American Spinal Injury Association
Annual Scientific Meeting
May 20-23, 2024 · San Juan, Puerto Rico

Award- Eligible Poster

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

Abstract 179

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.

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

Abstract 30

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

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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

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.

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

Abstract 192

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.

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Acquired Infections Drive Genetic and Immune Changes Acutely After SCI

Abstract 225

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

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Adaptive Sports for All: Investigating the Socioeconomic Challenges to Participation

Abstract 165

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 disproportionally 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

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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

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

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

Abstract 113

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.

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

Abstract 172

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

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

Abstract 230

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±0.5ºC. We conducted an acute intervention study with 4 treatment arms: 1) control (CTR; Lactated Ringer's, intravenous); 2) ENO (50ppm, inhalation); 3) dobutamine (DOB, 1ug/kg/min, intravenous); and 4) combined ENO+DOB. Spinal cords were collected, fixed in paraformaldehyde (4%), frozen at -80°C, and sectioned at 10µm. 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±8.3mmHg; P=0.002; n=5) and DOB+ENO groups (78.8±8.1mmHg; P=0.019; n=5) compared to control (61.9±6.3mmHg), while there was no difference in MAP with ENO (67.6±11.0mmHg; P=0.59). Preliminary data showed there was no difference in the IPH area between groups. IPH at the epicentre was 12.2±4.1% with CTR and was not different with ENO (14.6±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 CTRfor DOB (13.8±2.3%; P=0.71) or DOB+ENO (11.2±1.1%; P=0.81). In the rostral portion of the cord, there was an increase in IPH in the DOB (9.8±2.2%; P=0.042) group compared to CTR (6.9±1.9%). Conversely, there was no IPH increase in the combined DOB+ENO (6.7±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

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

Abstract 17

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

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Award- Eligible Poster

A Biomarker to Predict Spasticity Reduction Following Transcutaneous Spinal Stimulation

Abstract 223

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.

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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

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

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Award- Eligible Poster

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

Abstract 84

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 guidleline 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

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Overground Robotic Exoskeleton Use for Early Mobility After Spinal Cord Injury During Acute Care Hospitalization: A Case Series

Abstract 193

Jaime Gillespie, PT, DPT, Baylor Scott & White Institute for Rehabilitation

Background and purpose: Early mobility (EM) of patients with spinal cord injury (SCI) in the acute care hospital setting is recommended to reduce secondary complications and promote functional recovery. However, delivery of EM faces practical challenges to achieve the patient's highest level of mobility (i.e., standing and walking) including physical burden on physical therapists and limited equipment to decrease burden. Contemporary overground robotic exoskeleton (ORE) devices may allow the rehabilitation professional to overcome known barriers to delivery of EM. The purpose of this case series was to describe the ORE use to deliver EM for two patients with SCI in the acute care hospital setting. Case description: Patients were two adults with traumatic incomplete SCI [patient A=65 years old male with C4 ASIA Impairment Scale (AIS) D; patient B=56 years old male with C5 AIS D] referred to physical therapy for EM within the acute care hospital setting. Patients participated in EM with usual care (20–30 minutes) and ORE (30–45 minutes) approaches during separate sessions. The goal during each EM session was to achieve the highest level of mobility as measured by the John Hopkins Highest Level of Mobility Scale (JH-HLM) [1 (bed level activities) to 8 (ambulated > 250 feet)]. During ORE sessions, the device was programmed to "variable assist", allowing the patient to contribute as much as possible to standing and walking efforts. Device-specific session details (up time, walk time, and step count) were documented during ORE EM sessions. Vital signs [blood pressure (mmHG) and heart rate [beats per minute (bpm)] were monitored to assess tolerance during usual care and ORE EM sessions. Outcomes: Usual care EM sessions yielded for patient A [6 sessions (vitals remained within normal ranges with no adverse events) over 17 day length of stay] a median JH-HLM score of 3 [range = 2 (bed activities / dependent transfer) to 4 (transfer to a chair) and patient B [8 sessions (one hypotensive syncopal episode) over 64 day length of stay] a median JH-HLM score of 5 [range = 4to 5 (standing 1 or more minutes)]. Both patients completed one ORE session [Patient A: up time=9:40 minutes, walk time=7:16 minutes, step count=249; Patient B: 10:18, 5:37, 120) yielding JH-HLM scores of 8 (Patient A; walking 250 feet or more) and 7 (Patient B; walking 25 feet or more) during their acute care stay. Vitals (blood pressure A=102-110/55-83, B=103-122/64-98; heart rate A=62-65, B=64-116) remained within normal ranges and no adverse events occurred during the ORE EM sessions. Discussion: Two patients with incomplete SCI achieved a higher level of mobility during their single ORE session than was attained during usual care EM session in the acute care hospital setting. Consideration for use of ORE as a tool to promote EM after SCI in the acute care setting may be warranted. A first step may be to explore the safety and feasibility of integrating ORE into the acute care therapy plan of care.

Learning Objective 1 Describe the integration of overground exoskeletons into the plan of care for early mobility after spinal cord injury during acute care hospitalization.

Learning Objective 2 Discuss the session outcomes associated with use of an overground exoskeleton for early mobility after spinal cord injury during acute care hospitalization.

Learning Objective 3 List the next steps for exploration of overground exoskeletons integrated into the acute care hospital for patients after spinal cord injury.

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The Gut Microbiome After SCI: A Preliminary Analysis of The Gut Microbiome to Identify Molecular Mechanisms of GI Dysfunction

Abstract 205

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

Objective: In addition to neurological impairment, chronic spinal cord injury (SCI) causes secondary complications that significantly compromise health and quality of life, including loss of bowel function and pathological dysfunction in the gastrointestinal tract. Current treatments for bowel dysfunction are limited and not without unwanted side effects, however, recent work on the gut microbiome holds potential for new therapeutics. Research shows that manipulating gut bacteria can alter the host's autonomic, inflammatory, metabolic, and gastrointestinal state. Additionally, prior work by our group determined altered composition of gut bacteria and bacterial quorum sensing molecules (QSMs), employed by bacteria to coordinate community behaviors, post-SCI in a rat model. Thus, we wish to investigate the gut microbiome, with a focus on bacterial QSMs, to determine the molecular mechanisms of gastrointestinal dysfunction post-SCI and potential therapeutic targets. Design/Methods: Persons with SCI (> 1-year post-injury, tetraplegia/paraplegia; C5-T6) and neurologically intact controls provided stool samples and information to assess diet and exercise habits, prescribed medications and supplements (e.g., probiotics), frequency of bowel movements, and typical bowel routine components. Metagenomic sequencing, metabolomics, bacterial QSM detection, and levels of cytokines, chemokines, and growth factors will assess putative mechanisms related to gastrointestinal dysfunction. Results: Stool samples from individuals with SCI and neurologically intact controls were assessed for four different classes of QSMs revealing decreased levels of 3,5-dimethylpyrazin-2-ol (DPO) in individuals with SCI. As DPO can be both a QSM and metabolite depending upon the bacterial species, we investigated the microbiome composition within these samples finding 47 significantly altered bacterial strains, including known intestinal pathogens Pseudomonas aeruginosa, Citrobacter rodentium, and Salmonella enterica being upregulated in these samples. Bacterial functions associated with biofilm and virulence factor formation and antibiotic resistance were also found to be significantly elevated in individuals with SCI. We also determined that the levels of IL-12/IL-23p40 and TNFα were statistically significantly lower and VEGF was statistically significantly higher in the stool of individuals with SCI as compared to controls. Conclusion: While further investigation is needed, this initial assessment of stool samples provides a framework of biochemical targets/pathways to evaluate as potential mechanisms towards restoration of gastrointestinal function post-SCI. Support: DoD W81XWH-20-1-0697

Learning Objective 1 Describe the physiological impact of SCI on the gastrointestinal tract and gut microbiome.

Learning Objective 2 Explain how alterations in the gut microbiome after SCI can can affect bowel dysfunction.

Learning Objective 3 Identify biochemical targets/pathways to evaluate as potential countermeasures for restoration of gastrointestinal function post-SCI.

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Genetic Variability and DVT after Spinal Cord Injury (SCI): A Negative Pilot Study Highlights Barriers and Opportunities to Exploring Gene Association in SCI Outcomes

Abstract 216

Lauren Hall, MD, Spaulding Rehabilitation Hospital

Objective: Acute traumatic SCI disrupts motor, sensory, and autonomic functions, impacting physical and psychosocial well-being. Beyond primary deficits, individuals face an array of secondary complications, including deep vein thrombosis (DVT). Despite considering injury level, demographics, and acute interventions, outcomes vary among similar cases. Genetic variability may contribute to this variation, though few studies examine genetic variability in post-SCI outcomes. Single nucleotide polymorphisms (SNPs) in several candidate genes have been implicated in development of DVT, but to our knowledge only one study assessed this association in individuals with SCI. The development of biobanks linked to Electronic Health Records (EHR) offers an opportunity to explore these associations. To that end, we conducted a small "proof-of-principle" study leveraging biobank and EHR data to investigate the role of genetic variability in DVT formation post-SCI. Methods: The institutional biobank was queried for individuals ≥18 years of age with a diagnosis code for SCI. A subset was then curated with confirmed SCI diagnosis based on their admission to an inpatient rehabilitation SCI program. All patients had ISNSCI exams and screening vascular ultrasounds. Chart review was performed to extract relevant sociodemographic and pre- and peri-injury characteristics. Seven SNPs from six genes (MHTFR, Factor V Leiden, PAI-1, FSAP, Prothrombin, and PROCR) previously implicated in the development of DVT were selected and the available genotype data was extracted from the biobank. Summary statistics and logistic regression analysis was performed using institutional software. Results: The biobank query identified >600 individuals with a diagnosis code for SCI. Of these, 100 individuals had a confirmed diagnosis of SCI based on their admission to the SCI program at the acute rehabilitation hospital. Sixty-nine (55 male; average age of injury: 46; 31 (45%) with motor complete injury) of these had genotype data available from the Biobank. Twenty (29%) had US detected DVT after their injury. Two SNPs were excluded from analysis due to genotyping failure and minor allele frequency of 0. For the remaining five SNPs, logistic regression analysis, covarying for age, sex and motor complete status, did not identify any statistically associations with DVT occurrence (all P>0.05). Conclusion: There exists a paucity of data examining the associations of genetic variability and outcomes in SCI. Despite advancements in human genome analysis, significant barriers exist to functional applications in small rehabilitation populations. While no SNPs were found to be significantly associated, the small, underpowered study precludes any conclusions about the relative contribution of these genetic variants in the development of DVT post-SCI. Instead, this study supports the potential utility of using biobank data to explore these associations and highlights the need for reliable automated phenotyping of SCI status and DVT occurrence to fully exploit the available data as well as the need for collaboration across large health networks to further examine the contributions of genetic variability in neurorecovery and medical complications in SCI. Support: Milbank Foundation for PM&R

Learning Objective 1 Discuss the availability of literature evaluating genetic associations with neurologic and medical outcomes post SCI.

Learning Objective 2 Discuss barriers to effectively evaluate genetic associations with neurologic and medical outcomes post SCI.

Learning Objective 3 Discuss the utility of Biobank data to explore genetic associations with neurologic and medical outcomes following SCI.

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Characterization Of Chronic Incomplete Cervical Spinal Cord Injury with Magnetic Resonance Imaging and Assessments Of Sensory And Motor Functions: Case Reports

Abstract 73

Allison Lewis, DPT, PhD, Medical University of South Carolina

Spinal and brain magnetic resonance imaging (MRI) can provide valuable information about nervous system function and structure. However, quantitative imaging metrics have yet to be incorporated into upper extremity (UE) motor rehabilitation research for spinal cord injury (SCI). Therefore, as the first step in relating spinal/brain MRI with sensorimotor function in the chronic state after SCI, we are currently applying quantitative MRI analyses, with neurophysiological and clinical assessments, in individuals with stable incomplete cervical SCI. Two participants underwent neurophysiological assessment (motor evoked potentials [MEPs] to transcranial magnetic stimulation in extensor carpi radialis), clinical assessment, and brain/spinal MRI. Spinal imaging included T2 images for registration and to manually segment spinal lesions. The Spinal Cord Toolbox was utilized, and the spinal lesion was warped into PAM50 template space to calculate overlap between the lesion and atlas-based spinal white matter tracts (% spared lateral corticospinal tract, % spared fasciculus cuneatus). Brain imaging included T1, resting state functional, and diffusion weighted images. Warps were created and applied to the primary motor cortex (M1) template for seeding probabilistic tractography. Probabilistic tractography approximated the spatial location of the corticospinal tract (CST), and fractional anisotropy (white matter integrity measure) was extracted. Resting state functional images were analyzed using ROI-based connectivity analyses, and an average motor network connectivity value was generated for each hemisphere of the brain. Participant 1 (P1; age 63, female, 13 years post-injury) was diagnosed with C4-6 SCI from surgical resection of arteriovenous malformations. She presented with severe motor dysfunction (ARAT=12; UE manual muscle test score=0-2); small maximum MEP (MEPmax) amplitude (0.6 mV); and impaired sensation (light touch absent C5-8; sharp/dull sensation absent C4-T1). For P1, damage to the spinal cord was too extensive for lesion segmentation. Average cortical motor network connectivity was 0.45 (more impaired side) and 0.49 (less impaired). CST integrity in the brain was 0.49 (more impaired) and 0.47 (less impaired). Participant 2 (P2; age 63, male, 18 years post-injury) was diagnosed with a C6 SCI from a fall with hyperextension. He presented with moderate motor dysfunction (ARAT=40; UE manual muscle test scores=1-5); MEPmax of 1.1 mV; and impaired sensation (light touch diminished C6-T1; sharp/dull sensation absent C7-8). For P2, 56.3% of the lateral CST and 69.3% fasciculus cuneatus was spared on the more impaired side. Average motor network connectivity was 0.39 (more impaired) and 0.47 (less impaired). CST integrity in the brain was 0.47 for both sides. Quantitative MRI was successfully applied in two participants to quantify brain structure and connectivity; spinal lesion characterization was possible in the one with trauma. Spinal lesions due to surgical resection or congenital conditions may not be well suited for manual lesion segmentation from MRI. Quantitative MRI could be a useful tool for quantifying pathophysiology underlying sensorimotor dysfunction in individuals with chronic cervical SCI. *case(s) will be added for poster

Learning Objective 1 Describe basic methods of quantitative MRI in chronic incomplete spinal cord injury

Learning Objective 2 Explain cases where quantitative MRI was applied in conjunction with clinical and neurophysiological assessment of motor and sensory function

Learning Objective 3 Discuss potential applications and implications for research

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Effectiveness of Hydrotherapy on Neuropathic Pain and Pain Catastrophization In Patients With Spinal Cord Injury: Protocol For A Pilot Trial Study

Abstract 3

Luz Miriam Leiva Pemberthy,Md, Fundacion Alle De Lili

Background Neuropathic pain (NP) is one of the most frequent spinal cord injury (SCI) complications. Pain, quality of life, and functionality are associated and can lead to pain catastrophization. Pharmacological management of patients with NP secondary to SCI is widely known and there is increasing evidence in the area. Nevertheless, nonpharmacological management is not fully elucidated since its efficacy is inconclusive. Objective We hypothesize that (1) hydrotherapy is effective in reducing NP secondary to SCI. Additionally, our secondary hypotheses are that (2) hydrotherapy decreases the catastrophization of NP, and that (3) hydrotherapy improves life quality and minimizes the degree of disability, when compared to physical therapy. Methods A sample of approximately 20 participants will be randomly assigned to either the intervention (hydrotherapy) or control group (standard physical therapy). Both interventions will be administered twice a week over a 9-week period (18 sessions in total). Primary outcomes are changes in neuropathic pain perception and pain catastrophization. Secondary outcomes are changes in disability and quality of life scores. They will be assessed at baseline and follow-up at 4 weeks after discharge. Validated Spanish language scales that will be used are the following: Numerical Pain Rating Scale, Pain Catastrophization, Health-related Quality of life, and the World Health Organization's Disability Assessment Schedule 2.0. Generalized mixed linear models will be used for comparing baseline and postintervention means of each group and their differences, together with 95% CIs and P values. A P value of less than .05 will be considered significant. Results Recruitment began in April 2019, and we recruited the last participants by December 2019, with 10 individuals assigned to hydrotherapy and 8 to physical therapy (control). Results from this study will be disseminated via scientific publication, in ClinicalTrials.gov, and in national and international conferences in the latter half of 2022. Conclusions This trial will explore the effects of hydrotherapy on neuropathic pain, together with functionality and quality of life, in patients with SCI. Furthermore, this study aims to evaluate these therapeutic modalities, including perception variables, and mental processes, which may affect the clinical condition and rehabilitation outcomes in these patients. Hydrotherapy is likely to be a safe, efficient, and cost-effective alternative to the current standard of care for NP secondary to SCI, with comparable results between the two.

Learning Objective 1 To evaluate changes in neuropathic pain perception, pain catastrophization, disability, and quality of life using validated Spanish language scales.

Learning Objective 2 To investigate the effectiveness of hydrotherapy in reducing neuropathic pain (NP) secondary to spinal cord injury (SCI).

Learning Objective 3 To assess the effects of hydrotherapy on disability and quality of life in patients with NP secondary to SCI, in comparison to standard physical therapy.

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Factors Associated with Neuropathic Pain in Colombian Patients with Spinal Cord Injury of Traumatic Origin: Case-Control Study

Abstract 4

Luz Miriam Leiva Pemberthy, Md, Fundación Valle De Lili

Study design: Case-control study. Objectives: To identify factors associated with neuropathic pain (NP) in patients with spinal cord injury of traumatic origin (TSCI). Setting: University Hospital of Valle, Cali, Colombia. Methods: Study participants were individuals with diagnosis of TSCI who visited a trauma referral center from January 1st, 2016, to December 31st, 2016. Information was retrospectively extracted from the Hospital's Spinal Cord Injury registry and patients' medical records. Cases were defined as patients with NP and controls were those without NP. The exposure of interest was intentional injuries. Individuals were matched by age and stratified into 11 groups of ±3 years each. Results: We found 164 participants with an average age of 34 ± 13 years, of whom 95.1% were male, and 53.6% had NP. Neurogenic bladder and bowel occurred in 94.3% of NP patients. Cause of injury was not associated with NP. Older injuries were protective for NP (>10 years since injury OR = 0.10, 95% CI = 0.03-0.37, $p < 0.0001$) and neurogenic bladder and bowel were found as risk factors (OR = 5.89, 95% CI = 1.84-18.88; $p = 0.003$). Conclusions: Our study uniquely shows time since injury as a protective factor for NP and neurogenic bladder and bowel as a risk factor, while violence was not found associated. This could help guide the scope of future research about NP secondary to SCI.

Learning Objective 1 To identify factors associated with neuropathic pain (NP) in patients with traumatic spinal cord injury

Learning Objective 2 To evaluate the association between the duration of injury and the presence of neuropathic pain in SCI patients.

Learning Objective 3 To identify neurogenic bladder and bowel dysfunction as potential risk factors for neuropathic pain in SCI patients.

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Perceived Effectiveness and Use of Seven Active Pain Management Tools by Individuals with Paraplegia Participating in a 9-Week Chronic Neuropathic Pain Management Program

Abstract 48

Lisa Haubert, MPT, DPT, KEMG, Pathokinesiology Laboratory, Rancho Research Institute, Rancho Los Amigos National Rehabilitation Center

Objective: Chronic pain is a debilitating secondary condition impacting up to two-thirds of individuals after spinal cord injury (SCI). Neuropathic pain is particularly difficult to treat: the first-line therapy, pregabalin, provides only modest, inconsistent relief and is often accompanied by negative side-effects. Thus, an exigent need exists for alternative non-pharmacologic approaches to enhance existing pain management efforts. The goal of this study was to evaluate the use and perceived effectiveness of six active pain management tools (APMTs) by those with SCI and chronic neuropathic pain (CNP) participating in a 9-week pain management program.
Methods: Study participants had paraplegia from SCI and CNP lasting ≥3 months (intensity ≥4/10 in last week) at enrollment. Participants tested a pilot 9-week pain management program consisting of education classes and opportunities to practice 6 APMTs: Meditation (MED), Heart Rate Variability Biofeedback Training (HRVBT), Exercises for Positive Thoughts/Feelings (EPTF), Task Persistence (TP), Positive Coping Statements (PCS) and Physical Exercise (EXER). APMTs were introduced over 5 weeks, after which participants received nightly surveys for ≥3 weeks. Surveys asked which APMTs were used during the last 24 hours and, if used, the perceived effectiveness of each to reduce pain (Q1) and pain interference with daily activities (Q2). Responses were on a 5-point Likert scale (from: 1=Very slightly/not at all; to 5=Extremely). Participant effectiveness scores were calculated for each APMT by multiplying the average score for each follow up question by the percent use of the APMT for each subject, and then averaged across participants to calculate overall pain and interference reduction effectiveness scores for each APMT.
Results: The average (SD) number of surveys completed by the 21 participants was 28.1 (7.0), with 469 of 592 possible surveys completed. Across APMT effectiveness scores for reducing pain intensity, EPTF scored significantly higher than HRVBT (2.0 vs 0.6, p=0.03) and trended towards being higher than TP (1.3, p=0.054), while PCS scored higher than TP (1.9 vs 1.3, p=0.04) and trended higher than HRVBT (0.6, p=0.06). The EPTF effectiveness score (2.0) for reducing pain interference was significantly higher than HRVBT (0.6, p=0.01) and trended higher than TP (1.4, p=0.05). PCS Effectiveness Score for reducing pain interference (1.9) was greater than TP (1.4, p=0.04) and PCS and EXER (2.0) tended towards higher scores than HRVBT (0.6, p=0.08). Considering questionnaire responses alone, all average APMT ratings were “moderately effective” for reducing pain intensity (3.0-3.4/5) and interference (3.0-3.3/5). However, significant differences were observed in use frequency, with EPTF (85%) more utilized than HRVBT (23%, p=0.02) and TP (44%, p=0.01) and PCS (81%) more frequently used than TP (44%, p=0.01) and HRVBT (p=0.03). While HRVBT was used least (23%) it was the 2nd most effective pain reducer (3.3/5.0).
Conclusion: All APMTs were moderately helpful for decreasing pain intensity and interference, although HRVBT and TP were used less. Improved education regarding less employed APMTs, particularly in HRVBT approaches that rely less on biofeedback devices (e.g., self-paced breathing and positive visualization) might result in more frequent utilization and thus benefits for pain management.
Support: Craig H. Neilsen Foundation #641474

Learning Objective 1 Describe the most frequently utilized active pain management tools in a 9-week program for chronic neuropathic pain management in individuals with paraplegia and chronic neuropathic pain.
Learning Objective 2 Discuss the most effective active pain management tools for reducing pain intensity in the same program.
Learning Objective 3 Explain the most effective active pain management tools for reducing pain interference with daily activities in the 9-week program for those with paraplegia.

