PAEDIATRIC CARDIAC ARRESTS IN THE NORTHERN EMIRATES, UNITED ARAB EMIRATES

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ABSTRACT

Objectives: The objective of this study was to identify the incidence and clinical characteristics of paediatric out-of-hospital cardiac arrest (OHCA) cases in the emirates of Al-Sharjah, Ras-al-Khaimah, Umm Al-Quwain, Al-Fujairah and Ajman (collectively referred to as the Northern Emirates) in the United Arab Emirates (UAE).

Methods: This study was a prospective cohort study of all OHCA incidents treated or transported by National Ambulance LLC ambulance crews between February 2014 and March 2015. A subgroup analysis was performed on all paediatric OHCA patients (defined as less than 18 years old) presenting during this period.

Results: The subgroup comprised of 14 patients (3.6% of the overall cardiac arrest population). There were six male (43%) and eight female (57%) patients, with a median age of four years (interquartile range [IQR] 0.63-8.75). The majority of paediatric cardiac arrests occurred in patients from the Indian subcontinent (n=6, 43%) with UAE Nationals accounting for three cases (21%). Trauma induced cardiac arrest accounted for six cases (43%) with three of these (21%) as a result of traffic related incidents and two as a result of drowning (14%). The median response time was nine (9:00) minutes from receipt of emergency medical call to arrival of crew at scene (IQR 7:45-11:30). Bystander Cardiopulmonary resuscitation (CPR) was attempted in five cases (36%). Two patients (14%) presented in a shockable rhythm on first analysis. An overall out-of-hospital (at scene or en-route) return-of-spontaneous-circulation (ROSC) rate of two patients (14%) was observed in the paediatric population.

Conclusion: A low ROSC rate for paediatric cardiac arrest was identified in the population studied, in line with previous studies. This highlights the need for public education addressing prevention of paediatric cardiac arrest, particularly prevention of trauma induced cardiac arrest. In addition, providing education to the public surrounding the early recognition of paediatric cardiac arrest and subsequent actions to be undertaken, including early Emergency Medical Services activation and provision of bystander CPR is an identified priority action arising from this study. Determining the baseline data presented in this study is essential in recommending and implementing strategies to reduce mortality from paediatric OHCA.

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Authors' contribution

Batt A was the principal investigator for the study, and principal author of the manuscript.
Al-Hajeri A, Ward G, Pilapil C, Delport S and Cummins F assisted with study design, validated the dataset, and contributed to the final drafting and editing of the manuscript.

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INTRODUCTION

The United Arab Emirates (UAE) is a country composed of a multinational population with diverse educational backgrounds, cultural practices, and religious beliefs. Only an estimated 15-20% of the total population are UAE nationals, with the remainder comprised of a large proportion of expatriate workers from the Indian subcontinent, the Philippines and neighbouring Arab countries. As part of its commitment to reducing morbidity and mortality from out-of-hospital cardiac arrest (OHCA) in the population in the UAE, National Ambulance is a contributing member to the Pan-Asian Resuscitation Outcomes Study (PAROS - cardiac arrest registry).

Survival rates for OHCA in the Middle East and Asia are low compared to those in North America or Europe. Recent findings published from the UAE and Saudi Arabia have confirmed these anecdotal reports of low survival rates for OHCA [1-3]. Paediatric cardiac arrests generally have poorer survival rates associated with resuscitation, even though historically many of these cardiac arrests occur in a home residence and are witnessed by family members. Survival is greater in witnessed events, and even greater in those who receive bystander Cardiopulmonary resuscitation (CPR) [4].

Health and healthcare delivery has improved dramatically in the UAE over the past 40 years. Consequently, the infant mortality rate (< 5 years) has reduced from 223 per 1000 live births in 1960, to seven per 1000 live births in 2009. In childhood years however, approximately 107 children per year die from trauma in the UAE. Injury secondary to vehicular traffic incidents remains the leading cause of death for children aged 0 to 14 years old (63%), followed by drowning and falls (10% each) [5]. Reasons for this include poor compliance with traffic laws such as wearing of seatbelts and use of child seats, and inadequate safety measures applied to residential pools, beaches, and high-level windows and balconies.

This prospective cohort study aimed to identify the incidence and clinical characteristics, including aetiology, of paediatric out-of-hospital cardiac arrest (OHCA) cases presenting to National Ambulance (NA) crews in the Northern Emirates (NE).

METHODS

A subgroup analysis of a prospective cohort study was applied investigating all presentations of paediatric OHCA between February 2014 and March 2015 in the NA Northern Emirates service area of the UAE [2].

