Title: A Preliminary Investigation of Nociceptive Pathways in Cerebral Palsy via Heat Evoked Potentials

Authors: Kristin Frenn, Lisa Lykken, Frank Symons, Chantel Barney

Introduction: Among developmental disabilities, cerebral palsy (CP) is the most common cause of motor disabilities in children. Chronic pain is a common secondary condition associated with CP. To date, research investigating somatosensory function in CP has largely focused on assessing the large-fibers mediating tactile sensation (e.g., vibration detection, 2-point touch discrimination). While much of this work suggests tactile sensation may be reduced in CP, there is reason to consider whether small-fibers conducting nociceptive (pain) signals may also be impaired. Riquelme and Montoya (2010) found that participants with CP had reduced sensitivity for non-painful touch but increased sensitivity to painful touch (pressure). Participants with CP had enhanced pain evoked potentials compared to controls. We aimed to extend this work by developing a protocol to assess heat evoked potentials. As such, the goal of this pilot study was to establish the feasibility of our procedures for detecting and measuring heat evoked potentials in CP and control participants.

Method: In this ongoing case-controlled preliminary investigation of somatosensory function in CP, we tested the feasibility of a contact heat evoked potential (CHEP) approach. To date, we have enrolled 4 patients with CP (mean age = 21.8 years, SD = 1.0; 100% female) and 11 controls (mean age = 19.0 years, SD = 2.42; 45.5% female). A contact heat-evoked potential stimulator (Medoc, Israel) was used to deliver a rapid (<300ms) heat stimulation at 51°C. The stimuli were applied repeatedly within the target dermatomes for the distal volar forearm (C5 dermatome) and the distal lateral lower leg about 5 cm above the lateral malleolus (L5 dermatome). Three consecutive blocks of 20 stimuli were administered to the participants left arm followed by three consecutive blocks of stimuli to the left leg. Participants were asked to rate their pain using a numeric rating scale (scored 0-10) after each stimulus. The latency and amplitude of the evoked potentials were measured using EEG, with electrodes placed according to the international 10-20 system. Data were segmented to create trials -200ms and 1200ms around the CHEPs stimuli. Available clean trials were used to create and average waveform for each participant. The N2 and P2 latencies as well as the peak-to-peak N2-P2 amplitude of the evoked potential were reported from the Cz (vertex) electrode. CHEPs latency and amplitude values appear to be, in part, influenced by age and gender which we take into account for analyses.

Results: Because one participant with CP withdrew from the study after experiencing the stimuli and a second participant with CP did not complete the leg portion of the study due to mechanical failure we report on arm stimulus trials only. On average, participants with CP (all female; n=3) rated the arm stimuli as 4.6 out of 10 (SD = 2.13) compared to 3.1 (SD=0.58) in control females and 3.2 (SD = 0.85) in control males. For females with CP, the peak-to-peak N2-P2 amplitude of the evoked potential was on average 22.0µV (SD = 8.28; range 9.8 – 34.4µV) compared to 12.0µV (SD = 3.14; range 7.3-16.9µV) for female controls and 14.2µV (SD = 3.62; range 8.1-21.2µV) for male controls. For females with CP, latency to N2 and P2 peaks were on average 532.23ms and 677.73ms respectively. For controls, average latency to N2 and P2 peaks were 563.74ms and 704.5ms for female controls and 580.1ms and 736.65ms for male controls respectively.

Discussion: To our knowledge, this is the first documentation of heat evoked potential amplitude and latency in CP. This preliminary data demonstrates 1) the feasibility of our CHEP protocol in this population, and 2) females with CP have detectable heat evoked potentials on EEG using this methodology. CHEPs addresses the continuing need for additional objective, reliable, sensitive tools for testing somatosensory function in the possible presence of small fiber function disturbance. These preliminary results may indicate differences between CP and control participants EEG response to CHEPs, however more participants are needed to determine if the latency and amplitude differences described above are significant.

References/Citations: