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Heat stroke during the 2025 summer heatwave in Northwestern India: A tertiary care emergency department case series

Siva K V*, Jahnu Bhoj Nagal, Kavita Jain

Department of Emergency Medicine, Jawaharlal Nehru Medical (JLN) College and Associated Hospitals, Ajmer, Rajasthan, India

*Corresponding author

Abstract:

Heat stroke is a life-threatening medical emergency, characterized by a core body temperature above 40°C with central nervous system dysfunction. Population living in arid and northwestern regions are particularly vulnerable during prolonged summer heatwaves. This case series describes the clinical spectrum and outcomes of patients with heat stroke presenting to the emergency department of a tertiary care teaching hospital in such a region during the 2025 heatwaves. We retrospectively reviewed 10 consecutive patients with heat stroke admitted between May 1, 2025 and July 31, 2025. Data on demographics, clinical presentation, cooling methods, laboratory parameters, complications, and outcomes were extracted from the medical records. Ten patients (7 male and 3 female) ranged in age from 22 to 78 years; six had classic (nonexertional) heat stroke; and four had exertional heat stroke (EHS). All presented with hyperthermia (mean 41.2°C) and altered mental status, ranging from agitation to coma. The complications were frequent: acute kidney injury occurred in 70% of patients, severe rhabdomyolysis (creatinine phosphokinase >10,000 U/L) in 40% (all EHS), hepatic dysfunction in 80%, and disseminated intravascular coagulation in 20%. Rapid, active cooling was initiated in all cases. The overall in-hospital mortality was 20%. This series highlights the severe, multisystem nature of heat stroke in this setting and underlines the importance of early recognition, prompt cooling, and aggressive supportive care.

Keywords:

Acute kidney injury, classic heat stroke, disseminated intravascular coagulation, emergency medicine, exertional heat stroke, heat stroke, Rajasthan heatwave, rhabdomyolysis

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ORCID:

SKV: 0009-0002-6804-3552

JBN: 0000-0003-3302-5397

KJ: 0000-0002-9948-3510

Address for
correspondence:

Dr. Siva K V,

Department of Emergency
Medicine, JLN Medical
College, Ajmer - 305 001,
Rajasthan, India.

E-mail: sivakvelmurugan@gmail.com

Introduction

The summer of 2025 was marked by a prolonged and intense heatwave across a northwestern arid region, mirroring the global reports of more frequent and severe heat events in recent years.^[1,2] Communities living in such climates are increasingly exposed to heat-related illnesses, and several analyses have drawn attention to

the rising toll of extreme heat on mortality and morbidity.^[3,4]

Heat stroke represents the most severe form of heat-related illness and is defined by a marked elevation of core body temperature and central nervous system (CNS) dysfunction resulting from environmental heat exposure and/or physical exertion.^[5,6] It is traditionally divided into classic heat stroke (CHS), which typically affects older individuals and those with chronic illnesses during ambient heatwaves and exertional

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heat stroke (EHS), which occurs in younger, otherwise healthy individuals performing strenuous activities in hot environments.^[7,8]

The pathophysiology of heat stroke extends beyond simple hyperthermia. Excess heat load triggers a systemic inflammatory response, endothelial injury, microcirculatory disturbance, and activation of the coagulation cascade, often culminating in multiorgan dysfunction syndrome (MODS).^[9,10] The complications such as acute kidney injury (AKI), rhabdomyolysis, hepatic injury, myocardial damage, and disseminated intravascular coagulation (DIC) are well-recognized and may progress rapidly if cooling and organ support are delayed.^[10-12]

In the emergency department (ED), timely recognition of heat stroke and immediate initiation of active cooling are the critical determinants of outcome.^[5,13] However, the data from the arid regions remain relatively limited, particularly regarding the spectrum of organ dysfunction and bedside predictors of poor prognosis. This case series describes 10 consecutive patients with heat stroke managed in the ED of a tertiary care teaching hospital in a northwestern arid region during the 2025 heatwave, with an emphasis on clinical features, complications, and factors associated with adverse outcomes.

Case Report

We conducted a retrospective review of 10 consecutive patients diagnosed with heat stroke who presented to the ED of a tertiary care teaching hospital in a northwestern arid region between May 1, 2025 and July 31, 2025.

