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ORIGINAL RESEARCH

Survival Rates and Factors Related to the Survival of Traffic Accident Patients Transported by Emergency Medical Services

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Background: Traffic accident patients place a tremendous burden on health care services because they require substantial, rapid, and effective evaluation, management, and treatment by emergency medical services (EMS) to decrease morbidity and mortality rates. This study investigated the 1-month survival rate and factors related to the survival of traffic accident patients managed by EMS.

Patients and Methods: We retrospectively analyzed data of traffic accident patients serviced by the Surgico Medical Ambulance and Rescue Team (SMART) at Vajira Hospital, Bangkok, from January 1, 2018, to December 31, 2020. The data were collected from EMS patient care reports recorded using the emergency medical triage protocol as well as the criteria-based dispatch response codes in Thailand. Survival data at 1 month were obtained from electronic medical records.

Results: Of the 340 traffic accident patients who fulfilled the study criteria, 314 (92.35%) were alive at 1 month. A multivariable analysis using multiple logistic regression identified prehospital level of consciousness, airway management, and cardiopulmonary resuscitation as factors associated with survival. Unresponsive patients had a lower survival rate than responsive patients (adjusted odds ratio [OR_{adj}] = 0.16, 95% confidence interval [CI]: 0.05–0.56, p = 0.004). Prehospital airway management and cardiopulmonary resuscitation reduced the survival rate by 0.30 and 0.10 times, respectively (OR_{adj} = 0.30, 95% CI: 0.09–0.97, p = 0.045 and OR_{adj} = 0.10, 95% CI: 0.02–0.47, p = 0.004, respectively).

Conclusion: Traffic accident patients had a high survival rate at 1 month. We identified three factors regarding EMS treatment which were related to increased survival: a prehospital responsive level of consciousness, no prehospital airway management, and no prehospital cardiopulmonary resuscitation. Therefore, the development of standard guidelines for the management of traffic accident patients by EMS is crucial to increase the survival rate of traffic accident patients.

Keywords: EMS, level of consciousness, airway management, cardiopulmonary resuscitation

Introduction

The mortality rate of patients involved in traffic accidents severely impacts individuals, communities, societies, and nations. Traffic accidents place a global burden on health care services, affecting both societal and economic factors, as well as impeding country development. According to the World Health Organization, Thailand has the highest traffic accident mortality rate in Asia and the second highest globally in 2015.[1] The mortality rate of traffic accidents in low- to middle-income countries is 90%.[2] Emergency medical services (EMS) data from all 77 provinces of Thailand

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obtained from the Information Technology for Emergency Medical System, a national database for prehospital care, shows that the number of response code 25 (motor vehicle accident) criteria based dispatch (CBD) services has increased each year from 2016 to 2020.[3] However, The Injury Data Collaboration Center of the Division of Injury Prevention reported a decrease in the traffic accident mortality rate in Thailand during 2016–2019.[4]

An EMS has been set up and integrated into existing health care systems to minimize morbidity and mortality by providing pre-hospital treatments and transportation to the most appropriate hospital.[5] Traffic accidents require experts in patient management, handling accidents and disasters, and treating critical emergency medical conditions. EMS are a modern healthcare service tasked with reducing the rate of prehospital morbidity and mortality.[6–8] The main principle of the management of injured patients due to accidents is correctness. Prehospital, injured patients are managed according to two essential concepts: the golden period or golden hour and the platinum 10 minutes. The golden period refers to the 60 minutes from the time of the accident to receiving definitive care, after which morbidity and mortality significantly increase. Coupled with the golden hour, the platinum 10 minutes refers to paramedics having at most 10 minutes at the scene to manage severely injured patients to improve the rate of survival.[8] Many studies have focused on the survival of patients with general injuries.[9–11] A study of motor vehicle accidents conducted in the United States reported that the longer the time taken at the scene, the higher the rate of mortality rate.[12]

In a previous study, for traffic accident patients' characteristics and outcomes, EMS patients tended to have poorer Glasgow coma scale (GCS) and hemodynamic measures, compared to non-EMS patients. However, no patient factor affecting survival was reported in the study.[13] A limited number of studies have investigated the survival rate and factors related to the survival of traffic accident patients managed by EMS in Thailand, particularly in Bangkok, the capital city. To add to the body of knowledge, this study investigated the 1-month survival rate and associated factors related to the survival of traffic accident patients managed by EMS in zone 1 of the Bangkok EMS area.

