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Effects of regional differences on the outcome of cardiopulmonary resuscitation in children: How much different is Gaziantep from Izmir?

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Abstract:

OBJECTIVES: We aimed to compare the demographic and clinical characteristics between pediatric cardiac arrest patients treated in Gaziantep at South-eastern Anatolian region and Izmir at Aegean Shore.

MATERIALS And METHODS: We retrospectively reviewed sociodemographic characteristics, laboratory parameters, and clinical outcomes of pediatric patients that underwent cardiopulmonary resuscitation due to prehospital cardiac arrest at two pediatric emergency departments in Izmir Hospital of Health Sciences University and Gaziantep Cengiz Gökçek Kadın Doğum ve Çocuk Hospital of Health Ministry between August 2017 and August 2018.

RESULTS: The present study included 188 patients (112 patients from Gaziantep and 76 patients from Izmir). All patients arrived at the hospital through emergency medical services. The median age was lower (14 days vs. 15 months; $P < 0.001$), and the proportion of Syrian refugees was higher in patients from Gaziantep (78.6% vs. 7.9%; $P < 0.001$). In both centers, respiratory failure was the most common etiology. In patients from Gaziantep, pH levels were lower (median: 7.10 vs. 7.24), and lactate levels were higher (median: 6 mmol/L vs. 3.6 mmol/L; $P < 0.001$). The mortality rate was higher among patients from Gaziantep (27.7% vs. 7.9%; $P = 0.001$).

CONCLUSIONS: The rate of Syrian refugees among children who were brought to emergency department due to pre-hospital cardiac arrest was much higher in Gaziantep compared to Izmir. Syrian children were significantly younger and had more severe tissue hypoxia, resulting in a higher mortality rate.

Keywords:

Cardiac arrest, cardiopulmonary resuscitation, children, lactate, prehospital, refugee

Introduction

The cardiopulmonary resuscitation (CPR) is a cascade of life-saving actions to achieve the survival following cardiac

arrest.^[1-3] The incidence of out-of-hospital cardiac arrest in children is 2.28–20:100,000 per year, and the discharge rate is 2%–6%.^[4-11] The discharge rate of in-hospital cardiac arrests was reported as 27%–40%.^[10-12] Post-CPR survival and neurological outcomes are affected by etiology, setting and time of

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What is already known on the study topic?

In children, cardiac arrest can develop due to the causes such as respiratory failure, trauma, or shock

Survival and good neurological outcomes are associated with high-quality cardiopulmonary resuscitation, postresuscitative care, medical problems in the patients, and sociodemographic characteristics

Syrian Refugee children have serious health problems due to the civil war.

What is the conflict on the issue? Has it importance for readers?

The staminal difficulties of the refugees are remarkable; this article shows that the effect of war on children's health is worrying.

How is this study structured?

In two different geographical regions of Turkey, the clinical outcomes of children who underwent pediatric life support due to prehospital cardiac arrest were compared, and the possible factors were investigated

What does this study tell us?

This study demonstrated the regional differences in pediatric cardiac arrest patients in Turkey and status in refugee children.

arrest, presence of a witness, time to arrival at the hospital, available medical equipment, high-quality CPR, and postresuscitative care.^[2-4,13-19] Although there is regional variation in childhood, sudden infant death syndrome, trauma, respiratory failure, and shock are the leading causes of cardiac arrest at the infantile period.^[1,3-5,7,13,15,20-22] It is reported that trauma and respiratory failure are the leading causes in Turkey.^[12,22] Identification of medical and social reasons related to cardiac arrest will contribute to take the measures and perform appropriate interventions in children. However, comparative pediatric studies, in which different centers shared pediatric CPR experiences, are limited in Turkey.^[12,22]

The civil war started in March in Syria, 2011, led to the migration of a significant number of refugees to Turkey, and these refugees settled across Turkey, particularly in Istanbul, Gaziantep, Kilis, Hatay, Şanlıurfa, Adana, and Mersin.^[23,24] This population movement affected health parameters in Turkey. We think that the assessment of Syrian children regarding pediatric CPR, and outcomes are essential to develop future health policies.