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Battlefield Acupuncture in Action: Our Centers Experience with Battlefield Acupuncture for SCI Related Pain

Abstract 52

Samantha Mendelson ,DO, James A Haley VA Medical Center

Background: Pain is unfortunately a common secondary complication in people with spinal cord injuries. Frequently, pain may impact a persons performance in social and leisure activities as well as job performance In the SCI population, it may interfere with the quality of life, social functioning, employment, mood, as well as rehabilitation therapy and treatment. Design: Acupuncture is a health care treatment which originated in China over 5000 years ago. It has effects where needles are placed as well as in areas distinct from where the treatment is performed. The treatment is believed to reduce pain by two mechanisms: first pain transmissions at the level of the spinal cord are suppressed. Second, chemical transmitters in the brain are released, suppressing the sensation of pain. Over time, various schools of acupuncture have developed different styles with more limited and focused needle placement. In 2001 Dr. Richard Niemtzow, while on active duty in the United States Air Force discovered that a specific sequence of needles placed into the ears would provide rapid and effective relief of many types of pain. This treatment protocol has become well known as Battlefield Acupuncture. It is known to be a safe and effective treatment for many patients and pain conditions. Setting : We are a large VA SCI center. We have 100 dedicated SCI inpatient beds and serve a registry of more than 1500 paralyzed veterans. For the past year we have incorporated battlefield acupuncture in our methods for the treatment of pain. Methods: After hands on training of our providers (including attending physicians, residents, and nurse practitioners) we have been able to offer this treatment throughout our SCI center on a regular basis. The protocol involves auricular acupuncture with semipermanent needles in specific points. All patients with pain are considered for this safe, quick and effective treatment protocol. Results: We have been able to provide battlefield acupuncture throughout our SCI center on a regular basis for the past year. We have found many patients benefit from this treatment and have expressed neuropathic as well as nociceptive pain relief, stiffness and spasticity relief as well as improved mood and sleep. Many of our patients have been able to reduce their narcotic use - some by as much as 75% decrease - simply with the addition of this treatment. Conclusion(s): Battlefield acupuncture is a safe and effective treatment for individuals with SCI. We have integrated this treatment in our practice and have seen many positive outcomes for our paralyzed veterans.

Learning Objective 1 Understand role of Battlefield Acupuncture in the treatment of SCI related pain.

Learning Objective 2 Consider Battlefield Acupuncture for the treatment of SCI related pain.

Learning Objective 3 Describe the battlefield acupuncture treatment protocol.

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The Impact of SCI And SCI-Related Neuropathic Pain on Multisensory Integration

Abstract 81

Roberta Vastano, PhD, University of Miami, The Miami Project to Cure Paralysis

Objective: Our perceptions and actions require the integration of cross-modal stimuli. This process, called multisensory integration (MSI) generates a facilitatory effect on perception and action, known as multisensory enhancement. MSI requires intact sensorimotor mechanisms, absence of unisensory imbalance and exposure to cross-modal cues. To date, the association between the multisensory experience after spinal cord injury (SCI) and the sensorimotor impairments and neuropathic pain caused by the injury remain largely unknown. Design/Methods: We used a detection task in which redundant unimodal (visual, auditory, and tactile) and bimodal (audio-visual, visuo-tactile, and audio-tactile) stimuli were delivered. Participants (22 healthy controls, 22 individuals with SCI and neuropathic pain, 22 individuals with SCI without pain) were instructed to rapidly detect any of these stimuli and respond vocally by saying “yes”. We recorded vocal reaction times (RTs) and EEG signals. To quantify the multisensory enhancement effect, we used the independent race model and a logistic fit on the cumulative distribution functions of standardized RTs to obtain two coefficients, the slope and the intercept, for each subject. The multisensory enhancement effect is expressed as a violation of the race model, in which bimodal stimuli are faster than the summed unimodal probabilities. Additionally, to quantify the magnitude of MSI we calculated the area under the curve (AUC) on the differences between bimodal conditions and race model. We finally compared the coefficients and AUC values between groups and conditions using N-way ANOVAs. EEG data were processed, and event-related potentials (ERPs) were calculated. We hypothesized that a reduced multisensory enhancement effect and a reduced MSI magnitude (involving both RTs and ERPs) would be detected in SCI participants compared with healthy controls. These impairments could also be related to neuropathic pain severity in those with pain, due to maladaptive cortical reorganization. Results: We found evidence of reduced race model violations and reduced MSI magnitude in SCI participants with pain compared to control subjects only. This result involved all tested conditions (audio-tactile, audio-visual and visuo-tactile). We also found that SCI participants who reported greater neuropathic pain symptoms showed higher MSI values (although impaired compared to controls) and higher ERPs amplitudes in the bimodal conditions. Conclusions: Our results indicate that an SCI reduces MSI ability. This suggests that a reorganization of multisensory areas after an SCI may play a role in this deficit. The higher MSI values in SCI individuals with pain may be related to greater facilitation, decreased inhibition, or sensitization in multisensory processing. A better understanding of MSI in SCI with neuropathic pain may be crucial to develop multisensory training approaches to prevent maladaptive brain reorganization in multisensory areas. Support: Craig Neilsen Foundation # 732410

Learning Objective 1 Discuss the importance of multisensory integration after SCI with and without neuropathic pain

Learning Objective 2 Understand whether multisensory training approaches may be beneficial to prevent impaired multisensory integration.

Learning Objective 3 Evidence on impaired multisensory integration in SCI with pain will open avenues on new therapeutic interventions

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Determinants of Days with Manageable Pain After SCI

Abstract 125

Eva Widerstrom-Noga, DDS, PhD, Miami Project to Cure Paralysis, University of Miami, Miller School of Medicine

Objective: The persistence of neuropathic pain after SCI necessitates that those who experience it find ways to manage their pain by using combinations of different strategies including pharmacological and non-pharmacological strategies as well as self-management. Therefore, days with manageable pain has been suggested to be an important factor in determining pain's overall impact on life. The concept of manageable pain after SCI is to date unexplored. Manageable pain has been described as: "Pain…... relieved by either medication or exercise or meditation or any type of form where you can manage it, where it's not overwhelming or controlling your life in a negative way." The purpose of this study was to better understand the perspectives of people with SCI and the factors that may determine the extent of how manageable pain is. We compared demographic, pain-related factors, and pain impact on life between those who perceived their pain to be manageable every day and those who did not have any or only a few days per week of manageable pain. Design/Methods: The data presented in this study is a subset of a larger mixed-method study involving 29 people with SCI who experienced moderate to severe neuropathic pain and their perceptions regarding their participation in a pain program including pain education, exercise, and bodily illusions. Results: Thirteen participants reported having manageable pain (HighMP) every day, and 16 participants reported having between 0 to 4 days per week with manageable pain (LowMP). It was significantly (p=0.02) more common to have tetraplegia (53.8%) than paraplegia (12.5%) in the HighMP group. The HighMP group also tended (p=0.06) to have been injured longer than those in the LowMP group, possibly suggesting that participants acquire new skills to deal with pain over time. With respect to pain-related variables, we found that the HighMP group had significantly less severe burning pain (2.7±3.7 vs 5.7±3.8) than the LowMP group. Similarly, pain severity and life interference scores were significantly lower, and life control was significantly higher in the HighMP group compared to the LowMP group. Specifically, pain interference with sleep was significantly (p=0.007) higher in the LowMP group (7.0±2.9) compared to the HighMP group (3.1±3.6). Consistent with this, The LowMP group rated their difficulty in dealing with pain significantly (p=0.017) higher (7.13±2.3) than the HighMP group (4.15±3.6). Conclusions: Our results indicate that manageable pain after SCI is determined by several factors including the severity and quality of pain as well as how pain interferes with life (i.e., sleep). It is likely that other factors not assessed in this study, such as access to care and knowledge about pain, also strongly influence the ability to achieve manageable pain. Because neuropathic pain is rarely completely ameliorated, a better understanding of the factors that contribute to manageable pain is critical to improved quality of life after SCI. Support: CDMRP #SC200152

Learning Objective 1 Discuss manageable pain after SCI.

Learning Objective 2 Discuss the factors that contribute to manageable pain after SCI.

Learning Objective 3 Discuss how a better understanding of manageable pain may lead to greater QoL after SCI.

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Balance Between Spinothalamic and Lemniscal Tract Preservation As A Crucial Aspect In Neuropathic Pain Development After Spinal Cord Injury

Abstract 126

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Objective Neuropathic pain (NP) is a frequent complication following spinal cord injury (SCI). Several predisposing factors are being discussed, among them different preservation of the main ascending sensory tracts – the spinothalamic and lemniscal tract. Within the International Standards for Neurological Classification of SCI (ISNCSCI), the respective tract integrity is reflected by results of the pin prick (PP) and light touch (LT) examination, respectively. In the European Multicenter Study about SCI (EMSCI), ISNCSCI is assessed at different points in time during the first year post-injury. Furthermore, a pain questionnaire comprising the International Spinal Cord Injury Pain Classification (ISCIP) has been methodologically implemented. The aim of this study is to determine, whether a specific pattern of sensory tract preservation, reflected by the PP and LT examination, is related to neuropathic pain presentation in the subacute/chronic stage post-SCI (≥6 months). Design Analysis of prospective, multicentric collected data within EMSCI. The “early” ISNCSCI (24.5± 6.9 days post-SCI) and the “late” pain assessment (307.4± 115.2 days) were analyzed. Individuals suffering from at- and/or below-level NP according to the ISCIP classification were compared to those without. The percentage of preserved LT and PP scores below the neurological level of injury (1 segment below NLI to S4-5, in relation to the total achievable score) was determined. Additionally, the proportion of sensory preservation was calculated as normalized difference (LT-PP/(LT+PP); range -1 to +1). Subgroup analyses (complete/incomplete) were also conducted. Results The final analysis included 227 datasets of individuals with traumatic or ischemic SCI (82x AIS A, 25x B, 25x C, 76x D, 19x missing). The NLI ranged from C1 to L4 and a total of 64 individuals presented with NP (31x below, 28x at level, 5x both). No significant difference could be found between the NP and the non-NP group in respect to LT (NP group: median (M) 45.31, n=60; non-NP group: M 47.60, n=90; p=0.71) or PP preservation (NP: M 12.37, n=62; non-NP: M 5.90, n=90; p=0.09). However, in participants with incomplete SCI, PP was significantly more preserved in the NP group (NP: M 50.00, n=37; non-NP: M 34.00, n=53; p=0.05*). For the whole cohort, a significant normalized difference was observed favoring relative PP preservation in the NP (M 0.18, n=58) versus the non-NP group (M 0.33, n=87, p=0.02). A similar trend towards relative PP preservation was found in participants with complete SCI (NP: M 0.20, n=22; non-NP: M 0.50, n=34; p=0.06). Discussion & Conclusion Preservation of the spinothalamic tract is associated with NP presentation ≥6 months post-SCI. This is confirmed by own unpublished preclinical data, which also indicate preservation of the spinothalamic tract more frequently seen in SCI mice with pronounced pain behavior. Whether the spinothalamic tract acts only as the mediating pathway of pain initiating signals originating elsewhere has yet to be determined. The analyses, along with differences comparing sensory complete to incomplete individuals, require further investigation and, concerning the subgroups, larger sample sizes. Funding Deutsche Forschungsgemeinschaft (SFB 1158), EMSCI network.

Learning Objective 1 Analysing ISNCSCI parameters associated with neuropathic pain development

Learning Objective 2 Interpretation of light touch and pin prick preservation below the NLI

Learning Objective 3 Discussing spinal tract integrity in the context of neuropathic pain

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The Synergistic Effect of Acute TBI And SCI on The Development of Chronic Pain: A Populational Cohort Study on 2389 Patients in Québec, Canada

Abstract 265

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

Background: It is now well established that the occurrence of a concomitant traumatic brain injury (TBI) can have detrimental impacts on the recovery and community reintegration of patients with spinal cord injuries (SCI). Individually, these two conditions are also associated with the development of chronic pain. Unfortunately, impact of concomitant TBI on the development of chronic pain in SCI patients has never been specifically examined. We hypothesize that a concomitant TBI increases chronic pain in SCI individuals. Methods: A retrospective observational cohort study on 2389 neurotrauma patients from three prospective governmental populational databases was conducted. The main independent variable was the nature of neurotrauma sustained: SCI only vs. concomitant TBI-SCI. The main outcome was the development of chronic pain between 3 months to 8 years following the initial accident. Secondary outcome measures were receiving a formal diagnosis of chronic pain, using significant amounts of opioids, and receiving a referral to a chronic pain clinic. Results: Out of the all the included patients, 1528 had TSCI only (64.0%) and 861 (26.0%) had concomitant TBI-SCI diagnosis. Patients with concomitant TBI tended to be younger and were more likely to be male, to have suffered a motor vehicle collision ($p<0.001$), and to have sustained a trauma of higher severity. Chronic pain occurred in 11.2% and 17.3% of SCI only and concomitant TBI-SCI patients, respectively At the multivariate level, the nature of neurotrauma sustained was significantly associated with all the studied outcomes. In all cases, concomitant TBI-SCI was associated with increased odds of having a poor outcome when compared to patients with SCI/TBI only. Finally, a synergistic effect between SCI and TBI was confirmed for the main outcome (OR 1.67; $p<0.001$) and the use of opioids (OR 1.92; $p<0.001$). Conclusion: Problematic chronic pain is frequent following TSCI. This study supports a synergistic effect of TBI and SCI for the development of problematic chronic pain. Prompt identification of patients with concomitant TBI should be prioritized to minimize the development of chronic pain and reduce long-term opioid consumption.

Learning Objective 1 Review the incidence of chronic pain after SCI

Learning Objective 2 Discuss the impact of concomitant TBI on the development of chronic pain

Learning Objective 3 Evaluate possible solutions to reduce chronic pain after SCI

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Trial of Early Intervention with Transcutaneous Electrical Nerve Stimulation for The Prevention of Neuropathic Pain After Spinal Cord Injury

Abstract 168

Elizabeth Felix, PhD, University of Miami Miller School of Medicine

Objective: Following SCI, approximately 50% of individuals will develop chronic neuropathic pain (NeuP), which can greatly impact well-being and is notoriously refractory to treatment. A preemptive analgesic approach, aimed at preventing the establishment of the abnormal central nociceptive processing associated with the onset and maintenance of chronic NeuP, may be a promising avenue for reducing this negative consequence of SCI. Thus, the purpose of this study was to test the ability of transcutaneous electrical nerve stimulation (TENS) to reduce the onset and/or severity of NeuP after SCI. Design/Methods: A randomized, blinded, controlled trial was conducted (NCT03267810). Participants were at least 18 years old, had a traumatic SCI, and were within 4 months of injury. Participants were scheduled to receive 16 sessions across 8 consecutive weeks. They were randomized into the Treatment TENS arm (Treat), including a 15-min period of high-frequency TENS (80Hz pulse frequency, 200µsec pulse duration) and a 15-min period of low-frequency TENS (4Hz, 200µsec), or the Sham TENS arm (Sham), including approximately 30 secs of suprathreshold stimulation at the start of the period which was then reduced to 0 amplitude for the remainder of each 15-min period. Four electrodes were used for stimulation, with two pads affixed paraspinally, at or one level above the level of injury, and two pads affixed on the ventral side to areas corresponding to the same dermatome. At the baseline, pre-treatment visit, demographic information and assessments of pain symptoms (if present) were collected, and injury characteristics were extracted from medical records. Primary pain outcome metrics at 12-mo post-injury included: the presence of NeuP at or below the LOI (based on a score of ≥ 2 on the Spinal Cord Injury Pain Index (SCIPI) and based on expert diagnosis) and total score on the Neuropathic Pain Symptom Inventory (NPSI). Statistical comparisons were made between the Treat and Sham groups for each of these outcome measures using non-parametric tests. Results: Twenty-six individuals were enrolled and randomized to one of the treatment arms (Treat: n=13; Sham: n=13), with no significant differences in age, sex, race, or ethnicity. There was no significant difference in percentage of individuals who had NeuP at 12-months post-SCI between the Treat and the Sham study arms based on SCIPI cut-off scores for NeuP (Treat: 31%; Sham: 46%) or based on expert diagnosis of NeuP (Treat: 46%; Sham: 54%). Severity of NeuP symptoms (NPSI total score) at the 12-month endpoint were also not significantly different between the groups when considering all subjects (Treat median: 23; Sham median: 14) or when only considering those with diagnosed NeuP (Treat n=6, median: 34.5; Sham n=7, median: 18). Conclusion: The results of this clinical trial did not support the effectiveness of an 8-week TENS protocol initiated within four months of SCI for the prevention of chronic NeuP. However, the failure to reach the target enrollment numbers caused the study to be underpowered, and the current lack of evidence regarding optimal dosing and timing of TENS intervention for this indication warrants additional study of this low-risk, nonpharmacologic strategy to mitigate chronic NeuP in SCI.

Learning Objective 1 Describe the incidence and impact of neuropathic pain in people with SCI

Learning Objective 2 Describe the methods used to study the effect of TENS on the prevention of neuropathic pain in people with SCI

Learning Objective 3 Discuss results showing limited effectiveness of an 8-week course of TENS treatment to mitigate the development and severity of neuropathic pain at 12 months post-SCI

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Changes of Pain Cortices in Adults with Chronic SCI: The Underpinnings of the Resting State BOLD fMRI

Abstract 255

Abdulaziz Alhussein, BA, Sidney Kimmel Medical College of Thomas Jefferson University

Introduction: SCI can contribute to the development and intensification of neuropathic pain. 53% of SCI patients suffer from chronic neuropathic pain that can severely impact their quality of life. Our study aims to investigate pain-related brain regions that might be disturbed after SCI through using rsfMRI in SCI patients, comparing those with pain to SCI patients without pain and healthy controls. We hypothesized to detect significant, bilateral alterations in the connectivies seen in SCI patients with pain compared to the other groups and vice versa. M&M: Rs-fMRI data were obtained for 4 SCI patients with pain, 6 without pain, and 18 injured healthy controls. These data were preprocessed using DPABI, V5.1_201201 based on SPM12-2 running on MATLAB R2020b. The resting state quantitative measures (Amplitude of Low Frequency Fluctuation (ALFF), fractional ALFF (fALFF), Degree of Centrality (DC), Regional Homogeneity (ReHo), and Voxel-Mirrored Homotopic Connectivity (VMHC)) were used to assess each subject's pain neural activities of their brain. A total of 46 Regions of interest (ROIs) were selected from the human brain atlas of pain. The differences between the three groups were investigated through linear regression analysis using age and gender as confounding variables. The results were corrected for multiple comparisons by False Discovery Rate (FDR) correction. Significance levels were set to 0.05. Results: Different degrees of global and local reconfigurations within the pain NeuroMatrix have been detected between the groups. These alterations were bilateral for all regions and mainly focused on areas in the motor, sensory, and insular cortices. VMHC and ReHo were most sensitive to representative organization of the pain cortices. Regions that demonstrated significance were: Supplementary Motor Cortex, Mediodorsal Thalamic Nucleus, Intralaminar Thalamus, Ventral Posterolateral Nucleus, Anterior Cingulate Cortex, Poster Cingulate Cortex, Basal Ganglia, Hippocampus, Hypothalamus, Periaqueductal Grey, Orbitofrontal Cortex, and Middle Short Gyrus. Conclusion: Our findings showed significant changes in regional neural activity and functional connectivity in SCI patients with and without pain. This classification could offer insights into the complex mechanisms of pain, identify biomarkers for pain profiling, and improve treatment approaches.

Learning Objective 1 Discuss theory and technique of BOLD fMRI

Learning Objective 2 Elaborating on the use of fMRI in detecting changes in the brain of SCI patients

Learning Objective 3 Explaining how SCI impacts pain cortices in neuropathic and non-neuropathic patients

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Neuropathic Pain in Patients with Spinal Cord Injury

Abstract 228

Johnny Barona Velez, MD, Universidad del Valle

Objective: The global annual incidence of traumatic spinal cord injury is 10.5 cases per 100,000 people [1]. In Colombia, the average annual incidence is 56.7 cases per million [2]. Spinal cord injury is often linked to the development of chronic neuropathic pain that is difficult to control [3]. In a systematic review and meta-analysis conducted in high-income countries, the prevalence of neuropathic pain in spinal cord trauma was 53% [4]. From the medical point of view, it is of utmost importance to identify factors related to this outcome both at the time of injury and in the early stages, in order to anticipate therapeutic approaches [5]. Design/Methods: Cross-sectional study with retrospective collection in which the medical records of all patients registered in the spinal trauma program of a tertiary level hospital in southwestern Colombia from 2015 to 2022 were reviewed. In addition to collecting demographic data, the cause of trauma, level of injury, associated injuries, presence of urinary tract infections, pressure ulcers, heterotopic calcifications, autonomic dysreflexia, degree of spasticity, bone deformities, pharmacological treatment, use of orthoses and multidisciplinary approach, as well as the interventions of the rehabilitation team were recorded. Bivariate analysis and simple and multivariate logistic regression were performed in Stata 15 to identify associations between conditions present in the group of patients with spinal cord trauma and neuropathic pain. Results: A total of 556 patients were registered. Of these, 340 had neuropathic pain below the level of injury, 90% were male and approximately 60% were young adults. Interpersonal violence was identified as the main cause of injury (232 cases). The distribution of injury levels showed a similar prevalence in various segments, with a predominance in the thoracic region (T7-T12). In patients with neuropathic pain, 64.7% had a complete spinal cord lesion. Among the conditions that showed statistical significance were the increase in the degree of spasticity, associated lesions, especially visceral, vascular and extremity lesions, as well as proinflammatory states related to urinary infections and pressure ulcers (OR 2.3 CI95% 1.4-5.8; $p<0.05$). Conclusions: Difficult-to-manage neuropathic pain is frequently associated with spinal injuries. In this study, it was shown that greater systemic involvement with concomitant injuries at the time of injury is associated with an increased likelihood of neuropathic pain. During the early stages of spinal injuries, the presence of proinflammatory states such as urinary tract infections and pressure ulcers also showed a relationship with neuropathic pain. As expected, the degree of spasticity correlated directly with the likelihood of neuropathic pain.

Learning Objective 1 Describe the epidemiological characteristics of patients with SCI

Learning Objective 2 Define the clinical features associated with SCI.

Learning Objective 3 Discuss the possible association between clinical conditions associated with SCI and neuropathic pain.

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Empowering Parental Caregivers: An investigation of a pilot program

Abstract 213

Elena Martino,BS Health Sciences, OTD Candidate, Duquesne University

Objectives: Parents of children with spinal cord injury or disorder (SCI/D) face a variety of mental and physical challenges after their child sustains the injury or is diagnosed with a disorder. Occupational therapists (OTs) play an essential role in caregiver training during the rehabilitation phase, and increasingly OTs are involved in caregiver supports when families reintegrate into the community (Rouch et al., 2021). This pilot study investigated the potential of an OT-facilitated seven-week online support group with problem solving training on the psychosocial wellbeing of parental caregivers of children with SCI/D. Design/Methods: The study used a single group pre-test/post-test quantitative design. A convenience sampling method required potential participants to meet the following criteria: 18 years or older, a parent or guardian of a child with a SCI/D, and be that child's primary caregiver. The virtual group was designed to establish an online community of parents of children with SCI/D using a pre-existing platform with a population-specific non-profit organization. Meetings involved client-chosen topics with problem-solving training using the facts, optimism, coping, understanding and solve (FOCUS) model (APA, 2011). This approach was selected as it could assist parents in working through a variety of caregiver challenges. Quantitative measures used in the study included the Brief COPE, the Caregiver Self-Assessment Questionnaire (CSAQ), a research-team developed Knowledge Check, and the Client Satisfaction Questionnaire-8 (CSQ-8). All measures except the CSQ-8 were administered both pre and post group participation. Implementation data including topics of importance, attendance, and midway feedback were also collected. Pre/post data was analyzed using descriptive statistics due to the preliminary nature of the investigation. Results: Five participants completed the students. All were mothers of children with SCI/D, identified as women, and were white/Caucasian. All their children were male with a median age of injury onset being 19 years. Four out of five participants demonstrated a median increase in percentage score of 40% on the Knowledge Check. Increased response accuracy was noted in the areas of problem solving techniques and steps to improve skin integrity. On the CSAQ, 4/5 participants demonstrated a decrease in the stress sub-scale scores, although similar changes were not observed on other sub-scales. On the Brief COPE, 3/5 individuals demonstrated an increase in problem-focused coping strategies and all individuals either decreased avoidant coping strategies or stayed the same, yet none of these changes were greater than the minimal detectable change. All participants rated high satisfaction with the program on the CSQ-8 (average score 31.2/32). Conclusions: This pilot-study provides preliminary data on an OT-led problem-solving based support group for parents of children with SCI/D. It highlights the potential for parent-focused support and training in an online group format that could be delivered post-discharge from direct therapy services. Given the high satisfaction of participants and the trends observed in the outcome measures, further development, and study of interventions like this is warranted.

