REMS was elaborated by logistic regression that analyzed several clinical characteristics of the patients. Its composition includes the independent predictors for mortality identified in multivariate analysis. As proposed by this instrument, the following scores are attributed to patients: for under 45 years of age, zero score; for 45-54 years, 2; for 55-64 years, 3; to 65-74, 5; for people over 74 years, 6. Regarding MAP (mmHg) the values are: 70-109, score zero; 110-129 or 50-69, score 2; 130-159, score 3; >159 or ≤49, score 4. As for HR (beats per minute), the values are: 70-109, score zero; 110-139 or 55-69, score 2; 140-179 or 40-54, score 3; >179 or ≤39, score 4. For RR (respiratory incursions per minute): 12-24, zero score; 25-34 or 10-11, score 1; 6-9, score 2; 35-49, score 3; >49 or ≤5, score 4. For SpO_2 (%): >89, score zero; 86-89, score 1; 75-85, score 3; <75, score 4. Finally, for GCS: 14-15, score zero; 11-13, score 1; 8-10, score 2; 5-7, score 3 and 3-4, score 4[17].

REMS is obtained by the sum of the scores attributed to age and other parameters. Their values range from zero to 26. Score below 6 is indicative of low risk of dying; from 6 to 13 points to intermediate risk; and higher than 13, high risk[17].

In this research, the evolution of the victims was analyzed as a categorical variable and considered favorable, unchanged and unfavorable, considering the differences in REMS scores and their physiological components between admission and 2 hours, 2 and 4 hours and 4 and 6 hours after arrival in the emergency room. The favorable evolution was identified by the positive result in the difference of two consecutive REMS evaluations; the unchanged,

by zero difference; unfavorable, by negative difference. In REMS and its components (GCS, HR, MAP, RR, SpO_2 and age), the highest scores are indicative of worse clinical conditions; therefore, a positive difference in two consecutive evaluations indicated patient improvement, and negative difference, worsening.

To identify the factors associated with length of stay in the emergency room (dependent variable), the following independent variables were analyzed: gender, age, REMS, ISS, GCS, type of unit used in Prehospital Emergency Service (PES) (basic or advanced), ventilatory support, hemodynamic support, continuous sedation and surgical treatment.

The information of interest for this investigation was collected and recorded in an instrument elaborated for this purpose, by one of the researchers of this study, with the help of trained nurses, who cared for the patients who participated in this research . After hospital discharge, the medical records of the patients selected for the study were consulted to identify the diagnoses of the injuries and estimate the severity of the victims according to the Injury Severity Score (ISS)[16].

The ISS indicates the general severity of the traumatized and is one of the most widely used trauma severity index worldwide. To determine this score, all injuries diagnosed in trauma victims and their scores obtained in the AIS are considered. The ISS is calculated by the sum of the square of the highest AIS of three distinct body regions. To calculate the ISS, the six body regions of the AIS are grouped as follows: head and neck; face; chest; abdomen and pelvic content; extremities or pelvic girdle; and external surface. The value of the ISS ranges from 1 to 75. The maximum value may be the result of three injuries in different body regions that received AIS 5 or some score 6. For the calculation of the ISS, a score 6 in the AIS always represents a score of 75, regardless of the severity or presence of other injuries.

Regarding The AIS, the ISS and the REMS, it is worth commenting that they are indicators used worldwide to identify the severity of traumatic injuries, of the trauma and patients in the emergency room, respectively. In addition, the

conformation and objectivity of its components (diagnosis of injuries, age and physiological parameters) have dispensed with the cross-cultural adaptation of these instruments for use in different countries.

The information collected for this research was stored in a database using the Microsoft Office Excel 2007 software and for the analysis the Statistical Package for the Social Sciences (SPSS) software was applied version 22. The consistency of the database was verified using the Excel program, through filters, one-dimensional and dynamic tables.