Our study emphasizes the differences between a Southeastern province, Gaziantep, which harbors a substantial number of Syrian refugees, and Izmir province at the Aegean shore, which holds far fewer Syrian refugees. In this study, we aimed to compare pediatric CPR patients and evaluate the regional differences in the two provinces, which have marked geographic differences.

Materials and Methods

Study locations, duration, and time

This study was conducted at the pediatric emergency departments (EDs) of Izmir Tepecik SUAM (ITSUAM) Hospital of Health Sciences University and Gaziantep Cengiz Gökçek Kadın Doğum Çocuk Hospital of Health Ministry between August 2017 and August 2018. We retrospectively reviewed pediatric patients who underwent CPR due to prehospital cardiac arrest. All patients arrived at the hospital through Emergency Medical Services (EMS). The pediatric ED of the ITSUAM Hospital of Health Sciences University is a subspecialty training clinic where seven clinicians and eight nurses work during each turn of work. The pediatric ED of the ITSUAM provides emergency medical care, including trauma, to all pediatric patients aged below 18 years. During the study period, 168,123 patients presented to ITSUAM ED. In the Pediatric ED of Gaziantep Cengiz Gökçek Kadın Doğum Çocuk (GCGH) Hospital of Health Ministry, three clinicians and eight nurses work during each turn of work. ED of GCGH provides emergency medical care, except trauma, to all pediatric patients aged below 18 years. During the study period, 254,784 patients presented to the ED of GCGH. This retrospective study was approved by the Ethics Committee of Gaziantep University (approval#2018/191, August 01, 2018) and Local Health Authority (approval#65587614-774.99, May 23, 2019).

Management

In both EDs, health-care providers follow basic and advanced life support guidelines published by the American Heart Association (AHA) in 2015. According to Advanced Life Support Guidelines, synchronized ventilation and compression support are provided to nonbreathing pediatric patients with no response to environmental stimuli or gasping with no central pulse or central pulse ≤ 60 bpm. In both EDs, the support is provided with 15 chest compression and two ventilations through balloon mask by at least two clinicians and three nurses in 2-min-long cycles, and the patient was re-assessed for a maximum of 10 s between the cycles.^[3,8] Automated chest compression device was not used in any patient. Both clinics have an in-service training program. All clinicians and nurses working in EDs had CPR training per AHA guidelines, and training is updated semi-annually. Ambulance crews routinely receive Pediatric Advanced Life Support Training. However, due to the retrospective character of our study, it was not determined how often the ambulance teams who brought patients to both centers received in-service training.

Definitions

Patients who died within 24 h after CPR were accepted

as exitus and those who survived >24 h were considered alive patients.

Study population and inclusion and exclusion criteria

We retrospectively reviewed the electronic charts of all children (age below 18 years) who arrived at the hospital through EMS and underwent synchronized ventilation and chest compression. We included patients who received chest compressions for at least 2 min and had a return of spontaneous circulation (ROSC) for at least 30 min after CPR. Patients with death bruises at arrival, those not meeting the inclusion criteria, with fatal outcomes, and with incomplete diagnostic or laboratory data were excluded.

Data collection

In all patients, electronic medical records were reviewed retrospectively. In patients transferred to another facility, medical records regarding clinical outcomes were obtained from the relevant center. In all patients, age, gender, refugee status (Syrian refugee or not), etiology, venous pH, pCO₂, HCO₃ and lactate levels, and the outcome status (survivor or nonsurvivor) were recorded. Venous blood gas was examined within the first 5 min after spontaneous circulation was achieved. The blood gas analyses were performed by the ABL800 Flex blood gas analyzer (Radiometer®, Denmark) in both centers. The etiology was classified according to potential underlying pathophysiological mechanisms: respiratory failure (not related to trauma, drowning, or foreign-body aspiration), septic shock, cardiogenic shock, trauma, drowning, and foreign-body aspiration. The data were collected under the Helsinki Declaration.

Statistical analysis

We assessed the normality of numerical variables by the Kolmogorov–Smirnov test. The numerical variables are presented with medians and interquartile ranges (IQRs) since their distributions were skewed. Categorical variables are presented with their counts (*n*) and percentages (%). We used the Mann–Whitney U-test and Chi-squared test to compare the variables between two independent groups. The accepted Type II error in this study was 5%. All statistical analyses were performed using the SPSS for Mac version 20.0 (Statistical Package for Social Sciences, IBM, IL, USA).

