



ORIGINAL ARTICLE

Retrospective analysis of out-of-hospital cardiac arrest outcome in a tertiary care emergency department in Abu Dhabi

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ABSTRACT

Background: Despite all the development in healthcare access and services, out-of-hospital cardiac arrest (OHCA) remains a challenge and still has a poor prognosis. Thus, this study aimed to retrospectively apply the American Heart Association (AHA), Advanced Life Support (ALS), and Termination of Resuscitation (TOR) 2010 criteria to all OHCA patients who arrived at the emergency department (ED) in Abu Dhabi and determine their survival outcome.

Methods: A retrospective chart review was done among OHCA patients received by a tertiary care hospital's ED in Abu Dhabi over a period of 1 year in 2018.

Results: A total of 87 patients were included; 21 (24.1%) patients met the AHA ALS TOR criteria and none of them survived To hospital discharge, with specificity and positive predictive value (PPV) of 100%. Only three patients (3.4%) who survived to be discharged from the hospital did not meet the AHA ALS TOR criteria.

Conclusion: AHA ALS TOR criteria were derived and validated; it must be applied by emergency medical services (EMS) on the field however, it could be applied on patient arrival to the ED in systems where EMS are not using it.

Keywords: Out-of-hospital cardiac arrest, emergency department, termination of resuscitation, return of spontaneous circulation, emergency medical services.

Introduction

Despite the ongoing advancement in cardiopulmonary resuscitation (CPR), out-of-hospital cardiac arrest (OHCA) still has a poor survival outcome specifically in non-western countries [1]. In 2015, England reported less than a 10% survival rate of OHCA to hospital discharge [2]. OHCA has a poor survival rate worldwide and outcome differs among countries depending on many factors like presenting rhythm, cardiovascular history, bystander CPR, and ambulance arrival [3]. In 2016, a study conducted in the Northern Emirates reported a 5% of termination of resuscitation (TOR) in the field and a 3.1% pre-hospital return of spontaneous circulation (ROSC), though it did not show results in the emergency department (ED) ROSC and survival to hospital discharge [4].

There have been several attempts to identify predictors of no survival of OHCA. A clinical prediction rule was derived and validated in Ontario, Canada with a specificity of 90.2% and positive predictive value (PPV)

of 99.5% with the following predictors used; no ROSC prior to transport, no shock given, and the arrest not being witnessed by emergency medical services (EMS) personnel [5]. American Heart Association (AHA) published TOR in the field criteria in 2010 and further details were published in the 2020 guideline, the criteria established were: the cardiac arrest was not witnessed by EMS personnel, CPR was not provided by any bystander, no ROSC after advanced life support (ALS) care in the field, and defibrillation was not delivered [6].

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In Abu Dhabi, AHA TOR criteria have not been applied by EMS; hence, many patients arrive at ED with active resuscitation efforts being performed; therefore, ED teams feel obligated to continue resuscitation before deciding to terminate resuscitation. The COVID-19 pandemic has alerted us that it is time to implement validated TOR criteria in order to appropriately use existing resources without compromising patient outcomes and reduce unjustified occupational hazards (e.g. infectious and non-infectious) to healthcare professionals performing futile resuscitation.

In cardiac arrest and CPR outcome literature, a futile resuscitation is defined as a chance of survival of less than 1% [6-8]. Thus, this study aimed to retrospectively apply the AHA ALS TOR 2010 criteria to all OHCA patients who had arrived at the ED in Abu Dhabi and determine the group survival outcome.

Subjects and Methods

A retrospective chart review of adult OHCA patients was done who were transported to one of the major EDs in Abu Dhabi over 1 year period (from January 1, 2018 to December 31, 2018). All adult patients (age > 18 years old) who reached the ED by EMS with OHCA were included. Patients who arrived at ED alive and had a cardiac arrest in the ED, pediatric patients, and patients with OHCA who were brought in private cars were excluded.

Data were extracted from electronic medical records in addition to chart review. Variables examined were patient demographics (age, gender) witnessed versus unwitnessed arrest, bystander CPR status, ED survival to hospital admission, survival in 24 hours, pre-EMS downtime, pre-hospital CPR duration, ED CPR duration, total CPR duration, EMS defibrillation status, performance of percutaneous coronary intervention (PCI) post-ROSC, baseline patient functional status, hospital length of stay, and functional outcome on hospital discharge.

The study's main purpose was to observe survival to hospital discharge of patients meeting the AHA ALS TOR criteria (EMS should have terminated resuscitation) and the secondary observations were survival to hospital admission and survival to hospital discharge with good neurological function.

