# STUDY OF CLINICAL PROFILE IN NEONATES AFFECTED BY HIGH ENVIRONMENTAL TEMPERATURE DURING SUMMER MONTHS 2016

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**ABSTRACT**

**BACKGROUND**

Definite data on effect of heat in neonate is not documented, although there are numerous studies and evidences on hypothermia in neonates.

The aim of the study is to study the-

1. Clinical and biochemical profile of neonate with hyperthermia and heat-related illnesses.
2. Outcome of neonates presented with hyperthermia.

**MATERIALS AND METHODS**

A retrospective observational study was carried out in our secondary level care NICU during summer months (1st April-31st May, 2016). An unusually high number of neonatal hyperthermia cases seen during summer months. Environment temperature range 41°C-45.8°C in Raichur during our study period. Their case records were primarily reviewed for presenting signs and symptoms, clinical assessment and appropriate laboratory investigations were used as tools to rule out other causes.

**RESULTS**

Clinical, biochemical profile and outcome of 46 cases of hyperthermia in neonates were analysed. We observed most of neonates were term (100%) with normal birth weight (67.39%), born through normal delivery (80.43%) and on exclusive breastfeeding (84.78%) were affected by high temperatures. All of them were successfully treated and discharged within short duration of time. The mean duration of time is 3.32.

**CONCLUSION**

Hyperthermia is an acute illness with very good prognosis, if identified and treated, timely and promptly. Hyperthermia is likely to be missed due to too general signs or symptoms. Inadequacy of feeding especially in early neonatal period during summer months plays an important role in developing hyperthermia in neonates.

**KEYWORDS**

Neonate, Hyperthermia, Dehydration.

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## BACKGROUND

Heat-related illnesses include a broad spectrum of diseases from mild heat cramps to most severe life-threatening heat stroke. The U.S. Centre for Disease Control and Prevention lists the three most common types of Heat-Related Illnesses (HRI) as- heat cramps, heat exhaustion and heatstroke.[1] They often occur when individuals are exposed to extreme heat and may lead to death if not properly diagnosed and treated.[1,2,3] Virtually, all heat-related illnesses and death are preventable, if appropriate prevention strategies are adopted and implemented by individuals and communities.[4] Factors that affect individual vulnerability to heat-related mortality and morbidity not only include environmental conditions, but also the age, pre-existing diseases, exposure behavior pattern, etc. The social and economic factors also play a crucial role in influencing the vulnerability.[5,6,7] Various studies have shown that extremes of age children and elderly are more at risk.

Homeotherm in neonates requires a balance among heat production, skin blood flow, sweating and respiration.[8] Neonates are prone to insult caused by extremes of temperature due to factors like larger surface area to volume ratio, relatively small insulating body shell and poorly-developed sweat mechanism. In neonate, heat balance mechanism is very delicate and poorly developed. There is a

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very narrow range of temperature (36.8°C-37.5°C) between which a neonate can maintain a minimal metabolic rate to maintain body temperature.[9] Heat exchanges with the environment are greater in neonates than in the adult explaining the increased risk of body hypo or hyperthermia. The newborn infant is a homeotherm, but over a long period of time, he cannot maintain the thermal process. Neonate losses heat by various heat exchange mechanisms like conduction, convection, radiation and evaporation.[9,10] The below figure depicts thermoregulation in neonates.