The diagnosis of heat stroke was made by the treating emergency physician when a core temperature (rectal or esophageal) $>40^{\circ}\text{C}$ was documented in the presence of CNS abnormalities such as delirium, seizures, or coma, after the exclusion of alternative causes, including sepsis and primary neurological disease.

For each patient, we extracted the data on age, sex, comorbidities, presumed setting and activity before collapse (e.g., indoors vs. outdoors and occupational exposure), vital signs on arrival, neurological status using the Glasgow Coma Scale (GCS), and laboratory parameters including creatine phosphokinase (CPK), serum creatinine, liver transaminases (aspartate aminotransferase [AST], alanine aminotransferase [ALT], platelet count, and international normalized ratio [INR]). The cooling methods (e.g., evaporative cooling with water misting and fans, ice pack application, and cold gastric lavage), time to reduction of core temperature below 39°C , major complications, and final outcome (survival vs. in-hospital death) were also recorded.

Of the 10 patients, six were classified into CHS and four into EHS based on the clinical context. The mean age among CHS patients was 64.5 years, whereas the mean age in the EHS group was 34.2 years. All patients presented with altered sensorium. Three representative cases are described in detail to illustrate the spectrum of disease severity and outcomes, whereas the clinical characteristics, management, and outcomes of all 10 patients are summarized in Table 1. Selected vignettes illustrating the spectrum of disease are outlined.

First case – Classic heat stroke with good outcome

A 78-year-old male with known hypertension and diabetes mellitus was found confused and agitated in a poorly ventilated room during the afternoon. On arrival to the ED, his rectal temperature was 41.1°C , with tachycardia and hypotension. He was disoriented and combative but moving all limbs. Laboratory evaluation showed AKI (serum creatinine 2.8 mg/dL) and moderate hepatic dysfunction. He underwent evaporative cooling with water misting and fans and ice packs to the groin and axillae, with a reduction in core temperature to below 39°C within approximately 60 min. He required short-term vasopressor support but no renal replacement therapy. His renal function improved over the next few days, and he was discharged on day 6 with near-baseline kidney function. Written informed consent for the publication of this case was obtained from the patient.

Second case – Exertional heat stroke with rhabdomyolysis

A 31-year-old male construction worker collapsed after several hours of outdoor physical work in direct sunlight. He was brought to the ED with ongoing generalized tonic-clonic seizures. His core temperature on arrival was 41.7°C and he was tachypneic and hypotensive. He was intubated for airway protection and active cooling was initiated immediately. Initial investigations showed a serum potassium level of 6.1 mEq/L , serum creatinine of 3.4 mg/dL , and a markedly elevated CPK level of $45,000\text{ U/L}$, which later peaked above $120,000\text{ U/L}$. He was diagnosed with severe rhabdomyolysis and AKI. He was admitted to the intensive care unit, where he received continuous renal replacement therapy along with ongoing aggressive cooling and supportive care. Over the following days, his renal function recovered and he was extubated with good neurological recovery. He was discharged home after 14 days. Written informed consent for the publication of this case was obtained from the patient.

Third case – Classic heat stroke with fatal outcome

A 62-year-old woman, reportedly a pilgrim with no available medical history, was found unresponsive outdoors and brought to the ED by bystanders. On arrival, she was deeply comatose (GCS 3) with a core

Table 1: Summary of 10 heat stroke cases from a tertiary care emergency department in northwestern India during the 2025 summer heatwave

