

Award- Eligible Poster

Acute Intermittent Hypoxia Improves Airway Protection during Swallowing in Chronic Cervical Spinal Cord Injury

Abstract 179 | Poster 1

Alicia Vose, PhD, CCC-SLP University of Florida

Objective: In acute spinal cord injury (SCI), ~60% of individuals experience swallowing impairments (dysphagia) due to prolonged intubation, prevertebral swelling, or neck surgery, which can impair upper airway function and increase aspiration risk. Yet, despite the negative impact of aspiration on pulmonary health, it is unknown if dysphagia persists in chronic SCI and whether it contributes to high respiratory infection rates. During swallowing, adequate airway closure is essential for preventing material from entering the trachea/lungs (aspiration) and requires precise timing and coordination of upper airway structures. Deficits in airway closure significantly increase the risk of developing pneumonia – a leading cause of respiratory illness and mortality. Swallowing impairment—and subsequent aspiration—may be an under-recognized yet profound complication of chronic SCI. If airway closure deficits are evident, interventions are needed to address inadequate airway protection. The aims of this ongoing case series are to characterize swallow function in 4 adults with chronic SCI and examine changes after daily exposure to acute intermittent hypoxia (AIH). Although AIH-induced plasticity has been predominantly shown in the phrenic and limb motor systems, AIH triggers similar plasticity in many other motor neuron pools, including those critical for swallowing. We hypothesized that exposure to daily AIH would improve the timing of airway closure in chronic SCI. **Methods:** 4 males with chronic SCI (28.5 + 9 yrs. of age; 2-9 yrs. post-SCI; C1-C6 AIS A-C) completed blinded, random-ordered 5-day protocols of AIH and SHAM, >3 weeks apart. Pre- and 1-day post-intervention tests included a videofluoroscopic swallowing exam using full-resolution x-ray videos (30 frames/sec) to assess the frequency and severity of aspiration, as well as swallow function; specifically, timing of airway closure. AIH intervention consisted of 15, 1-minute bouts of breathing 9% inspired O₂, interspersed with 1.5-minute bouts of room air (21% O₂). Sham treatments involved room air only. **Results:** All participants had baseline deficits in airway closure with thin liquid swallows. Participants took notably longer to close the airway (415+30ms; >2SD outside the mean) compared to an established normative range (21-379ms). In addition, the duration of airway closure was shorter (213+80ms, >2SD outside the mean) than the normative lower range (220-652ms). In 2/4 participants, timing deficits led to episodes of silent aspiration, meaning participants were unaware of aspiration and had no motor response (i.e., cough). However, after 5 days of AIH, airway closure duration increased by 66ms (34%; 286+30ms), and the airway closed 136ms faster (27%; 279+30ms). Importantly, airway closure timing metrics were within the normative range post-AIH. For those who aspirated at baseline, improved airway closure timing eliminated episodes of aspiration post-AIH. There were no airway closure changes after Sham (<5%). **Conclusion:** Airway closure deficits and aspiration may be an undiscovered, silent contributor to respiratory illness in chronic SCI. AIH may improve airway closure, thereby preventing aspiration, reducing infection risk, and preserving pulmonary health after SCI.

Learning Objective 1 List common causes of swallowing impairment in acute SCI.

Learning Objective 2 Discuss the impact of airway closure deficits on pulmonary health.

Learning Objective 3 Discuss the negative impact of aspiration in chronic SCI.

Award- Eligible Poster

Dating Satisfaction and Sexual Behaviors of Adults with Pediatric-Onset Spinal Cord Injury

Abstract 30 | Poster 2

Justine Stewart, PsyD, Shriners Children's Chicago

Background: Involvement in romantic relationships and physical intimacy are significant factors for quality of life. Physiological and psychological changes following an SCI can pose obstacles to physical intimacy (Papadakis et al., 2017). There is a growing literature that adults with pediatric-onset SCI delay dating and have reduced sexual activity (Ferreiro-Velasco et al, 2005; Nosek et al., 2001). Objectives: (1) Examine the prevalence of sexual behaviors: (a) physical intimacy, (b) sexual intercourse, and (c) use of sexual aides in a sample of non-cohabitating adults with pediatric-onset SCI. (2) Examine the associations between post-injury sexual aid use, frequency of physical intimacy, age of injury, and duration of injury, on dating satisfaction. Population: Non-cohabitating adults who sustained an SCI before age 19. Participants were at least 19-years old at time of interview and received pediatric rehabilitation treatment in a U.S. hospital system. Method: This study uses cross sectional data from a longitudinal outcome study. Data collected through a structured interview administered over the phone or in-person. Interview questions assessed functioning across physical, psychological, and social domains. Data analyses included descriptive statistics and hierarchical regression. Stepwise regression analyses conducted with dating satisfaction measured on a 6-point Likert scale, controlling for race, gender, education, employment, and injury severity. Predictor variables were physical intimacy frequency, sexual intercourse frequency, use of sex aides, age of injury, and duration of injury. Results: Among 196 individuals, 62% were male with a mean age of 35.9 years (SD = 8.85) and mean age at injury of 13.4 years (SD = 4.8). 29% of participants were full-time employed, 56% had tetraplegia, and 63% had complete injuries. Only 16% of participants described dating as not important, while the rest (84%) rated dating as a little important to extremely important. The majority of participants (67%) reported they were between moderately and very satisfied with their current dating life. Approximately half (51%) of participants had no physical intimacy in the past year. Of those who reported being physically intimate, frequency was reported as 11.7% monthly, 18.9% weekly, and 7.7% daily. Similarly, 56% had not had sexual intercourse in the past year. Monthly, weekly, and daily sexual intercourse was endorsed by 15.3%, 15.3%, and 2% of participants, respectively. Just over a-third (35.2%) reported post-injury use of sexual aides. In the model, age of injury, duration of injury, and use of sexual aides were not associated with dating satisfaction. Participants who had physical intimacy monthly ($p < .01$), weekly ($p < .01$), and daily ($p < .01$) had significantly higher rates of dating satisfaction compared to those having physical intimacy yearly. Conclusion: Dating is important to adults with pediatric-onset SCI. Although physical intimacy and sexual intercourse do not occur for about half the sample, the majority were satisfied with their dating life. Having physical intimacy at least monthly was linked to higher dating satisfaction. Clinicians and researchers should assess perceived barriers, whether psychosocial or physical, to physical intimacy.

Learning Objective 1 Assess the frequency of physical intimacy and sexual intercourse for adults with pediatric-onset SCI

Learning Objective 2 Assess the relationship between frequency physical intimacy and dating satisfaction

Learning Objective 3 Assess the relationship between use of sexual aides and dating satisfaction

Award- Eligible Poster

Working Hard or Hardly Working? Comparing Physical Therapist Burden During Different Gait Training Approaches with A Patient with An Acute Spinal Cord Injury

Abstract 46 | Poster 3

Lindsey Wynne, PT, DPT, NCS, Baylor Scott & White Institute for Rehabilitation- Dallas; Baylor Scott & White Research Institute

Background and Purpose: Delivering effective gait training interventions to patients following acute spinal cord injury (SCI) during inpatient rehabilitation can create high burden for the physical therapist (PT) providing the training. Anecdotally, different modalities of gait training place differing degrees of burden on the PT. The purpose of this case report is to describe the physiological and perceptual burden on a PT delivering two different modalities of gait training for a patient with SCI. **Case Description:** A 34-year-old female PT with 9 years of neurological rehabilitation experience delivered two separate gait training interventions via (1) overground robotic exoskeleton (ORE) and (2) overground body weight support LiteGait system (LG) during which physiological and perceptual burden were recorded. Physiological burden was measured using heart rate (HR), metabolic equivalents (METs), energy expenditure (EE), and respiratory exchange ratio (RER). Perceptual burden was assessed by the NASA Task Load Index (workload questionnaire of mental demand, physical demand, temporal demand, performance, effort, and frustration scaled from 0-100). Physiological variables were measured using a wearable metabolic system (K5, COSMED, Rome, Italy) worn by the PT during gait interventions. The patient for both gait training sessions was a 59-year-old male admitted to inpatient rehabilitation 12 days after traumatic SCI classified as C4 ASIA Impairment Scale D with a body mass index of 29.3. The patient presented with functional dependency (total assistance for transfers) and was unable to ambulate (Walking Index for Spinal Cord Injury II= 0/20). Gait training performance metrics [step count, walk time, time in moderate to vigorous intensity (MVI), and rate of perceived exertion (RPE)] achieved by the patient were recorded for each session. **Outcomes:** PT outcomes during ORE were HR=90 [range=79-101] bpm with 0% of the session spent at MVI; METs= 4.4 [1.9- 5.4] with 9.4%, 90.6%, and 0% of the session spent in light, moderate, and vigorous intensity, respectively; EE=308 kcal/hour; RER=0.81 [0.72-0.91]; and perceptual burden was scored at 37. During LG, PT outcomes were HR=115 [81-149] bpm with 41.8% of the session spent at MVI; METs=5.3 [1.9-7.7] with 25.5%, 18.2%, and 56.4% of the spent in light, moderate, and vigorous intensity, respectively; EE=381 kcal/hour; RER=0.90 [0.77-1.13]; and perceptual burden was 49. Patient metrics during ORE were 1,013 steps during 25 minutes walking, 87% of the session in MVI, and RPE of 4. Patient metrics during LG were 684 steps during 20 minutes walking, 57% of the session in MVI, and RPE of 6. **Discussion:** Physiological and perceptual burden on the PT was substantially higher during the LG session across all outcomes than during ORE. By contrast, the patient demonstrated higher intensity during ORE with a higher step count, longer walk duration, and more time in MVI than during LG. This finding suggests delivering gait training intervention via ORE may decrease physical therapist burden while providing MVI to patients with SCI during inpatient rehabilitation.

Learning Objective 1 Discuss the physiological and perceptual burden endured by a physical therapist while delivering gait training interventions with a patient with an acute spinal cord injury in an inpatient rehabilitation hospital setting.

Learning Objective 2 Compare the differences in physiological and perceptual burden endured by a physical therapist while delivering different modalities of gait training interventions with a patient with an acute spinal cord injury in an inpatient rehabilitation hospital setting.

Learning Objective 3 Illustrate physiological and perceptual exertion of a patient with an acute spinal cord injury in an inpatient rehabilitation hospital setting during various modalities of gait training.

Award- Eligible Poster

A Pilot Study Testing Safety and Benefits of Ursolic Acid as a Countermeasure to Myopenia and Insulin Resistance in Chronic SCI

Abstract 192 | Poster 4

Mark Nash, PhD, University of Miami Miller School of Medicine

Objective: Alterations in body composition accompanying spinal cord injuries (SCI) include neurogenic myopenia - a clinically relevant loss of skeletal muscle associated with impaired functional capacity and pathological glucose homeostasis. The decline of metabolically active muscle mass reduces whole body caloric expenditure and creates myopenia-related co-morbid risks as cardioendocrine disease clusters, which include obesity and elevated fasting glucose. This project addresses an overarching need for the community of SCI individuals to maintain pulmonary function, cardiorespiratory capacity, and cardioendocrine health throughout their lifespans. This small pilot examined safety of administration and tested effects of a non-prescription nutraceutical – Ursolic Acid (UA) - in sedentary individuals with tetraplegia on whole body lean mass, a biomarker of pulmonary function, cardiorespiratory fitness, and fasting blood glucose. Design/Methods: The pilot was approved by an institutional Human Subjects Committee accompanying waiver of an Investigational New Drug (IND) application filed with the US Food and Drug Administration. Two individuals with chronic (> 1 year) motor-complete (AIS A/B) injuries from C4-C7 received 400 mg of oral UA each day for 12-weeks. Whole body lean mass was determined by DXA scan before and after 12 weeks of treatment. Pulmonary function was expressed as the mean inspiratory pressure (MIP) and a fatigue index test (FIT) following test habituation as described by Palermo et al. (2022 and 2023). Glucose was measured by auto-analysis on venous blood following an overnight fast. Results: Preliminary analysis identified encouraging changes in several measures of respiratory function, body composition, and a key glycemic marker of disease risk. Early results suggest safe administration with no adverse events related to UA intake over three months. After a 12-week UA supplementation course, maximal inspiratory pressure (MIP) and fatigue index test (FIT) – which are proxies for respiratory strength and inspiratory muscle function – were improved by +14.5% and +23.8%, respectively. This improvement was accompanied by a 3% increase in whole body lean mass, which may represent a contributing factor to the improvement in respiratory muscle function. UA supplementation also resulted in a -7.5% reduction in plasma fasting glucose levels from the baseline, which was a primary aim of our testing, and may be important in mitigating cardiometabolic risk. The magnitude of change for pulmonary function can be explained by factors other than treatment. Conclusion: This study is the first to examine safety and benefits of a non-prescription nutraceutical on body composition, pulmonary function, and glycemic control after SCI. Increases in lean mass are suggested by improved pulmonary function and increased whole body lean mass. The increase in lean mass and reduced fasting glucose are important findings previously reported in controlled studies of non-disabled individuals taking UA. A larger sampling and exploration of effects on insulin resistance are needed to confirm these findings. Here however, no claims for clinical benefit or creation of a “label” are advanced. Support: COPBC-R2 and the Florida Department of Health.

Learning Objective 1 Describe the secondary complications of SCI related to chronic myopenia.

Learning Objective 2 Discuss the effect of the nutraceutical Ursolic Acid on post-SCI body composition.

Learning Objective 3 Describe the effects of the nutraceutical Ursolic Acid on post-SCI pulmonary function and glycemia.

Award- Eligible Poster

Acquired Infections Drive Genetic and Immune Changes Acutely After SCI

Abstract 225 | Poster 5

Angela Filous, Ph.D. The Ohio State University

Objective: Spinal cord injuries leave patients immune compromised and highly susceptible to infections. While many of these patients die from these infections, even those that survive have long-lasting deficits in neurological recovery compared to SCI patients without infections. Nothing is known about how these infections drive functional deficits. We developed a mouse model of acquired pneumonia after SCI (SCI-AP) to study how these infections impair functional recovery. Design/Methods: Eight week old male C57Bl/6 mice (Charles River) received moderate contusions (75 kdyne) at thoracic level 9. At day 3, when mice are most immune compromised, the mice are inoculated with *Streptococcus pneumoniae* directly into their lungs. Functional recovery is then assessed weekly for 4 weeks using the Basso Mouse Scale (locomotor recovery). Bulk RNA-sequencing and flow cytometry were performed at 4dpi (1 day post-infection), and immunohistochemistry to assess changes in the tissue. Results: We found that acquired pneumonia triggers a macrophage response locally in the lung and systemically in the spleen and spinal cord. We observed dramatic hemorrhagic transformation early that persists chronically. RNA sequencing begins to show possible pathways that facilitate this bleeding. Conclusion: Acquired pneumonia impairs locomotor recovery after SCI, through hemorrhagic transformation and immune changes.

Learning Objective 1 Introduce novel clinically relevant model of acquired pneumonia after SCI

Learning Objective 2 Describe immune changes triggered by acquired pneumonia

Learning Objective 3 Illustrate gene changes elicited by acquired pneumonia after SCI

Award- Eligible Poster

Adaptive Sports for All: Investigating the Socioeconomic Challenges to Participation

Abstract 165 | Poster 6

Allyson Gorman, BS Medical College of Wisconsin

Background: Adaptive sports are a source of physical activity for the disabled population and the benefits are well-documented. There are barriers to participation, such as difficulty identifying programs, transportation, personal cost, and access to facilities/equipment; however, no studies investigate how barriers differ among socioeconomic groups. We hypothesize that barriers to adaptive sports participation disproportionately affect participants of low socioeconomic status (SES). Purpose: This study intends to determine if participants of low socioeconomic status face disproportionately more barriers to adaptive sports participation. Methods: A survey was emailed to adaptive sports organizations for distribution to participants. Qualtrics was used to collect data anonymously from August 2021-February 2022. The primary outcome of this study was the relationship between low socioeconomic status (SES) and number of barriers reported. Low SES indicators were female sex, low income (<\$12,888 annually), public insurance (Medicare/Medicaid), and race (non-white). Wilcoxon rank-sum test was performed to compare the total number of barriers between two groups for each socioeconomic status. Secondary outcomes included the relationship between indicators of low SES and each individual barrier to adaptive sports participation. A simple logistic regression was fitted for each outcome on each socioeconomic predictor. Odds ratios and 95% confidence intervals calculated from the simple logistic regression. Analyses were performed using R version 4.0.3. Results: Of 122 total respondents, the mean age was 44.3 years. Of respondents, 56(46.7%) identified as male, 63(52.5%) female, 90(76.9%) white, and 27(23.1%) as non-white. The sample consisted of 75(61.5%) participants with a bachelor's degree, 70(59.8%) employed, and 33(27.7%) with low-income status. Of respondents, 72(60.5%) listed visual impairment as their primary disability, 21(17.7%) spinal cord injury, 7(5.9%) cerebral palsy, and 2(1.7%) listed amputation. Of respondents, 46(40.0%) were not current adaptive sports participants, 29(25.2%) were current in 1 sport, and 40(34.8%) in 2 or more sports. There were no statistically significant relationships between the indicators of SES and number of barriers reported. Analysis of secondary outcomes showed female participants were more likely to report difficulty with transportation 2.26[1.1, 4.76] and discriminatory attitudes 10.57[1.93,197.24]; participants of non-white race were more likely to report lack of knowledge of adaptive sports opportunities 3.25[1.31,8.11] and inaccessible fitness facilities 3.15[1.02, 9.51]; participants in the low-income group was more likely to report problems with personal cost 2.36[1.04, 5.41] and lack of caregiver support 4.94[1.14, 25.35]; and participants with public insurance were more likely to report difficulty with transportation 2.42[1.17, 5.10]. Conclusions: This study identified seven barriers to adaptive sports participation among four demographic groups. While further research is warranted with a larger sample size, low-income participants seem to face more barriers to adaptive sports participation, and thus would be a good primary target for outreach programs to increase involvement.

Learning Objective 1 Describe barriers to adaptive sports participation

Learning Objective 2 Identify 4 indicators of low socioeconomic status

Learning Objective 3 Compare barriers to adaptive sports participation between socioeconomic groups

Award- Eligible Poster

Activity Based Restorative Therapy (ABRT) and The Risk of Developing Medical Device Related Pressure Injuries in pediatric patients with Spinal Cord Injury: A Case Report

Abstract 69 | Poster 7

Marjorie Morgan, PTA, Kennedy Krieger Institute, International Center for Spinal Cord Injury

The National Pressure Ulcer Advisory Panel (NPUAP) defined Medical Device Related Pressure Injury (MDRPI) as arising “from the use of devices designed and applied for diagnostic or therapeutic purposes.”¹ MDRPI are not associated with bony prominence, but mimic the shape of the device, especially in areas with a lack of adipose tissues; they are the number one cause of pressure injuries in children.^{1,2,3} A paradox exists in which MDRPI affects the most vulnerable, and yet medical devices are integral to the provision of patient care, including monitoring, diagnostics, and other treatment components of patient care. In this case report presentation, the authors will explore the causes associated with MDRPI during therapy and how MDRPI can affect therapy plan of care. A single-site, descriptive, retrospective study was conducted at a specialized outpatient SCI rehabilitation unit between January 1, 2019, and October 31, 2020. 58 patients, under 18 years of age, with spinal cord dysfunction were treated for MDRPI. These patients were subdivided into two groups, “wounds ever” and “wound never.” There were 31 patients in the “wound ever” group, which represents patients who either reported a history of Medical Device Related Pressure Injuries (MDRPI) or had an MDRPI at admission. While the “wound never” group represented patients who have never had an MDRPI. Once an MDRPI had been identified by the therapist, a wound specialist was consulted for management and treatment with the goal of preventing future pressure injuries. Throughout the healing process, the wound specialists would reassess the wound every 3-5 days, change the dressing, increase patient comfort, and provide education. With each incident, policies were reviewed, and modifications were made to decrease the risk of re-occurrence. Furthermore, staff in-services were held to educate staff members on the proper use of equipment, promote regular skin checks, and create wear schedules to build up tolerance to devices such as orthotics. A Chi-Square analysis showed a lack of sensation, lower SCIM-III scores, and lower Braden scores were associated with an increased likelihood of developing an MDRPI ($p < .05$). Traumatic injury trend toward being associated with never having had an MDRPI ($p < 0.7$). The following were mechanics in which the MDRPI were acquired: 26 with orthotics, 1 with trach ties, and 4 with wheelchairs. Although MDRPI may not appear serious, initially, if not addressed immediately, it could develop into a larger wound and need a significant amount of time to heal. As demonstrated by these cases, pediatric patients with spinal cord injury who participated in ABRT are at high risk for MDRPI due to decreased sensation, more regular use of wheelchairs and/or orthotics to assist with mobility, and massed practice therapy interventions. Modifications and changes, along with education, and an interdisciplinary team approach are integral to improving skin protection and preventing future MDRPI.

Learning Objective 1 Describe one key difference between Pressure Injury and Medical Device Related Pressure Injury (MDRPI)

Learning Objective 2 List two common causes associated with MDRPI in the outpatient rehabilitation setting

Learning Objective 3 Discuss two factors associated with an increased likelihood of developing an MDRPI

Award- Eligible Poster

An Unusual Presentation of Spinal Arachnoid Cyst: The Value Of SCI/D Annual Evaluation

Abstract 113 | Poster 8

Ryan Shields, MD, MSc Medical College of Wisconsin Physical Medicine and Rehabilitation

Background: Spinal arachnoid cysts (SAC) are collections of cerebrospinal fluid (CSF) surrounded by arachnoid mater uncommonly causing spinal cord compression. SACs are congenital or acquired, located ventral, dorsal or lateral to the cord. Acquired SACs are thought secondary to fibrosis from arachnoiditis, after trauma, procedures, meningitis, and subarachnoid hemorrhage (SAH). Clinical course varies from asymptomatic incidental diagnoses to severe myelopathy. Generally, cord compressive SACs cause intermittent pain and progressive paraparesis. Case Description: A 76-year-old male with history of C4 AIS C tetraplegia secondary to traumatic spinal cord injury (SCI) with subsequent anterior cervical fusion, C3-C4 posterior cervical laminectomy and fusion, SAH, and syringomyelia. Patient presented to the VA with subacute pain characterized by band-like pressure, paresthesia, and increased inferior thoracic/superior abdominal spasming, worsened with exertion during transfers. Examination revealed T4-T8 dermatomal hypesthesia, though otherwise consistent with stable C4 tetraplegia. Workup excluded cardiac etiology and gastroesophageal reflux. Cervical and thoracic MRI noted stable C3-C4 syrinx, and extramedullary, intradural cystic lesion, hyperintense on T2, surrounding the thoracic cord. Abnormal cord signal changes were noted below T4-T5, suggesting SAC with variable thoracic cord compression. Neurosurgery deferred acute intervention, opting for serial observation given stable functional status. Discussion: This is a rare case of compressive myelopathy due to SAC with circumferential thoracic cord mass effect associated with syringomyelia in patient with prior SAH and tetraplegia after traumatic SCI. Ventral thoracic SAC presentation is unusual, with majority located dorsally. To our knowledge, after PubMed review, this is the fifth case of thoracic intradural SAC with concurrent dorsal and ventral cord compression; first in an SCI patient. This SAC was likely acquired; exact etiology is unclear given substantial arachnoiditis risk factors—prior vertebral trauma, anterior/posterior surgical intervention, and SAH. Spinal cord compressive SACs cause progressive symptoms and may be exacerbated with Valsalva and mistaken for angina. Ventral SACs may produce weakness, while dorsal SACs tend to cause paresthesia and pain. Presence of both sensory change and myelopathic features was unsurprising, given circumferential cord compression. Preservation of patient's truncal coordination, despite ventral compression, was attributed in part to limited descending motor fibers within anterior cortical spinal tract. SACs frequently occur with syrinxes, possibly due to CSF obstruction, complicating the clinical picture. The syrinx was noted via cervical MR prior to SAC detection, though SAC had potentially been present prior to the syrinx given thin-walled SACs are easily missed. Thus, with SCI and co-existing syringomyelia, it is difficult to assess the clinical manifestation of SAC with localized cord compression. Conclusion: This case highlights importance of annual SCI exams and emphasizes consideration of SACs and syringomyelia as late coinciding complications of traumatic SCI. Given this manifestation's rarity, insight into management is clinically relevant.

Learning Objective 1 Discuss basic understanding and etiology of spinal arachnoid cysts.

Learning Objective 2 Discuss differences in clinical presentation and frequency of spinal arachnoid cysts based upon location.

Learning Objective 3 Highlight the importance of annual SCI/D evaluations for health maintenance in the VA system.

Award- Eligible Poster

Upper Extremity Motor Scores and Functional Outcomes in Tetraplegic Spinal Cord Injury

Abstract 172 | Poster 9

Emily Chen, BS, Georgetown University School of Medicine

Objective Regaining hand and arm function is a priority of individuals with tetraplegic SCI. Thus, accurate prediction of functional outcomes and likelihood of recovery is useful for clinicians and informative for patients. Generic hand function tests have limited use with this population, focusing on performance/capacity over capability of task completion. This study aimed to determine whether upper extremity International Standards for Neurological Classification of Spinal Cord Injury motor scores correlate with functional outcomes at time of discharge from patient rehabilitation. We hypothesized motor scores of at least 15 in each arm (upper extremity total motor score of at least 30) are associated with greater independence with self-care and fine motor skills. Design/Methods The prospective study includes individuals with traumatic and non-traumatic SCI admitted to MedStar National Rehabilitation Hospital in Washington, D.C. (N=48) from September 2021 to February 2023, a subset of the longitudinal National SCI Model Systems database. Motor scores for each upper extremity myotome obtained at admission to inpatient rehabilitation according to the ISNCSCI and raw scores for self-care and fine motor function by the Spinal Cord Injury-Functional Index Form I at discharge were correlated to ascertain significance of upper extremity motor function at injury to functional recovery. Functional outcomes analyzed include six self-care (i.e. ability to brush teeth, grasp a fork or spoon, dress upper body, inspect skin, clean oneself after bowel movement, and dress lower body) and five fine motor items (i.e. ability to make/receive cell phone calls, pick up a small object, press with the index finger, pick up a piece of paper, opening a small bottle). Spearman correlation coefficients were used to evaluate associations. Sidak correction was added to account for multiple comparisons. Statistical significance was determined a priori at the level of $p=0.05$. Results N=39 participants had complete data for analysis. The group aged 63.0 ± 13.2 years and was mostly male (85.4%), 47.9% White, 37.5% Black, and 6.3% Asian/Pacific Islander. C5 motor scores were strongly correlated with self-care and fine motor functionality (r 's = 0.70, 0.61; p 's<0.001). C6 motor scores were moderately correlated with self-care and fine motor (r 's = 0.58, 0.57; p 's=0.003, 0.004). C7 motor scores were strongly correlated with self-care and fine motor (r 's = 0.68, 0.64; p 's<0.001). C8 motor scores were strongly correlated with fine motor but moderately with self-care (r 's = 0.621, 0.595; p 's<0.001, $p=0.002$). T1 motor scores were moderately correlated with both self-care and fine motor (r 's = 0.56, 0.55; p 's=0.005, 0.006). We will analyze individual SCI-FI Form I analyses by myotome to determine which level is most correlated with which specific functional outcome. This may confirm current knowledge on the clinical significance of C5, C6, and C7 myotomes for self-care tasks and C8 and T1 for fine motor. Conclusion These results suggest that all baseline upper extremity myotome levels are important correlates of individuals' dexterity and self-care capability. ISNCSCI motor scores at time of admission to inpatient rehabilitation may be useful in determining prognosis of paralysis.