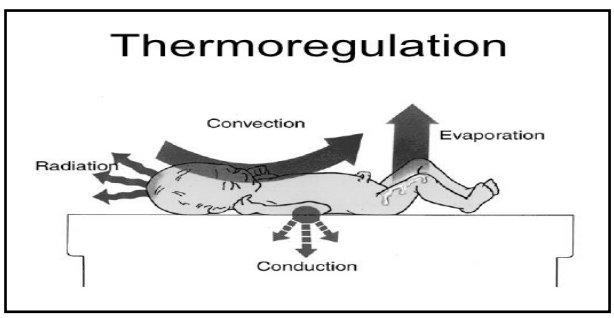


***Figure 1. Thermoregulation***

When the environmental temperature is higher than the body temperature, the only effective mechanism of heat loss is evaporation. Sweating is a relatively poor defense against overheating in newborn because production of sweat per unit area of skin is low as compared to a child or an adult. This is also a result of neurological rather than purely glandular immaturity, although there are numerous studies and evidences on hypothermia in neonates as it is one of the major causes of death in neonates, but definite data on effect of heat on neonate is ill documented.[11] This is perhaps due to the fact that most studies are carried out using data from developed countries where most indoor settings are climate controlled. Currently, available references show that high body temperature (>38°C) in neonate maybe because of infection or overheating. In a larger study of term infant with high body temperature, 90% were found to be overheated and 10% had infection.[9] Hyperthermia has been reported in neonates when they are exposed to very hot environment, direct sunlight or accidentally in NICU with overheated radiant warmer.[9] Unless there is high degree of suspicion, hyperthermia is likely to be missed due to "too general" signs or symptoms as a signal of thermal discomfort or get confused with hyperpyrexia. While the hyperpyrexia (febrile) neonate tries to conserve heat, a hyperthermic neonate will try to lose heat to restore normalcy.[9]

### Aims and Objectives

1. To study the clinical and biochemical profile of neonate presented with hyperthermia and heat-related illnesses.
2. To study the outcome of neonates presented with hyperthermia and heat-related illness.

## MATERIALS AND METHODS

An unusually high number of neonatal hyperthermia cases were reported at the secondary level care NICU of Sri Amrutha Children's Hospital during summer months (1st April - 31st May, 2016). A retrospective observational study was conducted to study the clinical and biochemical profile as well as outcome of neonatal hyperthermia cases. All the neonates who presented with hyperthermia (high body temperature >100°F) were selected. Their case records were primarily reviewed for other symptoms like weight loss (>10% of birth weight), dehydration, refusal to feed, vomiting, jaundice, decreased urine output, convulsions, lethargy, drowsiness, irritability, etc. As thorough clinical examination by senior faculty member of our hospital is a routine, their clinical assessment findings and appropriate laboratory investigations were used as a tool to rule out hyperpyrexia and other causes of such symptoms including septicaemia, acute gastroenteritis, infections of the central nervous system or infections like malaria.[11] Whenever such conditions were found, they were excluded from the study.

## RESULTS

There were 141 neonates admitted in our secondary level care NICU during April and May 2016. Amongst these 141 cases, 46 (32.62%) cases of neonatal hyperthermia were reported. The profile of these 46 cases of hyperthermia is described in Table 1. Various signs and symptoms like refusal to feed, lethargy, irritability, increased respiratory rate, etc. can appear anywhere in the spectrum of clinical illness following hyperthermia. Some of the common signs and symptoms observed in hyperthermic neonates are shown in Table 2. The biochemical profile of these neonates is shown in Table 3. Type of fluid required by these hyperthermic neonates is shown in Table 4. The duration of stay among hyperthermia cases ranged from 1-10 days with mean duration of stay 3.34 as shown in Table 5. Most of them also received 1st line antibiotics cefotaxime along with fluid support. However, no mortality was observed in our study.

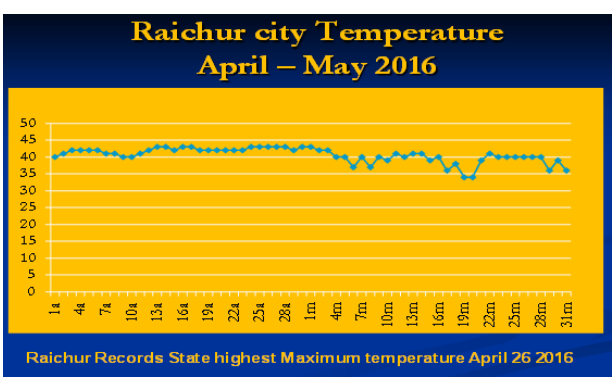


***Figure 2. Shows Raichur City Temperature During Our Study Period***

| Month (2016) | Cases | Percentage |
|---|---|---|
| April | 20 | 43.47% |
| May | 26 | 56.52% |
| **Gender** | | |
| Male | 28 | 60.86% |
| Female | 18 | 39.13% |
| **Gestational Age** | | |
| >37 weeks | 46 | 100% |
| <37 weeks | Nil | 0% |

