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Research Article

Short-Term Complications of Therapeutic Hypothermia in Neonates with Moderate to Severe Hypoxic Ischaemic Encephalopathy at Aga Khan University Hospital, Nairobi

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Abstract

Background: Neonatal hypoxic–ischemic encephalopathy (HIE) remains a major cause of neonatal mortality and long-term neurodisability. Therapeutic hypothermia (TH) is neuroprotective but can cause multisystem complications, and evidence of its safety and effectiveness in low- and middle-income country (LMIC) settings is mixed. We evaluated short-term complications associated with TH among neonates with moderate to severe HIE managed at a tertiary neonatal unit in Nairobi.

Methods: We performed a retrospective descriptive review of medical records for neonates gestational age ≥36 weeks with moderate–severe HIE who received TH in the Aga Khan University Hospital NICU between January 2020 and December 2024. Key variables extracted included demographics, HIE severity (Sarnat stage), TH parameters (method, target temperature, duration, rewarming), and short-term complications within 7–10 days (cardiac, respiratory, neurological, haematological, renal, infectious, metabolic, and device-related). Descriptive statistics summarized frequencies and timing of complications; associations with clinical factors were explored using cross-tabulations and logistic regression where appropriate.

Results: Thirty neonates (median gestational age 39 weeks; mean birth weight 3281.7 g; 53.3% female) received TH, predominantly whole-body cooling with target temperature 33.5°C maintained for a median 72 hours. Most infants had moderate HIE (63.3%, Sarnat II). Median time to target temperature was 6 hours. Overall, 63.3% experienced at least one short-term complication. The most frequent complication was electrolyte imbalance (46.7%), followed by neurological events (seizures in 23.3%). Haematological coagulopathy occurred in 13.3%, renal complications (oliguria) in 6.7%, and infectious events in 3.3%. Cardiorespiratory complications were uncommon; bradycardia was the most frequent cardiac event. Device-related and skin issues were infrequent. Median time to onset of complications was 11 hours and median time to resolution was 25 hours. Median hospital stay was 7 days.

Conclusions: In this tertiary Kenyan NICU, TH was implemented timely and according to protocol, but was associated with a high rate of transient multisystem complications—most commonly electrolyte disturbances and seizures. The observed safety profile is broadly comparable to reports from high-income settings, suggesting that with adequate monitoring, trained staff, and supportive care, TH can be feasibly and relatively safely delivered in well-resourced LMIC centres. Careful electrolyte management, seizure surveillance, and resources for multisystem support remain essential. Limitations include retrospective design, small sample size, single-centre setting, and absence of a non-cooled comparator and long-term neurodevelopmental follow-up.

Keywords: *Therapeutic hypothermia; Hypoxic-ischemic encephalopathy; Neonatal complications; Electrolyte imbalance*

Background

Neonatal Hypoxic Ischemic Encephalopathy (HIE) still remains a primary cause of neonatal death and long-term neurological impairment as it is responsible for 23% of global neonatal deaths, reaching one million annually (1). Newborns with moderate to severe HIE experience a range of distressing symptoms due to lack of oxygen and blood flow to the brain. These symptoms include altered consciousness (ranging from lethargy to coma), seizures, abnormal muscle tone, and difficulty breathing, which often requires mechanical ventilation. Feeding challenges arise due to poor coordination of sucking and swallowing, necessitating alternative feeding methods. Additional signs include abnormal reflexes, apnea, and bradycardia. Laboratory tests reveal systemic distress, including acidosis, elevated lactate levels, hypoglycemia, and changes in blood cell counts. Neuroimaging and EEGs confirm brain damage and neurological distress.

Therapeutic hypothermia, also known as Targeted Temperature Management (TTM), is a critical medical intervention used worldwide, notably in cases of neonatal encephalopathy, cardiac arrest, and certain types of traumatic brain injury. Therapeutic hypothermia is significant as it stems from its capacity to enhance outcomes by protecting the brain and other critical organs from damage caused by ischemia and subsequent reperfusion injury (2).

