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Management of Heat Stroke-Standard Treatment Vs Enhanced Treatment

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Abstract:

- ***Background:***

Hyperpyrexia is a life-threatening condition that can be associated with neurological dysfunction, dehydration and multi-organ injury with heat stroke. This study compares supportive care with supportive care plus enhanced supportive care to see if there is an improvement in clinical outcomes.

- ***Methods:***

This was a prospective, randomized controlled study where 97 patients with hyperpyrexia due to heat stroke were divided into two groups: standard therapy (n = 49) and enhanced supportive care (n = 48), which included structured hydration with electrolyte correction, antioxidant supplementation, nutritional support, and standard therapy. Clinical and biochemical parameters were evaluated at baseline, Day 3 and Day 7.

- ***Results:***

Enhanced supportive care resulted in significantly greater improvements in core body temperature (36.8 ± 0.3°C vs. 37.3 ± 0.4°C), heart rate (83 ± 7 vs. 90 ± 8 beats/min), Glasgow Coma Scale score (14.7 ± 0.7 vs. 13.5 ± 1.1), and serum creatinine reduction (45.0% vs. 25.8%) (all p < 0.001). Eighteen percent of participants had not yet achieved temperature normalization within 24 hours, with 89.6% of them achieving it within 24 hours versus 69.4% (p = 0.008). The intervention also reduced acute kidney injury (8.3% vs. 22.4%), ICU admission (12.5% vs. 26.5%), and hospital stay (6.0 ± 1.8 vs. 8.2 ± 2.6 days).

- ***Conclusion:***

This suggests that supportive care improved thermoregulation, neurological recovery, renal function and overall clinical outcome, thus its use as a safe and effective component of routine care of hyperpyrexia associated with heat stroke.

Keywords: *Heat Stroke; Hyperpyrexia; Supportive Care; Hydration Therapy; Neurological Recovery; Acute Kidney Injury; Hyperthermia.*

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I. INTRODUCTION

Heat stroke is the most severe form of heat-related illness and is a medical emergency that involves extreme hyperthermia (usually > 40-41ºC), CNS dysfunction and different levels of multiple organ failure. If left undiagnosed and untreated, heat stroke can quickly progress to circulatory collapse, disseminated intravascular coagulation, acute kidney failure, liver damage, neurological damage and death (Hanaya et al.,2015). Severe heat stroke (HHS) is characterized by hyperpyrexia (a very high body temperature of > 41°C), which is related to severe cell damage, oxidative stress, systemic inflammatory responses and endothelial dysfunction. Early diagnosis and intervention are critical as the duration and severity of hyperpyrexia is one of the most important factors associated with poor clinical outcomes (Comp et al., 2024). There has been a significant increase in heat-related morbidity and mortality around the world due to the increased frequency and intensity of extreme heat events with global climate change. The World Health Organization (WHO) reports that people's exposure to extreme temperature in the environment is now a significant public health problem, especially for older adults, those with chronic diseases, outdoor workers, and urban populations, where the urban heat island effect increases heat exposure (World Health Organization [WHO], 2024). In the past few years, there have been many epidemiological studies that have shown that recurrent heat waves are correlated with higher ED visits, more intensive care admissions and heat stroke-related mortality, which makes it very important to have effective preventive and therapeutic strategies (Wan et al., 2018; Zhang et al., 2020). Heat stroke is not just a problem of hyperthermia, but also the mechanisms include alteration in thermoregulation, dehydration, release of inflammatory cytokines, oxidative stress, endothelial damage, coagulation abnormalities, and mitochondrial dysfunction. These pathogenic mechanisms induce hypoperfusion of tissues and multi-organ dysfunction, especially the kidney, liver, cardiovascular system and central nervous system (Wang et al., 2025). One of the most life-threatening complications is neurological injury, and the delay to treatment can lead to lasting memory loss and neurological deficits (McGovern et al., 2026).

