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MINISYMPOSIUM

State of the art in diffusion tensor imaging

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In March 2011, Prof. Guy Sebag invited me to serve as a guest editor for a state-of-the-art minisymposium for *Pediatric Radiology*. Of course I accepted this honour with pleasure and pride, especially because I was allowed to choose a topic within paediatric neuroradiology. I decided to focus this symposium on diffusion tensor imaging (DTI), one of the MRI tools that has truly revolutionised paediatric neuroradiology in the last decade. This technique not only increases our diagnostic sensitivity and specificity in many acute and chronic paediatric neurological diseases but also helps us better understand many complex developmental disorders.

Initially, diffusion-weighted imaging (DWI) was used for the early identification of ischaemic stroke, differentiation between vasogenic and cytotoxic oedema, and diagnosis of brain abscesses. However, with the development of DTI, multiple quantitative scalars (apparent diffusion coefficients, fractional anisotropy, radial and axial diffusivity) became available to characterise multiple normal and abnormal developmental processes within the brain like white matter myelination, progressive packing of white matter tracts and even migration of neurons. Most important, these objective, quantitative DTI scalars allow comparison with normative data. Consequently, disease processes may be diagnosed before they become visible on conventional T1/T2-weighted MRI or even before symptoms become clinically apparent. Moreover, DTI also allows the demonstration of neuro-architecture in two and three dimensions. The integrity, density and course of white-matter tracts can be studied and displayed in vivo, as MR tractography. This is especially helpful to begin to separate complex developmental disorders whose seemingly endless variety and overlapping symptoms and signs have defied prior classification. In combination with other advanced MRI techniques, like perfusion-weighted MRI, MR spectroscopy, connectivity MRI, resting-state MRI and functional MRI, intact and injured functional centres within the brain can be studied in detail. Consequently, the various DTI scalars and DTI tools described in this symposium may guide and monitor treatment options.

The unravelling of paediatric brain disorders is only possible when representatives of multiple scientific disciplines work together as a team. This is reflected in the group of authors that accepted my invitation and who all generously contributed in their respective fields. Susumu Mori and his team of MR physicists share their expertise in the quantitative evaluation of the normal brain development. Petra Hueppi and her team of developmental neuroscientists discuss the value of DTI in comparison with its competitors to better understand how the brain grows and progressively masters complex cognitive functions. Andrea Poretti, Charles Raybaud and I, a team of paediatric neuroradiologists and paediatric neurologists, present the significance of DTI in the evaluation and characterisation of complex brain malformations. Finally, neuroradiologists Jim Barkovich and Pratik Mukherjee, with physicist Duan Xu, discuss whether DTI scalars can predict functional outcome in paediatric brain injury.

I hope you will share my excitement and enjoy reading these updates on DTI in paediatric neuroradiology. It was a pleasure and honour to work with these expert authors and I would like to thank them once again for sharing their knowledge and expertise with us. Without their effort and commitment this would not have been possible. Thank you, merci bien, grazie, arigatou gozaimashita, xiè xie nin.

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