Therapeutic hypothermia is an increasingly common treatment when a newborn has been deprived of oxygen during the birth process. But cooling can impact brain imaging results, and children with normal imaging may still experience cognitive, memory, and behavioral issues.

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### By || JESSE REITER AND REBECCA WALSH

Hypoxic-ischemic encephalopathy (HIE), which is sometimes referred to as birth asphyxia or neonatal encephalopathy, is a brain injury caused by a lack of oxygen or blood flow to the brain.<sup>1</sup> In babies, HIE can cause severe physical, cognitive, and motor disabilities, including cerebral palsy, learning disabilities, seizures, and behavioral issues.<sup>2</sup> HIE occurs in 3.75 of every 1,000 live births.<sup>3</sup>

In 2010, after years of clinical trials, therapeutic hypothermia or cooling became the standard of care for newborns of 36 or more weeks gestation with moderate to severe neonatal encephalopathy.<sup>4</sup> A cooling blanket usually is used to decrease the body temperature of the newborn to 33–35°C, and the cooler temperature slows the rate of swelling in the brain, leading to less cell damage. Babies are cooled for 72 hours and then are rewarmed.<sup>5</sup>

When a newborn's brain is asphyxiated, cooling should be administered as soon as possible but at least within six hours of birth.<sup>6</sup> Studies have shown that cooling lowers the rate of death and major disability in newborns with moderate to severe HIE.<sup>7</sup> When handling an HIE case, review the clinical picture of the baby and the test results to see whether the criteria for cooling were met and if so, whether and when cooling was administered. The absence of cooling in the presence of these criteria may indicate negligence and a violation of the standard of care.<sup>8</sup>

## **Brain Imaging**

MRI is the preferred method of imaging to identify and estimate long-term outcomes in neonates with HIE.<sup>9</sup> This is because MRI is noninvasive and free of radiation, provides clear images of the brain, and gives useful information about future outcomes.<sup>10</sup> If an MRI shows damage to the basal ganglia and other deep structures of the brain, this indicates that some degree of motor deficit is likely.<sup>11</sup> Damage to the cortical areas often leads to cognitive, emotional, behavioral, and adaptive difficulties. Often, damage to either area will lead to a mixed pattern of deficits.

One study found that abnormal MRI results predicted major disability in 73% of cases after cooling, backing up the idea that MRI can be used to help determine future outcomes.<sup>12</sup> However, the specific impacts of cooling on brain imaging results and long-term outcomes are not as clear. Researchers have identified changes to the expected patterns of injury after a baby with HIE has been cooled that are different from babies who are not cooled.<sup>13</sup> With more hospitals cooling babies, questions have arisen about the findings seen on MRI.

**Pseudonormalization.** Look to see how many days after birth the MRI was completed and whether cooling was done. Pseudonormalization happens when brain damage is present although an MRI appears to show a normal brain. Without cooling, pseudonormalization occurs six to eight days after birth on average, while with cooling, it can occur as long as 10 days after birth.<sup>14</sup>

Under this revised time line for pseudonormalization, doctors may assume that brain damage is less severe than it really is, leading to inaccurate estimates of future outcomes and delay in obtaining needed therapies.<sup>15</sup> This is important in birth injury cases because the MRI findings historically have been used to time when the injury occurred and with cooling, that timing can change. This is particularly true when general radiologists who may not have the experience necessary to pick up on subtle details and abnormal findings read hospital MRIs—so be sure to hire an experienced neuroradiologist to review all head imaging in birth injury cases.



Normal MRI does not rule out brain injury or poor outcome. Radiologists may not detect subtle lesions on an MRI that could be associated with a poor outcome.16 In fact, "as many as 26% of [babies] who underwent [cooling] and had normal MRI findings experienced abnormal neurodevelopmental outcomes."17 Studies have found that normal MRI findings after HIE may be seen in children with poor outcomes, especially if cooling is given and testing did not indicate normal cognitive function or language ability at two years of age.18 These children start to exhibit subtle changes as they get to preschool age. By the time they are in upper elementary school, their deficits are more pronounced, and they need special education services. Meet with school personnel and have neuropsychology testing done to learn more about your client's deficits. You may require expert testimony to confirm the deficits.

## Neurodevelopmental Outcomes After Cooling

Cooling decreases the likelihood of death and major disability in those with moderate to severe HIE.<sup>19</sup> However, the specific impacts on neurodevelopmental outcomes (outcomes related to brain function including memory, emotion, learning ability, and self-control) are not as clear.

*Motor deficits.* Many infants with HIE are later diagnosed with cerebral palsy, a group of conditions that affects muscle tone, posture, and movement.<sup>20</sup> Cooling has been shown to decrease the rate of cerebral palsy after HIE—in one study of babies at 18 to 22 months, researchers found that the rates of moderate or severe cerebral palsy were significantly lower in the group that was cooled.<sup>21</sup>

Cooling also may have an impact on the *severity* of cerebral palsy. Before cooling was used, severe cerebral palsy, including severe spastic quadriplegic cerebral palsy (a type of cerebral palsy that causes spasticity in all four limbs), was common for children who suffered HIE.<sup>22</sup> With cooling, cerebral palsy appears to be milder, and many children can walk later in life, although their injuries likely would have confined them to a wheelchair had they not been treated with cooling.<sup>23</sup>

When reviewing these cooling cases, keep in mind that motor deficits may be more subtle and may not be diagnosed as early as they were before the advent of cooling.

**Cognitive impairment:** While cooling often improves motor outcomes (cerebral palsy), it appears to be less effective in preventing cognitive disabilities. One study showed that babies who were cooled had higher survival rates and a lower incidence of neuromotor disability, but cognitive impairments were not reduced significantly.<sup>24</sup> Even with cooling, mild HIE that doesn't result in cerebral palsy may still impact the hippocampus and striatum, parts of the brain that are both heavily involved in memory and attention.<sup>25</sup>

Children without cerebral palsy who have moderate encephalopathy have been shown to have an increased risk of delayed school readiness in comparison with those without encephalopathy, as measured by performance on school-readiness tests.26 Look carefully at pediatric and school records for cognitive deficits and behavioral issues. Cooling may decrease the rate of cerebral palsy, but babies who have been cooled are often diagnosed during their toddler and elementary school years with other cognitive disabilities, such as developmental delay, language and speech delay, or memory problems. In some cases, cognitive damages may not be apparent until the child is 6 to 8 years old. This delay in identifying injuries could lead to claims being time-barred in some states. For instance, in Louisiana, the statute of limitations is one year—well before you would expect to see injuries manifest.<sup>27</sup>

When reviewing birth injuries cases in which a baby experienced HIE, brain MRIs may look different for babies who have been cooled—some injuries may not be as apparent. Even if children have normal imaging and do not exhibit signs of cerebral palsy, they still may experience cognitive, memory, and behavioral issues as a result of HIE.



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#### Notes

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