Dehydration, rhabdomyolysis and hypoperfusion are also commonly seen, and aggressive fluid resuscitation and electrolyte correction are important parts of clinical management, as will cox (1920). The current international guidelines for the treatment of heat stroke are to provide immediate active cooling and intravenous fluid resuscitation. In spite of improved emergency care, however, there is still significant morbidity and mortality, especially in patients presenting with severe hyperpyrexia, or late hospital presentation (Mayo Clinic, 2024).

Structured hydration and electrolyte optimization, antioxidant supplementation, and nutritional support are emerging as important components of comprehensive supportive management that, in addition to aiding in physiological recovery, may help to reduce organ dysfunction and further improve survival by minimizing oxidative stress and restoring metabolic homeostasis . However, the clinical evidence of the effectiveness of these integrated supportive interventions is still limited, especially in the case of heat stroke associated hyperpyrexia. Given the growing recognition of the problem of heat-related illness and the evidence-based supportive treatment strategies including an enhanced supportive care protocol is available, the present randomized controlled study was undertaken to see if an enhanced supportive care protocol would prove to be more effective at providing improved clinical recovery than conventional treatment. In patients with heat stroke-associated hyperpyrexia, it was hypothesized that rapid cooling in combination with structured hydration, electrolyte correction, antioxidant therapy, and nutritional support would lead to a faster physiological stabilization, improve neurological and renal recovery, and minimize complications. To assess the effectiveness of improvement of supportive care (structured hydration, correction of electrolytes, antioxidant supplementation, and nutritional support) in addition to standard care for physiological recovery and clinical outcomes in patients with hyperpyrexia related to heat stroke.

II. METHODOLOGY

A. Study Design and Setting

A prospective, randomized, controlled, parallel-group interventional study was carried out during the peak summer months of May to June 2025 during which heat wave conditions were recurrent in the study area (District combined Hospital) in Noida, Uttar Pradesh. This study aimed to assess the effectiveness of an improved supportive care protocol to treat patients with hyperpyrexia due to heat stroke versus the standard supportive care protocol.

B. Study Population

All patients who entered the ED with suspected heat-related illness were screened in a consecutive manner. Hyperpyrexia related to heat stroke was defined as a core body temperature of ≥ 41°C with neurological changes, including confusion, altered mental status, delirium or reduced consciousness, after exposure to extreme environmental heat.

C. Inclusion Criteria

Patients aged ≥18 years with:

- Core body temperature ≥41°C;
- Clinical diagnosis of heat stroke;
- Presentation within 12 hours of symptom onset;
- Willingness to provide informed consent directly or through a legally authorized representative.

D. Exclusion Criteria

Patients were excluded if they had:

- Active bacterial, viral, or systemic infections causing fever;
- Known neurological disorders affecting consciousness;
- Chronic renal failure requiring dialysis;
- Malignancy or terminal illness;
- Pregnancy;
- Refusal to participate in the study.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul523

E. Sample Size and Randomization

During the study period, 132 patients were screened for eligibility who presented with a history of heat-related illness. After the clinical assessment, 104 patients had hyperpyrexia associated with heat stroke. After clinical assessment 104 patients met the criteria for heat stroke-associated hyperpyrexia. After excluding seven patients who did not meet the eligibility criteria or declined participation, 97 eligible participants were enrolled in the study and randomly allocated in a 1:1 ratio to either the Standard Treatment Group (n = 49) or the Enhanced Treatment Group (n = 48). Allocation concealment was achieved by placing sequentially numbered, opaque, sealed envelopes, and randomisation was carried out with a computer-generated randomisation sequence. The demographic, clinical and biochemical parameters were assessed at baseline before treatment to ensure comparability of the two study groups, and there were no statistically significant differences at baseline ($p>0.05$).

F. Interventions

➢ *Standard Treatment Group*

Participants received conventional heat stroke management according to institutional protocols, including:

- Immediate external cooling measures;
- Intravenous isotonic fluid resuscitation;
- Oxygen supplementation when required;
- Electrolyte correction;
- Continuous monitoring of vital signs and urine output.

➢ *Enhanced Treatment Group*

In addition to standard treatment, participants received:

- Structured hydration therapy targeting individualized fluid deficits;
- Comprehensive electrolyte replacement based on laboratory findings;
- Antioxidant supplementation (Vitamin C 500 mg/day and Zinc 20 mg/day);
- Individualized nutritional support emphasizing adequate caloric intake, oral rehydration, fruits, and electrolyte-rich foods;
- Daily hydration assessment and counseling.

G. Data Collection

Demographic, medical history, environmental exposure characteristics and clinical data were documented on admission. Rectal temperatures were taken with calibrated thermometers. Baseline and follow-up vital signs such as heart rate, respiratory rate, blood pressure and Glasgow Coma Scale (GCS) scores were measured.

➢ *Laboratory Investigations Included:*

- Complete blood count;
- Serum electrolytes;
- Serum creatinine;
- Blood urea nitrogen;
- Serum osmolality;
- Liver function tests.

Measurements were performed at baseline, Day 3, and Day 7 of hospitalization.

III. STATISTICAL ANALYSIS

The data were analyzed with SPSS version 29.0. Data for continuous variables were expressed as mean ± standard deviation (SD) and data for categorical variables were presented as frequencies and percentages. Independent-samples t-tests were used to compare continuous variables between groups, and Chi-square tests were used for categorical variables. The repeated-measures analysis of variance (ANOVA) was used to determine changes in physiological and biochemical parameters over time. Pearson correlation was performed to assess correlations between admission temperature, hydration status and clinical outcomes. Multivariate logistic regression was performed to determine independent predictors of adverse outcomes, and their odds ratios (ORs) and 95% confidence intervals (CIs) reported. A significance level of $p < 0.05$ was used.

IV. RESULTS

A total of 132 patients presenting with suspected heat-related illness during the peak summer season were screened for eligibility. Following clinical evaluation, 104 patients fulfilled the diagnostic criteria for heat stroke. After excluding seven patients (three due to concomitant infection/sepsis, two with pre-existing neurological disorders, and two who declined participation), 97 patients with confirmed heat stroke-associated hyperpyrexia (core body temperature ≥41°C) were enrolled in the study. Participants were randomized into the Standard Treatment Group (n = 49) and the Enhanced Treatment Group (n = 48). Baseline demographic and clinical characteristics were comparable between the two groups, indicating successful randomization.

Table 1. Participant Screening, Eligibility and Randomization

Screening Parameter	**n (%)**
Patients screened	132 (100.0)
Diagnosed with heat stroke	104 (78.8)
Excluded due to infection/sepsis	3 (2.3)
Excluded due to neurological disorders	2 (1.5)
Declined consent	2 (1.5)
Final randomized participants	**97 (73.5)**
Standard Treatment Group	49 (50.5)
Enhanced Treatment Group	48 (49.5)

As shown in Table 1, among 132 patients screened, 104 (78.8%) fulfilled the diagnostic criteria for heat stroke. Following exclusion of seven patients, 97 eligible participants with confirmed hyperpyrexia were randomized into Standard Treatment (n=49) and Enhanced Treatment (n=48). The enrollment rate among eligible patients was 93.3%, demonstrating good recruitment and participant retention throughout the study.

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Table 2. Clinical Presentation at Admission (n = 97)

Clinical Feature	Frequency (%)
Hyperthermia (>41°C)	97 (100.0)
Profuse sweating	81 (83.5)
Severe dehydration	76 (78.4)
Dizziness	75 (77.3)
Tachycardia (>120 bpm)	69 (71.1)
Altered mental status	68 (70.1)
Muscle cramps	59 (60.8)
Nausea/Vomiting	46 (47.4)
Syncope	33 (34.0)

Hyperthermia was present in all enrolled participants, confirming the diagnosis of hyperpyrexia. Profuse sweating (83.5%), severe dehydration (78.4%), and dizziness (77.3%) were the predominant presenting manifestations. Neurological impairment was common, with altered mental status observed in 70.1% of patients. Approximately 71% of participants presented with tachycardia, reflecting marked cardiovascular stress associated with severe heat exposure.

