Analysis of trauma patients treated at a Brazilian university hospital during the "Golden Hour".

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Abstract

Introduction and objectives: To evaluate the impact of the "Golden Hour" in the morbidity and mortality of trauma patients treated at a Brazilian university hospital.

Materials and methods: A descriptive cross-sectional epidemiological study involving 604 trauma patients admitted to the emergency service from December 2013 to February 2014. Data were collected through questionnaires filled by researchers at emergency room associated with prehospital care information. Gender, age, type of injury, Revised Trauma Score (RTS), hospitalization time and mortality related to the time between the traumatic event and the admittance to the emergency department were analyzed.

Results: Most patients were male (67.7%), the mean age being 36.7 years. Blunt traumas accounted for 93.5% of the admissions. The most frequently used transport was Integrated Service Trauma Care Emergency (SIATE - 62.58%), followed by Mobile Emergency Service (SAMU – 25.33%). The mean RTS was 7.72 (ranging from 0.00 to 7.84). Deaths amounted to 10 (1.65%) and the average length of hospitalization was 2.23 days (ranging from 0 to 140 days). The mean time between the traumatic event and the arrival at the hospital was 57 minutes (minimum of 11 minutes and maximum of 22 hours). The majority of patients (75.16%) arrived within 1 hour at the emergency room. In this group, the mortality rate was 1.54%, the average length of stay amounted to 1.98 days and the mean RTS was 7.74. Patients admitted after the "Golden Hour" (24.84%) achieved a mortality rate of 2.0%, an average hospitalization time of 2.97 days and mean RTS of 7.69.

Conclusion: Most patients treated in this emergency room were young males, victims of blunt trauma, brought by SIATE and admitted within the "Golden Hour" of trauma. Patients admitted within the aforementioned period had, in this study, a tendency towards lower lengths of hospitalization, higher RTS and superior survival rates.

Keywords: Emergency medical services, Emergency service, Hospital, Transportation, Survival Rate, Morbidity, Hospitalization

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Introduction

The importance of time elapsed between time of trauma and the treatment for the shock caused by the injuries was firstly described in 1918 by Santy, during World War I. This concept was used by Cowley in the development of one of the most important tenets in trauma care: the "Golden Hour" [1,2].

In 1985, Trunkey and colleagues described a trimodal curve of death as a possible outcome in trauma, in which half of the victims will die while still at the scene, 30% in the first 24 hours and the remaining 20% after this period [3]. This data has also been observed in the traumatic events that affect pediatric population: 44% will die within minutes, 20% in a few hours and 36% in a few days [4]. Hence, most of the deaths occur immediately or within the first hour after the traumatic event, which makes this the critical period for interventions - especially with regard to transportation and proper choice of care facility - in order to reduce mortality and improve results [5].

The organization and standardization of the care delivered to the patients in this initial period, of extreme importance, had its beginnings in the major armed conflicts of the last century. The removal of the injured from the battlefield during World War II was reported to take, on average, 4 hours. During the Vietnam War, this time dropped to 27 minutes [5-8].

In Brazil, the pre-hospital care service for trauma patients begun to develop in the 90s, being unevenly implemented in large Brazilian cities. In 2003, this service was redesigned, from then on also being responsible for clinical emergencies via the Mobile Emergency Care Service, the SAMU [5]. In the state of Paraná (Brazil), the Integrated Care Service for Trauma and Emergency (SIATE) has been implemented since 1990, having answered more than 100,000 calls related to traffic accidents alone over these 26 years [9].

The "Golden Hour" has been interpreted as an absolute truth for a long time, even though there has been conflicting scientific

evidence [10]. The study by Newgard et al. was important in the way that no significant differences were found, both in terms of survival and in long-term outcomes for patients with isolated head trauma. However, it showed superior results that were statistically significant in patients who presented with hypovolemic shock and received care and treatment within the first hour after injury [11,12]. Therefore, the "Golden Hour" is no longer seen as an absolute dogma or fundamental truth in the treatment of trauma patients. However, it should be noted that data on the civilian population is limited since most of the work in this regard has been done in military environments [13].

In this context of intense debate regarding the "Golden Hour", other aspects involving the pre-hospital care remain essential and must not be put aside, such as rapid, conscious and rational decisions in order to reduce morbidity and mortality.

