RESEARCH

Factors Associated With Interhospital Transfer of Trauma Victims

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ABSTRACT

This study aimed to identify the factors associated with interhospital transfer of trauma victims treated in the emergency department of a nontertiary hospital. Retrospective analysis of medical records of trauma victims treated from January to July 2014 in the emergency department of a hospital not specialized in trauma care and located in Brazil was undertaken. The inclusion criteria were as follows: being 15 years or older; being a trauma victim; having received prehospital care; and being admitted to the hospital directly from the scene of the accident. Pearson's chi-square, Mann–Whitney *U*, Fisher's exact tests, and multiple logistic regression were used in the analyses. The sample was made up of 246 patients, mostly men (67.9%) and blunt trauma victims (97.6%). The mean age of the trauma victims was 44.2 (*SD* = 22.1). Falls were the most frequent external cause (41.1%). Forty patients were transferred to a tertiary care center, mostly for orthopedic treatment (70%). The factors associated with interhospital transfer of victims were severity of the trauma according to the Injury Severity Score ([ISS]; mean ±*SD* of ISS = 8.1 ± 4.5; odds ratio = 1.14; 95% confidence interval [1.06, 1.24]; $p = .001$) and extremities/pelvic girdle as the body region most severely injured (mean ±*SD* of extremities/pelvic girdle Abbreviated Injury Scale score = 2.9 ± 0.5; odds ratio = 3.86; 95% confidence interval [1.71, 8.72; $p = .001$). Identification of the risk factors for interhospital transfer of trauma victims treated in hospitals without a trauma center provides important information for the creation of referral and counter-referral policies to facilitate the process and ensure definitive early treatment and improved patient survival.

Key Words

Emergency hospital service, Interfacility transfer, Trauma

The World Health Organization (WHO) recognizes accidents and violence as external causes (WHO, 2018), considered public health problems and viewed as a major epidemic in the 21st century. Efforts have been made to control and minimize this situation through preventive campaigns and greater commitment to training multiprofessional teams that treat trauma victims.

All trauma victims need a quick, accurate, and systematic evaluation to immediately identify and treat life-threatening injuries. During the initial assessment performed in the emergency department, the need to transfer the patient for definitive treatment should be anticipated, which may include another unit (operating theater, intensive care unit, or inpatient unit, for example) or a trauma specialized hospital (American College of Surgeons, 2018).

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In this sense, interhospital transfers should be considered whenever the patient's treatment needs, including equipment, resources, or team, exceed the capacity of the institution that received the victim (American College of Surgeons, 2014, 2018).

Through initial evaluation and treatment of trauma victims, it is possible to identify which level of tertiary care center they will need for definitive treatment. In this context, it should be taken into consideration that some severely injured patients will be triaged and receive preliminary care in outlying hospitals before being transferred to a trauma center for definitive treatment.

In a systematic literature review about the impact of interhospital transfers on the clinical outcome of patients, some studies suggested there is no difference in mortality between victims transferred to and those directly admitted to tertiary care center. However, the authors pointed out that the high level of heterogeneity in the methodology of the studies makes it difficult to draw conclusions from this evidence (Hill, Fowler, & Nathens, 2011).

A study that assessed the variability of interhospital trauma transfer practices and nonclinical factors associated with the transfer of injured patients showed that several nonclinical variables, such as insurance status, hospital remoteness, and hospital type, are independently

associated with transfer to a tertiary center from emergency departments (Newgard, McConnell, & Hedges, 2006).

In terms of the impact of initial care in small hospitals and subsequent transfer to trauma centers, the findings of the studies on the benefit of this process are contradictory: It not only results in higher survival of victims (Garwe et al., 2010; Newgard, McConnell, Hedges, & Mullins, 2007) but also reflects higher mortality rates (Harrington, Connolly, Biffl, Majercik, & Cioffi, 2005) and higher costs due to the delay in definitive treatment (Nathens, Maier, Brundage, Jurkovich, & Grossman, 2003).

However, when considering geographical distance between the site of accident and the closest specialized hospital, the severity of the patient's injury and transfer time should be estimated and taken into account. Therefore, in the case of severely injured patients where transfer time will be longer than an hour, they will benefit from receiving prior stabilization care in a smaller hospital closer to the scene of the accident (Harrington et al., 2005).

In the Brazilian context, many trauma victims are first treated in smaller hospitals and then transferred to tertiary care centers with more resources. Minimizing the interval between the occurrence of a traumatic event and the start of definitive treatment is essential for achieving satisfactory treatment results (American College of Surgeons, 2014). To optimize this process, the team providing care to the trauma victim must know the factors associated with the need for transfer to other tertiary care centers so that referral and counter-referral policies are established with the respective parameters for the sake of care quality and improved patient survival.

