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Survival after motor vehicle crash: impact of clinical and prehospital variables

ABSTRACT

OBJECTIVE: To assess clinical and prehospital variables associated with survival of motor vehicle crash victims.

METHODS: Study carried out in the city of São Paulo (Southeastern Brazil), from 1999 to 2003. Data from 175 patients, who were aged between 12 and 65 years and had been motor vehicle crash victims, were analyzed. Kaplan-Meier Survival Analysis was used to approach the results at the accident scene with victims scoring <11, according to the Revised Trauma Score. Variables analyzed were: sex, age, injury mechanisms, basic and advanced support procedures, Revised Trauma Score parameters and fluctuations, time elapsed in the prehospital phase and trauma severity according to the Injury Severity Score and Maximum Abbreviated Injury Scale.

RESULTS: Analysis revealed that victims who were less likely to survive during the hospitalization period showed serious lesions in the abdomen, thorax, or lower limbs, with negative fluctuation of respiratory frequency and Revised Trauma Score in the prehospital phase. In addition, they needed specialized interventions or thoracic compressions. Brain lesions were associated with late death.

CONCLUSIONS: Recognition of variables involved in the survival of motor vehicle crash victims may help to determine protocols and to make decisions in order to perform pre- and in-hospital interventions and, consequently, maximize survival.

DESCRIPTORS: Accidents, Traffic. Wounds and Injuries. Survival Analysis. Emergency Medical Services. Emergency Nursing.

INTRODUCTION

Motor vehicle accidents have consequences for society, on account of both the deaths and the victims' sequelae, safety expenses and high consumption of medical-hospital and technological resources.[9]

Countless technological advances have been incorporated into trauma care worldwide, in an attempt to lower social costs and improve care for the victims. However, it is not always possible to see the actual impact of care on the victims' survival, once there are many factors involved in this result. Among these factors, there are aspects related to the victim and trauma mechanism, in addition to clinical aspects, such as the severity of injuries and their physiological repercussions, as well as the initial care provided.[9,10,12-14]

Among the technologies that have been employed in the initial care of the trauma patient, prehospital care stands out,[8-11] having two categories[11] – Basic Life

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Support, whose main characteristic is not to perform invasive, life-preserving procedures, and Advanced Life Support, which involves invasive procedures.

Prehospital care in the first minutes after trauma aims to employ resuscitation and stabilization measures that can prevent deterioration of one's medical condition and also influence the victim's survival, allowing one to remain alive until hospital treatment can be performed.[8-10]

However, to statistically verify the association between prehospital interventions and survival has been a difficult task for researchers worldwide, creating controversies over this resource's usefulness.[9,14]

Instead of the fatality analysis, which examines the "alive or dead" dichotomy, survival analysis has been supported by researchers all over the world[6,7,10,13] to assess the prehospital care phase. Survival analysis considers survival time as a dependent variable and analyzes factors that may interfere with this result as independent variables.[6,7,13,16] No studies on trauma, where survival analysis was used to assess variables related to the prehospital period, were found in the literature.

The present study aimed to analyze the clinical and prehospital variables associated with survival of trauma victims of motor vehicle accidents.

METHODS

Data from 175 patients, aged between 12 and 65 years, victims of motor vehicle accidents (collisions and run-over accidents) in the city of São Paulo, between April of 1999 and March of 2003, were analyzed. All the victims had a Revised Trauma Score (RTS) <11 at the accident scene and were cared for and sent to hospitals for the city's advanced support prehospital care. This sample of victims was selected based on the following: similar trauma mechanism, physiological changes detected during the prehospital phase, and demand for more medical resources while recovering, which included advanced support measures and referrals to tertiary hospitals.

To estimate the severity, data from medical charts and necropsy reports in case of death were gathered. Information about the prehospital phase was obtained directly from service forms. Access to victims' records took place after obtaining due research ethics committee authorizations from the institutions that had been involved in the victims' care.

Kaplan-Meier survival analysis[16] was used to identify clinical and prehospital variables associated with survival. This analysis indicates one's likelihood to survive during a certain period of time, by means of a coefficient. When multiplied by 100, this coefficient shows the corresponding percentage of survival. Results from this analysis are indicated in percentages so it can be understood.

The clinical variables analyzed were: sex, age, trauma mechanisms, physiological repercussion of trauma at the accident scene and severity of trauma. The prehospital variables assessed were: time spent in the different care phases and procedures performed.