Results

Overall, CPR was provided to 211 patients during the study period. However, thirteen patients without ROSC and ten patients already dead at arrival were excluded; thus, the final analysis included 188 patients (GCGH: 112 patients; ITSUAM: 76 patients; median age: 4 months [IQR: 15 days–15 months; minimum–maximum:

1 day–17 years], 102 boys and 86 girls). Ninety-four (50%) patients were Syrian refugees. The most common etiology was respiratory failure (61.2%). Asystole or pulseless electrical activity was detected in all patients. During the first 24 h, 37 cases (19.7%) died, 31 of whom were in Gaziantep.

The patients were younger (median age: 14 days vs. 15 months; $P < 0.001$), and the proportion of Syrian refugees was higher (78.6% vs. 7.9%; $P < 0.001$) at GCGH. Venous pH values were lower (median: 7.10 vs. 7.24), whereas the lactate levels were higher (median: 6 mmol/L vs. 3.6 mmol/L) at GCGH ($P < 0.001$). The mortality rate was also higher at GCGH [27.7% vs. 7.9%; $P < 0.001$; Table 1].

The median age of the survivors was higher than the nonsurvivors (3 months vs. 15 days; $P = 0.028$). There were significant differences in venous pH, pCO₂, HCO₃, and lactate levels between survivors and nonsurvivors [$P < 0.05$, Table 2].

Male gender was more common among Syrian refugees (61.7% vs. 46.8%; $P = 0.040$), and they were younger (median age: 10 days vs. 4 months ($P = 0.004$)). Septic shock incidence was higher in Turkish citizens (24.5% vs. 8.5%; $P = 0.003$). Venous pH and HCO₃ levels were lower, and pCO₂ and lactate levels were higher among Syrian refugees ($P < 0.05$) [Table 3].

Discussion

This is the first study comparing children who underwent CPR in a South-eastern province, GCGH, which harbors a substantial amount of Syrian refugees, and ITSUAM province at the Aegean shore, which holds far less Syrian refugees together, emphasizing regional differences. Our study showed that the children were younger, more severely impaired in metabolic balance, and mortality rates were higher in the province of GCGH, where the Syrian refugee population was significantly higher.

Immigration is an expected consequence of war, leading significant health-care issues for both refugees and the local community dealing with migration.^[25] According to the March 2020, data from the Directorate General of Migration Management, 3,647,750 registered refugees are living in Turkey. Of these, 1,657,936 are younger than 18 years of age. There are 146,352 registered refugees in ITSUAM (3.3% of the city population) and 450,031 registered refugees in GCGH (22.1%). GCGH harbors the highest number of refugees following Istanbul.^[24] In studies from Turkey, the most common cause for ED presentation was trauma among Syrian children in Hatay, the city on the border of Syria.^[26] A study conducted in a PED in Ankara showed that the most common cause was

Table 1: Comparison of patients underwent cardiopulmonary resuscitation in pediatric emergency departments of Izmir Tepecik SUAM Hospital of Health Sciences University and Gökçek Kadın Doğum Çocuk Hospital of Turkish Health Ministry

	GCGH (n=112)	ITSUAM (n=76)	P
Age, median (IQR)	14 days (5 days- 6 months)	15 months (8- 46 months)	<0.001 ^a
Age groups			
<12 months	89 (79.5)	30 (39.5)	<0.001 ^{b,c}
1- 4 years	21 (18.8)	28 (36.8)	
5- 12 years	2 (1.8)	12 (15.8)	
≥ 13 years	0	6 (7.9)	
Male gender	66 (58.8)	36 (47.4)	0.118 ^c
Syrian refugee	88 (78.6)	6 (7.9)	<0.001 ^c
Nonsurvivor	31 (27.7)	6 (7.9)	0.001 ^c
Etiology			
Respiratory failure	80 (71.4)	35 (46.1)	<0.001 ^{c,d}
Septic shock	8 (7.1)	23 (30.3)	
Cardiogenic shock	20 (17.9)	5 (6.6)	
Trauma	0	11 (14.5)	
Drowning	2 (1.8)	2 (2.6)	
Foreign body	2 (1.8)	0	
pH, median (IQR)	7.10 (6.90- 7.20)	7.24 (7.07- 7.36)	<0.001 ^a
Acidosis, pH <7.30	92 (82.1)	46 (60.5)	0.001 ^c
HCO ₃ (mEq/L), median (IQR)	15 (5- 18)	18 (11- 22)	<0.001 ^a
pCO ₂ (mmHg), median (IQR)	59 (45- 69)	40 (32- 47)	<0.001 ^a
pCO ₂ >50	73 (65.2)	14 (18.4)	<0.001 ^c
Lactate (mEq/L)	6 (3- 15)	3.6 (2- 7)	<0.001 ^a

