

PODIUM SESSION ONE:

0952

ABSTRACT 1

Establishing a cardiovascular disease risk profile for individuals with spinal cord injury

Matthew C. Dorton, Sonja de Groot, Marcel Post, & Victoria E. Claydon.

Introduction/Objectives: Cardiovascular disease (CVD) is the leading cause of mortality following spinal cord injury (SCI). Obesity, injury characteristics and impaired autonomic function may influence the increased CVD risk following SCI. We aimed to further understand the role of these variables and establish cut-points for CVD risk for individuals with SCI.

Methods: We performed a multicentre cross-sectional study of individuals with traumatic SCI (n=257, 61 females, aged 47±9 years, duration of injury [DOI] 23±9 years). Risk factors for CVD included: waist circumference (WC); body mass index (BMI); waist-to-height ratio (WHtR); DOI, level, and completeness of injury; resting blood pressure; and peak heart rate (HR peak) response to exercise (n=126).

Results: Most lesions were cervical (45%) or thoracic (50%); 71% were motor/sensory complete and 78% had lesions that could affect cardiovascular autonomic control. WC was the most strongly correlated anthropometric measure with CVD risk ($r=0.439$; $p<0.0001$). The area under the curve was significantly higher ($p<0.05$) for WC (0.69) than WHtR (0.66) and BMI (0.65). The optimum WC cut-point was 96cm. Akaike information criteria identified important predictors for CVD risk: DOI (importance 1.0, estimate 0.30 ± 0.06); chronotropic incompetence ($HR_{peak}\leq 125bpm$) (importance 0.89, estimate -4.26 ± 2.38), WC (importance 0.83, estimate 0.12 ± 0.08), and HR_{peak} (importance 0.81, estimate -0.06 ± 0.03).

Conclusions: DOI, WC, and HR measures are important variables for CVD risk following SCI. WC

provides a convenient predictor of CVD risk after SCI and a healthy WC is smaller than in the able-bodied.

1005

ABSTRACT 2

A study evaluating the implementation of the Graded Repetitive Arm Supplementary Program (GRASP) for individuals with stroke in a local community centre

Chieh-ling Yang, Marie-Louise Bird, & Janice J. Eng.

Objectives: The Graded Repetitive Arm Supplementary Program (GRASP) is a stroke rehabilitation intervention shown to improve arm and hand function under randomized controlled trial settings. However, translating evidence-based interventions to "real-world" settings while maintaining the fidelity is challenging. The aim of this study is to evaluate the implementation fidelity of the GRASP delivered by trained instructors in a local community centre.

Methods: Prior to implementation, instructors who had the intention to deliver the GRASP participated in a workshop, which consisted of lectures, hands-on practice, discussion, and evaluation of the confidence and knowledge of delivery the GRASP. A fidelity checklist was embedded in the workshop to emphasize the critical principles and components that were required for intervention fidelity.

Results: Adaptions were instituted by the study team to contextualize the GRASP for the community centre, which included increasing the program length to 10 weeks and running as weekly 60-min group classes with individualized homework. All instructors improved their confidence and knowledge of delivery of the GRASP after the workshop. The fidelity checklist was successfully used as the audit tool for the ongoing program during in-class observation to assess the extent to which the GRASP is delivered as intended.

Conclusion: We have demonstrated that the workshop embedded with a fidelity checklist improved the instructors' confidence and knowledge of the GRASP which may, in turn, enhance the implementation fidelity. The results from the ongoing study will not only inform the feasibility of translating GRASP into the community settings but also serve as the first step for future larger-scale implementation.

1018

ABSTRACT 3

Advice to rest for more than two days after mild traumatic brain injury is associated with delayed return to productivity: A case-control study

Noah D. Silverberg & Thalia Otamendi.

Objectives: Following mild traumatic brain injury (mTBI), gradual return to activity after 1-2 days of rest is now endorsed, which differs from previous recommendations to rest until symptoms subside. The present study aimed to: (i) document the state of de-implementation of prolonged rest advice, (ii) identify patient characteristics associated with receiving this advice, and (iii) examine the relationship between exposure to this advice and clinical outcomes.

Methods: In a case-control design, 146 participants were recruited from two Canadian publicly-funded concussion clinics and queried for: (i) post-concussion, anxiety, and depression symptoms; (ii) return to work status; and (iii) exposure to rest with the question: "Were you advised by at least one health professional to rest for more than 2 days after your injury?"