Learning Objective 1 Describe the role of occupational therapy in caregiver training

Learning Objective 2 Assess the impact of a virtual support group on psychosocial wellbeing of caregivers

Learning Objective 3 List FOCUS problem solving strategy steps utilized in empowering parental caregivers program

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Development of a Mobile Application for Patients with Spinal Cord Injury

Abstract 226

Johnny Barona Vélez,MD Universidad del Valle

Objective To describe the process of developing a mobile application designed for patients with spinal cord injury (SCI). The application will consist of two modules, one for consultation and the other for education, aimed at providing information, assessment, and support for managing this medical condition. Design and Methods Development Phases 1. Module Design: An initial phase will involve designing the interfaces and structures of the consultation and educational modules in collaboration with experts in user experience and education. 2. Alpha Versions Development: Alpha versions of the modules with basic functionalities will be created. 3. Alpha Testing: Internal testing will be conducted to identify errors and make necessary adjustments. 4. Beta Versions Development: Module functionalities will be expanded, and beta versions will be created for testing with a group of patients. 5. Beta Testing: Beta version testing will be carried out with a group of patients who will provide feedback. 6. Adjustments and Improvements: Adjustments and improvements will be made based on patient feedback. Consultation Module Description: The consultation module will allow patients to complete a questionnaire related to aspects of SCI. Each section of the questionnaire will evaluate and record relevant data about the patient's condition in the following areas: complementary exams, genitourinary tract, gastrointestinal tract, pain, spasticity, autonomic dysreflexia, bone health, sexual health, skin, mental health, rehabilitation, orthotic devices, and mobility assistance. Key Features: 1. Questionnaires. 2. Periodic data recording. 3. Alerts and notifications. 4. Intuitive interface. Educational Module Description: Educational resources for patients, including informative videos about common pathologies related to SCI, self-care measures, activities of daily living training, assistive devices, and mobility assistance devices. Key Features: 1. Categorized library of educational videos. 2. Downloadable educational materials. 3. Interactive exercises. Outcome A mobile application for patients with SCI. The application is expected to provide relevant information, tracking tools, and educational resources to facilitate the rehabilitation process, self-care, and improve the quality of life of patients. Conclusions The development of this mobile application represents an advancement in the healthcare of SCI patients. The combination of consultation and educational modules has the potential to facilitate self-care, medical monitoring, and patient education, contributing to better management of this condition. The project will be carried out by the Research Group GIRUV (Grupo de Investigación en rehabilitación de la Universidad del Valle).

Learning Objective 1 Describe the development of an application for the use of patients with SCI

Learning Objective 2 Assess the role of technologies in the self-care of patients with SCI

Learning Objective 3 evaluate the perception of patients regarding the management of their health through mobile applications

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Perceptions of Photovoice as a Virtual Fall Prevention and Management Intervention After Spinal Cord Injury

Abstract 133

Katherine Chan, MSc, KITE-Toronto Rehabilitation Institute, University Health Network

Objective: Over two-thirds of wheelchair users living with spinal cord injury (SCI) experience at least one fall each year, resulting in negative physical and psychosocial consequences. One consequence is a fear of falling, often leading to reduced mobility, restricted participation and loss of autonomy. There is a need for evidence-based interventions that improve falls self-efficacy to address the high fall risk and fear of falling, which are common after SCI. Photovoice, a participatory method that combines photographs and dialogue to share knowledge and experiences, was developed into a virtual intervention to improve falls self-efficacy. The objective of this study was to explore the experiences with, and perceptions of, photovoice as a virtual fall prevention and management intervention for wheelchairs users with SCI. Methods: Individuals living with chronic SCI who used wheelchairs as their primary means of mobility participated in a six-week, virtual photovoice intervention. The intervention consisted of two photo-assignments, two meetings with a peer mentor and four group discussions (8-9 participants/group). Three months post-intervention, participants completed a semi-structured interview with a researcher not involved in intervention delivery. Participants were asked open-ended questions related to their experience with the photovoice intervention. Interviews were audio-recorded and transcribed verbatim. A thematic analysis was applied. Results: Seventeen individuals aged 49±11.5 years participated (4 women, 13 men). Participants were 18.9±16.4 years post-SCI (6 non-traumatic, 11 traumatic) and seven participants had incomplete injuries. One overarching theme was identified: the virtual photovoice intervention was an opportunity to reflect on strategies to manage fall risk, but was not perceived to prevent falls. Three sub-themes were identified. 1) Exchanging knowledge and experience is beneficial: The intervention provided participants with an enjoyable opportunity to help others, as well as discuss fall prevention topics that were new to them. Some participants found it challenging to share experiences through photography, while others found the photo-assignment facilitated discussion by reducing the stigma associated with having a fear of falling. 2) Photovoice encourages self-reflection, but does not prevent falls: Participants described the intervention as prompting self-reflection and increasing awareness of fall risk. Some participants reported reducing risk-taking behavior post-intervention, but photovoice was not perceived to prevent falls. 3) Considerations for delivery of a photovoice intervention: All participants acknowledged that virtual delivery facilitated participation by eliminating the need to travel and enabled participants from a large geographical area to connect. However, an in-person component may have facilitated stronger connections between participants. Conclusion: A virtual photovoice intervention focusing on falls self-efficacy was viewed positively by wheelchair users with SCI. The intervention encouraged self-reflection and knowledge sharing on fall risk, but was not perceived to prevent falls.

Learning Objective 1 Define photovoice as a virtual intervention for fall prevention

Learning Objective 2 List the overarching theme and subthemes of participants' experiences with and perceptions of photovoice

Learning Objective 3 Utilize photovoice as an intervention for fall prevention and management for people living with spinal cord injury

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Effects of Lactobacillus rhamnosusGG Bladder Wash versus Saline Bladder Wash on Urinary Function and Bladder Symptom Burden in Intermittent Catheter Users: Preliminary Results

Abstract 243

Emily Leonard, PhD, Medstar Health Research Institute

Background: Among individuals with neurogenic bladder (NB) due to a spinal cord injury or disease (SCI/D,) urinary tract infections (UTI) are a frequent, recurrent condition that presents unique challenges to treatment and prevention. Among this population, UTI's are the most common cause of infection, emergency room visits and hospitalizations. Thus, using a proactive approach to UTI prevention would greatly benefit this population. Preliminary studies on intravesicular Lactobacillus rhamnosusGG (LGG®), a live biotherapeutic product (LBP), suggest it may be safe and effective in resolving pre-UTI symptoms and potentially decreasing bladder and urine quality symptom burden as defined by the Urinary Symptom Questionnaire for Neurogenic Bladder-Intermittent Catheterization (USQNB-IC) in this population. Objective: Compare the prophylactic effects of LGG + saline bladder wash (BW) versus saline BW on bladder function (B1) and urine quality (B2) symptom burden as defined by the USQNB-IC. Design/ Methods: This randomized control trial included individuals with NB due to a SCI, Multiple Sclerosis (MS) or Spina Bifida (SB) and use an intermittent catheter (IC). Prior to treatment, participants completed weekly USQNB-IC surveys to report B1 and B2 symptoms until experiencing cloudier and/or smellier urine (trigger symptoms) on 2 separate occasions. Participants were then randomized to LGG + saline BW group or saline group. During prophylaxis, once participants reported a trigger symptom, participants completed a first instillation, waited 72 hours, completed a second instillation, then continued to instill every 3 days for the remainder of the 6 months. Participants continued to complete USQNB-IC surveys after each instillation. Baseline and prophylactic symptom burden was calculated by categorically tallying total endorsed symptoms and dividing by the total possible symptoms of that category. Average burden was then determined by subtracting prophylaxis burden from baseline burden and averaging by group. A higher symptom burden indicates that the individual was more symptomatic. Results: Three participants were randomized into the LGG + saline group (1 female) and the saline group (2 females). Baseline burdens for subject 1 (LGG group) were B1= 0.14 and B2= 0.33 and prophylaxis burdens were B1= 0.06 and B2= 0.06. Baseline burdens for subject 2 (saline group) were B1= 0.14 and B2= 0.33 and prophylaxis burdens were B1= 0.07 and B2= 0.39. Baseline burdens for subject 3 (saline group) were B1= 0 and 0.26 and prophylaxis burdens were B1= 0.03 and B2= 0.24. The average change from baseline to prophylaxis in B1 symptoms was -0.08 for the LGG group and -0.05 for the saline group. The average change from baseline to prophylaxis in B2 symptoms was -0.27 for the LGG group and -0.04 for the saline group. Conclusion: Results from this small sample of the study indicate that both groups experienced improvement in both bladder and urinary symptom burden, but the LGG treatment was more effective when used as a prophylactic treatment. Further analyses will be done on more participants later in the study.

Learning Objective 1 Discuss the depth of the problem of UTI within this population.

Learning Objective 2 List findings from previous studies utilizing the study drug.

Learning Objective 3 Discuss between-group results and what they may mean for this treatment.

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Passive Heat Therapy to Improve Cardiometabolic Health In Persons with a Spinal Cord Injury – A Case Series

Abstract 144

Sven Hoekstra, PhD, University of Texas Health Science Center at San Antonio

Objective: Passive heat therapy, by means of hot water immersion or sauna bathing for example, has been shown beneficial for vascular, glycemic and inflammatory outcomes in able-bodied individuals. However, the feasibility and efficacy of passive heat therapy in persons with spinal cord injury (SCI) has not been studied and may diverge because of the reduced heat tolerance found in this population. In this case series we report descriptive data on the tolerability of passive heat therapy, and its effect on cardiometabolic outcomes in three individuals with SCI. Design/Methods: Three adults with SCI (1 female, age: 43 (30 – 60) yrs, BMI: 29 (27 to 30) kg/m2, years since injury: 8 (1 – 11) yrs, lesion level: T5 – T11) enrolled in an 8-week passive heat therapy intervention consisting of 24 session during which the oral temperature was elevated by 1°C by means of a water-perfused suit and heating blankets. The number of completed sessions, time to reach the desired oral temperature and adverse events were reported. Thermoregulatory and perceptual responses to a single passive heat therapy session were assessed during the first session of the intervention. Fasting interleukin-6 (IL-6), C-reactive protein (CRP) and glucose concentration were determined in plasma. Data are expressed as median (range). Results: The median time to reach a 1°C increase in oral temperature during passive heating was 69 (49 – 75) min, which was accompanied by a final mean skin temperature of 38.7 (36.5 – 38.9)°C, a thermal sensation of 9 (8 – 9) on a 1 to 9 ratings scale and a basic affect of +3 (+1 - +4) on a -5 to +5 rating scale. Two out of the three participants completed all prescribed passive heating sessions. However, 10 and 2 sessions out of the 24 were stopped after an oral temperature increase of 0.8°C due to thermal discomfort experienced by two participants. The third participant had to stop the intervention after 18 sessions due to an adverse event unrelated to the intervention. Resting IL-6 and CRP changed from 3.2 (2.7 – 10.5) pg/ml to 8.1 (7.6 – 11.1) pg/ml and 0.40 (0.14 – 1.16) to 1.11 (0.51 – 1.26) pg/ml, respectively. Fasting glucose was changed from 86 (85.5 – 90) mg/dl to 94.5 (69 – 101) mg/dl. Conclusion: These preliminary findings of a novel, accessible health promoting intervention suggest that it may be feasible and safe for persons with SCI to engage in repeated heat therapy, but that modifications to the thermal load may need to be considered to ensure intervention adherence. A full data set of this ongoing study is needed to provide more conclusive insight into its effects on cardiometabolic health outcomes.

Learning Objective 1 List the potential beneficial effects of passive heat therapy on cardiometabolic health outcomes

Learning Objective 2 Describe how the preliminary study findings in persons with spinal cord injury presented here compare to previous studies investigating able-bodied individuals

Learning Objective 3 Describe through which physiological mechanisms passive heating may improve cardiometabolic health outcomes

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Understanding The Impact of Screening Location on Depressive Symptom Scores Among Acute Traumatic and Non-Traumatic Patients With Spinal Cord Injury

Abstract 112

Ramya Gopalan, MS, MPH, Santa Clara Valley Medical center

Background: It is estimated that 20-38% of individuals with a new spinal cord injury (SCI) will show significant depressive symptoms during their inpatient rehabilitation stay. The levels of depressive mood symptoms may vary among individuals undergoing inpatient rehabilitation as several factors related to the recent injury and hospitalization, such as sleep, fatigue, nutrition, and support, can influence depressive symptom scores. Post-discharge, individuals may face additional challenges with coping and psychological adjustments related to community reintegration that can potentially exacerbate depression risk. Understanding how depressive symptoms change across settings can be valuable in planning standardized mental health screening strategies to identify patients that may be at risk for depression. Objective: To compare PHQ-9 (Patient Health Questionnaire-9) scores among participants with acute spinal cord injury (SCI) screened during their inpatient-rehabilitation stay and participants screened at home following discharge. Design/Methods: Eighty-three acutely injured traumatic and non-traumatic SCI participants were screened for eligibility to participate in a telepsychology clinical trial using the PHQ-9. Screening for depressive symptoms occurred in-person during the acute inpatient rehabilitation stay or over the phone after discharge at home, within the first year of injury. Main Outcome Measures: PHQ-9 scores, suicide ideation (SI) measured using PHQ-9 (Q.#9) Results: Fifty-eight individuals (67% male; 55% with paraplegia; 58% with traumatic injuries; average age 52±19.2) were screened using the PHQ-9 during their inpatient rehabilitation stay while 25 participants (68% male; 44% with paraplegia; 48% with traumatic injuries; average age 47±19.9) were screened post-discharge in their homes. The average PHQ-9 total score was significantly higher for the group screened at home (9.1+5.8), compared to those screened at the hospital (6.8±4.8); p=.03. Additionally, 24% of the participants screened at home had PHQ-9 scores greater than 15 (indicative of moderately severe or severe depression) compared to 8.6% in the group screened at the hospital. Furthermore, 15.3% of individuals who were screened at home endorsed SI compared to 3.4% screened at the hospital ($\chi 2$= 4.1, p=.04). The duration of injury at screening, although significantly different for the home and hospital groups (97±60.3 and 46±36.8 days, respectively, p<.001), showed weak linear correlation with PHQ-9 scores, (r(81)=0.17,p=.058) across the whole group. Conclusions: In this sample, acutely injured individuals screened at home exhibited increased depressive symptom scores and higher rates of SI endorsement compared to those screened during inpatient rehabilitation. Understanding how and why depressive symptoms change from an inpatient to community setting can inform planning of targeted interventions as well as better prepare newly injured individuals and their families. Future investigations should additionally advocate greater mental health screenings post-discharge, to ensure that the risk of depression and SI do not go unrecognized in the community and appropriate support and resources are made available. Funding Source: Department of Defense Award#: W81XWH-18-1-0254

Learning Objective 1 Discuss the importance of mental health screening among individuals with acute SCI .
Learning Objective 2 Differentiate depressive symptom scores between individuals screened at home and rehabilitation settings.
Learning Objective 3 List key confounders contributing to differences in PHQ-9 scores

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Bladder and Bowel Dysfunction, Cognitive Appraisals of Disability, and Life Satisfaction in Individuals with Pediatric-Onset Spinal Cord Injury

Abstract 124

Olivia Clark, MA, Loyola University Chicago

Objective: Individuals with pediatric-onset spinal cord injury (SCI) may face medical, physical, and psychosocial complications that necessitate daily medical tasks. Bladder and bowel dysfunction have been identified as particularly salient aspects of life following SCI, causing distress and disruption to social functioning. For individuals with pediatric-onset SCI in particular, bladder and bowel problems are typically persistent across the lifespan. Cognitive appraisal of one's disability, an individual's assessment and interpretation of their injury/disability, its significance, impact, and their ability to cope with it, has demonstrated associations with life satisfaction and daily functioning. Efficient bladder and bowel management and positive cognitive appraisals may be protective against poor life satisfaction in the context of pediatric-onset SCI. Design/Methods: As part of a larger study examining outcomes of individuals with pediatric-onset SCI, 180 adults who had sustained an SCI at or before age 18 and received treatment at a pediatric rehabilitation hospital system in North America completed telephone interviews. Participants were 55.6% male, 83.3% white, 38.6 years old on average at time of interview, 13.05 years of age at time of injury, 66.1% had a complete injury, and 51.1% had an SCI resulting in paraplegia. Participants completed study-specific surveys regarding demographic and medical complication information, including information pertaining to bladder and bowel dysfunction and management. Cognitive appraisals of disability were assessed via self-report on the Appraisals of DisAbility Primary and Secondary Scale – Short Form (ADAPSS-sf). Participants also completed the Satisfaction with Life Scale (SWLS). Multivariable linear regression models using bowel program duration and cognitive appraisals as predictors of life satisfaction were conducted. Results: Few participants reported bladder and bowel accidents, in line with extant literature suggesting generally satisfactory bladder and bowel management in adults with pediatric-onset SCI. Bivariate correlations suggest that increased frequency of bladder accidents and increased bowel program duration are associated with negative appraisals of disability ($r=.19$ to $.22$, $p<.05$) and reduced life satisfaction ($r=-.17$, $p<.01$). Further, increased bowel program duration is associated with increased appraisal of growth and resilience ($r=.32$, $p<.001$). Multivariable regressions indicate that increased bowel program duration and negative appraisals of disability are associated with reduced life satisfaction in individuals with pediatric-onset SCI ($R2=.12$ to $.24$). Conclusion: Findings highlight links between bladder and bowel management, cognitive appraisals of disability, and life satisfaction in individuals with pediatric-onset SCI. Fostering efficient bladder and bowel management practices may be important in positive cognitive appraisals of one's disability and life satisfaction. Further, this study highlights the role of cognitive appraisals of disability in life satisfaction following injury. This has important clinical implications for the role of mental health providers in supporting cognitive appraisals following SCI.

Learning Objective 1 Highlight difficulties specific to individuals with pediatric-onset SCI.

Learning Objective 2 Discuss associations among bladder and bowel dysfunction and management, cognitive appraisals of disability, and life satisfaction in the context of pediatric-onset SCI.

Learning Objective 3 Examine predictors of life satisfaction in the context of pediatric-onset SCI.

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A Qualitative Study on The Impact of Oral Health on Quality of Life: The Lived Experience of People With SCI

Abstract 89

Jennifer Coker, PhD, MPH, Craig Hospital

Objective Oral health is a global concern to overall health and well-being. The definition of oral health recognizes that poor oral health is related to physical and psychological health and social well-being. Realities of living with SCI, which include functional limitations, an increased risk for secondary health conditions, and barriers to accessing care may impact the ability of people with SCI to maintain oral health and receive adequate oral healthcare. Poor oral health also impacts quality of life (QOL) by causing pain that affects appetite, eating, and sleeping. Additionally, having missing and broken teeth can decrease social engagement as people tend to avoid conversation, smiling, laughing, and intimacy, which can increase depression and anxiety. The purpose of this study was to explore the oral health lived experience of people with chronic SCI and the impact of oral health on their QOL. Methods Following Institutional Review Board approval, focus group participants were recruited via emails and social media postings. Four focus groups with a total of 26 participants with SCI were conducted via web conference. Using the perspective of grounded theory, focus group transcripts were independently coded by the authors and consensus on themes was reached. Results Focus group participants were primarily male, non-Hispanic White, an average of 43 years old at the time of the study, an average of 11 years since injury, and most had cervical level injuries. Several themes emerged. Relevant factors in maintaining oral health included pre-injury oral health and health behaviors, oral health education and training during initial rehabilitation, and knowledge of and availability of insurance coverage. Oral health impacted QOL in several ways, including limiting social participation and smiling due to embarrassment because of yellowing, broken, and missing teeth. Increased tooth hypersensitivity after injury made brushing their teeth and seeing a dentist more painful. Anxiety about oral health was a major theme, with participants noting fear of going to the dentist, treatment costs and, especially for those who use their teeth as tools, breaking a tooth. Barriers to accessing care and maintaining oral health included finding dentists with accessible offices and equipment (or who could treat them in their wheelchairs), who took their insurance, and were knowledgeable about SCI-related conditions that could impact oral health (eg, dry mouth due to SCI medications). Management of SCI-related health issues was often a higher priority, yet most understood that oral health impacts their overall health. Conclusion Oral health is critical to overall health and oral disease can have persistent negative effects over a person's lifetime. These qualitative data are the first step to enable SCI health providers and dentists to deliver services more effectively to help people with SCI maintain or improve their oral health and maximize societal integration. Support Neilsen Foundation #857539

Learning Objective 1 Discuss the impact of oral health on general health

Learning Objective 2 List factors that impact oral health for people with SCI

Learning Objective 3 List ways in which oral health impacts quality of life for people with SCI

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Longitudinal Satisfaction with Life Among Individuals with Spinal Cord Injury: A Multilevel Multiple Indicator Multiple Cause Model

Abstract 241

Elizabeth Pasipanodya, PhD, Santa Clara Valley Medical Center

Objective: Little longitudinal work has examined satisfaction with life (SWL) among individuals with spinal cord injury (SCI) and, in this small corpus, findings are mixed. This study examines the trajectory of change in SWL and its predictors among individuals with chronic SCI. Design: Longitudinal observational study. Measures: Satisfaction with Life Scale, Patient Health Questionnaire-9 (PHQ-9), SCI Quality of Life Resilience, CDC Healthy Days Measure, Craig Handicap Assessment and Reporting Technique (CHART). Methods: Participants were 920 individuals with traumatic SCI at a SCI Model Systems center who completed Form II follow-ups with the SWLS. Confirmatory factor analyses modeled a one-factor model of SWL. Multilevel modeling examined change in SWLS factor scores over time. Rate of change in SWL was modelled as a random slope of SWL on duration of injury and differences in slope and in within- and between-person levels of SWL were examined by sociodemographic factors, injury characteristics, depressive symptomology, resilience, self-perceived health status, and degree of handicap due to disability (CHART). Results: A total of 2476 surveys (mean=2.7) were completed and spanned between 1 and 44 years postinjury (mean=18.16 [SD=12.28]years). Participants were mostly male (77%), non-Hispanic white (72%), and with tetraplegia (55%). A one-factor model of SWL fit the data well ($\chi 2[4]=60.307$, $p<.001$; CFI=0.987; RMSEA=0.075; SRMRwithin=0.016; SRMRbetween=0.0014). SWL increased over time ($\beta=0.018$, $p<.001$). Among demographic and injury characteristics examined, only age at injury was associated with SWL; those injured as older individuals had lower average levels SWL but had steeper increases in SWL over time. Controlling for age at injury, depressive symptomology, resilience, self-perceived health, and degree of handicap were associated with SWL. At both within- and between-person levels, depressive symptoms ($\beta=-0.144$, $p=.007$ and $\beta=-0.142$, $p<.001$, respectively) and poorer health ($\beta=-0.473$, $p<.001$ and $\beta=-0.698$, $p<.001$, respectively) were associated with lower SWL. This was such that on an occasion when a participant reported greater depressive symptoms or poorer health than their own average levels, they also reported lower SWL and, across individuals, greater levels of depression and lower levels of self-perceived health were associated with lower SWL. Conversely, at the between-person level, individuals with greater resilience had greater average SWL scores and steeper increases in SWL over time. Furthermore, on the CHART and at both within and between-person levels, greater physical independence ($\beta= 0.007$, $p=.007$ and $\beta= 0.010$, $p<.001$, respectively), mobility ($\beta= 0.015$, $p<.001$ and $\beta= 0.021$, $p<.001$, respectively), and social interaction ($\beta= 0.012$, $p=.002$ and $\beta= 0.023$, $p<.001$, respectively) were associated with greater SWL. Greater occupation levels on the CHART were associated greater between person levels of SWL ($\beta= 0.011$, $p<.001$). Conclusion: Examining life satisfaction over time and factors associated with better subjective wellbeing may help identify supports that are malleable to intervention. Evidence-based interventions that improve mood, behavioral activation, and health behaviors (e.g., cognitive behavioral therapy) may be efficacious.

Learning Objective 1 Discuss changes in subjective wellbeing over time in the context of aging with SCI.

