Prediction of outcome in asphyxiated newborns treated with hypothermia: Is a MRI scoring system described before the cooling era still useful?

Fatema Al Amrani a, Jaclyn Marcovitz b, Priscille-Nice Sanon b, May Khairy b,c, Christine Saint-Martin d, Michael Shevell a, Pia Wintermark b,*

a Division of Pediatric Neurology, Department of Pediatrics, Montreal Children’s Hospital, McGill University, Montreal, Canada
b Division of Newborn Medicine, Department of Pediatrics, Montreal Children’s Hospital, McGill University, Montreal, Canada
c Neonatal Follow-up Clinic, Department of Pediatrics, Montreal Children’s Hospital, McGill University, Montreal, Canada
d Department of Radiology, Montreal Children’s Hospital, McGill University, Montreal, Canada

Aim: To determine whether an MRI scoring system, which was validated in the pre-cooling era, can still predict the neurodevelopmental outcome of asphyxiated newborns treated with hypothermia at 2 years of age.

Patients and method: We conducted a retrospective cohort study of asphyxiated newborns treated with hypothermia. An MRI scoring system, which was validated in the pre-cooling era, was used to grade the severity of brain injury on the neonatal brain MRI. Their neurodevelopment was assessed around 2 years of age; adverse outcome included cerebral palsy, global developmental delay, and/or epilepsy.

Results: One hundred and sixty-nine newborns were included. Among the 131 newborns who survived and had a brain MRI during the neonatal period, 92% were evaluated around 2 years of age or later. Of these newborns, 37% displayed brain injury, and 23% developed an adverse outcome. Asphyxiated newborns treated with hypothermia who had an adverse outcome had a significantly higher MRI score (p < 0.001) compared to those without an adverse outcome.

Conclusion: An MRI scoring system that was validated before the cooling era is still able to reliably differentiate which of the asphyxiated newborns treated with hypothermia were more prone to develop an adverse outcome around 2 years of age.

© 2018 European Paediatric Neurology Society. Published by Elsevier Ltd. All rights reserved.

Please cite this article in press as: Al Amrani F, et al., Prediction of outcome in asphyxiated newborns treated with hypothermia: Is a MRI scoring system described before the cooling era still useful?, European Journal of Paediatric Neurology (2018), https://doi.org/10.1016/j.ejpn.2018.01.017
1. Introduction

Neonatal encephalopathy remains a major cause of mortality and morbidity for newborns. It accounts for an estimated 9% of all causes of mortality in children below 5 years. Hypothermia treatment has improved the prognosis of term newborns with neonatal encephalopathy by reducing both mortality and morbidity. However, long-term neurological sequelae still develop in approximately 65% of all the asphyxiated newborns treated with hypothermia, an improvement compared to 78% neurodevelopmental morbidity in the non-treated newborns.

Predicting the future neurodevelopmental outcome of newborns who suffer from neonatal encephalopathy remains a major challenge in the neonatal period. MRI scoring systems have been developed specifically for asphyxiated newborns treated with hypothermia, and have been shown to be effective predictors of neurodevelopmental outcomes in these newborns at 18–24 months of age. However, they include the gradation of injury in different regions of the cerebrum and are often cumbersome to assess reliably from one newborn to the other and from one assessor to another. Before the cooling era, several MRI scoring system were validated to grade the severity of the brain injury depicted on the MRIs performed on these asphyxiated newborns during the perinatal period, and to predict eventual neurodevelopmental outcome. In particular, one of these scoring systems described by Barkovich et al. was able to predict later neurodevelopmental outcome for these newborns at 12 months and 30 months. However, it is currently unclear whether the same scoring system can be used to evaluate asphyxiated newborns treated with hypothermia and to predict their later neurodevelopmental outcome, since it has been suggested by some researchers that hypothermia modifies the predictability of such a scoring system.

The objective of this study was to determine whether an MRI scoring system, which was described and validated by Barkovich et al. in the pre-cooling era, can still predict the neurodevelopmental outcome of asphyxiated newborns treated with hypothermia at 2 years of age.

2. Method

2.1. Participants

We conducted a retrospective cohort study of term asphyxiated newborns admitted to our neonatal intensive care unit from 2009 to 2014 — who met the following criteria for therapeutic hypothermia: (1) gestational age ≥ 36 weeks and birth weight > 1800 g, (2) evidence of fetal distress, i.e., a history of an acute perinatal event, cord pH < 7.0 or base deficit < -16 mEq/L, (3) evidence of neonatal distress, such as an Apgar score ≤ 5 at 10 min, postnatal blood gas pH obtained within the first hour of life ≤ 7.0 or base deficit ≤ -16 mEq/L, or continued need for ventilation initiated at birth and continued for at least 10 min, (4) evidence of moderate or severe encephalopathy revealed by an abnormal neurological exam and/or an amplitude-integrated electroencephalogram. Eligible patients received whole-body cooling to an oesophageal temperature of 33.5 °C, initiated within the first 6 h of life and continued for 72 h. The retrospectively collected database was approved by the institutional research ethics board, which waived the need for informed consent, since the data were collected from charts without requiring any additional testing of the newborns.

2.2. Brain magnetic resonance imaging (MRI)

As per the standard clinical protocol at our institution for the evaluation of brain injury in these newborns, a brain MRI scan was performed using a 3 T MRI scan after the hypothermia treatment was completed, usually around day 10 of life. Pediatric neuroradiologists, who were blinded to the clinical conditions of the infants, interpreted the MRI studies of these newborns and reported the severity of brain injury as per a MRI scoring system previously described and validated by Barkovich et al.; i.e., basal ganglia/watershed score (BG/W score) of 0 for “normal,” score of 1 for “abnormal signal in basal ganglia or thalamus”, score of 2 for “abnormal signal in cortex”, score of 3 for “abnormal signal in cortex and basal nuclei”, and score of 4 for “abnormal signal in entire cortex and basal nuclei”. T1-weighted imaging, T2-weighted imaging and/or diffusion-weighted imaging were used to score the MRIs depending on the timing of the imaging.

2.3. Neurodevelopmental assessment

The assessment was done around 2 years of age or later by specialized pediatricians in the neonatal follow-up clinic and/or pediatric neurologists using detailed histories and structured neurodevelopmental evaluations. Children were evaluated and followed by occupational therapists, physiotherapists, and/or speech language pathologists as clinically indicated. When present, these evaluations were used to support the diagnoses of cerebral palsy and global developmental delay. Electroencephalograms were performed to confirm the diagnosis of epilepsy. Adverse neurodevelopmental outcomes at around 2 years of age were defined as the presence of any of the following diagnoses:

(1) Cerebral palsy (CP): static, non-progressive motor impairment of early onset, featuring subjective changes in tone, muscle strength, posture, reflexes, and motor skills on a standard neurological examination. Levels of cerebral palsy were described according to Gross Motor Function Classification System (GMFCS).

(2) Global developmental delay (GDD): objective, significant delay in two or more developmental domains — gross or fine motor function, speech and language, cognition, personal social, and activities of daily living.

(3) Epilepsy: recurrent unprovoked seizures according to present International League Against Epilepsy guidelines. It was also noted if the seizures could be controlled or not with antiepileptic medications, and how many antiepileptic medications were needed.

The 2-year mark was chosen for the key neurodevelopmental outcome evaluation, as this is typically the youngest age when cerebral palsy can be fairly reliably confirmed.
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات