



Clinical Manifestations and Effects of In-Hospital Resuscitative Procedures in Patients with Traumatic Out-of-Hospital Cardiac Arrest from Three Hospitals in Southern Taiwan

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Background: The prognosis of patients with traumatic out-of-hospital cardiac arrest (TOHCA) is poor. Few studies have evaluated whether the commonly conducted in-hospital resuscitative interventions have beneficial effects on the return of spontaneous circulation (ROSC) and survival rate in patients with TOHCA. Therefore, we conducted a retrospective study to reveal the clinical manifestations of patients with TOHCA in Southern Taiwan and evaluate the effectiveness of various common in-hospital interventions in these patients.

Methods: This retrospective chart review of patients with TOHCA was conducted in three hospitals in Southern Taiwan between January 1, 2014, and December 31, 2016, to demonstrate the characteristics of patients with TOHCA and compare the differences in in-hospital interventions before ROSC between ROSC and non-ROSC groups.

Results: In total, 272 patients with TOHCA were reviewed; their average age was 50.7 years, and men constituted the predominant sex (73.2%). Moreover, 91 patients (33.5%) experienced at least transient ROSC, 40 patients (14.7%) were admitted to hospitals, and 4 patients (1.5%) survived to hospital discharge. The ROSC and non-ROSC groups did not differ in in-hospital interventions, including chest tube and central venous catheter insertions, defibrillation, and pressor infusion. However, the non-ROSC group had a higher rate of transfusion than the ROSC group (17.7% vs. 6.6%, $p = 0.015$).

Conclusion: The outcomes of patients with TOHCA in Southern Taiwan remained dismal. None of the in-hospital interventions, including blood transfusion, chest tube and central venous catheter insertions, defibrillation, and pressor infusion, were determined to be beneficial for patients with TOHCA. We suggest that these in-hospital interventions should not be routinely performed in every patient with TOHCA.

Key words: *trauma, out-of-hospital cardiac arrest, asphyxia, prognosis, in-hospital intervention*

Introduction

The prognosis of patients with traumatic out-of-hospital cardiac arrest (TOHCA) is poor, with an estimated survival rate of approximately 3.3%.¹

Studies have revealed age, cardiac arrest etiologies, the electrocardiogram (ECG) rhythm, the prehospital cardiopulmonary resuscitation (CPR) duration, nondilated reactive pupils, and the presence of a prehospital pulse or respiratory effort as the predictors of survival in pa-

Received: August 16, 2017; Revised: September 4, 2017; Accepted: November 10, 2017.

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tients with TOHCA.¹⁻⁵ Few studies have reported about in-hospital resuscitative interventions. Emergency thoracotomy, open-chest CPR, and extracorporeal life support have been performed in patients with TOHCA.⁶⁻⁹ However, the beneficial effects of commonly conducted in-hospital interventions, such as blood transfusion and chest tube and central venous catheter insertions, for resuscitating patients with TOHCA have not been verified. Therefore, we conducted the present retrospective study to reveal the clinical manifestations of patients with TOHCA in Southern Taiwan and evaluate the effectiveness of various common in-hospital interventions in these patients.

Methods

This study was approved by the Institutional Review Board of Chi Mei Medical Center. We conducted a retrospective chart review of patients with TOHCA from three hospitals in Southern Taiwan between January 1, 2014, and December 31, 2016. The three hospitals comprised a trauma center (Chi Mei Medical Center), a teaching hospital (Chi Mei Hospital, Liouying), and a local hospital (Chi Mei Hospital, Chiali). We reviewed the triage data and obtained data on patients who sustained a traumatic event and presented at emergency departments (EDs) in a state of cardiac arrest. These patients could have been taken to EDs by friends and families or by paramedics or could have been transferred from the EDs of other hospitals. All patients received basic life support, ECG monitoring, and intravenous adrenaline infusions until they were declared dead or they experienced the return of spontaneous circulation (ROSC). For all patients, we collected demographic data (age, sex, and traumatic mechanisms), data on various resuscitative interventions (tracheal intubation, cricothyroidotomy, blood transfusion, chest tube and central venous catheter insertions, interosseous needle placement, defibrillation, and pressor infusion), and data on hospital courses (ROSC, hospital stay, survival to hospital discharge, and Cerebral Performance Categories Scale scores on the discharge of survivors).

Patients who had palpable pulses and nonasystolic rhythms on the ECG monitor were allocated to the ROSC group. The remaining patients were allocated to the non-ROSC group. We reviewed patient charts and determined whether in-hospital interventions were conducted before or after ROSC. Subsequently, we compared the differences in in-hospital inter-

ventions before ROSC between the ROSC and non-ROSC groups.

Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Science (SPSS Inc., Chicago, IL, USA). We performed Fisher's exact tests to evaluate the differences in categorical variables between the ROSC and non-ROSC groups.