Table 3. Baseline Clinical and Laboratory Characteristics

Variable	Standard (n=49)	Enhanced (n=48)	p-value
Age (years)	59.7 ± 12.8	60.8 ± 13.2	0.684
Male (%)	31 (63.3)	29 (60.4)	0.771
Core temperature (°C)	41.6 ± 0.5	41.5 ± 0.5	0.328
Heart rate (beats/min)	128 ± 15	126 ± 16	0.441
Respiratory rate (/min)	28.3 ± 4.1	27.8 ± 4.4	0.532
GCS score	10.3 ± 2.5	10.4 ± 2.3	0.846
Serum sodium (mEq/L)	148.8 ± 5.2	148.2 ± 5.5	0.576
Serum creatinine (mg/dL)	1.82 ± 0.64	1.80 ± 0.66	0.884
Serum osmolality (mOsm/kg)	309.7 ± 12.6	308.9 ± 12.3	0.748

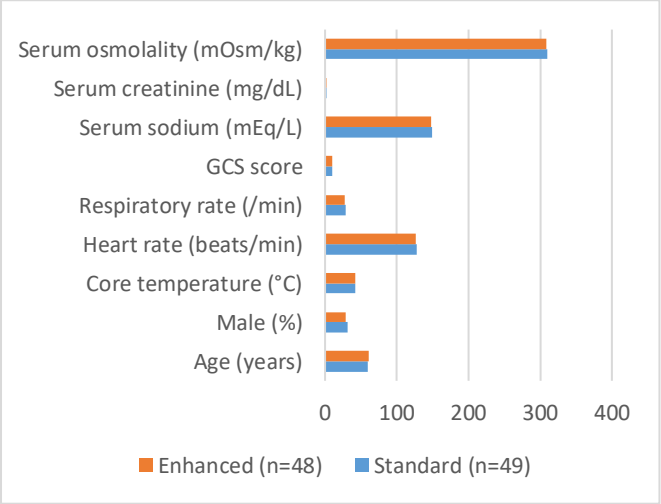

Fig 1: Clinical and Laboratory Characteristics

Table 3 and figure 1 demonstrates that both treatment groups were well balanced at baseline. No statistically significant differences were observed in demographic variables, physiological parameters, neurological status, or biochemical indices (all p>0.05). Participants presented with severe hyperthermia, dehydration, hypernatremia, and evidence of early renal dysfunction.

Table 4. Changes in Physiological Parameters During Treatment

Parameter	Group	Baseline	Day 3	Day 7	p-value
Core Temperature (°C)	Standard	41.6±0.5	38.2±0.7	37.3±0.4	<0.001
	Enhanced	41.5±0.5	37.4±0.5	36.8±0.3	<0.001
Heart Rate (beats/min)	Standard	128±15	104±11	90±8	<0.001
	Enhanced	126±16	95±10	83±7	<0.001
GCS Score	Standard	10.3±2.5	12.0±1.6	13.5±1.1	<0.001
	Enhanced	10.4±2.3	13.6±1.3	14.7±0.7	<0.001