Pre-arrest functional status was defined as an adult patient who was independent of the activity of daily living. A good prognosis was defined as a patient with a cerebral performance category (CPC) score of 1-2. The CPC score is widely used to assess neurologic outcomes after cardiac arrest. It is categorized into five levels, with CPC level 1 (good performance) and 2 (moderate disability) classified as good neurological status. CPC levels 3 (severe disability), 4 (vegetative state), and 5 (death, brain death) were classified as poor neurological status [9].

Results

In 2018, the ED patient admission was about 100,000 and 142 were identified to have OHCA. As per exclusion criteria, 55 patients were excluded; 18 patients of them

had ED cardiac arrest rather than OHCA, six patients never had OHCA (wrong Medical Record Number (MRN) was extracted), 12 were pediatric patients, and 19 patients had OHCA but arrived by private car. Therefore, the total OHCA population was 87 patients (Figure 1).

13 patients (14.8%) had ROSC, where 3 patients (3.4%) survived hospital discharge and only 1 of them (1.1%) was discharged with a good neurological outcome that is CPC score of 1-2. One patient who was transferred to another facility so was labeled as having an unknown outcome due to a lack of data after the transfer. The majority of the study population were males and patient ages varied from 19 to 118 years old. Timing of presentation to ED was classified into three time periods: Day shift (7:00-14:59), Evening shift (15:00-22:59), and Night shift (23:00-6:59) according to the shift timing in the ED. The mean duration of CPR performed prior to arrival to ED was 30 minutes and the total CPR mean was 49 minutes with a maximum of 180 minutes (Table 1).

Most of the cardiac arrests were non-shockable rhythm (pulseless electrical activity (PEA) or asystole) and 71.3% had no bystander CPR preformed (Table 2).

Patients who met the AHA ALS TOR criteria were 21 (24.1%) and none of them survived hospital discharge, which resulted in a tool sensitivity of 25% and specificity of 100%, negative predictive value (NPV) of 4.5%, and PPV of 100%. The patients who survived hospital discharge were 3 (3.4%), but they did not meet the AHA ALS TOR criteria (Figure 2).

Discussion

Resuscitation is a resource of intensive care and it is indicated when cardiac arrest is believed to be reversible; hence, identifying patients with less than a 1% chance of survival (Futile) would aid in resource allocation and prevent prolonging unnecessary patient and family suffering [6]. Specifically, OHCA has a low survival rate and in United Arab Emirates (UAE), the survival to hospital discharge for OHCA was reported to be only 3% from data published in 2015, in which initial shockable rhythm was 19% [10]. In this study, survival to hospital discharge was 3.4%, where only 5.7% of the total study population had an initial shockable rhythm. None of the survivors met the AHA ALS TOR criteria. This is reassuring that the application of the criteria on patients' arrival to the ED would most likely pose no harm to patients.

The AHA ALS TOR criteria have already been validated in many different populations worldwide, however, were never validated in the Middle East [11]. It has not been implemented in Abu Dhabi by EMS, hence, many patients arrived at ED with active resuscitation efforts being performed. In Detroit, the specificity was found to be 88.9% with a PPV of 99.1% [12]. In this study, patient specificity and PPV were both 100%, hence, performing resuscitation on a patient meeting ALS TOR criteria does not seem to change the patient predicted outcome and does not lead to survival to discharge; yet it takes away precious resources from other patients and exposes both pre-hospital and ED staff to unjustified infection risk of COVID-19 pandemic or similar future infectious emergencies [13].

