Online Proceedings

Session 1B

Unmasking Brain Function: From Single Molecules to Complex Information Processing

Session Moderator: Tom Daniel, Biology
MGH 228
12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Cervical and Thoracic Mapping of Respiratory Motor Neurons

Comron Nasser Ganji, Senior, Neurobiology
Mary Gates Scholar, UW Honors Program
Mentor: Michael Sunshine, Rehabilitation Medicine
Mentor: Chet Moritz, Physiology & Biophysics

Respiratory dysfunction is the leading cause of death in the acute phase of high-cervical spinal cord injuries (SCIs). While survivors of high-cervical SCIs regain some of their respiratory function, many individuals require assisted ventilation. Despite the fact that there are currently many ongoing treatments, more needs to be understood about the anatomy and physiology of the respiratory pathways in the spinal cord in order to find cures for those suffering from high-cervical SCIs. Recent rodent studies using intra-spinal micro-stimulation (ISMS) for forelimb motor recovery has shown moderate functional recovery. In this study we mapped the motor neuron pools of three muscles used in respiration along the cervical and upper thoracic spinal cord. Additionally we explored the extent to which we can activate those muscle with ISMS in spinally intact rats.

Session 2E

Stem Cells and Regenerative Medicine

Session Moderator: Benjamin Freedman, Medicine/Nephrology
MGH 238
3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Automated Rehabilitative Training and Epidural Stimulation Following Spinal Cord Injury

Alice Catherine Bosma Moody, Senior, Neurobiology, Bioengineering
Goldwater Scholar, UW Honors Program
Mentor: Michael Sunshine, Rehabilitation Medicine
Mentor: Chet Moritz, Physiology & Biophysics

Over a quarter of a million individuals live with Spinal Cord Injury (SCI) in the United States and experience debilitating chronic conditions, reduction of quality of life, and an accumulation of high healthcare costs. Recent clinical studies have shown that epidural spinal stimulation can lead to improvements in motor function, weight bearing, and autonomic dysreflexia among patients with SCI. It is thought that epidural stimulation creates an excitatory environment in the spinal cord and allows descending signals that were previously too weak to effect a motor output to reach a supra-threshold level. While the results are promising, both the mechanism of action and optimal parameters for stimulation and rehabilitation remain unknown. Therefore, in order to further develop this potential therapy, it is necessary to create a clinically relevant research model for the study of the treatment in question. This project addresses this through the development of an automated rehabilitative device for animal subjects following spinal cord injury, designed to mimic the extensive rehabilitation received by human patients with SCI and measure functional recovery following injury and during epidural stimulation treatment. Initial results show that subjects interact with the automated device, indicating a potential for more widespread implementation. Specifically, this high-throughput and automated system will be initially utilized for the study of the effects of epidural spinal stimulation in the rat cervical cord following contusion injury in order to quantify both transient and lasting motor improvements.

SESSION 2E

STEM CELLS AND REGENERATIVE MEDICINE

Session Moderator: Benjamin Freedman, Medicine/Nephrology

MGH 238

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Assessment of Recovery from Spinal Cord Injury using a Haptic Interface Device

Oliver Riley (Oliver) Stanley, Senior, Bioengineering, Neurobiology

Levinson Emerging Scholar, Mary Gates Scholar, UW Honors Program

Mentor: Chet Moritz, Physiology & Biophysics

Spinal cord injury (SCI) can severely impair quality of life. While there are a variety of accommodations for individuals with SCI, there are no clinically available treatments which restore pre-injury levels of function to these patients. The optimization of emerging treatments for SCI will require a large amount of detailed experimental trial data in animal models. Assessments of trained motor behavior in animal models of SCI recovery typically fail to capture information about fine gradations in the course of recovery, which interferes with the development of new restorative treatments. To better characterize these gradations during the study of an emerging method for cervical SCI rehabilitation, I monitored forelimb movements of a cohort of injured rats during a motor behavior task using a high-precision haptic interface device - a machine which simulates physical interactions with virtual objects or events by applying forces to its user. I used the motion information gathered by this device to trigger electrical stimulation of the spinal cord to enhance attempted movements and encourage Hebbian plasticity within the spinal cord. Functional recovery of strength and range of motion was assessed relative to pre-injury baseline, demonstrating the utility of 3D haptic interfaces for the assessment of promising SCI treatments. Our goal is to help individuals with disabilities due to spinal cord injury regain function and independence by quantifying, optimizing, and the accelerating the translation of potential new treatments for SCI using these precise and clinically relevant recovery measures.