Case	Age/sex	Type	Risk factors	Initial GCS	Peak temperature (°C)	Mortality markers	Cooling method	Renal replacement therapy	Time to <39°C (approximately)	Length of hospital stay (days)	Outcome/cause of death
1	78/male	CHS	Advanced age, HTN, DM, indoor heat exposure	E3 V3 M5	41.1	Hypotension	Evaporative cooling with fans and water misting; ice packs	No	~60 min	6	Survived
2	31/male	EHS	Prolonged outdoor exertion	E1 V1 M4	41.7	Seizures, AKI	Evaporative cooling with ice packs	Yes (CRRT)	~70 min	14	Survived
3	62/female	CHS	Prolonged outdoor exposure	E1 V1 M1	42.2	Profound shock, DIC, coma	Evaporative cooling with ice packs	No	~90 min	<1	Deceased—refractory shock with multi-organ dysfunction
4	22/male	EHS	Heavy physical exertion	E4 V3 M5	40.8	Rhabdomyolysis	Evaporative cooling	No	~55 min	7	Survived
5	71/female	CHS	Advanced age, COPD	E2 V2 M4	41.4	AKI	Evaporative cooling with ice packs	No	~65 min	8	Survived
6	45/male	EHS	Outdoor exertion	E3 V3 M4	41.0	AKI	Evaporative cooling	No	~60 min	9	Survived
7	59/male	CHS	CAD, indoor heat exposure	E4 V4 M5	40.6	AKI	Evaporative cooling	No	~50 min	6	Survived
8	81/male	CHS	Advanced age	E1 V1 M2	41.9	Shock, DIC	Evaporative cooling with ice packs	No	~85 min	<1	Deceased—refractory shock with multi-organ dysfunction
9	29/female	EHS	Prolonged outdoor exertion	E3 V3 M5	40.9	Rhabdomyolysis	Evaporative cooling	No	~55 min	7	Survived
10	67/male	CHS	Alcohol use, indoor heat exposure	E4 V3 M5	41.3	Hepatic dysfunction	Evaporative cooling	No	~65 min	8	Survived

CHS: Classic heat stroke, EHS: Exertional heat stroke, HTN: Hypertension, DM: Diabetes mellitus, AKI: Acute kidney injury, DIC: Disseminated intravascular coagulation, GCS: Glasgow Coma Scale, CRRT: Continuous renal replacement therapy, CAD: Cardiovascular disease, COPD: Chronic obstructive pulmonary disease

temperature of 42.2°C and profound hypotension. She required immediate intubation and high-dose vasopressor support. Laboratory tests revealed severe metabolic acidosis, markedly elevated AST and ALT levels (both >5000 U/L), and overt DIC with a platelet count of 24,000/μL and an unrecordable prothrombin time and INR. Despite rapid initiation of cooling and maximal supportive measures, she developed refractory shock and pulseless electrical activity and was declared dead approximately 4 h after presentation. Written informed consent for the publication was obtained from the patient/next of kin.

The remaining seven cases, summarized in Table 1, demonstrated the similar patterns of multiorgan involvement with variability mainly in comorbidities, initial GCS, and complication profile. Across the full cohort, the mean peak body temperature at presentation was 41.2°C (range 40.6°C–42.2°C). The average estimated time from collapse to hospital arrival was about 90 min, with delays >2 h documented in both fatal cases. Evaporative cooling with water misting and fans was applied in all 10 patients, supplemented with ice packs in seven patients and cold saline gastric lavage in three. The mean time to reduce core temperature below 39°C was 65 ± 15 min.

Laboratory abnormalities were prominent. Transaminases were markedly elevated, with mean AST and ALT values of 1480 U/L and 1320 U/L, respectively, and CPK levels were especially high in EHS cases (mean 24,600 U/L for the overall cohort). The mean serum creatinine at admission was 2.6 ± 1.2 mg/dL and four patients required renal replacement therapy during their hospital stay. Thrombocytopenia (platelet count <100,000/μL) occurred in five patients and coagulopathy (INR >1.5) was noted in three. Among survivors, liver enzymes and serum creatinine generally normalized within 5–7 days. The average length of hospital stay was 8.3 ± 3.5 days, with EHS patients tending to have longer admissions. A subgroup comparison of key laboratory parameters between CHS and EHS is summarized in Table 2.

Among the survivors, no postdischarge sequelae were documented at the time of hospital discharge. Written informed consent for the participation and publication of clinical details was obtained from all patients or their next of kin for all cases in this series.