Learning Objective 2 Identify factors associated with life satisfaction and potential intervention targets to improve subjective wellbeing among individuals with SCI.

Learning Objective 3 Appreciate the application of multilevel modeling for longitudinal data.

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Depression In Patients with Spinal Cord Injury

Abstract 198

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Objective: Spinal cord injury (SCI) can be a devastating trauma for the patient, as it is associated with high mortality and morbidity rates (1). It is estimated that between two and three million people in the world live with SCI-related disability (2). According to studies carried out in the main hospital center for trauma care in the city of Cali, Colombia, the first cause of TRM in 47.25% are interpersonal violence, followed with 33.6% by falls (3). In addition to the physical sequelae, there are psychological and mental health repercussions that can affect the quality of life and functionality of patients, including their survival (4). It is estimated that between 20% and 30% of people with SCI present clinically significant signs of depression (5). Our objective is to determine the prevalence of depression in patients with SCI treated in the Physical Medicine and Rehabilitation service of the medium and high complexity University Hospital of the city of Cali, in the period between July 2023 and December 2023. Design/Methods: Cross-sectional study with prospective collection in patients with SCI. Sociodemographic and clinical variables were collected with application of Whodas 12 to determine functional compromise and the PHQ9 scale for the prevalence of depression. This is a preliminary analysis of the first 14 participants of this cohort, since the research is still in the collection phase. A sample of 117 participants is estimated at the end of 2023. Results: In this population 79% of the patients were men, mean age 41.5±13.4 years, marital status 51% single, 28% married, 71% with secondary education, 57% unemployed. The neurological level was ASIA A in 78% of patients, the most affected segment was at the thoracic level in 64%. Pain was present in 85% of the population (VAS 5 in 43% of them), all of them receiving analgesic treatment. It was documented that more than 85% of the population was attending rehabilitation and the mobility device was a manual wheelchair in 71.43% of them. Sixty-four percent had spasticity; 78% were not sexually active. In relation to the presence of depression, 57% had mild depression, 14% had moderate depression and 28% did not have depression. The average score of functional compromise in the group was 28%±14% with a maximum score of 59% and a minimum of 8%.

Learning Objective 1 Illustrate the presence of depression associated with spinal cord trauma.

Learning Objective 2 Assess functional impairment in patients with SCI.

Learning Objective 3 Describe the possible association between functional impairment and depression in patients with SCI.

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Rehab In Rehab: A Prospective Analysis of The Effect of Substance Use Disorders on Inpatient Rehabilitation for Traumatic Spinal Cord Injury

Abstract 50

Shane Stone, MD, Kessler Rehabilitation Institute

Background: Investigators have determined that about 30% of patients with acute traumatic spinal cord injury (tSCI) have a comorbid substance use disorder (SUD). However, there is limited data on the impact this has on functional outcomes. Additionally, there has been limited inquiry into whether it is appropriate for patients to undergo rehabilitation for their SUD while completing their physical rehabilitation. The objectives of this project are to estimate the prevalence of SUD in the tSCI population at single, standalone acute inpatient rehabilitation center, to compare the rehabilitation outcomes of patients with and without SUD, to assess willingness for patients with SUD to undergo treatment for their disease, and to assess the hypothetical willingness of SUD patients who are open to treatment to receive treatment while in acute inpatient rehabilitation. Design: IRB approved prospective cohort study on inpatients with acute traumatic SCI at SRAlab. This is an interim analysis of 95 of the patients. Outcome measures include the proportion of patients with SUD (WHO and CRAAFT surveys), rehabilitation outcomes (Motor and Self Care QI Scores), and the proportion of patients with SUD ready for treatment (SOCRATES survey). Results: 21.05% (n=20) of patients met the criteria for SUD. Of those patients, 15% (n=3) were ready for treatment. 2/3 of patients ready for treatment were hypothetically interested in receiving SUD care during their rehabilitation stay. There was a greater average improvement in mobility and self-care scores in patients with SUD (30, 16.9 respectively), than those without (25.52, 12.31 respectively). However, when age is taken into consideration there is not a statistically significant difference in motor scores (p=0.423) nor self-care scores (p=0.113). Conclusion: The prevalence of SUD in patients with acute, traumatic SCI at a single, standalone acute inpatient rehabilitation center is similar to the prevalence in the literature. Since patients with SUD do not appear to have worse functional outcomes than those without SUD, they appear to be appropriate candidates for acute inpatient rehabilitation. At this time, it does not appear that patients with acute SCI are ready for treatment, though those who do may be interested in rehabilitation while in rehabilitation.

Learning Objective 1 Analysis data related to a a single center prospective study investigating the prevalence and rehabilitation impact of substance use disorder on patients with acute traumatic spinal cord injury during acute inpatient rehabilitation

Learning Objective 2 Assess the impacts of this data on rehabilitation for patients with acute traumatic Spinal cord injury

Learning Objective 3 Initiate conversation as to how these patients should be managed during acute inpatient rehabilitation

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Comparative Analysis Between Acute Phase And 30 Years of Evolution In People With Tetraplegia Due To Spinal Cord Injury: Clinical Cases

Abstract 67

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Introduction Having information on the passing of time in people with spinal cord injury can allow us to review and reconsider therapeutic approaches. This study presents three individuals with tetraparesis due to spinal cord injury, whose injuries date back to 1991 and 1992. All of them present ASIA A classification, at C4, C5 and C7 neurological levels. A comparative analysis was made between the acute phase and the situation at present. Method A survey was conducted consisting of 108 questions, supplemented with information from their medical records. The survey included 8 topics: Personal and injury data. Clinical and respiratory situation. Objectives and expectations regarding the paralysis. Rehabilitation received. Home care and orthotic equipment. Urinary and bowel management. Daily routines and nursing Work and social life. Results Their clinical status is good, with no hospitalizations in the last 5 years, and none of them receives respiratory rehabilitation or requires oxygen. They only have sporadic urinary infections, treated outpatient with antibiotics. Drugs are used for urinary problems, spasticity, anxiety, stomach and intestinal problems. They make medical interconsultations with urology, internal medicine and physiatry. All of them have had grade IV bedsores, but none have bedsores at present. All of them agree that their rehabilitation goals and expectations in the acute stage were focused on total recovery, walking again, and so dedicated their lives to rehabilitation. At present, the goals are personal and work related. Two are currently undergoing physical therapy and psychology. All have good standing tolerance, just one stands periodically. None of them has relevant muscular retractions, all of them present increased cyphosis, without the development of scoliosis.

Learning Objective 1 see what happens in a person after 30 years with spinal cord injury

Learning Objective 2 differences between the objectives of his rehabilitation 30 years ago and now

Learning Objective 3 discuss about the assist elements that were requested and those that are used now

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Challenges in Virtual Healthcare for Patients with Disabilities

Abstract 138

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Background/Objectives: Advances in technology have become a crucial method for delivering virtual healthcare.1. However, Veterans who have activity limitations and are living in rural communities, are elderly, or have limited access to technology experience unique discrepancies when utilizing telerehabilitation. 2. Veterans with a disability may be less likely to own personal devices and access the internet regularly, creating further inequalities related to technology and internet access.2. This narrative review seeks to understand the impact of disparities in internet access on access to care using telehealth or virtual care modalities to highlight the value of understanding and overcoming these challenges for patients with spinal cord injuries. Methods: The following key words were used to search for literature published between 2013-2023 using the Pubmed database. Key words included; "telehealth" or "virtual care" AND "health equity." AND "disability" or "Spinal Cord Injury" Results: Health equity is the state in which everyone has a fair and just opportunity to attain their highest level of health.3 Social cohesion and generational cycles of poor health are addressed through focusing on equity research and more equitable opportunities.4 Research shows that individuals living with disability have less access to healthcare, worse mental health, increased rates of engaging in risky behaviors, and are less physically active.3 Telehealth has led to notable improvements in spinal cord injury (SCI) rehabilitation, including improving outcomes in mortality, function, and mood disorders.5, 6. Importantly, in this new era of telehealth and virtual healthcare, Drake et al. found that Black/African American, Hispanic, Asian patients, and male patients are less likely to use telemedicine than white patients and female patients. In addition, older patients, and commercially insured patients (versus publicly insured patients) were less likely to use telemedicine.1 Studies have noted this starts at a fundamental level with lack of research on the intersection of disability with other social determinants of health including race, ethnicity, or gender,5,6 and especially since people living with spinal cord injuries and other disabilities have more barriers to transitioning to virtual care.6 Conclusions: We propose that understanding these trends in telerehabilitation can help clinicians adopt better approaches to prevent further discrimination both in-person and virtual care. Based on our narrative review findings, and due to the notable gaps in telerehabilitation literature for individuals with disabilities, we recommend a multi-faceted approach to optimally support rural veterans with disabilities. In our approach, we suggest creating designs of accessible telehealth applications, access to adaptive equipment, and electronic health literacy support.

Learning Objective 1 1.Recognize the barriers present in equitable telerehabilitation for veterans with activity limitations by examining how racial, gender, age disparities, or limited technology can affect telerehabilitation access.

Learning Objective 2 2. Analyze potential technology barriers faced by patients with activity limitations like SCI injury when these patients utilize telerehabilitation.

Learning Objective 3 3. Assess strategies to enhance equitable telerehabilitation for patients with spinal cord injuries.

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Safety And Feasibility of Transcutaneous Spinal Cord Stimulation To Stabilize Blood Pressure For Acute Inpatients With Spinal Cord Injury

Abstract 154

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Objective: The primary objective was to determine the safety and feasibility of using transcutaneous spinal cord stimulation (TSCS) to promote stable blood pressure during acute inpatient rehabilitation (AIR) in newly injured patients with spinal cord injury (SCI). The target range was defined as a systolic blood pressure (SBP) of 110-130 mmHg in males and 100-130 mmHg in females. Design/Methods. This prospective, randomized, single-blinded trial, was conducted in the SCI AIR unit at Mount Sinai Hospital, NY, USA. During the TSCS mapping protocol, a cathode electrode was placed randomly over spinous processes T7/8, T9/10, T11/12, or L1/2, on separate laboratory visits, with anode electrodes placed bilaterally on the right and left iliac crests. Stimulation was administered using either a biphasic or monophasic waveform, with or without a carrier frequency (10kHz), with a pulse width of 1000 microseconds, at frequencies of 30, 60, 120, or 240 Hz. Stimulation amplitude was increased from 0 to 100 mA depending on participant tolerability and the SBP response. Results. From March 2022 to August 2023 a total of 23 patients with acute SCI were identified as eligible for TSCS testing by the clinical staff, 16 participants were enrolled, and 13 underwent at least one TSCS mapping session for BP stabilization. Three participants were withdrawn prior to testing due to a stage 4 pressure injury (n=1) and normotensive seated BP (n=2). Of the 13 participants who underwent at least one TSCS mapping session, six withdrew from subsequent testing sessions prior to discharge due to orthostatic intolerance from withholding midodrine (n=2), voluntary withdrawal (n=3), and a mild skin burn deemed likely related to stimulation (n=1). To date we have conducted a total of 19 TSCS mapping sessions in six participants. Average seated SBP prior to TSCS was 93.3±15.0 mmHg, increasing to 104.4±12.9 mmHg with TSCS; however, there was no evidence of a stable BP, and effective TSCS cathode electrode placement locations and parameters varied among these participants. While a few participants reported pain with stimulation at the site of the cathode and/or anode placement, the most common side effect noted was tingling. One participant reported feeling more alert and two participants felt more relaxed while receiving biphasic stimulation. Conclusions. Implementation of a TSCS mapping protocol to identify stimulation parameters that stabilize seated BP within the SCI AIR unit was feasible but presents unique challenges. Clear communication with the clinical staff was required to overcome competing factors and to limit interfering with scheduled rehabilitation activities. While effective TSCS parameter settings varied among this small cohort of participants with SCI, and BP was not consistently stabilized, adverse events were few, and the patients tolerated the mapping protocol. Data collection is ongoing, which represents an important step towards identifying optimal TSCS parameter settings that promote BP stability during AIR in newly injured patients with SCI. Support. This work was supported by a SCI Model Systems grant # 90SIMS0003 from NIDILRR.

Learning Objective 1 Discuss the safety of transcutaneous spinal cord stimulation to stabilize blood pressure for patients with spinal cord injury during acute inpatient rehabilitation.

Learning Objective 2 Discuss the feasibility of using TSCS to stabilize blood pressure in the acute inpatient setting for patients with spinal cord injury.

Learning Objective 3 Outline the protocol used to implement TSCS to stabilize blood pressure in the acute inpatient setting for patients with spinal cord injury.

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Changes In Cough Effectiveness Following 5-Days of Therapeutic Acute Intermittent Hypoxia in Chronic SCI

Abstract 233

Michela Mir, PhD CCC-SLP, University of Florida

Background: Cough is a vital function that maintains clear airways. Spinal cord injury (SCI) severely impairs cough since it disrupts neural pathways to the respiratory muscles that generate high intrathoracic pressures and drive particulate from the lungs at high airflow velocities. Ineffective airway clearance contributes to increased respiratory infections, rehospitalization, increased costs, and reduced quality of life. Thus, it is critical to develop interventions that improve cough after SCI. Therapeutic acute intermittent hypoxia (AIH)—repetitive exposure to brief, one minute episodes of low inspired oxygen—is a promising new strategy that improves both respiratory and non-respiratory motor systems. Despite the importance of cough to maintain lung health, AIH effects on airway clearance after SCI are unknown. Thus, we tested the hypothesis that daily AIH would improve cough in chronic SCI. Participants: Eight participants volunteered to participate (1 female; 7 males; 18-62 years of age; 1-28 years post-SCI; 6 cervical, 2 thoracic; C1-T5 AIS A-C). Maximal inspiratory pressure at baseline was 103% of predicted normative values; maximal expiratory pressure was 48%; and forced vital capacity was 74%. Methods/Design: Participants completed 5-daily sessions of AIH and Sham treatment (3+ weeks apart) in a random ordered cross-over design study. AIH involved 15, 1-minute episodes of 9% inspired O2 (Sham=21% inspired O2), interspersed with 1.5 minutes of room air. Participants produced at least three maximal-effort coughs into a facemask connected to a pneumotachograph. The cough with the highest peak expiratory flow rate was used for analysis. Outcomes included cough airflows, volumes, and timing metrics from the inspiratory, compression (vocal fold closure), and expiratory phases of cough. Percent change from baseline and effect sizes (eta squared) were used to assess outcome differences 1- and 3-days after intervention. Results: There were no changes (<6%) after Sham treatment. The following changes were evident 3-days after AIH intervention: compression phase duration increased by .10s, yielding a 65% increase ($\eta 2$= .41) from baseline; peak expiratory flow rates increased by .56 L/s ($\eta 2$= .24); and the duration to achieve peak flow decreased by .01s ($\eta 2$= .02). Quickly reaching higher peak flows contributed to a 41% increase (+10.86 L/s/s) in cough volume acceleration ($\eta 2$= .01)—a metric of velocity over time. Conclusions: These data suggest improvements in cough outcomes that contribute to overall cough effectiveness, most notably 3-days after a 5-day AIH intervention protocol. These gains may be due to increased duration of the compression phase, such that vocal folds adduct longer and enhance the build-up of subglottic pressure—increasing the intrathoracic pressure required to quickly drive air (and particulate) from the lungs. As such, participants were more efficient with reaching higher peak expiratory flows after AIH, suggesting more effective dynamic compression of the chest wall. These important findings support future research to continue investigating AIH effects on cough function to advance treatment efficacy for airway defense after SCI.

Learning Objective 1 Discuss components of effective cough

Learning Objective 2 Discuss dysfunctional components of cough after SCI

Learning Objective 3 Discuss therapeutic potential of acute-intermittent hypoxia to improve cough in SCI

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Viral Myelopathy: A Rare Subset of Non-Traumatic Spinal Cord Dysfunction

Abstract 183

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Objective: SCI Model Systems Program is piloting non-traumatic SCI data collection. Of note however, non-traumatic SCI diagnosis and classification poses unique challenges in comparison to traumatic SCI. There is a paucity of information in the literature regarding rehabilitation outcomes and long term follow up for persons impacted by viral related myelopathy. This presentation explores clinical outcomes and issues related to viral related myelopathy. Method: All non traumatic myelopathy patients discharged from inpatient rehabilitation at Mayo Clinic-Saint Marys Hospital between January 1, 1995 and December 31, 2021 were potential participants. There were 2230 potential participants. 59 declined to allow retrospect medical record review for research purposes and were excluded. Main outcome measure was Functional Independence Measure (FIM), change form inpatient rehabilitation admission to discharge, and FIM efficiency. Demographic and descriptive data were also collected including age, gender, rehabilitation length of stay (LOS) and type of viral infection related to myelopathy. Results: 17 (0.8%) patients were admitted with viral related myelopathy over the study period, which included the early portion of the pandemic. The average age at admission was 54 years, 4 (24%) were female, 13 (76%) male. 76% of those with viral related myelopathy discharged to the home setting. Average length of stay was 30.2 days for those with viral related myelopathy, compared to the total non-traumatic SCI group, 15.5 days. The average FIM admission score was 53.3, discharge was 77.4, with a FIM change of 24.0 for the viral myelopathy group. As a whole, viral myelopathy patient function status was generally lower than the NT SCI population with FIM admit of 63.7, discharge 89.4 and FIM change 25.6. FIM efficiency (FIM change/LOS) of the viral related myelopathy group was 0.79 compared to NT SCI population average 1.65. Conclusion: Out of a large non traumatic myelopathy population, viral related myelopathy is rare. We see lower function at admission and discharge from IRF, of the viral related myelopathy group. Although we saw similar amount of FIM change between groups, yet the viral group required longer time achieve functional outcomes (lower efficacy) compared to the NT group as a whole.

Learning Objective 1 To describe the spectrum of characteristics, and rehabilitation outcome of individuals affected by viral myelopathy compared the a larger non-traumatic spinal cord dysfunction population.

Learning Objective 2 To review case situations related to difficulty of diagnosis and need for ongoing follow up.

Learning Objective 3 Discuss potential classification difficulties for Model Systems data collection related to viral myelopathy

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Does Race/Ethnicity Influence Epidemiology, Survival and Neurological Outcomes After Acute Traumatic Spinal Cord Injury?

Abstract 55

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Objective: Given that little is known about the impact of race/ethnicity on the outcomes of individuals following acute tSCI, this retrospective cohort study examined the influence of race and ethnicity on the individuals' survival and neurological recovery within the first year after tSCI using data from a prospectively accrued database. Design/Methods: This retrospective cohort study included all 306 cases enrolled in the First National Acute Spinal Cord Injury Study (NASCIS-1), who were grouped into: (a) African American individuals (n=84), (b) non-Hispanic white individuals (n=159), and (c) other races/ethnicities that included Hispanic (n=60) and Asian individuals (n=3). Outcome measures included survival and neurological recovery (as assessed using the NASCIS motor, and pinprick and light-touch sensory scores) within the first year post-tSCI. Data on survival with the first year after tSCI was analysed out using Fisher exact test, and Kaplan-Meier curve with log-rank test. Multiple regression analyses were used to evaluate the potential effects of the race/ethnicity on the neurological recovery (i.e. motor recovery, and pinprick and light-touch sensory recovery) at 1 year after tSCI. Those multiple regression analyses were adjusted for major potential confounders including the individuals' sex, age at the tSCI onset, level of SCI, cause of injury, type of wound, level of consciousness at admission, and total received dose of MPSS. Results: There were 39 females and 267 males with mean age of 31 years who mostly sustained cervical severe tSCI after motor vehicle accidents or falls. The three groups were comparable regarding sex distribution, level and severity of tSCI, level of consciousness at admission, and total received dose of methylprednisolone. However, African American individuals were significantly older than non-Hispanic white individuals (P=0.0238). African American individuals and individuals of other races/ethnicities more often had a tSCI with open wound caused by missile and water-related accidents than non-Hispanic white individuals (P<0.0001). However, survival rates within the first year post-tSCI were statistically comparable among the three groups (P=0.3191). Among survivors, there were no significant differences among the racial/ethnical groups regarding their motor recovery at 1 year post-tSCI (P=0.2231), pinprick sensory recovery at 1 year post-tSCI (P=0.8606), or light-touch sensory recovery at 1 year post-tSCI (P=0.5965). Conclusions: The results of this study suggest that epidemiology of tSCI might vary depending upon the individual's race/ethnicity. Nevertheless, race/ethnicity did not influence survival rate or neurological recovery within the first year post-tSCI. Altogether, those results reinforce the notion that race/ethnicity is not a key determinant for clinical and neurological outcomes after tSCI. This does not undermine the fact that there may be significant racial/ethnical disparities with regard to healthcare access in the acute care setting and rehabilitation setting.

Learning Objective 1 Discuss the effects of race/ethnicity on the epidemiology of acute traumatic spinal cord injury.

Learning Objective 2 Discuss the effects of race/ethnicity on the survival after acute traumatic spinal cord injury.

Learning Objective 3 Discuss the effects of race/ethnicity on the neurological recovery following acute traumatic spinal cord injury.

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Presence, Descriptors, and Perceived Locations of SCI Related Painful Sensations During the First Year Post Injury

Abstract 261

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Introduction Most people with spinal cord injury (SCI) commonly report chronic pain. In one study, pain of at least 1-year duration shows prevalence rates of approximately 50% in people with SCI. In a meta-analysis of the prevalence of chronic pain after SCI, the pooled prevalence of chronic pain after SCI was found to be 68%, and the prevalence of neuropathic pain (NeuP) after SCI was 58%.The purpose of this study was to document the presence, descriptors, and perceived locations of SCI related painful sensations at several time points during the first-year post-injury in a diverse sample of persons with SCI. Methods A hybrid cross-sectional, longitudinal repeated measures design was used to assess for the presence of painful sensations at 3 timepoints: within 2-months post-injury (baseline), at 6-months, and 1-year post-injury at four SCI Centers. Demographic and injury data were collected at enrollment. R version 4.2.2 was used to produce descriptive statistics of the demographics of the sample and of the different sensations at each timepoint. The sensations were categorized by location and sensation quality. Results One hundred and two adult participants (79.4% male, 55.4% tetraplegia) with a median age of 31 years at onset of injury completed data collection at all three time points and were included in the analysis. 50% of these 102 participants had painful sensations at all three time points. 4.9% had pain at baseline and at 1-year, 2.0% had pain at 6-months only, 3.92% had pain at 6-months and 1-year, and 0.98% had pain at 1-year only. At baseline and 1-year respectively, of those diagnosed as having painful sensations, 34.5% and 42.9% described this pain with words related to warmth/burning, 34.5% and 30.0% described it as squeezing, 57.1% and 54.0% described it as pressure, 21.4% and 41.3% as related to electric shocks, 36.9% to 25.4% as related to stabbing, 29.8% to 41.3% as related to pins and needles, and 28.6% to 52.4% as related to tingling. Regarding pain in general, at baseline and 1-year, 40.5% and 36.5% respectively endorsed that their pain worsened with touch to the skin over the area of pain, 71.4% and 49.2% endorsed that their pain increased with pressure to the area, and 14.3% to 25.8% endorsed that their pain increased with cold. At baseline, of those with painful sensations, 12.7% localized their worst pain to the lower back only, 6.9% to the shin and calf, 6.9% to the ankles and toes, and 7.8% to the neck only. At 1 year, 11.8% localized their worst pain to the shoulders only, 3.9% to the shin and calf, and 5.9% to the ankles and toes only. Conclusion Over fifty percent of people with SCI experience painful sensations during the first-year post-injury, and prevalence seems to remain constant throughout that year. Though the prevalence of pain is high, these sensations also seem to be concurrent with nonpainful sensations of similar characteristics. Future analyses will be done to investigate these relationships.

