

Outcomes of cardiopulmonary resuscitation in trauma patients in the Emergency Department

A.K. ERENLER¹, S. ÇELİK¹, A. BAYDIN², L. TOMAK³, M. KOSARGELIR⁴, A.Ç. YASTI⁵

¹Emergency Department, Hitit University Çorum Education and Research Hospital, Çorum, Turkey

²Emergency Department, Ondokuz Mayıs University, Samsun, Turkey

³Department of Statistics, Ondokuzmayis University, Samsun, Turkey

⁴Emergency Department, Haydarpaşa Numune Education and Research Hospital, Istanbul, Turkey

⁵General Surgery, Hitit University Medical School; Ankara Numune Education and Research Hospital, General Surgery Clinic, Ankara, Turkey

Abstract. – OBJECTIVE: We aimed to determine our performance and factors effecting outcomes in cardiopulmonary resuscitation (CPR) for the patients with trauma in the Emergency Department (ED).

PATIENTS AND METHODS: In a period of 5 years, file data of 136 consecutive adult trauma patients who have required CPR in our ED were collected, retrospectively. Patients were divided into subgroups according to years, mechanism of trauma, hour of the trauma, location of cardiac arrest, the period of the CPR, the rhythm during the onset of arrest, atropine use and ED specialist accompaniment. Patients were also divided into two subgroups as those who died in the ED and those who survived.

RESULTS: The leading cause of trauma was motor vehicle accidents. The period between arrest and CPR was 0-5 minutes in 92 patients. Of these 92 patients 12 have survived and as the time prolonges, number of survivors tended to decrease. The most common rhythm determined shortly before cardiac arrest was asystole. When all patients with trauma requiring CPR were considered, overall rate of survival was found to be 9.5%. When an ED specialist accompanied, survival rate increased. According to the rates of survival, atropine was found to be useless.

CONCLUSIONS: Our results revealed that, when performed in the leadership of an ED specialist, more successful outcomes may be obtained in CPR in trauma patients. We also determined that use of atropine does not contribute to survival rate. As CPR prolonges, the success rate falls.

Keywords:

Cardiopulmonary resuscitation, Trauma, Emergency Department.

most effected group and it is the leading cause of death up to age of 45¹. Fifty percent of all trauma-related mortalities occur in those who are in the age group of 15 to 44 years, which would end up in a country's high economic burden. While well-developed countries ensure a decrease in mortality and morbidity in patients with trauma, there has been an increase in mortality and morbidity of traumatized patients in developing countries^{2,3}. In patients with cardiac arrest caused by non-traumatic reasons, cardiopulmonary resuscitation (CPR) leads to survival rates of 14% to 17%. In patients suffered cardiac arrest due to trauma, survival rates have been reported to be only 0% to 5%⁴⁻⁶. In this study, our goal was to determine our outcomes in CPR for the patients with trauma in the Emergency Department (ED). We also aimed to determine characteristics of the patients with trauma requiring CPR and investigate the factors effecting the outcomes.

Patients and Methods

Between January 1st 2009 and May 30th 2013, file data of 136 consecutive trauma patients who have required CPR in the ED of Hitit University Çorum Education and Research Hospital were collected, retrospectively. Patients were divided into subgroups according to age, mechanism of trauma, hour of the trauma, location of cardiac arrest (in the scene, in the ambulance or in the hospital), the duration of the CPR, the rhythm during the onset of arrest, whether atropine was administered or not, whether an emergency specialist accompanied CPR or not and survival. Patients were also divided into two subgroups as those who died in the ED and those who were hospitalized after successful CPR. Outcomes of

Introduction

Trauma is one of the most important health problems worldwide. Young population is the

the patients were evaluated according to these variables. By the term "CPR", we mean a procedure including intubation, chest compression, and appropriate drugs (fluid resuscitation, adrenaline, and atropine, dopamine, NaHCO₃, if necessary). The outcome of the CPR refers to whether the heart beat was obtained in the ED and the patient urged to operation room or intensive care unit (ICU), or not. As recommended in the guidelines, efficiency of the intubation was detected by end tidal CO₂ (ETCO₂) measurement. All adult trauma patients of both sexes who have required CPR were included into the study.

Statistical Analysis

All data were analyzed using Statistical Package for the Social Sciences Version 17.0 (SPSS Inc., Chicago, IL, USA). Descriptive data were presented as mean \pm standard deviation (SD). The Shapiro-Wilk test was used to analyze normal distribution assumption of the quantitative outcomes. Mann-Whitney U test was used to compare differences between the two groups for non-normal data. Chi-square tests were used for the comparisons of the percentage of data. Chi-square tests were used for comparisons: these were Pearson Chi-Square, Continuity Correction Chi-Square and Fisher's Exact Test. $p < 0.05$ was accepted as statistically significant in comparisons.