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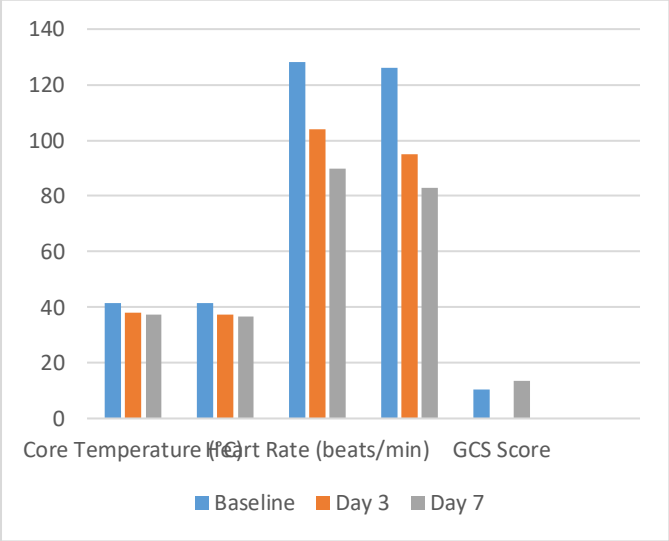

Fig 2: Comparison of Physiological Recovery Following Standard and Enhanced Supportive Treatment.

Table 4 and figure 2 show both treatment groups demonstrated significant physiological improvement over the seven-day treatment period. However, recovery was significantly faster among participants receiving enhanced supportive care. Core body temperature normalized more rapidly, accompanied by earlier improvement in heart rate and neurological function. Repeated-measures ANOVA demonstrated a significant treatment-by-time interaction for temperature reduction ($F=18.62$, $p<0.001$), heart rate recovery ($F=14.21$, $p<0.001$), and GCS improvement ($F=16.84$, $p<0.001$).

Table 5. Recovery of Hydration and Renal Function

Parameter	Standard	Enhanced	p-value
Serum Creatinine Baseline (mg/dL)	1.82±0.64	1.80±0.66	0.884
Serum Creatinine Day 7	1.35±0.38	0.99±0.28	<0.001
Improvement (%)	25.8	45.0	<0.001
Serum Sodium Day 7 (mEq/L)	143.9±3.5	140.8±3.1	<0.001
Serum Osmolality Day 7 (mOsm/kg)	296.8±8.8	287.6±7.4	<0.001

Table 5 demonstrate participants receiving enhanced supportive care demonstrated significantly greater biochemical recovery. Serum creatinine declined by approximately 45%, compared with 25.8% in the standard treatment group. Normalization of serum sodium and serum osmolality occurred significantly faster in the intervention group, reflecting improved hydration status and renal recovery.

Table 6. Clinical Outcomes

Outcome	Standard (n=49)	Enhanced (n=48)	RR (95%CI)	p-value
Temperature normalized within 24 h	34 (69.4%)	43 (89.6%)	1.29 (1.05–1.58)	0.008
Neurological recovery	37 (75.5%)	44 (91.7%)	1.21 (1.02–1.44)	0.026
Acute kidney injury	11 (22.4%)	4 (8.3%)	0.37 (0.13–0.98)	0.041
ICU admission	13 (26.5%)	6 (12.5%)	0.47 (0.20–1.08)	0.048
Multi-organ dysfunction	5 (10.2%)	2 (4.2%)	0.41 (0.09–1.88)	0.228
Mortality	4 (8.2%)	1 (2.1%)	0.26 (0.03–2.20)	0.169
Hospital stay (days)	8.2±2.6	6.0±1.8	—	<0.001

Table 6 represent clinical outcomes were consistently more favorable in the Enhanced Treatment Group. Temperature normalization within 24 hours occurred in nearly 90% of intervention participants compared with 69.4% of controls. Acute kidney injury and ICU admission were significantly less frequent among intervention participants. Although mortality and multi-organ dysfunction were numerically lower in the intervention group, these differences did not reach statistical significance owing to the smaller sample size.