Methods

Study Design and Setting

This retrospective cohort study was researched at the Surgico Medical Ambulance and Rescue Team (SMART), Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Thailand, which is situated in zone 1 of the Bangkok EMS area from a total of nine areas that are dispatched by the Bangkok EMS dispatch center (Erawan Center). This dispatch center also receives emergency calls, and traffic accident services are its fourth-busiest service. The study period was from January 1, 2018, to December 31, 2020 (3 years). SMART is responsible for 50 km^2, serving a population of >500,000 people around-the-clock. This area covers six hospitals, including both public and private ones, which have been overseen and serviced since 1985.

Population

Data of patients involved in traffic accidents were collected from EMS patient care reports recorded using the emergency medical triage protocol as well as CBD RCs 25 red 1–25 red 5, managed by SMART, Faculty of Medicine Vajira Hospital.

Eligibility Criteria

Traffic accident patients aged >18 years whose treatment was recorded using the emergency medical triage protocol as well as CBD RCs 25 red 1–25 red 5 and who were serviced by SMART, Faculty of Medicine Vajira Hospital, and sent to the emergency department of Faculty of Medicine Vajira Hospital were eligible for study enrolment.

Exclusion Criteria

The injured who were dead at the scene, those without complete data, and those denied treatment and transportation were excluded.

Sample Size Determination

We investigated the 1-month survival rate and factors related to the survival of traffic accident patients managed by EMS. The primary outcome was the 1-month survival rate, and the sample size estimation was calculated using a population proportion formula.[14] The confidence interval (CI) was 95%, with an error margin of 2%. The proportion (survival rate of traffic accident patients managed by EMS) was taken as 98.56%, as referred to in a previous study.[15] The calculated sample size was at least 137. We used two independent proportions[16] to calculate the sample size for the secondary outcomes (factors related to survival). The 1-month survival rates of responsive and unresponsive patients were 99.5% and 86.5%, respectively, as previously reported.[13] The ratio of responsive to unresponsive patients was 0.126 (301 responsive and 38 unresponsive patients), as recorded in the medical records of motor vehicle accident patients serviced by SMART, Faculty of Medicine Vajira Hospital. A CI of 95% and a power of 80% were used to calculate a sample size of no less than 156 and 20 for responsive and unresponsive patients, respectively (total sample size = 176). We added 20% of the sample size to compensate for incomplete data using the formula $n_{new} = 176/(1 - 0.2)$,[17] resulting in a final sample size of at least 220. From January 1, 2018, to December 31, 2020, 340 patients met these criteria.

Operational Definitions

1. The RC was defined as one of 25 severity codes assigned at the scene, derived from acquiring patients' symptoms from informers. RC 25 refers to a traffic or motor vehicle accident, defined as injury due to motor vehicle usage, pedestrian crash, or motorcycle crash. The RC 25 red included red 1–red 5.[18]

2. The 1-month survival rate was defined as the survival of traffic accident patients (RC 25 red) serviced by EMS. The day that the patient received the service was considered day 1. Survival was evaluated on day 28 using information obtained from EMS patient care reports and electronic medical records from the Faculty of Medicine Vajira Hospital.

3. The response time was defined as the time elapsed between the emergency call to the arrival of the ambulance at the scene.

4. On-scene time was defined as the duration from the time of ambulance arrival at the scene to its departure from the scene.

