RMMG
Revista Médica de Minas Gerais

ORIGINAL ARTICLE

Massive transfusion protocol: experience in trauma care.

Protocolo de transfusão maciça: experiência no atendimento ao trauma.

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ABSTRACT

Introduction: Trauma is one of the main causes of death in the world and hemorrhage is responsible for 30% to 40% of trauma-related mortality. The establishment of a massive transfusion protocol (TMP) offers the opportunity for preventive measures to control damage to the patient with severe hemorrhagic shock. Objective: to analyze epidemiological data of patients submitted to the MTP in a trauma reference institution. Methods: this is a study retrospective with a quantitative approach, involving patients undergoing MTM from January to December 2018. Blood data, patient identification, trauma site, accident type, clinical information and outcome were obtained through review of medical records and information collected at the hospital transfusion center. Statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) version 23. Results: 306 patients were evaluated, there was a predominance of males and ages from 18 to 30 years. 55.9% of the patients were from Fortaleza. The predominant blood group was O, being the majority with Rh positive factor. The thorax was the most common site of trauma. Most cases were related to penetrating trauma, being 53.6% for firearms and 8.5% for white weapons. Median ABC score, concentration of red blood cells and fresh plasma used were 2. 29.7% were dead in 24 hours and only the trauma site - abdomen - was revealed as a protective factor for this outcome. Conclusion: it was observed, after completing the study, the inexistence of significant associations between the protocol variables and the clinical death outcome.

Keywords: Transfusion of Blood Components. Trauma. Epidemiology.

RESUMO

Introdução: O trauma é uma das principais causas de morte no mundo e a hemorragia é responsável por 30% a 40% da mortalidade relacionada ao trauma. O estabelecimento de um protocolo de transfusão maciça (PTM) oferece oportunidade de medidas preventivas de controle de danos ao doente com choque hemorrágico grave. **Objetivo:** analisar dados epidemiológicos dos pacientes submetidos ao PTM em instituição de referência em trauma. **Métodos:** estudo quantitativo, envolvendo pacientes submetidos ao PTM no período de janeiro a dezembro de 2018. Dados sanguíneos, identificação do paciente, local do trauma, tipo de acidente, informações clínicas e desfecho foram obtidos por meio de revisão de prontuários e informações coletadas no núcleo transfusional do hospital. A análise estatística foi feita com o programa Statistical Package for the Social Sciences (SPSS) versão 23. **Resultados:** 306 pacientes foram avaliados, houve predominância do sexo masculino e idade de 18 a 30 anos. 55,9% dos pacientes eram procedentes de Fortaleza. O grupo sanguíneo predominante foi O, a maioria fator Rh positivo. O tórax foi o local mais comum de trauma. A maioria dos casos foi relacionada a trauma penetrante, sendo 53,6% por armas de fogo e 8,5% por armas brancas. As medianas do Escore ABC, de concentrado de hemácias e de plasma fresco usados foram de 2. 29,7% tiveram óbito em 24 horas e apenas o local do trauma - abdome - revelou-se como fator protetor para esse desfecho. **Conclusão:** observou-se a inexistência de associações significativas entre as variáveis do protocolo e o desfecho clínico de óbito.

Palavras-chave: Transfusão de Componentes Sanguíneos. Trauma. Epidemiologia.

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Conflito de Interesse:
Não há.

Recebido em: 06/05/2021.
Aprovado em: 26/09/2021.
Data de Publicação: 28/01/2022.

DOI: 10.5935/2238-3182.2021e31116

INTRODUCTION

Trauma is one of the main causes of death in the world, and in Brazil, interpersonal and traffic violence place trauma as a serious public health problem, claiming thousands of Brazilian lives annually. Hemorrhage is responsible for 30% to 40% of trauma-related mortality and, among these deaths, 33% to 56% occur during pre-hospital care and is considered a potentially preventable cause of death. (1,2)

The approach used for patients with severe hemorrhagic shock was based on fluid replacement in order to maintain volemia and red blood cell (RBC) concentrates in situations of severe hypoxia, with replacement of the other hemocomponents, according to the laboratory result, aiming to correct hematological complications.

