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Analysis of the efficiency of an emergency network for the treatment of multiple burn victims.

Análise da eficiência de uma rede de urgência para tratamento de múltiplos queimados.

Fábio Mendes Botelho Filho, ACBC-MG[1]; Iara Mateus Marçal[1]; Lina Roa[2]; André Gonçalves Marinho[1]; Gabriela Zamunaro Lopes Ruiz[1]; Leonardo Motta Costa Lopes[1]; Lígia Ferreira Brenck[1]; Juliana Louzada Campos[1]; Letícia Maria Moreira Rabelo[1]; Taylane Vilela Chaves[1]; Luide Scalioni Borges Dias[1]; Ana Paula Rosendo Santos[1]; Lucas Barbosa Tolentino[1]; Nivaldo Alonso[2]

A B S T R A C T

Objective: to evaluate the effectiveness of the adopted strategy and the care quality for pediatric trauma in the survival of patients attended after a disaster in a city in the interior of Minas Gerais state, compared to the expected results of studies on infant mortality in major burns. **Methods:** retrospective observational analysis of ten patients who were burned and transferred to a trauma reference center. We used the modified R-Baux score to estimate the expected mortality. We compared the expected mortality predicted by R-Baux score and the actual mortality determined from one-ratio test. We also compared time of post-trauma admission with mortality and burned body surface area with mortality. **Results:** mean R-Baux score was 75.2, which means an expected mortality of 5% among major burn patients. However, in this study, mortality in the group of children with large burned body surface area was of 60%, p=0.001, a rate far beyond that expected in literature. **Conclusion:** despite the innumerable variables, we consider the hypothesis of the pediatric trauma care infrastructure being inferior than the one needed in the state. This study suggests a greater incentive for public policies concerning pediatric trauma care, prepared referral center, well-established transfer agreements, and optimization of catastrophe plans, in order to reduce morbimortality of patients who survive the first hour after trauma.

Keywords: Trauma Centers. Wounds and Injuries. Burns. Child.

INTRODUCTION

On October 5th, 2017, in the city of Janauba, about 557km from Belo Horizonte (MG), the watchman of a municipal education center set fire to himself, other employees, and the children of the nursery where he worked, provoking a great tragedy[1]. At that time, there were 75 children and 17 employees. Four children died on the spot. One died during the transport to the city of Montes Claros (MG), located 134km from Janauba. Santa Casa de Montes Claros confirmed the death of two other children in the afternoon of the following day. After screening in the origin city, the ten most severe cases were referred to Hospital João XXIII (HJXXIII), in Belo Horizonte. In this hospital, three other children did not resist, totalizing ten infant deaths.

HJXXIII is the largest trauma reference center in Latin America[2], and, for the tragedy in Janauba, the hospital triggered its catastrophe plan: reorganization strategy of teams, sectors, and hospital resources, in order to optimize and prioritize care in challenging situations where the demand for care disproportionately grows in relation to the capacity offered by the institution[3]. The total daily attendance capacity of HJXXIII is 400 patients, but the hospital can receive, in disaster situations, up to 80 people only in its emergency unit.

The most elaborate level of the catastrophe plan was put into practice for the trauma in question: triggering the network to get the aid of other hospitals, concerning the reservation of beds and the reassignment of previously hospitalized patients;

1 - João XXIII Hospital, Pediatric Trauma Research Group, Belo Horizonte, MG, Brazil. 2 - Harvard Medical School, Program in Global Surgery and Social Change, Boston, Massachusetts, United States of America.

total release of beds in the polytrauma room and of vacancies from the pediatric ICU; the pediatric emergency team (17 professionals presented themselves) and intensivist pediatricians, besides the Plastic Surgery, Anesthesiology, and Toxicology (due to smoke inhalation) teams, were extraordinarily called up. All elective procedures were suspended.

The present study aims to evaluate the survival of the pediatric patients attended at HJXXIII after Janauba tragedy in comparison to the expected results of studies on infant mortality in major burn patients. From the outcome, it is expected to analyze the possible factors that influenced this mortality.

METHODS

Retrospective observational analysis of ten patients who were burned and transferred to HJXXIII in Belo Horizonte, from October 5th to 7th, 2017. We analyzed only the victims of Janauba tragedy, screened at the scene, needing attendance at a reference center and being able to survive during transport. Victims who were treated at the regional reference hospital or who died at the site, or during transportation, were not considered.

This study is part of the research project on pediatric trauma, authorized under number 094B/ 2017 by the Ethics and Research Committee of *Fundação Hospital de Minas Gerais*.

The following variables were collected: gender, age, time between the traumatic event and the admission to the reference unit, length of hospital stay, total body surface area (TBSA) for second and third-degree burns, presence of airway injury or inhalation injury, and mortality. Modified R-Baux score was used to estimate the expected mortality. Then, we compared the expected mortality predicted by R-Baux score and the actual mortality determined from one-ratio test.