Methods

Descriptive cross-sectional epidemiological study, with prospective data collection of 604 trauma patients treated in the emergency room of a specialized trauma care center. Medical students from the Trauma Academic League of Cajuru University Hospital (LATHUC) gathered the data from December 2013 through February 2014, uninterruptedly, having previously received proper training on how to fill out the treatment protocols.

The following variables were analyzed: gender, age, type of injury, type of transport, Revised Trauma Score (RTS), length of hospitalization, and mortality related to the time between the trauma and the arrival at the emergency service. Were included in this study all of the trauma victims admitted to the emergency service, being excluded those with inadequate or incomplete data. Such an extensive epidemiological study had never been performed in this university hospital, rendering the researchers unable to accurately calculate the expected sample size. Besides, the 24-hour basis of the data collection could only be properly maintained during the aforementioned period.

The data was stored, processed and analyzed by Microsoft® Office Excel 2007 and STATA v.13.1. For statistical purposes, two groups were created according to the time elapsed between the traumatic event and hospital arrival. These groups were entitled group A (patients admitted within the "Golden Hour") and group B (patients admitted at least 1 hour after the traumatic event). For the analysis of hospitalization time and mortality, the non-parametric Mann-Whitney test and the chi-square test were used, respectively. The Student's t-test was used regarding the RTS analysis. P values <0.05 were considered statistically significant.

This study was approved by the Research Ethics Committee of the Pontifical Catholic University of Parana (decision 480,483 of 12/04/2013).

In regard to RTS, groups A and B achieved the same median (7.84) and performed similarly considering the mean scores (7.74 and 7.69, respectively) (Table 4).

The hospitalization time was shorter in group A (mean of 2 days) than in group B (mean of 3 days) (Table 5). Furthermore, group A had a higher number of hospitalizations that lasted less than 24 hours when compared with group B (67.8% and 60.0%, respectively). Other hospitalization times are shown in Table 6.

Statistical analysis

Time to death (months) from surgery were considered. Survival lifetimewas analyzed by using Cox regression models [10], adjusting for age and sex and setting type of prosthesis and co-

Table 1. *Epidemiologic data for group A admission within the "Golden Hour" and group B admission after the "Golden Hour".*

Variable analyzed	Group A (0-1 h) n = 454 (75.2%)	Group B (>1 h) n = 150 (24.8%)
Age (mean ± standard deviation)	35.8 ± 17.2	39.3 ± 19.6
Gender		
Female	144 (31.7%)	40 (26.7%)
Male	310 (68.3%)	110 (73.3%)
Type of injury		
Blunt	422 (93.0%)	143 (95.3%)
Penetrating	32 (7.0%)	7 (4.7%)
Type of transport		
SIATE	289 (63.7%)	89 (59.4%)
SAMU	120 (26.4%)	33 (22.0%)
Private-controlled highway emergency transport	20 (4.4%)	9 (6.0%)
Private transport (automobile)	16 (3.5%)	2 (1.3%)
Others (motorcycle, bicycle, walking)	9 (2%)	17 (11.3%)

Note: SIATE: Integrated Care Service for Trauma and Emergency; SAMU: Mobile Emergency Care Service.

Table 2. *Mortality rates for group A admission within the "Golden Hour" and group B admission after the "Golden Hour".*

Mortality	Group A (0-1 h) n = 454 (75.2%)	Group B (>1 h) n = 150 (24.8%)
No	447	147
	98.5%	98.0%
Yes	7	3
	1.5%	2.0%
p-value: 0.703 (Chi-square test, p<0.05)		

morbidities as covariates to estimate the survival probabilities or hazard ratios. Then, the presence of complications (e.g. blood transfusion) and scales of risk-benefit were included in a second model stratified by gender. Kaplan-Meier survival curves were also estimated [11] for every co-morbidity in order to estimate the probability at specific cut-point for age [12]. In addition, a random intercept was included in the Cox model to quantify the variability between clusters of patients with similar characteristics [13].

Results

The study analyzed 604 protocols for trauma patients, 67.7% (n=408) being male and the mean age corresponding to 36.67 years (ranging from 06 to 102 years old). Blunt traumas accounted for 93.5% of the admissions. The transportation most commonly used to get to the hospital was the Integrated Care Service for Trauma and Emergency (SIATE), involved in 62.58% of the occurrences, followed by the Mobile Emergency Care Service (SAMU), accounting for 25.33% of the admittances. A comparison of the epidemiological data between patients admitted within and after the "Golden Hour" is available on Table 1.

