Laying the Groundwork for More Personalized Rehabilitation Therapies After Stroke

September 19

Tuesday, 12:30 pm

Billings Building—Rosedale Room

SPEAKER:

Ania Busza, M.D., Ph.D.

Assistant Professor of Neurology, Neuroscience, Neurosurgery, and Physical Medicine and Rehabilitation

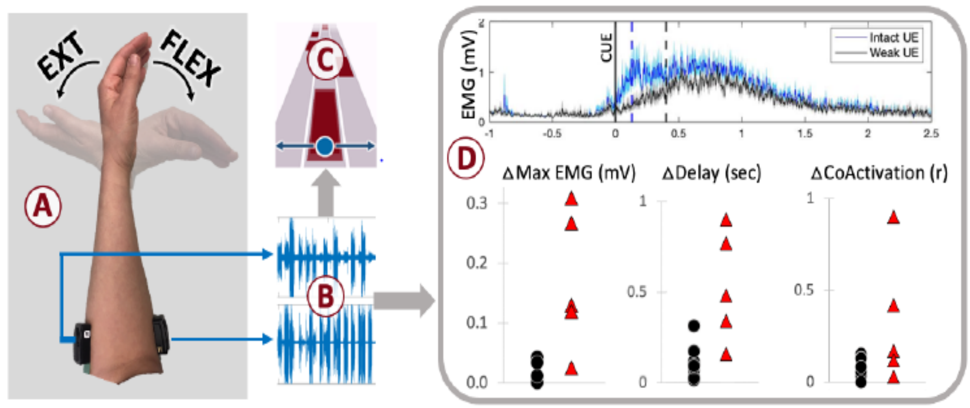
The University of Rochester School of Medicine and Dentistry

Host: Dianna E. Willis, Ph.D.

For more information contact
Darlene White
daw9085@med.cornell.edu

Abstract

Stroke is the leading cause of adult disability in the US. Of those who receive rehabilitation therapy, approximately 40% have chronically impaired motor function of the upper extremity, contributing to decreased quality of life and increased societal burden of stroke. Currently, clinical rehabilitation focuses on repetitive motor exercises, but interventions are not adapted to individual stroke lesion location or predicted trajectory of recovery. Prior studies have identified distinct impairments of motor control that contribute to poor function at the chronic stage and likely depend on neuroanatomical structures damaged by the stroke, but the details of what contributes to development of these impairments and timing of when they emerge remains unclear. In order to create optimal rehabilitation strategies and maximize each individual patient's rehabilitation potential, we need better methods for predicting and treating these motor control impairments. In this talk, I will describe several projects in my lab including (1) a longitudinal study using an electromyographic computer interface to study motor impairments in patients with arm impairment after stroke (2) using gyroscope and accelerometer data from wearable sensors to categorize and quantify rehabilitation dose and (3) adaptation of a VR and finger tracking system to study proprioception in patients with cerebellar damage due to stroke. By better understanding the relationship between stroke location, rehabilitation practice, and recovery, we ultimately hope to contribute towards the development of personalized and more effective therapies for patients with disability from stroke.



An Electromyographic Computer Interface for measuring motor control abnormalities after stroke. (A) wireless EMG sensors are placed on wrist flexor/extensor muscle groups (B) EMG signals are collected, filtered, then used to (C) control the left/right movement of a computer game (see text for details). In parallel, data is collected for analysis of EMG signals (D) *Upper Panel*: Mean muscle activation delay (dotted lines) as compared to game Cue for movement (solid line) in the intact UE (blue) and hemiparetic UE (black). x-axis: time (sec), y-axis: mean EMG envelope (mV) +/- SEM. *Lower panels:* Difference in measures between both arms of 10 Healthy Controls (black circles) and 5 patients with hemiparesis due to recent ischemic stroke (red triangles). *Left panel*: Mean difference of maximum extensor EMG (mV), *Middle panel:* Mean difference of muscle activation delay (in seconds), *Right panel:* Mean difference between flexor/extensor coactivation (r) between the subject's two arms. Data was acquired in isometric conditions; for simplicity panel (A) is shown without immobilizing hand brace.

Publications

1. Balestra N, Sharma G, Riek LM, Busza A. *Automatic Identification of Upper Extremity Rehabilitation Exercise Type and Dose Using Body-Worn Sensors and Machine Learning.* A Pilot Study. Digital biomarkers. 2021 5(2):158-166. Epub 2021 Jul 02.

2. Isenstein EL, Waz T, LoPrete A, Hernandez Y, Knight EJ, Busza A, Tadin D. *Rapid assessment of hand reaching using virtual reality and application in cerebellar stroke.* PloS one.. 2022 17(9):e0275220. Epub 2022 Sep 29.

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Academic Affiliate of Weill Cornell Medicine
785 Mamaroneck Avenue, White Plains, NY 10605
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