As regards trauma mechanisms, the following were considered: the victim's motor vehicle, the victim's position in this vehicle, and the type of impact.

The time intervals taken into consideration during prehospital care were: response time (between the call and arrival at the scene), on-scene time (between arrival at and departure from the scene), and total time (between the call and the arrival at the hospital).

Procedures performed during prehospital care were as follows:

- Basic respiratory support: oxygen therapy, Guedel airway, aspiration and immobilizations (cervical collar, long board and limb immobilization);
- Basic circulatory support: cardio-pulmonary resuscitation and compression dressing;
- Advanced respiratory support: oral-tracheal intubation, percutaneous trans-tracheal ventilation, punction and/or thoracic drainage;
- Advanced circulatory support: peripheral or central venous access, crystalloid solution for volemic replacement (> or ≤1,000 ml) and medications administered.

The physiological repercussion of the trauma at the accident scene was assessed by means of the RTS: total (=11 and ≤10), parameters (systolic arterial pressure, respiratory frequency and Glasgow Coma Scale) and fluctuation of the total value and parameters from the accident scene to the arrival at the hospital unit.

Fluctuation between the accident scene and the hospital was calculated by means of the subtraction equation:[11,12] Fluctuation = Parameter $_{hospital}$– Parameter $_{scene}$. Thus, positive fluctuation indicates an improvement in the victim's physiological condition, whereas the negative one indicates worsening of the parameter. Values equal to zero, observed in the absence of fluctuation, point to maintenance of the victim's condition until arrival at the hospital.[11,12] The severity of trauma was evaluated according to the body part, using the Maximum Abbreviated Injury Scale (MAIS),[1] and, according to the global severity, described by the Injury Severity Score (ISS).[2]

The dependent variable was survival time after the accident. Considering the time of call as the initial time, survival analyses were performed for the following intervals: until 6 hours, until 12 hours, until 24 hours, until 48 hours, until 7 days, and until hospital discharge.

Results from the Kaplan-Meier survival analysis show the cumulative probability of an individual's surviving throughout time, when exposed to the independent variables under analysis.[16] Death occurring on account of trauma until each of the times mentioned was considered as event, while patients who were either alive, discharged or transferred until each of the times mentioned were considered as censoring. The descriptive level of significance was obtained by means of the log-rank test. The statistically significant cut-off point was ≤0.05. Data treatment was carried out by the SPSS 10.0 software.

The study was approved by the *Comitê de Ética em Pesquisa da Secretaria Municipal de Saúde de São Paulo* (São Paulo Municipal Department of Health's Research Ethics Committee)

RESULTS

A total of 86.9% of the sample were men and the mean age was 31.9 years (sd±11.3). Considering the trauma mechanism, 45.1% of the victims were pedestrians and had been run over, while 30.9% were either motorcyclists or passengers on a motorcycle. Among those who found themselves in some type of vehicle, 36.4% were involved in a frontal impact and 27.1% were involved in a side impact; the remaining types of impact were less frequent.

On average, the response time for prehospital care was 8.6 minutes (sd±6.3 minutes), on-scene time was 20.2 minutes (sd±11.7 minutes), and total time was 41.0 minutes (sd±17.7 minutes).

Among basic support procedures, immobilizations were the most frequent (98.9%), while the most common (50.3%) was the cervical collar placement associated with the long board. The use of oxygen therapy was necessary among 96.0% of the victims. External thoracic compression technique was performed in 16 victims (9.2%).

Peripheral venous punction for volemic replacement or medications was the most frequent advanced support procedure (92.0%), and the most frequent choice of solution and volume (52.0%) was Ringer's lactate below 1,000ml. The use of medications was described only among 33.1% of victims, of which psychotropics, sedatives, and myorelaxing drugs were the most common (16.0%). Advanced procedures for airway maintenance were performed in 38.2% of victims, and oral-tracheal intubation was the most frequent intervention.

At the accident scene, the mean of the RTS was 8.8 (sd± 3.2). Victims with RTS≤10 totaled 57.1%. Characterization according to the RTS parameters showed that values coded as 3 and 4 were more frequent. RTS fluctuation was observed in 54.3% of victims (39.4% with positive fluctuation). The Glasgow Coma Scale was the parameter with highest fluctuation, both positive (19.4%) and negative (12.0%), with one victim showing improved parameter per each five evaluated, and one with worsened parameter per each eight evaluated.