One feared consequence related to severe trauma is coagulopathy triggered by tissue damage that leads to the onset of an inflammatory response. The activation of endothelial cells, blood coagulation and fibrinolysis are associated with the triggering of severe coagulopathy, exacerbated by tissue hypoxia and acidosis, resulting from low volemia (3).

New evidence has demonstrated the need to apply an early approach to controlling coagulopathy associated with trauma. The so-called reanimation of damage control is strengthened through military experiments in the Iraq war (4).

One of the strategies of resuscitation for damage control is Mass Transfusion (TM), which is defined as replacement of blood greater than 75 milliliters per minute in 24 hours, replacement of 50% of body volemia in 3 hours or loss of 1.5 milliliters of blood per Kg/min/ 20 minutes, associated with replacement of 10 or more units of CH in adults in 24 hours (5). The American College of Surgeons also defines TM as a transfusion of four units of CH in one hour (6).

The establishment of a TMP offers the opportunity for preventive measures to control damage to the patient with severe hemorrhagic shock. This protocol consists of a balanced replacement of CH, fresh frozen plasma (CFP) and platelets in a proportion close to 1:1:1, associated with other measures, such as restriction of the use of crystalloids, control of compressible bleeding and priority for surgical control. This strategy demonstrated a reduction in mortality among trauma patients (7).

However, due to hemostatic and metabolic complications, which can affect the clinical evolution of patients, the massive transfusion must be done in a rational way. It is necessary to select appropriate quantities and types of blood components, taking into consideration issues such as volemia, tissue oxygenation, coagulation and metabolic changes, mainly related to calcium levels and the acid-base balance of the patient (8).

The identification of the patient with TM potential can be performed through the ABC score that considers the type of injury, systolic blood pressure, heart rate, and trauma-focused ultrasound (FAST) outcome. Each item receives 1 point and, when equal or greater than 2, presents a specificity and sensitivity corresponding to, respectively, 86% and 75% in predicting the patient's need for massive transfusion (9). Although there are other ways to identify the severity, the ABC score for being easy to use, to approach clinical criteria, to have a high sensitivity, specificity and accuracy, is widely used to predict situations in which there is a need for blood transfusion (10).

IJF is one of the main public hospitals in Brazil to assist trauma patients. Since 2017, it has established a MTP in the emergency. The objective of this study is to analyze the epidemiological data of patients submitted to this protocol in this institution.

METHODS

It is an observational, transversal, descriptive, retrospective study with quantitative approach, carried out in the largest emergency and emergency center of the State of Ceará, located in Fortaleza, from January to December 2018. The population studied consisted of patients undergoing TMP, using the ABC score or by clinical judgment of the assistant physician.

The data obtained and analyzed were gender, age, origin, blood type, injured body segment, mechanism of trauma, ABC score, transfusions performed and clinical outcome in the first 24 hours.

For the elaboration of the database, spreadsheets were used in the Excel program (Microsoft Corp. Redmond, WA, USA). The statistical analysis was done with the help of the *Statistical Package for the Social Sciences (SPSS)* (SPSS Inc., Chicago, IL, USA) version 23. Descriptive statistics were performed for the qualitative variables by means of absolute and relative frequencies. For continuous and discrete quantitative variables, mean, standard deviation, median, minimum and maximum were calculated. Data normality was demonstrated using the Kolmogorov-Smirnov test.

Some associations were sought whose purpose was to understand how the variables of identification, blood classification, site of injury, mechanism of trauma and clinical data of research participants can influence, positively or negatively, the outcome of the first 24 hours. For this, Pearson's chi-square test was performed, being considered statistically significant the value of $p<0.05$, the strength of this association by the calculation of odds *ratios* (OR) and logistic regression by the *backward* method to adjust the model. For the entry of variables in the model, it was considered the $p<0.20$ and, for its permanence, the $p<0.05$.

