

Impact of heat waves on patients presenting to the emergency department of a tertiary care hospital — A single center cross-sectional study

Shahan Waheed, Muhammad Akbar Baig, Munawar Khursheed, Safia Awan

Abstract

In the present cross-sectional study we aimed to identify factors associated with morbidity and mortality in patients during the heat wave period (June 17th till 23rd, 2015) in the emergency department. The inclusion criteria of the study was core temperature >38 degree Celsius and signs of dehydration recorded in-patient notes and CNS dysfunction without infection recorded through GCS. Of 400 patients mortality was observed in 50 patients (12.7%) of which majority were males (54%). Of the non-survivors, 27.3% had prior history of cerebrovascular accident. Difference was noted in clinical presentation among non-survivors with unconsciousness (14%) and gasping (12%). Differences were noted in median of platelets [251(190-331) versus 183.5(155-228.5)] and Creatinine [1.1(0.9-1.7) versus 2.1(1.4-2.4)] between survivors and non-survivors. Majority of non-survivors had deranged coagulation profile and hypoxaemia.

Keywords: Heat wave, Emergency, Risk factors, Pakistan.

Introduction

Extreme heat is an important weather hazard associated with high morbidity and mortality with as estimated 94 million people being affected worldwide. It is projected that the public health impact of extreme heat exposure will continue to rise, as the climate change becomes more pronounced.^{1,2}

Karachi, which is the largest metropolis of Pakistan, suffered a devastating heat wave in the summer of year 2015 claiming large number of deaths over 1200 people.³

There is paucity of data regarding presentation characteristics of patients treated during the heat wave in year 2015. The Aga Khan University Hospital (AKUH), received a large number of patients during the heat wave.

This study aims to identify presentation characteristics associated with the morbidity and mortality in patients

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Department of Emergency Medicine, Aga Khan University Hospital, Karachi, Pakistan.

Correspondence: Muhammad Akbar Baig. Email: dr_akbar2007@hotmail.com

presenting to the emergency department during the heat wave period.

Methodology

A cross-sectional study in the emergency department of Aga Khan University Hospital was conducted from June 17th to 23rd, 2015. Data was retrospectively collected from Medical records of 520 patients received during the heat wave period. The extent of maximum temperature and heat index lasting during the heat wave period was retrieved from the Pakistan Metrological Department.⁴

The ethical review board approved the study (ERC number: 3752-EM-ERC-15). The inclusion criteria of the study was core temperature >38 degree Celsius, dehydration mentioned either as "clinically dehydrated" or two of the following signs of dehydration in patient notes (i.e., dry mucous membrane or axilla, sunken ocular globes and reduced skin turgor with prominent cutaneous skin folds) and central nervous system dysfunction without infection recorded from the Glasgow Coma Scale (GCS < 15). Patients with incomplete medical records or inadequate evaluation were excluded. Patient confidentiality was strictly maintained as no unauthorized person had access to data.

Patients were recorded for demographics, clinical examination findings, treatment offered, laboratory test values and final diagnosis. Outcome data on length of hospital stay, mortality during ED or hospital stay was noted.

Data was analyzed using SPSS-21. The proportions of categorical variables were compared between survivors and non-survivors using the chi-square test at 5% level of significance. If the assumption of chi-square were not satisfied, Fisher's exact test was used. Mann Whitney U test was performed to compare median values between survivors and non-survivors. For bivariate analysis p-value < 0.05 was considered significant.

Results

The heat wave period lasted from 17th till 23rd June 2015. As per the report of meteorological department of Pakistan, average temperature was of 41.2 degree Celsius

Table-1: Comparison of Patient Demographics and Clinical presentation findings among survivors and non-survivors.