| **Birth Weight** | | |
|---|---|---|
| >2.5 kg | 31 | 67.39% |
| 2.4-1.5 kg | 15 | 32.60% |
| <1.5 kg | Nil | 0% |
| **Mode of Delivery** | | |
| Vaginal | 37 | 80.43% |
| Caesarean section | 9 | 19.56% |
| **Age of Neonate at Time of Admission** | | |
| <72 hours | 2 | 4.34% |
| >72 hours - 7 days | 32 | 69.56% |
| 7 days - 14 days | 8 | 17.39% |
| >14 days | 4 | 8.69% |
| **Feeding Practices** | | |
| Ex. breastfeeding | 39 | 84.78% |
| Mixed feeding | 7 | 15.21% |

***Table 1. Clinical Profile of Hyperthermic Neonates***

| | **Cases (N=46)** | **Percentage** |
|---|---|---|
| Fever | 40 | 86.95% |
| Refusal of feeds | 37 | 80.43% |
| Dehydration | 40 | 86.95% |
| Weight loss >10% | 30 | 65.21% |
| Lethargy | 20 | 43.47% |
| Jaundice | 19 | 41.30% |
| Decreased urine output | 19 | 41.30% |
| Respiratory distress | 3 | 6.52% |
| Convulsions | 2 | 4.34% |

***Table 2. Signs and Symptoms of Hyperthermia***

| **Blood Urea (mg/dL)** | | |
|---|---|---|
| <50 | 7 | 15.25% |
| 50-100 | 16 | 44.44% |
| 100-200 | 18 | 39.13% |
| 200-300 | 3 | 8.33% |
| >300 | 2 | 5.55% |
| **Serum Creatinine (mg/dL)** | | |
| <0.6 | 1 | 2.17% |
| 0.6-0.8 | 11 | 23.91% |
| 0.9-1.3 | 17 | 36.95% |
| 1.4-2 | 5 | 10.86% |
| 2-4 | 6 | 13.04% |
| 4-6 | 2 | 4.34% |
| >6 | 4 | 8.69% |
| Hypernatraemia | 21 | 45.65% |
| Hyperkalaemia | 23 | 50.00% |
| Hyponatraemia | 3 | 6.52% |
| Hypocalcaemia | 2 | 4.34% |
| **C-Reactive Protein** | | |
| 1-5 | 38 | 82.60% |
| 5-10 | 2 | 4.34% |
| 10-20 | 1 | 2.17% |
| 20-30 | 3 | 6.52% |
| >30 | 2 | 4.34% |
| **Serum Bilirubin (mg/dL)** | | |
| <10 | 12 | 26.08% |
| 10-15 | 7 | 15.21% |
| 15-20 | 9 | 19.56% |
| >20 | Nil | Nil |

***Table 3. Biochemical Profile of Hyperthermic Neonates***

| **Type of Fluid** | **Number of Cases** | **Percentage** |
|---|---|---|
| 0.45% DNS | 22 | 47.82% |
| 10% electrolyte P | 22 | 47.82% |
| 10% dextrose | 2 | 4.37% |
| Normal saline bolus | 6 | 13.04% |
| Dopamine drip | 2 | 4.37% |

***Table 4. Shows Type of Parenteral Fluid Required by Hyperthermic Neonates***

| **Duration of Stay in NICU** | | |
|---|---|---|
| 1-3 days | 14 | 30.43% |
| 4-7 days | 29 | 63.04% |
| 8-10 days | 3 | 6.52% |
| >10 days | Nil | Nil |

***Table 5. Duration of Stay in NICU***

## DISCUSSION

The dry and warm condition in Raichur is conducive for heat waves. Summer of 2016 was one of the hottest summer on record in India. In May 2016, Raichur experienced a record setting heat wave with temperature reaching as high as 45.8°C.[1] This heat waves during the summer months in Raichur explains the most cases reporting in April followed by May.