R-Baux score is calculated by the following formula: R-Baux score = TBSA + age + [17 x R], where R=1 if there is inhalation injury and R=0 if there is no inhalation injury. The value found in a normogram is then placed to evaluate the expected mortality from that value.

We also compared the time of post-trauma admission with mortality, and the body surface degree with mortality. These comparisons were performed using Mann-Whitney test, since the sample was small. The analyses were performed using MINITAB software (version 18). The adopted significance level was 5%.

RESULTS

HJXXIII attended ten children (60% females) who were victims of severe burns in the described period. The mean age was 4.6 years. All were injured by inhalation and intubated in the pre-transference period. Of this total, six children had skin burns and four suffered only inhalation injury. The mean TBSA was 27.6%. The mean time from trauma up to hospital admission was 18.5 hours and the mean hospital stay at HJXXIII was 23.5 days. The overall in-hospital mortality at HJXXIII was 30% (Table 1). Two stable children were transferred to another hospital after a 24-hour observation period by the referral team.

Patients were evaluated as major burn patients, that is, those with burns covering more than 20% of total body surface area. The expected mortality predicted by R-Baux score was calculated for each one of these patients, according to table 2.

For this latter group, therefore, the mean age was 4.6 years, and the mean burned body surface area was 54% (Table 3). The mean R-Baux score was 75.2, which means an expected mortality of 5%. However, the actual mortality in this group was 60%, p-value =0.001.

Finally, table 4 illustrates the following comparisons: the time between the traumatic event and the admission to the reference unit with the body surface grade and mortality. There was no significant difference for these comparisons.

Table 1. *Burn victims transferred to João XXIII Hospital according to the time between the traumatic event and the admission to the reference unit, gender, age, TBSA, airway injury, death, and length of hospital stay.*

Patient	Time between the traumatic event and the admission to the reference unit (hours)	Gender	Age	TBSA*(2º and 3º degree burns)	Definitive airway	Death	Length of hospital stay (days)
1	10	M	5	80%	Yes	Yes	98
2	11	F	4	63%	Yes	No	42
3	11	M	5	8%	Yes	No	18
4	11	F	6	0	Yes	No	5
5	16	F	5	0	Yes	No	6
6	17	F	5	25%	Yes	No	61
7	17	M	5	50%	Yes	Yes	2
8	23	F	3	0	Yes	No	1
9	23	M	4	0	Yes	No	1
10	46	F	4	50%	Yes	Yes	1

TBSA: total body surface area.*

Table 2. *R-Baux: expected mortality and mortality found for patients with TBSA>20%.*

Patient	Time between the traumatic event and the admission to the reference unit (hours)	Gender	Age	TBSA*	R-Baux/Expected mortality (%)	Death
1	10	M	5	80%	102/30%	Yes
2	11	F	4	63%	84/9%	No
6	17	F	5	25%	47/<1%	No
7	17	M	5	50%	72/4%	Yes
10	46	F	4	50%	71/4%	Yes

TBSA: total body surface area.*

Table 3. *Characteristics of the group of major burn patients (BBS>20%).*

Major burn patients (TBSA>20%)	
Mean age	4.6 years
TBSA*	54%
Airway injury	Yes
Mean R-Baux score	75.2
Expected mortality (%)	~5%
Actual mortality (%)	60%

TBSA: total burned body surface area.*

Table 4. *Comparing the time between the traumatic event and the admission to the reference unit with the body surface grade and mortality.*

Characteristics	Mortality								p-value
	Yes				No				
	n	Mean	SD*	Median	n	Mean	SD*	Median	
Time between the traumatic event and the admission to the reference unit (hours)	3	24	19.1	17	7	16	5.4	16	0.909**
Body surface grade	3	60	17.3	50	7	14	23.6	0	0.069**

** SD: standard deviation; ** Mann-Whitney test.*

DISCUSSION

Pediatric trauma is still responsible for most child and adolescent deaths in Brazil[4]. Despite this, few studies on the subject are widespread, and few are the reference hospitals that are qualified to treat pediatric trauma, not only in Brazil, but also in the world[5,6]. Following the national trend, the pediatric age group is the one that presents the great majority of deaths which occur outside the hospital due to burns. From 2008 to 2014, this proportion was 85%[7] among children aged five to 14 years. This fact, taking into account a national reference center, raises the question of whether the care for traumatized children in this study could present a better outcome than the one achieved. Janauba tragedy was an event that mobilized the emergency network of Minas Gerais state, being important the data analysis in order to evaluate ways to improve the system for other possible catastrophic situations.