This study aimed to identify the factors associated with interhospital transfer of trauma victims treated in the emergency department of a hospital that is not specialized in trauma care.

METHODS

This is a retrospective cohort study that involved analysis of medical records of patients treated between January and July 2014 in the adult emergency department of a hospital not specialized in trauma care and located in the west zone of the city of Sao Paulo, Brazil.

A convenience sample was used to evaluate patients who met the following inclusion criteria: being 15 years or older; having suffered a trauma, whether blunt or penetrating; having received prehospital care (basic or advanced support); and being admitted to the hospital directly from the scene of the traumatic event.

The dependent study variable was interhospital transfer of patients, divided into two groups: transferred and nontransferred. The independent variables examined were age, sex, type of prehospital care, external cause of morbidity according to the *International Classification of Diseases* ([*ICD-11*]; WHO, 2018), trauma mechanism, trauma severity based on anatomical indices (Injury Severity Score [ISS]; Baker, O'Neill, Haddon, & Long, 1974; Restrepo-Álvarez et al., 2016), and New Injury Severity Score ([NISS]; Osler, Baker, & Long, 1997; Restrepo-Álvarez et al., 2016), physiological indices (Revised Trauma Score [RTS]; Champion et al., 1989; Restrepo-Álvarez et al., 2016) and mixed indices—anatomical and physiological (Trauma and Injury Severity Score [TRISS]; Boyd, Tolson, & Copes, 1987; Restrepo-Álvarez et al., 2016), number of body regions affected, and most severely injured body region.

The ISS (Baker et al., 1974; Restrepo-Álvarez et al., 2016) was developed in 1974 by Baker et al., based on the fragility of the Abbreviated Injury Scale ([AIS]; Association for the Advancement of Automotive Medicine [AAAM], 2008), which is a scale used to describe injuries resulting from a trauma and to identify the severity of the injury in isolation. The ISS takes into consideration the following body regions: head/neck, face, chest, abdomen/pelvic content, extremities/pelvic girdle, and external surface. The overall severity of a trauma, according to the ISS, is estimated by the sum of the squares of the highest AIS code in each of the three most severely injured body regions, and its score can range from 1 to 75. The higher the score, the more severe the trauma and, consequently, greater the probability of death. The ISS enables establishing a prognostic measure for patients with multiple injuries and is considered the gold standard for stratifying trauma severity. But it is important to emphasize that the ISS is collected retrospectively and it is one of its limitations.

The NISS (Osler et al., 1997; Restrepo-Álvarez et al., 2016), in turn, was developed with the objective to correct distortions found and expand the predictive value of the ISS because the latter only considers the most severe injury per region, often ignoring the second most severe injury, which can be located in the same body segment as the first. It is obtained from the sum of the squares of the AIS codes of the three most serious injuries, regardless of the body region.

The RTS (Champion et al., 1989; Restrepo-Álvarez et al., 2016), a physiological severity index, considers the parameters of the vital functions of the victim—Glasgow Coma Scale score, systolic pressure, and respiratory rate—at the time of hospital admission. Its score ranges from 0 to 4 for each parameter, with a maximum value of 12, where the higher the score, the better the prognosis and survival probability.

The TRISS (Boyd et al., 1987; Restrepo-Álvarez et al., 2016), developed by the American College of Surgeons, is a mixed index that associates the ISS with the RTS. It also adds age and trauma mechanism (blunt or penetrating) to the calculation. This index serves as a predictor of patient survival.

For comparing the groups in relation to the nominal variables, Pearson's chi-square or Fisher's exact test was used. With respect to the quantitative variables, the comparison of the groups was done through the Mann–Whitney *U* test. Multiple logistic regression was used to identify the predictive factors of interhospital transfer of victims. To build the model, all the study variables were tested using the stepwise backward method. The variance inflation factor (VIF) was applied to detect the possibility of multicollinearity of the variables that remained in the final model. The significance level used in all the analyses was 5%.

The study was conducted in accordance with ethical standards and was approved by the Ethics and Research Committee of the institution (Opinion No. 772022).

RESULTS

The sample was made up of 246 patients treated in the studied hospital, which is a teaching, public, and secondary (nonspecialized) facility with 236 beds, of which 12 are allocated to the adult intensive care unit. Most of the patients were male (67.9%) and blunt trauma victims (97.6%). Their mean age was 44.2 (*SD* = 22.1). The most frequent external causes were falls (41.1%), followed by motorcycle accidents (35.4%). Prehospital care (basic support) was the most prevalent (72.8%).

