Therapeutic hypothermia with Whole Body Cooling and its Adverse Effects in Newborns with Perinatal Asphyxia

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ABSTRACT: Hypothermia is the most promising therapy care in infants with birth asphyxia. However during cooling period brain temperature fluctuation leads to cerebral edema and subsequently adverse effects on hemodynamic status and brain development. Therefore, this study conducted aim to determine side effects of hypothermia during cooling period in newborns with perinatal asphyxia. This is a descriptive-analytical study in which 25 infants with birth asphyxia were selected using census method from a teaching hospital affiliated with Tabriz University of Medical Sciences. These babies underwent topical head cooling up to target rectal of 32.5-33.5 °C temperature. They remained in this temperature for 72 hours and then it was gradually increased during 8-12 h to 36.5 °C. During the cooling period possible short term side effects were observed and mortality was assessed. Data was analyzed using SPSS/17 and descriptive (mean, standard deviation, number, percent) and repeated ANOVA statistics. According to the findings the mean time to cool newborns was 4.7± 1.8 hours after delivery while temperature fluctuation was about 0.41° C. Meanwhile seizure (n=21, 84%) and pulmonary hemorrhage (n=3,12%) were respectively the most and the least common short term side effects. Findings showed reduction in both frequency of incidence of side effects and newborns’ mortality during the intervention. Thus hypothermia can be one of the most effective therapeutic approaches to increase survival rate and quality of life of infants with birth asphyxia.

Keywords: Hypothermia complications, Whole body cooling, Asphyxia

INTRODUCTION

Birth asphyxia is a major cause of neonatal morbidity and mortality. The incidence of asphyxia in developed and developing country settings are respectively1-6 per thousand and 5-10 per thousand(Penneniger et al., 2001). Although accurate statistics are not available in our country, Iran, experts estimate that the asphyxia incidence rate among newborns in Tabriz is 60 per year while 30 of them are eligible for undergoing hypothermia therapy. 20-25 percent of these infants with moderate to severe asphyxia will survive and 60% of the survived babies die within the first 2-4 years due to sustained and severe damage to brain, heart and kidneys and the rest of 40% live with severe neurological impairments and cerebral palsy or mental retardation(Kliegman, 2007, Leifer and Hartson, 2003, Thomas N et al., 2011).

There are some alternative therapies for babies with birth asphyxia including, anticonvulsants, calcium blockers, antioxidants, corticosteroids(Kliegman, 2007). The most common method of treatment is whole body hypothermia used to treat a wide range of patients including cardiac arrest and cardiac surgery in adults, brain trauma injuries, perinatal asphyxia, etc(Nicholas Hoque et al., 2010). The outcomes of hypothermia in birth asphyxia are promising so it is considered a standard care procedure for this group of newborns(Nicholas Hoque et al., 2010, Simbruner et al., 2010).

Different methods used for cooling include head cooling using Cool Cap system, cooling mattress (automatic or manual), cold water mittens(Nicholas Hoque et al., 2010). The basis for cooling is always the
same for various methods but different surveys have reported different outcomes (Lin et al., 2006, Nicholas Hoque et al., 2010). In this regard, the most practical method of hypothermia is whole body cooling by turning off the warmer or using cold water bag (12-15 °C) that lower body temperature to 32.5-33.5°C (Guidelines, 2012).

However, no study was found on temperature fluctuations of perinatal asphyxia in newborns and hemodynamic management in cooling methods (head cooling and whole body cooling) (Nicholas Hoque et al., 2010, Shankaran, 2009). Body temperature fluctuation that causes brain temperature fluctuation can affect permeability of the blood brain barrier and more often occur during hypothermia. Re-warming procedures also negatively affect cerebral hemodynamics and brain development leading to increased mortality as well as short term and long term complications (Jacobs et al., 2007, Nicholas Hoque et al., 2010, Shankaran, 2009). his indicates the importance of nursing care plan for hypothermia (Shankaran et al., 2002). In recent years therapeutic cooling after perinatal asphyxia has been executed in one of the research and training hospitals of Tabriz by using whole body cooling system, turning off the warmer and using cold water bag. To date, despite extensive and repeated internet searches no study was found done in this regard. Therefore this survey aimed to determine hypothermia side effects on the babies with moderate to severe birth asphyxia.

METHODS

This analytical descriptive study was conducted through October 2010 and April 2013 in one of the research and training hospitals of Tabriz 35 neonates with perinatal asphyxia were selected by using census method. The inclusion criteria included the subject babies born at ≥35 weeks gestational age, postnatal age less than 6 hours, weighing more than 1800 gr, Apgar Score at less than 6 minutes at birth, umbilical artery PH=7 and base deficit ≤12 within the first 60 minutes of birth, moderate to severe hypoxic ischemic encephalopathy, absence of congenital anomalies and lack of IUGR. Obtaining informed consent from their parents, cooling procedure was carried out in three different times using whole body cooling, turning off the warmer and cold water bag (12-18).  

1) Passive and rapid cooling phase (within 1 hour) was initiated to reach the rectal goal temperature of 32.5-33.5°C.  
2) They were remained in goal temperature for 72 hours.  
3) The subjects were re-warmed within 8-12 hours until the normal body temperature of 36.5°C was reached.  

If the temperature does not reach the target one or fluctuate outside of the range 1-4 cold packs were applied to the head, neck, shoulders and chest until the core body temperature reaches to the goal rectal temperature. Short term effects of hypothermia were compared and the incidence of any adverse events were recorded. The subjects were excluded in the case of any adverse effects including bradycardia less than 70, hypertension unresponsive to vasoconstriction drugs, pulmonary hemorrhage, coagulopathies, resistant to hypoxia and supplemental oxygen (100%). Data was assessed using SPSS/ 17 and descriptive statistics (mean, SD, number, percentage) also variance analysis.