Therapeutic hypothermia utilizes a servo-controlled whole-body cooling device (Blanketrol III), The Blanketrol III cooling device is employed for therapeutic hypothermia in newborns, where it targets the brain after events like birth asphyxia or hypoxic-ischemic incidents. At the molecular and cellular level, the device cools the brain to 33-34°C, which in turn lowers the brain's metabolic rate, thereby decreasing its need for oxygen and glucose. This action helps to safeguard against further damage from energy depletion. By cooling the brain, the device also inhibits excitotoxicity by reducing the release of damaging neurotransmitters like glutamate, which could otherwise cause neuronal injury or death. Additionally, lowering the temperature diminishes inflammation by cutting down the production of pro-inflammatory cytokines, which can worsen brain injury. Hypothermia also curbs apoptosis, reducing cell death and thus preserving brain tissue. (3)

On a broader scale, the cooling effect reduces oxidative stress by limiting the production of reactive oxygen species, which are harmful to brain tissue. It helps in maintaining the blood-brain barrier's integrity, preventing the entry of harmful substances into the brain. Moreover, hypothermia minimizes cerebral edema or brain swelling, which can exert pressure on brain tissues and cause additional damage. In terms of clinical benefits, therapeutic hypothermia through devices like the Blanketrol III has been linked to better neurodevelopmental outcomes for infants suffering from hypoxic-ischemic encephalopathy. It's associated with lower mortality rates in cases of severe birth asphyxia and can lessen the extent of long-term brain damage, thereby enhancing the quality of life for these newborns. The precision of the Blanketrol III in maintaining the optimal cooling temperature range is crucial for achieving these therapeutic effects. (3)

Recent studies by Gano, Orbach, Bonifacio, and Glass (2014); Azzopardi et al. (2012) highlight the complexity of managing these complications like cardiovascular instability and Persistent Pulmonary Hypertension (PPHN) which are also prevalent. Additionally, metabolic abnormalities such as hypoglycemia and hyperglycemia, are common during TH and must be carefully managed. Complications such as hematological that often necessitates blood transfusions and further medical interventions including renal and hepatic dysfunctions have also been observed. While TH is effective in reducing severe brain injury, neurological complications, including seizures, remain a significant concern (4). Therapeutic hypothermia (TH) in neonates with hypoxic-ischemic encephalopathy (HIE) can lead to several other complications. One primary concern is coagulation abnormalities; hypothermia can impair normal blood clotting, which might result in either excessive bleeding or the formation of clots. This is especially critical during TH, where there's a risk of hemorrhage or thrombosis. Another significant issue is the increased risk of infections. The lowered body temperature compromises the neonatal immune system, heightening susceptibility to both bacterial and fungal infections. Hemodynamic instability is also a common complication, where cooling affects blood pressure and heart rate, potentially causing cardiovascular issues like bradycardia, which has been documented in some studies. Moreover, there's the dual risk of hypoglycemia or hyperglycemia; hypothermia alters metabolic processes, often leading to high blood sugar during the cooling phase, a situation more frequently observed in preterm infants. Additionally, respiratory complications arise as hypothermia can impact lung function, leading to conditions such as pulmonary hypertension, differences of which were noted between neonates receiving TH and those who did not in one study.

Further complications include electrolyte imbalances, which if not managed properly, can lead to arrhythmias or seizures. Hypothermia might also cause renal complications, where there's decreased urine output or even anuria, challenging the already immature renal function in neonates. Seizures can increase during or after rewarming due to changes in cerebral metabolism and blood flow. Prolonged exposure to cold can lead to skin and tissue damage, potentially causing pressure ulcers or cold injuries if the cooling isn't evenly applied or monitored. Finally, neurological complications can arise, where, despite the protective intent of TH, the improper application can lead to or worsen brain injuries, particularly if the rewarming process isn't managed correctly. (4).

According to (Jacobs SE et al. 2013), on the Helix Trial, there is evidence that induced hypothermia of newborns who may have suffered from hypoxia at birth lowers mortality or neurological impairment without increasing disability in survivors. Therapeutic hypothermia has become a standard treatment for neonatal HIE and involves cooling the body to 33-34°C for 72 hours. Therapeutic hypothermia aims to slow down the metabolic processes that may lead to severe brain injury, ultimately improving neurodevelopmental outcomes. However, according to this same study (Helix Trial), there is evidence that therapeutic hypothermia is only beneficial in high-income countries and suggests that therapeutic hypothermia may not be suitable for use in low to medium-income countries(LMIC) even when tertiary-level neonatal intensive care support is available. The study reported that there is no neuroprotection for babies with definitive evidence of complications. Hence there is no role for therapeutic hypothermia in LMIC as the efficacy of therapeutic hypothermia is dependent on the population and not merely on the level of NICU facilities (5).