According to the TRISS, the mean survival probability of patients was 98.5%. Based on the distribution of the victims into three groups (ISS <16, minor trauma; ISS ≥16 and <25, moderate trauma; and ISS ≥25, severe trauma), minor traumas were the most predominant (97.2%). The ISS and the NISS over 16 were identified in seven and 17 patients, respectively. Of the total number of patients, 19 (7.7%) had three or more body regions affected and the body region most severely injured was extremities/pelvic girdle (45.9%).

The length of stay in the emergency department was approximately 35 min, and 40 patients (16.3%) were transferred to a tertiary care center, mostly for orthopedic treatment (70%). Of the 206 trauma victims who stayed in the institutions, two (1%) died.

The results presented in Table 1 show that there was a significant difference between the groups (transferred vs. nontransferred patients) in relation to the body region most severely injured—head/neck, extremities/pelvic girdle, and external surface—in addition to the number of body regions affected and the RTS, ISS, NISS, and TRISS indices. It can be seen that the injuries of transferred patients were more severe (higher ISS and NISS and lower RTS and TRISS) and that they had more severe injuries in the head/neck, extremities/pelvic girdle, and external surface regions than patients who were not transferred.

The final regression model that identified the factors associated with interhospital transfer of trauma victims included the ISS variables and the most severely injured body region: extremities/pelvic girdle (Table 2). Every additional point in the ISS severity index increased the odds of patient transfer by 14%. The odds ratio of individuals being transferred, when the extremities/pelvic girdle was the most severely injured body region, was 3.86 compared with patients without severe injuries in this body region. The mean of the ISS and AIS of extremities/pelvic girdle region of the transferred patients was 8.1 ± 4.5 and 2.9 ± 0.5, respectively. The VIF values indicated that was no collinearity among the variables that remained in the regression (Table 2).

DISCUSSION

In this study, as well as others that examined victims treated in hospitals not specialized in trauma care, there was a prevalence of male patients and blunt trauma victims due to falls (Garwe et al., 2010; Nathens et al., 2003). The mean age of the patients in this study was similar to the one in a study conducted in the state of Rhode Island (43.0 ± 1.2; Harrington et al., 2005) and lower than the mean in another investigation that examined 3,560 patients (54.6 ± 24.8 years) admitted to a nontrauma specialized hospital in the state of Oklahoma (Garwe et al., 2010).

If only the characterization of transferred patients is considered, it can be seen that the mean age of the sample is higher than those in other studies that evaluated trauma victims transferred to specialized hospitals: 27 ± 23 (Garwe et al., 2010) and 39.1 ± 24.3 years (Helling, Davit, & Edwards, 2010). In relation to external causes, most of the transferred patients were victims of traffic accident, which corroborates findings of other studies (Fatovich, Phillips, & Jacobs, 2011; Garwe et al., 2010; Nathens et al., 2003).

As for the severity of the victims transferred, calculated by the mean ISS, it could be identified that the hospital in the present study treated patients of less severity compared with other studies: mean ISS of 17 (Helling et al., 2010) and median of 24 (Fatovich et al., 2011). This may be due to the fact that the hospital under study was a secondary level hospital and did not have, for example, specialties such as neurosurgery.

Identification of patient severity and need for interhospital transfer can be established by calculating trauma indices that, apart from facilitating the triage of victims, make it possible to examine care quality, assist in the planning of services, and compare morbidity and mortality of a group of victims from the same hospital or between hospitals (Pereira, Scarpelini, Basile-Filho, & Andrade, 1999).

The importance of calculating trauma severity was stressed in a study that examined trauma patients transferred from other institutions and found that these victims had lower systolic blood pressure levels and Glasgow

TABLE 1 Comparison Between the Groups (Transferred and Nontransferred) in Relation to Sociodemographic and Trauma Characteristics

Variable	Transferred	Nontransferred	*p*
Sex, *n* (%)			
Male	28 (70.0)	139 (67.5)	.854[a]
Female	12 (30.0)	67 (32.5)	
Age, mean ± *SD*	49.5 ± 24.0	43.4 ± 21.8	.161[b]
Trauma mechanism, *n* (%)			
Blunt	40 (100.0)	200 (97.1)	.762[c]
Penetrating	–	6 (2.9)	
External cause of morbidity and mortality, *n* (%)			
Falls	17 (42.5)	84 (40.8)	.927[c]
Traffic accidents—motorcycle	17 (42.5)	70 (34.0)	
Traffic accidents—pedestrian	3 (7.5)	12 (5.8)	
Assault	1 (2.5)	10 (4.9)	
Traffic accidents—motor vehicle occupant	1 (2.5)	9 (4.4)	
Exposure to inanimate mechanical forces	–	10 (4.8)	
Not specified	1 (2.5)	11 (5.3)	
Type of prehospital care, *n* (%)			
Basic support	33 (82.5)	146 (70.9)	.287[c]
Advanced support	6 (15.0)	41 (19.9)	
Not specified	1 (2.5)	19 (9.2)	
Number of body regions affected, mean ± *SD*	1.7 ± 0.7	1.3 ± 0.7	.001[b]
RTS, mean ± *SD*	7.7 ± 0.5	7.8 ± 0.3	.003[b]
ISS, mean ± *SD*	8.1 ± 4.5	4.2 ± 4.8	<.001[b]
NISS, mean ± *SD*	10.4 ± 6.3	5.5 ± 6.0	<.001[b]
TRISS, mean ± *SD*	97.6 ± 2.7	98.6 ± 5.4	<.001[b]
Body region most severely injured, *n* (%)			
Head/neck	6 (15.0)	11 (5.3)	.039[c]
Face	1 (2.5)	8 (3.9)	1.000[c]
Chest	2 (5.0)	8 (3.9)	.668[c]
Abdomen/pelvic contents	1 (2.5)	6 (2.9)	1.000[c]
Extremities/pelvic girdle	30 (75.0)	83 (40.3)	<.001[a]
External surface	2 (5.0)	83 (40.3)	<.001[a]