RESULTS

In 2018, 306 patients submitted to TMP were registered, an average of 25.5 activations per month. The patients were predominantly male (254; 83%), coming from the capital (171; 55.9%), most with ages between 18 and 30 years 151 (49.3%), with a general variation of 3 years minimum and maximum age of 86 years. As for the blood classification, the group O predominated (160; 52.3%), followed by group A (105; 34.3%), B (29; 9.5%) and AB (12; 3.9%), being the almost totality with Rh positive factor (282; 92.2%) (table 1).

Regarding the analysis of the regions of the body most affected by traumatic lesions, the predominance of the thorax (155; 50.7%) was identified, followed by the abdomen (123; 40.2%), head (109; 35.6%), lower limbs (106; 34.6%), upper limbs (82; 26.8%) and neck (35; 11.4%) (graph 1).

Table 1. Characterization of the patients (to be continued).

Variables	n	%	Other statiscs
Identification			
Sex			
Female	52	17,0	
Male	254	83,0	
Age group			
Up to 10 years	4	1,3	
11 a 17 years	18	5,9	
18 a 30 years	151	49,3	Min. = 03 years; Max. = 86 years; Median = 28 years; Average = 32.2 years; SD = 14.6 years
31 a 40 years	63	20,6	
41 a 65 years	61	20,0	
> 65 years	9	2,9	
Origin			
Capital	171	55,9	
Interior	75	24,5	
Metropolitan region	60	19,6	
ABO Rh Classification			
Blood group			
O	160	52,3	

Table 1. Characterization of the patients (conclusion).

Variables	n	%	Other statistics
A	105	34,3	
B	29	9,5	
AB	12	3,9	
Rh Factor			
Negative	24	7,8	
Positive	282	92,2	
ABC Score			
No score	04	1,3	
01 point	55	18,0	Min = no score; Max = 04 points; Median = 02 points; Average = 2.137 points; SD = 0.8 points
02 points	153	50,0	
03 points	83	27,1	
04 points	11	3,6	
CRC			
Up to 02 bags	155	50,7	
Over 02 bags	151	49,3	
FFP			
Up to 02 bags	202	66,0	
Over 02 bags	104	34,0	

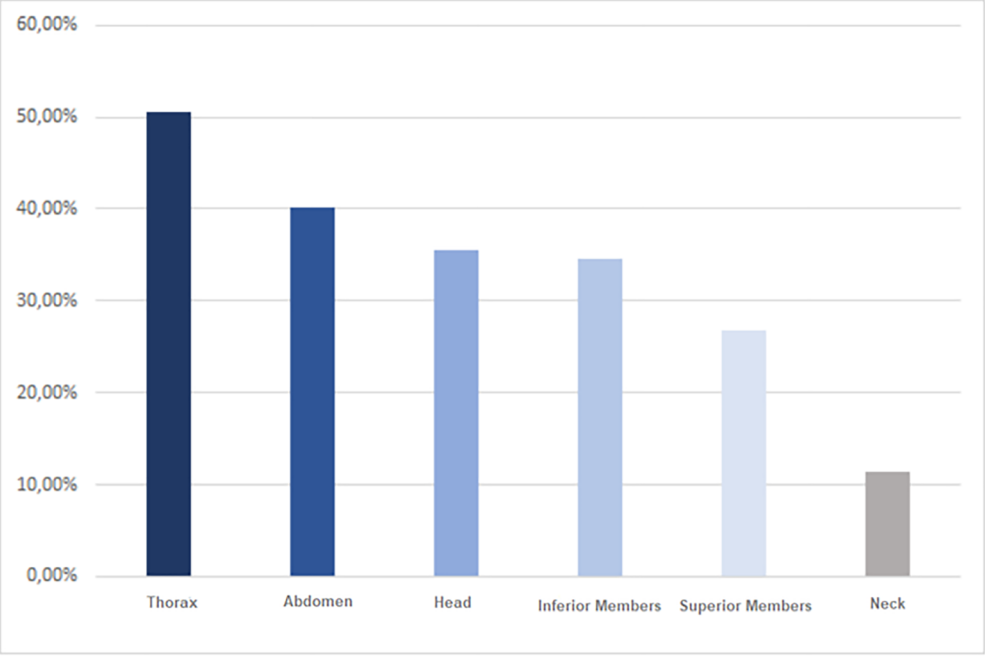
Legend: n = absolute frequency; % = relative frequency; SD = standard deviation; Min = minimum value; Max = maximum value; CRC: concentrate of red cells; FFP: fresh frozen plasma; Source: own elaboration.