The mean value on the ISS scale was 19.4% (sd 14.1, mean 17, min 1, max 57), victims with mild trauma (ISS <16) totaled 39.4%; with moderate trauma (between ≥16 and <25), 22.3%; and with severe trauma (≥25), 37.2%.

The body parts that were most frequently hit were the head (58.8%), lower limbs (45.1%), and the external surface (40%). MAIS values of 4 and 5 were observed in victims with injuries on the head (36.0%), thorax (15.4%), abdomen (8.0%) and lower limbs (2.3%). There were no records of maximum severity injuries (MAIS value equals 6) in the sample.

There were 63 deaths (36.0%), of which 50.8% happened until 6h after trauma, while 20.6% happened after one week of hospitalization.

According to the Kaplan-Meier survival analysis, the clinical variables related to sex, age, trauma mechanism, systolic arterial pressure fluctuation, as well as those related to the severity of trauma on the face, neck, spine and upper limbs, were not statistically associated with the survival result.

When applied to prehospital variables, Kaplan-Meier survival analysis pointed to a lack of association for the variables "times spent in prehospital care" and also for the immobilization procedures. Basic respiratory procedures and the MAIS value for the head were associated with the results in certain intervals exclusively (until 12h and until hospital discharge, respectively).

All other clinical and prehospital indicators analyzed showed significant differences among survival probabilities in all intervals and were considered as factors that influence survival in this group of victims. These indicators were the following: basic and advanced circulatory procedures, advanced respiratory procedures, replaced volume and medications administered, RTS (total, parameters, and fluctuation), and MAIS and ISS scales for the thorax, abdomen, lower limbs and external surface.

Among basic life support procedures, the need for external thoracic compressions during cardio-pulmonary resuscitation (Table 1) determined a probability of surviving hospitalization below 10%. When thoracic compressions were associated with the administration of adrenaline and atropine (n=11; 6.3%), survival percentage rose to 19.2%. Nonetheless, of the 16 victims who needed cardio-pulmonary resuscitation (9.2%), 13 died until 6h, one died until seven days of hospitalization and two survived.

Among advanced support procedures (Table 1), low percentages of victims' survival who needed respiratory procedures were observed. Until 6 hours, victims who needed oral-tracheal intubation or percutaneous trans-tracheal ventilation reached a 60% chance of survival. Until hospital discharge, this probability decreased to 26.8%.

In all intervals, victims who needed volume replacement <1,000ml in the prehospital care phase (Table 1) showed higher probability of survival, compared to those who needed volumes >1,000ml in the same phase or who did not receive volume replacement.

The analysis of survival results observed according to the RTS scale (total, parameters, and fluctuation), shown on Tables 2 and 3, revealed that victims with RTS≤10 showed lower probability of survival in all intervals, in relation to victims with RTS=11.

Victims with significant physiological changes (coded as zero and one by the RTS scale) obtained low probabilities of survival, when compared to those whose coded value corresponded to minor changes (coded as 3 and 4).

Victims with positive fluctuation on the Glasgow Coma Scale and total value of the RTS scale reached the highest percentages of survival, whereas victims with negative fluctuation in these parameters and in the respiratory frequency obtained the lowest percentages.

Considering the severity of injuries per body part, measured by the MAIS (Table 4), it is observed that, for victims with injuries in the abdomen classified with values between 3 and 5 (serious to critical) and those with injuries in the thorax with severity between 4 and 5 (severe to critical), there was less than 50% of probability of survival in all time intervals. Until hospital discharge, thorax and abdomen injuries with MAIS of 4 or 5 led to less than 20% of probability of survival. All victims with MAIS of 4 or 5 in the lower limbs (n=4) died until 6h.

Moreover, while considering the MAIS, victims with external surface injuries with MAIS of 1 or 2 (minor or moderate) showed decrease in the probability of survival in all intervals evaluated, with a 27% chance of survival until hospital discharge.

Table 1. Probability of survival measured by Kaplan-Meier survival analysis, according to prehospital procedures and time intervals. City of São Paulo, Southeastern Brazil, 1999-2003.