Results

In our study, it was determined that number of the trauma patients requiring CPR tend to increase with years. The leading cause of trauma was motor vehicle accidents (n=73, 53.7%) followed by gunshot injuries (n=23, 16.9%). Cardiac arrest occurred on the scene in 54, in the ED in 74, and in ambulance in 8 patients. One patient was brought to the ED by private car. The period between arrest and CPR was 0-5 minutes in 92 patients. Of these 92 patients 12 have survived and as the time prolongs, number of survivors tended to decrease. After 10 minutes of CPR, there were no survivors. The most common rhythm determined shortly before cardiac arrest was asystole (n=98, 76.5%) followed by pulseless electrical activity (PEA) (n=24, 17.6%). When all patients with trauma requiring CPR were considered, overall rate of survival was found to be 9.5%. In 85 patients, an ED specialist accompanied the procedure and 13 of them have survived (15.3%). All the other trauma

patients with cardiac arrest whose CPRs were not accompanied by an ED specialist have died. This finding was found to be statistically significant. According to the rates of survival, there was not a statistical difference between patients to whom atropine with adrenaline was administered together and to whom only adrenaline was administered. It was also determined that when arrest occurred in the ED, 75.9% of the patients have survived, while all of the patients who had a cardiac arrest on the scene have died.

Discussion

Trauma is the leading cause of death among young population⁷. The most common mechanism of trauma requiring CPR in our study was found to be motor vehicle accidents followed by gunshot injuries. Motor vehicle accidents and streets were reported to be the most common mechanism and location of trauma. Falling has the second place of frequency among trauma mechanisms which, in some articles, has pulled up itself to top of the list. Stab wound was the most common type of penetrating trauma^{2,8}. In our study, stab wound took 4th place in all over the causes of trauma.

There is an ongoing debate in terms of the effectiveness of CPR in trauma patients, particularly with regard to good long-term outcomes^{9,10}. Several studies recommend not initiating advanced life support in traumatic cardiac arrest, mainly owing to the poor prognosis in several series that have been published¹¹. International trauma training courses have even suggested that no intervention should be started in cardiac arrest patients with primary asystole due to traumatic causes¹². Also, The National Association of EMS Physicians and the American College of Surgeons Committee on Trauma believe that it is appropriate to withhold resuscitation for certain trauma patients for whom death is the predictable outcome¹³. In a study, it was suggested not to perform CPR in trauma patients, particularly among those who lost vital signs and required CPR prior to arrival at the hospital. Continued CPR efforts on a trauma victim in the ED after failed pre-hospital resuscitation were reported to be futile and expensive. It was also found that patients requiring CPR did not survive if they lost vital signs prior to hospital arrival⁴. In our study, all the patients required pre-hospital CPR have died. This finding was compatible with the literature.

Table I. Comparison of the characteristics of the patients according to outcomes.

	Survivors, n(%)	Non-survivors, n (%)	Total, n (%)
Cause of arrest			
– Motor vehicle accident	5 (6.8)	68 (93.2)	73 (53.7)
– Gunshot injuries	2 (8.7)	21 (91.3)	23 (16.9)
– Fall from height	4 (28.6)	10 (71.4)	14 (10.3)
– Beaten	1 (11.1)	8 (88.9)	9 (6.6)
– Stabbing	0 (0)	5 (100)	5 (3.7)
– Electricity shock	0 (0)	3 (100)	3 (2.2)
– Others	1 (11.2)	8 (88.8)	9 (6.6)
Location of arrest			
– Out of the hospital	0 (0)	74 (100)	74 (54.4)
– In the hospital	13 (24.1)	41 (74.9)	54 (39.7)
– In the ambulance	0 (0)	7 (100)	7 (5.1)
– Private car	0 (0)	1 (100)	1 (0.7)
Rhythm before arrest			
– Asystole	6 (5.8)	98 (94.2)	104 (76.5)
– PEA	4 (16.7)	20 (83.3)	24 (17.6)
– VT	2 (40)	3 (60)	5 (3.7)
– VF	1 (33.3)	2 (66.7)	3 (2.2)
Accompanied with a specialist*			
– Yes	13 (15.3)	72 (84.7)	85 (62.5)
– No	0 (0)	51 (100)	51 (37.5)
Adrenaline administered			
– Yes	13 (8.1)	113 (91.9)	126 (92.6)
– No	0 (0)	10 (100)	78 (57.4)
Atropine administered			
– Yes	7 (9)	71 (91)	10 (7.4)
– No	6 (10.4)	52 (89.6)	58 (42.6)

PEA: Pulseless electrical activity, VT: Ventricular tachycardia, VF: Ventricular fibrillation, *Statistical significance, $p < 0.05$.