The analysis of the trauma mechanism showed the predominance of penetrating trauma (188; 61.4%), of which 164 (53.6%) were cases per firearm projectile (PAF) and 26 (8.5%) per gunshot wound (FAB). The main cause of the trauma was motorcycle accidents (75; 24.5%), hit by a car (16; 5.2%), fall (05; 1.6%) and heavy machinery (1; 0.3%). Combined mechanisms were found in three cases: two by FAB and PAF injuries, and another by PAF and automobile accident (graph 2).

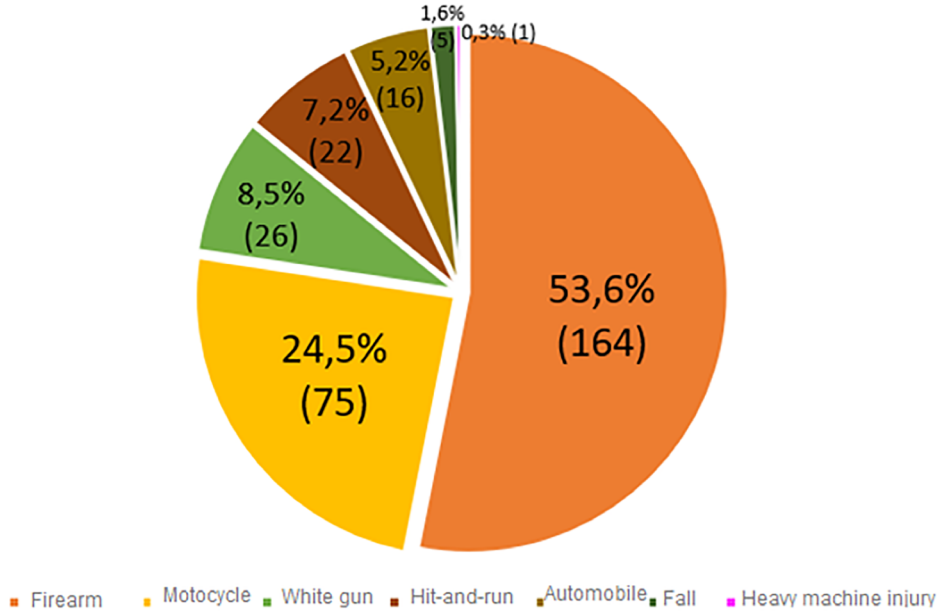
As for the criterion of activation of the MTP by means of the ABC score, patients with two points were predominant (153; 50%). Regarding the use of blood components, the use of CH ranged from 0 to 14 bags, with a median of 2 bags. As for fresh frozen plasma, it varied from 0 to 12 bags, also with a median of two bags.

When the deaths were analyzed, it was found that 91 (29.7%) patients died within 24 hours, as shown in graph 3.

Graph 1. Body regions affected by traumatic injuries.



Graph 2. Mechanisms of trauma.