In regard to time elapsed until admission, 75.16% (n=454) were admitted to the emergency service in less than 1 hour after the traumatic event (group A), while 24.84% (n=150) arrived after this period (group B). The overall mean time between the traumatic event and the arrival at the hospital was 57 minutes (minimum of 11 minutes and a maximum of 22 hours). Regarding mortality, group B faced it as an outcome more frequently than group A (2.0% and 1.5%, respectively) (Table 2). Epidemiological data on the mortality group is available on Table 3.

Discussion

In the present study, most of the occurrences involved young and male subjects, which has already been reported in the literature. This reinforces the fact that the trauma remains a worldwide epidemic, affecting mostly young adults in the prime of their socioeconomically active ages [5,14,15].

Table 3. *Mortality group epidemiologic data – group A admission within the "Golden Hour" and group B admission after the "Golden Hour".*

Variable analyzed	Group A (0-1 h) n = 7 (70.0%)	Group B (>1 h) n = 3 (30.0%)
Age (mean ± standard deviation)	56.9 ± 17.5	39.3 ± 19.6
Gender		
Female	0 (0%)	40 (26.7%)
Male	7 (100%)	110 (73.3%)
Type of injury		
Blunt	4 (57.1%)	143 (95.3%)
Penetrating	3 (42.9%)	7 (4.7%)
Type of transport		
SIATE	3 (42.9%)	1 (33.3%)
SAMU	4 (57.1%)	0 (0.0%)
Private-controlled highway emergency transport	0 (0.0%)	2 (66.7%)
RTS - mean (minimum, maximum)	5.49 (1.89 – 7.55)	3.15 (0 – 7.55)

Note: SIATE: Integrated Care Service for Trauma and Emergency; SAMU: Mobile Emergency Care Service; RTS: Revised Trauma Score.

Table 4*. Comparison of RTS (mean, median, minimum, maximum and standard deviation) between group A admission within the "Golden Hour" and group B admission after the "Golden Hour".*

Group	n	Mean	Median	Minimum	Maximum	Standard Deviation
A (0-1 h)	454	7.74	7.84	1.9	7.84	0.5
B (>1 h)	150	7.69	7.84	0.0	7.84	0.8
p-value: 0.489 (Student's t test, p<0.05)						

Table 5. *Hospitalization time – comparison between group A admission within the "Golden Hour" and group B admission after the "Golden Hour".*

Group	n	Mean	Median	Minimum	Maximum	Standard Deviation
A (0-1 h)	454	1.98	0	0	140	9.4
B (>1 h)	150	2.97	0	0	107	10
p-value: 0.053 (non-parametric Mann-Whitney test, p<0.05)						

Table 6. *Hospitalization time according to intervals – comparison between group A admission within the "Golden Hour" and group B admission after the "Golden Hour".*

Length of stay in hospital (days)	Group A (0-1 h)	Group B (>1 h)
0	308 (67.8%)	90 (60.0%)
1 or 2	82 (18.1%)	29 (19.3%)
> 2	64 (14.1%)	31 (20.7%)
Total	454	150
p-value: 0.120 (Chi-square test, p<0.05)		

The results obtained on the average time until the arrival of these patients in the hospital (57 minutes) are similar to those reported in the literature. The study by Newgard et al. was conducted cooperatively with pre-hospital trauma care from American and Canadian cities, having assessed 2,222 patients, and the average pre-intervention time was of 44 minutes, with only 22% of patients in hypovolemic shock and 26% of victims with traumatic brain injury taking longer than 60 minutes to get to the hospital. According to the authors, the fact that multiple emergency medical services were analyzed increases the generalizability of their findings [12,16].

Even in countries with irregular geography, like Korea, where the transportation of these victims is a challenge, the pre-hospital care proved to be very effective, as demonstrated in the work of Kim et al. In that study, the transfer of 1,626 patients was analyzed, with an average time of 47 minutes when taken by road and 60 minutes with aero-medical support. However, only victims of blunt trauma were included in this study [14].

Even when patients are not transported in urban or civil context, but on the battlefield - military studies -, similar data are found. Kotwal et al. conducted a descriptive analysis of the data on the war in Afghanistan between September 2001 and March 2013, finding an average time of 43 minutes to transport the patients from the battlefield to the proper medical facility. A limitation of this study could rely on the fact that victims of minor traumas were not taken into consideration [10].