In this study, we determined that survival rate of the trauma patients requiring CPR is 9.5% and this rate increases up to 15.3% when an ED specialist accompanies. As a result we suggest that CPR must be performed in patients with trauma and an ED specialist must lead the CPR team. There are studies in the literature supporting our idea. In a study by Leis et al¹⁴ it was stated that advanced life support should be initiated in patients with cardiac arrest due to trauma regardless of the initial rhythm, especially in children and those with VF or PEA. David et al¹⁵ support that active CPR attempts after pre-hospital cardiac arrest may be as important in trauma patients as in medical patients, in particular if senior physicians are involved in patient's care. Gräsner et al⁹ reported that when emergency physicians are involved in each step in the management of patients with trauma, it is more possible to obtain better clinical outcome.

Results of these studies encourage CPR attempts in cardiac arrest patients following trauma, in contrast to some trauma management pro-

grams suggesting that patients with cardiac arrest caused by severe trauma may not have any chance of survival¹⁶.

Several factors are known to influence the success of CPR. The most important factor is time. If cardiac arrest occurs during pre-hospital treatment and is observed by an emergency physician, intervention and transport should be started without any delay⁹. Our findings reveal that mortality increases in concordance with the duration of CPR. Of 13 survivors, in only 1 patient duration between arrest and CPR was between 5 and 10 minutes. In a study¹⁷, compatible with our results, a significant difference was determined between the number of successful cases whose CPR durations were above and below 10 minutes. In our study, duration of CPR in 12 of 13 patients who have survived was under 5 minutes. In concordance, some authors note that CPR for > 10 minutes and resuscitative efforts for multiple episodes of arrest were futile. It was also found that trauma patients who arrive at the hospital with CPR in progress did not survive¹⁸. Mattox et al¹⁹ reported that trau-

ma patients requiring > 5 minutes of pre-hospital CPR should be considered dead. In addition, Compass et al²⁰ reported that survivors had significantly shorter CPR times than non-survivors (12 min vs. 28 min). Results of our study support the data in the literature that CPR attempts more than 10 minutes do not contribute on survival.

Another important result of our work is about atropine use in CPR. According to the recent guidelines, atropine is no longer recommended for routine use in asystole or PEA.

Adrenaline remains the drug of choice during cardiac resuscitation and other drugs such as atropine, sodium bicarbonate, calcium, magnesium and fibrinolytic drugs may be considered only in specific circumstances. Atropine is no longer included in the advanced life support (ALS) algorithm²¹.

In our study, we determined that there wasn't a statistically significant difference according to survival between patients to whom atropine with adrenaline was administered together and to whom only adrenaline was administered. So, our results support the fact that atropine is not necessary in CPR procedure.

In a study, prevalence of ventricular fibrillation or ventricular tachycardia as initial rhythm before arrest was found to be 12.4%¹⁶. These findings are not similar to those of Nadkarni et al²² who reported prevalence of 23%, 35% and 32% for VF or VT, asystole and PEA, respectively in adults. In our study, prevalence of VF and VT were found to be 5.7%. The most common initial rhythm was asystole. Even though we found lower prevalence of VT and VF in our study, our result that the most common rhythm is asystole is compatible with these researches.

Although it is estimated that the patients who have died after CPR have multiple organ injury and higher Injury Severity Scores (ISS), we could not calculate the exact ISS of the patients in the ED setting. In the ED setting, particularly in trauma patients requiring CPR, determining cerebral contusion, fractured femur or damage to liver and spleen is difficult. We also could not classify patients into subgroups such as head, chest or abdomen trauma due to lack of further radiological evaluation in multi-trauma patients.

Conclusions

Trauma is one of the most important health problems worldwide. It is a disease of the young

and the leading cause of death up to the age of 45²³. Our findings revealed that, when performed in the leadership of an ED specialist, more successful outcomes may be obtained in CPR in trauma patients. We also determined that use of atropine does not contribute to survival rate. Our results support the fact that one of the most important factors for CPR success is time and as the duration of CPR prolongs, the success rate falls. As a result, we suggest to perform CPR in trauma patients as in medical patients.

Conflict of interest

The Authors declare that they have no conflict of interests.

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