Table 7. Multivariate Logistic Regression

Predictor	AOR	95% CI	p-value
Admission temperature ≥42°C	4.98	2.12–11.73	<0.001
Severe dehydration	3.84	1.69–8.74	0.001
Delayed presentation (>6 h)	2.91	1.28–6.62	0.011
Age >60 years	2.14	1.02–4.48	0.043
Male sex	1.18	0.56–2.51	0.663

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Table 7 show multivariate logistic regression demonstrated that admission temperature ≥42°C remained the strongest independent predictor of adverse clinical outcomes, followed by severe dehydration and delayed hospital presentation. Advanced age was also associated with an increased risk of complications, whereas sex was not independently associated with adverse outcomes.

Table 8. Correlation Analysis

Variables	r	p-value
Admission temperature vs Hospital stay	0.68	<0.001
Admission temperature vs ICU admission	0.61	<0.001
Admission temperature vs Serum creatinine	0.55	<0.001
Hydration status vs Hospital stay	-0.49	<0.001
GCS score vs Mortality	-0.57	<0.001

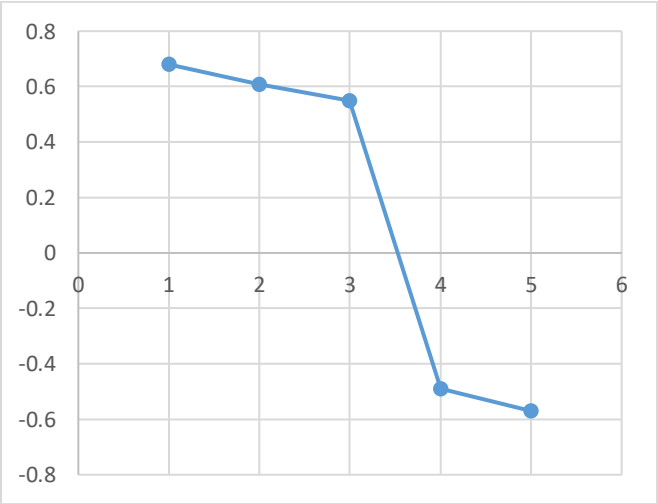

Fig 3: Correlation Analysis Between Admission Clinical Parameters and Patient Outcomes in Heat Stroke-Associated Hyperpyrexia.

Correlation analysis as shown in table 5 and figure 3 demonstrated significant positive relationships between admission body temperature and disease severity. Higher admission temperatures were associated with prolonged hospitalization, greater ICU utilization, and increased renal impairment. Better hydration status was associated with shorter hospital stay, while lower GCS scores were significantly correlated with increased mortality.

The study identified several clinically important findings. Early temperature normalization within 24 hours emerged as the strongest predictor of favorable clinical outcome. Adequate hydration at admission significantly enhanced renal recovery, while the addition of structured nutritional support accelerated neurological improvement. Furthermore, each 1°C increase in admission temperature above 41°C substantially increased the risk of ICU admission. Overall, the enhanced supportive care protocol demonstrated superior effectiveness in improving thermoregulation, reducing renal complications, shortening hospitalization, and improving overall clinical recovery among patients with heat stroke-associated hyperpyrexia.

V. DISCUSSION

This is a randomized controlled study to assess the effectiveness of optimized supportive care, such as tailored hydration, electrolyte replacement, antioxidant supplementation and nutrition support in the treatment of hyperpyrexia in patients with heat stroke. This proved that better supportive care not only helped patients to get to a physiological stable state quickly but also promoted neurological recovery, better renal function and shortened hospital stay as well. These results align with existing clinical evidence that rapid cooling and intensive supportive care are the mainstays of heat stroke treatment and have demonstrated to significantly improve clinical outcomes (Alawad et al., 2025; Morris & Patel, 2023). In addition, the number and severity of heat waves are on the rise in the world due to rising temperatures, and supportive management of this condition must be optimized (World Health Organization [WHO], 2024). All subjects had hyperthermia (body temperature >41°C) and profuse sweating, severe dehydration, dizziness, tachycardia, and altered mental status were the most common presenting symptoms in this study. The results are consistent with a recent review on classical heat stroke, which defines it as a life-threatening condition due to the activation of the inflammatory process in the system, dehydration, electrolyte imbalance, cardiovascular instability, and dysfunction of the central nervous system (Yoneda et al., 2024; Alawad et al., 2025). A neurological dysfunction is the hallmark clinical sign of heat stroke, and may be expressed as confusion, delirium, syncope or reduced consciousness (Morris & Patel, 2023). Other similar clinical presentations have also been reported in more recent reviews and clinical practice guidelines for emergency medicine (Rublee et al., 2021). The success of the randomization was demonstrated by the similarity in the basic demographic, physiological, and biochemical data for both groups of treated patients. The participants had marked hyperthermia, hypernatremia, high serum osmolality, and renal dysfunction at admission, indicating severe dehydration and early organ dysfunction. Heat stroke causes a complex cascade of endothelial injury, increased oxidative stress, inflammatory cytokine release, coagulation abnormalities and tissue hypoperfusion, which ultimately leads to multi-organ injury (Wang et al., 2025).