In the present study, it was observed that the time between the traumatic event and the admission to the reference unit was prolonged, in average, 18.5 hours. It is known that, for those with a burned body surface, the definitive airway management technique in the first hour after trauma and the volume resuscitation technique in the first eight hours are critical measures for patient's survival[8]. It is inferred, therefore, that children arrived late at the definitive reference unit, and, given the geographical distances to this reference center (557Km) and to the regional center (Montes Claros, 134km), it was not possible to perform the immediate care before arriving at the final destination. This delay was due both to the great distance from the city to the capital and to the great number of victims. The fact that children arrived at the reference center after the most critical resuscitation hours may justify the absence of an association between mortality and the time between the traumatic event and the admission to the reference unit, since there were no children who arrived within the first initial eight hours to compare the outcomes. If children had arrived within the first eight hours after trauma, there could have been a significant change in mortality.

A second aspect noted in the study was that there was no association between mortality and TBSA (p-value =0.069), which may be explained by the small sample size. Although airway lesions are critical in the treatment of burns, children with only inhalation lesions had length of hospital stay and expected mortality in agreement with literature, whereas patients with skin lesions presented higher morbimortality. The essential treatment of a major burn patient, with significant skin destruction, is volume resuscitation in the first hours, followed by infection prevention care[8,9]. Updates on volume resuscitation and infection prevention in burns could be themes best worked out with state emergency teams and could have modified the outcome of the major burn patients. In this group (with more than 20% TBSA), mortality was higher in comparison with that predicted by R-Baux score (p-value =0.001).

Modified R-Baux score was used in this study, because it is considered to be one of the best prognostic scoring system in burns. Modified R-Baux score considers as decisive prognostic factors: age, total burned surface area, and inhalation injury[10] (presence or absence). This score has already been validated in previous studies and, despite the criticism regarding the pediatric population (because, in infants, observed mortality is usually higher), it is still one of the most reliable scores[10-13]. The adjustment of the score for the pediatric population, P-Baux, has already been attempted; however, the methodology and its validation are still under development[12,13].

Although it is a limited study, due to the scarce literature on predictors of pediatric trauma mortality[13] and the small sample size, we concluded that there is still a need for a greater incentive to implement public policies concerning child trauma treatment in Minas Gerais state. According to Citron *et al*.[7], the percentage of burn deaths reduces for each dollar increase in per capita income. Brazil's more developed regions, with better income and greater health infrastructure, have lower rates of extra-hospital mortality (although still high) and higher rates of in-hospital admission. The opposite is also true: in less-developed regions, there are more deaths outside the hospital and fewer admissions to health institutions. Although a greater severity of the initial lesions may justify a share of extra-hospital mortality, such analysis allows us to assume that the difficulty of access to health services and the distance from specialized trauma centers are the likely responsible factors for this high disparity.

It is important to have specialized centers located within a two-hour distance from each citizen[14]. Prepared reference centers, well-established transfer agreements, and implementation of catastrophe plans, as seen in HJXXIII, are essential for reducing the morbimortality of patients who survive the first hour after trauma. But isolated strategies do not work.

Strategies should be decentralized, regionalized, and integrated. With this study, we alert governments of the need for rethinking their policies of urgency, so that, in the future, the treatment of children, always innocent creatures, be more effective.

R E S U M O

Objetivo: *avaliar a eficácia da estratégia adotada e a qualidade do atendimento em trauma pediátrico na sobrevivência dos pacientes atendidos após desastre em uma cidade do interior de Minas Gerais, em comparação a resultados esperados por estudos sobre mortalidade infantil em grandes queimados.* **Métodos:** *análise retrospectiva observacional de dez pacientes que sofreram queimaduras e foram transferidos para um centro de referência de trauma. Utilizou-se o escore de R-Baux modificado para estimar a mortalidade esperada. Comparou-se a mortalidade esperada a partir do escore de R-Baux e a mortalidade real, a partir do teste de uma proporção. Comparou-se, também, tempo de admissão pós-trauma com mortalidade e grau de superfície corporal queimada com mortalidade.* **Resultados:** *o R-Baux médio foi de 75,2, o que significa uma mortalidade esperada para grandes queimados de 5%. No entanto, a mortalidade do grupo com grande área de superfície corporal queimada desse estudo foi de 60%, valor p=0,001. Observou-se neste caso uma mortalidade muito além da esperada pela literatura.* **Conclusão:** *apesar das inúmeras variáveis, aventa-se a hipótese de infraestrutura de atendimento em trauma pediátrico aquém da necessária no Estado. Este estudo sugere maior incentivo à políticas públicas para atendimento de trauma pediátrico, centro de referência preparado, acordos de transferência bem estabelecidos e otimização de planos de catástrofe para diminuição da morbimortalidade para os pacientes que sobrevivem à primeira hora após o trauma.*

Descritores: *Centros de Traumatologia. Ferimentos e Lesões. Queimaduras. Criança.*

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Mailing address:
Fabio Mendes Botelho Filho
E-mail: mendesbotelho@hotmail.com