	Survivors n=350	Non-survivors n=50	p-value
A. Patient Demographics			
Age (in years)	50.7±26.3	60.8±16.6	0.01
Gender			
◆ Male	175(50.1)	27(54)	0.61
◆ Female	174(49.9)	23(46)	
B. Comorbidities			
Diabetes	59(17.6)	6(18.2)	0.92
Cerebrovascular accident	22(6.5)	9(27.3)	<0.001
Seizure disorder	6(1.8)	1(3)	0.61
Kidney Disease	6(1.8)	2(6.1)	0.10
C. Presentation Findings			
Unconsciousness	3(0.9)	7(14)	<0.001
Drowsiness	121(34.6)	23(46)	0.11
Seizure	20(5.7)	1(2.0)	0.27
Headache	14(4.0)	0	0.15
Confusion	7(2.0)	0	0.55
Gasping	1(0.3)	6(12)	<0.001
Intubation	28(8.0)	22(44)	<0.001
Systolic Blood Pressure (mmHg)	123.6 ± 29.7	113.3 ± 34.4	0.07
Diastolic Blood Pressure (mmHg)	72.3 ± 19	59.8 ± 24.5	0.001
Pulse (beats/min)	103[85-128]	110[92.5-147.5]	0.10
Respiratory Rate (breaths/min)	26.4 ± 15.3	26.2 ± 8.9	0.92
Oxygen saturation (%)	96.8 ± 4.9	92.1 ± 13.5	<0.001
Temperature (degree Celsius)	37.6 ± 2.9	38.2 ± 1.2	0.24

with a maximum temperature of 44.8 degree Celsius recorded on 20th June 2015. The heat index was higher than 50 degree Celsius with a maximum value of 66.1 degree Celsius recorded on 20th June 2015.⁴ Table-1 compares the patient demographics and clinical presentation characteristics among survivors and non-survivors during heat wave period.

Mortality was observed in 50(12.7%) patients of which majority were males 27(54%). Differences was noted in clinical presentation of non-survivors presenting with unconsciousness 7(14%) and gasping 6(12%). A large portion of patients required Intubation 22(44%). 9(27.3%) of non-survivors had prior Cerebrovascular accident followed by kidney disease. Differences were observed in median Diastolic Blood Pressure 72.3±19 versus 59.8±24.5; p-value 0.001) and Oxygen Saturation 96.8±4.9 versus 92.1±13.5; p-value <0.001 between survivors and non-survivors. 23(46.9%) of non-survivors required Cardiopulmonary resuscitation.

Table-2 demonstrates the comparison of laboratory values and treatment offered among survivors and non-survivors of heat wave period. Significant differences were noted in median of platelets [251(190-331) versus

Table-2: Comparison of Laboratory values and treatment offered among survivors and non-survivors.

	Survivors n=350	Non-survivors n=50	p-value
A. Laboratory Values			
Haemoglobin (gm/dL)	12.5 ± 2.3	12.7 ± 2.5	0.63
Haematocrit (%)	36.4 ± 6.0	36.9 ± 7.3	0.66
Mean cell volume	80.9 ± 7.8	86.7 ± 7.8	0.002
Total leucocyte count (cells/mm ³)	5.7 ± 5.8	4.3 ± 6.6	0.54
Neutrophil (%)	68.1 ± 18.8	70.8 ± 12.8	0.46
Platelets (cells/mm ³)	251[190-331]	183.5[155-228.5]	<0.001
Blood Urea Nitrogen (mg/dL)	15[9-27]	23[15.5-42.5]	0.002
Creatinine (mg/dL)	1.1[0.9-1.7]	2.1[1.4-2.4]	<0.001
Sodium (mEq/L)	127.8 ± 17.6	127.8 ± 11.5	0.99
Potassium (mEq/L)	3.9[3.4-4.4]	3.9[3.4-4.8]	0.31
Chloride (mEq/L)	92.8 ± 16.5	86.9 ± 24.2	0.09
Bicarbonate (mEq/L)	20.1 ± 4.0	19.9 ± 17.9	0.92
Prothrombin time (PT)	12.4[11.3-14.2]	13[12.2-14.8]	0.05
International Normalized Ratio (INR)	1.5 ± 2.5	2.6 ± 3.9	0.09
Activated Partial Thromboplastin time (APTT)	25.2[23.2-29]	29.4[26.1-41.5]	0.002
Arterial blood gas			
◆ pH	6.8 ± 0.7	7.3 ± 0.4	0.01
◆ pO ₂ (mmHg)	97[70.3-153.4]	74.9[55.5-128]	0.19
◆ pCO ₂ (mmHg)	26.4[21.4-33.9]	31.6[22-57.6]	0.05
◆ HCO ₃ (mEq/L)	18.4[14.3-22.7]	13.7[10.8-19.1]	0.16
◆ Base Excess	9.9 ± 41.6	-7.8 ± 5.0	0.81
◆ SpO ₂ (%)	93.4 ± 11.3	93.4 ± 7.3	0.99
B. Treatment Offered			
Intravenous fluids	279(79.7)	37(74)	0.35
Antibiotic administration	145(41.7)	13(26)	0.03
Paracetamol Infusion	180(51.4)	19(38)	0.07
Cooling measures	16(4.6)	4(8.2)	0.28
Cardio Pulmonary Resuscitation (CPR)	5(1.4)	23(46.9)	<0.001

Table-3: Final diagnosis among survivors and non-survivors.