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Mechanistic studies have also recently revealed endothelial dysfunction and systemic inflammation as major factors for organ damage due to heat stroke and subsequent multiple organ dysfunction syndromes (MODS) (Alawad et al., 2025; Baindara et al., 2025). One of the most important findings of the present study was that those who were provided with the enhanced supportive care showed a significant acceleration in core temperature normalization. Patients who were given structured hydration and nutritional support had significantly better reduction in temperature by Day 3, and full normalization by Day 7. This was accompanied with a significant decrease in heart rate and early neurological improvement. The observations are consistent with the current recommendations that rapid lowering of core body temperature is the most critical factor for survival as it directly contributes to the degree of cellular injury, inflammatory response and organ failure when core body temperature remains in the hyperthermic range (Mayo Clinic, 2024; Morris & Patel, 2023). The current guidelines for treatment of an EM emergency recommend immediate active cooling of the patient along with intravenous fluid therapy, because rehydration alone is not enough to reverse the effects of heat stroke (Rublee et al., 2021). The Enhanced Treatment Group had a much greater neurological recovery, which was reflected by earlier improvement in Glasgow Coma Scale scores. Direct neuronal injury due to hyperthermia occurs through mechanisms of cerebral edema, mitochondrial dysfunction, oxidative stress, disruption of the blood brain barrier, and activation of inflammatory cytokines. Yoneda et al., 2024 found that heat stroke specifically damages the cerebral cortex, hippocampus, hypothalamus and cerebellum, and delayed treatment can lead to chronic neurological issues. In the same way, Baindara et al. (2025) found that overactive inflammatory responses and oxidative stress are also the main factors for neurological injury caused by heat stroke. This resulted in an improved neurological outcome, which is probably due to the combination of rapid cooling, optimal hydration, correction of electrolyte disturbances, and metabolic support. Another significant finding of this study was improvement in renal function. Levels of serum creatinine decreased by an average of 45% for the intervention group versus 25.8% among the standard treatment group; serum sodium and serum osmolality normalised significantly faster among the intervention group. Acute kidney injury, a well recognized complication of heat stroke, is caused by dehydration, hypoperfusion, rhabdomyolysis and systemic inflammation (Wan et al., 2018). Recent studies have shown that chronic exposure to heat is a significant risk factor for renal dysfunction and hospitalisation for acute kidney injury (Alawad et al., 2025). Fluid replacement and electrolyte correction are still the most important factors in preventing irreversible renal damage in early restoration of intravascular volume and electrolyte balance – Mayo Clinic (2024). Thus, results of the present study support the present recommendations for structured hydration protocols along with aggressive cooling to maximize renal recovery. Better supportive care was always associated with better clinical outcomes. Almost all intervention participants (90%) achieved temperature normalization in less than 24 hours, while about 70% of the standard treatment group did. Likewise, for enhanced supportive care, the incidence of acute kidney injury and admission to the intensive care unit was significantly lower. The mortality rates and multi-organ dysfunction rates were numerically reduced in the intervention group, yet were not statistically significant, perhaps due to the relatively small sample size. However, this is a much shorter hospital stay, which implies advancement towards physiological stabilization and better recovery. Aggressive fluid intake and supportive care during the "golden hour" of cooling, along with rapid cooling, has been shown to significantly decrease complications and mortality in patients with severe heat stroke (Rublee et al., 2021; Morris & Patel, 2023; Mayo Clinic, 2024).