^aMann- Whitney U-test, ^bOrigin of difference <12 months group, ^cChi-square test, ^dOrigin of difference septic shock and trauma. Bold P values denote statistical significance. ITSUAM: Izmir Tepecik SUAM, GCGH: Gökçek Kadın Doğum Çocuk, IQR: interquartile range

Table 2: Comparison of survivors and nonsurvivors among patients underwent cardiopulmonary resuscitation

	Survivor (n=151), n (%)	Nonsurvivor (n=37), n (%)	P
Age, median (IQR)	3 month (15 days- 5 months)	15 days (7 days- 6 months)	0.276 ^a
Age groups			
<12 months	90 (59.6)	29 (78.4)	0.165 ^b
1- 4 years	43 (28.5)	6 (16.2)	
5- 12 years	12 (7.9)	2 (5.4)	
≥ 13 years	6 (4)	0	
Male gender	49 (60.5)	17 (54.8)	0.586 ^b
Syrian refugee	62 (76.5)	26 (83.9)	0.398 ^b
Etiology			
Respiratory failure	65 (80.2)	15 (48.4)	0.016 ^{b,c}
Septic shock	1 (1.2)	8 (21.6)	
Cardiogenic shock	14 (9.3)	11 (29.7)	
Trauma	9 (6)	2 (5.4)	
Drowning	4 (2.6)	0	
Foreign body	2 (1.3)	0	
pH, median (IQR)	7.20 (7.10-7.30)	6.80 (6.80-6.96)	<0.001 ^a
Acidosis, pH <7.30	101 (66.9)	37 (100)	<0.001 ^b
HCO ₃ (mEq/L), median (IQR)	16.5 (11-21)	5 (3-10.5)	<0.001 ^a
HCO ₃ <20	106 (70.2)	35 (94.6)	0.001 ^b
pCO ₂ (mmHg), median (IQR)	45 (35-61)	78 (52-94)	<0.001 ^a
pCO ₂ >50	59 (39.1)	28 (75.7)	<0.001 ^b
Lactate (mEq/L)	4 (2-7)	16 (11-20)	<0.001 ^a

^aMann- Whitney U-test, ^bChi-square test, ^cOrigin of difference: respiratory failure and cardiogenic shock. Bold P values denote statistical significance. IQR: interquartile range

respiratory system complaints among Syrian refugees.^[27]
In a study from academic PED in Izmir, it was reported

that more consultations were ordered for Syrian children,
and admission rates to ward or intensive care unit were

Table 3: Comparison of Turkish citizens and syrian refugees among children underwent cardiopulmonary resuscitation

	Syrian refugees (n=94), n (%)	Turkish citizen (n=94), n (%)	P
Age, median (IQR)	10 days (5 days- 4 month)	4 months (15 days- 12 months)	<0.001 ^a
Male gender	28 (29.8)	9 (9.6)	<0.001 ^b
Nonsurvivor	28 (29.8)	9 (9.6)	<0.001 ^b
Etiology			
Respiratory failure	63 (67)	52 (55.3)	0.003 ^{b,c}
Septic shock	8 (8.5)	23 (24.5)	
Cardiogenic shock	18 (19.1)	7 (7.4)	
Trauma	2 (2.1)	9 (9.6)	
Drowning	2 (2.1)	2 (2.1)	
Foreign body	1 (1.1)	1 (1.1)	
pH, median (IQR)	7.10 (6.80- 7.20)	7.15 (7- 7.20)	0.002 ^a
HCO ₃ (mEq/L), median (IQR)	10 (5- 18)	16 (8- 20)	<0.001 ^a
pCO ₂ (mmHg), median (IQR)	62 (45- 69)	56 (38- 73)	<0.001 ^a
Lactate (mEq/L), IQR	7 (4- 15)	5 (3- 14)	<0.001 ^a