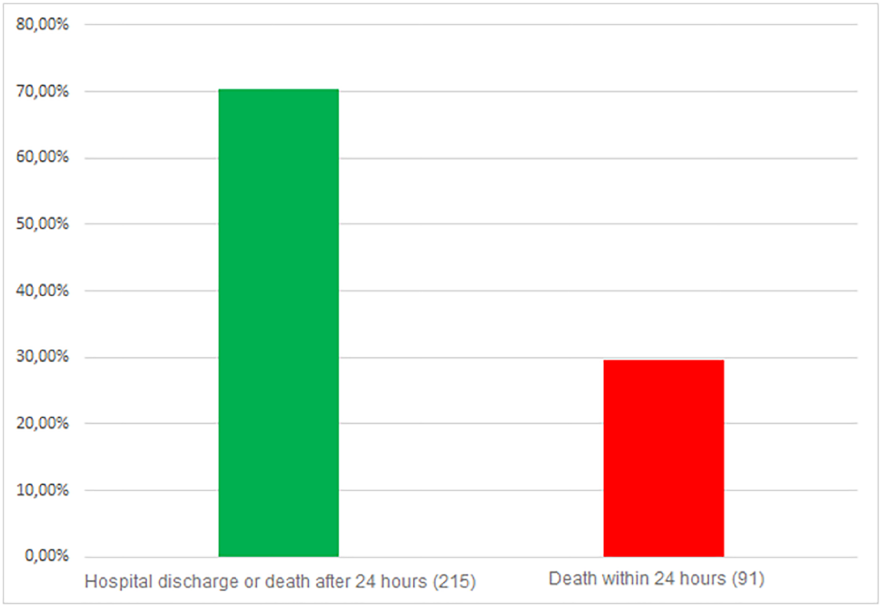


Source: own elaboration.

Regarding the associations between the protocol variables and the clinical outcome of death (table 2), it was observed the inexistence of significant associations. However, gender (p=0.069), site of trauma - abdomen (p=0.058), type of accident - fall (p=0.136) and fresh frozen plasma transfusion (p=0.062) entered the regression model.

It remained in the final regression model only the trauma site - abdomen (p=0.045; OR = 0.600 [0.364-0.990]), revealing itself as a protective factor for death within 24 hours.

Graph 3. Number of deaths in up to 24 hours.



Source: own elaboration.

Table 2. Association between MTP variables and the clinical outcome of death (to be continued).

Variables	Death (24 hours)				p-valuer	OR (IC95%)
	Yes		No			
	n	%	n	%		
Identification						
Age group					0,304[a]	
Up to 28 years	48	31,2	106	68,8		0,871 (0,53-1,42)
Over 28 years	43	28,3	109	71,7		1
Sex					0,069a	
Female	10	19,2	42	80,8		1,97 (0,94-4,12)
Male	81	31,9	173	68,1		1
Procedência					0,294a	
Capital	53	31,0	118	69,0		-
Interior	21	28,0	54	72,0		
Metropolitan region	17	28,3	43	71,7		
Blood classification						
Blod group					0,619a	
A	34	32,4	71	67,6		
AB	03	25,0	09	75,0		
B	08	27,6	21	72,4		
O	46	28,7	114	71,3		

Table 2. Association between MTP variables and the clinical outcome of death.

Variables	Death(24 hours)				p-value	OR (IC95%)
	Yes		No			
	n	%	n	%		
Rh Factor					0,688[a]	
Negative	08	33,3	16	66,7		0,83 (0,34-2,02)
Positive	83	29,4	199	70,6		1
Trauma sites						
Head					0,500a	
Yes	35	32,1	74	67,9		1
No	56	28,4	141	71,6		1,19 (0,72-1,98)
Neck					0,816a	
Yes	11	31,4	24	68,6		1
No	80	29,5	191	70,5		1,09 (0,51-2,34)
Thorax					0,306a	
Yes	42	27,1	113	72,9		1
No	49	32,5	102	67,5		0,77 (0,47-1,27)
Abdomen					0,058a	
Yes	44	35,8	79	64,2		1
No	47	25,7	136	74,3		1,61 (0,98-2,65)
Superior members					0,501a	
Yes	22	26,8	60	73,2		1
No	69	30,8	155	69,2		0,82 (0,47-1,45)

Table 2. Association between MTP variables and the clinical outcome of death.