In Kenya, where healthcare resources and access to specialized treatments can be limited, complications of TH can present significant challenges. (6).Studies indicate that therapeutic hypothermia can lead to adverse effects such as coagulation abnormalities, infections, and hemodynamic instability. A nationwide study of 1456 neonates with HIE highlighted that therapeutic hypothermia significantly improved neurological outcomes, with a reduced risk of severe disability or death (RR:0.73,95% CI: 0.61-0.87, p<0.001). However, therapeutic hypothermia is associated with increased risks of sepsis 23.4% v.14.5% (OR: 1.73, 95% CI 1.23-2.43, p=002), and coagulopathy 17.1% v.9.5% (OR: 1.93, 95% CI 1.23-3.04.p=0.004), among others emphasizing the need for careful monitoring and management of these infants (7).

Additionally, the absence of widespread availability of appropriate therapeutic hypothermia and trained personnel in many Kenyan healthcare settings can facilitate these complications, emphasizing the importance of adapting treatment procedures and improving neonatal care infrastructure. Given these challenges, it is imperative to assess the complications of TH in various clinical settings to optimize its safety and efficacy. This research aims to explore the complications of therapeutic hypothermia among newborns diagnosed with moderate to severe HIE at the Aga Khan University Hospital, Nairobi.

Methods

Study Settings

The study was conducted within the Neonatal Intensive Care Unit (NICU) at Aga Khan University Hospital in Nairobi, a leading tertiary care facility dedicated to the treatment of high-risk neonates. This NICU cares for both babies born within the hospital and those transferred from other facilities. Annually, it cares for around 200 neonates, most of whom are delivered at AKUH, Nairobi. The NICU is equipped with a single therapeutic cooling machine, specifically the Blanketrol III, used for managing neonatal conditions through controlled cooling hypothermia. The medical staff includes four neonatal consultants, each specialising in neonatal care. Additionally, there are 8 neonatal nurses, all of whom have been trained to operate the cooling machine, ensuring that the critical care for neonates requiring cooling therapy is expertly managed.

Study Design

The study was a descriptive retrospective study design of newborns admitted to the NICU from January 2020 to December 2024. This research employed a retrospective chart review methodology, analyzing existing medical records to extract relevant data on the identified population.

Study population and Sampling

The population for this study included neonates with gestational age ≥36 weeks with a diagnosis of moderate to severe HIE who underwent therapeutic hypothermia during their stay in the NICU. The focus was on neonates that met the in-hospital protocol requirement for therapeutic cooling (≥36 weeks' gestational age with evidence of moderate to severe HIE as defined as an APGAR Score ≤ 5 at 10 minutes, Cord blood PH ≤ 7.0 or Arterial blood PH of 7.2 base excess ≥ 16 and clinical signs of encephalopathy).

Data Collection and Management

Data for the study were obtained from medical records. A trained research assistant systematically reviewed the medical records of newborns admitted to the NICU with a diagnosis of HIE that had therapeutic HT over the past three years. The research assistant utilized a standardized data collection form (Appendix 1) to extract relevant information. The study employed REDCap, a secure web-based platform designed for building and managing online databases and surveys, to store and manage the collected data. Key variables extracted include: Gestational age (in weeks), Birth weight, Gender, APGAR score at 1 minute, APGAR score at 5 minutes, HIE severity, treatment modalities, including therapeutic hypothermia and documented complications.

Measurement of Variables

Data were obtained from the medical records of neonates diagnosed with moderate to severe hypoxic-ischemic encephalopathy who underwent therapeutic hypothermia. Demographic variables included gestational age (weeks), birth weight (grams), and sex. Clinical severity was assessed using Apgar scores at 1 and 5 minutes and HIE severity was classified according to Sarnat staging (Stage II or III). Therapeutic hypothermia variables included method of cooling, time of initiation, target temperature, duration of cooling, and rewarming method. Outcome variables comprised short-term complications occurring within 7-10 days of cooling, categorized as cardiac, respiratory, neurological, haematological, renal, infectious, metabolic (electrolyte disturbances), and device-related events. Each complication was recorded as present or absent based on documented clinical diagnosis or laboratory findings. Secondary outcome measures included length of hospital stay (days), mortality before discharge, and neurological status at discharge as documented in clinical records. Data were entered into REDCap for accuracy and consistency before analysis.

