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ADVANCES IN PEDIATRICS

Hypothermia in Hypoxic Ischemic Encephalopathy

A 5-Year Experience at Phoenix Children's Hospital Neuro NICU

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Keywords

• Hypoxic ischemic encephalopathy • Therapeutic hypothermia
• Neurodevelopmental • NICU

Key points

- TH is safe and effective at improving survival and neurodevelopmental outcomes following HIE in term children.
- A properly staffed and equipped environment ensuring optimal monitoring and timely intervention is essential for the adequate management of these patients.
- The retrospective character of our study limited our capacity to identify the specific sources for our improved outcomes, further prospective efforts are necessary to define them.

INTRODUCTION

Perinatal cerebral hypoxia remains a significant cause of death and disability affecting approximately 1 to 2 per 1000 full-term newborns and up to 9 per 1000 preterm live births in developed countries [1–4]. These numbers are substantially higher in developing countries where its incidence can reach up to 75 per 1000 live births [5]. More than 15% of infants experiencing cerebral hypoxia die during the newborn period and from those who survive, a quarter develop permanent neurodevelopmental conditions ranging from cerebral palsy to area-specific learning disabilities and epilepsy [6].

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Limited therapeutic alternatives and a relative increment in the incidence of hypoxic ischemic encephalopathy (HIE) secondary to the constantly improving survival of preterm babies led to the identification and re-evaluation of new and former therapies [7–9]. Several studies focused on the evaluation of hypothermia as a potential neuroprotective alternative following brain insult in animal models [10–17]. During the past decade, several investigators have been working on the evaluation of the safety and effectiveness of therapeutic hypothermia (TH) in term babies with moderate to severe HIE; their results have been consistent at demonstrating improved survival and decreasing short-term disability [18–24].

In 2006, the National Institute of Child Health and Human Development invited a panel of experts to review the available evidence on TH in HIE. The panel concluded that TH was an evolving therapy and that given this condition, institutions providing TH in patients with HIE must develop appropriate cooling protocols and standardized testing mechanisms while gathering short- and long-term evidence about the safety and effectiveness of the therapy [25].

The administration of TH to term babies with HIE at Phoenix Children's Hospital (PCH) was strategically planned and instituted only after establishing a dedicated neurologic neonatal intensive care unit (Neuro NICU) that includes a multidisciplinary approach to care combining neonatology and neurocritical care rounds, pediatric neuroradiology support with prioritized neonatal magnetic resonance imaging (MRI) and MRI spectroscopy, bedside electroencephalographic monitoring, and cerebral near-infrared spectroscopy. A Neuro NICU provides patients with the necessary elements for TH treatment and continuous cerebral function monitoring to ensure optimum care during treatment.

METHODS

The PCH Neuro NICU database was queried to perform a systematic evaluation of the information from patients referred for and/or treated with TH at PCH for the management of HIE during the 5-year period between April 1, 2008 and March 31, 2013. This review was made under PCH Institutional Review Board (IRB) exempt determination #13-135.

COOLING PROTOCOLS

In 2008, the TH program was established at PCH based on previously established models using selective head cooling with the Olympic Cool-Cap from Tiara Medical Systems (Lakewood, OH) [21,26,27]. TH was initiated in infants greater than or equal to 36 weeks of gestational age and greater than or equal to 1800 g of weight who met specific inclusion criteria evaluated in two steps: presentation and neurologic examination (Table 1). Once enrolled, patients were cooled to a rectal temperature of $34.5 \pm 0.5^{\circ}C$ and maintained in such range for 72 hours. The rewarming period was aimed to an incremental rate of $0.5^{\circ}C$ per hour. After our first year using selective head cooling and despite the potential complications of whole-body hypothermia [22], it was decided through a consensus to change to whole-body hypothermia because scalp