Final Diagnosis	Survivors n=350	Non-survivors n=50	p-value
Source of infection	25(33.3)	1(5.3)	0.01
Heat Stroke	60(19.2)	5(10.9)	0.17
Heat Exhaustion	70(22.4)	0	0.001
Meningoencephalitis	4(1.3)	3(6.5)	0.01
Pneumonia	20(6.4)	3(6.5)	0.97
Urinary Tract Infection	44(14.1)	1(2.2)	0.02
Diabetic Ketoacidosis	1(0.3)	1(2.2)	0.27
Electrolyte Imbalance	73(23.4)	12(26.1)	0.68
Admission to hospital	207(59.1)	8(16)	<0.001
Length of Stay	2.5 ± 3.2	2.4 ± 2.9	0.87

183.5(155-228.5)] and Creatinine [1.1(0.9-1.7) versus 2.1(1.4-2.4)] between survivors and non-survivors. Majority of non-survivors had deranged coagulation profile and hypoxaemia.

Table-3 shows the final diagnosis among survivors and non-survivors. 70(22.4%) survivors were diagnosed with Heat Exhaustion and 60(19.2%) as Heat Stroke. 207(59.1%) survivors and 8(19%) non-survivors required admission to hospital with a mean length of stay of 2.5 days.

Discussion

Our study demonstrates that elderly patients were affected more by the heat illnesses and the mortality was higher in males. There was a difference in clinical presentation features among the survivors and non-survivors and the large portion of non-survivors required intubation and cardiopulmonary resuscitation. Deranged coagulation, INR and low platelets were present in the majority of non-survivors, which are seen in the later stages of the heat stroke. There was also associated acute kidney injury that is in accordance to the multi-organ dysfunction that is seen in later stages of the heat stroke. These findings are consistent with prior studies that conclude that older population is more at a higher risk to heat related illnesses.^{5,14} The underlying factors of such vulnerability can be explained due to both social and medical reasons. An ageing society means a higher prevalence of chronic and degenerative diseases. For the elderly, their physiological responses to the environment decrease with ageing and medications interact with thermoregulation. Also elderly patients with decreased mobility either due to stroke, arthritis or any other chronic diseases may suffer increase risk of getting heat stroke/exhaustion as were depicted in our study. Therefore this particular sect of society shows greater vulnerability to extremely high temperatures. Males are proportionately more affected as seen in previous studies that may be explained in part by greater exposure to extreme climate.⁶ Numerous studies have enumerated the associations between specific disease and heat related illnesses.^{7,8} Also, individuals with poor cognition may be less able to undertake protection from extreme heat conditions.⁹

This study demonstrated that majority of non survivors had elevated body temperature, reduced diastolic blood pressure and decreased conscious level which was consistent with prior studies.¹⁰ The elevated temperature is due to the loss of thermoregulation and systemic inflammatory response with hypovolaemia compounds the blood pressure changes.⁹ A total of 12.7% suffered heat related mortality, which is much higher compared to findings reported in a systematic review by Basuon in USA.¹¹ In order to reduce mortality, it is important to identify the heat stroke and heat exhaustion earlier on and institute effective management as soon as possible.¹²

The findings of our study of deranged coagulation profile and reduced platelet counts are either due to the severity of the illness or due to non-specific tissue damage as the trigger mechanism for Disseminated Intravascular Coagulation due to activation of extrinsic pathway.¹³ The higher Urea and Creatinine may be due to Rhabdomyolysis resulting in acute tubular necrosis. Even though rising creatinine values depict poor prognosis of patient outcome,^{14,15} every attempt should still be made in ensuring adequate urine output in order to avoid complications as a result of Acute Kidney Injury. The findings were similar to those reported by Saleem et al, which reported results from the same population but from a different hospital.¹⁴

Conclusion

This study examined the health impact of 2015 heat wave on mortality and ED visits. This will improve the understanding and provide deep insight for weather forecasters to improve heat-wave warning systems and for local government agencies to design better preparation and intervention strategies in order to minimize adverse health effects in the instance of future heat waves.

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