



# Pediatric Clips

## Head cooling for neonatal hypoxic-ischemic encephalopathy

By Jay Dritz, MD

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Pediatric Clips from The Children's Medical Center of Dayton are quick reviews of common pediatric conditions.

Dayton Children's is the region's pediatric referral center for a 20-county area. As the only facility in the region with a full-time commitment to pediatrics, Dayton Children's offers a wide range of services in general pediatrics as well as in 35 subspecialty areas for infants, children and teens. We welcome your inquiries about services available – call 937-641-3666 or e-mail marketing@childrensdayton.org.



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### **HYPOXIC-ISCHEMIC ENCEPHALOPATHY (HIE)**

HIE is a condition of antepartum or intrapartum brain hypoxia (decreased oxygenation) and/or ischemia (impaired cerebral blood flow) leading to short-term and possibly long-term neurologic injury. Moderate to severe HIE is seen in up to one per 1000 live births and is associated with up to 60% mortality and long term neurologic deficits in up to 25% of survivors. Formerly known as birth asphyxia, it is now recognized that hypoxic-ischemic neurologic injury to the neonate can occur prior to the onset of labor, as well as at any point during the labor or birth process. In many cases of neonatal HIE, no identifiable etiology of the neurologic injury is found. However, certain events or circumstances such as shoulder dystocia, profuse hemorrhage, placental abruption, prolapsed cord, nuchal cord, uterine rupture or placenta previa put the infant being delivered at higher risk of hypoxic-ischemic brain injury. Additionally, meconium stained amniotic fluid, decreased fetal movement or nonreassuring fetal heart tones can be signs of distress that may be associated with hypoxia-ischemia.

Infants with HIE have a spectrum of abnormal clinical signs, ranging from hyperalertness and poor suck to stupor, coma and death (Table 1). Clinical signs of HIE are often present immediately after birth, but some signs, such as seizures, can take hours to appear. Multisystem involvement, including coagulopathy, renal insufficiency and cardiovascular collapse, is common due to global hypoxia-ischemia.

Almost all infants with mild HIE have good neurodevelopmental outcomes and those with severe HIE have poor outcomes. The outcomes for infants with moderate HIE are more variable. Long

term neurologic sequelae of HIE include blindness, deafness, mental retardation, cerebral palsy and seizure disorders.

### **TREATMENT OPTIONS**

Until recently, no therapeutic interventions existed other than supportive care for newborns with HIE. Ventilatory, nutritional and cardiovascular support are undertaken to assure adequate delivery of oxygen and glucose to the brain. Infants with seizures are given anticonvulsants.

Initial studies of hypothermia for neonatal HIE showed no serious adverse effects of hypothermia in newborns; therefore, randomized controlled trials of whole body cooling and selective head cooling for neuroprotection in HIE were conducted.

A Cochrane review of these trials demonstrated a significant improvement in the combined outcome of death and major neurologic disability at 18 months of age for infants who were cooled. The authors of the review concluded that "cooling decreases mortality, without increasing major neurodevelopmental disability in survivors."

Both modes of inducing hypothermia (whole body cooling and selective head cooling) have shown beneficial effects, but selective head cooling with mild systemic

hypothermia has the theoretical advantage of targeting cooling directly to the brain while avoiding systemic side effects of hypothermia.

### **THE COOL-CAP TRIAL**

In this trial, 234 term infants with moderate to severe HIE were randomized to conventional care or selective head cooling (while maintaining core body temperature 34-35°C) for 72 hours followed by rewarming to normothermia. The primary outcome was death or severe neurologic disability at 18 months (defined as gross motor function impairment, Bayley Mental Developmental Index <70 or bilateral cortical visual impairment).

Overall, a nonstatistically significant trend occurred towards decreased death (33% for cooled vs. 38% for control), severe neuromotor disability (19% for cooled vs. 31% for control) and the combined outcome of death and severe neuromotor disability (55% for cooled vs. 66% for control). Infants with the most severe HIE had minimal benefit from cooling, as expected from the very poor prognosis for these infants. When those infants were excluded, the benefit of head cooling achieved statistical significance. Improvement occurred in severe neuromotor disability (12% for cooled vs. 28% for control) and the combination of death and severe neuromotor disability (48% for cooled and 66% for control).