Variables	Death(24 hours)				p-value	OR (IC95%)
	Yes		No			
	n	%	n	%		
Inferior members					0,515[a]	
Yes	34	32,1	72	67,9		1
No	57	28,5	143	71,5		1,18 (0,71-1,97)
Tipos de acidentes						
Automobile					0,069[a]	
Yes	08	50	8	50		1
No	83	28,6	207	71,4		2,49 (0,91-6,87)
Motocycle					0,705[a]	
Yes	21	28,0	54	72		1
No	70	30,3	161	69,7		0,89 (0,50-1,59)
Violent Injury + Heavy machine Injury					0,409[a]	
Yes	53	28,0	136	72,0		1
No	38	32,5	79	67,5		0,81 (0,49-1,33)
Firearm					0,758[a]	
Yes	50	30,5	114	69,5		1
No	41	28,9	101	71,1		1,08 (0,66-1,77)
White gun					0,220[a]	
Yes	05	19,2	21	80,8		1

Table 2. Association between MTP variables and the clinical outcome of death.

Variables	Death(24 hours)				p-value	OR (IC95%)
	Yes		No			
	n	%	n	%		
No	86	30,7	194	69,3		0,54 (0,19-1,47)
Hit-and-run					0,825[a]	
Yes	07	31,8	15	68,2		1
No	84	29,6	200	70,4		1,11 (0,44-2,82)
Fall					0,136[a]	
Yes	03	60,0	02	40,0		1
No	88	29,2	213	70,8		3,63 (0,59-22,10)
Clinical Data						
ABC Score					0,403[a]	
No Score	0	0	04	100		
01 point	19	34,5	36	65,5		
02 points	45	29,4	108	70,6		
03 points	22	26,5	61	73,5		
04 points	05	45,5	06	54,5		
Bags (24 hours)					0,234[b]	
Yes	91	29,9	213	70,1		1
No	0	-	02	100		1,427 (1,33-1,54)

Table 2. Association between MTP variables and the clinical outcome of death.

Variables	Death(24 hours)				p-value	OR (IC95%)
	Yes		No			
	n	%	n	%		
CRC					0,306	
Up to 02 bags	42	27,1	113	72,9		
Over 02 bags	49	32,5	102	67,5		1,29 (0,79-2,11)
FFP					0,062	
Up to 02 bags	53	26,2	149	73,8		1
Over 02 bags	38	36,5	66	63,5		1,62 (0,97-2,69)
CRC/FFP Ratio						
Equal to 1:1	44	28,2	112	71,8	0,550	1
Different from 1:1	47	31,3	103	68,7		0,861(0,53-1,4)

Legend: n = absolute frequency; % = relative frequency; OR = odds ratio; IC = confidence interval; a = Pearson's Chi-square; b = Fisher's Exact Test; CRC: concentrate of red cells; FFP: fresh frozen plasma.
Source: own elaboration.

DISCUSSION

Sex and age

The study shows a striking profile of the reality of trauma in Brazil with a predominance of adolescent patients and young male adults. The prevalence in the first three decades of life is similar to the profile of cases seen in another Brazilian emergency hospital, which revealed that 85.4% of the patients were men and were up to 35 years old (11). In another survey that analyzed 200 trauma patients, a mean age of 36.42 ± 17.63 years was obtained, being 73.5% male (12).

Mechanism of trauma.

A higher rate of penetrating traumas (61.4%) was evidenced than in another study conducted in Campinas-SP, which presented a prevalence of 27.0% in relation to this mechanism (11). This corroborates the statistics of

the security agencies of the state of Ceará that point to interpersonal violence, with emphasis on PAF lesions, as one of the main causes of death by external factors (traumas). In 2018, 416 firearm-related deaths were registered in Ceará. Meanwhile, in the state of São Paulo, the most populous in the country, this number was lower (302), showing the impact of this trauma mechanism on the Ceará population (13).

Body segments.