RESULTS

Of the 25 samples subjected to the study, there were 21 full- term infants (84%). 15 cases were female (60%), 13 were delivered vaginally (52%) and 12 infants had severe asphyxia (48%). During the cooling procedure (respectively) 17 and 8 neonates were receiving respectively mechanical ventilation using a ventilator (68%) and oxygen therapy using oxygen hood (32%). Among mothers of babies with asphyxia, respectively, 8% (2 ones), 8% (2 ones) and 4% (1 ones) had (respectively) gestational hypertension, gestational diabetes mellitus and gestational coagulopathies.

The mean temperature before cooling initiation was 35.75 ± 0.60 while the mean time to start the cooling process was 4.72 ± 1.8h after delivery. The subjects received whole body cooling therapy by turning off the warmer and preparing cold water bag. In 15 cases the body temperature was decreased during the first hour of cooling while the mean time required to reach a rectal temperature of 32.5-33.5 degrees C was 115 minutes. The subjects were kept at this target temperature for a period of 72 hours. Temperature fluctuations was about ±0.41°C and mean re-warming rate was ±45 degrees C/h (mean re-warming duration = 12.7±6.8 hours). Table 2 shows short time side effects of hypothermia. According to it the most and the least common complications were, respectively, seizure (n=28, 80%) and pulmonary hemorrhage (n=5, 14.3%). Figures 1 to 4 show fluctuations on blood pressures, heartbeat, platelets and seizure in subjects during five cooling process (baseline, during first 24 hours, the first 72 hours and at the end of the intervention).
DISCUSSION

The intervention resulted in a reduction in incidence of short time complications as well as mortality rate for hypothermia in babies with severe asphyxia. Hypothermia can be used as an additional therapeutic intervention in order to increase survival and improve quality of life.

Optimal therapeutic hypothermia allows rapid cooling to target temperature without any adverse effects (5) while avoiding temperature fluctuations during cooling and re-warming operations (13-14).

In our study the adverse effects of hypothermia included: bradycardia (n=15, 42.9%), hypotension (n=11, 31.4%), seizure (n=28, 80%), pulmonary hemorrhage (n=5, 14.3%), skin injuries (n=13, 37.1%), thrombocytopenia (n=9, 25.7%). Our findings were consistent with those reported by George Sim Bruner: hypertension (n=33, 53.2%), seizure (n=26, 41.9%), pulmonary hemorrhage (n=3, 4.8%), thrombocytopenia (n=16, 25.8%), cardiac arrhythmias (n=3, 4.8%)/(Simbruner et al., 2010). They were also consistent with the results of the studies performed on 2008 by Sechta Shankaran that showed incidence of cardiac arrhythmias (n=1, 1%), persistent acidosis (n=2, 2%), severe hemorrhage (n=3, 3%), skin injuries (n=4, 4%) and hypertension (n= 42, 42%)(Shankaran et al., 2008). According to the findings of a research conducted in 2012, overall incidence of seizure in babies with birth asphyxia under hypothermia was 42% (n=41) (Shankaran et al., 2012), which was consistent with ours, too.

A study by Denis Azzopardi indicated that hypothermia decreases mean heart rate and increases mean blood pressure in asphyxic newborns (Azzopardi et al., 2009) which was consistent with the findings of Thoresen. (Thoresen and Whitelaw, 2005).

The overall morbidity and mortality rate in our study (9 babies, 27.5%) was consistent with the results of the studies by George Sim Bruner et al 2012 (n=5, 8.1%), Shakaran et al (n=13, 13%), Nicholas Hoque (n=8, 10.96%), Hannah Glass (n=2, 6%), Thoresen et al (n=18). In another study Shakaran (2012) reported mortality rate of these newborns 41 ones (42%) which was consistent with ours, too.

There was no significant statistical relationship between maternal age, blood pressure, diabetes or coagulopathies status during pregnancy as well as birth weight, gestational age, pre-cooling temperature and the severity of hypoxic ischemic encephalopathy, the incidence of hypothermia short-term adverse effects, morbidity and mortality. It was consistent with the findings of a survey by W-H Zhou that showed no relationship among mortality rates, sever injuries, febrile seizures, hypoxic ischemic encephalopathy(Zhou et al., 2010). But there was no significant relation between severity of hypoxic ischemic encephalopathy and incidence of hypothermia short term side effects, morbidity and mortality rates in these babies (P=0.001).

The main limitation of the present study was the relatively small sample size due to time and place constraint that reduced the power of the study on short term adverse effects of hypothermia head cooling method, mortality and morbidity rates. Therefore, it is suggested that further studies be conducted in our country with a larger sample sizes and a larger spatial and temporal coverage. These validated findings will be utilized by medical services to identify training deficiencies and weaknesses during hypothermia treatment of babies with perinatal asphyxia. This can minimize or prevent subsequent short term side effects resulting in sustained neurological disturbances, mental retardation, longer hospital stay and higher treatment cost as well as mortality rate.

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REFERENCES


Guidelines NC. 2012. total body cooling guideline systemic cooling for neuroprotection in neonates>35 wks gestational age with hie. princess margaret perth western australia: king edward memorial.


Thomas n, george kc, sridhar s, kumar m, kuruvilla ka, jana ak 2011. Whole body cooling in newborn infants with perinatal asphyxial encephalopathy in a low resource setting: a feasibility trial. Indian pediatr, 48(6), 445-51.
