ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 7, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

THE ASSESSMENT OF CLINICAL PROFILE AND PROGNOSTIC FACTORS AMONG PATIENTS OF HEAT STROKE IN A RURAL POPULATION: A CASE SERIES

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Received: 11 March 2024, Revised and Accepted: 25 April 2024

ABSTRACT

Objective: The objective was to study the clinical profile, prognostic factors, and outcomes of heat stroke in a rural population.

Methods: This was a prospective, single-center, observational study. A total of 20 consecutive patients hospitalized with a diagnosis of heat stroke were included in the study over a period of 2 months from May 1, 2023, to June 30, 2023. The baseline clinical and laboratory parameters were then studied and compared between the subjects that survived and those that did not.

Results: The mean age of patients was 58.8 years (standard deviation [SD]=10.4), and the mean body temperature on admission was 104.5°F (SD=0.910). Eighty percent of patients had non-exertional cause of heat stroke, whereas 20% had an exertional cause. The overall survival rate among hospitalized patients was 40%. In the multivariate analysis, serum creatinine, serum urea, serum sodium, and saturation of peripheral oxygen (SpO_2) at admission independently predicted mortality. Age, sex, body temperature, systolic blood pressure, blood sugar level, and platelet count at admission were not associated with mortality.

Conclusion: Heat stroke has a high hospital mortality rate. Serum sodium, serum creatinine, serum urea, and SpO_2 at presentation are independent predictors of hospital mortality. Body temperature is not associated with mortality.

Keywords: Heat stroke, Heat-related illness, Heat wave.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i7.50836. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

The months of April through August are hot and humid in most northern parts of India. In 2023, North India was scorched by intense heat. Maximum temperature was above normal by 4.4°C, mainly over most parts of North India and East and Northeast India, with many parts affected by heat waves [1]. Globally, extreme temperature is emerging as a major contributor to climate-related deaths. An increasing number of humans are dying from heat waves [2]. Directly or indirectly, mortality and morbidity are significantly influenced by heat waves [3]. In India, an estimated 3014 persons died from heat-related causes during 2001–2005. The number increased to 5157 in the period 2011–2015 [4]. Despite having a major impact on society, there is a lacuna in the knowledge regarding the clinical profile and tools required for predicting mortality that could otherwise affect the management of the patient. This dearth of knowledge is especially prominent in rural areas. Our aim was to study the patients affected by the current situation of severe heat-related illness in the rural belt of North India.

METHODS

This was a prospective, single-center, observational study which took place in a tertiary hospital in a rural part of North India after approval by the institutional research and ethical committee. The study period ran from May 1, 2023, to June 30, 2023. Heat stroke was diagnosed by a physician. Those patients, who were admitted to the hospital during the study period, were enrolled in the study. Informed written consent was taken from patients' attendants as most patients were in a state of altered sensorium at the time of presentation.

Twenty consecutive patients who were hospitalized with a confirmed diagnosis of heat stroke were included in the study. Heat stroke was defined as a clinical constellation of symptoms that resulted from a severe elevation in body temperature, often >40°C. In addition, central nervous system dysfunction must be present, which manifests as ataxia, altered sensorium, or seizures in the background of prolonged exposure to hot temperature or physical exertion [5].

Patient demographic data, pre-hospital information, situation causing heat exposure, vital signs at admission, laboratory data, survival at hospital discharge, and survival at 28 days after admission were collected.

Variables are expressed as mean (±standard deviation) or number (frequency). Differences between the groups were tested with the Mann–Whitney U-test. The analysis of mortality and neurological prognosis was done using multivariable logistic regression analyses. The positive or negative predictive value for a variable to cause hospital mortality was evaluated using receiver operating characteristic (ROC) analysis, with the areas under the ROC curves (AUCs) showing the highest sensitivity. Statistical analysis was carried out using STATA Statistics/Data Analysis software version 14.1.

RESULTS

Twenty consecutive patients with heat stroke were enrolled in the study. 45% (n=9) of the patients were male, and 55% (n=11) were female. The mean age of presentation was 58.8 years. Among the patients, 16 (80%) were admitted for non-exertional causes, and 4 (20.0%) were admitted for exertional causes. The mean body temperature at admission was 104.5°F. The baseline characteristics of various parameters in the study population are shown in Table 1.

Patients underwent conservative management including external cooling, infusion of cold saline, and gastric lavage. Organ dysfunction was treated accordingly. Patients were followed up after discharge for 28 days, or death, whichever occurred earlier. Patients were then ultimately categorized as either survivors or non-survivors. Various parameters were compared between the two groups using the two-sample Wilcoxon rank-sum (Mann–Whitney) test (Table 2).