5. Prehospital level of consciousness was defined as an assessment of the patient's level of consciousness as per the AVPU scale (A = alert, V = verbal, P = pain, U = unresponsive). Patients who were alert, verbal, and responsive to pain were assigned to the responsive group, whereas patients who were unresponsive were assigned to the unresponsive group.

Data Collection Tools, Procedures, and Quality Control

Data were collected from EMS patient care reports, a standard operational report of advanced EMS, Bangkok EMS dispatch center (Erawan Center), which is also used for the disbursement of emolument to paramedics. The reports were retrospectively collected by one author who input the data on a Excel. This eliminated the need to evaluate interrater reliability. The data were amassed in Microsoft Excel (Microsoft, Redmond, WA, USA). This included patient data (gender, age, prehospital systolic blood pressure, prehospital heart rate, prehospital oxygen saturation, prehospital level of consciousness, type of wounds, type of orthopedic injuries, type of hemorrhage, and body part injured), EMS data (RC, response time, on-scene time, distance from base station to scene, and distance from scene to hospital), treatment data (prehospital hemorrhage control, prehospital airway management, prehospital fluid management, prehospital immobilization, and prehospital cardiopulmonary resuscitation), and hospital follow-up data at 1 month (survival).

Data Processing and Analysis

We used descriptive statistics to analyze the collected data. First we quantitatively analyzed the patient and treatment data, and the results were expressed as the frequency distribution and percentage. Then, we performed a quantitative analysis of the EMS data. The results were expressed as means ± standard deviation (SD) or median and interquartile range (IQR), as appropriate. The 1-month survival rate of traffic accident patients serviced by EMS was reported as the frequency distribution and percentage (incidence rate) as well as the 95% CI. The factors related to survival were described using the frequency distribution and percentage as well as either the Chi-square test or Fisher exact test for crude analysis. Multivariable analysis was performed using multivariable logistic regression backwards stepwise regression and reported as the odds ratio (OR) and 95% CI.

All statistical analyses were performed using IBM SPSS Statistics for Windows v26.0. (IBM Corp., Armonk, NY, USA). A p-value ≤ 0.05 was considered statistically significant.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Review Board of the Faculty of Medicine Vajira Hospital, Navamindradhiraj University (No. COA. 164/2564).

Results

General Data and 1-Month Survival Rate of Traffic Accident Patients Managed by EMS

The survival rate at 1 month of the 340 traffic accident patients in our study cohort was 92.35% (95% CI: 89.00–

94.94). The majority of patients in both the alive and dead groups were male (71.0% and 73.1%, respectively; p = 0.824), and the mean age ± SD of the alive and dead groups was 37.33 ± 16.99 and 33.85 ± 17.00 years, respectively (p = 0.316). A prehospital systolic blood pressure >90 mmHg was observed in 93.9% of the patients in the alive group and only 50.0% of the patients in the dead group (p < 0.001). A prehospital oxygen saturation >94% on room air was observed in 83.4% of patients in the alive group and 57.7% of patients in the dead group (p < 0.001). The prehospital level of consciousness was recorded as responsive in 93.3% of patients in the alive group. On the other hand, the prehospital level of consciousness was recorded as unresponsive in 65.4% of the patients in the dead group (p < 0.001) (Table 1).

Regarding the RC, 49.0% of the alive group were classified as RC 25 red 4, whereas 42.3% of the dead group were classified as RC 25 red 1 (p < 0.001). The median on-scene time was 7 min (IQR = 4–9) and 8.5 min (IQR = 6–13) for the alive and dead groups, respectively (p = 0.012). The patients in the alive and dead groups had an on-scene time of not more than 10 min (82.5% and 61.5%, respectively, p = 0.017).

Prehospital airway management was necessary in 30.3% and 80.8% of the patients in the alive and dead groups, respectively (p < 0.001), which included a mask with bag (23.6% and 11.5%, respectively; p = 0.159), bag valve mask (6.4% and 61.5%, respectively; p < 0.001), and endotracheal tube (0.6% and 15.4%, respectively; p < 0.001). Prehospital cardiopulmonary resuscitation was performed on 1.0% and 42.3% of patients in the alive and dead groups, respectively (p < 0.001) (Table 2).