Variable	Until 6 hours	Until 12 hours	Until 24 hours	Until 48 hours	Until 7 days	Until hospital discharge
Basic circulatory procedure	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
Thoracic compression and compression dressing	17.6	17.6	17.6	17.6	17.6	8.8
Compression dressing	89.2	83.8	81.3	78.7	73.8	57.3
Not performed	86.2	86.2	80.3	77.6	68.9	41.1
Advanced respiratory procedure	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
OTI or PTV	60.0	54.2	51.7	48.2	44.5	26.8
OTI + punction and thoracic drainage	25.0	25.0	25.0	25.0	25.0	25.0
Thoracic punction	50.0	50.0	50.0	50.0	50.0	50.0
Not performed	96.1	93.8	89.9	88.5	81.5	64.6
Advanced circulatory procedure	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Peripheral vein or phlebotomy	83.3	79.5	77.0	74.4	68.5	45.1
Defibrillation / peripheral vein	50.0	50.0	50.0	50.0	50.0	50.0
Not performed	63.6	63.6	45.0	45.0	45.0	45.0
Volume replaced	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Crystalloid solution <1,000ml	89.1	85.8	83.6	81.0	75.1	51.1
Crystalloid solution >1000ml	68.0	63.3	60.0	57.2	54.4	40.8
Not performed	66.6	66.6	47.7	47.7	47.7	47.7
Medications used	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
Adrenaline / atropine	38.4	38.4	38.4	38.4	38.4	19.2
Glucose and others	94.1	85.5	76.0	76.0	54.3	54.3
Psychotropics and sedatives	92.6	92.3	92.3	92.3	92.3	36.6
Not performed	81.5	77.5	73.7	70.1	64.0	51.5

OTI: Oral-tracheal intubation
PTV: Percutaneous trans-tracheal ventilation

The MAIS value for the head did not show differences in probabilities of survival when evaluated in the intervals until seven days. Only in the analysis until hospital discharge, when there was an important decrease in the percentage of survival for injuries with MAIS of 3 or higher for this body part, was it possible to observe an association with survival.

The global severity of victims measured by the ISS scale showed differences in probabilities of survival in all times studied. Victims with ISS≥25 showed the lowest chances of survival in all intervals. Until hospital discharge, victims from this group reached a 21.5% chance of survival. Victims with ISS between 1 and <16 were more likely to survive in all intervals.

DISCUSSION

Considering that the sample studied was restricted to a specific trauma etiology (motor vehicle accident), defined age group (≥12 and <65 years), and a group of victims with certain physiological characteristics (RTS≤11), it is justifiable that the variables age, sex, and trauma mechanisms did not reach significance of association with survival results. These observations emphasize the idea of sample homogeneity.

Studies summarize the importance of prehospital care as that which saves time between the trauma and the hospital.[10] In the present study, the total time of prehospital care and the partial times, even when traditional cut-off points from the literature are used (10 minutes at the accident scene and 30 to 60 minutes of total time),[9] did not reach significant association with survival.

Basic support respiratory interventions and immobilization procedures did not reach significant association with survival either, probably because they are standard procedures in trauma and were performed in nearly the entire sample.

Prehospital variables associated with all intervals were the following: basic and advanced circulatory procedures and advanced respiratory procedures.

Among results related to procedures, performing external thoracic compressions showed the lowest probabilities of survival. Nonetheless, such procedures helped to save 2 out of the 16 victims with cardio-respiratory arrest at the accident scene. Recent studies on blunt trauma victims who underwent resuscitation have confirmed higher percentage of survivors than before.[3,15] Given the investment made in the pre- and in-hospital phases, these results bring an important perspective for care teams and the determination of cardio-respiratory arrest protocols in trauma.

Table 2. Probability of survival measured by Kaplan-Meier survival analysis, according to RTS scale parameters and time intervals. City of São Paulo, Southeastern Brazil, 1999-2003.

Variable	Until 6 hours	Until 12 hours	Until 24 hours	Until 48 hours	Until 7 days	Until hospital discharge
Initial respiratory frequency	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
0 = absent	18.7	18.7	18.7	18.7	18.7	12.5
1 = 1 to 5rmm	50.0	50.0	50.0	25.0	25.0	25.0
2 = 6 to 9 rmm	71.4	71.4	71.4	71.4	71.4	47.6
3 = >29rmm	80.6	77.9	69.6	66.7	59.9	52.1
4 =10 to 29 rmm	94.5	89.7	88.3	86.9	80.3	51.1
Initial systolic arterial pressure	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
0 = absent	15.8	10.5	10.5	5.2	5.2	5.2
1=1 a 49 mmHg	75.0	75.0	75.0	75.0	75.0	50.0
2=50 a 75 mmHg	50.0	33.3	16.6	16.6	16.6	16.6
3= 76 a 89mmHg	89.2	85.5	81.0	76.5	62.2	41.4
4= > 89mmHg	92.0	89.9	87.5	86.3	81.8	58.0
Initial Glasgow Coma Scale	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
0 = 3	42.3	38.4	36.0	36.0	32.0	10.6
1 = 4 to 5	75.0	68.7	56.2	56.2	42.8	19.0
2 = 6 to 8	87.8	82.5	82.5	79.9	79.9	70.4
3 = 9 to 12	95.5	95.4	92.3	89.2	89.2	70.8
4 = 13 to 15	85.8	82.8	78.9	74.8	59.8	54.4
Total Revised Trauma Score	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
=11	92.9	92.9	90.7	90.7	78.4	65.2
<10	72.8	67.1	64.6	63.6	57.9	36.7

