MRスペクトロスコピーにより早産児の脳の違いが示される（Abstract: CL-PDS-SU5A）

早産児に対するMRスペクトロスコピーにより白質の発達は灰白質の成長と"ずれている"ことが示された

Magnetic resonance spectroscopy on premature infants reveals white matter development is 'out of sync' with gray matter development

早産は、子供を先々衝動性や注意力散漫などの問題から自閉症や注意欠陥多動性障害などのさらに重症な状態のリスクを上昇させ得る白質の成長過程の引き金となるようである。構造的磁気共鳴画像検査（MRI）において何らかの白質の傷害は一目で明らかであったが、研究グループはMRスペクトロスコピー（MRS）を用いて光顕レベルでの違いを観察した。今回のスタディにおいて研究者らは満期産児51人および早産児30人において、成熟した白質および灰白質に関連するある化学物質の濃度を比較した。スタディ対象者群の構造的MRI所見は正常であったが、MRSの結果から白質の生物化学的成熟度は満期産児と早産児とで有意に異なることが示され、白質と灰白質の成熟のタイミングおよび同期の乖離が示唆された。新生児の脳は著明な可塑性を有しており、したがって、特に異常が早期に同定されれば治療的介入がより有効であり得る。このスタディ結果は2013年Radiological Society of North America年次集会で発表された。

Full Text

Premature birth appears to trigger developmental processes in the white matter of the brain that could put children at higher risk of problems later in life, according to a study presented at the 2013 annual meeting of the Radiological Society of North America (RSNA).

Preterm infants—generally those born 23 to 36 weeks after conception, as opposed to the normal 37- to 42-week gestation—face an increased risk of behavioral problems, ranging from impulsiveness and distractibility to more serious conditions like autism and attention deficit hyperactivity disorder (ADHD).

"In the United States, we have approximately 500,000 preterm births a year," said Stefan Blüml, Ph.D., director of the New Imaging Technology Lab at Children's Hospital Los Angeles and associate professor of research radiology at the University of Southern California in Los Angeles. "About 60,000 of these babies are at high risk for significant long-term problems, which means that this is a significant problem with enormous costs."

Dr. Blüml and colleagues have been studying preterm infants to learn more about how premature birth might cause changes in brain structure that may be associated with clinical problems observed later in life. Much of the focus has been on the brain's white matter, which transmits signals and enables communication between different parts of the brain. While some white matter damage is readily apparent on structural magnetic resonance imaging (MRI), Dr. Blüml's group has been using magnetic resonance spectroscopy (MRS) to look at differences on a microscopic level.

In this study, the researchers compared the concentrations of certain chemicals associated with mature white matter and gray matter in 51 full-term and 30 preterm infants. The study group had normal structural MRI findings, but MRS results showed significant differences in the biochemical maturation of white matter between the term and preterm infants, suggesting a disruption in the timing and synchronization of white and gray matter maturation.

"The road map of brain development is disturbed in these premature kids," Dr. Blüml said. "White matter development had an early start and was 'out of sync' with gray matter development."

This false start in white matter development is triggered by events after birth, according to Dr. Blüml.

"This timeline of events might be disturbed in premature kids because there are significant physiological switches at birth, as well as stimulatory events, that happen irrespective of gestational maturity of the newborn," he said. "The most apparent change is the amount of oxygen that is carried by the blood."

Dr. Blüml said that the amount of oxygen delivered to the fetus's developing brain in utero is quite low, and our brains have evolved to optimize development in that low oxygen environment. However, when infants are born, they are quickly exposed to a much more oxygen-rich environment.

"This change may be something premature brains are not ready for," he said.
While this change may cause irregularities in white matter development, Dr. Blüml noted that the newborn brain has a remarkable capacity to adapt or even "re-wire" itself—a concept known as plasticity. Plasticity not only allows the brain to govern new skills over the course of development, like learning to walk and read, but could also make the brains of preterm infants and young children more responsive to therapeutic interventions, particularly if any abnormalities are identified early.

"Our research points to the need to better understand the impact of prematurity on the timing of critical maturational processes and to develop therapies aimed at regulating brain development," Dr. Blüml said.

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