This study complies with the declaration of Helsinki and received ethical approval from the Office of the Chief Medical Advisor, National Ambulance LLC. The implementation of the PAROS study has received various IRB approvals from the countries involved in the PAROS study to which National Ambulance LLC is a contributing member. The PAROS network has a data sharing agreement that protects the confidentiality of all patients enrolled in the study.

Emergency Medical Technicians (EMTs) who provided care for cardiac arrest patients completed PAROS data collection forms designed for the PAROS study, which were then reviewed by the PAROS coordinator in National Ambulance. Data requiring clarification such as dispatch and arrival times were cross-referenced with dispatch information before entry into PAROS database.

All cases of paediatric out-of-hospital cardiac arrest (defined as under 18 years old) treated by NA EMTs crews were included in this study. Cardiac arrest was defined as cessation of cardiac mechanical activity that was confirmed by the absence of a palpable pulse, unresponsiveness, and absence of spontaneous respirations. NA clinical treatment protocols (based on the 2010 American heart association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care) during the period of this data collection mandated transport of all paediatric OHCA cases to hospital (unless obviously dead with rigor mortis, decapitation, dependant lividity, incineration, other injuries totally incompatible with life, etc.). Do-not-resuscitate orders do not exist within the UAE. Excluded from this study were all patients who were not treated by EMTs, due to recognition of death at scene, and any patient over the age of 18 years. Results from post-mortem examinations were not utilised.

Statistical analysis was performed using Statistical package for social sciences (IBM SPSS Version 20, NY, USA). Descriptive analysis was performed to determine distribution and frequency and percentages were used to describe and report variables and patient characteristics.

RESULTS

A total of 14 patients were identified in the NA PAROS dataset, using a combination of date of birth or age data variables. This subgroup represents 3.6% of all OHCA cases in the full dataset (n=384).Patients ranged in age from less than one hour old (new-born) to 17 years old. The median age was four years old (interquartile ranges [IQR] 0.63-8.75). Age or date of birth data was missing for 12 cases in the full dataset.

There were six male and eight female patients (43% and 57% respectively). Five patients (28%) had previous chronic medical histories, which included diabetes mellitus, pulmonary hypertension, cardiac issues and cerebral palsy. Six patients (43%) were from the Indian subcontinent, three (21%) were UAE nationals and three were of other arab descent (21%).

The most common locations for OHCA in this subgroup were at a home residence (n=5, 36%), street/highway (n=4, 28%) and healthcare facilities (n=3, 21%). The median response time was nine minutes (9:00) from receipt of emergency medical call to arrival of crew at scene (IQR 7:45-11:30). The most common aetiology (identified through a review of individual patient care records) was medical. Further patient characteristics are outlined on a case-by case basis in **Table 1**. All patients were transported to hospital (n=14) by National Ambulance crews. Data for paediatric OHCA cases presenting to emergency departments (EDs) by means other than NA crews is unavailable for this study period. Further patient demographics and OHCA characteristics are outlined in **Table 2**.

A total of nine incidents were witnessed by a bystander (63%) and one event was witnessed by NA EMTs (7%). There were four incidents that were not witnessed (28%). CPR advice was

	Gender	Age	Unit	Race	Medical History	Aetiology	Location Type	Witnessed by	b-CPR	ROSC
1	Female	4	Years	ISC	None	Trauma	Healthcare Facility	EMS	No	No
2	Female	13	Years	Arab	None	Medical	Public Building	HCP	Yes	No
3	Female	1	Years	ISC	None	Medical	Healthcare Facility	Family	Yes	Yes
4	Female	14	Years	ISC	CP	Medical	Home Residence	Not witnessed	No	No
5	Female	6	Months	ISC	None	Medical	Healthcare Facility	Family	Yes	Yes
6	Female	10	Years	Arab	Cardiac issue (unspecified)	Trauma	Home Residence	Family	No	No
7	Male	17	Years	UAE	Unknown	Trauma	Street/Highway	Not witnessed	No	No
8	Male	3	Years	ISC	None	Trauma	Street/Highway	Family	No	No
9	Male	5	Years	UAE	Unknown	Trauma	Street/Highway	Family	No	No
10	Male	1	hour	ISC	None	Medical	Street/Highway	Family	No	No
11	Male	5	Months	Unknown	TDNBg, PHTNh	Medical	Home Residence	Not witnessed	No	No
12	Male	4	Months	African	Encephalitis, CHDi	Medical	Home Residence	Witnessed	No	No
13	Female	4	Years	UAE	Hypothyroidism	Medical	Home Residence	Witnessed	Yes	No
14	Female	5	Years	Arab	None	Trauma	Place of recreation	Not witnessed	Yes	No

b-CPR = Bystander-performed Cardio-Pulmonary Resuscitation
ROSC = Return of spontaneous circulation
ISC = Indian subcontinent (India, Pakistan, Sri Lanka etc.)
EMS = Emergency Medical Services
HCP = Health care provider
CP = Cerebral Palsy
TDNB = Transient diabetes mellitus of the new-born
PHTN = Pulmonary hypertension
CHD = cyanotic heart defect