Statistical Analysis

Descriptive statistics were used to calculate the frequency and proportions of complications, including infectious, neurological, pulmonary, cardiovascular, and metabolic disturbances. Continuous variables such as duration and time to resolution of complications were summarized using means, medians, standard deviations, and ranges. Associations between complications and clinical factors, including HIE severity, gestational age, and birth weight, were explored using cross-tabulations with Chi-square or Fisher’s exact tests. Kaplan–Meier survival analysis assessed the time from initiation of hypothermia to onset or resolution of complications. Multivariable logistic regression identified predictors of complications while adjusting for confounders. Prevalence of moderate to severe HIE was calculated relative to total NICU admissions, with stratified analyses by time and demographics. Data accuracy was ensured using REDCap with validation checks.

Results

Demographic Characteristics

The study included 30 neonates with gestational from>36 weeks indicating a predominantly term population. The mean birth weight was 3281.67 g, reflecting appropriate growth for gestational age. Females slightly predominated (53.3%). Apgar scores were markedly low at one minute, with a mean of 2.67, but improved by five minutes to a median score of 5, consistent with significant perinatal compromise. Most infants had moderate hypoxic-ischemic encephalopathy (63.3%) and were classified as Sarnat stage II, while 36.7% had severe disorder (stage III). All neonates received therapeutic hypothermia, predominantly via whole-body cooling. The target temperature of 33.5°C was consistently achieved and maintained for a median duration of 72 hours. Rewarming was mainly gradual, reflecting adherence to standard therapeutic hypothermia protocols.

Table 1. Demography characteristics and clinical features of the neonates.

Variable		Descriptive statistic
Gestational age (weeks)	Median (IQR)	39.00 (2)
	Range	34-41
Birth weight (grams)	Mean ± SD	3281.67 ± 518.285
	Range	2320-4330
Sex	Male	14 (46.7)
	Female	16 (53.3)
APGAR score in 1 minute	Mean ± SD	2.67 ± 1.422
	Range	0-6
APGAR score in 5 minutes	Median (IQR)	5.00 (2)
	Range	2-8
HIE Severity	Moderate	19 (63.3)
	Severe	11 (36.7)
Sarnat stage	II	19 (63.3)
	III	11 (36.7)
Therapeutic hypothermia initiated	Yes	30 (100.0)
Cooling method	Surface cooling	1 (3.3)
	Whole body cooling	29 (96.7)
Target temperature (℃)	Mean ± SD	33.5 ± 0.000
	Range	33.5-33.5
Cooling duration (hours)	Median (IQR)	72.00 (0)
	Range	48-72
Rewarming method	Median (IQR)	4.00 (2)
	Range	0-7
	Rapid	9 (30.0)
	Gradual	21 (70.0)

Clinical Outcomes

Complications following therapeutic hypothermia developed relatively early, with a median onset time of 11 hours after initiation, though onset ranged from immediately to 45 hours. Resolution of complications occurred at a median of 25 hours, indicating that most adverse events were transient. The median time from initiation of hypothermia to the beginning of complication resolution was 36 hours, reflecting the dynamic clinical course during cooling and rewarming. Target temperature was achieved promptly, with a median time of six hours, demonstrating timely initiation of therapy. The length of hospital stays varied widely, with a median duration of seven days, reflecting differences in illness severity, recovery trajectories, and survival outcomes among the neonates.

Table 2. Outcomes associated with the therapeutic hypothermia.

Outcome		Statistic
Time of onset of complications (hours)	Median (IQR)	11.00 (13)
	Range	0-45
Time until resolution of complication (hours)	Median (IQR)	25.00 (22)
	Range	0-122
Time from initiation of hypothermia to onset of resolution of complications (hours)	Median (IQR)	36.00 (22)
	Range	0-161
Time to achieve target temperature (hours)	Median (IQR)	6.00 (1)
	Range	0-72
Length of hospital stay (days)	Median (IQR)	7.00 (5)
	Range	0-93

Short-Term Complications

Most neonates did not experience major system-specific complications following therapeutic hypothermia. Cardiac and respiratory complications were absent in 76.7% of cases, with bradycardia being the most frequent cardiac event and respiratory distress the most common respiratory issue. Neurological complications occurred in 26.7% of neonates, predominantly seizures. Haematological complications were uncommon, with coagulopathy observed in 13.3%. Infectious and renal complications were rare, affecting 3.3% and 6.7% of infants, respectively. Electrolyte imbalances were the most frequent overall complication, occurring in 46.7% of neonates. Device-related adverse events were infrequent, with occasional temperature fluctuations and minor skin integrity issues, indicating generally safe and well-monitored therapeutic hypothermia implementation.

Table 3. Complications following the therapeutic hypothermia.