In the analysis shown in Table 2, there was a significant correlation between mortality and serum creatinine, serum urea, serum sodium, and saturation of peripheral oxygen (SpO_2) levels at the time of admission. There was no association between mortality and body temperature, age, sex, blood sugar level, systolic blood pressure, serum potassium, and platelet count at the time of admission.

We applied AUC to variables that were significantly associated with mortality to obtain a cutoff value for that particular variable (Table 3).

Table 3 concludes that in patients with heat stroke, an Sp_02 level <89%, serum creatinine >1.46 mg/dL, a serum urea level >30 mg/dL, and a serum sodium level <133 meq/L act as cutoff values for predicting mortality (non-survival).

Table 1: Mean and standard deviation of baseline parameters

Characteristics	Mean	Standard deviation
Age (years)	58.8	10.4
Body temperature (°F)	104.5	0.910466
RBS (mg/dL)	248.7	111.395
SBP (mmHg)	138.8235	33.88996
SpO_2 (%)	87.67	12.04855
Serum creatinine (mg/dL)	1.6585	0.829777
Urea (mg/dL)	39.955	22.68307
Sodium (mEq/L)	127.3	18.86266
Potassium (mEq/L)	3.859	0.732508
Platelet count ($*10^5/mm^3$)	1.9565	1.018752

RBS: Random blood sugar, SBP: Systolic blood pressure, SpO_2: Saturation of peripheral oxygen

Table 2: Comparison of various parameters between non-survivors and survivors

Variable	Non-survivors (n=12) (mean value)	Survivors (n=8) (mean value)	p-value
Age (years)	61.1	55.3	0.199
Sex (female)	7	4	0.7136
Body temperature (°F)	104.6	104.3	0.411
RBS (mg/dL)	265	223	0.817
SBP (mmHg)	102	142	0.883
SpO_2 (%)	82.36	95.6	0.009*
Serum creatinine (mg/dL)	1.97	1.18	0.024*
Urea (mg/dL)	48.84	26.6	0.007*
Sodium (mEq/L)	124.1	132	0.025*
Potassium (mEq/L)	3.85	3.86	0.536
Platelet count ($*10^5/mm^3$)	2.07	1.78	0.757

*p<0.05: Significant. RBS: Random blood sugar, SBP: Systolic blood pressure, SpO_2: Saturation of peripheral oxygen

Table 3: Cutoff values for various predictors of mortality*

Variable	Cutoff value
SpO_2	89%
Serum creatinine	1.46 mg/dL
Serum urea	30 mg/dL
Serum sodium	133 mEq/L

*Using area under the receiver operating characteristic curve

DISCUSSION

Heat stroke is the most severe form in the spectrum of heat-related illness resulting from failure to dissipate excessive body heat. Here the intended meaning of the sentence is as follows- Heat stroke is broadly categorized as either exertional or non exertional; it is said to be exertional, when the physiologic heat loss mechanism of the body is overwhelmed by the rate of metabolic heat production (for example during prolonged intense exercise); on the other hand it is categorized as non exertional (also known as classic heat stroke) when there is exposure of exogenous or environmental heat [5]. Heatstroke is characterized, clinically, by central nervous system dysfunction and multiorgan failure in the setting of extreme hyperthermia (usually >40.5°C) [6,7]. Classic heat stroke occurs more commonly in the elderly population and in those who have chronic illnesses [8,9]. The prepubertal population is considered at risk owing to a high ratio of surface area to mass [10]. Mortality from heatstroke among the elderly may exceed 50% [5,9].

To the best of our knowledge, this is the first study assessing the clinical profile of heat stroke patients from the rural part of North India. Findings from previous studies have been quite inconsistent. Thus, for example, the European study concluded that women who suffered a heat stroke had a higher mortality rate than men [11]. However, a Japanese study found that there was no association between gender and mortality [12]. Similarly, a French study concluded that a higher age and a higher core body temperature were predictors of mortality [13]. Our study was consistent with some of the findings of the Japanese study, in that body temperature and sex of the patient were not predictors of mortality [12]. However, our study differed from the same Japanese study in that we did not find any significant correlation between mortality rate and age of the patient and platelet count [12]. Our study also found a significant association between SpO_2 at admission and mortality. We also found a significant association between mortality and serum sodium levels, which has not been studied previously. We also concluded that heat stroke has a high mortality rate, especially in rural settings.

The possible reason for discrepancy in the results is also the main limitation of the study, i.e., a small sample size owing to a single-center study and a short time span (single year).

CONCLUSION

Heat stroke has a high mortality rate. Serum sodium, serum creatinine, serum urea, and SpO_2 at presentation are independent predictors of hospital mortality. Body temperature is not associated with mortality.

ACKNOWLEDGMENTS

None.

AUTHORS' FUNDING

Nil.

CONFLICT OF INTEREST

None.

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