Characterizing the Etiology and Natural History of Neuro-developmental Abnormalities in Brain Structure of Children with New-onset Epilepsy

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The prevalence of epilepsy is the highest of all neurological disorders in the world, and there are an estimated sixty million peoples around the world diagnosed with epilepsy (WHO 2012). There are more than 40 types of epileptic syndromes that are defined by repeated epilepstiform discharges or seizures (England and others 2012). In this country epilepsy and seizures affect almost 3 million Americans of all ages, at an estimated annual cost of $15.5 billion in direct and indirect costs. In addition, approximately 200,000 new cases of seizures and epilepsy occur each year. And out of the ten percent of the American population who will experience a seizure in their lifetime, three percent will develop epilepsy by age 75 (England and others 2012). About 300,000 American children under the age of 14 have epilepsy. For some, epilepsy can be treated with medication and they eventually outgrow it, but for other, living with epilepsy is lifelong challenge. Furthermore, the impact of epilepsy on neurodevelopment and the long-term effects of epilepsy are poorly understood. Defining the effects of epilepsy in the long-term requires illuminating the role and possible interaction of a number of factors that influence this disorder. These factors include altered neurobiological processes that antedate the first recognized seizure epilepsy, and the changes caused by repeated seizures. The work of this thesis was to investigate and elucidate the state of the brain at onset of epilepsy and the subsequent changes caused by epileptic seizures. The potential for seizures to induce brain damage over time and the dynamics between seizures and other underlying etiology is controversial in the field of epilepsy research. This thesis examined the abnormalities in cerebral white matter and their clinical significance in pediatric epilepsy. Using Diffusion Tensor Imaging DTI as a tool, I investigated the differences between epileptic and normal children in cerebral white matter and the structural deficits and the neuropsychological abnormalities overtime caused by the disease. The goal of this research was to develop structural biomarkers to identify antecedent abnormalities and the cognitive substrates that are affected by subsequent chronic epilepsy. The aim is that these biomarkers would facilitate the treatment of cognitive abnormalities earlier. Furthermore, I anticipate that the findings of this thesis will help advance the efforts in disentangling the damage caused by seizures and other etiological factors that underlie epilepsy.