Factors Associated with Survival of Traffic Accident Patients Managed by EMS

We performed univariable analyses using binary logistic regression analysis. The results revealed that prehospital systolic blood pressure (>90 mmHg: OR = 15.53, 95% CI: 6.33–38.11, p <0.001), prehospital oxygen saturation (>94% on room air: OR = 6.87, 95% CI: 2.99–15.8, p <0.001), prehospital level of consciousness (OR = 0.04, 95% CI: 0.02–0.10, p <0.001), facial injury (OR = 0.30, 95% CI: 0.14–0.69, p = 0.004), RC 25 red (code 3: OR = 4.30, 95% CI: 1.61–11.43, p = 0.004; code 4–5: OR = 7.00, 95% CI: 2.52–19.40, p <0.001), on-scene time (≤10 min: OR = 2.94, 95% CI: 1.27–6.83, p = 0.012), prehospital airway management (OR = 0.10, 95% CI: 0.04–0.28, p <0.001), prehospital fluid management (OR = 0.24, 95% CI: 0.11–0.57, p = 0.001), and prehospital cardiopulmonary resuscitation (OR = 0.01, 95% CI: 0.01–0.05, p <0.001) were significant factors related to the survival of traffic accident patients managed by EMS (Tables 3 and 4).

Multivariable analysis was performed using multiple logistic regression analysis of the significant factors that were identified as related to the survival of traffic accident patients managed by EMS. Next, we performed a backward stepwise selection with a p-value of 0.05 defined as significant. The significant factors identified included prehospital level of consciousness (the unresponsive group had a survival rate 0.16 times lower than the responsive group; adjusted OR [OR_{adj}] = 0.16, 95% CI: 0.05–0.56, p = 0.004), prehospital airway management (the group with airway management had a survival rate 0.30 times lower than the group with no airway management; OR_{adj} = 0.30, 95% CI: 0.09–0.97, p = 0.045), and prehospital cardiopulmonary resuscitation (the group with resuscitation had a survival rate 0.10 times lower than the group without resuscitation; OR_{adj} = 0.10, 95% CI: 0.02–0.47, p = 0.004)] (Table 5).

Discussion

The survival rate of traffic accident patients managed by EMS at 1 month was 92.35%. The factors related to survival included a prehospital responsive level of consciousness, no prehospital airway management, and no cardiopulmonary resuscitation.

Although the 1-month survival rate was very high, it was comparable to the findings of Wongvatanakij et al,[19] who reported a survival rate of 97.9% for traffic accident patients who were treated in a tertiary hospital in Thailand, a study by Tesfay et al,[20] who reported that survival for traffic accident patients was quite good and had a short recovery time, and a study by Seid et al,[21] who reported a mortality rate of 7.4% for traffic accident patients in an emergency department in Addis Ababa, Ethiopia.

We only included data of severely injured patients with RC 25 red 1–red 5 and excluded those with code yellow or green because SMART only serviced only patients with code red (severe injury), and these patients were transported to the emergency department of Vajira Hospital, a level 2 trauma and university hospital in Bangkok. Therefore, it could be implied that the high 1-month survival rate was thanks to the effective management of the EMS team, the emergency department, and the hospital.

Table 1 Characteristics of the Traffic Accident Patients in Our Cohort (N = 340)