Results

During the 3-year study period, we collected the data of 272 patients with TOHCA (Chi Mei Medical Center, $n = 87$; Chi Mei Hospital, Liouying, $n = 120$; and Chi Mei Hospital, Chiali, $n = 65$). Patients' age range was 1–92 years (average: 50.7 years), and men constituted the predominant sex (73.2%). Furthermore, 70 patients (25.7%) belonged to the geriatric (> 65 years) group and 9 patients (3.3%) belonged to the pediatric (age < 18 years) group. Common traumatic mechanisms included motorbike traffic accidents (44.9%), car traffic accidents (18.4%), and falls (15.1%). In Southern Taiwan, penetrating injury is rare, and only one patient with such injury was observed. Asphyxia mechanisms represent those etiologies in which asphyxia was regarded as the immediate cause of death, including hanging (6.6%), smoke inhalation (0.4%), and drowning (0.4%; Fig. 1).

All patients underwent various airway management procedures, mostly tracheal intubations, and five patients underwent cricothyroidotomy. Peripheral venous access was the major route for fluid, blood, and adrenaline infusions. One patient received intraosseous needle placement, and 24 patients received central venous catheter insertion because of the difficulty in obtaining vascular access or because of requirements for rapid and larger volumes of and more rapid crystalloid and blood infusions.

In addition, 91 patients (33.5%) experienced at least transient ROSC; however, only 40 patients (14.7%) were admitted to hospitals and 4 patients (1.5%) survived to hospital discharge. All survivors had a Cerebral Performance Categories Scale score of 4 or 5 on hospital discharge. Patients with asphyxia mechanisms had improved prognoses, with nine patients achieving ROSC (42.9%), eight patients being admitted to hospitals (38.1%), and two patients being discharged from hospitals (9.5%). The only patient

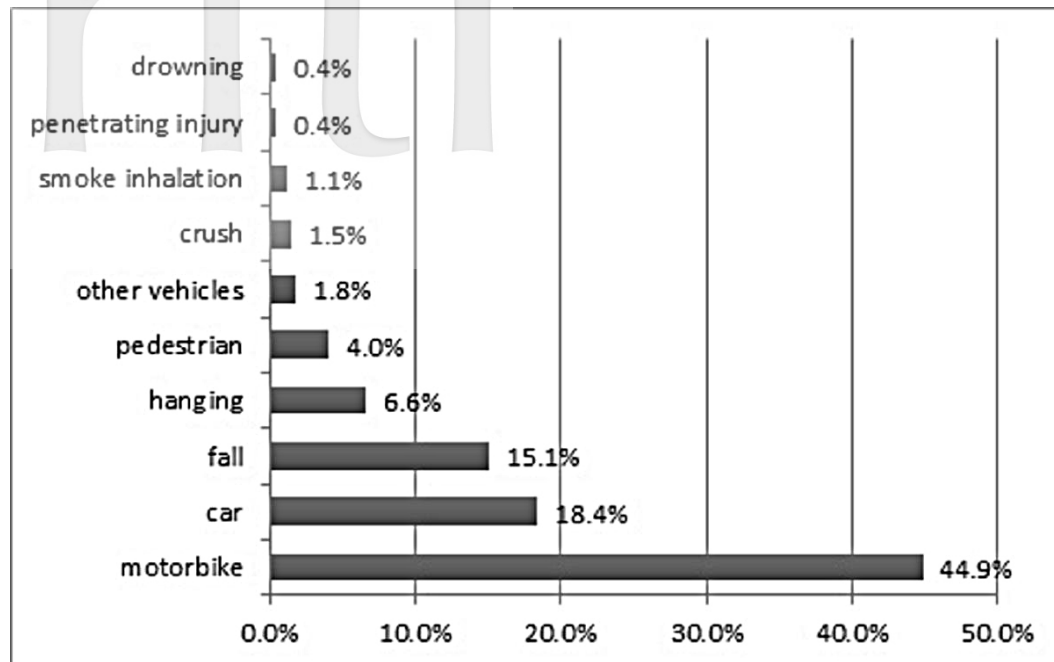


Fig. 1. Traumatic mechanisms.

with penetrating injury achieved transient ROSC but did not survive to hospital discharge. The pediatric group (age < 18 years) demonstrated a higher chance of ROSC (55.6% vs. 33.5%) and hospital admission (44.4% vs. 14.7%) than the study cohort. However, none of the pediatric patients survived to hospital discharge. The rates of ROSC in each hospital were as follows: Chi Mei Medical Center (36.8%); Chi Mei Hospital, Liouying (25.0%); and Chi Mei Hospital, Chiali (44.6%).

We evaluated the differences between the ROSC and non-ROSC groups. The two groups exhibited similar distributions in sex, age, and traumatic mechanisms. However, they did not differ in terms of in-hospital interventions, including chest tube and central venous catheter insertions, defibrillation, and pressor infusion. The non-ROSC group had a higher rate of transfusion than the ROSC group (17.7% vs. 6.6%, $p = 0.015$; Table 1). Cricothyroidotomy and interosseous needle placement were excluded from the comparison because only few patients had undergone these interventions.