In our study, higher number of males (60.86%) correlates with the slightly adverse sex ratio in favour of males. The gender difference between the neonates is not statistically significant. Most neonates (69.56%) were affected during the first 3-7 days of life and none of the neonates were reported after 14 days of life. This can be attributed not only to high environmental temperature, but can also be attributed to poorly-established feeding pattern and physiological phenomenon of fluid loss during the first days of life. All the neonates with hyperthermia were full term. Most neonates (67.39%) were of normal birth weight and few (32.60%) having low birth weight. No neonates from the very low birth weight category (<1.5 kg) developed hyperthermia. This can be explained by the fact that all preterm/very low birth weight neonates were admitted in NICU, which is a thermal control unit. Most neonates (80.43%) were delivered normally and remaining (19.56%) through caesarean section. Most of neonates affected were exclusive breastfed (84.78%) along with inadequacy in feeding was found supporting the fact that adequacy of feeding is directly linked with dehydration and poses an additional risk of hyperthermia to neonates. This shows that for prevention of dehydration and hyperthermia, adequacy of feeding is as important as exclusive breastfeeding particularly in early neonatal period. The duration of stay ranged from 1-10 days with mean duration of stay in hospital 3.32 only. The short duration of stay in hyperthermia signifies that it is an acute illness with very good prognosis if treated timely and promptly. This also clarifies and confirms that the clinical illness was surely a hyperthermic episode and not any other compatible illnesses like septicaemia. The relationship of dehydration with hyperthermia is bidirectional. Dehydration is not only the cause of hyperthermia, but also the effect of hyperthermia. This vicious relationship is aggravated by inadequacy of feeding. The presence of various signs supports the

sequential events during worsening of hyperthermia with refusal to feed and dehydration appearing first followed by irritability and lethargy. All the biochemical alterations shown in Table 3 can be explained by dehydration and hyperthermia. Immaturity of the kidneys to regulate fluid and electrolytes particularly in a neonate makes them more susceptible to biochemical alteration.[9,10] Very high values of blood urea (>300 mg/dL) and serum creatinine (>6 mg/dL) were observed in our study. Sepsis screen of most of neonates (89.11%) was negative, which rules out one of the common cause in neonates. The affected neonates were treated using parenteral fluids as per bodyweight; (47.82%) neonates required 0.45% DNS and other (47.82%) neonates required 10% electrolyte-P. Very few neonates (13.04%) required normal saline bolus and only (4.37%) were on inotropic support- dopamine drip. Clinical and biochemical parameters were monitored on regular basis. All 45 neonates recovered well within 72-96 hours as evidenced by decreasing blood parameters. Follow up done of all these neonates had normal postnatal course with normal weight gain.