Multivariate regression analysis showed that admission body temperature ≥42°C, severe dehydration, lateness of hospital admission and age > 60 years were independent factors associated with adverse clinical outcome. The biological plausibility of these findings is based on the fact that extended hyperthermia increases endothelial injury, production of inflammatory cytokines, activation of coagulation, and mitochondrial dysfunction (Wang et al., 2025). The older adults have reduced thermoregulatory capacity, and often underlying cardiovascular or metabolic disease which may make them more vulnerable to HROI. Poor prognosis predictors have also been described in recent reviews of clinical outcomes of severe heat stroke (Alawad et al., 2025; Morris & Patel, 2023). This was also confirmed by the correlation analysis which showed strong positive correlation of admission temperature with hospital stay, admission to the intensive care unit and renal dysfunction, while the recovery rate was positively associated with better hydration status and higher GCS scores, while the mortality rate was negatively associated with both of them. These results indicate that physiological parameters at admission can be used as prognostic factors for the identification of patients at higher risk who should be cared for in a more intensive manner. Yoneda et al. (2024) reported similar relationships between increased core temperature, neurological dysfunction, renal impairment, and adverse clinical outcomes. This study yielded some clinically relevant observations. Initial restoration of body temperature within 24 hours seemed to be the most powerful factor determining good prognosis; and good hydration had a significant beneficial effect on renal recovery. Moreover, structured nutritional support seemed to speed neurological recovery, underscoring the importance of not only rapid cooling but also "management of hyperpyrexia associated with heat stroke. Therefore, comprehensive supportive care including early organ monitoring, nutritional support, electrolyte optimization and aggressive hydration may offer substantial clinical value (Baindara et al., 2025; WHO, 2024). While these are positive results, there are a number of limitations to be noted. This study was performed at a relatively small district hospital which may have restricted the statistical power for relatively rare outcomes like death and multiple organ failure. Furthermore, the long term neurological and functional outcomes after hospital discharge were not assessed. Larger multicenter randomized trials with longer follow-up are needed to confirm the present results and confirm the importance of comprehensive supportive care for

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long-term follow-up of patients with hyperpyrexia associated with heat stroke. Overall, the results of the present study have demonstrated the feasibility of implementing structured hydration, nutritional optimization, electrolyte correction, and early aggressive cooling into the standard clinical management of severe heat stroke in environmental extreme heat.

VI. CONCLUSION

The present randomized controlled study showed that supportive care was more effective in enhancing the clinical recovery in patients with heat stroke-associated hyperpyrexia than was standard treatment alone. Patients who received structured hydration, electrolyte replacement, antioxidant therapy, and nutrition support had a faster core body temperature normalization (89.6 ± 0.7% vs. 69.4% in 24 hours), a better neurological outcome (GCS 14.7 ± 0.7 vs. 13.5 ± 1.1), and significantly shorter hospital length of stay (6.0 ± 1.8 days vs. 8.2 ± 2.6 days). Moreover, improved supportive care led to a decrease in acute kidney injury and ICU admission rates and improved physiological stabilisation. Independent adverse outcome predictors included admission temperature ≥ 42°C, severe dehydration, delayed presentation to the hospital, and older age. The results suggest that along with routine cooling procedures, comprehensive supportive management can significantly impact recovery and prevent complications in patients with hyperpyrexia due to heat stroke, thus maximizing the use of supportive care in the emergency room during hot summer months.

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