Learning Objective 1 Describe presence, descriptors, and perceived locations of SCI related painful sensations

Learning Objective 2 Distinguish between neuropathic and non-neuropathic painful sensations

Learning Objective 3 Illustrate relationships between painful and non-painful sensations

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Variability in the Risk of Elbow Flexor Tendon Retraction in Tetraplegia Due to Spinal Cord Injury at C5, C6 and C7 Levels. Clinical Evidence of Neuromuscular Response to FES Stimulation

Abstract 68

Diego Uberti,Licenciado En Kinesiologia Y Fisioterapia, Medico, Especialiasta En Medicina Fisica Y Rehabilitacion, Neuroability

Introduction From the clinical point of view, it is frequent to observe the presence of retraction in elbow flexor muscles in tetraplegia with spinal cord injury. The present study attempts to demonstrate the difference in the risk of such retraction at C5, C6 and C7 injury levels, and the possibility of early detection of this risk. Also, a comparative analysis of the neuromuscular response to the use of FES in different muscle groups was performed. Method The study was conducted with 9 patients with chronic spinal cord injury, all classified as ASIA A. Three of them with C5 neurological level, 3 with C6 level and 3 with C7 level. Strength, active mobility and joint ranges of the following muscle groups were assessed: elbow flexors, wrist extensors and elbow extensors. Electrostimulation was performed in the same muscle groups, and knee extensors, as a reference point for the area without voluntary movement. Compensated symmetrical, low frequency, biphasic, rectangular currents were used. With intensities between 20 and 40 mA, frequencies of 30 to 35 Hz and pulse width 300 ms. It was decided to use this type of current since it provokes excitomotor stimulation and muscle contraction in muscles that preserve their innervation and reflex arch. Each muscle group was stimulated in 5 tetanic muscle contractions. Results Regarding strength and mobility assessment, we found coincidence with their neurological level. When assessing the articular ranges, we found retraction of the elbow flexor muscles at the C6 levels. Two of the cases with irreducible shortening. We found 4 types of response to electrical stimulation. R1: Voluntary contraction and response to electrostimulation. Non-injured area. R2: Voluntary contraction without response to electrostimulation or very weak response. Partial injury area. R3: No voluntary contraction and no response to electrostimulation, with irradiation of electrical stimulation to innervated muscles. Area with lower motor neuron lesion. R4: No voluntary contraction and response to electrostimulation. Upper motor neuron lesion area. Response in the 3 C5 cases: Elbow flexors: R1 and R2. Wrist extensors: R3 Elbow extensors: R4 Knee extensors: R4 Response in all 3 C6 cases: Elbow flexors: R1 Wrist extensors: R2 Elbow extensors: R3 Knee extensors: R4 Response in all 3 C7 cases: Elbow flexors: R1 Wrist extensors: R1 Elbow extensors: R2 Knee extensors: R4 Conclusions In patients with a C6 neurological level, it was detected a lack of electrical stimulation and no voluntary mobility (R3) in the elbow extensors, suggesting lower motor neuron injury. This situation causes a muscular imbalance in the agonist-antagonist complex of the elbow, favoring the retraction of the active muscle. This group, C6, would be at greater risk of retractions, and it is where we should implement strategies to avoid shortening. It would be important to broaden this type of study with electromyography in the muscle groups concerned.

Learning Objective 1 identify people at risk of retraction in upper limbs

Learning Objective 2 Relate response to electrical stimulation with upper and lower motor neuron injury

Learning Objective 3 preventative about this important complication

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Reviving Intimacy After Spinal Injury: Unveiling a Novel Approach to Enhance Sexual Participation in a Male Patient with Incomplete Spinal Injury

Abstract 94

Jane Alkhazov,PT, DPT, NCS, Medstar National Rehabilitation Hospital

Background: After spinal cord injury/ disease (SCI/D), men struggle with sexual activity due to physiologic changes like reduced sensation, autonomic dysfunction, and issues with ejaculation and erection leading to lower quality of life (QOL) and increased depression. To overcome these barriers, rehab programs educate patients about sexual aids, positioning, and prognosis based on level and completeness of injury. Despite education and medical intervention, physical intervention targeted at improving sexual mobility is overlooked. Creating a tailored rehab plan for sex-specific tasks and endurance requires considering the design principles like intensity, repetition, and specificity to augment neuroplasticity. Blood flow restriction training (BFRt), an emerging modality, can enhance intensity during rehab by partially restricting arterial inflow and venous outflow of a limb during exercise or aerobic activity. BFRt studies show improvements in physiological changes in individuals with incomplete SCI (iSCI). However, no studies have examined BFRt to enhance sexual participation. This case aims to explore how BFRt used during an intensity-driven, task-specific motor rehab program enhanced sexual participation for an individual with iSCI. Methods: Patient is a 58-year-old cis-gendered male, 17 years post iSCI. Initial goals for PT included improving sexual mobility and endurance. Evaluation revealed reduced quality of life, confidence with sex, functional strength, and endurance. Measures collected included self-reports of Patient-Specific Functional Scale (PSFS) and World Health Organization Quality of Life (WHOQOL-BREF), Five Time Sit to Stand (5 TSTS), and 6 Minute Walk Test (6MWT). 14 sessions were completed of BFRt during task-specific strength and endurance training. BFR was applied on the lower extremity at 80% occlusion during bridging, tall kneeling, sit to stand and supine hip abduction exercises to promote intensity and repetitions during patient specified hip thrust task. For strength interventions, a set repetition scheme of 30/15/15/15 with a 30srest break between intervals. In addition, BFR at 70% occlusion during recumbent stepping and treadmill training between 8-30 minutes was included to improve endurance. Results: Improvements were reported in sexual mobility (PSFS from 5/10 to 8/10; MDC = 3), physical QOL (WHOQOL-BREF from 38% to 50%) and social QOL (WHOQOL-BREF from 31% to 69%). Functional lower extremity strength (5TSTS from 27 seconds with upper extremity support to 16 seconds without upper extremity support; cut off =12) and endurance (6 MMWT from 143m to 163m; MDC =45m) improved. Conclusion: While enhancing sexual engagement for individuals with SCI/D involves psychological, pharmacological, and educational methods, it's essential that SCI/D experts also recognize the potential of a physical approach. Given the influence of sexual participation on quality of life, this case serves as a catalyst for conversations surrounding the valuable role that a PT can assume in enhancing sexual mobility for patients with SCI/D.

Learning Objective 1 Discuss the successful implementation of BFRt in a strength and aerobic program tailored to improve sexual mobility for an individual with iSCI.

Learning Objective 2 Describe the benefits BFRt may provide during motor rehabilitation for patients with SCI/D.

Learning Objective 3 Facilitate discussions regarding clinical approaches and the role that physical therapists can play in improving sexual participation.

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Walking Outcomes Enhanced by Use of A Novel Electrode Array For Transcutaneous Spinal Cord Stimulation And Gait-Based Therapies In Patients With Incomplete Spinal Cord Injury

Abstract 103

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Objective: The objective of this study was to assess the feasibility and utility of transcutaneous spinal cord stimulation (TSS) via a multi-electrode array and associated stimulator, ExaStim (Aneuvo, California). This array allows for parameter adjustment of individual electrodes to target specific functions and location. We present the improvements of three participants treated with ExaStim and gait-based therapy. Methods: Participants, ages 19-25 with traumatic T11 AIS B-C tetraplegia participated in an 8-week intervention with 22, 90-minute sessions, 3 times per week. Each session included 60 minutes of TSS paired with interventions including targeted lower extremity strengthening, task-specific practice, balance, and gait training. Interventions were specific to our participants' function to address their gait and functional impairments. The novel electrode array allowed for multiple parallel current configurations to target function and location. Midline electrodes, utilized continuously for all activities, provided increased neural excitation for commensurate motor output, as confirmed with EMG. Lateral electrodes were selected to target preferred muscle groups for each activity. Attendance compliance, pain, adverse events and rate of perceived exertion (RPE) were collected to assess feasibility and safety. To capture improvements in walking function, 10-Meter Walk Test (10MWT), Walking Index for Spinal Cord Injury II (WISCI II), the Timed Up and Go Test (TUG), and 6-Minute Walk Test (6MWT) were assessed. The Berg Balance Scale and Function In Sitting Test (FIST) were completed to assess balance and trunk control. The ISNCSCI was used to gain insight into the participants' neurological change. Results: Each participant demonstrated improvements in all walking measures with average changes as follows: TUG (-39.48 seconds), 10MWT with walker (-0.08 m/s), and 6MWT with walker (+29.9 m). FIST scores improved 4 points on average. One participant showed significant improvement in overall ISNCSCI score, and one participant increased their WISCI II score by 3 points. Participants' subjective reports included improved core stability, increased lower extremity sensation, and decreased assistance for gait and functional mobility within the home and community. Greater magnitude of change was observed in walking tests, with all scores exceeding the MCID except for the 6MWT. This may be reflective of neuromodulation's preferential change in patterned activity, rather than selective isolation of voluntary function, or lack of measurement sensitivity. No adverse events were reported nor observed throughout the study. Conclusions: Results of this case series indicate TSS with an electrode array is safe and feasible. Participants demonstrated improvements in walking speed, endurance, quality of gait, and trunk stability. These therapeutic gains translated to improved independence and functional mobility. These results warrant additional investigation in future, larger, controlled trials. More rigorous investigation of parameter and electrode selection would help to optimize this intervention and ensure successful translation to clinical practice.

Learning Objective 1 Discuss utility of novel electrode array in application of targeted TSS

Learning Objective 2 Describe therapeutic outcomes of TSS paired with gait training in incomplete spinal cord injury

Learning Objective 3 Illustrate application of targeted TSS paired with task specific activities in clinical setting for improved gait outcomes

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Bladder, Bowel, Sexual Function Outcomes Within A Specialist Pelvic Health Physiotherapy Clinic At A Spinal Cord Injury Centre, UK

Abstract 181

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Pelvic floor muscle training (PFMT) is recommended for individuals with neurological conditions where they have the potential to voluntarily contract their pelvic floor (1). Yet, the implementation of services providing specialist physiotherapy to these individuals is not yet mainstay. In 2017, a Pelvic Health Physiotherapy Clinic was established at a Spinal Cord Injury (SCI) Centre in the UK. The aim of this service evaluation was to review the bladder, bowel and sexual function outcomes of patients who attend this clinic. Patients were asked to complete online bladder, bowel and sexual function questionnaires prior to each appointment between March 2022 and April 2023. Questionnaires were Urinary Symptom Profile Score (Stress Urinary Incontinence (SUI), Overactive Bladder (OAB), and Low Stream (LS) Scores), Neurogenic Bowel Dysfunction Score (General Satisfaction and Total Score) and Arizona Sexual Experiences Scale (ASEX). Patients attending the clinic received a tailored interventions and a home exercise programme. Questionnaire scores were expressed as mean +/- SD and compared using paired t-tests. A p-value of <0.05 was considered statistically significant. Patients (n=20) who completed questionnaires at two time-points were included. They were categorised by diagnosis, Cauda Equina Syndrome (CES) (n=9), Upper Motor Neuron injury (UMN) (n=8), and non-SCI (n=3). At the first data capture, the CES group reported higher severity scores for almost every questionnaire/domain, particularly for bowel function, NBD score 13.4 ± 11.8 ('moderate' severity) compared to that of the UMN and non-SCI group, 5.4 ± 3.6, 4.0 ± 3.6, respectively ('very minor' severity). For all patients, mean USP total score decreased by 2.1 ± 3.4 (p=0.01). Greatest reduction seen in SUI domain by 1.15 ± 2.3 (p=0.04), 3.8 ± 3.2 to 2.7 ± 2.9. Individuals with CES demonstrated the greatest improvement in USP score, reducing by 3.2 ± 2.8, with reduction in SUI and OAB domains, by 1.4 ± 2.2 and 1.6 ± 2.1, respectively. Overall, there was no change in NBD score for all participants, 0.34 ± 6.1 (p=0.8). However, in the CES group, score improved by 2.8 ± 5.6, which was also reflected in how they reported bowel management satisfaction, improving by 1.4 ± 4.2. There was minimal change in ASEX score, mean change reducing by 0.2 ± 4.1 (n=20). Yet, individuals with UMN injuries reported a reduction in ASEX score by 2.1 ± 4.7. There were statistically significant improvements in bladder outcomes across all patient groups, attributed to improvements in OAB and SUI. Of the three patient groups, individuals with CES reported more severe bladder, bowel and sexual dysfunction. However, this group demonstrated the greatest improvement in bladder and bowel outcomes whilst being assessed and treated within a specialist pelvic health physiotherapy clinic. Changes in sexual function varied between groups, with improvements demonstrated by individuals with UMN injuries. These findings suggest that PFMT within this population can improve bladder, bowel and sexual function outcomes.

Learning Objective 1 Describe the findings from online bladder, bowel, sexual function questionnaires in a specialist pelvic physiotherapy clinic

Learning Objective 2 Illustrate the differences found in the different group of patients

Learning Objective 3 Discuss the benefits of conservative management for bladder, bowel and sexual dysfunction after spinal cord injury

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Comparing Indirect Ventilatory Drive Outcomes in Chronic Spinal Cord Injury

Abstract 128

Tommy Sutor,MS, PhD, University of Florida

Spinal cord injury (SCI) disrupts neural pathways necessary to breathe. While most persons with SCI breathe independent of ventilator support, overall breathing function is decreased, negatively impacting daily life. Descending ventilatory drive, i.e. the neural output of brainstem respiratory centers, is thought to be altered after SCI. However, directly measuring brainstem respiratory center output is not feasible in humans, necessitating clinical outcomes which indirectly indicate ventilatory drive. Different outcome measures have yielded conflicting evidence as to whether ventilatory drive increases or decreases after SCI. One outcome is mouth occlusion pressure 0.1 seconds after an unexpected inspiratory occlusion (P0.1). Studies assessing resting P0.1 suggest increased ventilatory drive persons with acute (<6 months) SCI; data in chronic SCI are lacking. On the other hand, studies using another outcome, mean inspiratory flow (VT/Ti) suggest decreased ventilatory drive in persons with chronic SCI. To better understand changes in ventilatory drive after SCI and the implications of different indirect measurement approaches, resting P0.1 and VT/Ti were collected from quiet breathing trials in community-dwelling adults with chronic SCI (n=9; >1 year; C4-T6) who are enrolled in an ongoing clinical trial. Retrospective data from non-injured controls (n=9) were used for comparison. Percent of age-predicted forced vital capacity (FVC%), tidal volume (VT), breathing frequency (Fb) minute ventilation (VE), inspiratory time (Ti), P0.1 and VT/Ti at rest were collected. Neurologic level of injury (NLI), ASIA impairment scale (AIS), and time post-injury were recorded in participants with SCI. Differences between groups were compared via t-tests; $p<.05$ was considered significant, and Cohen's D effect sizes were calculated. FVC% was reduced in persons with SCI compared to non-injured participants (73±15% vs. 112±11%, $p<.01$, $d=2.9$). Participants with SCI showed no differences compared to non-injured participants in VT (0.634±0.19 vs. 0.689±0.25 liters, $p>.05$), Fb (14.9±2.9 vs. 15.3±4.2 breaths/minute), Ti (1.9±0.4 vs. 1.7±0.7 seconds, $p>.05$) or VE (9.1±1.9 vs. 9.8±0.98 liters/minute, $p>.05$, $d=0.45$). P0.1 was not different in participants with SCI compared to non-injured controls (1.31±0.7 vs. 1.38±0.75 cmH2O, $p>.05$, $d = 0.1$) whereas VT/Ti was significantly reduced (0.348±0.1 vs. 0.432±0.06 liters/second, $p<.05$, $d = 1.2$). A potential reason for discrepant findings between these two ventilatory drive outcomes is that VT/Ti necessitates taking a full tidal inspiration, and thus is influenced by mechanical constraints on ventilation which exist after SCI such as increased chest wall stiffness, whereas P0.1 is not influenced by these mechanical factors because of the short duration over which it is measured. These results underscore the importance of considering the mechanical factors that influence ventilatory drive assessments, particularly VT/Ti. Understanding these critical differences when attempting to measure ventilatory drive is important for evaluating the impact of rehabilitation interventions for individuals with SCI.

Learning Objective 1 Introduce ventilatory drive for unfamiliar viewers

Learning Objective 2 Delineate why different ventilatory drive outcomes are not interchangeable

Learning Objective 3 Discuss implications of choosing different ventilatory drive outcomes

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Mild Intermittent Hypoxia Elicits Ventilatory Plasticity Without Changes in Resting Blood Pressure

Abstract 189

Lexi Soltesz, Undergraduate Researcher, Wayne State University

Objective: To investigate long-term facilitation (LTF) of minute ventilation (VE) and blood pressure following acute and repeated exposure to mild intermittent hypoxia (MIH) in individuals living with motor incomplete spinal cord injury (SCI) and autonomic dysfunction. 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. Individuals underwent MIH each morning. MIH 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. MIH was administered for 8 days over 2 weeks. Individuals with sleep apnea were treated with continuous positive airway pressure throughout the 2 weeks. Main Outcome Measure(s): Long-term facilitation and progressive augmentation of VE (Liters/Min [L/min]) and blood pressure (BP). LTF is the difference between hypercapnic baseline and 20 minutes of end-recovery. Progressive augmentation (PA) was calculated as the difference between the average of the initial 2 and final 2 episodes of hypoxia. Data presented as fractional changes ± standard error. Results: Resting VE, tidal volume, breathing frequency, and BP were not different between day 1 and 8 of MIH ($P \geq 0.18$ for all comparisons). LTF of VE was significant on day 1 (1.33 ± 0.12) and day 8 (1.19 ± 0.03, $P \leq 0.03$). LTF was only found for tidal volume on day 8 (1.05 ± 0.003, $P = 0.031$) and no LTF was found for breathing frequency on either day (1.10 ± 0.05 vs 1.10 ± 0.04 $P \geq 0.14$). The magnitude of PA of VE was not different between day 1 and day 8 (1.68 ± 0.54 vs 1.10 ± 0.56, $P = 0.42$, respectively). PA of tidal volume did not change across days (1.51 ± 0.61 vs 1.11 ± 0.05, $P = 0.61$), but breathing frequency approached a significant decrease from day 1 to day 8 (1.12 ± 0.05 vs 0.98 ± 0.06, $P = 0.059$). No significant LTF of systolic BP was found on day 1 or day 8 (1.08 ± 0.08 vs 1.16 ± 0.13, $P \geq 0.37$), nor for diastolic BP (1.11 ± 0.08 vs 1.16 ± 0.13, $P \geq 0.32$). The magnitude of PA for systolic BP was not different between days (1.02 ± 0.25 vs 0.96 ± 0.09, $P = 0.5$). Likewise, PA for diastolic BP was not different between days (1.02 ± 0.03 vs 0.97 ± 0.07, $P = 0.41$). However, the initial systolic BP response to hypoxia was greater on day 8 than day 1 (1.03 ± 0.005 vs 1.10 ± 0.007, $P = 0.001$). Conclusion: MIH elicited LTF of VE, but not systolic or diastolic BP. 8 days of MIH did not augment recovery VE or BP. Likewise, 8 days of MIH did not augment PA for VE or BP. These data suggest that 8 days of MIH can elicit ventilatory plasticity that may not compound across days. Likewise, 8 days of MIH did not impact resting BP on either day. However, MIH did augment the initial blood pressure response to hypoxia which may have implications for autonomic dysreflexia and orthostatic hypotension for these individuals.

Learning Objective 1 Describe mild intermittent hypoxia

Learning Objective 2 Describe long-term facilitation of minute ventilation and blood pressure

Learning Objective 3 Understand the impact of mild intermittent hypoxia on long-term facilitation

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Improving Breathing After Spinal Cord Injury by Electrical Stimulation of Locomotor Circuits

Abstract 210

Ian Walling,BS, University of Cincinnati MSTP

Objective: Prior research has shown that locomotor and respiratory circuits are co-activated. We hypothesize that stimulation of locomotor circuits could activate respiratory muscles after SCI. Stimulation of limb sensory afferents can improve locomotor function following spinal cord injury (SCI), but the effects on breathing have not been studied. Design/ Methods: C57/Bl6 mice underwent lateral hemisection spinal cord injury at cervical level 2 (C2Hx) and were allowed 24 hours to recover. Animals underwent bilateral diaphragm electromyography recording under anesthesia. During this recording, electrical stimulation was applied via cuff electrodes to the sciatic nerve, either contralateral or ipsilateral to injury. After recordings, animals were perfused and tissue from the injury sites was collected for assessment of injury location and severity using eriochrome cyanin stain. Results: Electrical stimulation of the sciatic nerve following C2Hx can restore rhythmic activity to the previously paralyzed diaphragm. Conclusions: We show that electrical stimulation of limb afferents can restore respiratory activity to the paralyzed diaphragm after a C2Hx injury. This has potential therapeutic application in spinal cord injury patients, as epidural stimulation of sensory afferents is already being tested for restoration of locomotor function following SCI. Our results suggest that epidural stimulation could improve breathing in patients with cervical injuries.

Learning Objective 1 Describe interactions between locomotor and respiratory circuits

Learning Objective 2 Describe pathways through which limb afferent stimulation can alter breathing

Learning Objective 3 Discuss advantages of activating the diaphragm via locomotor circuits

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Spinal Cord Injury due to Ligamentum Flavum Buckling in a Transgender Elhers-Danlos Patient

Abstract 74

Adam Haniff, MD, Cleveland Clinic

Objective: To describe a case of tetraplegia after a spinal cord injury in a Elhers Danlos patient due to ligamentum flavum buckling. Design / Method: Case Study Case Description: A 26-year-old transgender man with a history of Ehlers-Danlos syndrome was seen for neck pain, diminished arm sensation and gait dysfunction. Electrodiagnostic study was significant for an intraspinal canal process affecting the C5-8 roots/segments. An MRI of the cervical spine was significant for cervical stenosis due to ligamentum flavum buckling in extension and a new focus of myelomalacia at the C3-4 level. A physical examination revealed diminished sensation in the C2-T1 dermatomes with scattered motor deficits and severe spasticity. Discussion: This is the first reported case, to our knowledge, of spinal cord injury in a patient with Elhers Danlos due to ligamentum flavum buckling. Hypermobility type Elhers-Danlos patients are known to be at risk for atlanto-axial instability and general ligamentous instability which are believed to have directly caused many of the symptoms present in our patient1. Elhers Danlos patient's also experience increased rates of carpal tunnel syndrome which may delay the diagnosis of spinal cord pathology2. Care must be made to follow neurological symptoms and functional status closely. It is also important to evaluate patients with flexion and extension MRI in order to evaluate for dynamic spinal cord compression. Conclusion: In Elhers-Danlos patient's presenting with upper extremity neurologic symptoms, spinal cord pathology although rare, should not be discounted. Flexion and Extension MRI imaging is necessary to assess degree of ligamentum flavum buckling.

Learning Objective 1 To raise awareness of potential for spinal cord injury in the Ehlers Danlos population

Learning Objective 2 To discuss a rare etiology of spinal cord injury

Learning Objective 3 To prevent delay of diagnosis of spinal cord injury in Ehlers Danlos patients

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Bladder And Bowel Function in Adult Subjects with Spinal Cord Injury In Argentina

Abstract 180

Julia Abudarham **,**PT, Universidad Nacional de La Matanza

Background. Subjects with spinal cord injury present autonomic disorders that affect bladder and bowel functions. Associated complications include urinary and fecal retention and incontinence, and urinary infection. These dysfunctions are referred as the most problematic for spinal cord injury patients, having a negative impact on daily life activities and social participation. The management and complications of this population in Argentina are currently unknown. Objectives. To describe the management of bladder and bowel functions, related complications, and participation restrictions, in people with spinal cord injury in Argentina. Methods. A descriptive, observational, prospective, and cross-sectional study was carried out. A self-administered survey evaluated the management of bladder and bowel functions, their complications and impact on participation. People over 18 years with diagnosis of spinal cord injury of any type and neurological level who wanted and were able to answer the survey were included. The data with the highest response rate for each variable was presented. Results. The study included 74 people with spinal cord injury who answered the survey. From these, 39.2% were between 30 and 44 years old, 78.4% were men, and 33.8% had lesion level C5–C8, ASIA A, B, or C. For bladder emptying, 54.1% used an intermittent catheter (catheterization), 44.6% did it with a frequency of 5-6 times a day, 63.5% without assistance and 52.7% without medication. The most frequent complication was urinary infection in 50% of the cases. 68.9% presented partial interference in daily routines and 63.5% in social activities. Regarding to bowel evacuation, 29.7% did not use any method, 32.4% did it daily, 52.7% without assistance and 78.4% without medication. 43.2% presented constipation as the most frequent complication. Interferences in daily routines and social activities were partial in 63.5% and 47.3%, respectively. Conclusion. The results show that most subjects with spinal cord injury perform bladder and bowel management independently, daily and without using medication. The most frequent complications were urinary infection and constipation, which partially impact on daily routines and social activities. We hope this information will be useful to improve education strategies and decision-making when addressing these problems in spinal cord injury patients, their family members, and health professionals.