Learning Objective 1 Relate upper extremity motor scores to functional outcomes in SCI tetraplegics

Learning Objective 2 Ascertain which myotomes are most significant for which fine motor and self-care tasks

Learning Objective 3 Discuss how the objective International Standards for Neurological Classification of Spinal Cord Injury can be useful for prognosis of paralysis

Award- Eligible Poster

Adjuvant Ethyl Nitrite on Hemodynamic Management and Spinal Cord Intraparenchymal Hemorrhaging In The Acute Phase Following Traumatic SCI

Abstract 230 | Poster 10

Erin Erskine, MSc, The University of British Columbia

Objective: Following traumatic spinal cord injury (SCI) there is a reduction in mean arterial pressure (MAP) due to a loss of descending sympathetic control to the heart and vasculature. There are also many intrinsic and extrinsic changes that occur following SCI, such as intraparenchymal hemorrhage (IPH). IPH has been shown to have detrimental effects on neurological outcomes. We have previously shown that dobutamine (DOB) can be used to maintain MAP while having the added benefit of reducing IPH. Ethyl nitrite (ENO) inhalation has been shown to elicit vasodilation in the setting of neurotrauma. We aimed to assess the influence of adjuvant ENO on hemodynamic management and IPH progression in the acute phase following SCI. Design/Methods: Rodents were anesthetized with urethane (~1.6g/kg, intraperitoneal). Following a 300Kdyn T3 SCI, male Wistar rats were immediately instrumented with a solid-state pressure catheter (femoral artery) to measure MAP, and polyethylene catheters (femoral artery & vein) to simultaneously deliver drugs and measure arterial blood gases. Animals were intubated (tracheotomy) and mechanically ventilated. Core temperature was maintained at $37\pm 0.5^{\circ}\text{C}$. We conducted an acute intervention study with 4 treatment arms: 1) control (CTR; Lactated Ringer's, intravenous); 2) ENO (50ppm, inhalation); 3) dobutamine (DOB, $1\mu\text{g}/\text{kg}/\text{min}$, intravenous); and 4) combined ENO+DOB. Spinal cords were collected, fixed in paraformaldehyde (4%), frozen at -80°C , and sectioned at $10\mu\text{m}$. Spinal cord sections were subsequently stained with hematoxylin and eosin to stain for red blood cells, representing IPH. Spinal cord sections were analyzed in ImageJ, where red blood cell-positive pixels were determined using two segmentation techniques: colour deconvolution and global thresholding. IPH was quantified as the %cross-sectional area of the spinal cord positive for red blood cells. Results: MAP was elevated in the DOB ($84.1\pm 8.3\text{mmHg}$; $P=0.002$; $n=5$) and DOB+ENO groups ($78.8\pm 8.1\text{mmHg}$; $P=0.019$; $n=5$) compared to control ($61.9\pm 6.3\text{mmHg}$), while there was no difference in MAP with ENO ($67.6\pm 11.0\text{mmHg}$; $P=0.59$). Preliminary data showed there was no difference in the IPH area between groups. IPH at the epicentre was $12.2\pm 4.1\%$ with CTR and was not different with ENO ($14.6\pm 3.6\%$, $P=0.45$). Despite the increase in MAP associated with treatment with DOB and DOB+ENO, IPH at the epicentre was not increased compared to CTR for DOB ($13.8\pm 2.3\%$; $P=0.71$) or DOB+ENO ($11.2\pm 1.1\%$; $P=0.81$). In the rostral portion of the cord, there was an increase in IPH in the DOB ($9.8\pm 2.2\%$; $P=0.042$) group compared to CTR ($6.9\pm 1.9\%$). Conversely, there was no IPH increase in the combined DOB+ENO ($6.7\pm 1.9\%$; $P=0.86$) compared to CTR. Conclusion: Our preliminary data and analyses indicated that DOB+ENO did not worsen IPH despite increasing MAP following acute SCI. Applying ENO as an adjuvant to MAP augmentation may mitigate the increase in IPH commonly associated with increases in MAP.

Learning Objective 1 Employ adjuvant ethyl nitrite for hemodynamic management

Learning Objective 2 Employ adjuvant ethyl nitrite to mitigate intraparenchymal hemorrhaging

Learning Objective 3 Utilize colour deconvolution and global thresholding for tissue analysis

Award- Eligible Poster

Addressing Sexual Health in Individuals With Spinal Cord Injury (SCI) In Latin America: Results From A Survey Study

Abstract 17 | Poster 11

MELINA LONGONI, MD, Los Madroños Hospital

Objective Sexuality is a central and fundamental aspect in the lives of people with SCI and their families. People with SCI often experience changes in their sexual health and in the ways they perceive their sexuality. The aim of this study was to know if the most common professional interventions in the area of sexuality meet the needs of people with SCI. **Design and methods** 248 individuals with SCI and 318 health professionals working with this population from Latin America answered 2 online questionnaires related to sexuality after SCI. **Results** Of the 248 participants with SCI (71% women), 94.6% indicated that they would have liked to receive information about sexuality after their SCI, 99% of the professionals agreed that it is a subject that should be discussed with these people. However, 76.1% of people with SCI have never received any type of rehabilitation or intervention in this regard, although 85% of the professionals affirm that there are no reasons that prevent them from talking about sexuality issues with their patients, only 35.4% of the professionals reported that they address sexuality issues as a regular practice. The main barrier is found in the lack of training, 61.5% reported not being prepared at a scientific, therapeutic and/or educational level to be able to advise people with SCI in the area of sexuality. 67.0% of the people with SCI stated that the treatment of sexual problems after the SCI was important to them and that they believed that a professional from the rehabilitation team was the best person to talk to, resolve doubts or seek solutions about issues related to sexuality (74.5%). 94.8% of professionals stated that implementing a comprehensive approach to address difficulties with sexuality in people with SCI is part of their professional responsibilities. Of those who reported that addressing sexuality was not part of their responsibilities (5.2%), the majority indicated that sexual problems should be handled by psychologists (62.5%) and sexologists (56.3%). **Conclusions** The findings provide relevant information on the way in which sexuality is addressed, omitted, intervened or advised in the field of rehabilitation in Latin America and give information about initiatives to improve the provision of care in the field of sexuality for individuals with SCI. The results of this study recognize the needs and interests of patients, their families and partners about sexuality after SCI. For this reason, it is important to highlight the importance of rehabilitation professionals being able to answer questions and doubts at the level that the PwD group deserves and thus contribute and accompany in the construction of an informed and enjoyable sexual health.

Learning Objective 1 Discuss the importance of sexual health in people with SCI

Learning Objective 2 promote competencies in the area of sexuality in rehabilitation professionals

Learning Objective 3 List barriers and solutions in the area of sexuality

Award- Eligible Poster

A Biomarker to Predict Spasticity Reduction Following Transcutaneous Spinal Stimulation

Abstract 223 | Poster 12

Kelly Thatcher, PT, DPT, Shepherd Center

Objective: Transcutaneous spinal stimulation (TSS) is a non-invasive, neuromodulatory intervention that has demonstrated promising effects on spasticity reduction in individuals with neurologic injuries.^{1,2} Despite promising outcomes, variable responses to neuromodulatory interventions limit translation of evidence-based interventions to practice. Thus, in order to broaden the clinical utility of TSS, it is imperative to identify characteristics to predict responsiveness. Posterior root-muscle reflexes (PRMRs) elicited by paired-pulses, provides insight into disruption of spinal circuits implicated in spasticity.³ TSS can modulate these same spinal circuits.⁴ This study aims to identify baseline electrophysiologic characteristics of spinal circuit excitability to predict TSS effectiveness on spasticity reduction in individuals with spinal cord injury. Design/Methods: PRMRs of the soleus were evoked transcutaneously using a single cathode over the T11/12 interspinous space and a pair of interconnected anodes over the umbilicus. Reflex threshold (RT) intensity was defined as > 3 of 5 response amplitudes of > 100V. After establishing RT, a recruitment curve was completed in 5mA intervals up to 100mA. TSS was applied for 30 minutes using a charge-balanced, symmetrical, biphasic waveform at 50Hz with a pulse width of 1ms per phase. Spasticity was measured before and immediately after TSS using first swing excursion (FSE) of the pendulum test and the reflex threshold angle (RTA) of the ankle clonus drop test. Results: Statistical analyses are currently underway. Intended analyses will correlate percent depression of the paired PRMRs at multiple intensities of the PRMR input-output curve with the pre-post change in FSE and RTA. Conclusion: Results from this study are essential in understanding responsiveness to TSS in order to refine treatment prescription in a clinical setting. Utilization of baseline characteristics as biomarkers will help further precision practice. Support: National Institute of Health (NIH), Hulse SCI Research Fund

Learning Objective 1

Discuss the utility of posterior root-muscle reflexes as a measurement of spinal excitability.

Learning Objective 2

Identify the relationship of posterior root-muscle reflexes to spasticity in SCI.

Learning Objective 3

Discuss paired pulse depression as a biomarker for responsiveness to transcutaneous spinal stimulation.

Award- Eligible Poster

A Feasibility Study of High Intensity Interval Training (HIIT) to Reduce Cardiometabolic Disease Risks in Individuals with Acute Spinal Cord Injury

Abstract 43 | Poster 13

James Bilzon, PhD, University of Bath

Introduction: Individuals ageing with spinal cord injury (SCI) experience an accelerated trajectory of diseases and disorders that resemble those experienced with ageing alone. A greater emphasis needs to be placed on identifying effective therapeutic interventions. Currently, an evidence-based approach toward managing this problem does not exist. **Objective:** To determine the feasibility of conducting a high-intensity exercise intervention in individuals with acute (<6 months postinjury) SCI with regards to 1) recruitment rate, 2) retention and adherence, 3) quantitative data collection, and 4) acceptability of the intervention. **Design/Methods:** We completed a single- centre, two parallel-arm, randomised feasibility study of a high-intensity interval training (HIIT) intervention in individuals with acute SCI attending inpatient rehabilitation. Participants were randomly allocated to the intervention group (HIIT) or control group (CON) for 18 weeks. Both groups participated in standard care throughout the duration of the study. The HIIT group also performed supervised HIIT exercise on an arm cycle ergometer three times per week. We assessed cardiorespiratory fitness, glycaemic control, lipid profile and body habitus as well as qualitative assessments of acceptability at weeks 0, 9 and 18. **Results:** We recruited 60% of the target sample size. Of 135 patients screened, 51 (37%) were eligible. Of those, 27 declined to participate for various reasons and 24 were enrolled (47%), of which 23 were randomised. (12 HIIT, 11 CON). Sixteen individuals completed the 18-week follow-up testing (8 HIIT (67%), 8 CON (73%) and participants in the HIIT group completed 77% of the exercise sessions. The quantitative data collection methods surrounding health outcomes yielded completion rates of 65-70% across both groups. However, when considering only the 16 individuals who completed the 18-week follow-up, the completion rates increase to 94-100%. In total 21 interviews were conducted with the participants: 13 at week 9 (6 HIIT, 7 CON), and eight at week 18 (3 HIIT, 5 CON). Four themes were developed from the interviews: Recruitment, Understanding the process, Taking part, and Post study implications. Overall, the study participants in both groups were positive about the experience of taking part in the trial. Reinforcement from the research team was a key component of the participants' enthusiasm and was also important in their decision to take part in the study. **Conclusion:** The evidence generated from this feasibility trial will inform the design of a longer-term, definitive multi-centre trial which is necessary to establish the impact of this exercise intervention in maintaining cardiometabolic health of patients during the acute phase of SCI. This study has fulfilled the a priori success criteria for progressing to a full trial. No substantive issues were identified during extensive qualitative interview process that would contraindicate progression and study participants found the intervention generally acceptable and overall positive. We identified areas in which we can refine the study design and intervention for a successful subsequent randomised controlled trial. This work was supported by The National Institute of Health Research [NIHR 201591].

Learning Objective 1 Describe the purpose and significance of an early exercise intervention feasibility trial in acute SCI

Learning Objective 2 List the intervention and methods being evaluated for feasibility

Learning Objective 3 Discuss how the feasibility results contribute to the shaping future research directions and interventions

Award- Eligible Poster

The Need to Establish A Model Systems of Care For The Non Traumatic Spinal Cord Injury Population

Abstract 84 | Poster 14

Melissa Michaluk, DO, University of Pittsburgh Medical Center

Traumatic SCI bears a heavy presence in the literature and as a focal point in annual conferences where SCI Professionals gather. Though there is an established Model Systems of Care, educational materials such as University of Alabama's "Facts and Figures at a Glance," and standardized guidelines for accurately assessing a neurologic level of injury for the traumatic population, there is a scarcity of standardizations with regards to the Non Traumatic Spinal Cord Injury (NTSCI) Population. As the population continues to age, there is a growing need to be able to provide well regarded and researched information that relates to prognosis for ambulation, and medical care of the sequelae from NTSCI. Often times, SCI trained Physicians extrapolate outcomes and medical sequelae utilizing information gathered from the Model Systems, which is a database of individuals who sustained a traumatic SCI. The International Standards for Neurologic Classification of Spinal Cord Injury (ISNCSCI), for example, is the guideline for classifying injury, yet it is only to be used for traumatic SCI. We have compiled a comprehensive database of individuals admitted to this ,s Inpatient Rehabilitation Facility who met medical coding guidelines for a diagnosis of Spinal Cord Injury. A certified Rehabilitation Outcomes Clinical Coordinator collects this information utilizing the Uniform Data System ProCentral Database (UDS). A separation of those admitted with traumatic versus non-traumatic etiologies were assessed. From 2016 through 2021, a total of 152 patients with diagnosed spinal cord injury were admitted to our inpatient rehabilitation unit. Of that total number, 94/152 were admitted with a NTSCI. The total percentage of those admitted with a NTSCI was therefore 61.8%. Examples of NTSCI include myelopathies from degenerative spine disease causing severe canal stenosis and cord compression, malignancy, epidural spinal abscesses, transverse myelitis, and occlusion of arterial blood flow leading to ischemia of the spinal cord. Outside of major trauma institutions, it is not unreasonable to draw a conclusion that this is not an isolated finding. Establishing Model Systems of Care for the NTSCI population is needed to enhance the care SCI professionals provide.

Learning Objective 1 Understand the need to establish a Model Systems database for the NTSCI population

Learning Objective 2 Understand that Physicians heavily utilize TSCI standards when treating both NTSCI and TSCI

Learning Objective 3 Understand that differences in patterns of injury and etiologies can affect recovery differently and the ability to better prognosticate would be invaluable

Management of Durable Medical Equipment in Latin America: The Healthcare Provider's Experience

Abstract 16 | Poster 15

Melina Longoni, MD, Los Madroños Hospital

Objective Durable Medical Equipment (DME) refers to equipment and supplies prescribed by healthcare providers for long-term use by patients. It includes a wide range of devices that cater to various medical needs. The availability and accessibility of DME vary in Latin American countries due to differences in healthcare systems. This study aims to investigate the knowledge of healthcare providers regarding DME. **Design and methods** A total of 148 healthcare providers completed an online questionnaire designed by three physical medicine and rehabilitation (PM&R) and two physical therapists (PT). The questionnaire was distributed among professionals in Latin America through workgroups associated with the Americas Committee. **Results** Out of the 148 participants, 72% were women, and they came from 14 Latin American countries, with Mexico (26%), Argentina (24%), and Peru (18%) being the most represented. Among the participants, 70% were PM&R specialists, 9% were PTs, 7% were PM&R residents, and 5% were occupational therapists (OT) (with 8% being nurses, speech therapists, and psychologists). Of the PM&R specialists, 62% had some knowledge of DME, 24% had a very good understanding, and 14% did not know DMEs. Among PTs, 50% had some knowledge, 40% had a very good understanding, and 10% did not know DME. Among PM&R residents, 63% had some knowledge, and 37% did not know DME. Regarding availability in their workplace, 23% had no options to prescribe or advise on DME, 69% had basic options, and 8% had many options. Additionally, 95% believed that the entire team caring for people with SCI should know the available DME options, and 98% believed they should receive theoretical and practical training in DME. **Conclusions** Accessibility to durable medical equipment (DME) is generally low in Latin American countries. This, coupled with a lack of knowledge among healthcare professionals regarding the appropriate equipment for patients with spinal cord injuries (SCI), leads to inadequate provision of equipment that can hinder the individual's integration into society. Nevertheless, healthcare providers in Latin America are keen to expand their knowledge of DME to enhance their patients' quality of life.

Learning Objective 1 Discuss the significance and constraints of DME use and training for healthcare professionals in Latin America.

Learning Objective 2 Evidence the need of training regarding DME for providers in Latin America

Learning Objective 3 Discuss the lack of accessibility regarding DME

Flooding And SCI: Characterizing Weather Effects on The SCI Community in South Florida

Abstract 245 | Poster 16

Danielle Bass, MPH, University of Miami

BACKGROUND Southeast Florida is vulnerable to extreme weather events due to its geographic location and subtropical climate. This increases the risk of events like flooding following heavy rain, sea level rise or hurricanes. While flooding makes managing daily activities like transportation tedious for most individuals, it can be detrimental to the safety and health of people living with spinal cord injury (PSCI). This qualitative research study assessed the lived experiences and behaviors of PSCI in response to flooding. **METHODS** Semi-structured interviews were conducted with PSCI (n=20; 18 Male; 8 Paraplegic, 12 Quadriplegic) residing within Miami-Dade County, and frequent visitors at the Miami Project to Cure Paralysis. Interviews were conducted virtually via Zoom for approximately 1 hour. The interview transcripts were entered and analyzed in NVivo Software using a thematic analysis approach to inductively produce a codebook and identify themes. **RESULTS** The following themes were extrapolated from the flooding-related data of a complete interview assessing how extreme weather events influence PSCI. These were: (1) Most participants have experienced flooding that has impacted them in their daily activities, (2) Several of the participants expressed personal transportation barriers like concern over their wheelchairs being damaged, (3) Their most common solution to coping with flooding is to not leave their homes until the flooding has subsided. Of those interviewed, 16 described an experience with flooding, primarily following a heavy day of rain. When asked to elaborate, several participants expressed that they feared flooding due to the damage it could cause for their electric wheelchairs. Similarly, physical discomfort due to exposure to flooding was also expressed. One participant stated, “Yeah, when you walk the water, it sucks. Imagine pushing yourself in a chair. It sucks even more.” Overall, 7 participants described flooding as a barrier to their ability to transport themselves independently. In fact, 8 participants described their only solution to flooding as not leaving their home until the flooding clears. In response to how they cope with flooded streets, one participant stated [translated from Spanish to English], “What else can I say? I don’t go outside. I don’t go to my medical appointments, I don’t socialize, I don’t go anywhere.” Another participant stated, “It’s kept me indoors...it’s kind of depressing... it keeps you from being around people that you would want to be around.” **CONCLUSION** Flooding, even just a few inches, can have devastating direct and indirect consequences for PSCI. The impact of flooding on the limited independence that this population has can also exacerbate psychological symptoms, such as feelings of isolation. This is the first study assessing flooding and its impact on PSCI. Much work is needed in the arena of climate and its consequences on PSCI. We aim to utilize this information to inform and develop collaborations with local government aid systems and stakeholders, such as emergency transportation for people with disabilities, to help mitigate the burden on other transport mechanisms, and ensure that PSCI are able to adapt to activities of daily living despite climatological challenges.

Learning Objective 1 Characterize the lived experiences and behaviors of people living with spinal cord injury when facing flooding in South Florida.

Learning Objective 2 Assess coping strategies for experiencing flooding and heavy rain

Learning Objective 3 Illustrate the need for increased awareness of the special needs of those living with spinal cord injury when creating solutions to climate and health issues.

Does Participating in a National Research Registry Impact Patient Outcomes Following Traumatic Spinal Cord Injury? A Population-Based Study from The Rick Hansen Spinal Cord Injury Registry

Abstract 76 | Poster 17

Andréane Richard-Denis, MD-MSc, University of Montreal

Objective: The Rick Hansen Spinal Cord Injury Registry (RHSCIR) is one of the largest longitudinal patient registries for spinal cord injury (SCI) research worldwide. In preliminary work based on a subset of the RHSCIR, the authors have shown that patients who decline to participate in this voluntary-based registry are more likely to suffer from complications and present overall poorer health outcomes than patients who provide full consent. To determine if the level of participation to the RHSCIR is associated with the care pathway of SCI patients based on the full RHSCIR dataset. **Design/Methods:** A retrospective cohort study was conducted on 2847 individuals with acute SCI that were prospected for participation in the RHSCIR between 2014 and 2019. The main independent variable of interest was the status of consent: provided full consent (PC) vs. provided minimal consent (collection of only a limited subset of patient variable) or withdrew consent (MC-WC) vs. declined consent to any data collection (DC). Baseline characteristics and outcomes (acute complications, length of stay (LOS) in acute hospital, in-hospital mortality, etc) were compared between patients from the PC and MC-WC groups (and not DC group since no data collection for this subset). Finally, multivariate regressions were performed to determine if the level of consent (PC vs. MC-WC) was independently associated with the collected outcomes while controlling for relevant confounders. **Results:** Out of the 2847 included patients, 2101 (73.8%) provided consent (PC group), 553 (19.4%) provided only minimal consent of eventually withdrew consent (MC-WC group) and 157 (5.5%) declined consent to all (DC group). At the bivariate level, patients from the MC-WC group had significantly longer acute LOS, developed more pneumonias and pressure injuries during the acute care and were less likely to be discharged home from the hospital than patients from the PC group. All these associations – except for the development of acute pneumonia – remained significant at the multivariate level. **Conclusion:** The level of consent to participate in longitudinal research registries can be indicative of several patient outcomes following TSCI. Patients who chose not to participate fully represent a vulnerable subgroup of patients.

Learning Objective 1 Determine the level of participation to the national Rick Hansen SCI registry.

Learning Objective 2 Discuss the impacts of consenting to the RHSCIR (in terms of care pathway and medical complications) as opposed to those who declined full participation.

Learning Objective 3 Discuss the representativeness of national disease-specific registries, such as the RHSCIR.

How Does Extreme Heat Impact SCI Daily Living? Perspectives and Considerations from Southeastern Floridians Living with Spinal Cord Injury

Abstract 232 | Poster 18

Daniel Samano, MD, MPH, MSCHc, University of Miami

Due to its subtropical climate, Southeast Florida is more vulnerable to extreme weather events, including extreme heat. During summer 2023, Miami, FL has experienced 46 days with extreme heat index above 100 degrees, with alarming heat advisories above 105 heat index. Extreme heat, exacerbated by climate change, poses a risk to health and safety, particularly for individuals living with spinal cord injury (SCI). SCI are at greater risk for deadly heat effects such as heat exhaustion, heat stroke or dehydration due to their impaired thermoregulation (dependent on their level of injury). This qualitative research study assessed the personal experiences, behaviors, and perspectives of SCI regarding extreme heat events in South Florida. **METHODS** Semi-structured interviews were conducted with SCI (n=20; 18 Male; 8 Paraplegic, 12 Quadriplegic) residing within the greater Miami-Dade County area, and frequent visitors at the Miami Project to Cure Paralysis. Interviews were conducted virtually via Zoom for approximately 60 minutes each. Their transcripts were entered and analyzed in NVivo Software using a thematic analysis approach to inductively produce a codebook and identify themes. **RESULTS** Within the heat-effect sub-section of a comprehensive study assessing SCI and extreme weather events, there were three major findings: (1) All participants have experienced a heat-related event in their lifetime, (2) None of the participants prepare for extreme heat the way they would for a hurricane, (3) How SCI cope with these events is individualized and is learned through their lived experience. Among all the interviews, all 20 participants stated they had experienced a heat event that personally affected them. These events took place both outdoors and indoors, and occasionally followed loss of power due to a hurricane. One participant stated that they had to remain in their home for 7 days without central air conditioning, while others described being outside enjoying time with their families when they experienced heat-related illness. When asked how they prepare for heat waves or particularly hot days, none of the participants indicated preparation that occurred prior to the heat event or summer heat exposure. However, several participants described coping mechanisms they used while experiencing heat acutely. These included going to publicly available spaces with air conditioning such as libraries, maintaining adequate hydration, and dressing appropriately. Additionally, 4 out of the 20 participants described how their impaired thermoregulation affected them during extreme heat. One participant stated, "I didn't realize how much temperature, I guess controlled our bodies, post spinal cord injury." Another participant mentioned, "I think it was especially my first time like back out in summer heat and I wasn't feeling hunger and thirst the same way you would without a spinal cord injury." **CONCLUSION** SCI are more vulnerable to extreme heat and heat related illness, but lack the necessary self-awareness and healthcare guidance to adequately prepare for these events. From these findings, we are developing interventions to educate the community of SCI and regional stakeholders, so they may better prepare to cope with extreme weather events.

Learning Objective 1 Assess and characterize the lived experience, perspectives, and behaviors regarding extreme heat and heat related illness, of people living with spinal cord injury.

Learning Objective 2 Describe regional weather patterns and their influence on SCI communities

Learning Objective 3 Demonstrate an interdisciplinary research approach to set an example for other vulnerable population groups.

Preliminary Results of Participants Engagement in The Peer-Led Workout on Wheels Internet Intervention Program

Abstract 252 | Poster 19

Clare Morey, MA, CCC-SLP, Craig Hospital

Objective: Individuals living with chronic spinal cord injury (SCI) are more sedentary and less physically active than Americans generally, despite the known physiologic and functional benefits exercise yields for those living with SCI. Limited evidence supports how to effectively promote regular exercise participation among those with chronic SCI. This study examines program engagement by participants with SCI in an evidence- and theory-based 16-week intervention that is virtually delivered by trained peer facilitators. **Design/Methods:** Single group, pre-test post-test trial in which individuals who are at least 12 months post-injury, use a wheelchair at least 50% of the time, and have sufficient arm movement for arm-based exercise were recruited from two US SCI Model System rehabilitation facilities. Eligibility was established over the phone or by completing a screening survey via RedCap, eligible participants signed a consent and signed medical clearance was obtained for all. Participants received a starter package of exercise equipment that included a pedal exerciser, strength bands, and Garmin Venu sq activity tracker. Four peer facilitators, two men and two women received 16 hours of training to deliver the 16-week program which teaches participants behavioral skills to initiate and maintain behavior change and encourages practice of those skills. Participants attend weekly group-based virtual meetings led by peer facilitator, had access to a program website that includes 16 modules that correspond with the weekly meeting topic, and completed module activities online to practice the skill taught. Engagement data were based on a) participants weekly meeting attendance, b) module activity completion, and c) syncing exercise data recorded on the Garmin watch. **Results:** Of the 128 eligible and consented individuals, 117 initiated the intervention, defined as attending at least one virtual meeting and 101 (86.3%) stayed over the 16 weeks. Participants were an average age of 47.0+13.8 years old, were predominantly male (53.7%), included some individuals of Hispanic ethnicity (5%) and of Black race (15.7%) though were predominantly White (78.5%). Weekly meeting attendance for the 111 individuals who remained in the program averaged 82.4%, completing weekly online modules averaged 85.9%, and 88.9% of participants used the Garmin watch to record and sync their exercise data. **Conclusion:** Participant engagement in the 16-week, peer-facilitated exercise intervention was high, with an average >80% attending weekly meetings, completing module activities, and providing exercise at least 1 of the 16 program weeks. Training peers to deliver the behaviorally-based program resulted in high retention and program engagement. **Support:** The study was supported by funding from NIDILRR's FIP mechanism, grant #IFRE0037.

Learning Objective 1 Describe the theoretical underpinnings that guided the use of specific components included in the intervention.