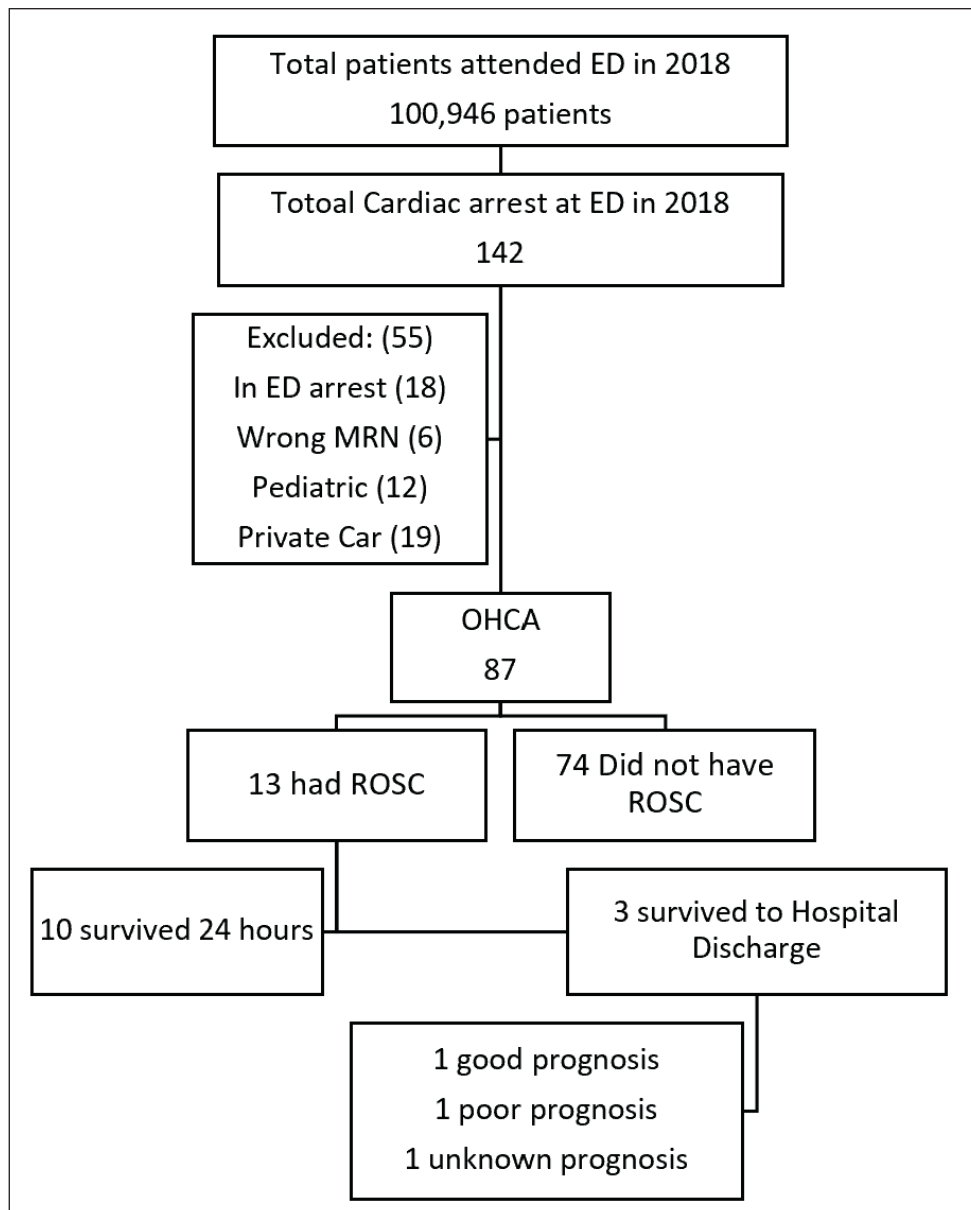


Figure 1. Main data of OHCA reported in 2018.

Table 1. Demographic data of the patients (N = 87).

Variable	N (%)	
Age mean (min-max)	48 (20-118 years)	
Gender	Male	60 (69)
	Female	27 (31)
Timing of presentation to ED	Day shift	35 (40.2)
	Evening shift	30 (34.5)
	Night shift	22 (25.3)
Duration of pre-hospital CPR mean (min-max)	30 minutes (0-90 minutes)	
Total duration of CPR Mean (max-min)	49 minutes (0-180 minutes)	
Patient who had post-ROSC PCI	1 (1.1)	
	Functional	68 (78.1)
	Non-functional	15 (17.2)
	Unknown	4 (3.7)
	1-2	1 (1.1)
	>2	1 (1.1)
	Unknown	1

Table 2. Patients meeting and not meeting criteria of AHA ALS TOR (N = 106).

		N (%)
Initial rhythm	Shockable	5 (5.7)
	Non-shockable	82 (94.3)
Bystander CPR preformed	Yes	16 (18.4)
	No	62 (71.3)
	Unknown	9 (10.3)
Witnessed arrest	Yes	60 (68.9)
	No	26 (29.8)
	Unknown	1(1.1)
Pre-hospital shock delivered	14 (16)	
Meeting AHA ALS TOR	21 (24.1)	

	Did Not Survived to Hospital Discharge	Survived to Hospital Discharge
Meeting AHA ALS TOR 21	21	0
Not Meeting AHA ALS TOR 66	63	3
	Specificity: $3/(3+0)=1=100\%$ Sensitivity: $21/(21+63)=0.25=25\%$	PPV: $21/(21+0)=1=100\%$ NPV: $3/(63+3)=0.045=4.5\%$

Figure 2. 2 × 2 table of study OHCA.