Among advanced procedures, victims who needed oral-tracheal intubation or percutaneous trans-tracheal ventilation were associated with low chances of survival, while those who received volumes below 1,000ml were associated with high chances of survival. Victims with greater respiratory and circulatory compromise at the accident scene are precisely those who need advanced interventions and, due to these dysfunctions appearing early, have a tendency to deteriorate to a critical condition and less chance of survival.

As regards volemic replacement, researchers[9] emphasize the importance of volume control in the prehospital phase and defend the idea of smaller volume replacements, especially in abdominal and thoracic traumas. This practice aims to avoid an increase in hemorrhage, given the volume added and resulting systolic arterial pressure rise. As victims' chance of survival was higher among those who received volumes below 1,000ml, results from this study corroborate this assumption and are also an important indication of intervention when approaching blunt trauma victims.

Clinical variables showing statistical association with survival in all intervals were as follows: RTS scale (total and parameter); fluctuation of the total RTS scale and their parameters (except for systolic arterial pressure) and severity of injuries measured by the MAIS and ISS scales for the thorax, abdomen, lower limbs and external surface. The MAIS score for head injuries was only associated with the survival result after the first week.

Information about the RTS behavior and its parameters confirm the usefulness of this scale in clinical practice, once prehospital care teams can use the information about the patient's physiological condition, at the scene and during transportation, to make decisions on interventions and level of complexity of the destination hospital.

Among the practical aspects for use of the scale, it can also be observed that the greater the changes in respiratory frequency, systolic arterial pressure and Glasgow Coma Scale (coded as zero and one), the lower the probability of survival. The worsening of the respiratory function decreases the chance of survival, while improvement in the level of consciousness measured by the Glasgow Coma Scale indicates a better prognosis for victims.

However, by comparing this study's survival percentages to those obtained through the RTS scale when it was published in 1989,[4] it is observed that victims with RTS=11 or RTS≤10 were less likely to survive (65.2% and 36.7%, respectively) than what was shown by the scale authors (96.9% for RTS=11 and 87.9% or below for RTS≤10). The sample used by the scale authors involved trauma victims with distinct etiologies (penetrating and blunt) and degrees of severity, including victims with RTS=12 (maximum value).

Given this comparison, fatality or survival results of trauma victims shown by international studies cannot be extrapolated to our reality without considering the characteristics of the population studied and the pre- and in-hospital care model of each country.

Table 3. Probability of survival measured by Kaplan-Meier survival analysis, according to fluctuation of RTS scale parameters and time intervals. City of São Paulo, Southeastern Brazil, 1999-2003.

Variable	Until 6 hours	Until 12 hours	Until 24 hours	Until 48 hours	Until 7 days	Until hospital discharge
Total RTS fluctuation	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Absent	80.2	78.0	77.1	75.5	68.4	34.8
Positive	89.0	83.3	78.7	78.7	72.8	61.9
Negative	62.5	61.5	54.1	45.4	45.4	30.3
Initial respiratory frequency fluctuation	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Absent	83.0	79.3	77.8	75.8	68.9	53.8
Positive	84.0	83.4	71.6	71.6	71.6	53.7
Negative	54.5	53.8	45.4	36.3	36.3	-
Initial systolic arterial pressure fluctuation	p>0.05	p>0.05	p>0.05	p>0.05	p>0.05	p>0.05
Absent	81.4	79.1	76.8	73.9	69.5	44.6
Positive	85.0	74.3	68.8	68.1	54.5	34.1
Negative	66.6	66.6	50.0	50.0	50.0	33.3
Initial Glasgow Coma Scale fluctuation	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Absent	80.3	76.3	72.9	71.7	63.8	37.4
Positive	96.7	93.3	93.1	93.1	93.1	78.7
Negative	61.9	61.9	57.1	47.1	47.1	29.4