^aMann-Whitney U-test, ^bChi-square test, ^cOrigin of difference: Septic shock. Bold P values denote statistical significance. IQR: Interquartile range

higher.^[28] However, none of the studies mentioned above investigated CPR in the ED. In a study on refugees living in the USA, it was reported that being a refugee did not increase the mortality rate.^[29] In an Indian study, it was found that the negative outcome of CPR in children was associated with the low sociocultural level of the family, and respiratory problems were more common in those with low socioeconomic status.^[30] In a study conducted in Canada and the USA on children who received CPR, it was reported that racial and ethnic differences did not correlate with the prognosis.^[9] In our study, we found that the mortality rate was significantly higher among pediatric patients who underwent CPR due to prehospital cardiac arrest in GCGH than those in ITSUAM. The most crucial difference between the two centers was that the majority of patients who underwent CPR in GCGH were Syrian refugees; however, this rate was markedly lower in ITSUAM. The patients in ITSUAM were younger, and their venous blood gas parameters and lactate values were dramatically lower compared to those in ITSUAM. Since cardiac arrest due to respiratory failure takes time, the presence of impaired blood gas parameters and elevated lactate levels suggest delayed presentation to a health-care facility. These findings indicate that patients underwent CPR in GCGH had more severe tissue hypoxia at baseline when compared to those in ITSUAM, which helps to explain the higher mortality rate among Syrian refugees and patients underwent CPR in GCGH.

In the literature, it was reported that pediatric cardiac arrest is more common at infancy and in boys.^[5,9,31] In agreement with the literature, it was found that the mortality rate was higher in children younger than 12 months of age. The mean age was markedly lower in Syrian refugees when compared to Turkish citizens. The median age corresponding to the neonatal period in nonsurvivors seems to be one of the causes of a higher mortality rate in GCGH, where a substantial number of

refugees reside. The high mortality rate in the neonatal period suggests the insufficiency of antenatal follow-up and postnatal care. These patients have worse metabolic balance, which indicates that they were brought to the hospital late or were not noticed. The unfavorable living conditions of the refugees may be associated with their difficult adaptation to another country.

Limitations

This study has some limitations. First, it was failed to accurate records of drugs (mainly adrenalin) used during CPR in medical records. Second, medical records regarding chronic diseases were also lacking. Third, the duration of CPR could not be ascertained in both prehospital and in-hospital settings. Fourth, we could not obtain any information about the CPR quality of ambulance crews transporting the patients to the EDs. However, we know that the 112 ambulance teams receive pediatric advanced life support in-service training at various intervals. Finally, neurological outcomes at discharge and during follow-up could not be identified. Besides, long-term neurological assessments were also lacking in survivors.

Conclusions

Our study emphasizes that demographic characteristics of a geographical region served when assessing CPR data in a specific localization. As of 2011, the presence of Syrian refugees in Turkey has an important impact on medical practice and outcomes. The Syrian children requiring CPR were significantly younger and had more severe tissue hypoxia, resulting in a higher mortality rate.

Prior presentation

This article was presented in the 15th National Pediatric Emergency Medicine and Intensive Care Congress (Ulusal XV. Ulusal Çocuk Acil Tıp ve Yoğun Bakım Kongresi) as an oral presentation.

Consent to participate

Taken according to ethical rules.

Authors' contributions statement

Conceptualization: OTK, MA, Design: OTK, MA, Data Collection or Processing: OTK, MA, SB, ŞD, EB, GG, GD, ŞB Analysis or Interpretation: OTK, MA, Literature Search: OTK, MA, Writing: OTK, MA. Each author has participated sufficiently in the work to take public responsibility for appropriate portions of the content.

Conflicts of interest

None Declared.

Ethical approval

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