Resident Research Rotation Opportunity

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Area of Research Interest:

The main goal of our research is to understand the neuronal mechanisms that mediate the development of spasticity and motor dysfunction after spinal cord injury and cerebral palsy.

We examine how neurons and neuronal circuits in an injured nervous system adapt to produce the uncontrolled and unwanted muscle contractions that affect the majority of patients with spinal cord injury and cerebral palsy. One of the neurons that we study is the motoneuron that excites the muscles of the limbs to produce movement. Previously, we have shown that after spinal cord injury, the excessive and uncontrolled activity of motoneurons during muscle spasms is mediated, in large part, by the activation of voltage dependent persistent inward currents (PICs) in the human motoneuron. We study why motoneurons recover PICs and self sustained activity after chronic spinal cord injury and if similar mechanisms exist in cerebral palsy. We also examine the effects of intensive motor training in adults with incomplete spinal cord injuries and in babies with stroke.

We aim to develop new pharmacological and rehabilitative therapies to both control spasticity after trauma to the central nervous system and improve residual motor movements.

General Description of Potential Projects:

Mechanisms of Spasticity in Cerebral Palsy

Little is known about the causes of spasticity in patients with cerebral palsy (CP) where damage to cortical and sub-cortical areas of the brain occurs at or before birth. Like in stroke in adults, spasticity in CP involves flexed postures of the limbs and difficulty to rapidly and smoothly relax muscles following a voluntary contraction. We think that the excessive muscle activity in CP results from an uncontrolled descending drive from the brain or brainstem due to damage of the motor cortex and surrounding structures. We are also testing if sensory activation of the motoneurons in the spinal cord is normal in CP, which would question the use of dorsal rhizotomies (cutting sensory nerves) that are performed in children with CP. In this project we also use motor unit recordings in addition to brain stimulation techniques with transcranial magnetic stimulation (TMS) and brain imaging techniques with MRI. Minimum rotation time: 3-6 months

Motor Training after Perinatal Stroke

Neuronal activity during critical periods of development is crucial to normal development. Perinatal stroke, for example, reduces the number of active neurons from the injured motor cortex during a critical time when tracts from the motor cortex to the spinal cord (corticospinal tract or CST) are developing. Because the CST is essential for skilled movements including walking in humans, this deprivation of activity could lead to permanent impairment of function on the affected side. The objective of this project is to stimulate the damaged CST in the critical time of a child's development to improve motor functioning. Babies trained at a critical developmental period (8mo to 2 yrs) will be compared to babies trained at later developmental stages (2-3 yrs). Gait patterns, segmental reflexes, somatosensory evoked potentials and motor evoked potentials to transcranial magnetic stimulation will be assessed. This project is in collaboration with Dr. Jaynie Yang in Physical Therapy. Minimum rotation time: 3 months