Descriptive statistics were used to characterize the sample in relation to the variables of interest and to analyze the evolution of the victims in the emergency room. Categorical variables were analyzed using absolute and relative frequencies; for the numerical ones, the mean and the standard deviation were calculated. To identify the factors associated with length of stay in the emergency room, the Person Correlation Coefficient was applied when the analysis was performed between two variables of metric scale. The Student's T Test was used to compare the means of length of stay in the emergency room of two independent groups, when normal distribution of the data was verified. In cases of non-normal distribution, the Wilcoxon-Mann-Whitney nonparametric test was applied to compare these times. To test adherence to normality, the Shapiro-Wilk Test was applied. For inferential analyses, the significance level of 5% was considered.

This study was approved by the Research Ethics Committee on 5/18/2017, Certificate of Presentation of Ethical Appreciation (CAAE), nº 65147317.0.0000.5392. The Informed Consent Form and the Free and Informed Consent Term were applied, according to pertinence, to certify the participants' support to the research.

Results

Of the 79 victims aged 15 years or older and blunt TBI admitted to the emergency room during the data collection period, 4 arrived at the service in cardiac arrest, without success in resuscitation attempts. Twenty patients were admitted to the hospital after one hour of the traumatic event, 7 did not present TBI as the main injury and 2 refused to participate in the study. Therefore, 46 patients with blunt TBI remained, who comprised the sample of this study.

Most of these victims was involved in traffic accidents (63%) or falls (28.3%), was male (84.7%), with a mean age of 34.7 years (±15.1). On admission to the emergency room, the mean REMS value was 4.0 (±2.5) and the variation from zero to 11. Regarding the severity of the trauma, the mean ISS was 11.8 (±7.7) and the majority (54.4%) had severe TBI indication by GCS (mean of 8.3±5.0).

93.5% of the victims were attended by PES and 6.5% did not have this care. Basic life support and advanced life support teams attended, respectively, 52.2% and 41.3% of the sample.

Interventions related to ventilatory support were the most frequent in the emergency room, used in 87.0% of the cases. It was found that most of the victims, 65.0%, had orotracheal intubation in the emergency room. Oxygen catheter and mask were used in 22.0% of the cases. Volume administration occurred in 18 victims, being in 15 patients as isolated management and in 3 accompanied by vasoactive drugs, 2 of whom also used blood components. One victim received only vasoactive drugs in the emergency room, totaling 19 participants with hemodynamic support.

16 patients received continuous sedation in the emergency room, 34.8% of the sample. About one third of the victims, 32.6%, underwent surgical treatment and were referred directly from the emergency room to the operating room.

34.7% of the participants in this study remained still under observation in the emergency department after leaving the emergency room. 32.6% of the patients were referred to the operating room and 21.7% to the intensive care unit. Two (4.4%) patients died in the emergency room, two (4.4%) were referred to the ward and one (2.2%) was transferred to another hospital.

Table 1 shows that the cases with unfavorable evolution, according to REMS, occurred in 35.1% of the victims in the first two hours after admission to the emergency room. The highest frequency of unfavorable evolution occurred in the interval of 4 to 6 hours in 42.8% of the cases that remained in the emergency room for this time. The percentage of patients who evolved with improvement was similar in the three-time intervals, from 27% to 28.6%.

Table 1 – Victims of blunt traumatic brain injury according to evolution by the Rapid Emergency Medicine Score in the evaluation intervals. São Paulo, São Paulo, Brazil – 2017. (N= 37)

| Evolution by Rapid Emergency Medicine Score | Evaluation intervals | | | | | |
| | Admission to 2 hours | | 2 to 4 hours | | 4 to 6 hours | |
	n	%	n	%	N	%
Favorable (1)	10	27.0	6	27.3	4	28.6
Unchanged (2)	14	37.9	13	59.1	4	28.6
Unfavorable (3)	13	35.1	3	13.6	6	42.8
Total	37	100.0	22	100.0	14	100.0

Source: Created by the authors.

(1) Positive difference between consecutive evaluations by REMS.
(2) Difference zero between consecutive evaluations by REMS.
(3) Negative difference between consecutive evaluations by REMS.

The length of stay of patients in the emergency room ranged from 30 to 1,080 minutes (18 hours). On average, the stay was 295.3 (±274.5) minutes, about 4 1/2 hours. Nine participants remained in the emergency room for less than 2 hours, 15 victims were transferred between 2 and 4 hours and 8 in the interval of 4 to 6 hours.