Note. ISS = Injury Severity Score; NISS = New Injury Severity Score; RTS = Revised Trauma Score; SD = standard deviation; TRISS = Trauma and Injury Severity Score.

[a]*Pearson's chi-square test.*

[b]*Mann–Whitney U test.*

[c]*Fisher's exact test.*

Coma Scale scores, greater severity, and higher mortality rates than those transferred directly from the scene of the accident to a trauma center. The authors found that the severity of these patients, measured by the ISS, was undervalued and did not result in timely transfer to a hospital with more resources (Harrington et al., 2005).

TABLE 2 Logistic Regression Model of the Factors Associated With Interhospital Transfer of Trauma Victims

Variables	Odds Ratio	95% Confidence Interval	*p*	VIF
ISS	1.14	1.06, 1.24	.001	1.00
Body region most severely injured: extremities/pelvic girdle	3.86	1.71, 8.72	.001	1.00

Note. ISS = Injury Severity Score; VIF = variance inflation factor.

In addition to this important aspect of patient severity, some studies were conducted to identify the impact of transfer on the clinical outcomes of patients (Garwe et al., 2010; Nathens et al., 2003). A study from Oklahoma indicated greater survival benefits for trauma victims treated first in small hospitals and afterward transferred to specialized hospitals than those who remained in small hospitals (Garwe et al., 2010). Another study from the United States showed that patients treated in general hospitals and then referred to a trauma center did not have a negative effect on the clinical outcome. However, in the cost analysis, these victims used more hospital resources due to the delay in receiving definitive treatment (Nathens et al., 2003).

No studies were found in the literature that analyzed the factors associated with interhospital transfers, as identified in the present study. Most of the studies made comparisons between transferred patients and those who were directly admitted to trauma centers, in relation to different variables. However, the importance of identifying trauma severity, as a predictive factor of transfer, should be taken into consideration.

It should also be pointed out that injuries that receive an AIS score 3 or more are potentially life-threatening (AAAM, 2008). The body region with the most severe injuries was extremities/pelvic girdle, which constitutes a risk factor for transfer because fractures in the femur or pelvis occur frequently in falls and motorcycle accidents. These injuries receive an AIS score of 3 or more, which directly impacts overall trauma severity calculated by the ISS.

Hospital professionals should also seek to establish referral and counter-referral policies to expedite the transfer of these victims, in addition to agreements with prehospital services, in terms of identifying victims who would benefit from initial care in a trauma center, thereby optimizing patient care and survival.

LIMITATIONS

In applying the results of this study, certain limitations should be taken into account: The sample comprised patients from just one institution, which could place restrictions on the generalization of the findings. It should also be borne in mind that analyses of medical records depend directly on the quality of the entries of the professionals involved in the care.

CONCLUSION

The results of this study allowed us to conclude that trauma victims with severe injuries in extremities/pelvic girdle or multiple severe injuries (AIS score ≥3) in different body regions, which substantially increases the ISS, require special attention during initial care in order to quickly identify the need for interhospital transfer for definitive treatment at a specialty hospital (trauma center).

The results of this study are being used in the development and validation of an institutional protocol that will allow early identification of this population of patients and optimize the process of interhospital transfer.

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KEY POINTS

- Interhospital transfers should be considered whenever the trauma patient's treatment needs exceed the capacity of the institution that received the victim.
- The study results showed that trauma severity and extremities/pelvic girdle as the body region with the most severe injuries were factors associated with interhospital transfer of the victims.
- Nurses working in pre- or intrahospital services play a key role in early detection of victims who need care in a trauma center for definitive treatment.
- The hospital should establish collaborative agreements and policies between specialty hospitals.

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