Learning Objective 2 Describe the behavioral skills taught to participants as they made behavioral changes.

Learning Objective 3 Identify several ways in which peer facilitators supported SCI participants in their attempts to initiate behavioral change.

Is There an Optimal Mobility Pattern For Preventing Pressure Injuries During Acute Care After SCI: A Prospective Cohort Study To Objectively Monitor Nighttime Mobility Using Actigraphy

Abstract 162 | Poster 20

Islam Krazdi, MSc, University of Montreal

Objective: Assessment of night-time in-bed mobility and its relationship with the incidence of pressure injury during acute care after SCI has been very little documented in the literature because of the lack of objective measurement tools. Clinical recommendations for pressure injuries (PI) prevention such as repositioning in bed were based on results carried in studies using subjective measurement tools. Also, recommendations for mobility in bed have always been limited to repositioning (Repositioning every 2-3 hours) and no study considered the impact of active mobility as transient hip movements on the incidence of PI. **Design/Method:** A prospective observational cohort of 41 subjects sustaining an acute SCI was used to objectively assess and characterize mobility in hospital bed during night-time. A GT9X-Link Actigraph with the ability to collect continuously movement and orientation data was placed on subject's chest (sternum) and upper thigh for an average of 6 nights. Data was analyzed to identify mobility patterns by calculating repositioning number and frequency, time spent on each position (lying on back, on side and sitting) and number/frequency of transient movements recorded on hips. Pressure injury information as timing of occurrence, location and grade during subjects' hospitalization was investigated. Socio-demographic and neurological injury characteristics were also collected. **Results:** Results showed that half of subjects that developed PI during hospitalization were subjects graded AIS D, with a higher PI occurrence rate than subjects graded AIS A (9 vs 5 PI occurrences). Results also showed that only one subject repositioned at least once every 3 hours as recommended while the other 40 subjects all had at least 1 period during the night with more than 3 hours without repositioning. However, results also showed that 40% of subjects who developed PI had a repositioning number < 4/night, while for individuals who didn't develop PI, only 18 % had a repositioning number < 4/night. Results also showed that Individuals who haven't developed PI during hospitalization had a mean number of active movement (transient hip movements) 30% greater than Individuals who developed PI. **Conclusion:** This study is the first we know of to examine objectively, using an actigraph, the relationship between mobility patterns in bed during nighttime of individuals in acute care after SCI and the incidence of pressure injuries. This study showed that repositioning at a frequency of every 2-3 hours, considered in literature as the best prevention technique for PI prevention, isn't applied in hospital settings. Our results also reveal that beside repositioning frequency that showed no significant relationship with PI incidence in our cohort, a combination of active movements (at least 2 transient hip movement every hour) with passive movements (at least 2 repositioning during the whole night) would greatly reduce PI incidence since this combination was associated to no PI occurrence in our cohort. Further studies with a bigger sample would lead us to determine more specific mobility pattern (passive and active movements) that would be more optimal in greatly reducing PI occurrence risk during acute care .

Learning Objective 1 Assess active and passive mobility in bed using an objective mobility measurement technique

Learning Objective 2 Identify and characterize nighttime in-bed mobility patterns in spinal cord injured individuals during acute care

Learning Objective 3 Study the relationship between nighttime mobility in bed in SCI individuals during acute care and pressure injuries

The Impact of The Educational Interventions by The Americas Committee of ASIA In Latin America

Abstract 99 | Poster 21

Melina Longoni, MD, Los Madroños Hospital

Latin America (LA) is a vast and diverse region with a complex social, cultural, and economic landscape, common barriers, and healthcare challenges. The insufficient exposure to neurorehabilitation during residency and the lack of SCI-trained providers compound the obstacles faced. Evidence-based information is scarce in Spanish, and poor infrastructure leads to fragmented SCI care. All these barriers negatively affect patient outcomes, including in SCI rehabilitation. Education of providers is critical to reducing secondary complications and improving patients' quality of life. Work done through ASIA's Americas Committee has provided a more precise depiction of SCI medicine in the region; we now know there is significant interest, lack of information, and no standardized approach to caring for this patient population. In response to the state of SCI in LA, we looked for ways to share knowledge with regional providers. The information was delivered mainly by online lectures, workshops, translation of the 19 PCP guidelines, fast information in flashcards, and several working groups from different disciplines and countries. The objective is to describe the impact of the educational interventions done by the committee for the last two years.

Design and methods 182 healthcare providers in Latin America completed an online questionnaire created by three physical medicine and rehabilitation (PM&R) professionals and two physical therapists (PT) associated with the Americas Committee. Results Out of the 182 participants, a significant majority, 74%, were women originating from 15 Latin American countries. Mexico (36%), Argentina (19%), and Venezuela (16%) were the most well-represented. The professionals' backgrounds were diverse, with 78% being PM&R specialists, 6% PTs, 5% PM&R residents, and 3% occupational therapists, while 8% were nurses, speech therapists, and psychologists. Regarding the Committee's activities, online conferences were found to be the most helpful by 89% of professionals, followed by multidisciplinary online meetings (25%) and talks with experts (22%). Over the last two years, ASIA's YouTube channel has gained 2,130 subscribers, with its Spanish lecture based on Interpretation of the ISNSCI having a total of 17,000 reproductions. Based on professional feedback, 45% found the talks uploaded to the channel highly beneficial, 26% found them moderately helpful, 19% somewhat helpful, and 10% not useful at all. The Committee's information was found to be helpful by 70% of professionals in their daily practice, while 28% found it somewhat helpful.

Conclusions Although individuals with spinal cord injuries in LA countries face significant obstacles in rehabilitation, there has been a marked rise in interest in SCI rehabilitation training. To address the gap and enhance access to high-quality, evidence-based care, educational materials in Spanish and interdisciplinary groups custom-tailored to SCI have been developed. Thanks to the Committee's endeavors to make SCI resources and experts more accessible, in addition to forming interdisciplinary working groups representing over 15 countries across LA, the knowledge gap in the region has been successfully reduced. Consequently, there is a growing appetite for SCI medicine.

Learning Objective 1 Present a comprehensive perspective on spinal cord injury rehabilitation in Latin America, addressing the challenges and constraints encountered.

Learning Objective 2 Delve into the value of educational interventions delivered through diverse channels to healthcare providers to improve the region's patient care.

Learning Objective 3 Underscore the importance of creating a network of healthcare professionals focused on treating spinal cord injury patients in developing nations.

Developing a Functional Electrical Stimulation Garment for the Upper Limbs

Abstract 164 | Poster 22

Eugene Eunoia Brukhman, Pratt Institute

Objective: Functional Electrical Stimulation (FES) has been used to help restore motor function after SCI¹. At the present moment, FES takes significant amounts of time and/or specialized expertise to set up individual electrodes over specific points on muscles on the surface of the skin. The process of setup is lengthy and prone to error. This project will present the initial design and evaluation of an FES sleeve with removable conductive fabric electrodes that can be placed in multiple locations within the sleeve along a person's upper arm and forearm. **Design/Methods:** After researching electrode materials and components, a reusable conductive fabric electrode composed of 3 layers was designed and evaluated alongside the current standard surface electrode. A series of sleeve design prototypes were constructed and the design was refined with feedback from someone with lived experience with a cervical SCI, and a method for inserting electrodes was developed. A pilot study was conducted to determine which types of electrode and interface combination are most effective and comfortable for the user. The study was conducted on 3 able-bodied participants. Each trial consisted of stimulating the biceps until we reached either a threshold of discomfort, or contraction of the muscle was not increasing with more stimulation. Kendall's Manual Muscle Test (MMT)² was then performed and noted, and directly following stimulation, test subjects were asked to complete a Sensation Register which consisted of the Transcutaneous Electrical Stimulation Comfort Questionnaire³ and Mankoski Pain Scale (PS)⁴. Design ideation led to the development of 5 sleeve garment prototypes that were evaluated alongside feedback from Ian Burkhart, who has lived experience with cervical SCI. This led to the design and creation of a second generation prototype. A method to reliably insert electrodes into designated areas on the sleeves was developed and tested for efficacy. **Results:** The conductive fabric electrodes that were manufactured for the experiment worked as well or better than the standard electrodes used on the market at evoking muscle contractions without causing pain. Standard electrodes had an avg MMT 5.33, and avg PS 3.33, conductive fabric with electrode gel had an avg MMT 6.33 and avg PS 2, and with hydrogel had an avg MMT 5.67, and avg PS 2.33. The second generation sleeve garment makes use of compressive properties of neoprene and stretchiness and breathability of power stretch mesh, along with a thumb strap and zipper design that allows for one handed donning and doffing. A conductive fabric snap electrode was developed which, alongside a snap adapter for the FES wire, could snap into labeled holes in the sleeve. This would allow researchers or users to, after an initial calibration, have settings to place electrodes into every time. This sleeve system successfully facilitated FES on one test subject. **Conclusion:** It is possible to create a washable and reusable electrode sleeve for functional electrical stimulation, though there are many challenges regarding changing electrode placement in the upper limbs from person to person. **Acknowledgements:** This work is supported by NSF grants #1950558 and #2025142. Feedback and design critique provided by Ian Burkhart.

Learning Objective 1 Describe functional electrical stimulation benefits and applications

Learning Objective 2 Describe the components of a functional electrical stimulation system

Learning Objective 3 Appraise a functional electrical stimulation garment prototype

Deep Learning Classification of Pediatric Spinal Cord Injury from Diffusion Tensor Imaging Measurements

Abstract 221 | Poster 23

Christian Raimondo, MS, Sidney Kimmel Medical College at Thomas Jefferson University

Objective: This study evaluates the performance of deep learning models trained on quantitative measures derived from diffusion tensor imaging in the classification of spinal cord injury versus healthy controls. **Design/Methods:** This study includes 27 pediatric patients with spinal cord injury (SCI) and 42 healthy controls (TD) for a total population of 69 patients. Diffusion tensor imaging was performed on T1-weighted MRI images and quantitative measurements from 18 vertebral levels were recorded. Each patient had 2 MRIs performed which were treated independently for a total of 138 inputs to the deep learning models. Four popular deep learning frameworks, multi-layer perceptron (MLP), 1D-Convolutional Neural Network (1D-CNN), Long Short-Term Memory Network (LSTM), and a Transformer Model were trained and evaluated by accuracy and ROC-AUC score in the classification of SCI vs TD. **Results:** The 1D-CNN performed the best on the test set with an accuracy of 90% and AUC of 0.98. The LSTM and MLP models showed comparable test accuracy (85%) and AUC (0.9 vs. 0.92). The Transformer did not perform well in this task, registering a test accuracy of 65% and AUC of 0.65. **Conclusion:** This study demonstrates the ability of deep learning to aid in the distinction of spinal cord injury from healthy individuals, supporting the exploration and application of artificial intelligence tools in aiding clinical practices.

Learning Objective 1 Describe the components of a deep learning pipeline.

Learning Objective 2 List the common measures used for evaluating deep learning model performance.

Learning Objective 3 Illustrate the potential of artificial intelligence to aid clinical diagnosis and management of spinal cord injury.

Unlocking Independence: Exploring Assistive Technology Use Among Individuals with Tetraplegia and Its Impact on Psychosocial Well-Being

Abstract 18 | Poster 24

Kimberley Monden, PhD, University of Minnesota Medical School

Introduction: Assistive technology (AT) is crucial for independence, productivity, and participation among individuals with spinal cord injuries (SCI). However, many people who could benefit from AT do not utilize it. The first step to ensure that AT devices get to those who need them is to understand AT users' demographic and injury characteristics and whether utilization is related to psychosocial outcomes in this population. This study aims to identify predictors of AT use among adults with tetraplegia and its connection to psychosocial outcomes. **Methods:** Participants (N=300) completed an online survey of demographic and injury information, AT use, functional ability (Spinal Cord Injury Functional Index using Assistive Technology[SCI-FI/AT]), and psychosocial outcomes including depression symptoms (Patient Health Questionnaire-8), quality of life (Satisfaction with Life Scale), self-efficacy (Moorong Self-Efficacy Scale), participation (Participation Assessment with Recombined Tools-Objective), and perceived management of needs (Perceived Manageability Scale Needs Assessment Checklist). Descriptive statistics were employed for continuous and categorical variables. Differences between AT users and non-users were analyzed using t-tests and chi-square tests. Linear regression was used to estimate the effect of the number of AT devices used (range = 0-15) on psychosocial outcomes while controlling for relevant covariates. **Results:** Participants (average age: 48, 68% male) were 20 years post-injury on average. About 62% used AT, primarily those who were younger, female (70% vs. 58% male), college-educated (67% vs. 43% no college degree), employed/studying (72% vs. 55% unemployed/retired), had motor complete injuries (77% vs 20% incomplete), and private insurance (70% vs 58% VA/government/worker's compensation). No differences in AT utilization were found by time-post-injury, race, or income level. After adjusting for income, private insurance predicted more AT devices used ($\beta=1.17$, $p=0.03$, 95% CI [.09, 2.25]). After adjusting for multiple comparisons using FDR corrections, functional status (SCI-FI/AT) was the only outcome that was significantly predicted by the number of AT devices used ($\beta=-.68$, $p<0.00$, 95% CI [-0.89, -0.46]). **Conclusions:** This first-of-its-kind study explored AT's impact on psychosocial outcomes among individuals with tetraplegia. Most participants utilized AT regardless of income, race, or injury duration. Private insurance predicted higher device usage. AT use did not significantly affect psychosocial outcomes, but using more AT devices was linked to better functional ability. Strategies should target specific demographics for effective AT delivery and utilization promotion. Implications and limitations will be discussed. Support: DoD SC170159

Learning Objective 1 Discuss the demographic and injury characteristics of individuals who are more likely to use assistive technology.

Learning Objective 2 Discuss the relationship between AT use and functional and psychosocial outcomes.

Learning Objective 3 Discuss strategies for effective AT delivery and utilization promotion.

Investigating the Influence of Spinal Cord Injury on Sympathetic Ganglionic Control of the Heart

Abstract 54 | Poster 25

Alissa Taki, BSc, University of British Columbia

Objective: Cervical or high-thoracic spinal cord injury (SCI) impairs descending input to the sympathetic pre-ganglionic neurons controlling the heart, which is purported to impair cardiac function post-injury. However, subsequent sympathetic circuitry to the heart remains intact after injury and may allow for modulation of cardiac function. The objective of this study was to examine the role of the superior cervical ganglia (SCG) and stellate ganglia in controlling cardiac function in rats with and without chronic complete transection SCI at the T3 level, as well as assess anatomical plasticity to the ganglia post-injury. **Methods:** In vivo functional study: 12 male Wistar rats (6 naïve, 6 complete T3-transection at 4 weeks post-injury) were assessed for cardiac and hemodynamic function. Under urethane anaesthesia, rats were instrumented with left-ventricular (LV) and arterial catheters. A fluid line was placed in the femoral vein to enable a controlled hemodynamic challenge via hemorrhage. In addition, fluid lines were placed in the jugular vein and femoral artery for drug delivery and blood gas analysis, respectfully. Both the SCG and stellate were isolated prior to excision. Atropine was delivered to block cardiac parasympathetic transmission. Once stable, hemorrhage was initiated, targeting a 10% reduction in mean arterial pressure (MAP) to elicit sympatho-excitation. Next, rats received a bilateral superior cervical ganglionectomy (SCGx). Following 30 min of re-stabilization, baseline and hemorrhage assessments were repeated. A bilateral stellate ganglionectomy (StGx) was then conducted and assessments were repeated after re-stabilization. **Anatomical study:** Ganglia excised during the in vivo study were prepared for histological examination. Immunofluorescent staining was used to identify cardiac projecting neurons in the SCG and stellate, based on the presence/absence of Neuropeptide Y, calbindin, and tyrosine hydroxylase. In tandem, 4',6-diamidino-2-phenylindole was used to stain nuclei for the quantification of cell populations. **Results:** In both groups, all recorded indices were unaffected following SCGx. After StGx, at rest, the naïve group exhibited significant reductions in MAP (102 ±12 at baseline vs. 83 ±12 mmHg, p=0.02), heart rate (406 ±23 at baseline vs. 372 ±21 BPM, p=0.02), max LV pressure (123 ±11 at baseline vs. 107 ±9 mmHg, p=0.02), and rate of rise of the left-ventricular waveform (8190 ±1500 at baseline vs. 6410 ±895 mmHg/s, p=0.03). Conversely, the SCI group had no significant reductions in indices after StGx. Histology analyses are currently underway and will be presented at the conference. **Conclusion:** Using in vivo assessments of cardiac and hemodynamic function following the removal of cardiac-innervating sympathetic ganglia, our findings demonstrate that sympathetic control of the heart is primarily contributed by the stellate ganglia in uninjured rats, but notably absent in the chronic stage of complete T3 transection. **Support:** This research was supported through a grant provided by the Natural Sciences and Engineering Research Council of Canada.

Learning Objective 1 Describe the cardiovascular system in the context of spinal cord injury

Learning Objective 2 Revise structures and pathways involved in the sympathetic nervous system

Learning Objective 3 Illustrate the procedures utilized for in vivo experiments in rodent models

Overexpression Of Sox11 Restores Embryonic, Pro-Regenerative Gene Transcription in Adult Corticospinal Tract Neurons After Spinal Injury

Abstract 246 | Poster 26

Elizabeth Batsel, BS, Marquette University

Objective: Mature axon pathways including the corticospinal tract (CST), fail to regenerate after spinal cord injury, leading to lasting dysfunction. In contrast, embryonic neurons display a high growth potential and rapidly extend axons toward their target cells. We have recently shown that adult CST neurons differ significantly in gene expression from their embryonic counterparts, with numerous genes showing at least a twofold up- or downregulation. Moreover, we find that adult CST neurons exhibit only a subdued transcriptional response to spinal injury, indicating that regeneration is limited in part by a failure to re-express regenerative transcripts. Thus, we aimed to identify a means to recapitulate an embryonic, pro-growth pattern of transcription in adult CST neurons. Here we focused on Sox11, a transcription factor that plays a role in promoting axon growth during development and which has been shown to enhance axon growth when overexpressed in adult neurons including CST. **Design/Methods:** Our approach involved retrogradely labeling the cell nuclei of CST neurons through spinal injection of AAV2-retro-H2B-mGL and co-injecting AAV2-retro-Sox11 or tdTomato control. After labeling, the animals underwent cervical spinal hemisection followed two weeks later by fluorescence-activated nuclei sorting and single nuclei sequencing (10X Chromium). Differential gene expression analysis was conducted in Seurat using Wilcoxon rank-sum tests, and ontological enrichment analysis was carried out using Homer. **Results:** Sox11 produced large changes in gene expression, with hundreds of genes significantly up or downregulated. Ontological enrichment analysis revealed that genes upregulated by Sox11 were highly enriched for growth-relevant terms including axonogenesis and neuronal projection development and downregulated genes were linked to synaptogenesis. Importantly, these changes showed significant similarity to developmental gene changes. In ongoing experiments, we are testing Sox11's transcriptional effects in additional descending cell populations. In addition, Sox11's striking transcriptional effects have motivated us to revisit its utility as an activator of axon growth. Current experiments are testing Sox11 overexpression in combination with neural progenitor transplantation to promote CST regeneration in mouse models of spinal injury. **Conclusion:** This study reveals that Sox11 induces a regenerative state in injured adult neurons, potentially poising them for enhanced response to additional pro-regenerative strategies.

Learning Objective 1 Discuss gene therapies

Learning Objective 2 Utilize Sox11

Learning Objective 3 Analyze gene expression

Effect Of Two Different Training Programs on Cardiovascular Response and Functional Activity In Individuals With Chronic Spinal Cord Injury

Abstract 95 | Poster 27

Zoila Rosa Oliveros Ribero, MD, National Institute of Rehabilitation "LGII" (INRLGII)

Effect of two different training programs on cardiovascular response and functional activity in individuals with chronic spinal cord injury Background: Cardiovascular disease (CVD) in patients with chronic spinal cord injury (SCI) is the main source of death and occurs almost three times more than in the general population. Different modalities of aerobic exercise with and without resistance in individuals with SCI reported a significant improvement in maximal tolerated power and maximal oxygen consumption (VO₂ max). Thus, the prevention and health care guidelines in SCI document that the intervention with aerobic exercise from low to moderate intensity induces favorable adaptations in patients with chronic SCI and reduces cardiovascular risk. Objective: To determine the effect of two different types of aerobic training on cardiorespiratory endurance and functional activity in individuals with chronic spinal cord injury. Design: Randomized clinical trial. Sixteen patients with a history of chronic SCI (>6 months) with neurological level above C8; AIS A, B, C or D; from the National Rehabilitation Institute Luis Guillermo Ibarra Ibarra (INR LGII) were included in an 8-week (5-day a week) training program. The subjects were randomized into one of two groups, the first consisting of continuous aerobic training on a kayak ergometer and the second of aerobic endurance circuit. The main measures that were explored were the potential effects of training on cardiovascular function and clinical variables. At the beginning and end of the study, all the patients underwent a cardiopulmonary stress test, Spinal Cord Independence Measure III (SCIM-III), International Standards for Neurological Classification of SCI (ISNCSCI), trunk control test (TCT), and life satisfaction (LISAT-9). Results: 100% completed the follow-up. Adherence to the performance of exercises was 90% and no adverse effects were recorded. Changes were observed in all groups. Independent of the training, both interventions showed improvement in VO₂ max and functional independence. However, there is a trend in favor of the kayak training group for better cardiovascular function and functional independence in comparison to the aerobic endurance circuit group. Functional independence and life satisfaction also improved in both groups parallel to the VO₂ max. Conclusions: The implementation of an aerobic training program based on the results of the cardiopulmonary stress test on a crank ergometer is highly recommended to improve cardiorespiratory endurance and functional activity in individuals with chronic SCI. Increasing the sample size will help find out which type of training has the best statistically significant results.

Learning Objective 1 determine the effect of two different types of aerobic training on cardiorespiratory endurance and functional activity in individuals with chronic spinal cord injury.

Learning Objective 2 determine the effect of two different types of aerobic training on functional activity in individuals with chronic spinal cord injury.

Learning Objective 3 Implementation of an aerobic training program based on the results of the cardiopulmonary exercise test to improve cardiorespiratory endurance and functional activity

Effects of a Feedback-Controlled Heated Vest on Core Temperature in Persons with Spinal Cord Injury during Cool Exposure

Abstract 177 | Poster 28

Ian Paez, BA, Spinal Cord Damage Research Center

Purpose/Hypothesis. In healthy, able-bodied individuals, thermoregulation in response to cold exposure involves homeostatic mechanisms of vasoconstriction to preserve body heat, shivering for thermogenesis, and behavioral responses to add clothing or move to a warmer environment to maintain core body temperature (T_{core}) within a narrow range ($37.0 \pm 0.6^\circ\text{C}$). Following spinal cord injury (SCI), interruptions of autonomic, motor, and sensory pathways impair sympathetic-mediated peripheral vasoconstriction, shivering, and recognition of skin temperature below the neurological level of injury (NLI), as well as behavioral responses, causing dysfunctional thermoregulation. Impaired vasomotor control below the NLI results in persons with higher levels of SCI ($\geq T6$) being in a state of chronic peripheral vasodilation resulting in an inability to control heat loss. These impairments increase the risk of adverse physiological and cognitive outcomes during cold exposure and cause cool seasonal temperatures to become an environmental barrier for persons with higher levels of SCI. **Purpose:** To determine the efficacy of a feedback-controlled heated vest (HV) in minimizing the expected decline in T_{core} and cognitive performance. **Hypotheses:** In persons with Hi-SCI, wearing a HV compared to a non-heated vest (NHV: control condition), will: 1) Limit the expected decrease in T_{core} by $\geq 50\%$, 2) Limit the expected decline in cognitive performance. **Number of Subjects.** 8 persons with tetraplegia (NLI: C4 to C7, AIS: A, B) **Materials and Methods.** A novel feedback-controlled electrically heated vest (HV) was developed and tested for safety in collaboration with the Department of Civil and Mechanical engineering, USMA at West Point. On 2 separate, randomized visits, subjects had a baseline of 15 minutes of thermoneutral exposure (27°C), donned either a HV or the same non-powered vest (NHV), followed by 120 minutes of cool challenge (18°C). Outcomes of T_{core} , anterior chest and abdomen skin temperatures ($T_{sk\ Abd-Chest}$), and working memory (Delayed Recall of the MoCA) were measured at baseline and at the end of cool challenge. **Results.** The change from baseline to cool challenge, in the HV condition compared to the NHV condition, resulted in an attenuated decline in T_{core} ($-0.2 \pm 0.34^\circ\text{C}$ vs. $-0.46 \pm 0.24^\circ\text{C}$; $p=0.02$), greater $T_{sk\ Abd-Chest}$ ($4.64 \pm 1.20^\circ\text{C}$ vs. $0.77 \pm 0.42^\circ\text{C}$; $p<0.001$), and improved Delayed Recall (3.89 ± 0.99 words vs. 2.38 ± 1.59 words; $p=0.02$), respectively. **Conclusions.** The supplementation of heat energy by the HV, resulted in greater chest/abdominal skin temperatures, preserved T_{core} , and improved working memory during the cool challenge in the HV condition compared to the NHV in persons with tetraplegia. **Clinical Relevance.** The efficacy demonstrated by the HV in controlled conditions has potential to reduce the environmental barrier that cool seasonal temperatures present for persons with high SCI.

Learning Objective 1 Describe the response of core temperature to cool environmental conditions, in individuals with spinal cord injury (at or above T6).

Learning Objective 2 Describe the potential for an associated decline in cognitive performance that individuals with spinal cord injury may experience when exposed to cool environmental conditions.

Learning Objective 3 Describe how this feedback-controlled heated vest, can attenuate the expected decrease in core temperature that individuals with spinal cord injury may experience when exposed to cool environmental conditions.

Mild Intermittent Hypoxia Acutely Exacerbates Autonomic Dysreflexia, but Orthostatic Hypotension

Abstract 190 | Poster 29

Fei Zhao, PhD, Wayne State University

Objective: To investigate the acute effect of Mild Intermittent Hypoxia (MIH) on autonomic dysreflexia, orthostatic hypotension, and indirect measures of autonomic function (i.e. heart rate and blood pressure variability [HRV, BPV]). **Design/Methods:** Three individuals with motor incomplete SCI (C4, T1, C7/T5, AIS: 1 D, 2 C) aged 43 ± 3.461 (1 Male, 2 Female) with signs and symptoms of autonomic dysfunction were exposed to MIH in the morning. MIH consisted of twelve two-minute bouts of intermittent hypoxia interspersed with two-minutes of normoxic recovery. Slight hypercapnia (+2 mmHg) was maintained throughout the entire protocol. Autonomic dysreflexia (AD) and Orthostatic Hypotension (OH) were measured before and 20 minutes following the MIH protocol. AD was elicited by inflating a tourniquet to 300-mmHg around the participants' thighs for 6 minutes. OH was elicited with a sit-up test. AD and OH were calculated as the max and minimum, respectively, compared to 3 minutes of beat-to-beat blood pressure (BP) measured prior to the maneuvers. **Results:** Thigh occlusion resulted in an increase in systolic and diastolic BP of 19.72 ± 1.86 and 15.67 ± 4.14 mmHg, respectively. The sit-up test resulted in a reduction in systolic and diastolic BP of 30.32 ± 10.15 and 14.45 ± 4.79 mmHg, respectively. Following MIH, systolic and diastolic BP increased by 28.63 ± 4.78 and 19.41 ± 0.88 , during occlusion, resulting in an increase of 8.91 ± 5.09 and 3.74 ± 4.83 percent for systolic and diastolic BP compared to pre-MIH. Additionally, following MIH, the sit-up test resulted in an increase in BP of 20.05 ± 1.25 and 13.19 ± 5.01 which was decreased by 10.27 ± 9.66 and 1.26 ± 2.59 mmHg, respectively compared to the pre-MIH BP response. Following MIH, sympathetic HRV increased by 1.38 ± 0.48 as parasympathetic HRV remained unchanged 1.004 ± 0.04 . Likewise, the RMSSD increased following MIH (1.24 ± 0.30). The high to low frequency of systolic and diastolic BPV increased by 1.23 ± 1.74 and 1.99 ± 1.25 , respectively. **Conclusions:** Acute exposure to MIH may exacerbate AD while improving OH. These data suggest that consideration is warranted prior to employing task specific training immediately following MIH. Likewise, these data suggest additional research is needed to investigate if repeated daily MIH continues to augment AD as this has implications for combining MIH with task specific training.