Consequently, it is observed in Tables 1 and 2 that the evaluations two hours after admission to the emergency room had 37 participants; in those performed four hours later, 22 victims participated, of which 14 (30.3%) remained in the emergency room for a time of 6 hours or more.

Table 2 – Traumatic brain injury victims according to the evolution by the physiological parameters of the Rapid Emergency Medicine Score in the evaluation intervals. São Paulo, São Paulo, Brazil – 2017

(continued)

| Parameters | Evolution - between admission and 2 hours after (N=37) | | | | | |
| | Favorable (1) | | Unchanged (2) | | Unfavorable (3) | |
	n	%	N	%	N	%
Glasgow Coma Scale	2	5.4	28	75.7	7	18.9
Heart rate	6	16.2	24	64.9	7	18.9
Mean arterial pressure	6	16.2	27	73.0	4	10.8
Respiratory rate	3	8.1	27	73.0	7	18.9
Peripheral oxygen saturation	-	-	35	94.6	2	5.4

| Parameters | Evolution - between 2 and 4 hours after admission (N=22) | | | | | |
| | Favorable (1) | | Unchanged (2) | | Unfavorable (3) | |
	n	%	n	%	N	%
Glasgow Coma Scale	-	-	22	100.0	-	-
Heart rate	5	22.7	12	54.6	5	22.7
Mean arterial pressure	1	4.5	19	86.4	2	9.1
Respiratory rate	3	13.6	19	86.4	-	-
Peripheral oxygen saturation	-	-	22	100.0	-	-

Table 2 – Traumatic brain injury victims according to the evolution by the physiological parameters of the Rapid Emergency Medicine Score in the evaluation intervals. São Paulo, São Paulo, Brazil – 2017

(conclusion)

Parameters	Evolution - between 4 and 6 hours after admission (N=14)					
	Favorable (1)		Unchanged (2)		Unfavorable (3)	
	n	%	n	%	N	%
Glasgow Coma Scale	-	-	14	100.0	-	-
Heart rate	2	14.3	9	64.3	3	21.4
Mean arterial pressure	3	21.4	8	57.2	3	21.4
Respiratory rate	-	-	13	92.9	1	7.1
Peripheral oxygen saturation	-	-	14	100.0	-	-

Source: Created by the authors.

Note: Conventional signal used:
- Numeric data equal to zero not resulting from rounding.
(1) Positive difference between consecutive evaluations considering the scores assigned to the parameters by REMS.
(2) Zero difference between consecutive evaluations considering the scores assigned to the parameters by REMS.
(3) Negative difference between consecutive evaluations considering the scores assigned to the parameters by REMS.

As shown in Table 2, in the first two hours in the emergency room, cases with unfavorable evolution were observed in relation to all parameters. HR, GCS and RR showed a higher percentage of victims with this evolution, 18.9% each. SpO$_2$ was the most stable parameter in the entire evaluation period and only two patients had unfavorable alteration, which occurred in the first two hours after admission to the emergency room. The GCS, which presented one of the highest frequencies of unfavorable evolution initially, was stable in patients who remained in the emergency room after 2 hours of admission. In the evaluations after 2 hours, HR and MAP were the only parameters that presented expressive frequencies of unfavorable alterations.

Table 3 – Tests of association between length of stay in the emergency room and the variables gender, age, severity and characteristics of pre- and in-hospital care. São Paulo, São Paulo, Brazil – 2017. (N=46)

Variables	Correlation coefficient	p-value
Gender and permanence		0.596(2)
Age and permanence	-0.155	0.303 (3)
Rapid Emergency Medicine Score on Admission and Permanence	0.111	0.461 (3)
Injury Severity Score and Permanence	0.137	0.366 (3)
Glasgow Coma Scale and permanence	-0.174	0.247 (3)
Unit used in Prehospital Emergency Service (1) and permanence		0.200 (4)
Ventilatory support and permanence		0.062 (4)
Hemodynamic support and permanence		0.016 (4)
Continuous sedation and permanence		0.252 (4)
Surgical treatment and permanence		0.505 (4)

Source: Created by the authors.