Learning Objective 1 Describe the management of bladder and bowel functions in SCI in Argentina.

Learning Objective 2 Provide a voice to SCI patients about their complications and participation restrictions.

Learning Objective 3 Discuss education strategies and decision-making when addressing bladder and bowel functions.

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What Is the Status of Research Spinal Cord Injury In Latin America?

Abstract 264

Florencia Fernandez,Lic, Universidad Abierta Interamericana

Objetive: Research in Spinal Cord Injury (SCI) rehabilitation advances is critical for the fast translation of new knowledge to benefit patients with the latest scientific discoveries. However, often health care providers in Latin America (LA) do not have access to emerging technologies or novel pharmaceutical therapies. This gap in access results in higher mortality and morbidity among regional patients. Mitigation of negative outcomes can be achieved if the new therapies are developed following local research and resources. In order to develop the regional research capacity, we evaluated the status of research and perceived existing limitation among SCI rehabilitation practitioners in LA. We implemented a workshop on introduction to research methods focused on SCI rehabilitation research and qualified the experience. Methods: A descriptive and cross-sectional study was carried out. We created an anonymous survey that was administered in 2021 and 2023. Based on the responses a total of 20 professionals from LA were invited to participate in a workshop on introduction to research methods focus on SCI rehabilitation research. Thirteen participants took part in the virtual synchronous workshop held in 2022; an additional group of seven were selected to join the virtual asynchronous workshop held in 2023 and the experience was rated. Results: 335 responses were received from participants from 19 countries, 51% were PM&R physicians, 18% residents, 16% physical therapists, 5% occupational therapists, 4% nurses, 3% investigators, 3% physicians from other specialties and 2% were “other”. Only 55% had some training on research, 99% reported they would participate on research methodology training, and 100% reported that research in the field is extremely important. 67% reported that applied research findings to their practice, 40% never published, 22% has published in national journals, 13% in international journals, and 18% have presented in conferences. Among the barriers to access and perform research, 25% report lack of resources, 19% lack of time, 16% lack of knowledge, 10% lack of initiative, 5% lack of patients with SCI, and the rest listed “other barriers”. Participants were asked to rate the workshop with a numerical scale from 1-10, and qualitative open- ended questions. Participants rated the overall quality of the course as 8.22, their confidence about publishing their clinical and experimental data as 8.78, their confidence about presenting 9.63, their willingness to participate again as 9.5, the duration of the course 7.25, the section “introduction” 9.5, the section “methods” as 9.25, the section “results” 9.13, the section “conclusions” as 9.5. At the conclusion of the first workshop, 100% of the participants developed a posted and 10% presented in ASIA 2023. Conclusions: Only half of the professionals have training in research and all of them consider it relevant. In order to improve patient outcome and experience it is critical to support research initiatives in the area of SCI in the LA, not only by creating educational outreach programs in the region, but also by creating opportunities of collaboration in order to allow for the professional growth of physicians and health care providers in LA.

Learning Objective 1 Show the need and relevance of research in the area of rehabilitation of spinal cord injuries

Learning Objective 2 Discuss and reflect on the state of the research and the existing limitations among SCI rehabilitation professionals

Learning Objective 3 Provide research tools for the training of human resources

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Healthcare Utilization in Veterans with Cervical Spinal Cord Injury: Defining the Opportunities for Dissemination of Treatment Information

Abstract 120

Katharine Tam, MD, St. Louis VA Healthcare System

Objective: Information delivery is critical to expanding knowledge about treatment options for restoration of upper limb function after cervical spinal cord injury (SCI), specifically nerve and tendon transfer surgeries. Nerve transfers can be time-sensitive; providing information early is imperative to preventing missed treatment opportunities. Previous work showed high levels of health-care system utilization in SCI, but detailed information about the number and types of encounters was lacking. The purpose of this study is to quantify healthcare utilization and identify providers who could disseminate information about upper limb and other novel treatment options to people with SCI. Design/Methods: This retrospective cohort study utilized the Veterans Health Administration (VHA) SCI and Disorders (SCI/D) Registry to identify Veterans with cervical SCI. Inclusion criteria were informed by clinical characteristics that determine surgical candidacy for upper limb surgery. Individuals aged 18-89 years who received care at 25 VHA regional SCI/D Centers between October 1, 2012 and September 30, 2019 were identified and screened for the following characteristics: traumatic etiology, C5-8 neurologic level of injury (NLI), and American Spinal Injury Association (ASIA) Impairment Scale (AIS) A-C classification. The VHA Corporate Data Warehouse (CDW) was then used to characterize healthcare utilization by type and number of clinical encounters across the VHA system in this cohort. Subgroup analysis of rural and urban populations was performed. Results: Of the 23,307 participants in the SCI/D Registry, 884 individuals who met inclusion criteria had complete data. These Veterans were 98% male with a mean age of 39 years (SD 15.99), race was 66% white; ethnicity was 91% non-Hispanic. Injury severities were as follows: NLI C5 (43%), C6 (30%), C7 (21%), and C8 (6%); AIS A (49%), B (25%), and C (25%). The SCI was due to vehicular etiology (51%), followed by falls (19%), sports (16%) and violence (6%); with a median duration of 20 years (CI 9.16, 34.05) since injury. In the first year after SCI, 489 of these individuals (55%) had at least one VHA outpatient visit. For those receiving care within the VHA, there was a mean of 131 outpatient visits during the first year after injury. Most had a least one visit with a physician (N=350, 72%) including the following types: physiatry (N=176, 36%), internal medicine (N=182, 37%), urology (N=86, 18%) and resident trainee (N=194, 40%). Most also had at least once visit with the following non-physician providers: physical therapy (N=369, 75%), occupational therapy (N=318, 65%), nursing (N=383, 78%) and social work (N=319, 65%). Veterans in rural settings had higher Area Deprivation Index (ADI) scores ($p<0.001$), fewer physician visits ($p=0.01$), and fewer SCI/D service visits ($p=0.04$). Conclusion: This study found that Veterans with mid-cervical level SCI had a high number of healthcare encounters within the first year of injury that could be opportunities for disseminating treatment information. However, there is a large proportion of Veterans that do not receive care within the VHA system. Further work is needed to elucidate patterns of care and improve access, particularly for rural Veterans with SCI.

Learning Objective 1 Quantify healthcare utilization patterns of persons with mid cervical SCI

Learning Objective 2 Analyze differences in care received by Veterans with SCI living in rural and urban settings

Learning Objective 3 List opportunities for disseminating treatment information to persons with mid cervical SCI

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Body Composition and Muscle Mass and Its Effect On Functional Activities of Males In Comparison To Females With Chronic Spinal Cord Injury

Abstract 140

Shannon Inches, Kennedy Krieger Institute

Background: Muscle mass, or amount of muscle in the body, is measured as part of the body total composition, along with fat and bone mass. Low muscle mass can negatively impact the overall health of the person, leading to low quality of life. Changes in body composition among individuals with Spinal Cord Injury (SCI) develop rapidly after injury. Several factors have a major influence on bone/muscle mass in SCI individuals, such as the degree of the injury, muscle spasticity, age, sex and duration after injury. There was significant bone loss in the paralyzed limb in both sexes, "accounting for up to 6.3% in women", according to studies. It has been determined that degree of bone loss depends significantly and directly on the length of immobilization, even when controlling for age and sex. Introduction: The relationship between muscle mass and function in the SCI population has been well documented. The purpose of this review is to look at changes in muscle and bone that occur following an SCI, and functional activities and ambulatory skills of males in comparison to females. Our goal is to evaluate relationship between muscle and bone mass and functional /ambulatory abilities in individuals with chronic SCI/D, based on age and gender. Method: Retrospective review of data analysis of a cohort of 622 individuals aged 18-65 years with SCI related paralysis, seen in a specialized outpatient SCI rehab center in Baltimore, MD, between January 1, 2005 and June 30, 2022. Study population include individuals with chronic SCI/D, both tetra and paras. The 223 female patients and 399 male were divided in four groups: male/female age 18-49 and 50-89. Body composition measures, including muscle and bone mass was obtained by Dual Energy Absorptiometry, (DXA). Other data extracted includes severity of injury International standards for neurological classification of Spinal Cord Injury (ISNCSCI); Spinal Cord Independence Measures-III (SCIM-III), a self- reported assessment containing 19 items of self-care, respiration and mobility; Berg balance Scale; Walking Index for Spinal Cord Injury (WISCI); 10 MWT; Modified Ashworth; taken within 6 months of recorded date of DXA Result: Analysis shows that in individuals with tetraplegia, Lean Body Mass correlates with function, Bone Mineral Content and Bone Mineral Density. Secondly, for every 100 grams increase in lean muscle mass, there is a 0.5 SCIM points increase (5%). TLBM correlated with gait ability and scores. Conclusion: Higher muscle mass is associated with increased function among persons with SCI/D related paralysis. The correlation between muscle mass, bone density daily and function shows that preserving and increasing muscle mass regardless age, gender, or onset of neurologic deficit, is of utmost importance to improve the quality of life for the individual.

Learning Objective 1 Evaluate relationship between muscle mass and bone mass and function in SCI/D individuals

Learning Objective 2 Changes in body composition and how it affects daily function in individuals with spinal cord injury

Learning Objective 3 Evaluate changes in functional/ambulatory abilities in individuals with chronic SCI/D, based on age and gender

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

Abstract 51

Laura Ramirez Abadia, MD, Specialist in Physical Medicine and Rehabilitation, Diploma in Sports Rehabilitation Fundamentals - Mexican Society Physical Medicine and Rehabilitation, Universidad del Valle

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. Keywords. Spinal cord injuries, sexuality, validation studies as topic.

Learning Objective 1 Validate the Knowledge, Comfort, Approach and Attitude towards Sexuality Scale (KCAASS) in Spanish language.

Learning Objective 2 Give the possibility of applying this scale in patients with spinal cord injury in Latin America

Learning Objective 3 Educate about objective assessment options on issues of sexuality in patients with spinal cord injury

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Promoting Reproductive Health Equity After Spinal Cord Injury: Identifying Needs for Health Professional Training and Continuing Education

Abstract 38

Chloe Slocum,MD, MPH, Harvard Medical School Department of Physical Medicine and Rehabilitation, Mass General Brigham Spaulding Rehabilitation

Accurate, timely, and comprehensive information regarding contraception is critical to the reproductive health of women with spinal cord injury (SCI). Women with SCI face health disparities related to structural, attitudinal, social, programmatic, and policy barriers and women with SCI of childbearing age may be at increased risk of ineffective contraception and thus greater risk of unintended pregnancy due to potentially impaired hand function and aforementioned multifactorial barriers to care. We aimed to evaluate contemporary references commonly used by physiatrists in training and clinical practice for the scope, depth, and accuracy of information regarding contraception for women with SCI and identify areas that may need improvement. We conducted a search using PubMed, Web of Science, and MEDLINE and reviewed eight contemporary textbooks commonly used in Physical Medicine and Rehabilitation (PM&R) residency and Spinal Cord Injury Medicine fellowship training for comprehensive information on contraceptive methods for women with SCI and compared the breadth and detail of information with that available for able-bodied women through the Reproductive Health National Training Center (RHNTC) and Centers for Disease Control and Prevention (CDC). We focused on articles published in English and major textbooks used by PM&R graduate medical education (GME) trainees, including residents and Spinal Cord Injury Medicine fellows. Three reviewers consisting of two Spinal Cord Injury Medicine fellows and a dual-boarded physiatrist with fellowship training in Spinal Cord Injury Medicine reviewed and scored all resources. We focused on educational materials used by many of the more than 10,000 board-certified physiatrists in the U.S. and hundreds of graduate medical trainees each year. We viewed inclusion of accurate, up-to-date information on contraceptive methods, including reversible long-acting contraception, oral hormonal contraception, barrier methods, and emergency contraception as comprehensive coverage of contraception. Our search results returned 134 articles, only 17 of which were deemed relevant. No articles or major textbooks included comprehensive information on contraception and specific, accurate details of why particular methods may be preferred or avoided in specific populations, although several references did contain accurate but partially complete information. Providing essential health care for women with spinal cord injury requires physiatrists and health care professionals, including other physicians, advanced practice providers (APPs), and physical and occupational therapists, to provide accurate and reliable information concerning reproductive health, including options for contraception. Professional organizations and authors of physiatry textbooks must strive to improve the quality of evidence and information presented by engaging with consumers and collaborating across clinical disciplines.

Learning Objective 1 Describe 1-2 possible barriers to reproductive health care and contraception for women with SCI

Learning Objective 2 Explain the role for health care professionals in providing accurate and up-to-date information regarding contraceptive methods

Learning Objective 3 Articulate 1-2 strategies for improving the quality of information presented on contraception in contemporary literature

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Staged Pressure Ulcer Therapy with Larval Therapy and Placental Disc Connective Tissue Matrix: A Case Study

Abstract 6

Colton Sauer, MD, Medical College of Wisconsin

Objective: Patients with spinal cord injury are at increased risk for pressure injuries secondary to their impaired mobility, sensation, and skin physiology. Medical maggot therapy (MMT) and placental extracellular matrix injectates (PECMIs) have been described to provide beneficial effects for wound healing for chronic wounds when used independently. MMT likely contributes to improved wound healing via debridement of necrotic tissue, decreasing wound bioburden, production of pro-inflammatory markers, increasing vascularization, and promoting fibroblast migration and proliferation. PECMIs have been shown to promote wound healing by providing extracellular matrix for cellular migration and providing factors to assist in vascularization and proliferation of new tissue within the matrix. These two methods, when used together, may provide a more optimal wound healing environment within a chronic wound than when used independently. Design/Methods: One patient chart was accessed that had undergone MMT followed by PECMI treatment at a local VA medical center. Inpatient and outpatient notes were reviewed for changes in wound size and quality. Results: This patient developed sacral and left posterior greater trochanter pressure ulcers that had previously failed wound offloading, wet-to-dry dressings, and two trials of amniotic membrane film therapy – both progressing to a Stage IV pressure ulcers with progressive increase in wound size and limited granulation tissue. The sacral wound underwent MMT for 48 hours followed by PECMI 24 hours after completion of MMT. Two months after sacral wound treatment, the left trochanter wound underwent MMT for 24 hours followed by PECMI 24 hours after completion of MMT. At the time of MMT and PECMI treatment for the trochanter wound, the sacral wound had completely healed with healthy epithelialized tissue. Following MMT, the trochanter wound was highly vascularized at the time of PECMI placement along the wound bed. At their two-month outpatient follow-up appointment, the trochanter wound was notable for 20% reduction in area. The wound base had significantly improved granulation tissue over the majority of the area with new epithelization over roughly 25% of the wound. Wound depth had significantly improved, with granulation and epithelization that was now flush in some areas with the edges of the wound. This healing occurred despite sub-optimal length of MMT and without significantly restricting time sitting upright in their wheelchair. Conclusion: This study serves as a case study discussing a possible wound treatment algorithm that may improve outcomes for chronic non-healing pressure injuries. In this case study the patient obtained complete healing of a chronic sacral wound and significant wound healing of a chronic posterior trochanter wound with the staging of MMT followed by PECMI, despite previously failing solitary amniotic membrane film implant and more conservative wound healing methods.

Learning Objective 1 Illustrate utility of MMT staged with PECMI for non-healing chronic wounds

Learning Objective 2 Discuss physiology of medical maggot therapy in wound healing

Learning Objective 3 Discuss physiology of placental extracellular matrix injectate in wound healing

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The Feasibility of Admitting Patients to Acute Rehabilitation with Severe Pressure Injuries

Abstract 236

Elizabeth Twist, MD, UAB

Objectives Classically patients with pressure injuries (PI) classified as stage IV, deep tissue injuries and unstageable injuries are not admitted to acute rehabilitation due to concern of further wound deterioration. Paradoxically we recognize the importance of bowel/bladder management and pressure relief in the setting of pressure injury management; however, when patients and families discharge home without this education, they are unable to apply these preventative measures. We sought to maximize patient care by providing SCI education to patients who sustained severe pressure injuries during their acute hospitalization. We hypothesized that severe pressure injuries can remain stable on acute rehabilitation with appropriate multidisciplinary care and patients will leave with the necessary SCI education and rehabilitation to improve their quality of life. Design/ methods Patients admitted to an acute inpatient rehabilitation hospital from an attached level 1 trauma center and outside facilities. Patients were admitted for 3 hours of therapies, 5 days a week, with therapy divided into 1 to 1.5 hours sessions. Results We present a series of three patients admitted with severe pressure injuries and their courses at acute inpatient rehabilitation. Patient A is a 26-year-old male due to motor vehicle accident with C4 AIS A who transferred to IPR from OSH on 1/31/23 with an unstageable sacral PI on admission. Admission measurements 3x1x0.2cm. On 2/10 progressed to stage IV 4x3x2 with undermining, and diagnosed with osteomyelitis on CT. On 2/28 injury noted to be 3x1x2cm, with undermining and patient was discharged on 3/2. Patient B was a 54-year-old female with T6 AIS A due to gunshot wound in 2022, admitted one year later (6/7/23) for SCI rehabilitation. She was known to have a stage IV sacral wound, 3x2x2.5cm, undermining 2cm all around on admission. On the week of discharge, 7/18, it was 2x2x1.5cm with 1cm undermining from 11-12 o'clock. Patient C was a 35-year-old female with C4 AIS A due to motor vehicle accident in October 2022. Initially admitted on 1/24/23 as an obstetrics admission with unstageable PI of 6x6x2.5cm, tunneling 9-12 o'clock deepest of 2.5cm. She was managed with Veriflow and pressure relief until birth of her child. She then admitted to acute rehab on 4/26 and the injury was noted to be 4x7x4cm on 5/2, undermining from 10-4 o'clock of 7cm. In wound care rounds found to have foul odor, bone culture collected, CT AP showing osteomyelitis, and 6 week course of Linezolid and Bactrim initiated. On 5/24, the week of discharge, the injury measured 4x6x3cm with undermining 10-4 o'clock deepest at 5cm, remainder 3cm. Conclusion By utilizing multidisciplinary wound care rounds we aimed to maximize patient outcomes and education for patients that have severe pressure injuries prior to admission to acute rehabilitation. Patients had stable to improving pressure injuries despite 3 hours of therapy a day. We believe that the SCI education provided to these patients will improve their overall care and outcomes. Further formal studies including increased sample size, participant characteristics and formal data analysis is required.

Learning Objective 1 Illustrate the need for SCI education (specifically bowel, bladder and pressure relief) in prevention and treatment in pressure injuries in the acutely injured SCI patient.

Learning Objective 2 Recognize the ability of severe pressure injuries to remain stable or improve in the acute inpatient rehabilitation setting.

Learning Objective 3 Emphasize the need to determine the patient population and types of pressure injury that can be safely brough to acute inpatient rehabilitation.

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Development of A Virtual Teaching Tool for Support In The Application of Botulinum Toxin

Abstract 5

Daisy Falla Ramirez ,PhD Endoscopy Center Delt

Introduction: The idea of using botulinum toxin therapeutically was developed by the German physician and poet Justinus Kerner (1786-1862). Later it began to be used for the management of blepharospasm by the ophthalmologist Alan B. Scott (1981). Regarding the management of spasticity, it has been studied since 1992 in patients with cerebral palsy. Currently, according to different studies, it remains the gold standard for the management of focal or segmental spasticity. Objective: The objective of this degree project is to design a virtual pedagogical tool that facilitates and/or strengthens knowledge about botulinum toxin, additionally allows the calculation for its dilution and application, including a guide for application in the most frequent muscles in clinical practice, the above as a tool that is useful to different health professionals who use it. Materials and methods: A virtual pedagogical tool was designed in which 5 modules were included: 1. Educational module, 2. Dose calculation module. 3. Dilution calculation module. 4. Module of application points by anatomical guide. 5. Module with current consensus on the use of botulinum toxin in spasticity. Results: In the first instance, a survey was carried out on 16 residents of Physical Medicine and Rehabilitation from different years of residence as follows: a total of 13 questions (8 questions on knowledge about botulinum toxin and its application in the management of spasticity and 5 questions on content on the subject), where we found that 100% of the participants would believe it useful to carry out a virtual pedagogical tool for the use of botulinum toxin in the management of spasticity and would be willing to attend training on it. In the second instance, a search for the best educational method began under pedagogical advice, where it was found that the DUA method was the most effective for the development of the educational module in the tool made up of posters, slides, video and concept maps. In the third instance, the virtual pedagogical tool was designed under technical advice from technological tools including different programs and applications such as Power point, Genially, Thunkable, Excel, requiring a series of tests to reach the final model. In the fourth instance, a survey was carried out on the same participants after the use of the tool, an improvement of 43.8% was evidenced regarding the knowledge of the mechanism of action of botulinum toxin and 81.3% in the identification of the anatomical point of the psoas muscle for puncture with botulinum toxin. 100% was right about the composition of the molecule. The use of the virtual pedagogical tool demonstrated an impact on learning of 87.5%. Conclusion: In the present study, a virtual pedagogical tool was designed in order to find a benefit for the patient, reduce complications and facilitate learning, which demonstrated a high impact on the knowledge on the subject in the residents of physical medicine and rehabilitation of the El Bosque University.

Learning Objective 1 Develop and analyze the implementation of a virtual pedagogical tool that contributes to the learning of the application of botulinum toxin in the management of spasticity to medical professionals.

Learning Objective 2 Identify the pedagogical needs regarding the implementation processes of the application of botulinum toxin.

Learning Objective 3 Define a pedagogical model that allows the optimal development of the virtual pedagogical tool.

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The Surgical Enigma: Tracing Post-Surgical Guillain-Barre Syndrome

Abstract 118

Alwin David, MD, University of Miami/Jackson Memorial

Guillain-Barré syndrome (GBS) encompasses a heterogeneous group of immune-mediated disorders that target the peripheral nervous system, resulting in a diverse clinical presentation. It has been recognized as a significant cause of acute flaccid paralysis worldwide. Recent studies have unveiled the potential triggering role of surgery in GBS. A retrospective review found a higher relative risk of developing GBS in patients who had undergone surgery six weeks prior. This association has been observed across various surgical fields, including orthopedics, where instances of GBS post-total hip arthroplasty, trauma, and spine surgery have been documented. Understanding the pathophysiology and epidemiology of GBS is vital for clinicians, as the syndrome may present in various contexts, including post-surgical. A 68-year-old woman with Parkinson's disease and lumbar disc disease who had a history of lumbar fusions presented with back pain and lower extremity weakness stemming from the prior lumbar surgery. Spinal revision surgery improved her mobility along with inpatient rehabilitation, but she later returned to the hospital with acute numbness in her legs, leading to intubation and admission to the ICU. After 18 days, she was diagnosed with Guillain-Barré syndrome (GBS) confirmed by EMG/NCS and was treated with IVIG. She was eventually extubated and transferred to inpatient rehabilitation, where she dealt with intermittent rigidity and numbness, but ultimately was successfully discharged with a comprehensive rehabilitation plan, including interdisciplinary therapy and neurology follow-up. Her story highlights resilience and progress in the face of intricate medical challenges. The relationship between GBS and surgery has been investigated through multiple studies and some evidence indicates a heightened relative risk of GBS within six weeks post-surgery. GBS management necessitates a multifaceted approach encompassing supportive therapy and immunotherapy. Critical care is often crucial, as 25% of patients might experience respiratory failure, requiring intubation, as in our patient, or temporary pacemaker insertion. Customized rehabilitation programs aim to enhance muscle strength, mobility, and functional independence. Early engagement with physical and occupational therapy, coupled with psychological support, can facilitate smoother recovery and mitigate potential enduring disabilities. The complexities of managing this syndrome necessitate a multidisciplinary approach that revolves around recognizing the possibility and clinical presentation of GBS during the postoperative course. Integrating acute medical intervention with a proper rehabilitation plan that includes physical and occupational therapy, emphasizes the need for comprehensive patient care. Furthermore, a deepened understanding of the pathophysiology and commitment to research in treatment modalities will contribute to the reduction of morbidity and mortality associated with GBS in the post-surgical setting. Further investigation into the mechanistic links between surgery and GBS may also provide insights that could lead to preventative measures and optimized patient outcomes.

