Using MEG for studying developmental somatosensory and motor problems*

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During the last decade magnetoencephalography (MEG) has been used to study the development of cortical somatosensory functioning in infants and children. The studies on typically developing infants and children have made it possible to extend the investigations on to clinical groups. MEG as a noninvasive neuroimaging method with good spatial and temporal resolution promises new vistas in studying the at-risk infants. For example, the preterm infants, whose survival has tremendously increased in the last decades, form a group of patients susceptible to neurological impairments, such as cerebral palsy (CP). The structural neuroimaging methods, e.g., cranial ultrasonography and magnetic resonance imaging, are known to partly fail in detection of milder abnormalities that may compromise later neurocognitive development of these preterm infants. Further, traditional evoked potential measurements with only few electrodes mainly help in detecting the problems in the somatosensory nerve conductions but tell little about the processing in the somatosensory cortices.

Our recent MEG studies on preterm infants suggest that somatosensory evoked magnetic fields (SEFs) may give valuable prognostic information on development of these infants. SEFs to tactile stimulation of the index finger were recorded at term age in 30 preterm infants (< 28 weeks). The SEFs measured at term age were compared with neurodevelopment at two years of age. Controls were 11 healthy infants born at term. All infants showed normal responses from the primary somatosensory cortex. However, in 30% of the preterm infants SEF was categorized abnormal on the basis of lack of response from the secondary somatosensory cortex (SII). The absent SII responses at term age were associated with poor mean developmental quotient and locomotor subscale assessed by Griffiths Mental and Developmental Scales at two years. White matter abnormalities in MRI were not associated with absent SII response or neurodevelopmental outcome.

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CP is characterized by difficulty in the control of movement and posture as a result of brain injury during early development. The motor symptoms may include hypertonia of the muscles in the affected limbs resulting in difficulties to relax and move the limbs. In addition to motor problems, tactile discrimination deficits are prevalent in people with CP. We measured SEFs in children with hemiplegic CP and showed that, though the symptoms and anatomical lesions were unilateral, the modifications in somatosensory cortical functioning were bilateral. In participants with CP the representation areas of digits II and V in the primary somatosensory cortex were closer to each other in both hemispheres compared with cortical representation of the fingers in children with neurotypical development. In addition, the morphology of SEFs to median nerve stimulation was altered in both affected and unaffected hemispheres of the children with CP.

In conclusion, MEG measurements, and specifically SEFs, may give additional information on the cortical functioning in infants and children with or at risk for developmental problems affecting the somatomotor system.