Table 4. Probability of survival measured by Kaplan-Meier survival analysis, according to degrees of severity and time intervals. City of São Paulo, Southeastern Brazil, 1999-2003

Variable	Until 6 hours	Until 12 hours	Until 24 hours	Until 48 hours	Until 7 days	Until hospital discharge
MAIS head	p>0.05	p>0.05	p>0.05	p>0.05	p>0.05	p<0.05
1 to 2	86.9	86.3	86.3	86.3	86.3	86.3
3	88.2	87.5	86.6	86.6	86.6	57.7
4 to 5	79.3	73.0	68.2	65.0	58.1	34.2
No injuries	79.6	77.7	75.1	72.5	65.4	61.1
MAIS thorax	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
1 to 2	80.0	80.0	80.0	80.0	60.0	30.0
3	75.0	65.0	63.1	63.1	57.8	45.0
4 to 5	34.9	31.0	23.2	23.2	19.4	19.4
No injuries	92.5	90.5	88.2	84.6	80.2	49.3
MAIS abdomen	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
1 to 2	72.2	72.2	64.1	57.7	50.5	43.3
3	42.1	31.5	31.5	31.5	26.3	26.3
4 to 5	42.8	35.7	28.5	21.4	14.2	14.2
No injuries	93.4	91.4	89.1	87.9	83.8	54.5
MAIS lower limbs	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
1 to 2	82.6	76.7	73.8	67.3	63.4	50.0
3	80.5	77.1	73.4	73.4	62.8	44.3
4 to 5	0.0	0.0	0.0	0.0	0.0	0.0
No injuries	84.8	82.2	79.1	77.5	77.8	43.7
MAIS external surface	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
1 to 2	63.4	59.9	56.1	54.3	44.5	27.0
3*	-	-	-	-	-	-
4 to 5*	-	-	-	-	-	-
No injuries	94.8	91.3	88.6	85.9	84.2	59.5
ISS scale	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
1 to <16	97.1	97.0	97.0	97.0	97.0	97.0
16 to <25	89.5	86.5	86.2	77.7	77.7	67.1
>25	60.0	53.8	47.7	47.7	39.7	21.5

MAIS - Maximum Abbreviated Injury Scale
ISS - Injury Severity Scale
*Absence of cases

Kaplan-Meier survival analysis enabled to detect that injuries with a certain severity and from specific body parts show statistically significant association with survival. Low survival probability of victims having thorax injuries with MAIS≥3, the impact of abdomen injuries of any severity until the seventh day after trauma and the higher percentage of survival of victims not having injuries in these body parts indicate that the involvement of these parts is highly relevant for the survival result of the blunt trauma victim in this time interval. In these cases, the existence of hemorrhagic events is probably associated with early death.

All external surface injuries were classified as minor (MAIS scale 1 and 2); nonetheless, the presence of these injuries led to low chance of survival. This result indicates the importance of injuries in this body part, once they point to the existence of internal injuries. The presence of abdomen, thorax, external surface and head injuries were also associated with low probability of survival of critical patients in a study performed in England.[13]

The involvement of hemorrhagic causes in early death and traumatic brain injury in late death of trauma victims has been reported in another study that used survival analysis.[7] It can be concluded that death determining variables of trauma victims differ throughout time and, as a result, time elapsed after trauma must be considered in the clinical investigation.

Even though the approach of injury impact per body parts is relevant, analysis of their cumulative effect using the ISS scale may be more indicated for victim characterization.

In the present investigation, the survival percentage shown by victims with ISS of 16 to <25 and ≥25 was below that shown by the Major Trauma Outcome Study[5] (for victims of blunt trauma with comparable severity) in 1988. In this comparison, only in the ISS<16 group are the percentages of survival similar (around 97%). However, there are differences in size, sample selection and mostly the statistical method used (mortality analysis in the American study, in comparison to the survival analysis of the present study).

These observations about the ISS scale, associated with those previously mentioned about the RTS scale, point to current results of survival below the ones pointed by developed countries, roughly 20 years ago. This approach must be further investigated by trauma researchers so as to provide proper assessment and intervention tools to those responsible for public policies and health care professionals.

Finally, among pre- and in-hospital care teams, acknowledging the variables involved in the survival results may help to make decisions about interventions to be performed at the accident scene, transportation to the most adequate hospital resources, and hospital procedures needed to maximize survival.

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