Learning Objective 1 Describe what mild intermittent hypoxia is

Learning Objective 2 Describe how mild intermittent hypoxia may acutely impact autonomic dysreflexia

Learning Objective 3 Describe how mild intermittent hypoxia may acutely impact orthostatic hypotension

Cardio-Vagal Responses to The Cold-Face Challenge In People with SCI: Effects of Cholinergic Agonist and Antagonist

Abstract 207 | Poster 28

Jacob Goldsmith, MS, PhD, James J. Peters VA Medical Center

Objective: Following spinal cord injury (SCI), impaired autonomic nervous system (ANS) function leads to inappropriate heart rate (HR) and blood pressure (BP) responses to provocations. Although anatomically intact after SCI, we reported functional deficits in vagal nerve control of the SA node, reflected by a paradoxical increase in HR during a cold face challenge (CFC) in individuals with SCI, regardless of level. This suggests that the cardiovagal reflex is altered in persons with SCI, but it is unclear if this reflects changes in receptor sensitivity to acetylcholine (Ach) or impaired efferent transmission of vagal traffic to the heart. Therefore, the purpose of this study was to assess the HR response to the CFC after administration of a 1) placebo, 2) vagal agonist (edrophonium; EDRO), and 3) vagal antagonist (glycopyrrolate; GLYCO) in persons with SCI compared to uninjured controls. **Methods:** We conducted a randomized, placebo-controlled, double-blinded study in 17 individuals with chronic SCI, and 17 age-matched uninjured controls (38.5±12.2 vs. 39.7±11.2 years, respectively). The participants with SCI included ten with paraplegia (PARA, T1-L2) and seven with tetraplegia (TETRA, C4-7). Participants were placed in the supine position and the medications were intravenously administered 10 minutes prior to the CFC on three separate study visits. Continuous HR was recorded using electrocardiography (ECG) electrodes, BP was measured at the brachial artery and at the finger, and respiration frequency was monitored. After a 20-minute supine rest period, a 5-min baseline data sample of continuous HR and BP was collected and then the CFC was performed, consisting of placement of cold packs (ice and water slurry at ~4°C) on the forehead and maxillary areas of the face. During the CFC, continuous HR and BP were recorded for 2-minutes prior to CFC, 1-minute during the CFC, and 2-minutes after removal of the cold stimulus. Participants underwent the CFC after administration of a 1) Placebo (normal saline), 2) EDRO (0.2 mg/kg), or 3) GLYCO (0.4 mg). **Results:** Under the placebo condition, the CFC caused a modest increase in HR in individuals with SCI (+1.4±5.0 bpm) and a small reduction in HR in the controls (-0.4±3.4 bpm). With EDRO, a comparable slowing of HR was elicited in the PARA and control groups (-2.6±4.4 vs. -2.5±4.3 bpm, respectively), whereas HR was increased in the TETRA group (+0.7±3.6 bpm). Following GLYCO administration, there was a comparable increase in HR during the CFC in the TETRA and control groups (+4.7±3.0 vs. +4.5±8.8 bpm, respectively), which was magnified in the PARA group (+6.6±4.9 bpm). **Conclusion:** The findings suggest that the mechanism responsible for the paradoxical increase in HR during the CFC in participants with SCI may differ by the neurological level of injury. Individuals with cervical injury appear to have blunted HR responses to Ach, suggesting altered receptor sensitivity. Whereas those with thoracolumbar injuries had increased HR responses to an anti-cholinergic agent, suggesting a potentially greater reliance on adrenergic cardiac chronotropy that is unmasked following the loss of tonic vagal restraint. Future work should attempt to further tease out the mechanisms of cardiovagal dysfunction following SCI.

Learning Objective 1 Distinguish differences in response to a vagal-inducing cold face challenge in people with cervical and thoracolumbar SCI and uninjured controls.

Learning Objective 2 Assess the effects of a pro-cholinergic and anti-cholinergic medication or placebo on the response to cold face challenge.

Learning Objective 3 Describe the potential consequences of diminished cardiovagal function following SCI.

Vascular Dysfunction Following Spinal Cord Injury: A Systematic Review and Meta-Analysis

Abstract | Poster 31

Ali Hosseinzadeh ,BSc, International Collaboration On Repair Discoveries (ICORD)

Objective: Although vascular dysfunction is a known consequence following spinal cord injury (SCI), the degree to which vascular function is impaired in individuals with SCI relative to non-injured individuals remains relatively understudied. While one meta-analysis has been conducted to examine the impact of SCI on clinically pragmatic assessments of cardiovascular function (i.e., blood pressure, heart rate), a comprehensive synthesis of other vascular parameters (e.g., blood flow volume, velocity) following SCI is currently lacking from the literature. Additionally, the development of novel imaging modalities have enhanced our ability to evaluate central vascular alterations. However, a comprehensive synthesis of both novel and conventional methods used to assess vascular dysfunction after SCI is also lacking. This review aims to (1) identify structural and functional adaptations to central and peripheral vasculature after SCI and (2) assess the impact of SCI on these parameters relative to able-bodied controls. **Methods:** In accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines, a systematic search of MEDLINE, CINAHL, EMBASE, Web of Science and Scopus databases was conducted. Studies reporting structural or functional changes to vasculature following SCI in human participants were included. Information and data describing participant and injury characteristics, outcomes, and assessments used were extracted. Risk of bias was assessed using the Cochrane Risk of Bias, Risk Of Bias In Non-randomized Studies of Interventions, and the Newcastle-Ottawa Scale tools. Primary and sensitivity analyses were conducted for adequately powered subgroups based on outcome type, measurement site, and level of injury. **Results:** Data from 42 studies involving 829 participants with SCI and 849 non-injured controls were extracted. Studies described injury level (36/42) and severity (32/42) and used Doppler or Duplex ultrasound (30/42), transcranial Doppler (4/42), applanation tonometry (4/42) or other methods (4/42) to assess structural (22/42) and functional outcomes (42/42) for peripheral (36/42) and central vasculature (9/42). For arterial blood flow volume measured above and below the level of injury, the impact of SCI relative to controls was small ($d=-0.426$, 95%CI=-1.040-0.187) to moderate ($d=-0.736$, 95%CI=-1.181-0.291), respectively. Relative to non-injured controls, the impact of SCI on arterial diameter was small ($d=-0.417$, 95%CI=-0.852-0.058) to large ($d=-1.555$, 95%CI=-2.062-1.089) for vessels measured above and below the level of injury, respectively. Subgroup analyses showed the impact of SCI on arterial diameter below the level injury was significantly greater than vessels above the level of injury ($Q=10.446$, $p=0.001$). **Conclusions:** Most included studies involved the use of Doppler ultrasound to assess structural and functional alterations to peripheral vasculature following SCI. Analysis results suggest the magnitude structural and functional alteration attributed to SCI varies according to the level of injury and vasculature measured. In future, more studies investigating the impact of SCI on central vasculature relative to able-bodied individuals are warranted.

Learning Objective 1 Describe the major findings of the review and discuss the potential clinical implications.

Learning Objective 2 Describe the impact of spinal cord injury on specific structural and functional vascular outcomes.

Learning Objective 3 Describe the influence of injury level on structural and functional vascular outcomes.

The Effect of Transcutaneous Spinal Cord Stimulation on Peripheral Vascular Responses During Urodynamic Assessment

Abstract 249 | Poster 32

Ali Hosseinzadeh, BSc, International Collaboration on Repair Discoveries (ICORD)

Background: Autonomic dysreflexia (AD) is a known concern following spinal cord injury (SCI) and has been shown to impact vascular function, increase the risk of cardiovascular disease (CVD), and severe health complications (e.g., stroke, myocardial infarction and death). Roughly 80% of episodic AD is attributed to triggering stimuli originating from the lower urinary tract (LUT) (e.g., bladder distention). Recent evidence suggests transcutaneous spinal cord stimulation (tSCS) mitigates episodic AD resulting from noxious stimuli originating below the level of injury. However, there is a lack of research investigating peripheral vascular responses associated with AD caused by LUT irritation. Moreover, the effect of tSCS on peripheral vascular responses remains unknown. Objectives: This study aimed to characterize carotid arterial blood flow during urodynamic assessment (UDS) (i.e., filling cystometry) with and without the application of tSCS. Methods: Six participants (females=2, males=4, age=30[20]) with chronic, motor-complete SCI (T6 and above, AIS A and B) underwent UDS. Common carotid artery blood flow was measured using pulse wave Doppler ultrasound. Measures were collected during (1) baseline, (2) initial bladder filling without tSCS, (3) AD onset during bladder filling without tSCS and (4) bladder filling with tSCS applied at T11 and L1 spinal segments (30Hz, monophasic waveform, 1ms pulses, 10kHz carrier frequency, 1-130mA). Differences in ultrasound parameters between events were determined using Friedman tests with Wilcoxon Signed Ranks post hoc comparisons ($p \leq 0.05$). Results: Significant differences in mean arterial shear rate were observed between UDS events ($p=0.008$). Post hoc analyses showed significantly lower mean shear rate during bladder filling with tSCS (377.1[150.4]) compared to initial filling (430.1[232.8]) and AD onset without tSCS (529.2[307.3]) ($p \leq 0.013$) but not baseline (389.6[90.4]) ($p=0.594$). Significant differences in arterial diameter were also observed between UDS events ($p < 0.001$). Post hoc analyses also showed significantly greater arterial diameter during bladder filling with tSCS (5.73[0.85]) compared to initial filling (5.40[0.98]) and AD onset without tSCS (5.29[1.10]) ($p \leq 0.003$) but did not differ significantly from baseline (5.73[0.86]) ($p=0.374$). Differences in time-averaged mean velocity were marginally insignificant between events ($p=0.051$). Conclusions: Our preliminary results suggest tSCS reduces arterial shear rate and increases vasodilation during bladder distention by blunting sympathetic outflow to peripheral vasculature. These findings contribute to the growing body of evidence promoting the use of tSCS as a potential therapy for mitigating episodic AD and potentially reducing long-term CVD risk. Future research studies involving larger cohorts are needed to enhance the generalizability of these findings. Support: International Spinal Research Trust (ISRT), Michael Smith Health Research BC

Learning Objective 1 Describe the potential triggers of autonomic dysreflexia and its associated cardiovascular consequences.

Learning Objective 2 Describe the major findings of the study and discuss the potential clinical implications.

Learning Objective 3 Describe the effect of transcutaneous spinal cord stimulation on arterial responses during urodynamics.

When Paresthesias are More Than Skin Deep: A Case Report

Abstract 104 | Poster 33

Michiko Paschall, MD, Medical College of Wisconsin

Case Diagnosis A 57 year-old male with a past medical history of L4-S1 spinal fusion 25 years ago with chronic low back pain who presented to his primary care provider with progressive bilateral lower extremity paresthesias for the past year. **Case Description** Two weeks after his PCP visit, the patient had an EMG/NCS which was essentially normal, and he was clinically diagnosed with idiopathic peripheral polyneuropathy. Six months after visiting his PCP, he underwent a CT PE angiography for evaluation of acute chest pain and shortness of breath, and at that time was noted to have an incidental small lower thoracic spinal cord syrinx. Upon further investigation, a small syrinx in the lower thoracic cord was able to be seen on an MR abdomen without and with contrast performed two years prior to presentation. Dedicated imaging of the syrinx with an MR T-spine without and with contrast revealed a large cystic and solid intramedullary lesion spanning T7-T11 with adjacent pre-syrinx versus cord edema, favoring ependymoma over astrocytoma or central canal drop metastasis. The patient subsequently underwent a T8-T11 thoracic laminectomy and an intramedullary tumor resection. The pathology results were consistent with an intramedullary melanocytic neoplasm. Upon further workup, this was determined to be a primary intramedullary melanocytic tumor. Due to the absence of metastases, the patient completed adjuvant radiotherapy without systemic chemotherapy. At most recent follow up, there has been no radiographic or clinical evidence of disease recurrence. **Discussion** Intramedullary lesions represent the least common type of spinal cord tumor, comprising about 5% of all spinal cord tumors. In this subset of intramedullary lesions, melanocytomas only account for less than 30 documented cases in the literature. This case displays an exceedingly rare diagnosis in the setting of an incidental imaging finding. Further workup for an ‘incidentaloma’ may be of limited clinical utility in most cases. However, in the setting of new or progressive symptoms with otherwise negative workup, incidental findings from prior imaging may provide valuable insight into the underlying diagnosis. In this case, our patient had progressive lower extremity sensory changes with negative EMG and laboratory workup. Review of prior imaging with findings of an incidental syrinx ended up leading to the underlying etiology. **Conclusion** Previous workup, even if not related to the current symptoms or presentation, may provide valuable insight into the underlying exceedingly rare diagnosis. This case highlights how paresthesias and an incidental finding of a syrinx on a CT PE angiography can lead to a rare diagnosis of a primary intramedullary melanocytic neoplasm.

Learning Objective 1 Illustrate that incidental findings can be vital in leading to a diagnosis

Learning Objective 2 Explain how common presentations can lead to uncommon diagnoses

Learning Objective 3 Describe how primary intramedullary melanocytic neoplasms are rare

Surfer's Myelopathy: An Unusual Cause of Acute Spinal Cord Ischemia

Abstract 106 | Poster 34

Juan Jose Calvillo Ruiz, Md, National Institute of Rehabilitation "Luis Guillermo Ibarra Ibarra"

Spinal cord injury (SCI) 's etiology is divided into traumatic and non-traumatic. Within the non-traumatic causes, vascular lesions represent a diagnostic and management challenge for physician. The term "surfer's myelopathy (SM)" describes a type of non-traumatic SCI that occurs during amateur surfing, usually in the first lesson. It manifests with an acute neurological deficit and the severity is variable. The specific etiology is unknown and the current literature describes an episode of ischemia as a pathophysiological event; secondary to a flexion-extension mechanism that interrupts the medullary circulation. It's a rare entity first reported in 1976 with a total of 64 cases worldwide nowadays. All patients have common characteristics (age at presentation, history of athletic habits, and no pathological history). We present the first case of SM in Mexico and one of the few cases with a confirmed vascular cause. Case presentation: A 28-year-old male patient, with no medical history, participates in his first surfing lesson in Puerto Vallarta, Mexico. During his first surfing attempt, he presented with acute lumbar pain that progressed with weakness and loss of sensibility in the lower extremities accompanied by loss of sphincter control 1 hour later. He was transferred to the emergency department, where a CT scan was performed without evidence of traumatic pathology. He was referred to a hospital in Mexico City for further evaluation. Dorsolumbar angiography was performed with evidence of decreased caliber of the main trunk of Adamkiewicz's Artery; as a secondary finding, angiographic extension to the brain was performed and an aneurysm in the left MCA was reported. Subsequently, he was transferred to the SCI unit at the National Institute of Rehabilitation for further management. He was diagnosed with SCI AIS B neurological level L1. He received intensive rehabilitation management for 1 month to maximize neuronal plasticity and improve functional independence; he was discharged with the aforementioned diagnosis and continued outpatient follow-up. Four months after the event, he presented clinical evolution to SCI AIS D, achieving walking with the use of forearm crutches and management of neurogenic bowel and bladder independently with self-catheterization and bowel routine. Discussion: Although alterations of vascular origin have been reported as a possible pathophysiology, which can justify SM, there are few cases where vascular alteration is documented; the case we report has angiographic confirmation of vascular involvement in the lower circulation of the spinal cord. Furthermore, it has been demonstrated that neurological recovery varies depending of the first assessment: 51% were initially classified as AIS A or B and only 19.4% (n= 6, all AIS B) demonstrated motor recovery (B to C= 2, B to D= 3, B to E= 1); all AIS A showed no recovery. Our reported case shows recovery at 4 months, progressing from SCI AIS B to AIS D. Finally, we proved that with a specific rehabilitation program, this patient was able to achieve the objectives set to maximize his functional independence in activities of daily living.

Learning Objective 1 Describe the case presentation of a patient with surfer's myelopathy

Learning Objective 2 Analyze the pathophysiology of surfer's myelitis

Learning Objective 3 Evaluate the evolution and recovery of patients with surfer's myelopathy

The Importance of Spilling Their Guts: An Uncommon Case of Anemia in SCI

Abstract 136 | Poster 35

Lauren Shuda, MD, Medical College of Wisconsin

Case Diagnosis 40-year-old man with recent history C7 AIS C tetraplegia s/p C5-T1 decompression and fusion and provoked pulmonary embolism (PE) on rivaroxaban who presented with progressively worsening anemia 10 months after his initial spinal cord injury (SCI). **Case Description** Our patient was previously involved in a fall from a ladder, resulting in C7 AIS C tetraplegia. He completed inpatient rehabilitation and discharged home following a full course of DVT prophylaxis. Shortly after his discharge, he was readmitted with a submassive PE, treated inpatient, and continued oral rivaroxaban at home. At his initial SCI annual exam, all labs were within normal limits. Upon follow up ten months post injury, patient was found to have a mild anemia. Over the next eight weeks, patient's hemoglobin/hematocrit (H/H) continued to drop to a low of 7.7/24.9 with low normal MCV, high immature reticulocyte count, low reticulocyte hemoglobin, low iron, low TIBC, borderline low albumin, and high ferritin. At that visit, patient reported occasional blood per rectum and tarry stools with bowel program. His home rivaroxaban was held for two days with improvement of H/H to 9.4/30.7. Upon further inquiry, patient reported taking an over-the-counter iron replacement every other day since his discharge from the SCI unit. Patient's normocytic anemia was thought to be multifactorial with components of anemia of chronic disease and blood loss given history, low normal MCV, and low iron. He was started on appropriate dose of iron replacement and proton pump inhibitor with plan for ASAP outpatient GI consult after refusing inpatient admission for workup. Anticoagulation was also held per patient's preference after discussion with hematology regarding risks/benefits. Patient underwent endoscopy and colonoscopy and was found to have an area of erythema with friable tissue in the gastric cardia which was biopsied. Histology showed areas of mucosal ulceration overlapping extracellular crystalline iron particle deposition, consistent with iron pill gastritis. Iron replacement was stopped with resolution of anemia. **Discussion** After SCI, patients often undergo treatment for comorbidities related to their injury, including iron supplementation in the setting of anemia. While many of the side effects of oral iron are well recognized by the medical community, iron pill gastritis is often not considered until histology demonstrates the diagnosis. Given changes in gut motility post-SCI, it is not unreasonable to consider the increased risk of gastritis in the setting of oral iron supplementation in this population. Had this patient not revealed concerns for tarry stools, it is possible that endoscopic evaluation would not have been considered given underlying suspicion for anemia of chronic disease due to lower GI sources and improvement of anemia off of anticoagulation. Further, this case serves as a reminder to confirm all over-the-counter supplements patients are taking once home. **Conclusion** This case highlights the importance of considering less common etiologies for common conditions within the SCI population and the importance of thorough discussions regarding both prescribed and over-the-counter medications. It also illustrates a rare but not unreported cause of anemia.

Learning Objective 1 Illustrate the importance of considering less common etiologies for common conditions in SCI patients

Learning Objective 2 Recognize iron pill gastritis as a possible etiology of anemia

Learning Objective 3 Emphasize the importance of reviewing home over-the-counter medications with patients

Psychological Intervention Model Aimed to Inpatient Rehabilitation Spinal Cord Injury Individuals

Abstract 167 | Poster 36

Sandra R. Hernández-Sandoval, B.A. Psychology; Psy. M., Instituto Nacional de Rehabilitación (National Rehabilitation Institute)

Objective: Emotional disturbances and loss of control are manifestations that are present in different degree in individuals with spinal cord injury (SCI). The aim of this study is to show starting a psychological intervention in subacute inpatient rehabilitation individuals, means getting along with the individual during their adaptation process into a new lifestyle. Design/Methods: The case of a 35 years-old man, diagnosed with complete spinal cord injury (SCI), grade A of the American Spinal Injury Association Impairment Scale (AIS), C7 neurological level of injury (NLI) of traumatic etiology. The treatment was featured in a psychological cognitive-behavioural model. The model consisted in 13 sessions, 12 during his inpatient rehabilitation focused on recovery of control, depression and anxiety management, perception of his quality-of-life, facing strategies to family and relationship loss. The last session was focused on his adaptability one month after his discharge. He was assessed with the Beck Scale for Depression and Anxiety, Coping Adaptation Processing Scale (CAPS), Life Satisfaction Questionnaire 9 (LiSAT-9) and the Diagnostic and Statistical Manual of Mental Disorder 5 (DSM-5) was consulted for posttraumatic stress disorder (PTSD) symptomatology. The evaluations were carried out upon admission and discharge. Results: Depression and anxiety scores changed from a severe level to a mild one. Basic Mindfulness exercises turned out to be effective to reduce to minimum anxiety levels and to extinguish PTSD symptomatology. Throughout the psychological intervention, the individual improved his strategies of adaptation and coping with the SCI, such as the search of information and support, planning and positive reassessment; he modified avoidance, based on emotions, to a new active strategy to face his fears and give sense to the SCI. On his admission to inpatient rehabilitation, CAPS scores reflected low capability for adaptation. At the end of his hospital stay, he gained median to high adaptation capability scores. This improved his life satisfaction, loss processing, reintegration to activities of daily life and to work environment, as well as life outside institutional environment. Conclusions: This case study shows the importance of an early psychological intervention as part of the multidisciplinary management of inpatient rehabilitation traumatic SCI individuals.

Learning Objective 1 Recognize the importance of the psychologist within the multidisciplinary rehabilitation team.

Learning Objective 2 Discuss cognitive-behavioural therapy model applied to hospitalized inpatients.

Learning Objective 3 Utilize relaxing techniques (Mindfulness) to reduce anxiety levels.

Skipping Leg Day Isn't Always Bad: Complications Found in Heavy Lifters Who Experience Paralysis

Abstract 33 | Poster 37

Samantha Mendelson, DO, James A Haley VA Medical Center

Background and Issues: Strength and power athletes, such as weightlifters and jumpers, have superior bone mass and structure compared with their untrained counterparts in all age groups. While this is clearly beneficial in the ambulatory population, should a weightlifter experience paralysis, having an increased bone mass can quickly become a disadvantage. In our acute inpatient rehabilitation setting, we have seen multiple urologic and endocrine complications likely attributed to a higher-than-average bone density at the time of paralysis. **Purpose:** We will describe the clinical course of 5 recently paralyzed veterans. Prior to injury they were all very healthy and active. They all shared a passion for weightlifting and on average were able to back squat at least 400 lbs. They are all motor complete injuries. During their acute inpatient rehabilitation course, they all developed significant urological complications including renal and bladder stones within the first 6 months of their injuries. Some also developed hypercalcemia, which interrupted their rehabilitation course and required medical intervention. **Methods:** I will describe these patients' similarities in detail, and then present the complications - particularly related to the time frame of their complications, UTI's and hypercalcemia. I will contrast this to the expected time frame associated with typical bone loss associated with spinal cord injury. **Description of the project or program, of participants, procedures, measures and clinical intervention(s), analysis plan or criteria appropriate statistical analyses.** used to guide the analysis. **Results:** Consideration for habits prior to injury, particularly exercise habits can influence post injury complications. Keeping this in mind during rehabilitation, and giving daily attention to mobility, hydration and urine output and quality can prevent major emergent medical issues and long-term comorbidities. **Conclusions:** Based on this small patient sample, it would be recommended to carefully consider a newly paralyzed patient's premorbid history with emphasis on exercise routine. The veteran population is known to be more active than the general population, so coming across a newly injured veteran who was a very heavy lifter is not uncommon. Once identified, the complications associated with bone breakdown after immobility can be more carefully considered and prevented.

Learning Objective 1 Describe potential urological complications seen after a heavy lifter experiences paralysis.

Learning Objective 2 Recognize preventative measures to avoid urological complications after a heavy lifter experiences paralysis.

Learning Objective 3 Plan to carefully evaluate premorbid habits exercise habits and their effect on paralysis.

Complexities Of Bowel and Bladder Management in Cancer-Associated Spinal Cord Injury: A Mixed-Methods Study

Abstract 91 | Poster 38

Andrea Leyton-Mange,MD, Harvard-Spaulding Rehabilitation Hospital

Background: Patients with spinal cord injury due to cancer represent a unique subset of the spinal cord injured population, with complex care needs related to both their neurologic and oncologic conditions. To our knowledge there have been no prior studies describing distinctive features of bowel and bladder dysfunction in cancer-related spinal cord injury. Aim: To describe symptomatology and care of neurogenic bowel and bladder in a cohort of patients with cancer-associated spinal cord injury. Methods: This is a retrospective chart review study. Patients were identified by billing codes for neurogenic bowel and neurogenic bladder among outpatient encounters in a spinal cord injury clinic within a large academic cancer center. Medical records for included patients were reviewed for qualitative themes by a non-treating clinician. Descriptive data relevant to those themes were then quantified. Results: 33 adults with cancer-associated spinal cord or cauda equina injuries were included. Neurologic levels of injury were 24% cervical (N=8), 33% thoracic (N=11), 30% lumbar (N=10), and 12% sacral (N=4). Four primary themes emerged in qualitative review: 1) prevalent comorbid cancer-associated conditions outside of the primary cord insult which may affect bowel/bladder function, such as chronic opioid use, intrapelvic and pelvic ring tumors, pelvic radiation, neuropathies, and chronic pelvic pain, 2) interdisciplinary management across the spectrum of cancer care, with bowel and bladder treatment input coming from multiple care providers, 3) multimodal bowel and bladder management strategies targeted at patient's symptoms including lifestyle, diet, and self-guided emptying strategies in addition to medications, and 4) frequent changes in bowel and bladder function over time attributed to dynamic cancer-related processes such as progression of disease and treatment cycles, which necessitated ongoing adjustment of bowel and bladder care. All 33 patients were found to have at least one comorbid complicating condition related to bowel or bladder function, with a mean of 4.3 such conditions per patient. 52 percent of patients (N=17) were noted to have at least one significant change in bowel/bladder symptoms or management strategy attributed to progression of disease or cancer treatment during the course of their care. At the time of referral to outpatient spinal cord injury clinic, 85 percent of patients (N=28) had been prescribed bowel or bladder medications by another provider. In response to patient symptoms and compounding factors, spinal cord injury clinicians incorporated at least one noninvasive nonpharmacologic strategy into a multimodal treatment plan for 97 percent of patients (N=32), including pelvic floor physical therapy (30%, N=10), dietary changes (42%, N=14), adjustment of oral hydration (52%, N=17), bladder or bowel training (55%, N=18), and noninvasive emptying techniques such as double void, bladder tapping, abdominal breathing, and abdominal massage (79%, N=26). Conclusion: Management of neurogenic bowel and bladder in patients with cancer-associated spinal cord injury requires understanding of the multiple complexities that cancer imparts on symptom assessment, treatment, and trajectory of care.