(1) Victims without pre-hospital care were excluded.
(2) Wilcoxon-Mann-Whitney Test.
(3) Pearson Correlation Test.
(4) Student's T Test.

As shown in Table 3, there was a statistically significant difference in the length of stay in the emergency room only in relation to the use of hemodynamic support in this service (p value=0.016). Victims who required vasoactive drugs, volume replacement and/or blood components remained in the emergency room for a longer time.

Discussion

The purpose of the emergency department is to evaluate, stabilize, diagnose and refer the victim to the appropriate place for its definitive treatment as soon as possible; is a sector where the patient should remain for a short time. Emergency care models from several countries target the maximum length of stay of 4 hours in emergency departments[12], but studies that analyze patients with long stay in this sector consider time cuts from 2 to 6 hours in the analyses of their research[19-22].

In this study, the frequency of patients in the sample who spent 6 or more hours in the emergency room was great (30.3%), and, among them, unfavorable evolution reached its highest level (42.8% of cases). This result corroborates the recommendation of a maximum of 4 hours of stay inside the emergency room and with the indications that point to the period <6 hours as a time limit for permanence in this sector[22].

It is worth commenting that, in the first 4 hours in the emergency room, unfavorable evolution was observed more frequently in the initial 2 hours after admission to the unit. These first hours after admission to the emergency department have been recognized as the period directed to victim evaluation, diagnostic definition and beginning of the treatment plan[12], which may explain the results observed.

Especially in patients with TBI, the presence of hypoxia added to hypotension is associated with an increased risk of death and worse outcomes; therefore, the entire effort of the multidisciplinary team that assists these victims is focused on early hemodynamic and ventilatory stabilization in the emergency room[23]. Regarding the evolution of the REMS components, the GCS and respiratory parameters (RR and SpO_2) remained stable two hours after admission in this sector. The ventilatory support interventions were the most used (87.0% of the cases) and were probably essential for the rapid stabilization of RR and SpO_2 of the victims.

GCS is an important data in the evaluation of the evolution of acute brain injury. The stability of this parameter after two hours in the emergency room is an indicator that the victims of TBI of this investigation benefited from the interventions received. In general, in the hours and days following TBI, a set of secondary injuries, such as cellular ischemia, activation of the inflammatory cascade, edema of neurons and astrocytes, and vasogenic edema, exacerbates the initial damage. Within the rigid limits of the skull, edema increases intracranial pressure and reduces cerebral perfusion pressure. The worsening of cerebral ischemia, with the reduction of cerebral perfusion pressure and the increase in edema and intracranial hypertension, contributes to a vicious cycle of worsening of the clinical condition of the victim[24].

In this study, continuous sedation, essential to reduce metabolism and consumption of cerebral oxygen and protect the brain from damage resulting from the injury[24], was used in 34.8% of the sample and may have prevented and reduced secondary injuries, causing the early stability of the GCS of the victims. However, it should be considered that the sedated patient presents depression of the level of consciousness induced by drugs and that sedation impairs the evaluation of brain function. Stable values of the GCS, after two hours of admission, may be partially due to continuous sedation, which initially lowers the patient's responsiveness to external stimuli, but then keeps the GCS at stable values.

In all evaluation periods, unfavorable hemodynamic changes detected by HR and MAP occurred at an important frequency. There are different reasons for hemodynamic changes in the victim of TBI, including brain injuries, which can directly affect cardiovascular functions, and blood losses, which are important due to

associated injuries. On the other hand, arterial hypertension observed in Cushing's triad is found in severe cases of increased intracranial pressure and may be harmful to the patient by increasing vasogenic edema resulting from trauma[23-24].

Regarding the results related to hemodynamic changes, it should also be considered that the victims presented the TBI as the main injury, therefore, there was less possibility of large blood losses, due to the characteristics of this type of injury. However, the presence of major extracranial injuries may have triggered significant bleeding and blood pressure drop. On the other hand, the initial treatment of TBI focuses on the prevention of secondary injuries, through early procedures to avoid hypotension and hypoxia, aiming at maintaining adequate cerebral perfusion pressure and, by extension, cerebral blood flow[25].