Variables	Alive (n = 314)		Dead (n = 26)		p-value
Gender					
Male	223	(71.0)	19	(73.1)	0.824
Female	91	(29.0)	7	(26.9)	
Age (years), mean ± SD	37.33 ± 16.99		33.85 ± 17.00		0.316
Prehospital systolic blood pressure (mmHg)					
≤90	19	(6.1)	13	(50.0)	<0.001
>90	295	(93.9)	13	(50.0)	
Prehospital heart rate (bpm)					
≤100	213	(67.8)	14	(53.8)	0.146
>100	101	(32.2)	12	(46.2)	
Prehospital oxygen saturation on room air					
≤94%	52	(16.6)	15	(57.7)	<0.001
>94%	262	(83.4)	11	(42.3)	
Prehospital level of consciousness					
Responsive	293	(93.3)	9	(34.6)	<0.001
Unresponsive	21	(6.7)	17	(65.4)	
Wounds	285	(90.8)	23	(88.5)	0.724
Cut/laceration	164	(52.2)	13	(50.0)	0.827
Abrasion	142	(45.2)	16	(61.5)	0.109
Contusion	126	(40.1)	11	(42.3)	0.828
Amputation	1	(0.3)	0	(0.0)	1.000
Orthopedic injuries	173	(55.1)	14	(53.8)	0.902
Close fracture	120	(38.2)	11	(42.3)	0.680
Open fracture	55	(17.5)	5	(19.2)	0.791
Dislocation	13	(4.1)	0	(0.0)	0.610
Hemorrhage	121	(38.5)	12	(46.2)	0.444
Externally stopped	91	(29.0)	9	(34.6)	0.545
Externally active	23	(7.3)	1	(3.8)	1.000
Internal hemorrhage	12	(3.8)	2	(7.7)	0.291
Body part injured					
Extremity	209	(66.6)	17	(65.4)	0.903
Head/neck	170	(54.1)	16	(61.5)	0.466
Face	92	(29.3)	15	(57.7)	0.003

(*Continued*)

Table 1 (Continued).

Variables	Alive (n = 314)		Dead (n = 26)		p-value
Chest/clavicle	37	(11.8)	6	(23.1)	0.119
External body surface	27	(8.6)	2	(7.7)	1.000
Pelvis	27	(8.6)	2	(7.7)	1.000
Multiple injuries	24	(7.6)	3	(11.5)	0.448
Abdomen	22	(7.0)	2	(7.7)	0.704
Spine	18	(5.7)	2	(7.7)	0.658

Notes: Data are presented as number (%), mean ± SD or median (interquartile range). P-values correspond to the independent sample *t*-test, Mann–Whitney *U*-test, Chi-square test, or Fisher exact test.
Abbreviations: bpm, beats per minute; NA, data not applicable; SD, standard deviation.

However, we only studied factors concerning EMS. SMART, Faculty of Medicine Vajira Hospital, is an advanced life support unit. Emergency physicians, paramedics, emergency nurse practitioners, and emergency medical technicians are included in each emergency medical operation. In Thailand, both the Anglo-American and Franco-German emergency services system models are applied. The EMS team uses online and offline protocols under the instruction of the medical director.[22]

Our findings revealed that a prehospital responsive level of consciousness affected the survival rate. This correlated with the findings of Mahama et al,[15] who reported that the survival rate of patients with a prehospital responsive level of consciousness was 99.5%, while that of patients with a prehospital unresponsive level of consciousness was 86.5%. Moreover, the unresponsive patients typically had severe and critical injuries. The reason why patients without prehospital airway management have a higher rate of survival is probably because patients who are intubated at the scene always have severe symptoms or receive prehospital cardiopulmonary resuscitation, leading to a poor outcome. However, Hoffmann et al[23] reported that patients with a Glasgow coma scale ≤8 who were intubated in the field appeared to have a better outcome compared with those without intubation, and prehospital intubation for indicated patients might decrease the mortality rate and improve early neurologic outcomes. This correlated with a study by Denninghoff et al,[24] who reported that prehospital intubation was associated with a good outcome and decreased mortality rate and was not associated with increased illness and death.