As for Brazilian statistics, the work by Ladeira et al. analyzed 1564 traffic accident victims aided in the city of Belo Horizonte, between November and December 2003, and 58.7% of them were admitted to the hospital within the first hour of the occurrence of the traumatic event. The authors advert that their investigation did not contemplate whether or not stabilization procedures were performed on the scene of the accident, which could have delayed hospital admissions [5].

Harmsen et al. conducted a systematic review covering 20 observational studies that evaluated the following periods of pre-hospital care: activation time (time between the accident and the triggering of the rescue team); response time (time between the triggering of the team and the mobilization to the scene of the accident); time at the scene (time spent by the rescue team to provide initial care, immobilize and stabilize the victim); transportation time (travel time between the accident site and the hospital where the definitive treatment would be performed); and all pre-hospital time (sum of all the above intervals, i.e., the period between the trauma occurrence itself and the arrival of the victim to the definitive treatment site). According to the variables, the response time, time at the scene and transport time exerted positive influence on mortality, concluding that it would be beneficial for the victim to be approached by the trauma team at the trauma center as soon as possible. However, the care and attention necessary for stabilization measures at the scene of the accident should also be respected [13].

In this study, it was observed that mortality was higher in patients who received hospital care in a period longer than 60 minutes. Regarding this particular variable, the data in the literature are still conflicting.

The study by Kim et al. on the pre-hospital care in Korea showed increased survival in patients who were transported with aero-medical support when compared to the group transported by land (94.9% and 90.5%, respectively), even though air transport took a greater pre-hospital time in relation to land (60 minutes and 47 minutes respectively) [14]. In the same vein, the work by Kotwal et al. observed that patients with transport time shorter than 60 minutes had higher mortality and morbidity compared to the group with transport time exceeding 60 minutes. However, patients taken more quickly to the hospital had a higher prevalence of chest and abdominal injuries, not to mention lesions secondary to explosions [10].

The meta-analysis by Harmsen et al. involved 16 studies analyzing the effect of the total time of pre-hospital care and found no statistically significant evidence between the time spent on pre hospital care and mortality - although some isolated studies show an inverse proportional relationship between these variables [13].

On the other hand, some studies, such as the one by Gonzalez et al. show that the transportation time interferes in mortality numbers. Accordingly, the present study found that not only a mortality was linked to a higher number of patients admitted within the "Golden Hour", but also a decreased length of hospitalization [17].

In this study, most patients were discharged from the hospital within 24 hours of admission. This information possibly indicates an inadequate triage or inappropriate transportation, as suggested by Platts-Mills et al. In an editorial, the authors report that most victims who received care at specialized trauma centers had no injuries that presented a life risk. Therefore, emergency medical systems could have considered taking these victims to smaller hospitals instead, at which these patients could also have received proper care and probably be sent back home without needing to be admitted to a specialized trauma center [18].

The problems of under triage and inadequate transportation have been reported in American studies and are associated with worse clinical outcomes. One reason given for this type of bias is the use of subjective criteria by field staff based on, among other things, their sensitivities and previous experiences. In this context, a possible solution would be the use of specific protocols already adopted by most American states. However, as seen in other countries - such as Australia –, these protocols face obstacles to its widespread use due to poor adhesion of the emergency teams, making the resolution of this problem rather difficult [18].

In the present study, most patients (87.91%) were admitted and transported by integrated pre-hospital care systems, theoretically respecting principles of Prehospital Trauma Life Support (PHTLS) and Advanced Trauma Life Support (ATLS). These integrated systems are already a well-established reality in developed countries like the United States and Canada. In Brazil, however, it constitutes a rather recent service and still demands standardization for the triage and a more homogeneous coverage, especially in isolated and rural areas. Considering the data showing positive impacts when proper pre-hospital care is

provided for the patients in this study and the high frequency of trauma-related mortality in general, the importance of this type of service is reinforced.

Conclusion

In this study, the prospected data show a predominance of young people in socio-economically active age as major trauma victims. Most of these patients received primary care and transportation to the specialized trauma center in less than 60 minutes, within the so-called "Golden Hour" of trauma. It should be noted that the pre-hospital care in this study was carried out by integrated systems consisting of properly trained staff for triage, initial treatment and correct transfer. As for the length of stay and mortality, in this study, patients admitted within the "Golden Hour" performed better when compared to victims admitted after one hour of the traumatic event, although there are discrepancies in the literature.

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