Regarding the investigation of factors associated with length of stay in the emergency room of the victims of this study, the analyses indicated that there was no relationship between the variables gender, age, severity, PES characteristics and length of stay in the service. Previous studies have identified groups of patients who are likely to stay longer than 4 or 6 hours in the emergency department. Their results showed that older female patients (65 years or older), with more complex complaints, who arrived at the service during peak hours of care or at night, who required surgical interventions, clinical or neurological care, required radiological or laboratory tests, among other reasons, remained for a longer time in this sector[20-21].

In comparison with the present research, different variables were analyzed in those studies, as well as different results were observed in relation to gender and age. Undoubtedly, the specificities of trauma victims, young, mostly male, described in the literature[2,19,21] and observed in this study (average age of 34.7±15.2 years old and 84.7% of male sample), were related to these results.

In this research, the ISS did not have correlation with length of stay in the emergency service. The same result was found in an investigation that analyzed severe non-surgical trauma patients who needed intensive care[19]. Differently from these results, analysis of hemodynamically stable trauma victims (systolic blood pressure >100 mmHg, HR <110 beats/min) showed that the score of this index was significantly higher in the group with prolonged length of stay in the emergency room[21]. Probably, the hemodynamic stability of the patients in this investigation favored the severity of the trauma, established by the ISS, to be associated with the permanence in this sector.

Hemodynamic support was the only variable in this study that was associated with the greater length of stay in the emergency room of TBI victims. Although 41.3% of the sample received this treatment, HR and MAP alterations were significant in all evaluation periods. According to the results, hemodynamic stability was the most difficult goal to achieve in the emergency room and changes in MAP and HR were responsible for the worsening of the REMS values of almost all cases after 2 hours of admission.

As practical implications of the findings of this research, it can be highlighted that the results reinforce the recommendation of CFM Resolution nº 2,077/14[15] of maximum stay in the emergency room up to 4 hours after admission. In the last decade, several interventions to qualify assistance in the emergency department have been proposed, among them stand out the rules of maximum length of stay in the sector, such as the "4-hour rule" in the United Kingdom[22] and CFM Resolution nº 2,077/14[15]. It is evidenced in several studies that the shorter length of stay has been considered as a key element in the quality of the emergency department[12,20-22].

The results also highlighted the time intervals with the highest frequencies of unfavorable evolution of the victims (in the first 2 hours after admission to the emergency room and between 4 and 6 hours later), evidencing periods that patients needed redoubled monitoring of the nursing team and care and nursing management strategies that avoided their clinical worsening. In addition, the findings indicate special attention to victims with TBI and hemodynamic support

since they remained in the emergency room for longer and needed a longer time for clinical stabilization.

A study that analyzed the underlying causes of long-term stay in the emergency room (> 6 hours) identified that approximately 76% of these causes were organizational aspects and 22% related to the patient or disease[20]. Among the factors related to organizational character, the overcrowding of emergency departments has been highlighted, since it is associated with adverse outcomes to patients, including increased mortality[20]. The factor most reported as responsible for overcrowding of the emergency department is the lack of hospital beds. Moreover, overcrowding affects timely access to the necessary care for the patient, causing delays in care, almost always harming those who receive and care[22].

It is important to highlight, as limitations of this study, that the investigation was restricted to describing the evolution of victims in the emergency room without addressing their impact on the results of the TBI in the medium and long term. Moreover, the study was performed in a single hospital, a reference center, with advanced resources for the target population of this research and this may have provided a more favorable evolution of victims in the emergency room than in other services.

Another limitation refers to the objective of this investigation, conducted to identify clinical characteristics for long stay in the emergency department, without considering the interference of organizational aspects.

Conclusion

The analysis of the evolution of victims of blunt TBI in the first 6 hours after admission to the emergency room showed significant changes in the physiological conditions of the patients. The improvement of more than 25% of the sample was observed in all evaluations performed up to 6 hours. Between admission to the emergency room and 2 hours after, unfavorable evolution (35.1%) was more frequent than favorable

(27%) and reached its peak between 4 and 6 hours (42.8%). The stability of GCS and SpO_2 was identified up to two hours after admission to the service. On the other hand, unfavorable hemodynamic changes detected by HR and MAP occurred at an important frequency in all evaluations.