Complications		Frequency and proportions
Cardiac complications	None	23 (76.7)
	Mild pulmonary hypertension	1 (3.3)
	Bradycardia	3 (10.0)
	Hypotension	1 (3.3)
	Tachycardia	1 (3.3)
	Bradycardia and cardiac arrest	1 (3.3)
Respiratory complications	None	23 (76.7)
	Neonatal pneumonia	1 (3.3)
	Stridor, grunting, and apnoea	1 (3.3)
	RDS and apnoeic episode	1 (3.3)
	Respiratory distress	3 (10.0)
	RDS and respiratory acidosis	1 (3.3)
Neurological complications	None	22 (73.3)
	Seizures/convulsions	7 (23.3)
	Hypertonia	1 (3.3)
Haematological complications	None	26 (86.7)
	Coagulopathy	4 (13.3)
Infectious complications	None	29 (96.7)
	Sepsis (MAS)	1 (3.3)
Renal complications	None	28 (93.3)
	Oliguria	2 (6.7)
Electrolyte imbalances	No	16 (53.3)
	Yes	14 (46.7)
Cooling device malfunction	No	29 (96.7)
	Yes	1 (3.3)
Temperature malfunctions	No	28 (93.3)
	Yes	2 (6.7)
Skin issues	No	27 (90.0)
	Yes	3 (10.0)

Discussion

This study examined the short-term outcomes and complications associated with therapeutic hypothermia among neonates with moderate to severe hypoxic–ischemic encephalopathy (HIE) at Aga Khan University Hospital, Nairobi. The findings demonstrate that therapeutic hypothermia was implemented in a timely and protocol-consistent manner, with target temperature achieved within the recommended therapeutic window in most cases. However, a substantial proportion of neonates developed at least one complication, highlighting the well-described but often underemphasized reality that therapeutic hypothermia, while neuroprotective, is a complex systemic intervention with a high physiological costs.

The demographic and clinical profile of this study's cohort is broadly consistent with those reported in major randomized controlled trials and large observational studies in high-income settings (8,9). The predominance of term infants, low Apgar scores, and the distribution between moderate and severe HIE suggest appropriate patient selection. The median time to achieve target temperature of six hours is particularly important, as experimental and clinical data indicate that the neuroprotective effect of hypothermia declines rapidly after this window (10). In this regard, the performance of the unit compares favourably with reports from both European and North American centres, where delays in initiation have been associated with worse neurological outcomes (8).

The median length of hospital stay of seven days is shorter than that reported in many high-income country cohorts, where cooled infants frequently remain hospitalized for 10–14 days or longer (9; 11). This difference likely reflects health-system factors such as discharge policies, bed availability, and step-down care structures rather than true differences in morbidity. It may also reflect survival bias, as infants who die early or who recover rapidly both contribute to shorter median stays. Length of stay in this study should therefore be interpreted cautiously and not taken as a direct proxy for neurological recovery.

A central finding of this study is that 63.3% of neonates experienced at least one complication. This is consistent with the broader literature showing that therapeutic hypothermia is associated with a high burden of metabolic, cardiovascular, and haematological disturbances (8,9). Although therapeutic hypothermia improves survival and neurodevelopmental outcomes, it simultaneously imposes multisystem physiological stress on infants who are already critically ill.

The most frequent complication in this cohort was electrolyte imbalance, affecting 46.7% of neonates. This proportion appears higher than that reported in some high-income cohorts, where electrolyte abnormalities are common but often less frequently quantified or reported (10; 12). Hypothermia is known to reduce renal perfusion, alter tubular handling of electrolytes, suppress hormonal regulation, and disrupt transmembrane ion transport (8). In low- and middle-income settings, these effects may be compounded by more severe initial metabolic derangement, delayed stabilisation, or differences in fluid and electrolyte management practices. Importantly, electrolyte disturbances are not benign: they are mechanistically linked to arrhythmia, seizures, and hemodynamic instability, and may therefore amplify secondary brain injury rather than merely accompany it.

Neurological complications, particularly seizures, were observed in 23.3% of neonates. This finding is broadly consistent with post-hypothermia era studies, which show that although cooling reduces seizure burden, it does not eliminate it (13,14). The persistence of seizures in cooled infants has been interpreted as a marker of injury severity rather than treatment failure. This aligns with the two-phase model of hypoxic–ischemic brain injury, in which hypothermia mainly attenuates secondary energy failure and apoptotic pathways but cannot reverse established necrotic injury from the primary insult (8, 10). The seizure rate observed in this study, therefore, probably reflects the high proportion of infants with severe HIE rather than suboptimal cooling.