Learning Objective 1 N/A

Learning Objective 2 N/A

Learning Objective 3 N/A

Prevalence Of Current Pregnancy in Women with Traumatic Spinal Cord Injury: Findings from The National SCIMS Database 2000-2023

Abstract 158 | Poster 40

Yuying Chen, MD, PhD, University of Alabama at Birmingham

Objective: It was estimated that approximately 2.0% of women with traumatic spinal cord injury (tSCI) became pregnant annually during 2000-2013, similar to what was reported from a national sample of women with chronic physical disabilities during 2006-2011. With improvements in health care and societal attitudes toward disabilities, becoming pregnant has been increasingly accepted by women with physical disabilities. This study was conducted to update the prevalence of current pregnancy and associated factors among reproductive-aged women with tSCI. **Design/Methods:** Data were retrieved from the National Spinal Cord Injury Model Systems Database (SCIMS) in the USA, including women who had a tSCI during 1972-2022, were 18-49 years old at interview, and completed follow-up assessments at 1, 5 and then every 5 years post injury during 2000-2023. Current pregnancy was defined as any hospitalization during the past 12 months for the reason of uncomplicated childbirth or complications of pregnancy, childbirth, and the puerperium. Descriptive and logistic regression analyses were performed to identify significant factors associated with current pregnancy, including demographic, neurological, and psychosocial factors. To account for potential dependence among multiple interviews of the same woman, generalized estimating equations method was used to assess statistical significances. **Results:** 95 pregnancies were reported among 5,313 women with tSCI. This annual prevalence estimate of 1.8% varied by years since injury (ranging from 0% for years 30-45 and 0.4% for year 1 to 3.7% for year 15), but did not differ by calendar years (1.4%, 2.1%, 1.9%, 1.8%, and 1.6% for years 2000-2004, 2005-2009, 2010-2014, 2015-2019, and 2020-2023, respectively). Those reporting current pregnancy were significantly younger (31.9y vs 35.6y), married (66.3% vs 30.9%), employed (46.7% vs 29.1%), and catheter-free (38.5% vs 26.4%) as well as had better neurological function (AIS D: 31.1% vs 21.6%), lower pain severity score (3.7 vs 4.5), greater community participation, and higher satisfaction with life, as compared with non-pregnant women. There were no significant differences in race/ethnicity, education level, or injury etiology between pregnant and non-pregnant women. **Conclusion:** We did not see an increase in the annual prevalence of pregnancy among reproductive-aged women with tSCI over the last decade. Current estimate of pregnancy (1.8%) during 2000-2023 is slightly lower than what was reported in 2000-2013 (2.0%). This study highlights the need for further research into the barriers to conception and childbirth as well as pregnancy and birth outcomes among women with tSCI, which will help women with tSCI make an informed decision as well as optimize the safety of pregnancies and health of the newborn.

Learning Objective 1 Describe prevalence of current pregnancy among women with traumatic spinal cord injury (tSCI)

Learning Objective 2 Describe demographic, clinical, and psychosocial factors associated with current pregnancy among women with tSCI

Learning Objective 3 Discuss potential barriers to conception and childbirth among women with tSCI

A Phase 1b/2a Study of NVG-291 in Individuals with Subacute or Chronic Spinal Cord Injury

Abstract 10 | Poster 42

Daniel Mikol, MD, PhD, NervGen

Objectives: There is a high unmet need for treatments to repair damage after spinal cord injury (SCI). **Background:** NVG-291 is a systemically administered peptide mimetic of receptor protein tyrosine phosphatase sigma (PTP). The rodent version (intracellular sigma peptide [ISP]) has been shown to promote neural repair via enhanced axonal regeneration, plasticity, and remyelination and enable functional recovery (motor, bladder) in rodent models of both acute and chronic SCI when administered for 7-8 weeks as a daily subcutaneous (SC) injection. Successful translation of therapies from animals to humans has proven challenging in SCI. In our Phase 1b/2a proof-of-concept trial of NVG-291 in SCI, we take a pragmatic approach using electrophysiology as a surrogate efficacy tool to enable precise measurement of descending motor connectivity, in addition to using clinical outcome measures. **Design/Methods:** The ongoing Phase 1b/2a randomized, double-blind, placebo-controlled trial in traumatic SCI (NCT05965700) is being conducted at a single center (Shirley Ryan AbilityLab, Chicago, IL) to reduce variability of electrophysiological measurements and allow for a uniform exercise rehabilitation protocol. NVG-291 or placebo is being administered by daily SC injection for 12 weeks in two separate cohorts of ~20 subjects. Total study duration is 16 weeks. The two cohorts will enroll subjects with cervical motor incomplete SCI: cohort 1 chronic (1 – 10 years post-injury); cohort 2 subacute (10 – 49 days post-injury). A motor incomplete population is targeted because the animal models showing efficacy of ISP are motor incomplete models. A fixed dose of NVG-291 has been selected to achieve exposures that are comparable to or in excess of the exposures in animals at the highest efficacious dose tested in preclinical efficacy studies. **Results:** The primary efficacy objective is to evaluate the change in motor evoked potential amplitudes (MEPs) in predefined muscle groups. Key clinical outcome measures include GRASSP, pinch dynamometry, 10mWT, and upper/lower extremity motor scores. Other electrophysiological objectives are to evaluate changes in reticulospinal connectivity (based on startle-MEPs), MVC amplitudes, and MEP latencies. Exploratory measures will assess spasticity, autonomic function, mobility, and quality of life. In summary, this trial aims to successfully translate positive results from animal models of SCI to humans with SCI, leveraging electrophysiological and clinical measures to monitor functional recovery. **Conclusion:** This proof-of-concept trial of NVG-291 will assess changes in electrophysiological and clinical measures following treatment of individuals with subacute or chronic SCI. Results from the chronic cohort are expected in mid-2024. A clinical trial update will be presented. Supported by Wings for Life

Learning Objective 1 To explain key results of NVG-291 (rodent analogue) in preclinical animal models of spinal cord injury

Learning Objective 2 To discuss the target study population and key study assessments (clinical, electrophysiological) in an ongoing Phase 1b/2a clinical trial

Learning Objective 3 To analyze available blinded or unblinded results

Segmental Motor Recovery After Cervical Spinal Cord Injury

Abstract 64 | Poster 43

Gustavo Balbinot, PhD, Krembil Research Institute - University Health Network

Introduction: Cervical spinal cord injury (SCI) causes extensive impairments for individuals which may include dexterous hand function. Although prior work has focused on the recovery at the person-level, the factors determining the recovery of individual muscles are poorly understood. **Objective:** Here, we investigate the muscle-specific recovery after cervical spinal cord injury in a retrospective analysis of 748 individuals from the European Multicenter Study about Spinal Cord Injury (NCT01571531). **Results:** The clinical records of 748 research participants were reviewed in this study. At the segmental muscle level, after controlling for the distance from the motor level, proximal muscles such as the elbow flexors and extensors show superior recovery compared to distal muscles such as the intrinsic hand muscles, especially if distant from the lesion. The bulk of the results indicates greater impact of the spinal cord injury and lesser strength recovery of distal muscles (finger flexors and abductors) compared to proximal upper limb muscles (elbow flexors), especially in individuals with sensorimotor or motor complete SCI. **Conclusion:** Natural recovery after cervical SCI relates to the segmental innervation and follows a proximal-to-distal gradient in which distal muscles of the upper limb show limited and delayed strength recovery compared to proximal muscles. Our findings suggest that assessment strategies for muscle-specific motor recovery in acute spinal cord injury complement person-level predictions. These conclusions were possible because of the segmental analysis employed in the present study, which constitutes an alternative method to quantify recovery rates in future clinical trials.

Learning Objective 1 Understand the segmental recovery concept.

Learning Objective 2 Explore the utilization of the segmental recovery framework in upcoming clinical trial design and execution.

Learning Objective 3 Discuss the utilization of the segmental recovery as a primary/secondary outcome measurement in upcoming clinical trials.

Returning to Work After a Spinal Cord Injury in Latin America

Abstract 121 | Poster 44

Melina Longoni ,Md, Los Madroños Hospital

Objective Reentering the workforce is a pivotal component of social reintegration for those with spinal cord injuries and serves as an indicator of rehabilitation program success. Several factors can impact an individual's ability to return to work, including their level of injury, which often corresponds to their level of dependence for daily activities and work. According to recent findings from the Latin American Survey on Disability (E.LA.Dis), 72% of disabled individuals in 17 Latin American countries are not employed, and those who are employed often earn less than their able-bodied peers. This study aims to examine the employment status of individuals with SCI in Latin America through healthcare providers. **Design and methods** A total of 219 healthcare providers from 17 Latin American countries answered an online questionnaire distributed among those who treat patients with SCI. **Results** Among the 219 participants surveyed, the majority were women, comprising 82% of the total. The majority of participants hailed from Mexico (36%), followed by Argentina (23%) and Peru (11%). The study population included a diverse range of healthcare professionals, with 33% being occupational therapists (OT), 28% specializing in Physical Medicine and Rehabilitation (PM&R), 11% being physical therapists (PT), 10% being PM&R residents, and 9% being nurses. Interestingly, only 26% of respondents conducted a work environment assessment to adjust it to the situation after SCI, with PM&R specialists leading the way at 45%, and OTs following at 29%. Regarding the percentage of individuals with SCI who return to work, 85% of respondents reported that less than 50% of them returned to work. In contrast, 10% stated that more than 50% did, and 2% said that all people with SCI returned to work. Predictors of return to work were found to be primarily related to the neurological level of injury (74%), education and professional training (71%), and place of residence (34%). **Conclusions** Spinal cord injury survivors in Latin America often lack representation in the workforce. Unfortunately, there is a shortage of regional data available on the current situation of this community. Some data suggest that most individuals affected by spinal cord injuries (SCI) are young and able to work but encounter various obstacles when seeking employment. These obstacles include limited access to education, inadequate employment training opportunities, and widespread misconceptions and biases regarding the abilities of individuals with SCI. Unfortunately, there is a lack of reliable published statistics on the prevalence and incidence of SCI in Latin America. There is a need to conduct further research on this topic.

Learning Objective 1 Describe the state of workforce re-entry in people with spinal cord injury in Latin America from the perspective of healthcare professionals.

Learning Objective 2 Highlight the importance of workforce re-entry for individuals who have experienced a spinal cord injury.

Learning Objective 3 Outline factors that affect the re-entry of people with spinal cord injuries into the workforce in Latin America.

A Clinical Research Registry: The Power of Connection

Abstract 146 | Poster 45

Carolyn Ostrowski,PTA, CEAS, Shirley Ryan AbilityLab

Objective: The Clinical Research Registry (CRR) is an Institutional Review Board approved controlled database from which researchers at the Shirley Ryan AbilityLab (SRAlab) and the Departments of Physical Therapy and Human Movement Sciences (PTHMS), and Physical Medicine and Rehabilitation (PM&R) at Northwestern University can identify potential participants for research studies. This project supplies research clinicians/scientists with a tool for subject recruitment. Our presentation aims to describe the development of a series of diagnosis-specific databases used for rehabilitation research and patient-centered recruitment. **Methods:** REDCap, a secure web-based application serves as the CRR platform. Clinicians and scientists engaged in discussions to identify the data needed to facilitate enrollment and participation to create REDCap data dictionaries for specific diseases. A digital consenting process generates a participant unique REDCap record, based on their diagnosis. Data dictionaries include the following categories: (a) patient demographics; (b) patient medical history, (c) general and diagnosis-specific clinical data. Recruitment efforts include: (a) a CRR champion program, (b) DPT students and volunteers, (c) community outreach, and (d) diverse levels of hospital care. **Results:** Our current CRR repositories include the following diagnoses: spinal cord injury, stroke, traumatic brain injury, cerebral palsy, amputation/limb loss, musculoskeletal conditions, multiple sclerosis, and Parkinson's disease. Around 4000 participants from both inpatient and outpatient settings joined the registry since 2021. Over 50 principal investigators from SRAlab, PTHMS, and PM&R at Northwestern University are actively using the CRR to recruit participants for rehabilitation research studies. **Summary:** The CRR represents a critical resource for the advancement of translation rehabilitation research. Future efforts include automatic transfer of information from the electronic medical record to enhance the efficiency of enrollment efforts.

Learning Objective 1

Discuss the development of data dictionaries for multiple diagnoses

Learning Objective 2

Developing leadership teams to facilitate the advancement with recruitment of the specific repository.

Learning Objective 3

Advancement with recruitment to improve the growth and expansion of a hospital based registry and the maintenance of the registry with a multitude of staffing constraints.

Working Conditions in Patients with Spinal Cord Injury at The National Rehabilitation Institute, Mexico City

Abstract 161 | Poster 46

Aldo Rafael Montes Ugalde, MD, National Institute of Rehabilitation "Luis Guillermo Ibarra Ibarra"

Spinal cord injury (SCI) has multiple consequences that impact the patient's quality of life. An important area that is taken as an indicator of success in the social integration after their rehabilitation management is the return to working life. Most of these cases are of traumatic etiology, in people of productive age, so the individual and social economic cost is significant in the public health systems of the nations. At the international level, there are different norms and programs that are responsible for promoting work inclusion in people with disabilities and favoring adequate conditions for it to be successful; however, the reintegration rates vary, mainly due to inadequate follow-up in the chronic stage. In Mexico, there is little information on the working conditions of patients with SCI, which makes it difficult to assess the effectiveness of social programs that are responsible for promoting their reintegration into a working space. The objective of the following work is to describe the frequency and working conditions in patients with SCI at the SCI service of the Instituto Nacional de Rehabilitación (Mexico). Methodology: An observational, cross-sectional and descriptive study was carried out in patients with SCI in the subacute-chronic stage of any neurological level and severity. A descriptive and inferential statistics analysis was performed according to the type of variable and inferential to study associations between them to determine which variables are associated with the labor incidence of these patients. Results: 399 individuals were studied, the majority men (66.9%), with an average age of 43.98 years (SD: 15.7), with an average evolution time of 49.9 months (DS: 75.2). The order of frequency of AIS was A (43.6%), D (29.8%), C (13.8%), B (12.3%) and E (0.5%). Regarding NN, the majority were T1-T6 (30.1%), T7 and below (29.6%), C4 and above (17.3%) and C5-C8 (12.3%), the most frequent etiology was traumatic (67.2%). The vast majority do not work after the SCI (76.2%). Of those who work, the majority are salesmen (16.3%), students (14.3%) and auxiliary workers (14.3%), the return-to-work time was an average of 13.46 months (DS 14.13). A statistically significant association was found between working and age (work: 39.2 (SD12.6) years vs. non-work: 45.46 (DS16.27, $p < 0.001$)) and between work and life satisfaction (work: 41.73 (DS7.13) vs no work: 36.6 (DS: 7.9), $p = 0.044$). A significant association was also found in relation to the type of injury (Chi square = 0.048) Only 34 patients (8.5%) kept their job or got a job like the one they had. Conclusion: Most of the patients with SCI do not have a job, which is in relation to reports in the rest of the world. The presence of employment is an important factor in functional life satisfaction and translates into greater independence in these patients, and we found a significant association with age and type of SCI (AIS). Knowing this data helps us to create programs and tools to promote better labor inclusion.

Learning Objective 1 Describe the working conditions in patients with SCI

Learning Objective 2 Analyze work frequency in patients with SCI

Learning Objective 3 Discuss the factors that influence work frequency in patients with SCI

Sexuality In Patients with Spinal Cord Injury: Satisfaction Reported About the Intervention Received During Rehabilitation Program

Abstract 229 | Poster 47

Mariana Bonetto, OT, FLENI

Introduction: After a spinal cord injury (SCI), sexuality is affected by multiple factors described in the bibliography. Rehabilitation professionals have reported that limited knowledge of sexuality and sexual needs makes it difficult to answer questions about sexual health, so it is necessary to know the self-perception of patients regarding their specific needs for their approach. Objective: To know the type of intervention received on sexuality and the level of satisfaction with it, in patients with spinal cord injury during the period of hospitalization in a neurorehabilitation center. Method: Descriptive observational study. Participant: patients with SCI over 18 years of age, from Argentina; admitted in an inpatient program in a neurorehabilitation, between 2018 and 2022 inclusive. For data collection, an online survey sent by mail, through the Google Forms platform, with 25 questions with predetermined answers (multiple choice) and open. Questions were asked about sexuality before the injury and after hospitalization, type of information received during the hospitalization program, effectiveness, and level of satisfaction with the information received. Results: The survey was sent to 70 people and 27 responded anonymously. 63% men, with a mean age of 38 years, most of the participants with tetraplegia (44,4%) and with an incomplete lesion (63%). The majority of the sample affirms that sexuality was a concern after the injury. 77.8% of those surveyed reported having received information during their hospitalization. Such information was presented orally (66.7%), audiovisual (18.5%) and written (14.8%). 48.1% reported that it was requested out of their own interest, 44.4% was proposed by a professional and 7.4% was proposed by another non-professional (partner, another patient, friend, family). In 77.8% the intervention was individual, while 14.8% was in pairs and 7.4% in groups. 48% of the participants report that the information received was very effective and state that it was satisfactory. More than half of the sample reported having resumed sexual activity after the first month of hospital discharge. Conclusion: It is highlighted that the approach to sexuality is of interest to patients with spinal cord injury, in turn reflecting the need to optimize the sexuality intervention due to the low percentage of satisfaction with the information received. More research focused and based on the self-perception of patients is necessary to improve the efficacy in the approach to sexuality, as well as to investigate the possible factors that favor a return to sexual activity.

Learning Objective 1 show the importance of sexuality in the subacute rehabilitation program

Learning Objective 2 discuss the effectiveness of intervention in sexuality after SCI

Learning Objective 3 to know the satisfaction of people with sci about the intervention received in a rehabilitation program

Group Tele-Exercise Impact on Physical Activity Determinants and Behavior In Individuals With Spinal Cord Injury

Abstract 80 | Poster 48

Laura Baehr,PT, DPT, PhD, Temple University

Purpose/Hypothesis. Nearly 50% of individuals with spinal cord injury (SCI) report no regular physical activity (PA), which increases risk for chronic disease and early mortality. Synchronous group-based PA tele-strategies, or live remotely delivered interventions, are feasible, transcend physical barriers to PA behavior, and promote socialization yet the number of programs and quality of evidence on this method is limited. Our team previously developed Tele-exercise to Promote Empowered Movement in SCI (TEEMS) program, which is safe, feasible, based on SCI exercise guidelines, and directly responsive to needs and requests of individuals with SCI from our preliminary work. The goal of this study was to formally evaluate TEEMS for its impact on personal determinants of physical activity behavior as defined by Social Cognitive Theory for health behavior change. We hypothesized that participation would strengthen personal factors critical to PA behavior (exercise self-efficacy and exercise outcome expectations) and in turn increase PA behavior following the program and after a retention period.

Number of Subjects. Individuals with chronic SCI (n=22, injury duration 2-50 years) aged 26-68 years (10 male/12 female).

Materials and Methods. TEEMS, an 8-week synchronous group tele-exercise program, consisted of biweekly 60-minute classes delivered via live web-conferencing software. The study used a parallel mixed methods design in which quantitative and qualitative data were collected concurrently and integrated with equal consideration. This single-group repeated measures design assessed Exercise Self-Efficacy (Exercise Self-Efficacy Scale for SCI: ESES), Exercise Outcome Expectations (Multidimensional Outcome Expectations for Exercise: MOEES), and Weekly PA minutes (Leisure Time PA Questionnaire for SCI: LTPAQ) at pre-program (0-weeks), post-program (8-weeks) and retention (16-weeks) timepoints. Parallel focus group interviews were conducted to elaborate on these numeric constructs from the lived experience perspective.

Results. At post-program, improved exercise self-efficacy ($p=0.013$, $d= 1.243$) and self-evaluative expectations (psychological state, overall mood) of regular exercise ($p<0.001$, $d=1.974$) were facilitated by perceived exercise knowledge gained through instructors and social dynamic during TEEMS. Participants described that the portability and sustainability of TEEMS led to increased PA throughout the day. Despite a 75-minute median increase in moderate-vigorous PA weekly minutes on LTPAQ assessment, this change was not statistically significant ($p=0.804$).

Conclusions. Participation in TEEMS program positively impacted personal determinants of PA behavior immediately following participation. Future investigations should include a control group and biophysical PA measures such as wearable digital health devices.

Clinical Relevance. Our findings demonstrate that exercise self-efficacy is a critical personal determinant of physical activity behavior and should be integrated into the design and assessment of PA promotion strategies for individuals with SCI.

Learning Objective 1 Discuss the utility of Social Cognitive Theory as a theoretical basis for physical activity interventions for SCI

Learning Objective 2 Define Tele-Exercise to Promote Empowered Movement in Individuals with SCI (TEEMS) Program Goals and Elements

Learning Objective 3 Explain impact of non-randomized TEEMS clinical trial participation on physical activity determinants and behavior in individuals with SCI

Predicting Complete Vs. Incomplete Long-Term Functional Independence Early After Acute Motor-Incomplete AIS D Spinal Cord Injury to Optimize the Care Pathway. A Prospective Cohort Study.

Abstract 266 | Poster 49

Antoine Dionne, MD-MSc (candidate), Université de Montréal

Objectives: The proportion of AIS D traumatic spinal cord injuries (tSCI) is increasing, particularly in the elderly population. Although the initial motor deficits can be relatively mild, some individuals fail to recover functional independence. It is important to identify individuals who will likely fail to reach complete functional independence as early as possible, in order to optimize their care pathway and reduce the burden associated with this highly heterogeneous group. **Setting:** Level-1 trauma center specialized in SCI care **Methods:** A prospective cohort of 114 individuals with an AIS-D tSCI was considered. The baseline characteristics, length of acute stay, need for inpatient rehabilitation, and 12-month functional status were assessed. Univariate and classification and regression trees (CART) analyses were performed to identify factors associated with reaching complete vs. incomplete functional independence. **Results:** There were 69.3%, 83.3% and 61.4% individuals reaching complete independence in self-care, respiration/sphincter management and mobility, respectively. A total of 64 individuals (52%) reached complete functional independence in all three domains. On univariate analysis, age ≥ 65 years, the Charlson comorbidity index (CCI), a lower motor and sensory scores, a level of injury L1 or higher, prolonged acute stay and the need for inpatient rehabilitation were associated with non-complete independence in self-care and mobility, while comorbidities and the need for inpatient rehabilitation were associated with non-complete independence in respiration/sphincter management. In CART analysis, complete long-term functional independence was more likely with a baseline motor score 83 (65% individuals), particularly if they also have a low burden of comorbidity (70% individuals if CCI4). **Conclusions:** About half of individuals with AIS D tSCI can expect complete long-term functional independence. It is important to recognize early during acute care individuals with baseline motor score 83 or a high burden of comorbidities (CCI5), because they are less likely to achieve complete long-term functional independence, and may require specialized resources such as inpatient rehabilitation and home services.

Learning Objective 1 Review the epidemiology of patients with AIS grade D injuries

Learning Objective 2 Discuss their potential for complete functional recovery

Learning Objective 3 Classify these patients according to their expected functional outcomes

Results Of Telepsychology Intervention in People With Spinal Cord Injuries In Argentina During The Pandemic And Beyond

Abstract 96 | Poster 50

Fabiana Micozzi, Lic. Phd, Redel Rehabilitation Center

Objective The appearance of COVID-19, the confinement, social distancing, housing and work conditions, limitations of economic resources, interruptions in the usual treatments for chronic diseases, etc had a negative psychological impact on the population, generating symptoms of post-traumatic stress, confusion and anger, emotional crises, etc Outpatient rehabilitation centers were closed and the use of psychological support was essential Telepsychology is the provision of psychological services through technologies that allow remote communication. In Argentina, it was regulated by the National Directorate of Health Information Systems, which includes recommendations adapted to Remote Care Teleconsultations. This study is aim to share the experience of care through telepsychology of people with SCI during and after the pandemic **Design and methods** The intervention was carried out in 20 people with SCI from Argentina (11 women), 38 years (27-53), 5 years from the SCI (3-18), during the pandemic period with a 6 months follow-up. The attention was carried out by a psychologist, through the modality of video calls, once a week As a therapeutic device, the same principles were applied as in face-to-face therapy regarding the ethical regulations and deontology that guarantee an adequate psychological practice The professional assesses and evaluates the convenience, according to her clinical criteria, of providing the service based on the client's skills, knowledge, and competencies to use the necessary technological means in an appropriate manner. The GAD 7 was used to detect anxiety and PQH 9 for depression An average of 20 sessions was carried out for each patient and a follow-up after 6 months **Results** The main symptoms detected at the beginning of the pandemic were anxiety (80%) and depression (60%); they were related to the state of the pandemic After the treatment, the patients improved in the perception of symptoms (25% of anxiety and depression). As in the general population, the symptoms of fear, anger and frustration were present, there was a tendency to worsen the symptoms of depression and anxiety related to the uncertainty of the possibility of infection in people with SCI, as well as the lack of access to health centers and the interruption of rehabilitation treatments The psychological symptoms related to the underlying disability were mainly sleep disturbances, irritability and emotional lability, also, antisocial behaviors caused by a lack of social contact, associated with reaction behaviors to the environment; these symptoms remained after the intervention but improved substantially, not requiring pharmacological treatment **Conclusions** People with SCI present psychological symptoms related to disability, but new symptoms related to social distancing are associated Psychological treatment of these people constitutes a fundamental pillar in their mental health Telepsychology allowed in these cases to reduce the mental symptoms of depression and anxiety The information we now have about the impact of COVID-19 on mental health around the world is just the tip of the iceberg, according to the WHO. This is a wake-up call to all countries to pay more attention to mental health and do a better job of supporting the mental health of their populations

Learning Objective 1 Discuss the importance of treating mental health in people with SCI during major crises

Learning Objective 2 Describe a treatment based on telepsychology

Learning Objective 3 Describe the impact of the pandemic on mental health of people with SCI in Argentina

Autoimmune Cervicothoracic Myelopathy Following COVID-19 Infection: A Variable Presentation

Abstract 237 | Poster 51

Ishaan Hublikar, DO, TIRR Memorial Hermann

COVID-19 (SARS-CoV2)-induced myelopathy can cause motor weakness in patients along with other debilitating clinical manifestations.¹ It has been shown that the virus can cross the blood-brain barrier, leading to acute or delayed demyelination.^{2,3} One case study showed that patients with COVID-19 myelopathy had symptoms of ongoing generalized weakness after COVID-19 infection and also decreased strength in both upper and lower extremities despite continued rehabilitation efforts.⁴ Previous treatment for COVID-19 myelopathy has been either prednisone or plasmapheresis, with varying degrees of success in patients.⁵ Despite these pharmacologic options, patients still require long-term rehabilitation in order to improve their function.⁵ We describe a case of a 29-year-old female with history of COVID-19 complicated by MRI findings autoimmune cervicothoracic myelopathy, which caused incomplete spastic tetraplegia. She had rapid recovery following both her initial inpatient rehabilitation and following her outpatient rehabilitation. Upon examination in outpatient Spinal Cord Injury clinic 14 months later, manual muscle testing revealed an improvement from 0/5 to 4/5 in hip flexion and knee extension. Our case report demonstrates the potential variability that can exist post-rehabilitation among patients with myelopathy after COVID-19 infection, as there is limited research on this clinical presentation.

Learning Objective 1 Recognize the current rehabilitation outcomes in COVID-19 induced myelopathies in comparison to previously studied autoimmune myelopathies

Learning Objective 2 Evaluate the potential factors affecting variability in recovery of clinical manifestations of myelopathy, following SARS-CoV-2 infection.