The use of hemodynamic support was an independent factor for the length of stay in the emergency room. Victims who received this treatment remained longer in this sector.

Collaborations:

1 – conception, design, analysis and interpretation of data: Hosana da Silva and Regina Marcia Cardoso de Souza;

2 – writing of the article and relevant critical review of the intellectual content: Hosana da Silva, Lilia de Souza Nogueira and Regina Marcia Cardoso de Sousa;

3 – final approval of the version to be published: Hosana da Silva, Lilia de Souza Nogueira and Regina Marcia Cardoso de Sousa.

References

1. Maas AIR, Menon DK, Adelson PD, Andelic N, Bell MJ, Belli A, et al. Traumatic brain injury: integrated approaches to improve prevention, clinical care, and research. Lancet Neurol. 2017;16(12):987-1048. DOI: https://doi.org/10.1016/S1474-4422(17)30371-X

2. Capazzi A, Woo J, Verduzco-Gutierrez M. Traumatic Brain Injury: An Overview of Epidemiology, Pathophysiology, and Medical Management. Med Clin North Am. 2020;104(2):213-38. DOI: https://doi.org/10.1016/j.mcna.2019.11.001

3. Mehmood A, Zia N, Kobusingye O, Namaganda RH, Ssenyonjo H, Kiryabwire J, et al. Determinants of emergency department disposition of patients with traumatic brain injury in Uganda: results

from a registry. Trauma Surg Acute Care Open. 2018;3(1):e000253. DOI: https://doi.org/10.1136/tsaco-2018-000253

4. Dash HH, Chavali S. Management of traumatic brain injury patients. Korean J Anesthesiol. 2018;71(1):12-21. DOI: https://doi.org/10.4097/kjae.2018.71.1.12

5. Geeraerts T, Velly L, Abdennour L, Asehnoune K, Audibert G, Bouzat P, et al. Management of severe traumatic brain injury (first 24 hours). Anaesth Crit Care Pain Med. 2018;37(2):171-86. DOI: https://doi.org/10.1016/j.accpm.2017.12.001

6. Gao L, Smielewski P, Czosnyka M, Ercole A. Cerebrovascular Signal Complexity Six Hours after Intensive Care Unit Admission Correlates with Outcome after Severe Traumatic Brain Injury. J Neurotrauma. 2016;33(22):2011-8. DOI: http://doi.org/10.1089/neu.2015.4228

7. Almeida CER, Sousa Filho JL, Dourado JC, Gontijo PAM, Dellaretti MGMA, Costa BS. Traumatic brain injury epidemiology in Brazil. World Neurosurg. 2016;87:540-7. DOI: https://doi.org/10.1016/j.wneu.2015.10.020

8. Brasil. Ministério da Saúde. Informações de Saúde (TABNET). Epidemiológicas e Morbidade 2008-2020 [Internet]. Brasília (DF); 2020 [cited 2021 Jan 9]. Available from: http://www2.datasus.gov.br/DATASUS/index.php?area=0203&id=6926

9. Fu TS, Jing R, Fu WW, Cusimano MD. Epidemiological Trends of Traumatic Brain Injury Identified in the Emergency Department in a Publicly-Insured Population, 2002-2010. PLoS One. 2016;11(1):e0145469. DOI: https://doi.org/10.1371/journal.pone.0145469

10. Taylor CA, Bell MJ, Breiding MJ, Xu L. Traumatic Brain Injury-Related Emergency Department Visits, Hospitalizations, and Deaths – United States, 2007 and 2013. MMWR Surveill Summ. 2017;66(9):1-16. DOI: http://dx.doi.org/10.15585/mmwr.ss6609a1

11. Salway RJ, Valenzuela R, Shoenberger JM, Mallon WK, Viccellio A. Emergency Department (ED) Overcrowding: Evidence-Based Answers To Frequently Asked Questions. Rev Méd Clín Condes. 2017;28(2):213-9. DOI: https://doi.org/10.1016/j.rmclc.2017.04.008