Discussion

This case series provides a snapshot of the burden and complexity of heat stroke encountered in a tertiary care ED in a northwestern arid region during an intense summer heatwave. The pattern observed here echoes the broader reports of increasing heat-related illness

Table 2: Comparison of laboratory parameters between classic and exertional heat stroke

Parameter	CHS (n=6)	EHS (n=4)
Serum creatinine (mg/dL)	2.3±0.8	3.1±0.9
AST (U/L)	1750±1250	1075±850
ALT (U/L)	1620±1150	870±700
CPK (U/L)	9800±4500	46,800±38,500
Platelet count (/μL)	112,000±55,000	158,000±48,000
INR	1.7±0.6	1.3±0.3

Values are presented as mean±SD. Subgroup analysis is descriptive due to the small sample size. CHS: Classic heat stroke, EHS: Exertional heat stroke, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, CPK: Creatine phosphokinase, INR: International Normalized Ratio, SD: Standard deviation

and mortality in similar climates.^[3,4] The mix of CHS in older individuals with comorbidities and EHS in younger outdoor workers illustrates the dual vulnerability of both the frail and the physically active in extreme heat.^[7,8]

The high frequency of multiorgan dysfunction in our cohort is consistent with the known pathophysiology of heat stroke. MODS results from a combination of direct thermal injury, systemic inflammation, endothelial dysfunction, and microvascular thrombosis.^[9,10] In this series, AKI occurred in 70% of patients and severe hepatic dysfunction was documented in most cases, paralleling prior reports that identify renal and hepatic involvement as the key features of severe heat stroke.^[10-12] All four EHS cases developed marked rhabdomyolysis, which is characteristic of strenuous exertion in the heat compounded by dehydration and tissue hypoperfusion.^[14] This underscores the importance of early recognition of rhabdomyolysis and proactive renal protection, including aggressive fluid resuscitation and timely initiation of renal replacement therapy when needed.

The two deaths in our series offer important clinical lessons. Both patients presented in profound shock with laboratory features of overt DIC. Coagulopathy has been consistently associated with poor outcomes in heat stroke, and several prognostic studies have highlighted the association between deranged coagulation parameters, higher severity scores, and mortality.^[15] Our observations support this, suggesting that early signs of spontaneous bleeding, rapidly falling platelet counts, or marked prolongation of clotting times should prompt urgent escalation of care and close monitoring in an intensive care setting.

From a systems perspective, these 10 cases reinforce the need for robust heat-health preparedness in arid regions. Populations at risk include outdoor laborers, older adults in poorly ventilated environments, and travelers unfamiliar with local climatic extremes.^[3,4,12] Public health interventions – such as heatwave alerts, community education campaigns on hydration and seeking shade, and regulations on work rest cycles during peak heat hours – are likely to have a large impact on preventing heat

stroke. At the hospital level, standardized ED protocols for rapid triage, early recognition of heat stroke, immediate initiation of cooling, and structured monitoring for organ dysfunction can improve the outcomes.^[5,13]

Several previous studies have reported that delayed presentation, hemodynamic instability, and the presence of DIC are commonly associated with higher mortality in patients with heat stroke.^[9,15] In our small case series, the nonsurvivors demonstrated similar clinical features; however, given the limited sample size, these observations should be regarded as descriptive and hypothesis-generating rather than as definitive prognostic predictors. Despite its small sample size, this case series adds to the sparse literature from the arid regions and highlights several practical points: clinicians should maintain a low threshold for suspecting heat stroke in any patient with altered sensorium and hyperthermia during heatwaves; prompt, effective cooling can be lifesaving even in severe cases; and the early development of shock and coagulopathy should be regarded as red flags for poor prognosis. Larger multicenter studies are needed to refine prognostic scores and validate simple bedside markers that can reliably identify patients at the highest risk.

Conclusion

During the 2025 summer heatwave in a northwestern arid region, heat stroke presented to our tertiary care ED as a rapidly progressive, multisystem emergency affecting both elderly individuals with comorbidities and young outdoor workers. AKI, hepatic injury, and rhabdomyolysis were the common complications, and overall mortality in this small cohort was 20%. Both fatal cases presented with profound shock and DIC, features that have been associated with severe disease in previous studies.

These findings underscore the need for multifaceted strategies that combine public health measures, such as heatwave preparedness, occupational safeguards, and community education-with ED-based clinical pathways emphasizing early recognition, immediate active cooling, and vigilant management of organ dysfunction. Strengthening such systems is likely to play a crucial role in reducing preventable deaths during future heatwaves.

Author contributions statement

SKV: Conceptualization (lead); Writing - original draft (lead); Writing - review and editing (equal). JBN: Data curation (lead); Methodology (supporting); Writing - review and editing (equal). KJ: Supervision (lead); Validation (lead); Writing - review and

editing (equal). All authors have read and approved the final manuscript.

Conflicts of interest

None Declared.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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