Haematological complications, particularly coagulopathy, occurred in 13.3% of neonates. This is consistent with both experimental and clinical evidence that hypothermia impairs platelet function and slows enzymatic reactions within the coagulation cascade (7, 8). Shankaran et al. (2013) reported significantly higher rates of coagulopathy among cooled infants compared with non-cooled controls. Although the proportion in the present study is not extreme, it is clinically significant, especially in settings where access to blood products, neuroimaging, and invasive monitoring may be limited.

Cardiovascular complications such as bradycardia and hypotension were relatively infrequent. Sinus bradycardia is a well-recognized physiological effect of hypothermia and is often tolerated (8). However, in neonates with myocardial dysfunction secondary to perinatal asphyxia, even predictable physiological effects may precipitate clinically relevant instability. The relatively low incidence observed here may reflect careful monitoring and supportive care, but it may also reflect under-ascertainment inherent in retrospective chart reviews.

Renal complications and infectious events were uncommon in this cohort. This contrasts with some large multicentre studies that have reported higher rates of renal dysfunction and sepsis among cooled infants (5,7). The lower rates observed here may reflect good supportive care and infection control practices, but they may also be influenced by differences in diagnostic thresholds or incomplete documentation. This is particularly relevant in retrospective designs, where only clinically overt or recorded events are captured.

The findings of this study are especially important when considered in light of the HELIX trial and other LMIC studies, which reported increased mortality and no neuroprotective benefit of therapeutic hypothermia in low-resource settings (5, 15). In contrast, the present study suggests that, in a well-resourced tertiary Kenyan centre, therapeutic hypothermia can be delivered with a safety profile broadly comparable to that reported in high-income countries. This supports the argument that the effectiveness and safety of therapeutic hypothermia are highly context-dependent and critically reliant on the availability of intensive monitoring, laboratory support, trained staff, and multidisciplinary care.

From a health systems and policy perspective, these findings reinforce that therapeutic hypothermia should not be conceptualized as a simple technological intervention, but rather as a prolonged, multisystem physiological therapy. Its benefits and risks are inseparably linked, and its safe use requires substantial infrastructural and human resource investment.

Limitations

This study has several important limitations. First, its retrospective design makes it vulnerable to incomplete documentation and under-reporting of complications, particularly those that are transient or subclinical. Second, the sample size is relatively small and drawn from a single tertiary centre, which limits generalizability to other Kenyan or regional hospitals with fewer resources. Third, the study focuses exclusively on short-term outcomes and does not provide information on long-term neurodevelopmental status, which is the ultimate endpoint of therapeutic hypothermia. Finally, the lack of a non-cooled comparison group prevents causal inference regarding whether the observed complications are due to hypothermia itself or the underlying severity of illness.

Conclusion

Therapeutic hypothermia was successfully implemented for neonates with moderate to severe hypoxic-ischemic encephalopathy at Aga Khan University Hospital, Nairobi, with timely achievement and maintenance of target temperatures in all cases. Although the intervention was delivered in accordance with established protocols, a considerable proportion of neonates experienced short-term complications, most commonly electrolyte imbalances and seizures. Cardiovascular, respiratory, haematological, renal, and infectious complications were less frequent and were largely transient. These findings are consistent with existing evidence that therapeutic hypothermia, while neuroprotective, is associated with multisystem physiological disturbances that require close monitoring. Importantly, the overall safety profile observed in this tertiary care setting indicates that therapeutic hypothermia can be feasibly and safely administered in well-resourced centres within low- and middle-income countries. Ongoing staff training, robust monitoring systems, and context-specific protocols remain essential to optimize outcomes and minimise complications.

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Author Contribution

The author conceptualized and designed the study, collected and managed the data, performed data analysis, and interpreted the findings. The author also drafted, revised, and approved the final manuscript and is fully accountable for the accuracy and integrity of the work.

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Declarations

Ethical Approval and Consent to Participate

Ethical clearance was sought from the Institutional Scientific and Ethics Review Committee (ISERC) at the Aga Khan University, and permission to conduct the research was obtained from the head of the department. A research permit was additionally sought from NACOSTI. Patient confidentiality was observed, and their data was coded to declassify it. The primary researcher used a password to electronically encrypt data to reduce the risk of a breach of confidentiality.

Consent for Publication

Not Applicable

Conflict of Interest

The author declares no conflicts of interest.

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