Another important finding of our study was that patients who received prehospital cardiopulmonary resuscitation had a survival rate 0.1 times lower than those who did not need to be resuscitated. A possible explanation is that the patients who received prehospital cardiopulmonary resuscitation at the scene died in 1–2 days upon hospital arrival, which was comparable to the findings of Dorlac et al,[25] who reported that all patients who received prehospital cardiopulmonary resuscitation died, and those of Stewart et al,[26] who found that most of the deceased were severely injured and had received advanced lifesaving medical procedures, including prehospital intubation and cardiopulmonary resuscitation. Furthermore, Stockinger et al[27] reported that only 22 of 588 (3.7%) patients who received prehospital cardiopulmonary resuscitation survived and were discharged from hospital, and Alanezi et al[28] reported an overall mortality rate of 96% in 50 patients who received prehospital cardiopulmonary resuscitation, with only two patients surviving and being discharged from hospital. Most of the abovementioned studies were related to many different mechanisms of injury, so it was unclear whether traffic accident patients with prehospital cardiopulmonary resuscitation had poorer outcomes.

Study Strengths and Limitations

The strength of this study is that our findings will be instrumental in improving EMS management of traffic accident patients, thereby increasing the survival rate. Our findings can be used to develop standard guidelines for EMS for the management of traffic accident patients to increase their rate of survival. Our study had several limitations. Firstly, most patients (314 of 340) survived,

Table 2 Characteristics of the EMS Unit and Treatment in Our Cohort (N = 340)

Variables	Alive (n = 314)		Dead (n = 26)		p-value
RC 25 red					
1	17	(5.4)	11	(42.3)	<0.001
2	31	(9.9)	2	(7.7)	
3	111	(35.4)	7	(26.9)	
4	154	(49.0)	6	(23.1)	
5	1	(0.3)	0	(0.0)	
Response time (min)	6	(4–10)	6.5	(5–8)	0.927
≤8	213	(67.8)	20	(76.9)	0.338
>8	101	(32.2)	6	(23.1)	
On-scene time (min)	7	(4–9)	8.5	(6–13)	0.012
≤10	259	(82.5)	16	(61.5)	0.017
>10	55	(17.5)	10	(38.5)	
Distance from base station to scene (km)	2	(1–4)	3	(1–4)	0.481
Distance from scene to hospital (km)	2	(1–3)	3	(1–4)	0.270
Prehospital hemorrhage control	132	(42.0)	10	(38.5)	0.722
Pressure dressing	111	(35.4)	10	(38.5)	0.750
Dressing	32	(10.2)	0	(0.0)	0.152
Prehospital airway management	95	(30.3)	21	(80.8)	<0.001
Mask with bag	74	(23.6)	3	(11.5)	0.159
Bag valve mask	20	(6.4)	16	(61.5)	<0.001
Endotracheal tube	2	(0.6)	4	(15.4)	<0.001
Prehospital fluid management	99	(31.5)	17	(65.4)	<0.001
Ringer's lactate solution	65	(20.7)	14	(53.8)	<0.001
Normal saline solution	30	(9.6)	5	(19.2)	0.167
Heparin lock	1	(0.3)	0	(0.0)	1.000
Prehospital immobilization	220	(70.1)	19	(73.1)	0.747
Prehospital cardiopulmonary resuscitation	3	(1.0)	11	(42.3)	<0.001

Notes: Data are presented as number (%), mean ± SD or median (interquartile range). P-values correspond to the independent sample *t*-test, Mann–Whitney *U*-test, Chi-square test, or Fisher exact test.
Abbreviations: bpm, beats per minute; NA, data not applicable; SD, standard deviation.

and the remainder died within the first 1–2 days. Secondly, the retrospective nature of this study meant that incomplete data were excluded. Thirdly, this was a single-institution study with a limited follow-up time (28 days) and included only patients transported to the emergency department at the Faculty of Medicine Vajira Hospital. Therefore, our findings cannot be generalized to a broader population. Fourthly, pre-hospital factors and pre-hospital care could not be identified as factors associated with survival and severity of the injury had not been considered, which might affect survival. Finally, only pre-hospital factors from EMS patient care reports were

Table 3 Univariable Analysis for Factors Associated with the Survival Rate of Traffic Accident Patients Transported by EMS