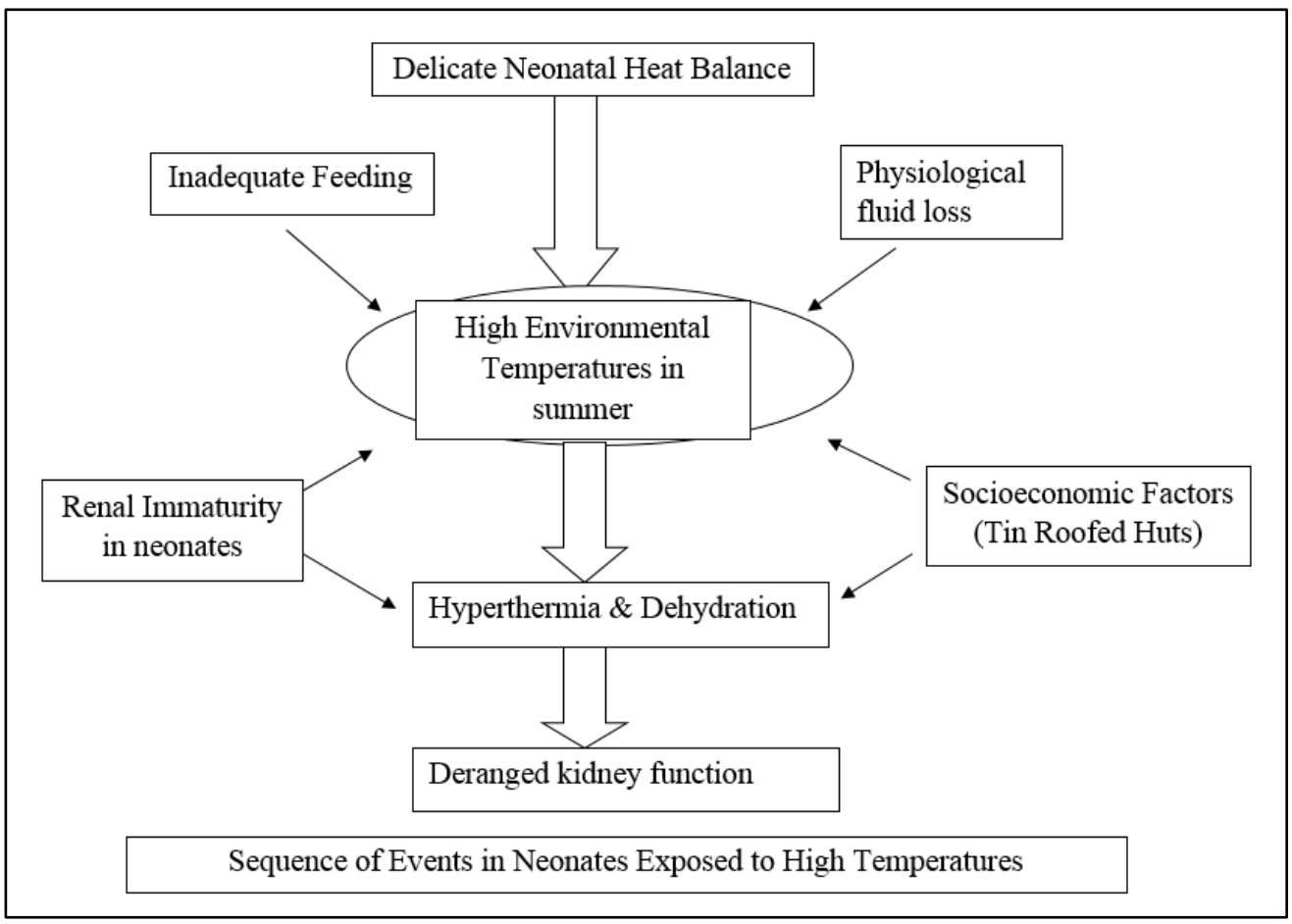


***Figure 3. Sequence of Events in Neonates Exposed to High Temperatures***

**CONCLUSION**

Hyperthermia in neonates is new concept arising in NICU. Hyperthermia is an acute illness with very good prognosis, if identified and treated timely and promptly. Hyperthermia and dehydration have bidirectional relationship making hyperthermia an important acute illness among neonates. Inadequacy of feeding especially in early neonatal period during summer months with high environmental temperature (heat wave) plays an important role in developing hyperthermia in neonates. There is lack of evidence of hyperthermia in literature when compared to infinite number of studies on hypothermia in neonates. Education and awareness needs to be created on effects and consequences of hyperthermia in neonates in communities.

**Recommendations**

Maintaining the room temperature and adequacy of feeding particularly in a postnatal period is crucial in preventing hyperthermia in neonates particularly during summer months with high environmental temperature or heat wave.

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