Discussion

In the present study population, the sex and age distributions were observed to be similar to those of a

previous report on patients with TOHCA.¹⁰ Because of the customs in Southern Taiwan, paramedics do not follow the guidelines for withholding or terminating resuscitation in prehospital traumatic cardiopulmonary arrest.¹⁰ All patients with TOHCA receive basic life support during transportation to hospitals, except under some extreme conditions such as decapitation or hemicorporectomy. The present retrospective study revealed that the rate of ROSC in Southern Taiwan was higher but the rate of survival to hospital discharge was lower than those reported by other studies.^{1,11-13} We believe that the higher rate of ROSC can be attributed to the relatively short transportation time. The transportation time from prehospital scenes to hospitals rarely exceeds 20 min in Southern Taiwan. The survival rates in different studies varied from 0% to 7.6% because of the distinct criteria applied in each study.^{1-5,11-13} Moreover, because resuscitations were conducted in all patients with TOHCA, regardless of the dismal anticipated chances of survival in some patients, the survival rate in this study was determined to be lower than the average survival rate.

Except in the reports from military hospitals, traffic accidents have always been the most frequent traumatic mechanism in patients with TOHCA. In American, Australian, or European countries, most traffic accidents result from car accidents. Neverthe-

Table 1. Comparison between ROSC and non-ROSC groups

	Total (n = 272)	ROSC (n = 91)	Non-ROSC (n = 181)	<i>p</i> value
Demographic data				
Male	199 (73.2%)	61 (67.0%)	138 (76.2%)	0.113
Pediatric(< 18 years old)	9 (3.3%)	5 (5.5%)	4 (2.2%)	0.167
Geriatric(> 65 years old)	70 (25.7%)	27 (29.7%)	43 (23.8%)	0.306
Penetrating injury	1 (0.4%)	1 (1.1%)	0 (0.0%)	0.335
Asphyxia mechanisms	20 (7.4%)	9 (9.9%)	11 (6.1%)	0.345
In-hospital interventions				
Transfusion	38 (14.0%)	6 (6.6%)	32 (17.7%)	0.015 ^a
Chest tube	25 (9.2%)	7 (7.7%)	18 (9.9%)	0.659
Central venous catheter	24 (8.8%)	8 (8.8%)	16 (8.8%)	1.000
Defibrillation	27 (9.9%)	8 (8.8%)	19 (10.5%)	0.830
Pressors	2 (0.7%)	1 (1.1%)	1 (0.6%)	1.000

ROSC: return of spontaneous circulation.

^aThe non-ROSC group had a higher rate of transfusion than the ROSC group.

less, the most common cause of TOHCA in Southern Taiwan involves motorbike traffic accidents. Motorbike riders have the risk of high speed and unprotected vehicles, which might also contribute to the high mortality rate of the study cohort.

Among the asphyxia mechanisms, hanging was the most dominant cause. Compared with patients associated with other blunt traumatic mechanisms, those with asphyxia mechanisms had an improved chance of survival. However, the survivors were accompanied by severe neurologic sequelae. Kim et al. proposed that therapeutic hypothermia should be considered in survivors after hanging.¹⁴ In the management of patients with hypovolemic trauma, emergency physicians and trauma surgeons always prevent the occurrence of hypothermia. However, therapeutic hypothermia might benefit the neurologic outcomes of patients after hanging, and these patients are invulnerable to hypothermic complications such as coagulopathy and shock. The treatment for this TOHCA patient subset should be different from the general treatments for patients with TOHCA having blunt or penetrating injuries.

In selected patients with TOHCA, emergency physicians have attempted several resuscitative interventions before ROSC. However, we could not justify the effectiveness of any in-hospital interventions including blood transfusion, chest tube and central venous catheter insertions, defibrillation, and pressor infusion. Moriwaki et al. compared the strategy

of free or restricted use of packed red blood cells in patients with blunt traumatic cardiac arrest before ROSC, and they suggested that blood transfusion before ROSC can improve the success rate of ROSC but not the survival rate.¹⁵ However, the beneficial effects of blood transfusion in patients with TOHCA were not explored in this study, and therefore require further investigation. Accordingly, we suggest that these in-hospital interventions should not be routinely performed in every patient with TOHCA. Additional studies are warranted to determine the patient groups that might benefit from these interventions.

Conclusion

The outcomes of patients with TOHCA in Southern Taiwan remain dismal. None of the in-hospital interventions, including blood transfusion, chest tube and central venous catheter insertions, defibrillation, and pressor infusion, have beneficial effects on patients with TOHCA. We suggest that these in-hospital interventions should not be routinely performed in every patient with TOHCA.

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