Learning Objective 3 Analyze how different settings of rehabilitation can influence the variability in recovery in myelopathy.

Transcutaneous Electrical Spinal Stimulation Attenuates Ankle Clonus in Humans with Chronic Spinal Cord Injury

Abstract 204 | Poster 52

Alex Benedetto, Northwestern University

Transcutaneous electrical spinal stimulation (TESS) has been used to improve voluntary motor output in humans with spinal cord injury (SCI). However, the effect of TESS on involuntary muscle activation patterns, such as clonus, after SCI remains poorly understood. To address this question, we tested the effect of 20 min of TESS (30Hz pulses with a 5kHz carrier frequency) applied between the L3-L4 spinous processes on ankle clonus in eight individuals with chronic SCI. During testing, participants were seated with their hips at 90° and the knee angle ~110°. Clonus was induced via rapid dorsiflexion stretch of the ankle plantar flexors by an experimenter, and soleus muscle electromyographic (EMG) activity was recorded during trials with a maximum duration of 60 seconds. Using EMG burst onsets and offsets, we quantified clonus duration, number of bursts, burst frequency, burst duration, interburst duration (i.e., a period of a decrease or a relative silence following the burst of EMG), and burst amplitude for each trial. We found that before TESS the median clonus duration was 8.4 sec (range 4.1-50.1 sec), number of bursts was 38 (range 15-265), burst frequency was 4.9 Hz (range 4.1-6.3 Hz), burst duration was 62.36 ms (range 50.9-69.6 ms), interburst duration was 120 ms (range 97.1-158.7 ms), and burst amplitude was 0.29 mV (range 0.15-0.45 mV) (n=8). In three out of the eight individuals evaluated clonus was completely abolished immediately after TESS and the suppression lasted for several hours. In the other five individuals, a Wilcoxon signed-rank test found a significant increase in interburst duration (from 117.7 to 138.4 ms, p =0.04) and significant reductions in clonus duration (from 36.1 to 4.8 sec, p =0.04), number of bursts (from 200 to 16, p=0.04), burst frequency (from 4.9 to 4.0 Hz, p=0.04) and burst amplitude (from 0.32 to 0.15 mV, p=0.04) following TESS. We did not observe a significant change in burst duration following TESS. These results suggest that TESS can suppress and modulate ankle clonus following chronic SCI.

Learning Objective 1 N/A

Learning Objective 2 N/A

Learning Objective 3 N/A

Measurement of Magnetization Transfer Ratio in Normal Pediatric Cervical Spinal Cord: Clinical Feasibility, Assessment of Normative Data and Age Correlation

Abstract 147 | Poster 53

Laura Krisa, LK, PhD, Thomas Jefferson University

Purpose: In this study, we propose an automated atlas-based analysis of magnetization transfer (MT) scans in normal pediatric cervical spinal cord. We report normative data and variability across the cervical spinal cord in the pediatric population. **Methods & Materials:** MT scans of 33 healthy females (mean age=12.8) and 22 males (mean age=13.09) were acquired from the cervical cord using a 3.0T MRI. Parameters: voxel size = 0.9x0.9x5 mm³, TR=35ms, TE=3.1ms. All data were processed using the Spinal Cord Toolbox (SCT) (1). Initially, the MT data were segmented and registered to the PAM 50 template (2). Next using non-rigid deformations, a series of affine transformations were estimated between the MT image and the template. The combined transformations were then used to co-register the PAM50 white matter atlas to the subject-specific space. Then, the magnetization transfer ratio (MTR) is computed by co-registering MT0 and MT1 images. The MTR is measured for the specific white matter (WM) tracts as well as the whole WM across the cervical cord (C2-C7) The tracts used for measurement are as follows: left and right dorsal fasciculus gracilis, dorsal fasciculus cuneatus, and lateral corticospinal tract. The mean, standard deviation and variability of the measurements were then compared between tracts using COV (coefficient of variations) as shown in the table and bar plot. Linear regression analysis is used to investigate the relationship between age and the MT ratios. An unpaired t-test was performed to investigate the MTR difference between the male and female groups. ($p < 0.05$) **Results:** Distribution of the MTR data by rostrocaudal were extracted for each level from C2 to C7. COV (coefficient of variant) of the normative data for each tract was calculated which indicates low variability in measurements between tracts. No significant difference was seen between MTR values across the levels in each tract ($P > 0.05$) therefore MTR is averaged across the levels. There was a statistically significant difference in MTR between males and females in WM and CST. ($p < 0.05$) Linear regression was performed and illustrated a positive correlation between age and MTR in all tracts. **Conclusions:** Reliable MT assessment of pediatric cervical spinal cord microstructure is possible by using clinically suitable methods. (i.e. MT images). A positive correlation between MTR and degree of myelination is observed. Our result showing higher MTR for CST and WM in the female group may indicate that boys have a more prolonged myelination process than girls specifically in the corticospinal tract. (3) **Clinical Relevance:** The results demonstrate reliable demyelination measurements using MTR, which has the potential for improving diagnostics, objectively monitoring disease progression, and predicting outcomes in spinal pathologies in children.

Learning Objective 1 calculate the normative MTR values in typically developed pediatrics aged between 6-17 years old.

Learning Objective 2 assess the correlation between MTR and age and sex in different tracts.

Learning Objective 3 illustrate the normative MTR values in different cervical levels of the healthy, typically developed children.

Metal Reduction Around Cervical Spine Implant Using Diffusion Tensor Imaging at 3T MRI: Preliminary Results

Abstract 184 | Poster 54

Slimane Tounekti, PhD, Thomas Jefferson University

Introduction: Diffusion Tensor Imaging (DTI) is key tool for in-vivo investigation of the spinal cord (SC) microstructure. It allows extraction of imaging biomarkers, to assess SC integrity and evaluate pre-operative injury. However, post-operative DTI of patients with metal implants results in severe geometric distortion around the hardware. Therefore, the use of DTI for post-surgery evaluation and prognostication remain an unexplored field and the assessment of injury is still heavily based on structural MRI techniques, clinical measures, and a surgeon's skills. In this study, we have developed and tested an MR pulse sequence to address the technical challenges facing DTI on post-operative cases with metallic hardware. **Methods:** The developed method is based on the reduced Field-Of-View (rFOV) strategy and multi-shot EPI (rFOV-MS-EPI). DTI data were collected using: the rFOV-MS-EPI and the single-shot EPI (rFOV-SS-EPI) typically used for SC scan. Geometric distortion and signal void were assessed to evaluate images and compare the two sequences on a custom-built cervical spine model with metal implants. Asparagus was used in this phantom as representative of the SC. Additionally, the MR sequence was tested on two SCI participants (F, 54Y, M, 45Y) with metallic implants at the C4-C6 and C3-C8 level, respectively. The experiments in this study were conducted on 3T Prisma (Siemens, Germany). In phantom model slice-by-slice ROIs were manually selected following the asparagus edge on T2-W image and the ADC maps computed from the rFOV-MS-EPI, rFOV-SS-EPI. Circularity and Eccentricity parameters were then extracted and used for pairwise comparison between the structural and diffusion data. A two-sample t-test was performed with p-value of 0.05 or less to indicate statistical significance. **Result:** The rFOV-MS-EPI method provided distortion-free images of the phantom at the level of the hardware. In addition, the suggested approach produced significantly reduced geometric distortion in Circularity ($p < 0.005$) and Eccentricity ($p < 0.005$) compared to the conventional rFOV-SS-EPI. No statistically differences were found for these measurements between the rFOV-PS-EPI and the T2-w images ($p > 0.05$). The in-vivo results showed that the rFOV-MS-EPI approach provides continuous cord visualization with less signal void at the level of the metal hardware compared to the standard method as indicated by arrows, allowing robust measurements at the site of the injury. The DTI data were overlaid on the structural T2-W image. The results show the DTI data obtained using the proposed PS-EPI DTI data has better visualization of the SC, less distortion, improved signal, and lesser cord displacement at the regions near and surrounding the metal hardware compared to the data collected using the conventional acquisition technique. **Conclusion:** The validity of the proposed approach to collect metal reduced DTI images on spinal model and SCI patient with metallic hardware was demonstrated by providing less geometric distortion DTI maps and smaller signal void area around the site of the metal at 3T, enabling quantitative measurement at the site of injury. These preliminary results are very promising and warrants a study on a larger group of SCI subjects with metal implants.

Learning Objective 1 Discuss the need of DTI imaging for SCI with metal

Learning Objective 2 illustrate the limitations of the available method to perform DTI around metal

Learning Objective 3 Application of the proposed method to extract metrics at the site of injury for evaluation

Data-Driven Characterization of Lower-Limb Kinematics During Breaststroke Swimming in Patients with Spinal Cord Injury

Abstract 122 | Poster 55

Melina Giagiozis, MSc, Spinal Cord Injury Research Center, University Hospital Balgrist, Zurich, Switzerland

Introduction: Neurological disorders, such as spinal cord injuries, can have significant effects on an individual's ability to control and coordinate their muscle movements. For the rehabilitation of these motor functions, aquatic therapy is often recommended. One benefit of therapy in water is that less pressure is put on the joints due to the water's buoyancy. Furthermore, the hydrostatics provide greater safety, minimize the risk of falling, and allow patients to move in ways they might otherwise not be able to. By tracking these movements during therapy, we can identify compensation patterns and tailor therapy contents to a patient's specific deficits. One way to do so, is with the use of inertial measurement units (IMUs), wearable movement sensors. These sensors have proven to be a reliable tool in assessing human motion and complementing clinical assessments. Additionally, they are low in cost and easy to use. IMUs have been successfully employed in studies involving functional gait assessments such as the six-minute walking test. However, their precision and efficacy during physical activities in water have yet to be analyzed in more detail. **Methods:** In this study, we assessed lower limb kinematics during breaststroke swimming using IMUs. We collected data from 23 spinal cord injury patients and 6 healthy controls, with eight movement sensors attached to the participants' legs and back. A clustering algorithm was performed on the sensor-derived parameters to group these patients into distinct clusters according to their movement patterns. First, a principal component analysis was applied to the normalized parameters to reduce the dimensionality of the dataset. Then, a k-means clustering was implemented. The clusters were subsequently evaluated using clinical scores and demographic data. The parameters that significantly differed between clusters were selected and compared to healthy controls. **Results:** The first five principal components explained 78% of the variance in the dataset and were used for the clustering algorithm. Moreover, the within-cluster sum of squares was minimized with three distinct clusters. Demographically, the patient clusters only significantly differed in age ($p = 0.002$). Additionally, the only clinical score that showed a significant difference between the clusters ($p < 0.001$) was the spinal cord independence measure. With respect to the swimming parameters, there were significant differences between clusters in distance per stroke, stroke rate, and the sagittal range of motion in both knees. Compared to healthy controls, all clusters showed a lower average distance per stroke. Furthermore, the clusters' sagittal range of motion of the knees was 8–20 degrees less than that of the healthy participants. **Conclusion:** In summary, this study aimed to show that sensor derived swimming parameters can offer clinicians additional information on patients' movement patterns. They provide the means to identify compensation strategies during breaststroke swimming, allowing for more deficit-oriented therapy during the rehabilitation of spinal cord injury patients.

Learning Objective 1 Identify compensation strategies during breaststroke swimming

Learning Objective 2 Cluster patients based on movement patterns

Learning Objective 3 Investigate difference between patient clusters in terms of clinical scores and demographic data

Longitudinal Functional Recovery After Spinal Cord Injury Using the Neuromuscular Recovery Scale

Abstract 88 | Poster 56

Doug Griffin, PT, Northwell Health

Objective: Several outcome measures are used to describe neurological injury level, severity, and functional recovery in individuals with traumatic spinal cord injury (SCI). The gold standard to define neurological level of injury (NLI) and severity (American Spinal Injury Association Scale, AIS, grade) is the International Standards for the Neurological Classification of SCI (ISNCSCI) exam(1,2). The Spinal Cord Independence Measure (SCIM) is a standardized, validated survey tool that measures functional status or improvement in performing daily activities(3). The Neuromuscular Recovery Scale (NRS) is a newer tool that measures how an individual with SCI performs tasks related to mobility, standing and walking without muscle substitution or use of an assistive device. The NRS classifies recovery into 4 phases: 1 is the lowest degree of recovery and 4 is defined as full recovery of function(4,5). Up to 18 items are tested, depending on ability. Our objective was to measure and compare the trajectory of functional recovery as measured by the NLI, AIS, SCIM, and NRS during the first year after SCI. **Design:** We conducted an IRB-approved prospective, observational study of biomarkers of spontaneous recovery during the first year after SCI. Persons with SCI were recruited within 0-3 days of injury. Neurological injury/functional abilities were measured acutely, 3-, 6-, and 12-months post injury (MPI), using AIS grades and SCIM scores. SCIM and NRS was not collected acutely, but was collected for at least 2 study visits at 3, 6 and 12 MPI. **Results:** Data was collected from four participants (N=3 male, 1 female).

See Table One:

	SCIM				Demographics				NLI				AIS			
	Acute	3MPI	6MPI	12MPI	Acute	3MPI	6MPI	12MPI	Acute	3MPI	6MPI	12MPI	Acute	3MPI	6MPI	12MPI
M	Fall		C8 C1	C7	T5	D	D	D	D	D	D	D	ND	88	89	
79		ND.	3B	3C	4A 2	54	M	Fall		C5 T1	C5	T1	D			
D	D	D		ND	100	100	100		ND.	3C	4B	4A 3	43			
M	Fall		C4 C5	C5	C4	C	D	D	D		ND	90	99			
94		ND.	3C	4A	4A 4	68	F	Fall		C5 C5	C6	C6	D			
D	D	D		ND	ND	50	68		ND.	ND	3A	3B	ND=not			

done Conclusion: This pilot data demonstrates that the NRS was more sensitive to changes in SCI recovery when compared to NLI, AIS, and SCIM.

Learning Objective 1 Describe Neuromuscular Recovery Scale (NRS)

Learning Objective 2 List differences between NRS and ISNCSCI exam

Learning Objective 3 List differences between NRS and Spinal Cord Independence Measure (SCIM)

Novel Superconditioning Transcranial Magnetic Stimulation (TMSsc) as a Sensitive Biomarker in Amyotrophic Lateral Sclerosis (ALS) Diagnosis

Abstract 105 | Poster 57

Ramza Malik, DO, Department of PM&R, State University of New York Upstate Medical University

Objective The diagnosis of amyotrophic lateral sclerosis (ALS) depends on the presence of both upper motor neuron (UMN) and lower motor neuron (LMN) signs in several body regions. LMN pathology can be diagnosed using electrodiagnostic studies. However, UMN signs are difficult to elicit and can be unreliable due to the neurological weakness caused by superimposed LMN disease. This leads to significant delay in the diagnosis of ALS. A reliable biomarker of UMN function can aid in early diagnosis and assist in monitoring disease progression or treatment efficacy. This study proposes the use of a novel form of transcranial magnetic stimulation (TMS) called superconditioning TMS (TMSsc) to serve as a biomarker of UMN in ALS. TMS is a non-invasive method of stimulating nerve axons and cell bodies in the central nervous system. Previously, single-pulse and dual-pulse TMS have been used in attempts to study abnormal central motor conduction and to quantify UMN function in ALS, respectively. As demonstrated in previous studies, TMSsc can more closely replicate the high-frequency firing patterns of cortical interneurons and UMNs and generate a more accurate interrogation of upper motor neuron functional integrity. **Methods** In this prospective, cross-sectional, open-label design, three cohorts will be studied: 1) adults without significant neurologic injury or disease (healthy controls; N=20); 2) adults with diagnosed cervical spondylotic myelopathy (CSM), a partial ALS mimic (diseased controls; N=20); and 3) adults with bulbar-onset (N=10) or limb-onset ALS (N=10). TMSsc-specific motor evoked potentials (MEPs) will be elicited bilaterally from muscles of the face/neck, hand, and leg in each subject. Statistical modeling will be used to compare electrophysiologic findings to clinical function, including motor strength and reflex status, speech and respiration, and swallowing. Persons with ALS will be tested 5 times (at 3-month intervals) over one year. Persons with CSM will be tested only twice: once at baseline and again around 3 months after surgery. **Expected Results** We hypothesize that superconditioning transcranial magnetic stimulation (TMSsc) will reveal abnormalities in upper motor neuron function that will serve as a sensitive biomarker in persons with ALS. We aim to establish the sensitivity and specificity of abnormal TMSsc-associated motor evoked potentials (MEPs) in bulbar and limb muscles in ALS subjects through comparison of the two control groups. We also aim to validate TMSsc-specific measures by establishing a relationship between TMSsc-associated metrics and (expected) functional decline in persons with ALS over a one-year period and TMSsc-associated metrics and (expected) functional improvement in persons with CSM after surgical decompression of the cervical spinal cord. **Conclusion** This study aims to demonstrate TMSsc as a practical, comprehensive, accessible, and patient-tolerable tool that may be a sensitive and specific functional UMN biomarker in the diagnosis of ALS.

Learning Objective 1 Discuss difficulty with early diagnosis of ALS

Learning Objective 2 Discuss how this proposed study differs from previous transcranial magnetic stimulation studies in ALS

Learning Objective 3 Learn how superconditioning transcranial magnetic stimulation can be used as a functional upper motor neuron biomarker in persons with ALS

Use of motor Score “5*” in the European Multicenter Study about Spinal Cord Injury (EMSCI)

Abstract 143 | Poster 58

Christian Schuld, Dipl.-Inform. Med., Heidelberg University Hospital

Objective: The International Standards for Neurological Classification of SCI (ISNCSCI) [1] previously included an option to grade key muscle strength as "5*", when motor deficits were assumed to be related to a non-SCI condition. The "5*" grade was abandoned in ISNCSCI rev. 2019 in favor of the non-SCI taxonomy [2]. The European Multicenter Study about Spinal Cord Injury (EMSCI) adopted "5*" in 2008. It is yet unknown, whether "5*" has been used regularly. The aim of this work is to analyze the use of "5*" in EMSCI. **Design/Methods:** The EMSCI sample from 2008-2020 comprises 276,820 motor scores of 13,841 ISNCSCI exams from 4,482 individuals with traumatic and ischemic SCI. The frequencies of "5*" are calculated as likelihoods for several factors, including spinal segment, location on upper or lower extremity, position above, at, and below the motor level and SCI center. **Results:** Out of all motor scores, only 1.8‰ were rated as "5*". The upper extremity scores contain a higher number of (3.2-3.4‰) of "5*" compared to the lower extremity scores (0.2-0.5‰). The majority of "5*" ratings were located above the motor level (4.8‰), with considerably fewer occurrences at (0.9‰) and below the motor level (0.3‰). Only 12 (max: 8‰ in the author's center) of the 30 contributing SCI centers used "5*" at all. Out of 13,841 ISNCSCI examinations, 163 (1.2%) had at least one "5*" (peaking at 1, 2 and 3 "5*" per exam). Out of 4,482 individuals with SCI, 101 (2.3%) had at least one examination containing "5*". **Conclusion:** With only 2 per thousand motor scores, "5*"s have rarely been used in EMSCI on the level of the individual, examination and motor score. This grade is used predominately above the level of the injury. Here, the "5*" served its purpose to indicated that the motor impairments are not attributed to the SCI but to other non-SCI related concomitant factors. Without the option of "5*", the motor function would have been rated as not testable resulting above the level to a not determinable motor level. Another even undesirable option would be to document the actual motor function resulting in a too rostral level. Using "5*" had the drawback, that the actual examination result was lost, if not documented in the comments box. Therefore, "5*" was replaced by the non-SCI taxonomy which defines clear rules for documentation of non-SCI related impairments: the actual motor and sensory exam scores are documented, '*'-tagged and information is given whether they should be handled as normal or not normal for classification. Whether this low rate of "5*" is attributed to EMSCI-specific factors or the fact that non-SCI related impairments are rare needs to be investigated in future studies using the "5*" successor, i.e. the non-SCI taxonomy. **Funding:** Partly supported by EMSCI.

Learning Objective 1 Differentiate "5*" from the newer non-SC taxonomy.

Learning Objective 2 Appraise the rare occurrences of 5*.

Learning Objective 3 Describe the need for clinical judgment in the ISNCSCI.

Not-Testable ISNCSCI Motor and Sensory Scores in The European Multicenter Study About Spinal Cord Injury (EMSCI): Occurrence Patterns and Consequences on Classification

Abstract 145 | Poster 59

Christian Schuld, Dipl.-Inform. Med., Heidelberg University Hospital

Objective: In the International Standards for Neurological Classification of SCI (ISNCSCI), 134 data points are documented: 10 motor scores (MS) + 28 light touch (LT) + 28 pin prick (PP) scores for each body side as well as voluntary anal contraction (VAC) and deep anal pressure (DAP) [1]. Not every dermatome or myotome may be testable due to various reasons, such as pain, casts, burns, insufficient range of motion, etc. This does not only result in not determinable total scores, but might also lead to not determinable classifications. This work aimed to analyze the pattern of not testable scores (NTs) in EMSCI and evaluated the influence of NTs on the determinability of classification variables. **Design/Methods:** The analyzed sample included 1,597,950 values from 11,925 ISNCSCI exams of 3,956 individuals with traumatic or ischemic SCI enrolled in EMSCI from 2010 onwards. Frequencies of NTs were aggregated based on factors such as examination modality (MS, LT, PP, VAC/DAP), spinal segment, body side and time point after SCI as likelihoods. Determinability of motor and sensory levels and the American Spinal Injury Association Impairment Scale (AIS) were calculated using the NTs-logic of the EMSCI ISNCSCI calculator [2]. **Results:** 3.07% of all scores are NT. NTs were more often present in VAC/DAP (5.04%) and PP (3.44%) compared to LT (2.87%) and MS (2.39%). NTs were more frequent in sacral segments (3.71%) compared to cervical (2.90%), thoracic (3.02%), and lumbar (2.91%) segments. Body side differences were marginal. The likelihood for NT exam values decreases with time after SCI, ranging from 7.15% for the initial exam within two weeks after injury, continuously decreasing to 1.13% at the 48 weeks exam. Among all exams, 7.5% exhibit up to 10 NTs, with the majority (2.36%) having 2 NTs. In cases with up to 10 NTs, the ASIA Impairment Scale (AIS) was determinable on average $67\pm 17\%$, whereas motor levels were determinable in $79\pm 13\%$ and sensory levels $87\pm 12\%$. **Conclusion:** With 3% of all scores, not testable scores are a small but relevant issue in the first year after SCI. The factor "early exam within 2 weeks after injury" was strongest associated with an increased NTs likelihood. This may be attributed to a number of challenges inherent to the acute clinical setting, which frequently challenge the thorough conduction of the ISNCSCI exam. A complete injury is defined by absent function in the lowest sacral segments. Therefore, our finding of 5% not testable scores there is noteworthy. Emphasis should be placed on this topic during trainings. A prior analysis from 2011, 9% of all exams contained up to 10 NT [2]. The current lower incidence of 7.5% could be attributed to the biannual ISNCSCI trainings within EMSCI [3], during which mitigation strategies to avoid NTs, such as splitting the exam into two parts, are taught. In the majority of cases with NTs, classification remains possible, even achieving excellent results with up to two NTs. We strongly recommend to not exclude datasets with NT scores per se from the analysis, but rather check for determinable classifications instead. **Funding:** Partly supported by EMSCI

Learning Objective 1 Discuss the need for not testable scores in the ISNCSCI.

Learning Objective 2 Discuss the higher incidence of not testable scores in the initial ISNCSCI exam including mitigation strategies.

Learning Objective 3 Differentiate between not testable score and not determinable classifications.

Biomarkers For Recovery Following Severe Spinal Cord Injury

Abstract 187 | Poster 60

Dalia De Santis, PhD, Shirley Ryan AbilityLab

Objective: A motor-complete spinal cord injury (SCI) results in the complete loss of voluntary motor control below the level of injury. These patients sometimes regain partial motor function during inpatient rehabilitation; however, there is no biomarker to identify which patients have this potential. Evidence indicates that spasticity and neurotrophic factors (i.e., brain-derived neurotrophic factor, BDNF) may be such markers. This presentation will describe the implementation of a collaborative module that is part of the Spinal Cord Injury Model System (SCISM) and involves five hospitals nation-wide, including the Shirley Ryan AbilityLab (Lead site), Craig Hospital, Baylor Scott and White Institute for Rehabilitation, University of Minnesota, Allina Health, and the Mayo Clinic. We hypothesized that individuals with motor complete SCI with more severe spasticity and higher levels of serum BDNF at admission will achieve greater neurological and functional recovery during inpatient rehabilitation compared with patients with less severe spasticity and lower BDNF levels. **Design/Methods:** We will enroll 150 individuals classified with T10 or above American Spinal Injury Association Impairment Scale (AIS) as A or B injuries admitted for inpatient rehabilitation to one of the collaborating SCISM sites. Spasticity, serum BDNF levels, and functional and neurological recovery are evaluated at two time points – within 2-3 weeks of admission and 2-3 weeks from discharge. Primary endpoints are (1) spasticity, using the Modified Ashworth Scale, kinematic analysis through the Pendulum test, and the Spinal Cord Assessment Tool for Spastic Reflexes (SCATS), (2) serum BDNF level, and (3) quality of life assessments using the Spinal Cord Injury – Quality of Life (SCI-QOL) survey. **Results:** The trial is ongoing and has currently enrolled 60 individuals with SCI. The preliminary sample consists of 75% males and 25% females, with 57% having cervical and 43% thoracic injuries. AIS score at the time of admission include A (67%) and B (33%). The average time from injury to the first assessment is 27±26 days. We will provide details into the structure of the multi-site study, including: coordination strategies, study-specific training across collaborative sites, and standardization of assessments for use in future clinical trials. **Conclusion:** The results of this collaborative module will provide knowledge that helps identify patients with complete SCI who have the potential for neurological and functional recovery. **Support:** NIDILRR 90SIMS0015; 90SIMS0011 (Baylor Scott & White Institute for Rehabilitation)

Learning Objective 1 Discuss the hypothesis foundation of the multi-site study and the need for easy-to-use biomarkers of recovery

Learning Objective 2 Manage coordination strategies and implementation of study-specific training across collaborative sites.

Learning Objective 3 Illustrate the need for standardized assessments for use in clinical trials.

Differences in Common Prehension Relevant Outcome Measures in Tetraplegia

Abstract 254 | Poster 61

Nilanjana Datta, MD, The University of Miami

Recovery of hand function contributes critically to recovery after cervical spinal cord injury (cSCI). As a clinical trial endpoint, accurately measuring change is essential. Recently, several clinical trials focused on upper extremity (UE) recovery in chronic cSCI have utilized The Graded Redefined Assessment of Strength, Sensibility, and Prehension (GRASSP). As we are also involved in stroke therapeutics studies, we considered whether the Action Research Arm Test (ARAT) might contribute unique information in studies of cSCI. We thus proposed to compare GRASSP with ARAT in the SCI population, hypothesizing that ARAT and GRASSP prehension assessments will be complimentary in quantifying UE function. Methods: In a cross-sectional observational study, hand function in 15 individuals with tetraplegia was assessed using both ARAT and GRASSP on the same day. Preliminary data from 4 individuals (2 males and 2 females) with cervical (C3B, C4A, C4C, and C7B) incomplete injury of average age 34.1 ± 5.5 years is reported here. Results: The ARAT and GRASSP tests captured different features when assessed in the same individuals on the same day. In each of these task groups, especially in the pinch category, ARAT was able to capture finer aspects of fine motor skills, which were not reflected in the GRASSP. These include

GRASSP Grasp feature	$14.1 \pm 3/36$	$6.8 \pm 6.8/18$	Grip feature	$9.6 \pm 2.6/24$	$4.3 \pm 4.4/18$
Pinch features	$12.5 \pm 4.3/36$	$4 \pm 4.5/36$	Tip-to-Tip pinch	$4.75 \pm 1.5/12$	$2.4 \pm 2.3/18$

Discussion: The design of the ARAT is such that tasks are progressively tougher. Depending on capability, it can stratify the level of function. During our experience, we saw that participants not being able to score in GRASSP were able to complete tasks in ARAT and hence cross the threshold and get a rating in ARAT. Conclusion: After cSCI, individuals develop compensated prehension skills, which add a layer of complexity to the understanding of upper extremity function. Objective outcome measures that correlate with a person's capabilities for activities of daily living are important in the development of new therapies. Our preliminary results indicate differences between GRASSP and ARAT in evaluating hand and finger functions. It may be useful to incorporate ARAT as an outcome measure for interventions targeting UE function. ARAT is a comprehensive tool to assess fine motor skills, composite movements, cognitive training, and graded tasks to quantify individuals' functional abilities. We have started to prospectively utilize ARAT in the assessment of hand function change in intervention studies in parallel with GRASSP. Our experience indicates the benefit of studying stroke and SCI to provide insight into the strengths and weaknesses of outcome measures.