Table 1: Demographics, characteristics and outcomes of paediatric OHCA cases in Northern Emirates, United Arab Emirates (UAE).

offered by NA Ambulance Communications Centre (NA-ACC) call-takers and dispatchers to all callers once a diagnosis of cardiac arrest was confirmed or suspected. Telephone CPR (dispatcher assisted) had been attempted in five cases (36%) of cases as confirmed by NA crews on arrival at scene. All of these cases of bystander CPR were performed by a healthcare provider bystander. Two patients were in an unknown shockable rhythm at time of first rhythm analysis (14%). Five patients presented in asystole (36%) and the seven remainders pourcentage were in an unknown non-shockable rhythm at time of first analysis.

Of the 14 patients transported to the ED, 12 patients were transported with no record of return of spontaneous circulation (ROSC) at any stage in the pre-hospital setting. An overall out-of-hospital (at scene or en-route) ROSC rate of 14% (n=2) was observed in the paediatric population. These two cases had sustained ROSC on arrival at ED. All patients were transported to tertiary level centres. CPR quality data was not collected for the study period.

A total of two patients (14%) gained ROSC at some stage in the pre-hospital setting. Both were female and were six months and one year old respectively. Both of these cases were bystander witnessed, were non-traumatic in nature and both had bystander CPR performed prior to ambulance crew arrival. The mean time from ambulance dispatch to arrival was eight minutes in both cases. Neither of these patients had a previous medical history. Both were documented as of Indian descent, and both presented in an unknown non-shockable rhythm on first analysis. These cases occurred at a healthcare facility, and both received some form of advanced airway management (one was orally intubated and one had a supraglottic device inserted) along with supplementary oxygen delivery. Both received epinephrine IV/IO from a healthcare provider at scene (physician or paramedic).

DISCUSSION

Findings from this study support previous studies on the low survival rate for paediatric OHCA in the region [6;7]. The low rate of bystander CPR may also be attributed to cultural norms, and a lack of knowledge surrounding first aid and CPR in general. Children with a chronic medical illness were less likely to have bystander CPR performed on them, and only one case with chronic illness received bystander CPR. The overall bystander CPR rate for all cases was less than 40%, yet over 70% of these cases were witnessed, the majority by a family member.

The findings of this study highlight the need for education of public regarding paediatric chain of survival, in particular, reinforcement of the first link, namely prevention of cardiac

Characteristics	Population (n=14)
Age	
Mean (SD)	5.52 (± 5.47)
Median (IQR)	4 (0.63-8.75)
Gender n (%)	
Male	6 (43)
Female	8 (57)
Past medical history n (%)	
Cardiac condition (unspecified)	2 (14)
Diabetes Mellitus	1 (7)
Pulmonary hypertension	1 (7)
Unknown	4 (28.5)
Location type n (%)	
Home residence	5 (36)
Healthcare facility	3 (21)
Public/commercial building	1 (7)
Street/highway	4 (28.5)
Place of recreation	1 (7)
Arrest witnessed by n (%)	
Not witnessed	4 (28.5)
Bystander	10 (71)
First arrest rhythm n (%)	
VT/VF/unknown shockable	2 (14)
Unknown unshockable	7 (50)
Asystole	5 (36)

Characteristics	Population (n=14)
Prehospital intervention n (%)	
Bystander CPR	5 (36)
Prehospital defibrillation	2 (14)
Prehospital advanced airway n (%)	
Oral/nasal endotracheal tube	1 (7)
iGel	1 (7)
None	12 (86)
Location of cardiac arrest by emirate n (%)	
Al-Sharjah	7 (50)
Ras al-Khaimah	3 (21)
Ajman	2 (14)
Al-Fujairah	0 (0)
Umm al-Quwain	2 (14)
Outcomes n (%)	
ROSC	2 (14)
Survived to admission	Not available
Survived to discharge	Not available
Post arrest CPCf 1/2	Not available

EMS Emergency Medical Services
VF Ventricular fibrillation
VT Ventricular tachycardia
CPR Cardiopulmonary resuscitation
ROSC Return of spontaneous circulation
CPC Cerebral Performance Category

Table 2: Patient demographics, out-of-hospital cardiac arrest characteristics and outcomes of paediatric OHCA cases in Northern Emirates, United Arab Emirates (UAE).

arrest. This can be achieved through community-based and systemic efforts to raise awareness of prevention, and increase capacity to respond in the unfortunate event of a paediatric OHCA. Many of the witnessed paediatric OHCA cases in our study had a large delay in time before activation of the emergency response system. This is likely due to the fact that many members of the public may have trouble identifying the patient who needs immediate medical assistance, cultural norms, a lack of knowledge surrounding first aid and CPR in general, fear of litigation and uncertainty.

However, the issue of potential litigation was addressed in a fatwa issued by the Official iftaa centre, General authority of islamic affairs and endowments who have stated that first aid should be administered by all people in accordance with Sharia law, and this aid provision would not attract any criminal liability [8].

Utilisation of ambulance services for emergency medical conditions in general is low in the region [3] and anecdotally, many patients are transported in private vehicles to EDs or medical clinics by individuals with limited or no medical training. Based on this, the results of this study likely represent only a percentage of the true paediatric OHCA issue in the UAE.

Most child injuries are predictable and preventable, and as previously identified, traumatic injuries are the main cause of death up to 19 years old in the UAE [5;9]. The primary cause of these traumatic injuries is vehicular traffic, which is supported by our findings. Although the incidence of vehicular crashes is decreasing according to police data, the severity of crashes is increasing [5;10].

Three of the children represented in this study suffered severe head injuries as a result of vehicular trauma (vehicle versus pedestrian), and a fourth suffered a severe head injury as a result of a fall from a height. Drowning as a common cause of paediatric death in the UAE is also supported by our findings, and previous literature indicates that occurrences of drowning are vastly under-reported in the UAE [5]. Thus this study likely under represents the issue of paediatric drowning in the country.

Of the two drowning cases in this cohort, one was in a pool in a hotel complex and the other was in a bathtub in a private residence. These six paediatric cardiac arrests (43%) occurred as a result of predictable, easily preventable trauma. The findings of this study highlight the continued need for OHCA system investment, public engagement and awareness campaigns for both the general public and healthcare professionals surrounding prevention of paediatric cardiac arrest.

One of the key factors in the strategy to reduce paediatric mortality and morbidity from trauma is the establishment of a trauma network in the UAE, with dedicated trauma centres and an organised trauma system which includes a national registry. Numerous studies have shown that severely injured patients have a greater chance of survival when cared for in an inclusive trauma system [11-14] and the treatment of paediatric cases at a dedicated paediatric trauma centre is associated with reduced mortality and morbidity [15]. National Ambulance LLC has recently been appointed the lead site for the UAE for the Pan-Asian Trauma Outcomes Study (PATOS). PATOS is a collaborative research network that aims to inform trauma policies and practices within member states and in the Middle East-Asia-Pacific region in general. This will further the future evidence-based management of trauma in the UAE.

This study was limited to data collected by National Ambulance crews in the prehospital setting utilising PAROS forms and patient care records. Limited data was obtained on other prehospital variables, such as time from arrest to hospital, cases which were transported by other means, and any performed interventions during these transports. The cause of arrest was not confirmed by post-mortem examination because of cultural standards.

A significant number of paediatric OHCA cases might still arrive at a hospital via private transport rather than by transport in an ambulance. This possibly resulted in incomplete enrolment of patients into our study. Our own data collection is incomplete for several variables, specifically 12 cases are missing age and/or date of birth data, and thus may have mistakenly been omitted from this subgroup analysis. This analysis may not be totally representative of the true paediatric cardiac arrest situation in the Northern Emirates. Our inability to discuss findings beyond the prehospital care phase, and the missing data on patient outcomes as a result, is an obvious limitation of this study.

CONCLUSION

A low prehospital ROSC rate for paediatric cardiac arrest was identified in the population studied. This study highlights the need for public education addressing prevention of paediatric cardiac arrest, in particular the prevention of trauma induced cardiac arrest. In addition, providing education to the public surrounding the early recognition of paediatric cardiac arrest and subsequent actions to be undertaken, including early EMS activation and bystander CPR provision is an identified priority arising from this study. Determining the baseline data presented in this study is essential in recommending and implementing strategies to reduce mortality from paediatric OHCA.

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