Factors	Alive (n = 314)		Dead (n = 26)		OR	95% CI	p-value
Gender							
Male	223	(71.0)	19	(73.1)	1.00	Reference	
Female	91	(29.0)	7	(26.9)	1.11	(0.45–2.73)	0.824
Age (years), mean ± (SD)	37.33 ± 16.99		33.85 ± 17.00		1.01	(0.99–1.04)	0.317
Prehospital systolic blood pressure (mmHg)							
≤90	19	(6.1)	13	(50.0)	1.00	Reference	
>90	295	(93.9)	13	(50.0)	15.53	(6.33–38.11)	<0.001
Prehospital heart rate (bpm)							
≤100	213	(67.8)	14	(53.8)	1.00	Reference	
>100	101	(32.2)	12	(46.2)	0.55	(0.25–1.24)	0.150
Prehospital oxygen saturation on room air							
≤94%	52	(16.6)	15	(57.7)	1.00	Reference	
>94%	262	(83.4)	11	(42.3)	6.87	(2.99–15.8)	<0.001
Level of consciousness							
Responsive	293	(93.3)	9	(34.6)	1.00	Reference	
Unresponsive	21	(6.7)	17	(65.4)	0.04	(0.02–0.10)	<0.001
Wounds							
No	29	(9.2)	3	(11.5)	1.00	Reference	
Yes	285	(90.8)	23	(88.5)	1.28	(0.36–4.53)	0.700
Orthopedic injuries							
No	141	(44.9)	12	(46.2)	1.00	Reference	
Yes	173	(55.1)	14	(53.8)	1.05	(0.47–2.35)	0.902
Hemorrhage							
No	193	(61.5)	14	(53.8)	1.00	Reference	
Yes	121	(38.5)	12	(46.2)	0.73	(0.33–1.63)	0.446
Body part injured							
Extremity	209	(66.6)	17	(65.4)	1.05	(0.45–2.44)	0.903
Head/neck	170	(54.1)	16	(61.5)	0.74	(0.33–1.68)	0.468
Face	92	(29.3)	15	(57.7)	0.30	(0.14–0.69)	0.004
Chest/clavicle	37	(11.8)	6	(23.1)	0.45	(0.17–1.18)	0.104
External body surface	27	(8.6)	2	(7.7)	1.13	(0.25–5.04)	0.874
Pelvis	27	(8.6)	2	(7.7)	1.13	(0.25–5.04)	0.874
Multiple injuries	24	(7.6)	3	(11.5)	0.63	(0.18–2.27)	0.484

(*Continued*)

Table 3 (Continued).

Factors	Alive (n = 314)		Dead (n = 26)		OR	95% CI	p-value
Abdomen	22	(7.0)	2	(7.7)	0.90	(0.2–4.08)	0.896
Spine	18	(5.7)	2	(7.7)	0.73	(0.16–3.33)	0.684

Abbreviations: bpm, beats per minute; OR, odds ratio; CI, confidence interval; NA, data not applicable.

Table 4 Univariable Analysis for the EMS Unit and Treatment Factors Associated with the Survival Rate of Traffic Accident Patients Transported by EMS