Table 1

The stages of HIE were classically defined by Sarnat and Sarnat and selected components are as follows.

Sarnat Staging	Mental Status	Breathing	Suck Reflex	Tone	Seizures	Probability of Death or Severe Handicap <sup>1</sup>
Stage 1	Hyperalert	Normal	Normal	Jittery	No	<1%
Stage 2	Lethargy	Periodic	Weak	Hypotonic	Yes	25%
Stage 3	Coma	Apnea	Absent	Flaccid	Yes	75%

Continued

Continued from the front.

The only side effects in the cooled infants were heart rate lowering, scalp edema and blood glucose elevations. These effects were all transient and all resolved shortly after warming to normal body temperature. No serious adverse effects were seen.

On the basis of these results, the United States Food and Drug Administration (FDA) approved the Olympic Cool-Cap® in December 2006, under strict guidelines for initiation of cooling. Only full-term infants with moderate to severe encephalopathy are candidates for cooling, as those infants with only mild forms of HIE are likely to improve with supportive care alone. Criteria for cooling can be found at [childrensdayton.org](http://childrensdayton.org).

### HEAD COOLING PROCEDURE

The earlier infants with HIE who meet criteria for cooling can be cooled, the better. To be cooled with the Cool-Cap

system, selective head cooling must commence within six hours of birth. Cooled water flows through a cap placed directly on the infant's scalp, which is then covered by an insulated outer cap. Active cooling with an initial water temperature of 8-12°C begins, and the core body temperature (as measured continuously with a rectal temperature probe) is maintained at 34-35°C using a radiant warmer under servo control. Hypothermia is maintained for 72 hours, after which passive rewarming to normothermia is allowed at no greater than 0.5°C per hour. Supportive care, including ventilatory, cardiovascular and fluid support is continued during the hypothermia period and seizures are treated; however, other interventions, stimulation and testing are kept to a minimum. After infants are warmed to normothermia, supportive care is continued. Feedings are begun as tolerated and routine NICU care continues for

the remainder of their hospitalization. Neurodevelopmental follow up is recommended for these infants, as they are still at high risk for neurologic disability and referral to therapy services (physical, occupational, developmental and speech) should be offered at the first sign of any delay.

### CONCLUSION

Hypoxic-ischemic encephalopathy continues to be a major cause of permanent neurologic injury in the newborn period. Selective head cooling with the Cool-Cap system has decreased the risk of death or severe neurologic injury in newborns with moderate to severe HIE. Dayton Children's is pleased to be able to offer the Cool-Cap system to eligible neonates.

### FEATURED SPECIALISTS



**JAY DRITZ, MD,** is a neonatologist at Dayton Children's. He received his medical degree from Washington University

in St. Louis and completed his pediatric residency and fellowship in neonatal-perinatal medicine at St. Louis Children's Hospital. He is board certified in neonatology.

### NEWBORN INTENSIVE CARE UNIT (NICU)

The Regional Level III Newborn Intensive Care Unit (NICU) at Dayton Children's is the only facility in the region with a full complement of pediatric subspecialists. Nationally recognized for design and innovation, the NICU was engineered to promote optimal growth and healing. Physicians are board certified in neonatal-perinatal medicine and are assisted by other members of the perinatal team including a neonatal nurse practitioner, nutritionist, social worker, speech therapist, OT/PT, clinical pharmacist, IV therapist and lactation consultant.

### TRANSPORT TEAM

Our specially-trained newborn transport team is available 24 hours a day to attend high-risk deliveries and stabilize sick newborns. If needed, the team can transport infants to an intensive care setting. To contact the newborn transport team, call 937-223-2229 (BABY).

### CONTACT INFORMATION

Call newborn medicine at 937-641-3414. Consultation and assessment of newborns hospitalized at other facilities is available 24 hours a day by calling the neonatologist on call at 937-641-3040.



For further information about The Children's Medical Center of Dayton or its specialists contact us at 937-641-3666 or [marketing@childrensdayton.org](mailto:marketing@childrensdayton.org).

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