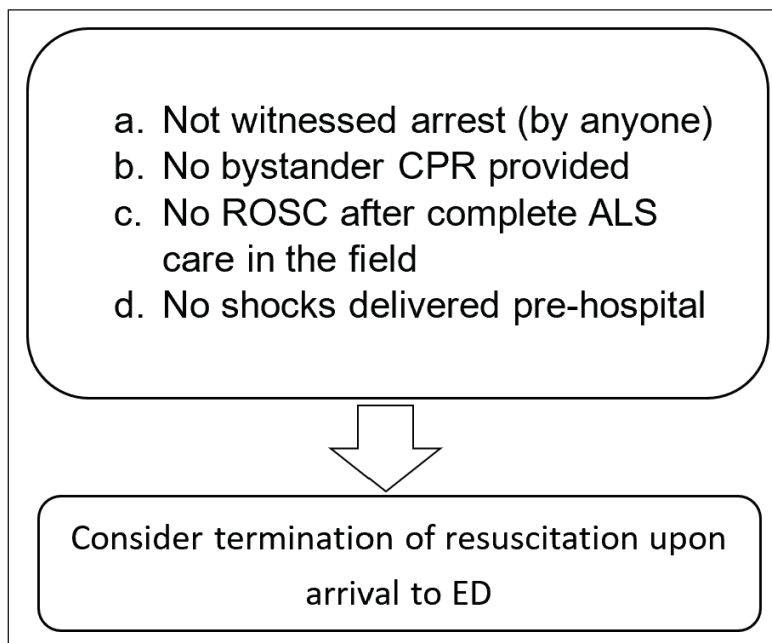


Figure 3. Proposed criteria for TOR.

Examining the characteristic of this study population, it was noted that 13 patients (14.9%) had ROSC and 10 patients (76.9%) of them did not survive beyond the first 24 hours. The mean age of the patients was 48, which is considered to be young, and the majority were male population. UAE has the majority of young male population, given the rapid development that necessitates the recruitment of young male labor population [10]. There was no significant difference in the time of presentation (day, evening, or night shift) with an average of 33% in each shift. The average accepted time of CPR duration was (20 minutes), and the studied patient population received a mean of 40 minutes of CPR by EMS, which implies the commitment and devotion of healthcare providers to their initial mission of saving lives [14].

The majority of patients were deemed to be functional pre-arrest based on the chart review and 3 (3.4%) of them survived hospital discharge while those who were non-functional pre-arrest did not survive hospital discharge. Data were lacking regarding the pre-arrest functional status, which is one of the determinants of post-arrest survival; as most literature reports post ROSC functional status [3].

Most of the study population's underlying initial rhythm was non-shockable rhythm (PEA or asystole) which was consistent with published international data [15]. Bystander CPR is not a common practice yet in UAE, hence, 77% of the study population did not receive bystander CPR. Governmental, as well as community, efforts are being provided to improve community CPR education and awareness which is one of the positive prognostic factors [16,17].

This study has retrospectively validated the AHA ALS TOR in a 1-year data of a single center ED in Abu Dhabi, UAE with specificity and PPV of 100%. However, the study's main limitation was a small sample size; however, results are consistent with published literature. It is proposed that AHA ALS TOR criteria must be applied on OHCA patient arrival to ED as a step forward until established EMS protocol incorporates TOR criteria (Figure 3).

Conclusion

AHA ALS TOR criteria were derived and validated and must be applied by EMS on the field, however, it could be applied on patients' arrival to the ED in systems where EMS are not utilizing it. OHCA has a poor prognosis overall, hence identifying patients who would not be benefitted from resuscitation would preserve patients' dignity and would also help in reallocating vital resources to patients who would benefit from it.

List of Abbreviations

AHA	American heart association
ALS	Advanced life support
CPC	Cerebral performance category
CPR	cardiopulmonary resuscitation
ED	Emergency department
EMR	Electronic medical records
EMS	Emergency medical services

OHCA	out of hospital cardiac arrest
PCI	Percutaneous coronary intervention
PEA	Pulse less electrical activity
ROSC	Return of spontaneous circulation
TOR	Termination of resuscitation
UAE	United Arab Emirates

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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None.

Consent to participate

Written informed consent was obtained from all participants.

Ethical approval

The study methodology was approved by the SEHA Corporate Institutional Review Board (IRB) – SEHA- IRB-020 – Date April 8, 2021.

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