Thoracic (50.7%) and abdominal (40.2%) trauma were the most registered, and cranioencephalic trauma represented 35.6%. These values are significantly different from those of another study on the epidemiology of trauma that presented rates of 55.3% of traumatic brain injury, 56.9% for thorax and 18.9% for abdominal trauma (14). In another epidemiological survey, which evaluated polytrauma patients in intensive care unit, rates of 71 % of cranioencephalic trauma, 37% of thoracic trauma and 21% of abdominal trauma were obtained (15). It is believed that this difference is related to the etiology of trauma which, in this study, was predominantly due to violent injuries (188;61.4%), being 164 (53.6%) due to firearms; while, in the other studies, the main cause was traffic accident with prevalence of 59.1% and 60.4%, respectively (14,15).

ABC score

The most prevalent score was 2 points with 153 records (50%) and an associated mortality rate of 29.4%. In another work on mass transfusion and ABC score, a prevalence of 48.9% was obtained for score 0 and mortality of 10% (9). A retrospective analysis performed in the trauma reference center in Arizona on mass transfusion and ABC score found a prevalence of 43.4% of patients with score 1 and a mortality rate of 23% (16) . When the highest mortalities are analyzed, this study presents a higher rate in patients with score 4 (45.5%). Something similar occurs in another study that has a death rate of 100% in patients with score 4 (16). However, there is a study in which this rate is higher in patients with scores 2 and 3 (35%) (9).

Blood type

The predominant blood type was O (52.3%), followed by types A, B and AB whose percentages were 34.3%, 9.5% and 3.9% respectively. With respect to the Rh factor D antigen, there was the predominance of the positive Rh factor in the studied population, being similar to what is verified in the general population. This finding, therefore, validates the process of blood component release made in the IJF which consists of using concentrates of red blood cells of the blood group O positive for men and reserve of O negative for women of fertile age in order to minimize the risk of obstetric complications (5).

24 Hour Outcome - Survival

A death rate in 24 hours (29.7%) lower than the study by Trajano *et. al,* which had a rate of 60%, but still high when compared to international studies (11). In a multicenter observational cohort study in India, with traumatized patients, a mortality rate of 6.5% in 24 hours was obtained (17). Another observational cohort carried out also in India showed 7.3% of deaths in 24 hours during the 30 days of the study (18). The most prevalent mechanism of trauma in these studies was traffic accident, with a prevalence of 42.3% in the first and 41.2% in the second (17,18). Meanwhile, in this study, the predominant mechanism was perforation by a firearm projectile, a high-energy lesion with the potential to damage various organs and noble structures, culminating in a state of greater severity. Therefore, it is believed that the important difference in mortality rate between studies must have occurred due to this.

Number of bags and how many patients had massive transfusion.

A total of 156 patients (50.9%) of the patients had volume replacement, following the 1:1:1 ratio of blood components. There were better survival rates in 24 hours of those who made the proportion 1:1:1 (71.8%) when compared to those who did not (68.7%), but there was no significance (P>0.05). Patients who needed massive transfusion represented only 0.6% of the sample.

Limitations

Among the limitations of the study, despite the difficulties encountered in collecting information, inherent to any retrospective study, with the use of data only from the emergency and emergency service of the Dr. José Frota Institute, it is noteworthy that it was possible to collect and analyze this information in a consistent manner. In addition, the limitations related to a newly-implemented protocol were not sufficient to make the study unfeasible.

Conclusion

Finally, the study showed the importance of the implementation of a massive transfusion protocol to establish strategies to better approach the patient of severe trauma with hemorrhagic shock. A profile of a young adult male patient for gun-related trauma was evidenced. There was a high survival rate in the first 24 hours, but an expressive mortality rate compared to international studies in trauma reference centers. The proposal of volume replacement, following the same proportion, was verified in more than half of the protocol patients. In addition, there was a very low number of patients in whom massive transfusion was performed.

Copyright

Authors' Contribution:

Daniel Souza Lima: review and guidance.Felício Holanda Moreira: data collection, writing, data analysis, and formatting. Samuel Bezerra Bastos: data collection, writing. Lucas Barbosa Cavalcante: data collection, writing. Velma Dias Nascimento: review, guidance, assistance in collection. Luciana Maria de Barros Carlos: review, guidance, assistance in collection.

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