Factors	Alive (n = 314)		Dead (n = 26)		OR	95% CI	p-value
RC 25 red							
1–2	48	(15.3)	13	(50.0)	1.00	Reference	
3	111	(35.4)	7	(26.9)	4.30	(1.61–11.43)	0.004
4–5	155	(49.4)	6	(23.1)	7.00	(2.52–19.40)	<0.001
Response time (min)							
≤8	213	(67.8)	20	(76.9)	0.63	(0.25–1.62)	0.341
>8	101	(32.2)	6	(23.1)	1.00	Reference	
On-scene time (min)							
≤10	259	(82.5)	16	(61.5)	2.94	(1.27–6.83)	0.012
>10	55	(17.5)	10	(38.5)	1.00	Reference	
Distance from base station to scene (km)	2	(1–4)	3	(1–4)	0.93	(0.77–1.13)	0.472
Distance from scene to hospital (km)	2	(1–3)	3	(1–4)	0.92	(0.75–1.14)	0.459
Prehospital hemorrhage control							
No	182	(58.0)	16	(61.5)	1.00	Reference	
Yes	132	(42.0)	10	(38.5)	1.16	(0.51–2.64)	0.723
Prehospital airway management							
No	219	(69.7)	5	(19.2)	1.00	Reference	
Yes	95	(30.3)	21	(80.8)	0.10	(0.04–0.28)	<0.001
Prehospital fluid management							
No	215	(68.5)	9	(34.6)	1.00	Reference	
Yes	99	(31.5)	17	(65.4)	0.24	(0.11–0.57)	0.001
Prehospital immobilization							
No	94	(29.9)	7	(26.9)	1.00	Reference	
Yes	220	(70.1)	19	(73.1)	0.86	(0.35–2.12)	0.747
Prehospital cardiopulmonary resuscitation							
No	311	(99.0)	15	(57.7)	1.00	Reference	
Yes	3	(1.0)	11	(42.3)	0.01	(0.01–0.05)	<0.001

Abbreviations: bpm, beats per minute; OR, odds ratio; CI, confidence interval; NA, data not applicable.

Table 5 Univariable Analysis and Multivariable Analysis of Factors Associated with the Survival Rate of Traffic Accident Patients Transported by the EMS

Factors	Univariable Analysis			Multivariable Analysis		
	OR[a]	95% CI	p-value	OR_{adj}[b]	95% CI	p-value
Prehospital systolic blood pressure (mmHg)						
≤90	1.00	Reference				
>90	15.53	(6.33–38.11)	<0.001			
Prehospital oxygen saturation on room air						
≤94%	1.00	Reference				
>94%	6.87	(2.99–15.8)	<0.001			
Prehospital level of consciousness						
Responsive	1.00	Reference		1.00	Reference	
Unresponsive	0.04	(0.02–0.10)	<0.001	0.16	(0.05–0.56)	0.004
Body part injured						
Face	0.30	(0.14–0.69)	0.004			
RC 25 red						
1–2	1.00	Reference				
3	4.30	(1.61–11.43)	0.004			
4–5	7.00	(2.52–19.40)	<0.001			
On-scene time (min)						
≤10	2.94	(1.27–6.83)	0.012			
>10	1.00	Reference				
Prehospital airway management						
No	1.00	Reference		1.00	Reference	
Yes	0.10	(0.04–0.28)	<0.001	0.30	(0.09–0.97)	0.045
Prehospital fluid management						
No	1.00	Reference				
Yes	0.24	(0.11–0.57)	0.001			
Prehospital cardiopulmonary resuscitation						
No	1.00	Reference		1.00	Reference	
Yes	0.01	(0.01–0.05)	<0.001	0.10	(0.02–0.47)	0.004

Notes: [a]Crude OR estimated by binary logistic regression. [b]OR_{adj} estimated by multiple logistic regression.
Abbreviations: OR, odds ratio; OR_{adj}, adjusted odds ratio; CI, confidence interval.

analyzed, and no data from the emergency department, operating theater, or other in-hospital treatments were included.

Conclusion

We observed a high survival rate of 92.35% in our cohort of traffic accident patients. In the context of traffic accident patients managed by EMS, we identified three factors that were related to increased survival: a prehospital responsive level of consciousness, no prehospital airway management, and no prehospital cardiopulmonary resuscitation.

Abbreviations

ALS, advanced life support; EMR, electronic medical record; EMS, emergency medical services; EMTs, emergency medical technicians; ENPs, emergency nurse practitioner; EPs, emergency physicians; IDCC, Injury Data Collaboration Center; ITEMS, Information Technology for Emergency Medical System; MVC, motor vehicle crash; S.M.A.R.T, Surgico Medical Ambulance and Rescue Team; WHO, World Health Organization.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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