Learning Objective 1 Discuss the knowledge gap in upper extremity outcome measure in tetraplegia from spinal cord injury

Learning Objective 2 List differences between ARAT (Action Research Arm Test) and GRASSP (The Graded Redefined Assessment of Strength, Sensibility, and Prehension)

Learning Objective 3 Utilize ARAT in assessing Upper Extremity functional change in studies targeting Upper extremity function

Establishment of Reference Scores for Trunk Control Assessment Using Smartphones in Patients with Spinal Cord Injury

Abstract 263 | Poster 62

Erika Abarca Ortega, MD, Instituto Nacional de Rehabilitación

Objective: It has been demonstrated as a valid and reliable approach for remote trunk control assessment in patients with lumbar and low thoracic levels of spinal cord injury and adequate trunk control is through the use of smartphones. Therefore, this study aims to establish the reference scores for instrumented assessment using smartphones and the Trunk Control Test application, performed both in-person and remotely, in a representative population of patients with spinal cord injury from the National Institute of Rehabilitation Luis Guillermo Ibarra Ibarra (INR-LGII). **Methodology:** A descriptive, observational study was conducted with 18 participants who met inclusion criteria. Participants underwent initial in-person assessment at the INR-LGII and were trained in the use of a smartphone application for remote evaluations. Subsequent assessments were conducted remotely via video call after one week. The smartphone was securely placed on the patient's chest, and the instrumented Trunk Control Test (ECTi) was administered, capturing three-dimensional acceleration data. Average, minimum and RMS values were calculated for the acceleration data, resulting in 39 ECTi parameters. Descriptive statistics and parameter reliability were determined using the intraclass correlation coefficient (ICC). The sample size N=18 was calculated for acceptable reliability ($p1=0.8$) with a minimum of $p0=0.5$ and a power of 0.80. The study protocol was approved by the Institutional Ethics and Research Committee, and all participants provided informed consent. **Results:** Patients between the ages of 20 and 75 were evaluated, the majority being women (67%), of traumatic etiology (89%), ASIA impairment scale (AIS) A (59%), high neurological level of thoracic injuries (67%) with an injury time between 24 days and 10 years, with an average score of 48 points for SCIM III and total scores on the ECT above 11 points. The average reliability of the ECTi evaluations was $ICC=0.68$. Specific values were observed for each parameter based on the ECT items, which serve as reference values. On average, acceleration values were close to $0m/s^2$, with few outliers and a range between -17 and 11 m/s^2 . Reference values were obtained for items of interest, such as average and minimum acceleration during turns, as well as RMS during sitting, which have been related in previous research to the total ECT score, AIS, neurological level injury, walking ability and level of trunk control. **Conclusion:** The sample of this study was representative of the population with spinal cord injury, covering low cervical and high thoracic levels, traumatic and nontraumatic etiologies and varying levels of trunk control (above and below 13 points). The findings provide valuable reference values for ECTi evaluations in this patient population. **Support.** None.

Learning Objective 1 Understand the validity and reliability of using smartphones for Trunk Control Assessment

Learning Objective 2 Learn about reference scores and their parameters

Learning Objective 3 Grasp the clinical implications for spinal cord injury patients.

Predicting Bladder Function During Acute Hospitalization with a Qualitative Voluntary Anal Contraction Assessment following Motor Incomplete Spinal Cord Injury

Abstract 78 | Poster 63

Andréane Richard-Denis, MD-MSc, Université de Montréal

Abstract : Objective: To determine if a qualitatively graded voluntary anal contraction can be predictive of bladder function at the end of acute hospitalization for spinal cord injury patients. Design: We retrospectively collected prospective data from 80 traumatic and non-traumatic spinal cord injury patients admitted to a single Level 1 Trauma Center. A present voluntary anal contraction was graded as either weak, moderate or normal and was assessed using anal tone as a baseline. Descriptive statistics were then used to assess the relationship between the anal contraction at initial evaluation and bladder function at discharge. Results: All 22 patients with a normal contraction force had no urinary impairments at discharge. For weak contractions, there were only two patients out of a total of 23 who had normal bladder function at the end of acute hospitalization. These two outliers also had fairly normal neurological evaluations and conus medullaris syndrome. 13 patients with a moderate contraction had urinary impairments at discharge while 22 patients had normal function. Conclusion: Our results suggest that the weak and normal qualitatively graded contraction is very predictive of bladder function at acute hospitalization discharge and is much more accurate than the bimodal method by which the anal contraction is currently graded.

Learning Objective 1 At the end of this presentation, participants will be able to identify the limitations of the current digital rectal examination to predict neurogenic bladder function

Learning Objective 2 At the end of this presentation, participants will be able to revise how to early identify presence of bladder dysfunction after acute SCI based on the acute rectal examination.

Learning Objective 3 At the end of this presentation, participants will be able to determine the need for sphincter rehabilitation after acute care based on our new qualitatively grading system for voluntary anal contraction assessment.

A Data-Driven Investigation of Historic Control Matching

Abstract 227 | Poster 64

Miklovana Tuci, PhD Student, ETH Zurich

INTRODUCTION The recovery process following spinal cord injury (SCI) varies significantly between individuals. Combined with the low incidence of SCI, this greatly challenges clinical trials. The concept of historic controls is attractive to mitigate these limitations. However, how to best identify such historical controls and what patient characteristics to include remains unclear. This study investigates data-driven concepts for the identifying SCI historic controls from longitudinal International Standards for Neurological Classification of SCI (ISNCSCI) assessments and explores the importance of the matching timepoint. **METHODS** We propose unsupervised K-nearest neighbor (KNN) regression as an interpretable approach. This in silico exploration is based on the European Multicenter Study about Spinal Cord Injury (EMSCI). We included 628 patients with cervical injuries. All included patients had complete ISNCSCI assessments in the very acute (0-14 days), acute (14-40 days) and recovery (26 weeks) phases of injury. We compared K-NN regression on all motor scores (MS) in three scenarios: matching in the i) very-acute, ii) acute phase, and iii) including both time points for matching. The evaluation endpoint was the agreement between the KNN-predicted and true recovery-phase MS sequences quantified as differences in the lower extremity MSs (Δ LEMS) and root mean squared errors (RMSE) in a leave-one-out cross validation. Hyperparameter tuning optimized the number of historic patients to match, the distance metric (Hamming, Euclidean), and the distance cutoff for “close” neighbors. MS assessment uncertainty was accounted for by 100-fold bootstrapping with results being reported as median values with 95% confidence intervals. **RESULTS** For case i) the best combination of hyperparameters resulted in an RMSE of 0.80(0.35,2.36) and Δ LEMS of -1.9(-17.9, 24.9), with Euclidean distance and distance cutoff of 0.2, against the RMSE 1.10(0.47 ,2.33) and Δ LEMS of -2.7(-20.5, 27.6) obtained with Hamming distance and distance cutoff of 0.7. This performance was improved by using a later time point for historic control matching: For the second time point ii) the best model achieved an RMSE of 0.66(0.23, 1.83), which shows a 17% improvement compared to the initial time point and Δ LEMS of -0.1(-12.0, 20.2). Finally, for the third case, where we consider both the very acute and acute time points, we obtain an RMSE of 0.76(0.27 ,2.45) and Δ LEMS of -0.18(-16.1, 27.0). This implies that the inclusion of longitudinal information and more features did lead to no further improvement beyond matching in the acute I phase as a result of a diminishing pool of patients to be considered for matching. **CONCLUSIONS** This study provides a further step towards an optimal strategy of identifying historic controls based on assessments of motor functions alone. We observed that a later time point (14-40 days) for matching improved performance. Our hypothesis regarding a benefit from simultaneous multiple-stage matching was not validated, likely due to the limited number of patients available in the database.

Learning Objective 1 Importance of Historic Controls for clinical trial in SCI

Learning Objective 2 How to employ unsupervised K-NN regression in the SCI setting applied to ISNCSCI data

Learning Objective 3 Hyperparameter tuning and identification of an optimal historical control matching strategy

Knowledge, Comfort, Approach and Attitude Towards Sexuality Scale in Spinal Cord Injured Population: Adaptation and Validation to Spanish Language

Abstract 2 | Poster 65

Luz Miriam Leiva Pemberthy, MD, Universidad Del Valle, Fundación Valle De Lili

Introduction. Altered sexual function is a common sequela following spinal cord injury. There are no validated scales in Spanish to assess knowledge, comfort, approach, and attitudes of health personnel towards sexuality in patients with spinal cord trauma. Objective. This study aimed to validate the Knowledge, Comfort, Approach and Attitude towards Sexuality Scale (KCAASS) in Spanish language. Materials and methods. The process included translation, back-translation, cultural adaptation, and face and content validity in professionals involved in the sexual rehabilitation of the patient with spinal cord injuries in Colombia. A total of 122 professionals participated in establishing construct validity and reliability. Results. The expert committee determined that the Spanish version of the scale evaluates knowledge, comfort, approach, and attitude toward sexuality in the patient with spinal cord injury by health professionals. In relevance, clarity, and sufficiency, the content validity index was more significant than 0.8 in 75.6% of the items and for 100% of the domains. The overall Cronbach's alpha value was 0.95. The factor analysis showed eigenvalues above 1.5 in 4 factors. Conclusion. The Spanish version of the KCAASS scale has adequate reliability, face, content, and construct validity and can be used to evaluate the training needs in specific professional domains in the sexual rehabilitation of the spinal cord injured.

Learning Objective 1 To evaluate the relevance, clarity, and sufficiency of the scale's content validity by calculating the content validity index for individual items and domains.

Learning Objective 2 To propose the use of the Spanish KCAASS scale for evaluating training needs in specific professional domains within the context of sexual rehabilitation for individuals with spinal cord injuries.

Learning Objective 3 To assess construct validity and reliability by involving a total of 122 professionals.

The Effects of High-intensity Interval Training on Fitness and Metabolic Health in Individuals with Acute Spinal Cord Injury

Abstract 44 | Poster 66

Jennifer Maher, PhD, University of Bath

Exercise interventions during the acute phase of inpatient rehabilitation following spinal cord injury (SCI) may serve as a preventative measure to reduce the burden of long-term chronic diseases on the patient and healthcare system. A growing body of evidence suggests that high-intensity interval training (HIIT) may yield more favorable effects on a range of measures related to glycemic control compared to moderate intensity exercise. **Objective:** To compare the effects of 18-weeks of HIIT on an arm crank ergometer versus standard care to improve glycemic control in individuals with acute (<6 months post-injury) SCI. **Design/Methods:** Twenty-four individuals attending inpatient rehabilitation were randomly allocated to the intervention (HIIT) or control (CON) group for 18-weeks. Both groups participated in standard care throughout the duration of the study with the goal of gaining efficiency in functional independence. The HIIT group also performed supervised HIIT exercise on an arm ergometer three times per week. Each HIIT session included a 5-min warm-up and cool-down at ~5 watts, and 10×60-s intervals at 80%–90% peak HR with 60-s recovery intervals (total exercise time: 30-min). During the intervention, four participants were discharged from the hospital, and the intervention transitioned to outpatient care. At baseline and week 18, body mass and waist and hip circumference were measured. Fasting (>8-h) blood samples were obtained and participants completed an oral glucose tolerance test (OGTT). Serial measurements of systemic glucose and insulin concentrations at baseline (fasting) and in response to the OGTT were converted into simple summary statistics: Insulin Resistance (HOMA2-IR); whole body insulin sensitivity (ISIMatsuda) and glucose and insulin incremental area under the curve (iAUC). Participants also performed a graded exercise test on an arm crank ergometer to assess cardiorespiratory fitness (VO₂peak) and peak power output (Wattpeak). To look for signals of efficacy in this small sample, 95% confidence intervals for differences in means for HIIT versus CON from multiple regression analyses for cardiometabolic health outcomes at week 18 adjusting for baseline values have been reported. **Results:** No adverse events were reported across the duration of the study. Sixteen individuals completed the study: 8 HIIT, 8 CON (9 male; 12 with paraplegia (PP); 54.3±12.1 years old; time since injury 4.1±0.9 months). Participants in the HIIT group completed 77% of the exercise sessions. After adjusting for baseline, there was evidence of a possible difference between groups (HIIT vs Control) in VO₂peak, (95% CI for difference in means -5.96, -0.03), and iAUC (95% CI 3578, 55806). There was no evidence of any differences with other measures of glycemic control. **Conclusion:** HIIT improved aerobic capacity and iAUC, but had no effect on other outcomes related to cardiometabolic health. This trial demonstrates that HIIT is a safe and feasible exercise intervention for individuals with acute SCI attending inpatient rehabilitation and supports the need for larger, multi-centre trials with longer intervention and follow-up durations. Supported by The National Institute of Health Research [NIHR 201591].

Learning Objective 1 Discuss the rationale for implementing HIIT in acute SCI

Learning Objective 2 Appraise the exercise intervention, study methods and health-related outcome measures

Learning Objective 3 Describe how these results contribute to the shaping future research directions and exercise interventions in acute SCI

Treatment of Obesity in Spinal Cord Injury with Tirzepatide: A Case Report

Abstract 197 | Poster 67

Michael Juszczak, MD, Tower Health Reading Rehabilitation Hospital

Case Description: A male person in his 40's with C6 AIS B SCI 15 years prior resulting in neurogenic bladder/bowel, autonomic dysreflexia, colostomy, and obesity presented to his primary care provider (PCP). Despite dietary modifications, increased physical activity, and trialing phentermine he was unable to lose significant weight. Tirzepatide is a new glucagon-like peptide-1 (GLP-1) and glucose dependent insulinotropic polypeptide (GIP) agonist medication that was approved by the FDA in May 2022 for the treatment of Diabetes Mellitus Type 2 (DM 2). It is associated with weight loss and improved glycemic control. Despite not having DM 2, his PCP initiated treatment with tirzepatide to facilitate weight loss. **Assessment & Results:** Prior to treatment, he weighed 115.7 kg (255 lb) with a body mass index (BMI) of 32. Labs prior to treatment were significant for a borderline elevated hemoglobin A1c (5.3%). The most recent lipid panel was done two years prior and showed an elevated low-density lipoprotein (LDL) (158 mg/dl) and total cholesterol (228 mg/dl). The patient was started on weekly tirzepatide 2.5 mg injections. After one month, his dose was increased to 7.5 mg weekly and again increased to 15 mg every week thereafter for 3 months. Over a 3-month period he reduced his weight by 14.1 kg (31 lb) and his BMI by 2.38 units. He now weighed 101.6 kg (224 lb) with a BMI of 28.62. A lipid panel 2 months after starting tirzepatide showed decreased LDL (139 mg/dl) and total cholesterol levels (203 mg/dl). The only adverse effect reported was heartburn. **Discussion:** Individuals with SCI have an elevated risk for cardiometabolic disorders (CMD) due to suboptimal nutrition and inadequate levels of physical activity resulting in obesity. Additionally, SCI contributes to the pathogenesis of CMD by altering carbohydrate and lipid metabolism. Up to 70% of patients with SCI will develop insulin resistance resulting in decreased lean body mass and accumulation of adipose tissue. This promotes chronic systemic inflammation and obesity, which accelerates the development of CMD. Increased exercise and dietary modifications are the primary interventions for preventing CMD. Although practical for many, individuals with SCI face several barriers to obtaining adequate exercise because of their injury. Furthermore, literature has shown that people with SCI often participate in exercise in which results in suboptimal caloric expenditure. This has led to the CSCM recommending nutritional modification being a more practical target for preventing CMD. However, the literature on dietary intervention to prevent CMD in people with SCI is scarce. **Conclusion:** The metabolic dysfunction associated with SCI and barriers to adequate exercise for weight loss place individuals with SCI at increased risk for obesity and developing CMD. Tirzepatide may be an effective adjunct therapy to exercise and dietary intervention to help prevent CMD in those with SCI. Further research is indicated to examine the long-term efficacy, benefits, and adverse effects that may be associated with tirzepatide. To the authors knowledge, this is the first case report of tirzepatide being used to treat obesity and metabolic disease associated with SCI.

Learning Objective 1 Discuss changes in metabolism associated with SCI

Learning Objective 2 Explore why those with SCI are at increased risk for cardiometabolic disease

Learning Objective 3 Discuss the use of adjunct pharmacologic intervention for weight loss in chronic SCI

Quantifying Volitional Leg Movement in the E-STAND Clinical Trial Using Surface Electromyography

Abstract 157 | Poster 68

Emily Haag, B.S., University of Minnesota - Twin Cities

Objective: Each year, there are approximately 17,700 new cases of spinal cord injury (SCI) in the United States. SCI results in any combination of: lower limb paralysis, spasticity, chronic pain, and changes in autonomic functions. There are currently no FDA approved treatments for restoring autonomic function or volitional motor function after SCI. Epidural spinal cord stimulation (SCS) has been used in clinical trials to restore some motor function and modulate deficits in autonomic function. Our lab has developed methods for optimization of this epidural SCS. To control for the inherent heterogeneity of SCI, our research has been limited to subjects with chronic motor-complete, thoracic-level spinal cord injuries. One significant challenge in the SCS field has been to identify a metric to quantify improvements in motor function observed during stimulation and over time. This project aims to assess the utility of the voluntary response index (VRI) for quantitative assessment of improvements in volitional motor control throughout the course of our study. **Design/Methods:** The current gold standard for assessment of volitional motor control is through recording surface electromyography (sEMG) during an 11-task Brain Motor Control Assessment (BMCA). This assessment was performed at each monthly follow-up visit in our E-STAND clinical trial using the participant's favorite setting from the last month, and new settings were programmed for the participant based on our systematic optimization. Data from these sEMG recordings were analyzed using the VRI to quantitatively measure voluntary motor control during the BMCA because it was presented as the primary outcome of the E-STAND trial. The VRI consists of: the response vector, which is the average of the muscle activity recorded during each task, and the similarity index, which is the muscle activity distribution during each task compared to a set of controls. Statistical analysis was then performed using Linear Mixed Effect models to determine the individual and combined effects of stimulation and time for this trial. **Results:** Recent studies in our lab have shown that as patients progress through our E-STAND study, leg muscle activity significantly increases, and number of synergies significantly decreases. These findings suggest that our delivered SCS is effective in modulating muscle activity using the neural circuitry that remains after SCI. **Conclusion:** To our knowledge, this is the first study to evaluate the VRI as a metric for assessing improvement in volitional motor control in this SCI participant population over the course of a SCS clinical trial. We hypothesize that the comparison of VRI across visits can be used to quantify improvements in volitional motor control, but further testing is required to determine whether or not there are specific use cases for this metric that produce high validity and reliability. As suggested by the initial creators of this metric, this analysis provides further insight into the clinical sensitivity of the VRI for a new movement disorder and evaluates the individual components of the VRI both together and separately. **Support:** College of Science and Engineering Fellowship, Minnesota Office of Higher Education SCI/TBI Grant Program (Grant Number 159800)

Learning Objective 1 Discuss limitations and utility of using surface electromyography for quantifying volitional leg movement after spinal cord injury.

Learning Objective 2 Analyze the overall utility of the Voluntary Response Index as a metric for our participant population.

Learning Objective 3 Discuss current clinical tools and metrics for quantifying volitional leg movement.

Mild Intermittent Hypoxia Improves Hand Function in Individuals with Motor Incomplete Spinal Cord Injury

Abstract 191 | Poster 69

Megan Hofman, Graduate OT Student, Wayne State University

Research Objective(s) To determine the effect of 8 days of mild intermittent hypoxia (MIH) on hand function in participants with motor incomplete spinal cord injury (SCI). Design/Methods: Three individuals with motor incomplete SCI (C4, T1, C7. AIS: 1 D, 2 C) aged 44 ± 3.61 (2 Male, 1 Female) with signs and symptoms of autonomic dysfunction were exposed to MIH each morning for 8 days over 2 weeks. The MIH protocol consisted of twelve two-minute bouts of hypoxia interspersed with two-minutes of normoxic recovery. Slight hypercapnia (+2 mmHg) was maintained throughout the entire protocol after an initial 10 minutes of breathing normoxic air. Individuals with sleep apnea were treated with continuous positive airway pressure throughout the 2 weeks. The primary outcome measured was the Graded Redefined Assessment of Strength, Sensibility, and Prehension (GRASSP). Comparisons were made at baseline, following MIH on day 1 and 8, and 1 day post-MIH. Data for the right and left hand were averaged together for a single variable and presented as a fraction of baseline. Results: Small increases in strength (1.05 ± 0.05), sensation (1.14 ± 0.18), and prehension performance (1.04 ± 0.04) were evident, along with a small decrease in prehension ability (0.83 ± 0.17) following MIH on day 1. Following MIH on the 8th day, only strength (1.11 ± 0.07) and prehension performance (1.07 ± 0.04) were improved. The only variable that was enhanced on Day 8 compared to Day 1 was strength (1.05 ± 0.012 , compared to post-MIH on day 1). The largest fractional increase in GRASSP outcomes occurred the morning after the 8th day of MIH. Increases in strength (1.17 ± 0.05), sensation (1.24 ± 0.12) and prehension performance (1.09 ± 0.06) were evident. Conclusions: In 3 individuals with chronic motor incomplete SCI, MIH increased hand function as evidence by GRASSP. Acute exposure resulted in increased strength, sensation, and prehension performance, but repeated exposure to daily MIH did not augment the acute effect of MIH on hand function. The largest improvements were found the morning following the MIH protocol. These data indicate MIH can improve overall hand function, but the acute effect of MIH may not be augmented with repeated exposure to MIH.

Learning Objective 1 Describe mild intermittent hypoxia

Learning Objective 2 Describe the acute impact of mild intermittent hypoxia on hand function in individuals with SCI

Learning Objective 3 Describe the impact of 8 days of mild intermittent hypoxia on hand function in individuals with SCI

Peripheral Plasticity of Nociceptive Afferents Following Spinal Cord Injury

Abstract 85 | Poster 70

Morgan Sharp-Forston, B.S., University of Louisville

Objective: Following spinal cord injury (SCI), CGRP+ nociceptors (predominantly C-fibers) sprout into dorsal horn laminae across multiple spinal segments. This occurs acutely and remains elevated chronically in experimental and traumatic SCI, contributing to complications such as neuropathic pain. While such plasticity is well-defined intraspinally, studies in intact animals have demonstrated that inflammation, atrophy, and denervation result in hyperinnervation of peripheral tissues. However, it is unknown if nociceptors undergo peripheral plasticity after SCI, a pathology seemingly conducive for sprouting. Therefore, we sought to investigate afferent plasticity in peripheral skeletal muscle, fascia, and skin post-SCI. We hypothesized that CGRP+ nociceptors sprout in muscle especially around blood vessels, a known landmark for C-fiber innervation and peptide release. Previous studies have also demonstrated reduced CGRP+ motoneuron cell bodies in the lumbar spinal cord post-SCI. Thus, we further hypothesized an inverse relationship between CGRP+ motor and sensory neurons in skeletal muscle post-SCI, marked by a decrease in CGRP+ motor endplates and increase in surrounding CGRP+ afferents. **Methods:** Female Sprague Dawley rats (n=30) were divided into Naïve, Uninjured + AAV, Transection only, and Transection + AAV. To label spinal neurons projecting from lumbar spinal cord to the periphery, AAV groups received bilateral sciatic injections of AAV PHP.S-hSyn1tdTomato and recovered for 4 weeks. Mechanical and thermal sensitivity were assessed using von Frey, Hargreaves, and tail flick assays and locomotor function via video-based gait analysis and the BBB open-field locomotor scale. Animals exhibiting deficits post-AAV were excluded. At 4 weeks post-AAV, SCI groups received a T10 spinal transection. Locomotor BBB scores were assessed weekly and tail flick was performed terminally at 6 weeks post-SCI. Animals were perfused to harvest spinal cord, muscle, skin, fascia, and L1-L6 dorsal root ganglia (DRGs) for immunohistochemistry, iDISCO, western blots, and RNAseq. **Results:** SCI resulted in robust muscle atrophy as well as intraspinal sprouting of CGRP+ afferents in lumbar dorsal horn and reduced CGRP+ motoneuron cell bodies in lumbar ventral horn. These changes correlated with thermal/mechanical hypersensitivity and limited locomotor recovery. Using intraneural AAV injections, we achieved robust labeling of motor axons and endplates in muscle. Following SCI, motor endplates were reduced in size and appeared disorganized in both gastrocnemius and tibialis anterior muscles. SCI also reduced CGRP expression by motor endplates and motor axons. Conversely, SCI rats displayed an increase in C-fibers in muscle, particularly around blood vessels. Changes in CGRP+ sensory innervation in fascia and skin are being evaluated. We are also processing muscle and DRGs for protein analysis in addition to RNAseq. We will evaluate differential expression of genes related to plasticity, sprouting, hypersensitivity, and inflammation. **Conclusion:** These findings will provide fundamental information regarding mechanisms that may contribute to sensory-dependent pathologies to the field of SCI, allowing for novel avenues of rehabilitative and pharmacological therapies.

Learning Objective 1 Analyze plasticity of nociceptive afferents in skeletal muscle following spinal cord injury.

Learning Objective 2 Describe the differences in peripheral plasticity of CGRP+ sensory and motor neurons following SCI.

Learning Objective 3 Discuss the clinical implications of peripheral and central sprouting of C-fibers.