Learning Objective 1 Review of GBS pathophysiology and management

Learning Objective 2 Describe the benefit of multidisciplinary approach to GBS and spinal surgery patients

Learning Objective 3 Analyze the relationship between GBS and surgical procedures

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Efficacy of Postoperative Spine Orthosis in the Prevention of Fixation Failure After Surgery for Unstable Thoracolumbar Fractures

Abstract 130

Mark Prasarn, MD, Houston Methodist

Introduction: There is a paucity of data in the literature on the use of postoperative orthosis after surgical stabilization of unstable thoracolumbar injuries. They are known to cause delay in time to ambulation, muscular atrophy, skin irritation, pressure ulcers, respiratory compromise, increased length of hospital stay and increased cost to the healthcare system. Proponents of postoperative thoracolumbar orthosis argue that there are improved rates of arthrodesis, an analgesic effect and theoretical decreased risk of breakage and loosening of hardware. To our knowledge no studies have investigated the efficacy of postoperative bracing for unstable flexion-distraction or extension type injuries of the thoracolumbar spine (AO thoracolumbar spine fracture types B1, B2, B3 and C). Methods: The institutional Research Electronic Data Capture (REDcap) database was used to identify all adult (age >18 years) trauma patients that underwent posterior spinal instrumented fusion (PSIF) for unstable thoracolumbar spine injuries by the orthopaedic spine trauma service at a single urban level-1 trauma center between January 2015 and August 2019 . Patients with incomplete clinical records or non traumatic pathology were excluded. All patients in the study were treated by one of two fellowship trained orthopaedic spine surgeons. Neither of these surgeons routinely uses post operative thoracolumbar orthosis unless there is a nonoperative and noncontigous spine injury that is not stabilized by the construct or if there is poor bone quality noted intraoperatively. Patient data, including spine injury, post-operative orthosis use, and secondary surgeries for loss of reduction were recorded for all patients. The patient's spine injury was further classified using the AO thoracolumbar fracture classification7. The primary outcome was loss of reduction or failure of fixation requiring revision surgery. Results: A total of 129 patients met inclusion criteria. There were 5 (3.9%) AO type A3 fractures, 21 (16.3%) type A4 fractures, 13 (10.1%) type B1 fractures, 47 (36.4%) type B2 fractures, 19 (14.7%) type B3 fractures and 24 (18.6%) type C fractures. 45 patients (34.8%) were treated with a post operative orthosis. 84 (65.1%) patients were treated without a brace. There were only two (1.5%) failures of fixation requiring a repeat trip to the operative room. One of the two failures was braced post-operatively, while the other was not. Conclusion: There is a paucity of data in the literature about the efficacy of postoperative bracing for unstable thoracolumbar spine fractures, specifically the AO type B1, B2, B3 and C injury patterns that comprise the majority (80%) of the patients in this study. Our data demonstrates that hardware failure requiring a repeat trip to the operating room is a rare complication in this population. The incidence of failure was low for both braced and unbraced patients. This suggests that managing these patients postoperatively without a brace is safe and effective. Given our results, the possible physical morbidity associated with bracing, the challenges to rehabilitation and increased cost, surgeons should be judicious in their indications for postoperative bracing after surgery for unstable thoracolumbar injuries.

Learning Objective 1 To discuss the literature regarding bracing after thoracolumbar injuries.

Learning Objective 2 To determine if there are less fixation failures with adjuvant bracing.

Learning Objective 3 To determine if there are more fewer of reductions with adjuvant bracing.

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Is Routine Use of External Spinal Orthoses Necessary After Operative Stabilization of Cervical Spine Injuries?

Abstract 129

Mark Prasarn, MD, Houston Methodist

Introduction There is no consensus in the literature regarding the use of post-operative spine orthoses in spine trauma patients. While cervical orthoses are still commonly used after surgical stabilization, it is not clear that post-operative bracing is effective at reducing the rate of fixation failure or non-union in this patient population1–4. Furthermore, the use of spine orthoses adds expense, commonly delays rehabilitation, increases risk of dysphagia and aspiration, and can contribute to skin and wound breakdown5–10. They are also not well tolerated and disliked by many patients. The purpose of this study is to evaluate the efficacy of post-operative cervical orthoses to prevent fixation failure and loss of reduction after operative treatment of unstable cervical spine injuries. Methods All patients that underwent anterior cervical discectomy and fusion (ACDF) and posterior spinal instrumented fusion (PSIF) for cervical spine injuries at a single , between January 2015 and August 2019 were identified through the institutional Research Electronic Data Capture (REDcap) database11,12. Patient data including cervical spine injury, surgery, post-operative orthosis use, and secondary surgeries for loss of reduction were recorded for all patients meeting the inclusion criteria. The primary outcome was loss of reduction or failure of fixation requiring revision surgery. Statistical analysis was performed using Jamovi (Version 1.1) statistical software13. Results A total of 202 patients meeting inclusion criteria were identified. 133 (65.8%) patients were treated with a cervical orthosis post-operatively and 69 (34.2%) patients were allowed to mobilize as tolerated without a cervical orthosis. 99 patients were treated with ACDF, 73 treated with PSIF, and 30 underwent anterior and posterior cervical fusion at the index surgery. Fixation failure and loss of reduction occurred in 5 (2.48%) patients, 3 (2.26%) patients were treated with a cervical orthosis post-operatively and 2 (2.89%) patients were not. There was no difference in risk of hardware failure between patients in the post-operative orthosis and no orthosis group (p=1.0). There was no difference in loss of reduction and fixation failure between patients that underwent ACDF, PSIF, or both (p=0.214) or number of cervical levels fused (p=.294). Subgroup analysis of surgical approach demonstrated no difference in risk of failure of fixation between post-op orthosis and no orthosis groups. Conclusions The use of cervical orthoses after operative stabilization of cervical spine injuries remains controversial. There was no statistically significant difference in hardware failure or loss of fixation between patients treated in cervical orthoses post-operatively and those that were not. Given the challenges to self-care and rehabilitation, as well as the risks and added cost with the use of post-operative cervical orthoses, surgeons should be judicious in their indications for post-operative bracing.

Learning Objective 1 To determine if cervical collars are routinely used following stabilization surgeries in the cervical spine.

Learning Objective 2 To determine if cervical collars result in less loss of reduction or fixation failures.

Learning Objective 3 To determine if there is a difference in failure rate following anterior or posterior surgery for cervical spine fractures.

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Utility of Augmented Reality and Virtual Reality in Spine Surgery

Abstract 8

Hasan Sumdani, MD, University of Arizona

Background: Augmented reality, virtual reality, and mixed reality (AR, VR, MR) are emerging technologies that are starting to be translated into clinical practice. There is limited data available about these tools being used in live surgery of the spine. The objective of this paper was to systematically collect, analyze, and interpret the existing data regarding AR, VR, and MR use in spine surgery on live people. Methods: A systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA). PubMed, PubMed Central, Cochrane Reviews, and Embase databases were searched. Combinations and variations of "augmented reality", "virtual reality", and "spine surgery" in both AND and OR configurations were used to gather relevant articles. References of included articles from the systematic review were also screened for possible inclusion as a part of manual review. Included studies were full text publications written in English that had any spine surgery on live persons with the use of virtual or augmented reality. Results: A total of 1566 unique articles were found and fifteen full-text publications met criteria for this study. The total number of patients from all studies was 241 with a weighted average age of 50.37. Surgical procedures utilizing AR, VR, and/or MR were diverse and spanned from simple discectomies to intradural spinal tumor resection. All patients experienced improvement in their symptoms from clinical presentation. The highest complication rate mentioned in the articles was 6.1% and was for suboptimal pedicle screw placement. There were no complications that led to clinical sequelae. Conclusions: The systematically collected, analyzed, and interpreted data of existing peer reviewed full text articles showed favorable metrics regarding surgical efficacy, pedicle screw target accuracy, radiation exposure, clinical outcome, and disability and pain in patients with spinal pathology treated with the help of AR, VR, and/or MR.

Learning Objective 1 Organize a comprehensive, single resource regarding augmented, virtual, or mixed reality on living people thus far

Learning Objective 2 Assess accuracy of novel surgical techniques including some form of augmented, virtual, or mixed reality

Learning Objective 3 Analyze patient outcomes in those using novel techniques versus those techniques that have already been established

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Improving Bowel Function in Chronic Spinal Cord Injury with Noninvasive Spinal Cord Neuromodulation: Translational Advances

Abstract 209

Rahul Sachdeva, PhD, ICORD/UBC

Objective: Spinal cord injury (SCI) results in loss of crucial autonomic control, significantly impacting the quality of life. Autonomic dysfunctions (such as impaired bowel function) have been identified as key priorities for recovery by individuals with SCI. 98% of individuals with SCI report at least one bowel issue, such as time needed for bowel management lasting up to 2 hrs, with over 60% reporting that bowel dysfunction adversely impacts their quality of life. Contemporary goals of bowel function management following SCI are mainly focused on symptom management rather than treating the underlying cause to control incontinence, improve defecation and prevent potential complications. We sought to test the efficacy of noninvasive transcutaneous spinal cord stimulation (TCS) to improve bowel function in clinically-relevant experimental SCI in rats as well as in individuals living with chronic SCI. Design/Methods: Pre-clinical: Twelve adult male Wistar rats received a severe midline contusion at the third thoracic segment and were tested for anorectal function using custom-built, balloon-tipped catheter paired with pressure transducers. Anorectal function was measured as rectal pressure at pre-injury and weekly post-injury for 6 weeks. At 6 weeks the rectal pressure was measured in absence and presence of low (1Hz) and high (30Hz) frequency TCS (TESCoN, SpineX Inc.) was delivered at 30Hz, 1ms, monophasic pulses by self-adhesive electrodes placed on the skin at L1 vertebral level (L5-S1 spinal segment). Clinical: Study participants (n=6) with motor complete SCI above T6 were enrolled in this study. Bowel function was assessed via high resolution anorectal manometry. We collected the anal canal resting pressure with and without TCS (TESCoN, SpineX Inc.). The stimulation was also applied to T11 and L1 regions separately to map the relation between TCS and anal canal pressure. The intensity was increased by increments of 13 mA (from 13mA to 130 mA). Results: Pre-clinical: In rats, SCI led to a significant decline in anorectal pressure at 24 h post injury (10.2 control vs. 5.2 mmHg 24 h post SCI; $p<0.05$), and abnormally high pressure in chronic SCI (10.2 control vs. 16.8 mmHg 6 wks post SCI; $p<0.05$). Real-time TCS at both high and low frequency immediately induced bowel contractions. Whether long-term TCS will lead to sustained improvement in bowel function is being investigated. Clinical: Real-time TCS led to increase in anal canal resting pressure in all participants with impaired bowel function. We also observed a graded response during the mapping procedure of both T11 and L1 stimulation, with the anal canal pressure increasing from 79.75± 29.73 and 91.52± 35.64 at baseline to 98.18± 32.04 and 91.52± 35.64 at 130 mA respectively. Conclusion: TCS is a noninvasive, fast-acting and clinically-viable therapy to mitigate bowel dysfunction after SCI. The acute results warrant more sophisticated investigation of TCS as a long-term therapeutic approach for sustained recovery. Support: Wings for Life Spinal Cord Research Foundation, US Dept. of Defense, International Spinal Research Trust

Learning Objective 1 To discuss the bowel dysfunction following SCI.

Learning Objective 2 To demonstrate the efficacy of a noninvasive neuromodulation for functional recovery in rodent model.

Learning Objective 3 To demonstrate the translational potential and efficacy of noninvasive neuromodulation in individuals with SCI.

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Targeting Intraparenchymal Hemorrhage After SCI

Abstract 218

Antje Kroner,MD, PhD, Medical College of Wisconsin

Traumatic spinal cord injury (SCI) is severely debilitating, and survivors experience worsened quality of life as well as a life-long increased need for health care services. Intraparenchymal hemorrhage has long been associated with worsened locomotor outcomes for patients compared to those with non-hemorrhagic lesions and is a known contributor to secondary tissue damage. We and others have reported that the hemoglobin (Hb) released from damaged red blood cells (RBCs) and its breakdown products worsen SCI-associated tissue damage by exacerbating inflammation and oxidative tissue injury. Hb- and heme-binding proteins (e.g., haptoglobin and hemopexin) can capture these endogenous inflammogens and mitigate their deleterious effects. Still the concentration of these proteins in the CNS is insufficient to rescue the hemorrhage-induced injury. Alternative heme-binding proteins like the lipocalin family member alpha-1 microglobulin (A1M) and the serine proteinase inhibitor alpha-1 antitrypsin (A1AT) have additional tissue homeostatic function, including inhibition of reactive oxygen species (ROS). Our recent data demonstrate A1AT and A1M are significantly upregulated after SCI and suppress heme mediated cell death and ROS production in vitro. Furthermore, enhanced expression of A1M produces a critical tissue-protective effect and improved functional recovery after cervical SCI. In summary, our data indicate that A1M and A1AT have the potential to mitigate secondary damage and improve function after SCI.

Learning Objective 1 Discuss the pathophysiological impact of intraspinal hemorrhage

Learning Objective 2 Inform about heme binding proteins

Learning Objective 3 Discuss the therapeutic potential of heme binding proteins to ameliorate heme mediated pathology

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The Concept of Positive Deviance Applied to Spinal Cord Injury Recovery - An Analysis of Medications Received By Patients Exhibiting A Phenomenal Recovery

Abstract 97

Lucie Bourguignon, MSc, ETH Zürich

INTRODUCTION Spinal cord injury (SCI) is a devastating condition for which there exists no pharmacological intervention. Recovery may spontaneously occur, at times to a greater extent than expected based on the initial injury severity, constituting a positive deviance from the norm. This project intends to identify patients exhibiting phenomenal recovery, a type of positive deviance, and study their pharmacological treatments. METHODS Using data from the Sygen clinical trial, we defined severely injured patients as those with American Spinal Injury Association Impairment Scale (AIS) A with no sensory function below L1 at weeks 1 and 4 after injury. Among the patients with severe injuries, phenomenal recovery is defined as a conversion from AIS A to C/D with a motor improvement of more than five points in the upper or lower extremity motor score (UEMS, LEMS) 52 weeks after injury. Alternatively, a "phenomenal recovery" would also be present if LEMS improved by five points alone. We analyzed data about all drugs prescribed in the first 30 days after injury, i.e. in the time window of sustained severe injury. Our analysis focused on prescription of antibiotics, in particular their prevalence and timing of administration. RESULTS 315 of 797 patients (39.5%) corresponded to our definition of a severe injury. Eleven (prevalence = 3.5%) patients exhibited phenomenal recovery, ten as an AIS grade conversion and six on the basis of recovering LEMS by more than five points. All phenomenal recoverers (n=11, 100%) and 200 of the remaining severely injured patients (non-recoverers, 60%) suffered from cervical injuries. A total of 58 distinct antibiotics were prescribed to the 315 patients of interest. Twenty-one were prescribed to both groups (phenomenal recovery and non-recoverers), while 37 were prescribed exclusively to non-recoverers. Vancomycin was more frequently prescribed in the phenomenal recovery group (n=7, 64%), compared to the non-recovery group (n=122, 40%). Eight patients with phenomenal recovery (73%) versus 160 in the non-recovery group (53%) received at least five different antibiotics in the first 30 days. During that time period, a majority of the phenomenal recovery group were prescribed antibiotics for more than half of the days (>=15 days, n=8, 73%), while this proportion was smaller in the non-recovery group (n=176, 58%). CONCLUSIONS We were able to define and describe a cohort of patients that presented with phenomenal recovery after SCI. Our results show a trend towards more antibiotics being prescribed in the group exhibiting phenomenal recovery. It remains to be determined whether they were prescribed for prophylaxis or the treatment of an infection. We intend to later enlarge the drugs of interest beyond antibiotics (e.g. pain and spasticity medications) to identify additional pharmacological interventions promoting phenomenal recovery. Studying SCI patients through the scope of positive deviance will help formulate new hypotheses on how to enhance recovery following SCI, particularly through drug repurposing.

Learning Objective 1 Define a cohort exhibiting a phenomenal recovery

Learning Objective 2 Compare the demographics and injury characteristics in the phenomenal and non-phenomenal recovery groups

Learning Objective 3 Compare the antibiotics prescribed in the phenomenal and non-phenomenal recovery groups

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Ethics, Access, and Inclusion: Human Subjects Considerations for Spinal Cord Injury

Abstract 251

B. Jenny Kiratli ,PhD, VA Palo Alto Health Care System

Two scenarios are considered in this presentation: primary SCI research and inclusion of persons with SCI in non-SCI focused clinical research. (1) Clinical researchers who focus on research involving individuals with spinal cord injury or disorders (SCI/D) are expected to be cognizant of issues such as physical access (eg, wheelchair accessibility) and the need to accommodate physical limitations (eg, availability of adaptive equipment), but may not consider other areas that may present barriers for a research participant with a physical disability. One major consideration is the requirement for a signature on informed consent and HIPAA Authorization documents. There are a number of accommodations that can be implemented at study inception including waiver of documentation of consent and waiver or alteration of HIPAA Authorization, which should be routine practice for SCI researchers in place of the common use of witness signatures and legally authorized representative signatures, which are inappropriate as they derive from a basis of compromised competency. Further, the concept of informed consent becomes paramount for high-risk studies (eg, stem cell transplants or novel translation techniques) especially where the participant's perceived expectation of benefit may be based more on hope than realistic understanding of the study protocols and potential outcomes. Techniques such as teach-back after the consent discussion should be utilized to ensure the level of comprehension prior to obtaining a signature, and the tendency toward therapeutic misconception should be actively explored and corrected, even at the risk of losing participants. (2) Clinical researchers whose research areas include conditions and treatments of relevance to persons with SCI/D may be resistant to including participants who are disabled. Recently, consensus recommendations have been proposed to ensure diverse population samples in clinical trials so as to make the research outcomes more broadly applicable. This includes inclusion of participants with disabilities. Numerous barriers exist that must be overcome before this can become common practice including architectural/environmental (eg, wheelchair accessibility), behavioral (eg, safe handling), and attitudinal. While differences in physiological responses due to neurogenic origin may alter study findings if participants with SCI/D are included, this could be managed within the data analysis rather than exclusion from participating. Researchers without experience nor exposure to the SCI/D population would benefit from education regarding respect (eg, person-first terminology) and autonomy (eg, signature issues, as above). Engagement of research collaborators and partners with lived experience can help researchers to avoid many of the ethical quagmires surrounding enrollment of this population. Given that sample sizes of SCI-focused studies are often too small to yield significant results, SCI researchers and advocates should work to ensure inclusion of participants with SCI/D in large clinical trials so as to expand research on treatments and outcomes that may address commonalities as well as differences.

Learning Objective 1 Identify elements of the Belmont Principles that must be accommodated for inclusion of people with SCI in clinical research.

Learning Objective 2 Discuss barriers to inclusion of people with SCI in clinical research.

Learning Objective 3 Assess advantages of broader inclusion of people with SCI in clinical research.

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Isn't it GRANND? Grasp-Release Assessment for a Networked Neuroprosthesis Device – A Clinical Trial Update

Abstract 194

Anne M. Bryden, PhD, OTR/L, MetroHealth Center for Rehabilitation Research

Objective To provide an overview of the design of the multi-site clinical trial entitled, Grasp-Release Assessment for a Networked Neuroprosthesis Device and present results from its first three participants. Design A pivotal, prospective, non-randomized, un-blinded, multi-methods single-arm trial of a device that restores functional grasp. Methods Eligible participants will undergo NNP implantation and participate in functional training and outcomes assessment at 3, 6 and 12 months. The primary outcome measure is the Grasp and Release Test (GRT). Secondary outcome measures include grasp force, Canadian Occupational Performance Measure (COPM), SCIM-III Self-Care Scale, and qualitative interviews. Results Preliminary results in our first three participants show improved performance in the GRT. Two participants who were unable to acquire any objects without the NNP were able to acquire 4 and 6 out of 6 objects respectively with the NNP. Another participant was able to acquire 2 objects without the NNP and all 6 objects with the NNP. GRT objects, and improvement in ADL performance as evidenced by the COPM and SCIM-III. Preliminary COPM results show that all three participants had improvements in performance and satisfaction scores by two points or greater compared to pre-implantation scores. There was no difference in SCIM-III scores at three months post-implantation. Early, emerging themes from qualitative interviews include insights about decision-making to have NNP surgery, post-operative experiences, excitement about hand moving for the first time, and experiences learning to use the NNP. Conclusions The NNP system provides increased strength and functional ability of the hand and arm. Efforts are being made to successfully translate this technology to commercial availability.

Learning Objective 1 Understand the study design for the GRANND Trial

Learning Objective 2 Identify candidates who may benefit from a neuroprosthesis

Learning Objective 3 Describe the outcome measures for assessing results after neuroprosthesis implantation

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Pilot Data to Develop a Multivariate Classification System for Upper Extremity Function and Participation Among People with Tetraplegia

Abstract 102

Ana Valeria Aguirre Guemez, MD, MedStar National Rehabilitation Hospital

Background: More than 50% of all spinal cord injuries (SCI) occur at a cervical level1. The highest priority for individuals with tetraplegia is restoration of upper extremity (UE) function,2,3 which translates to better quality of life, return to work and social participation4. Even small improvements in motor function, attained via tendon or nerve transfers can significantly improve independence with instrumental and activities of daily living. The use of electrodiagnosis for surgical planning is useful, but limited, as no functional outcomes are taken into consideration.5 Criteria to predict successful post-surgical functional outcomes with tendon/nerve transfers are yet to be defined. Objective: To use the Spinal Cord Injury Model Systems (SCIMS) dataset to determine longitudinally, patient and SCI specific factors that are significant determinants of UE performance and well-being for individuals with cervical SCI. Methods: Retrospective analysis from adults with a traumatic cervical SCI admitted to a SCIMS rehabilitation center between October 2016-May 2023. Follow-up records at 1 and 5 years post injury were included. This is a descriptive report of sample demographics, health conditions, and outcomes on structure, function, activities, participation, and quality of life. Results: Records from 1499 individuals who sustained a traumatic cervical SCI and who were admitted to a SCIMS center were analyzed. 1391 were followed at 1 year, and 108 at 5 years post injury. 77.3% were male at birth, with a mean age of 47.27±17.4. At rehabilitation admission, ASIA Impairment Scale (AIS) classifications were 24% A, 13.2% B, 22.9% C, 35.7% D, and 4.2% unknown. At discharge, AIS classifications were 20.4% A, 12.5% B, 16.7% C, 49.8% D and 0.6% unknown. The motor level at rehab discharge was at C5 (26%), C6 (19%), C4 (10%). The neurological level of injury (NLI) at discharge was 34.2% at C4 and 21.4% at C5. At 1 and 5 year follow-up (FU), more than 75% of the neuro outcomes were missing. From those reported: NLI at C4, sensory level C4, motor level C5, and AIS D, were the most prevalent. Before injury 96.9% were living at their private home and 0.1% at a nursing home, 66.8% were working, 16.1 retired and 8.8% unemployed. At their 1- and 5-years FU 90.7% were living in a private home and 5% in a nursing home, 40.9% unemployed, 28.4% retired, and 16.4% working. For the PHQ-9 at rehab discharge 60.7% had no depressive symptoms, 26.4% had mild, 6.7% moderate, 1.7% moderately-severe and 0.5% severe. At FU 51.2% had no depressive symptoms, 22.7% mild, 8.9% moderate, 4.6% moderately-severe and 2% severe. Conclusion: The population of people in the US (as represented by SCIMS data) with tetraplegia is characterized by: incomplete injury and motor levels predominantly at C5> C6> C4. The completeness of the injury and their functional level are part of the SCI factors that will determine UE performance. Outcomes such as the decreasing number of persons returning to work and/or their home, and the increase on individuals that are moderately to severely depressed, relate to diminished quality of life and social participation.