12. Oliveira AC. Modelos de organização de serviços de urgência: uma revisão da literatura [Internet]. Brasília (DF): Programa de Apoio ao Desenvolvimento Institucional do Sistema Único de Saúde; 2014 [cited 2021 Jan 9]. Available from: http://portalarquivos2.saude.gov.br/images/pdf/2016/setembro/26/7-Revisao-Urg--ncias.pdf

13. Vermeulen MJ, Guttmann A, Stukel TA, Kachra A, Sivilotti MLA, Rowe BH, et al. Are reductions in emergency department length of stay associated with improvements in quality of care? A difference-in-differences analysis. BMJ Qual Saf. 2016;25(7):489-98. DOI: http://dx.doi.org/10.1136/bmjqs-2015-004189

14. van der Veen D, Remeijer C, Fogteloo AJ, Heringhaus C, Groot B. Independent determinants of prolonged emergency department length of stay in a tertiary care centre: a prospective cohort study. Scand J Trauma Resusc Emerg Med. 2018;26(1):81. DOI: https://doi.org/10.1186/s13049-018-0547-5

15. Conselho Federal de Medicina. Resolução CFM 2077/14. Dispõe sobre a normatização do funcionamento dos serviços hospitalares de urgência e emergência, dimensionamento da equipe médica e do sistema de trabalho [Internet]. Brasília (DF); 2014 [cited 2021 Jan 9]. Available from: https://portal.cfm.org.br/images/PDF/resolucao2077.pdf

16. Association for the Advancement of Automotive Medicine. The Abbreviated Injury Scale (AIS): 2015 Revision. Des Plaines, Illinois (US); 2016.

17. Olsson T, Terent A, Lind L. Rapid Emergency Medicine score: a new prognostic tool for in-hospital mortality nonsurgical emergency department patients. J Intern Med. 2004;255(5):579-87. DOI: https://doi.org/10.1111/j.1365-2796.2004.01321.x

18. Lima KP, Nogueira LS, Barbosa G, Bomfim AKS, Sousa RMC. Severity indexes of blunt trauma victims in intensive therapy: prediction capacity for mortality. Rev Esc Enferm USP. 2021;31(55):e3747. DOI: https://doi.org/10.1590/S1980-220X2020003203747

19. Siletz A, Jin K, Cohen M, Lewis C, Tillou A, Cryer HM, et al. Emergency department length of stay in critical nonoperative trauma. J Surg Res. 2017;214:102-8. DOI: http://dx.doi.org/10.1016/j.jss.2017.02.079

20. Driesen BEJM, van Riet BHG, Verkerk L, Bonjer HJ, Merten H, Nanayakkara PWB. Long length of stay at the emergency department is mostly cause by organisational factors outside the

influence of the emergency department: A root cause analysis. PLoS One. 2018;13(9):e0202751. DOI: http://dx.doi.org/10.1371/journal.pone.0202751

21. Becker A, Segal G, Berlin Y, Hershko D. The emergency department length of stay: Is the time running out? Clin J Traumatol. 2019;22(3):125-8. DOI: http://dx.doi.org/10.1016/j.cjtee.2019.01.008

22. Hosseininejad SM, Aminiahidashti H, Pashaei SM, Khatir IG, Montazer SH, Bozorgi F, et al. Determinants of Prolonged Length of Stay in the Emergency Department; a Cross-sectional Study. Emerg (Tehran) [Internet]. 2017 [cited 2021 May 18];5(1):e53. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5325925/

23. American College of Surgeons. ATLS Advanced Trauma Life Support (Student Course Manual). 10a ed. Chicago (IL); 2018.

24. Ng SY, Lee AYW. Traumatic Brain Injuries: Pathophysiology and Potential Therapeutic Targets. Front Cell Neurosci. 2019;13:528. DOI: https://doi.org/10.3389/fncel.2019.00528

25. Vella MA, Crandall ML, Patel MB. Acute Management of Traumatic Brain Injury. Surg Clin North Am. 2017;97(5):1015-30. DOI: http://dx.doi.org/10.1016/j.suc.2017.06.003