Transcutaneous Spinal Cord Stimulation Combined with Activity-Based Therapy Leads to Sensorimotor Improvements in Chronic, Thoracic Spinal Cord Injuries

Abstract 41 | Poster 71

Jenny Suggitt, MSc, OTR/L, Neurokinex

Objective: Evaluate the efficacy of prolonged treatment with transcutaneous spinal cord stimulation (tSCS) in individuals with chronic spinal cord injury (SCI). **Design/Method:** Five participants with chronic, thoracic SCI completed 120 activity-based therapy sessions combined with sub-threshold tSCS delivered over the thoracolumbar spine (tSCS-ABT). Sensorimotor changes were assessed using NeuroRecovery Scale (NRS) and International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI). The NRS was measured at baseline and sessions 20, 40, 60, 80, 120. ISNCSCI was completed at baseline and sessions 40 and 120. **Results:** NRS-Total and NRS-Trunk scores significantly improved following 120 sessions of tSCS-ABT ($\Delta 1.1$ (95% CI 0.2–1.9) and $\Delta 2.3$ (95% CI 1.2–3.3), respectively), with these improvements dependent upon training dosage ($F_{1,460} = 5.840$, $p = 0.028$, $\eta^2 = 0.65$, $F_{2,045} = 8.180$, $p = 0.005$, $\eta^2 = 0.73$, respectively). Consistent with these findings, improved ISNCSCI sensation to pinprick ($\Delta 2.8$ (1.9), (95% CI 0.4–5.2), $p < 0.05$) and light touch ($\Delta 1.8$ (0.8), (95% CI 0.8–2.8), $p < 0.01$) were observed only after 120 tSCS-ABT sessions. Three individuals demonstrated improved American Spinal Injury Association Impairment Scale (AIS) classifications (A to C; B to C; C to D), with three individuals also demonstrating changes in level of injury (T6 to T11; T10 to T11; T10 to T11). **Conclusion:** Sub-threshold thoracolumbar tSCS facilitates recovery of trunk sensorimotor function in individuals with chronic SCI. Improvements required at least 60 tSCS-ABT sessions, with further exposure to tSCS facilitating continued improvements in function. These findings demonstrate that prolonged training with tSCS-ABT is an effective neuromodulation intervention for individuals with SCI. **Support:** This work was funded by International Spinal Research Trust grant number NMN008.

Learning Objective 1 Discuss the treatment efficacy of prolonged tSCS-ABT intervention for chronic SCI

Learning Objective 2 Describe optimal training dosage of prolonged tSCS-ABT intervention for chronic SCI

Learning Objective 3 Examine impact of prolonged tSCS-ABT intervention on AIS classifications and injury levels for chronic SCI

Restoring Function After Chronic Spinal Cord Injury from Electrophysiology to Kinematics

Abstract 141 | Poster 72

Tara Nash, CNP, Hennepin Healthcare Systems

One of the main objectives of the E-STAND clinical trial is to investigate the use of epidural stimulation to facilitate volitional movement as measured by surface EMG through the Brain Motor Control Assessment (BMCA) in participants with chronic spinal cord injury and motor paraplegia. The primary outcome requires careful assessment using surface electromyography (sEMG) from which we have shown improvements in muscle synergies both acutely and chronically. We set out to investigate the relationship between sEMG and linear accelerometry and angular gyroscopes in order to capture the short and chronic effects of stimulation on kinematic parameters. s Assessing how using an epidural stimulator will effect someone with a spinal cord injury in their ability to move has been limited to inpatient visits. This is assessed by using surface EMG while they perform a BMCA. The EMG is a very clinical approach to collecting data. The study was able to compare the use of the accelerometry measurement, inertial measurement units (IMU) to EMG data. Accelerometry data will allow for practicality and home measurements. The EMG data and Accelerometry data were compared and found to be reliably significant. Using Accelerometry data as a primary focus, the study is then able to be more cost effective, practical, and collect more data. Use stim to gain movement Measured with EMG while doing a task For those with SCI and motor paraplegia Taking EMG → IMU IMU is cheaper, easier

***** Introduction: The E-STAND clinical trial investigates the use of epidural spinal cord stimulation (eSCS) to restore volitional movement measured by the Brain Motor Control Assessment (BMCA) in participants with chronic spinal cord injury (SCI). Since EMG equipment is less portable and/or more costly than the IMU's, we investigated how these two measurement modalities compare to one another. Methods: Data from ten lower-extremity sEMG sensors and four IMUs, placed on the thighs and feet bilaterally, were collected from ten participants during stimulation off and on conditions during monthly visits. EMG data was 30-Hz high-pass filtered, rectified, then 5-Hz low-pass filtered to get the envelopes. IMU data was band-pass filtered between [0.2, 8] Hz, and the vector norm of every 3D measurement was calculated. Non-negative matrix factorization was used to conduct synergy analysis on the IMU and EMG data. Results: RMS magnitudes positively correlated between EMG and IMU when stimulation was on ($r=0.5$; $p<2e-16$). The interpolated number of EMG synergies at $R^2=85\%$ (XEMG) did not correlate with that of the IMU (XIMU). Linear mixed-effect models of these responses revealed that the EMG and IMU magnitudes (RMS) were driven by the stimulation condition (stim; $p<2e-16$), its interaction with visit (stim:visit; $p<=2e-10$), and the visit number ($p<=2e-5$). On the other hand, XEMG was driven by stim ($p=2e-12$), while XIMU was driven by visit ($p=8e-7$). Conclusion: IMU can quantify the magnitude of volitional movement due to eSCS in SCI patients similar to EMG.

Learning Objective 1 Describe the E-STAND clinical trial and the objective to investigate the effectiveness of epidural spinal cord stimulation (eSCS) in restoring volitional movement in participants with chronic spinal cord injury and motor paraplegia. Using the Brain Motor Control Assessment (BMCA) as a measurement tool for assessing movement improvements resulting from eSCS.

Autonomic and Motor Recovery with Non-Invasive Lumbosacral Spinal Cord Stimulation Following Cervical Motor-Complete Spinal Cord Injury: A Case Study

Abstract 166 | Poster 73

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Objective: Spinal cord injury (SCI) is a debilitating condition resulting in autonomic and sensorimotor consequences. Among these, recovery of bladder, bowel and sexual function were rated among the highest common priorities. Spinal cord stimulation (SCS) has gained significant recognition as a promising approach to target autonomic dysfunctions after SCI. Epidural SCS (eSCS) demonstrated to promote targeted autonomic recovery after SCI. Despite its effectiveness, eSCS is a highly invasive procedure and unable to activate multisegmented spinal cord. We have demonstrated transcutaneous SCS (tSCS), a non-invasive alternative to eSCS, could activate multiple spinal cord segments innervating multiple systems. In this study, we aimed to assess the effect of long-term tSCS on autonomic function as a primary outcome and sensorimotor function as a secondary outcome. **Methods:** A 28-year-old male with a chronic (11-years post-injury) cervical (C4) SCI with the American Spinal Cord Injury Association Impairment Scale (AIS) B, was recruited. He underwent tSCS treatment sessions 5 times per week for 6 weeks. tSCS was delivered over the T11 and L1 vertebral levels to stimulate the lumbosacral spinal cord segments. The stimulation was administered in a seated position without any activity. Bowel (anal canal resting pressure, time needed for bowel management (TNFBM)), bladder (maximum cystometric capacity (MCC)) and sexual function (international index of erectile function (IIEF)) were assessed using urodynamics, anorectal manometry, and semi-structured interviews. Furthermore, cardiovascular parameters (frequency of autonomic dysreflexia (AD) and maximum systolic blood pressure (SBP)) were measured at baseline at post-intervention via 24hr ambulatory BP monitoring. The participant was also monitored for any potential motor recovery. **Results:** Following the intervention, he displayed decreased anal resting pressure and TNFBM (111 to 73 mmHg; 39 to 31 min) compared to baseline. The participant also presented increased MCC (176 to 211ml) and increased erectile function score from 14 to 18 following the intervention. Moreover, the frequency and severity of daily AD decreased compared to baseline. These findings may indicate an improvement in pelvic organ function and cardiovascular function. Interestingly, after the intervention, the participant was able to perform knee extension against gravity bilaterally in a seated position with tSCS. **Conclusion:** This case study reports both quantifiable autonomic and motor recovery after 6-weeks of tSCS alone. Long-term lumbosacral tSCS led to multifaceted functional recovery, potentially contributing to improving the participant's quality of life. The results are paramount to future studies assessing the effect of accessible tSCS as a therapeutic modality for individuals with SCI. **Support:** International Spinal Research Trust (ISRT), UBC Faculty of Medicine

Learning Objective 1 Discuss the spinal cord innervation of the lower extremities, pelvic floor organs, as well as blood vessels for multifaceted effect.

Learning Objective 2 Illustrate the effect of non-invasive neuromodulation on voluntary motor function.

Learning Objective 3 Illustrate the effect of non-invasive neuromodulation on autonomic function.

Modulation of Spinal Cord Excitability and Motor Performance in Individuals with Chronic Cervical SCI Following a Single Spinal Cord Transcutaneous Stimulation Training Session

Abstract 176 | Poster 74

Pawan Sharma, PhD, Kentucky Spinal Cord Injury Research Center

Objective: The majority of spinal cord injuries (SCI) occur at the cervical cord level, and regaining arm and hand function remains the top rehabilitation priority of this population. We have shown that multisite non-invasive spinal cord transcutaneous stimulation (scTS) targeting cervical and thoracolumbar sites combined with motor recovery training facilitates hand function recovery post-cervical SCI. To understand the neurophysiological mechanisms contributing to the observed motor recovery, we investigated the effects of multisite stimulation on spinal network excitability and execution of motor tasks following a single training session. We hypothesized that a single training session will increase the spinal cord network excitability and improve motor execution capabilities. **Design/Methods:** To test the hypothesis, 1) spinal evoked responses in response to single pulse scTS targeting individual stimulation sites, and 2) electromyography (EMG) from selected upper extremity muscles while performing various motor tasks were recorded from ten participants with chronic cervical SCI (C2-C7, AIS A-C) before and after a typical training. A typical training session consisted of 60 minutes of scTS targeting C3-C4, C5-C6, C7-T1, and T11-T12 spinal levels (30-70 Hz subthreshold stimulation with a 5-10 kHz carrier frequency) combined with upper extremity motor recovery training. In addition, EMG from upper extremity muscles during similar motor tasks was collected from neurologically intact participants (N = 6) to obtain normal activation profiles. **Results:** Preliminary data from four SCI participants demonstrate increased peak-peak amplitudes, reduced activation threshold, and increased recruitment curve slope for most recorded muscles. In addition, motor performance analysis revealed that some participants were able to perform tasks more efficiently compared to their before scTS performance levels. Moreover, the relative contribution of different upper extremity muscles in a motor task demonstrated similar profiles as neurologically intact participants after a single scTS training session. Interestingly, the effects of a single scTS training session on spinal evoked responses and motor performance differed considerably between the right and left sides. **Conclusion:** Overall, findings from the present work suggest that multisite scTS facilitated motor recovery in humans with chronic cervical SCI is potentially mediated via alteration in the spinal cord excitability. The findings explain potential neurophysiological basis of motor and sensory function recovery seen in individuals with cervical SCI receiving motor training with scTS. **Support:** Kessler Foundation, NJ, USA

Learning Objective 1 Discuss effect of single training session with scTS on spinal cord excitability

Learning Objective 2 Discuss effect of single training session with scTS on upper extremity motor functions

Learning Objective 3 Discuss potential neurophysiological basis of motor recovery induced by scTS

Transcutaneous Spinal Cord Stimulation to Restore Cardiovascular Function in Chronic SCI

Abstract 200 | Poster 75

Caitlyn Peters, PhD, James J Peters VA Medical Center

Objective: Based on our understanding of somatovisceral neural integration within the spinal cord, it is plausible that transcutaneous spinal cord stimulation (tSCS) can be targeted to modulate spinal autonomic nervous system (ANS) circuitry to normalize blood pressure (BP). The aim of this study was to determine the optimal tSCS parameter settings that reliably increase and stabilize seated systolic BP (SBP) in hypotensive individuals with chronic SCI. **Design/Methods:** This was a randomized, single-blinded, prospective clinical trial. Participants were non-ambulatory, hypotensive (baseline seated rest SBP for males: <110 mmHg; females: <100 mmHg) individuals with injuries at T6 and above. Continuous BP was recorded at the finger arterioles while the participants sat upright in their wheelchair. Cathodal electrodes were placed midline at five spinous processes (T6-11, T7/8, T9/10, T11/12, L1/2), which were randomly placed on separate study visits. Anodes were placed bilaterally over the iliac crests. The tSCS ramp began at 0 mA, with 2-10 mA increments up to 120mA, using either a monophasic or biphasic waveform, with pulse width of 1 msec, at frequencies of 60-120 Hz with or without a carrier frequency of 10,000 Hz. The ramping algorithm was halted under three conditions: 1) the stimulus was intolerable to the participant, 2) 120 mA was attained without adequate SBP response, or 3) SBP was stable within a pre-defined range of 110-130 mmHg for male participants and 100-120 mmHg in female participants. **Results:** Data are presented in three hypotensive individuals with chronic, cervical SCI. Most notably, optimal tSCS parameter settings that increased and stabilized SBP varied among this small cohort of participants with SCI. Participant #001 was injured at C6-7, AIS B and had baseline SBP of 79±6 mmHg. Participant #001's optimal settings included cathode placement at interspinous T9/10, with a biphasic waveform, at 30 Hz, which elicited an average increase in SBP 10 mmHg to 89 mmHg. Participant #002 was injured at C5-6, AIS A and had a baseline SBP of 88±7mmHg. Participant #002's optimal settings were electrode placement at interspinous L1/2, with a monophasic waveform, at 60 Hz, which elicited an average increase in SBP 15 mmHg to 103 mmHg. Participant #003 was injured at C6-7, AIS C and had a baseline SBP of 83±4 mmHg. Participant #003's optimal settings were electrode placement at interspinous L1/2, with a monophasic waveform, at 60 Hz, which elicited an average increase in SBP 7 mmHg to 90 mmHg. **Conclusion:** Optimal tSCS parameter settings need to be individualized to increase SBP in hypotensive individuals with SCI. We anticipate completing 8 hypotensive individuals with SCI by May 2024. **Support:** VA Rehabilitation Research & Development Service (Grant # R-3706).

Learning Objective 1 Discuss secondary consequences of blood pressure instability after a SCI.

Learning Objective 2 Discuss findings related to effects of tSCS at different electrode sites, waveform and frequencies on seated blood pressure.

Learning Objective 3 Present findings on possible treatment for restoring cardiovascular function in SCI.

Participants and Caregivers' Perspectives of The Spinal Cord Epidural Stimulation Effect on Bowel Function and Management for Individuals with Spinal Cord Injury: A Qualitative Study

Abstract 201 | Poster 76

Beatrice Ugiliweneza, PhD, MS, University of Louisville

Objective: Quantitative investigations have shown the promise of Spinal cord epidural stimulation (scES) to improve cardiovascular, motor, bowel, and bladder function, thereby improving the quality of life for individuals with spinal cord injury (SCI). This project was designed to delve into the perspectives of participants and their caregivers, offering qualitative insights into the effect of scES, focusing on their experience in bowel function and management, while also capturing their insights about broader implications on their quality of life. **Design/Methods:** Participants enrolled in a scES optimized for cardiovascular function and voluntary movement at the Kentucky Spinal Cord Injury Research Center (KSCIRC) were recruited to participate in a secondary qualitative study focused on bowel function and management. Semi-structured interviews were performed prior to and after scES implant plus 80 sessions of training. Thematic analysis and narrative strategies were used. **Results:** A total of 29 participants with SCI (39+10 years old, 14+8 years since injury, 41% females, all cervical, AIS: 48% A, 31% B, 20% C) with their 8 caregivers (75% females) were interviewed. Two main themes were identified: bowel management time and bowel function. At baseline, both participants and caregivers shared the hope that scES would result in the restoration of bowel movement sensation and improved motility for the participants. At the end of 80 sessions, caregivers reported that they had observed increased consistency and a significant reduction in bowel management time. Participants conveyed their experiences of regained bowel function, some expressing an ability to “sense what is happening” while others noted the capacity to “control making it come out.” Almost all participants who previously experienced accidents no longer had them. This coupled with perceived improved blood pressure symptoms and enhanced core strength led to a perceived improvement in quality of life and an increase in socializing. **Conclusion:** Findings show that scES, optimized for cardiovascular function and voluntary movement, meaningfully improves bowel management and function as perceived by participants and their caregivers. They reported more regular, consistent, and shorter time bowel movements, increased sensation, and decreased instances of accidents. The decrease in bowel management time is consistent with our previous research, which showed similar effects of locomotor training. This provides further evidence of the benefit of activity-based therapies as beneficial interventions. Our findings indicate that tailoring neuromodulation treatments for bowel function SCI could potentially exert an even more significant influence on ameliorating such secondary consequences of SCI and enhancing overall quality of life.

Learning Objective 1 Explain how participants and caregivers perceive the effects of spinal cord epidural stimulation.

Learning Objective 2 Investigate the relationship between participants' and caregivers' subjective experience of change and quantifiable changes documented in previous studies.

Learning Objective 3 Discuss prospects for future research in this field.

Paired Brain and Cervical Spinal Stimulation Facilitates Hand Muscle Responses in Humans

Abstract 208 | Poster 77

Lynda Murray, PhD, Icahn School of Medicine at Mount Sinai

Objective: Spinal cord impairment results in a loss of both descending (motor) and ascending (sensory) projecting pathways in the spinal cord. However, in most cases, some neural pathways remain intact. Knowledge surrounding how to exploit spared neural circuitry and restore hand function for individuals living with spinal cord impairment is limited. Using paired stimulation of the brain and cervical epidural spinal cord during clinically indicated surgery, our group has demonstrated timing dependent facilitation of motor output (roughly 500% increase in average evoked potential amplitude) when stimulation is synchronized to converge at the cervical spinal cord. Here, we test the technique non-invasively in awake participants, with a focus on investigating the immediate effects of paired brain and cervical transcutaneous spinal cord stimulation. **Design/Methods:** We stimulated the motor cortex with transcranial magnetic stimulation and the cervical spinal cord noninvasively with transcutaneous spinal cord stimulation, to evoke motor responses in the targeted hand muscle (abductor pollicis brevis; APB). Immediate effects of paired brain and spinal cord stimulation were measured across customized synaptic pairing intervals (SPIs), based on an individual's central and peripheral motor conduction times. Motor evoked potentials were recorded in multiple arm muscles. **Results:** To date, compared to our intraoperative findings, a weaker immediate facilitation of motor output (roughly 50%) has been seen at the optimal SPI for the target APB. Investigating multiple stimulation parameters—including different active and off-target SPIs and intensities of stimulation—are ongoing. **Conclusion:** We aim to examine whether repetitively delivering paired stimulation at an individual's optimal SPI will lead to lasting improvement in surface electromyographic motor responses, hand strength, and hand dexterity. Upon completion, this study will provide insight into how different conditions affect timing dependent plasticity.

Learning Objective 1 Describe the concept of synaptic pairing intervals when combining noninvasive brain with spinal stimulation

Learning Objective 2 Discuss the benefits of optimal synaptic pairing intervals

Learning Objective 3 Describe other parameters that could influence these paired paradigms

Identifying Midbrain Locomotor Circuits That Improve Walking in Pigs Following Incomplete SCI

Abstract 253 | Poster 78

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Background: Deep brain stimulation (DBS) targeting the mesencephalic locomotor region (MLR), which encompasses the cuneiform (CnF) nucleus and pedunculopontine (PPN) nuclei, has been extensively investigated for treating freezing-of-gait (FOG) in Parkinson's disease. Although MLR-DBS-induced enhancement of locomotor function following incomplete spinal cord injury (SCI) have been demonstrated in small animal models, the utilization of larger animals, such as micropigs, offers distinct advantages for preclinical testing of novel DBS applications, as their larger brain enables the use of FDA-approved DBS electrodes alongside conventional medical imaging hardware. To achieve maximal clinical benefit from DBS, electrodes need to be placed at the target and the stimulation parameters must be optimized. To do so, we incorporated fiber tractography and finite-element modeling (FEM) to predict the neural activation and to characterize optimal stimulation parameters for initiating locomotion. The objective of this study was to develop a multimodal imaging-based stimulation model of the MLR in the micropig and utilize this model to optimize gait recovery moderate-to-severe contusion SCI. Methods: After acquiring multimodal imaging data (structural & diffusion-weighted MRIs) and implanting directional, 8-channel DBS leads bilaterally, we generated tractography utilizing a standardized seed region [CnF] and inclusion/exclusion criteria for the tracking algorithm in MRtrix3 [1], defined as regions-of-interest (ROIs) in a common template space [2]. During manual treadmill experiments, activation thresholds were determined for each contact and those parameters which elicited reproducible locomotion were identified. Using these stimulation parameters as inputs to the FEMs constructed for each subject, we were able to quantitatively predict a common volume of tissue activated (VTA) over six female Yucatan micropigs that explained MLR-DBS effects in terms of generating a group-averaged fiber activation distribution by registering all activated fibers to the template space. Results: Our results show that effective sites activate pathways entering and/or exiting the CnF seed region. Additionally, stimulation at the effective sites activate shows activation of streamlines the medullary medial reticular formation (medRF), a known relay projecting to locomotor circuits. Effective stimulation sites/contacts show activation profiles to the periaqueductal gray (PAG), known to elicit escape behavior. Stimulation of this circuit improved muscle activity, speed of locomotion, stepping frequency, interlimb coordination, improved weight bearing [hip height] while reducing stepping variability after SCI. Locomotor performance with stimulation was better than voluntary locomotion. Conclusion: Stimulation of the MLR after moderate-to-severe SCI improves locomotor recovery and shows promise for treating gait dysfunction after incomplete SCI. This modeling and simulation procedure confirms brainstem circuitry important for eliciting locomotion. Future DBS applications in patients should incorporate activation of this pathway for their stimulation programming. Support: DoDGrant W81XWH2110791 (SC200294).

Learning Objective 1 Discuss strategies to optimize DBS targeting of the midbrain for gait control after SCI.

Learning Objective 2 Describe improvements in gait with DBS.

Learning Objective 3 Discuss brainstem circuitry involved in the descending control of walking.

Restoration of Volitional Control with Non-Invasive Spinal Cord Stimulation: Responder Vs. Non-Responder

Abstract 28 | Poster 79

Raza Malik, PhD, University of British Columbia, International Collaboration on Repair Discoveries (ICORD)

Objective: Transcutaneous spinal cord stimulation (tSCS) is a promising non-invasive therapeutic intervention for functional recovery following spinal cord injury (SCI). By modulating spinal circuits through delivery of electrical currents, tSCS aims to activate and possibly rejuvenate latent neural pathways. In our current clinical trials utilizing tSCS, we observed that individuals with cervical and upper thoracic motor-complete SCI can regain anti-gravity voluntary lower limb motor control with real-time tSCS. However, the effects of this therapy are variable; some individuals are able to elicit motor responses in the presence of tSCS while others are unresponsive. In this study we conducted an array of neurophysiological and clinical assessments in one responder and one non-responder to tSCS. We aim to utilize these assessments to identify factors that can predict tSCS responsiveness for enabling voluntary motor function following SCI. **Methods:** Two males with chronic motor-complete SCI (AIS A) underwent comprehensive neurophysiological and clinical assessments following 6 weeks of tSCS, 3 times per week. One individual had a T6 injury and after 6 weeks of tSCS, could initiate motor responses in the presence of stimulation (responder); the other individual had a T5 injury and after 6 weeks of tSCS, did not exhibit the ability to initiate any motor responses with tSCS (non-responder). In these individuals we assessed corticospinal integrity by quantifying motor-evoked potentials in the Tibialis Anterior (TA) muscle elicited by transcranial magnetic stimulation (TMS) over the motor cortex. We assessed somatosensory integrity by measuring somatosensory evoked potentials (SSEPs) in response to tibial nerve stimulation. We assessed the integrity of the peripheral nerves by measuring TA compound muscle action potentials (CMAPs) in response to peroneal nerve stimulation. Peripheral muscle health was assessed by an ultrasound of the TA muscle and quantifying echogenicity. We used clinical assessments from the International Standards for Neurological Classification of SCI (ISNCSCI) to assess sensory and motor function. **Results:** The responder showed MEPs in TA at high TMS intensities when conducted in conjunction with tSCS (average latency: 53ms, average peak to peak amplitude at 100% maximum stimulator output: 0.044mA). The non-responder did not show any TA MEPs with or without tSCS. We also observed that the responder showed larger CMAPs and a less fibrotic TA (i.e., less echogenicity) compared to the non-responder (Echo Intensity (a.u): responder 58, non-responder, 78). In the responder, clinical assessments performed in the presence of tSCS resulted in motor and sensory function scores increasing by 9 and 2 points, respectively, and voluntary anal contraction compared to when stimulation was off. In contrast, the non-responder improved his overall sensory score by 7 points with tSCS but did not show changes in motor scores or voluntary anal contraction with tSCS. **Conclusion.** Corticospinal integrity and clinical assessments of motor and sensory scores in the presence of real-time tSCS, alongside peripheral nerve and muscle health, may be important predictors to identify individuals who can initiate volitional lower limb motor control with tSCS.

Learning Objective 1 Understand the therapeutic potential of non-invasive neuromodulation for enhancing voluntary motor control in individuals with complete SCI.

Learning Objective 2 Recognize the variability in responses to non-invasive neuromodulation, distinguishing between responders and non-responders.

Learning Objective 3 Familiarize with a variety of neurophysiological and clinical assessments that might predict responsiveness to neuromodulation in individuals with SCI.

Barriers to Health Promotion Among Young Adults with Pediatric-Onset Spinal Cord Injury

Abstract 65 | Poster 80

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Objective: Engaging in physical activity and taking care of one's health is essential to well-being. Compared to individuals without a physical disability, individuals with pediatric-onset spinal cord injury (SCI) may face unique barriers that can hinder their ability to maintain a healthy and active lifestyle. The primary objective of the current study was to examine perceptions of barriers to health promotion among two groups of young adults (1) those with pediatric-onset SCI and (2) a control group of peers. Additionally, potential psychological correlates and moderators of health barriers and disability were explored. Method: A total of 35 young adults between the ages of 18-29 (M=23.5, SD=3.5) participated in the study. Half of the participants had a confirmed SCI (n=18) sustained prior to age 18 (M=11.2, SD=5.7; range 0-17) and had been injured an average of 11.3 years (SD=6.2; Range 3-26). Participants with SCI were former patients at one of three pediatric SCI programs within a larger US hospital system. Control participants were recruited from the local community. Participants were predominantly Caucasian (n=26, 74%) and just over half identified as women (n=18, 51%). Participants completed measures assessing health behaviors, physical and psychological well-being, and barriers to health activities. Correlational analyses were used to examine how perceived barriers to health relate to psychosocial adjustment. T-tests were used to compare participants with SCI to controls on perceived health barriers. Two-way ANOVA was used to evaluate the effect of pain, SCI status, and the interaction term on overall perception of barriers to health. Results: Higher overall perceived barriers to health scores were associated with significantly higher depression ($r=.50$, $p=.002$) and anxiety ($r=.43$, $p=.011$) scores. When individual potential barriers to health were examined, groups did not differ significantly across 14 of the 18 potential barriers. Lack of time was the most frequent barrier to health noted among both groups of young adults. The four areas where those with SCI reported significantly greater barriers included lack of transportation, general impairment, lack of information, and concerns about safety. In two-way ANOVA models of overall perceived health barriers, significant main effects were observed for both SCI status, $F(1, 31) = 7.89$, $p=.009$, and pain, $F(1, 31) = 11.71$, $p=.002$. Importantly, these relationships were qualified by a significant interaction effect, $F(1, 31) = 5.76$, $p=.022$. Probing this interaction showed that in the absence of pain, there was only a small difference between those with a pediatric onset SCI (M=24.00, SD=4.97) and those without (M=22.85, SD=4.16) on overall perception of barriers. However, for those with pain, perception of barriers was substantially higher when the individual also had an SCI (M=40.60, SD=16.98) than when they did not (M=25.75, SD=1.89). Conclusion: This research suggests that on the whole, young adults with pediatric SCI experience a number of barriers to health promotion that are similar to their peers without an SCI. However, pain in particular, may exacerbate perceived barriers to health, and thus may require special attention, especially for those with pediatric-onset SCI.

Learning Objective 1 Identify barriers to health for individuals with pediatric-onset SCI compared to pairs.

Learning Objective 2 Describe how pain relates to health promotion behaviors.

Learning Objective 3 Explain the relation of subjective experiences of health barriers to mental well-being.