Learning Objective 1 Revise the SCIMS dataset as pilot data to, (1) refine our analytic approach for longitudinal modeling of multivariate data and (2) determine significant patient and SCI specific factors that lead to good vs poor long-term quality of life.

Learning Objective 2 Assess what determines a successful motor function recovery after tendon and/or nerve transfer procedures in the SCI population.

Learning Objective 3 Utilize the results to develop a longitudinal model that will serve as a reference for our future goal, which aims to develop a decision-making algorithm to be used by clinicians to determine candidacy of individuals with tetraplegia, to undergo surgery to ensure the optimal functional outcomes after nerve and/or tendon transfers.

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A Simplified Neuroprosthesis for Lateral Pinch in Cervical Spinal Cord Injury: Proof Of Principle

Abstract 155

Megan Moynahan, MS, Case Western Reserve University

Objective: Restoration of hand function represents the highest priority for people with cervical level spinal cord injury (SCI) [Anderson 2004]. Neuroprosthetics that use low levels of electrical current to activate nerves of paralyzed muscles offer the most promising method of providing hand function [Peckham 2001; Kilgore 2009]. We are developing a simplified neuroprosthesis that is designed for commercialization. Following dozens of interviews with engineers, surgeons, therapists, people living with SCI, business experts, regulatory and reimbursement specialists, and members of industry, we identified two critical design requirements: 1) the neuroprosthesis must offer reliable hand grasp for daily use; and 2) it must be implantable in an outpatient procedure. Interviews also highlighted acceptable design trade-offs: 1) it could offer only one grasp option, lateral pinch, to enable users to manipulate daily-use objects; 2) it could feature passive powering (that is, through the skin via an external component) to assure high reliability and fewer surgical revisions. The purpose of this study is to demonstrate that a simplified neuroprosthesis with only 2 or 3 electrodes can provide functional grasp to people with cervical SCI. Methods: We recruited five (5) people from our prior and current research studies who already have an implanted neuroprosthesis for hand grasp with 8, 10, or 12 electrodes. These candidates are typically C5/C6 AIS A-C. For the study, participants had to have lateral pinch as one of their grasp options. Their implants were temporarily reprogrammed to only activate 2 or 3 of the muscles used for lateral pinch. Participants were then evaluated for pinch strength and ability to manipulate the three objects of the Grasp-Release Test (GRT) validated for lateral pinch (peg, weight, fork). Results: Preliminary results on the first three (3) individuals are presented. Lateral pinch was created with two (2) electrodes by activating either flexor digitorum profundus or flexor digitorum superficialis; and either flexor pollicis longus or adductor pollicis. A third electrode was added either from among those options to increase force production, or by adding extensor pollicis longus to achieve active hand opening. Participants showed an increase in pinch force with stimulation ON (median: 8.15N) compared to OFF (median: 2.97N), with identical force production with either two electrodes or three. Participants showed an increase in the number of GRT objects successfully manipulated with stimulation ON (median: 3 objects) compared to OFF (median: 1 object). A clinically meaningful change on the GRT is an increase of at least one object. Better performance on the GRT was observed with the 3-electrode lateral pinch configurations (median: 3 objects) compared to the 2-electrode configurations (median: 2 objects). Conclusion: A simple neuroprosthesis featuring 2- or 3-implanted electrodes, configured to provide lateral pinch, can provide improved grasp strength and ability to manipulate standard objects compared to no stimulation in people with cervical spinal cord injury. Support: Coulter Translational Research Partnership, JobsOhio, and Ohio Development Services Agency.

Learning Objective 1 Describe the minimal design requirements for an implanted neuroprosthesis that provides lateral pinch to people with cervical spinal cord injury.

Learning Objective 2 Identify the muscles used in stimulated lateral pinch

Learning Objective 3 Describe the preliminary outcomes in pinch force and Grasp Release Test for people with implanted neuroprosthetics for lateral pinch

AMERICAN SPINAL INJURY ASSOCIATION
ANNUAL SCIENTIFIC MEETING
MAY 20-23, 2024 · SAN JUAN, PUERTO RICO

Chronic Electrical Stimulation to Reduce Bladder Hyperreflexia

Abstract 60

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Background: Neurogenic bladder is among the most common complications associated with spinal cord injury, multiple sclerosis, and stroke. Bladder inhibition and continence have been demonstrated using genital nerve stimulation (GNS) in acute studies (1-5). However, it is unknown if GNS can improve urinary continence or help meet individuals' bladder management goals during sustained use, which is required for GNS to be clinically effective. This work is a continuation of the work done by Cleveland FES Center investigators at the LSCDVAMC (6) Study Objective: By using take-home stimulation devices, the long-term effectiveness of GNS for increasing bladder capacity and decreasing incontinence episodes can be tested. Proposed Hypotheses Hypothesis 1.1: GNS will increase bladder capacity and decrease incontinence episodes over one year of extended testing Hypothesis 1.2: Subjects will need to catheterize less frequently and will be able to intake more fluids than they did before GNS Hypothesis 1.3: GNS will have a beneficial effect on quality of life, as shown by periodic standard surveys taken by subjects Study Design: Experiments will be conducted in 30 individuals with suprasacral SCI. All participants will undergo the same initial urodynamics testing. In this session, urethral and anal catheters will measure bladder and abdominal pressures, respectively. A host computer will communicate with a data acquisition board to acquire the transduced pressure signals and will trigger the stimulator device. The stimulator will then provide electrical stimulation across two surface electrodes placed on the dorsum of the penis, targeting the genital nerves. All participants will receive fully functional take-home stimulators programmed to the parameters (such as bladder capacity, threshold for the pudendo-anal reflex, and stimulus parameters) determined during initial testing. Urodynamics testing will occur at 6 and 12 months after the initial testing session. For a designated period of time surrounding these testing sessions, participants will keep a diary log of their stimulator use, urinary habits, and leakage events. Results: Our primary variable is bladder capacity, which will be used to power the study. In our preliminary data, the average bladder capacity increased in response to GNS from 340 mL to 420 mL, with a pooled standard deviation of 100 mL. A pair-sampled, one-sided t-test with n=10 subjects would have a statistical power of just over 0.8. Conclusion: This study is a step toward a human feasibility study of an implanted system that has the potential to make a significant improvement in the lives of people with SCI and neurogenic bladder overactivity. For the current study, patients will be preferentially selected if they would be considered possible future candidates for an implanted future device – and therefore potentially benefit from the overall study in the future. Additionally, subjects may experience an increase in quality of life for the duration of the experiment if the intervention successfully manages neurogenic bladder activity, as we expect.

Learning Objective 1 To describe the development of an easy and effective home stimulator design for neurogenic bladder

Learning Objective 2 To analyze the increase in bladder capacity over one year of extended testing of GNS

Learning Objective 3 To describe the long-term ability of GNS to reduce incontinence and improve quality of life

American Spinal Injury Association
Annual Scientific Meeting
May 20-23, 2024 · San Juan, Puerto Rico

Urinary NADH Levels as A Biomarker for Bacterial Metabolic Activity and Bladder Inflammation Among People With NLUTD

Abstract 222

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Background: People with neurogenic lower urinary tract dysfunction (NLUTD) due to spinal cord injury/disease (SCI/D) are more susceptible to urinary tract infections (UTIs). The standard of care for UTI diagnosis is the presence of urinary symptoms, bladder inflammation (urinalysis (UA)), and bacterial growth (standard urine culture(SUC)). People with NLUTD often have persistent bladder inflammation and bacteria in the absence of symptoms, so UTI diagnosis may not always align with standard diagnostic procedures. Additionally, the SUC takes 48-72 hours to complete and is not representative of the entirety of the urobiome. The presence of a urobiome has been established, which contains both beneficial bacteria and opportunistic uropathogens. Diagnostics need to evolve to be consistent with our understanding of the urobiome. Nicotinamide adenine dinucleotide hydrogen (NADH) is a metabolite that holds potential as a biomarker of urobiome bacterial activity. Bacteria release autofluorescent NADH in their metabolic processes. Its level of fluorescence (signifying NADH concentration) is quantified with relative fluorescent units (RFUs). The Jiddu® Analyzer [Astek Diagnostics, Inc.] can rapidly quantify NADH (as RFUs) as a measure of urobiome bacterial metabolic activity. Objective: Determine if there is a correlation between NADH levels and nitrite and LE (determined by urinalysis) among people with NLUTD due to SCI/D. Methods: This is a cross-sectional study of 136 participants. Inclusion criteria are ≥ 18 years of age and NLUTD. Medical history, bladder management (voiding=V; intermittent catheterization=IC, or indwelling catheterization=IDC) and one urine sample were collected. The urine sample was assessed separately using the Jiddu® Analyzer and urinalysis. Nitrite was either positive or negative and LE was defined as “positive” (≥ 2) and “negative” (< 2). Urinalysis definitions were: nitrite+ and LE+ = “UA+”; nitrite- and LE- = “UA-“; nitrite+ and LE- = “indeterminant”; and nitrite- and LE+ = “inflammation+”. NADH (in RFUs) was defined as: “NADH+” > 2 RFU; “NADH inconclusive” 1-2 RFU; and “NADH-” < 1 RFU. Results: This is an interim analysis of 36/136 samples. There were 15 female and 21 male participants. 11 participants voided, 16 used IC, and 9 used IDC. There were 7 NADH+ samples: N=5/16 IC; N=2/9 IDC; and 0/11 void. 4/7 (57%) were UA+, 3/7 (43%) were indeterminant or inflammation positive, while 0/7 (0%) were UA-. There were 23 NADH- samples: N=9/11 V, N=9/16 IC, and N=5/9 IDC. 14/23 (61%) were UA-, 8/23 (35%) were indeterminant or inflammation+, and 0/23 (0%) were UA+. There were 6 NADH inconclusive samples: N=2/11 V, N=2/16 IC, N=2/9 IDC. Amongst this group, 4/6 (67%) were UA+, 2/6 (33%) were UA-, and 0/6 (0%) were indeterminant or inflammation+. Conclusion: This trial of urine NADH as a biomarker for bacterial metabolic activity suggests preliminary positive and negative agreement with nitrite and LE levels. This approach is advantageous as it assesses bacterial metabolic activity of the urobiome. Future work will explore NADH in the context of 16s rRNA and shotgun sequencing to better determine its role in diagnosis.

Learning Objective 1 Discuss the implications of the Jiddu® analyzer for NADH, nitrite, and LE in those with NLUTD.

Learning Objective 2 Compare NADH levels with nitrite and leukocyte esterase levels.

Learning Objective 3 Describe the role of urine NADH as a potential biomarker.

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Within Individual Urinalysis and Urine Culture Variation with Symptoms Among People with Neurogenic Lower Urinary Tract Dysfunction Who Use Indwelling Catheterization

Abstract 257

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Background: The current diagnosis of urinary tract infection (UTI) among people without neurogenic lower urinary tract dysfunction (NLUTD) involves the presence of 1) urinary symptoms indicative of UTI; 2) urinary inflammation detectable on urinalysis (UA); and 3) bacterial load detectable on urine culture (UC). UTI diagnosis in individuals with SCI/D and NLUTD is complex due to altered perception of symptoms and the presence of bladder inflammation and bacteriuria in the absence of symptoms. The Urinary Symptom Questionnaire for Neurogenic Bladder (USQNB) used to assess symptoms indicative of UTI in indwelling catheterization (IDC) users includes symptoms categorized into actionable (A), bladder (B1), urine quality (B2), and other (C) symptoms. Objective: To determine whether real time variability in bladder inflammation (detected by WBC count on UA) and bacterial load (determined by bacterial growth on UC) correlates with urinary symptoms in individuals who manage their bladder with IDC. Method: This is a substudy of a larger cross-sectional study aiming to define healthy urine in individuals with SCI and NLUTD who use IDC. In that study, our intent is to collect 2 asymptomatic urine samples during catheter changes, defined as no endorsement of urinary/bladder symptoms on the self-administered USQNB-IDC for 72 hours pre and every 24 hours for 72 hours post urine collection. If symptoms developed within 72 hours postcollection we categorized the prior urine sample as presymptomatic. 7 participants (2 females, 5 males, mean age 57 years ± 10 years) provided at least one presymptomatic urine sample with 10 unique events. These presymptomatic samples were compared with asymptomatic samples to determine if UA or UC predict development of urinary symptoms. Results: The most common USQNB-IDC symptoms reported were category B1/B2 Bladder Specific (70% endorsement). Transition events (TE) were categorized into 3 groups: 3 TEs endorsed only B2 symptoms, 3 TEs endorsed A and B1 symptoms and one TE endorsed A and C symptoms. Corresponding UA/UCs collected at the time of USQNB reporting for these TEs showed that in the B2 only group, the TEs included 1/3 with increased nitrates and LE, and 2/3 with increased WBC count. In the A and B1 group, 3/3 TEs included increased WBC count and LE and 1/3 showed increased nitrates. In the A and C group, the TE showed an increase in WBC count and LE. No clear trends emerged in UC. Discussion: These results are consistent with previous findings that demonstrate that this set of symptoms are most often endorsed by people with NLUTD. In the context of clinical practice, this affirms the need for sensitive and specific diagnostic testing and criteria outside of UA/UC, as this analysis encountered patients reporting urinary symptoms with/without bacteriuria. None of the 7 participants reported medical intervention or being treated with antibiotics. Conclusion: This is the first descriptive characterization that we know of attempting to identify the real time transition in symptoms with change in UC. While further statistical testing is needed to establish a significant difference, this preliminary characterization does elucidate a clear trend in the type of urinary symptoms, UA results, and the TEs. Support: NIDILRR

Learning Objective 1 Discuss asymptomatic bacteriuria in indwelling catheterization

Learning Objective 2 Compare symptom profiles to trends in asymptomatic and presymptomatic urinalyses and urine cultures

Learning Objective 3 Utilize trends between asymptomatic and presymptomatic urinalyses and urine cultures to inform clinical practice

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Are AI-Based Conversational Agents a Reliable Support for Wheelchair Service Providers During The Selection of Appropriate Wheelchairs?

Abstract 244

Alberto Isaac Perez Sanpablo, DSc, National Institute of Rehabilitation Luis Guillermo Ibarra Ibarra

Objective: Although there are initiatives to address the problem of training for the supply of wheelchairs for individuals with spinal cord injury, such as the Wheelchair Service Training Package (WSTP), studies have shown issues of consistency in the application of the stages of the process. The selection of the wheelchair is a fundamental part of the process. AI-based conversational agents could help staff by providing decision support and suggestions. However, agents can present errors. Therefore, this work aims to evaluate the accuracy and reliability of the information supplied by conversational agents to wheelchair service providers as support during the selection of appropriate wheelchairs. Methods: Three agents (ChatGPT-3.5, Bing Chat, Bard) were selected due to their accessibility. The work was carried out in two stages. In the first stage, the ability of the agents to retrieve specific information on locally available wheelchairs was evaluated. Agents were asked to retrieve information on eleven locally available wheelchair models and fill out the WSTP Basic Level (WSTPb) Wheelchair Summary Form. The consultations were carried out twice. First, a prompt template was used to ensure the recovery of all information. In the second, prompts were added for the agent to review and identify errors in their response. In the second stage, the agents were assigned the role of wheelchair service personnel to select a wheelchair for a user. Two modified WSTPb histories were provided, including body measures and the list of available wheelchairs. Here, the agents used prompts to suggest alternatives to their answers, justify them, identify errors, and fill out the wheelchair summary form. All queries were performed twice to assess reliability. Accuracy was evaluated by two WSTPb experts. Descriptive statistics were performed for accuracy, Kappa index calculation for agreement, and intraclass classification coefficient calculation for reliability. Results: In the first stage, without prompts, Bard and Bing chat correctly retrieved 47-88% of the information with a 34% agreement—the addition of prompts modified 21% of Bing Chat responses. In the second stage, ChatGPT-3.5 and Bing chat correctly identified 17-33% of key wheelchair requirements. No agent could accurately present the calculation of the ideal wheelchair size. The agreement between evaluators was 70%, and the reliability was 88%. Conclusions: Agent conversations with internet access can help wheelchair service providers retrieve detailed information in specific formats. However, responses must be verified, and interactions that affect accuracy must be handled. Agents have problems making calculations and identifying useful information to match user needs with available solutions. Support. None.

Learning Objective 1 To evaluate the accuracy and reliability of AI-based conversational agents in providing information to wheelchair service providers when selecting appropriate wheelchairs.

Learning Objective 2 To assess the effect of using prompts to improve the accuracy of AI-based conversational agents in providing information to wheelchair service providers.

Learning Objective 3 To assess the effect of using prompts to improve the accuracy of AI-based conversational agents in providing information to wheelchair service providers. • To determine the limitations of AI-based conversational agents to make calculations and identify useful information to match user needs with available wheelchair solutions.

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Rotator Cuff Tendon Pathology is Associated with Satisfaction with Life in Pediatric and Adult Manual Wheelchair Users with Spinal Cord Injury and Dysfunctions

Abstract 239

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Objective: There are 368,000 individuals with spinal cord injury and dysfunctions (SCI/D) in the United States and many rely on a manual wheelchair for daily mobility [1,2]. Nearly 84% of these individuals will experience shoulder pain and most will develop rotator cuff tendon pathology, unfortunately, often at a younger age than would be typically expected [3-6]. Rotator cuff tendon pathology is known to contribute to upper extremity dysfunction and lead to loss of independence and decreased quality of life [7,8]. Despite this, the relationships among determinants of quality of life in manual wheelchair users remain unclear [4,9,10]. Thus, we hypothesized that increased shoulder pathology would decrease self-reported independence and satisfaction with life. Design/Methods: The Satisfaction with Life (SWL) Scale, Spinal Cord Independence Measure (SCIM III), and the Wheelchair Users Shoulder Pain Index (WUSPI) outcome measures were administered to 42 manual wheelchair users with SCI/D. We found that 11 children (6-16 years, 7 SCI, 3 spina bifida, 1 transverse myelitis) reported SWL: 5±12, SCIM III: 64±13; WUSPI: 0.3±25; 12 adults with pediatric-onset SCI/D (20-60 years, 9 SCI, 3 spina bifida) reported SWL: 21±7, SCIM III: 62±12, WUSPI: 25±25; and 18 adult-onset SCI (19-67 years) reported SWL: 21±9, SCIM III: 62±11, WUSPI: 25±21. Standardized clinical musculoskeletal ultrasound was used to assess the presence of rotator cuff tendon pathology in both shoulders of participants. Correlations among continuous outcomes measures and categorical rotator cuff tendon pathology were assessed. Results: 17 (40%) participants were free of rotator cuff pathology, 10 (2.4%) participants had unilateral pathology, and 14 (33.3%) had bilateral pathology. There was a correlation between the number of affected shoulders and SWL (r=0.397, p=0.012). Over half of participants reported being at least slightly dissatisfied with life, with the mean SWL scores lower in children than in adults. No correlation was identified between the number of affected shoulders and the SCIM III (r=0.093, p=0.562) or WUSPI scores (r=0.207, p=0.194). Conclusion: Contrary to our hypothesis, satisfaction of life was higher for those with rotator cuff tendon pathology than those without. SWL was also higher for adults than children. Notably three children were found to have evidence of rotator cuff tendon tendinosis or partial thickness tears. Interestingly, we found a lower amount of shoulder pathology in adults who sustained their SCI/D as a child than an adult. Consistent with other studies, no clear correlation was identified between shoulder pain and pathology [11,12]. Rotator cuff pathology may be present in those leading a more active lifestyle with greater participation in the community, which could lead to higher quality of life [13,14]. Pathology, however, was not related to independence in manual wheelchair users with SCI/D. Additional research is underway to investigate additional factors of level of injury and time since injury. Future directions will elucidate the relationships among physical activity, participation, and independence for a better understanding of how quality of life is influenced by shoulder pain and pathology. Support: NICHD of the NIH (1R01HD098698)

Learning Objective 1 identify relationships among between rotator cuff tendon pathology and patient-reported measures of independence, satisfaction with life, and shoulder pain in manual wheelchair users with SCI/D.

Learning Objective 2 Review implications of the relationship between shoulder pathology and quality of life and implications for recommendations for physical activity in manual wheelchair users with SCI/D.

Learning Objective 3 Discuss the influence of shoulder pain and pathology on independence in manual wheelchair users with SCI/D.

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Assessing the Quality of Information for patients on Wheelchair Services Provided by Conversational Agents based on Artificial Intelligence

Abstract 186

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Objective: Using conversational agents based on artificial intelligence is a growing health interest topic. Agents have demonstrated their ability to answer complex questions about health. Agents could be the new means for patients to access health-related information. One study found that ChatGPT-generated patients' cardiac health-related answers were as reliable as Google ones. However, more research is needed. On the other hand, individuals with spinal cord injuries require appropriate wheelchairs to maintain or improve their quality of life. However, only 15% have access to it. The need for more information and trained professionals for wheel supply is a worldwide barrier. To improve this situation, the World Health Organization created the Wheelchair Service Training Package (WSTP). Although progress has been made, there is still work to be done, and this is where conversational agents could help improve access to information for users, caregivers, and potential wheelchair service providers in an accessible and personalized way. However, conversational agents may have biases and knowledge gaps that generate misconceptions and outdated information, so it is necessary to study the accuracy and reliability, especially regarding basic information on wheelchair services. Then our objective was to evaluate the quality of the medical information conversational agents provide according to the basic level of WSTP. Methods: Three agents (ChatGPT-3.5, Bing Chat, Bard) were selected for accessibility. The quality of the agents' responses on basic wheelchair service issues and frequent alterations in wheelchair users was evaluated using the Ensuring Quality Information for Patients (EQIP) tool modified according to The EQIP tool has 36 elements divided into content, identification, and information structure domains. The tool was reformulated as a question entered by each conversational agent. Two experts assessed the accuracy of the answers based on the Basic WSTP. The queries were repeated twice during August 2023 to measure the reliability of the conversational agents using the intraclass compensation coefficient (ICC). Descriptive statistics and analysis of agreement between evaluations were performed. Results: The conversational agents presented an average information quality score of EQIP=45±5%, ranging between 40 and 48% for Bard and Bing chat, respectively. The domain with the highest average score was content with 62±10%, where all the agents' showed problems providing quantitative data, costs, and specific contact information. In the identification domain, all the agents received 16% quality since, due to their nature, the origin of the information used by the agent cannot be traced due to the presence of hallucinations. All the agents presented answers with good structure and tone but with complex, ambiguous language, receiving an average score of 33% in structure. The inter-rater agreement was 0.7 ($P<0.05$). The reliability of the answers provided by the conversational agents was 100%. Conclusions: The quality of the information provided by conversational agents regarding wheelchair service issues is still limited and should be handled with caution due to information content, structure, and traceability issues. Support. None.

Learning Objective 1 To evaluate the reliability and quality of the information provided by the conversational agents to wheelchair users regarding the Wheelchair Service Training Package – Basic level.

Learning Objective 2 To compare the quality of the responses provided by different conversational agents on issues related to wheelchair services and frequent complications in wheelchair users.

Learning Objective 3 To analyze the limitations and cautions associated with using conversational agents as sources of information about wheelchair services for patients in terms of content, structure, and traceability of data.