Results: 82.9% of participants reported being advised to rest longer than 2 days. This was not associated with gender, race, age, history of prior mTBI(s) or psychiatric problems, loss of consciousness, or access to financial compensation in logistic regression modeling (95% CI for odds ratios all included 1.0). In generalized linear modeling, exposure to prolonged rest advice predicted return to productivity status at intake (1-

2 months post-injury), even when controlling for potential confounds with regression-based propensity matching. The exposure group had marginally (non-significantly) higher post-concussion, depression, and anxiety symptoms.

Conclusions: mTBI patients continue to be told to rest for longer than recommended. The present study adds to the growing evidence that prolonged rest is generally unhelpful. We could not identify patient characteristics associated with getting prolonged rest advice

1031

ABSTRACT 4

Double and quadruple the dose during stroke inpatient rehabilitation improves walking recovery: Results from the Determining Optimal post-Stroke Exercise (DOSE) randomized controlled trial

Tara D. Klassen, Sean P. Dukelow, Mark T. Bayley, Oscar Benavente, Andrei V. Krassioukov, Teresa Liu-Ambrose, Sepideh Pooyania, Marc J. Poulin, & Janice J. Eng.

Background: As intensive therapy provided very early post-stroke has shown to hinder recovery, we investigated the effect of high therapeutic doses during inpatient rehabilitation, typically commencing 1-4 weeks post-stroke.

Methods: The Determining Optimal post-Stroke Exercise (DOSE) blinded-assessor randomised controlled trial recruited from six Canadian inpatient rehabilitation units, between 2014-2018 (ClinicalTrials.gov Registration NCT01915368). Subjects (n=75) were randomised into: Control (Usual Care) physical therapy (PT), n=25, typically 1 hour, 5 days/week; DOSE1, n=25, 1 hour, 5 days/week, more than double the intensity of Control (based on aerobic minutes and walking steps); and DOSE2, n=25, more than quadruple the intensity of Control, over 2 hours, 5 days/week, each for 4-weeks duration. The primary outcome, walking endurance at completion of the 4-week intervention (post-evaluation), was compared across these groups using linear regression, while controlling for the baseline measure. Secondary outcomes used the same analysis.

Results: Time post-stroke to study randomisation (days) was 27 (SD=10, range=7-56 days). The mean daily session activity (minutes \geq 40% HRR/steps) was: Control (11 min/623 steps); DOSE1 (27 min/2171 steps); DOSE2 (52 min/4539 steps). Both DOSE1 (61m, 95%CI=9-113,p=0.02) and DOSE2 (58m, 6-110,p=0.03) had greater walking endurance than Control at the post-evaluation, exceeding the minimal clinical important difference of 50m. Despite twice as much activity undertaken in DOSE2 over DOSE1, their improvements were similar. Significant improvements were also observed with DOSE2 in gait speed (5-meter walk), and both DOSE groups in quality of life (EQ-5D-5L) compared to Control.

Conclusion: This study provides the first preliminary evidence that stroke patients can improve their walking recovery and quality of life with higher doses of aerobic and stepping activity and within a critical time period for neurological recovery. However, within a 4-week treatment duration, there may be a limit on the walking endurance, but not the speed, that can be attained.

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ABSTRACT 5

Using a robotic device to enhance upper-limb 3D proprioception

Bulmaro A. Valdés, Mahta Khoshnam, Jason L. Neva, & Carlo Menon.

Objectives: Proprioception is important for performing activities of daily living and can be affected by neurological conditions and aging. As a preliminary step towards clinical application, we investigated if a robotic platform could be employed to enhance upper-limb 3D proprioception in people without disabilities.

Design: Single training session.

Setting: Research laboratory.

Participants: 6 adult participants (34 \pm 12 years) without disabilities.

Interventions: Participants reached with their dominant hand to two targets in 3D space without vision. The targets' locations resembled hand positions involved in self-feeding. At the end of each training trial, participants were able to see the end location of their hand on a monitor and move the cursor representing their hand to the exact target

location. The training was comprised of 3 blocks of 8 reaching movement trials (24 reaches to each target). Improvements were measured from baseline to post-measurements trials. A third target was added to baseline and post-measurements trials to test if results would generalize to an untrained target.

Main Outcome Measure: Primary: End-position error between virtual target and cursor. Secondary: Index of curvature (straightness of hand path).

Results: When all targets were combined, reaching accuracy and the index of curvature were improved on average by 41% and 13%, respectively.

Conclusions: This preliminary study provides support to the concept of employing robots to enhance proprioceptive sense of upper-limb position in 3D space. Larger samples are required to confirm these results, and future studies should investigate how this paradigm could be adapted to be beneficial for people with disabilities.

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ABSTRACT 6

Assistive Technology prevalence and demographics in Canada

Anna Berardi, Emma M. Smith, & William C. Miller.

Objective: The purpose of this study was to describe the current prevalence and unmet needs of assistive device use in community dwelling Canadians experiencing activity limitation (disability).

Design: Cross-sectional study.

Methods: Estimation of the prevalence of assistive technology use and unmet needs has been calculated using data from the 2012 Canadian Survey on Disability (CSD), and demographic data from the National Household Survey, using Wesvar Software to carry out Bootstrapping analysis, and SPSS to summarize demographic data. Data were obtained from the Statistics Canada Research Data Centre. Total sample size for the CSD was 45,443 individuals. Data were analyzed from survey respondents who indicated they use or need assistive devices.

Results: Among the estimated 3,775,920 Canadians with a disability (13.7% of the Canadian population) about 80% (3,020,736) used some form of assistive device. Among these individuals, 3,050,750 use

glasses or contact lenses and 1,109,060 bathroom aids. The results showed that the most common unmet need were hearing aids (0.86% of the total population), followed by bathroom aids (0.36%).

Conclusions: This study comes at a time when global attention is focused on research on access to assistive technology, from the World Federation of Occupational Therapy to the World Health Organization through the GATE project. This study using data from the CSD will serve disability and social policy analysts at all levels of government, as well as associations for persons with disabilities and researchers working in the field of disability policy and programs.

1110

ABSTRACT 7

Education after lower limb amputation: A qualitative study on clinicians' perspectives

Elham Esfandiari, William C. Miller, Sheena King, Maureen C. Ashe, & W. Ben Mortenson.

Background and Purpose. Each year, 7,300 Canadians have a Lower Limb Amputation (LLA). LLA is a costly, disabling condition, which is often accompanied by a decrease in confidence, depression, pain, and restriction to social and daily activities. In order to achieve best outcomes, it is critical for patients to make a variety of changes in ways that they perform activities of daily living and monitor their health conditions. However, not everyone has access to rehabilitation after LLA. A self-management program, which incorporates education and supportive interventions to increase patients' coping skills to better manage their own disease-related challenges, may provide an accessible cost-effective augmentative solution to help people with LLA learn these new skills. The purpose of our study is to explore the rehabilitation education preferences and experiences of clinicians that would be most helpful in aiding rehabilitation post LLA.

Materials and Methods. Adopting a user-centred approach, 23 clinicians were consulted using focus groups, paired- or one-on-one interviews. The inclusion criteria were physiotherapists or occupational therapists who had worked with at least 2 patients with LLA annually over the past 3

years, and prosthetists with at least 3 years of work experience with lower limb prostheses. Data were analyzed thematically. Three trustworthiness strategies were used in this study. Use of multiple groups for adopting multiple perspectives and involvement of an assistant in coding and analyses served as means of credibility and confirmability, and field notes were used as a self-reflective tool for improvement of dependability of research findings.

Findings. Our preliminary analyses identified three core themes: (1) Perceiving limitations with current education for patients with LLA; (2) Wanting to improve delivery of education for patients with LLA; and (3) Identifying potential challenges and benefits of an online education program.

Clinical Implications. Our study explored clinicians' perspectives on education post LLA and their concerns. In current practice, different approaches are used to deliver education to people with LLA. The findings of our study will aid in designing an online self-management program for people with LLA.

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ABSTRACT 8

The Rick Hansen Spinal Cord Injury Registry (RHSCIR) – a look at traumatic SCI in Canada

Suzanne Humphreys.

The Rick Hansen Spinal Cord Injury Registry (RHSCIR) is a prospective observational study that collects clinical and demographic data from Canadian acute and rehabilitation hospitals specializing in SCI care and treatment as well as information from individuals with SCI throughout their lifetime after integrating back into the community. With 30 participating facilities in major Canadian cities, RHSCIR includes 7000 participants (and counting) since its initiation in 2004, making it the largest database that tracks the experiences of individuals living with traumatic SCI in Canada.

The types of data collected include demographic data, injury and surgery details, neurological impairment, comorbidities, complications, length of stay, outcome measures, rehabilitation assessments, discharge information, and community follow-up questions relating to

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participation, health status, quality of life and functional outcomes.

As well as answering clinical and healthcare research questions, RHSCIR data is regularly reported back to participating sites to provide comparisons of clinical indicators to national averages, deliver information about clinically important assessments such as ISNCSCI and subsequently to help support training and implementation activities. The data have also been used to answer site-specific clinical operations questions such as those related to length of stay or patient flow as well as supporting resource planning.

An updated version of the registry is imminent with the major change being inclusion of individuals admitted to participating rehabilitation facilities with non-traumatic SCI

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SPECIAL PRESENTATION

REACH BC- an online platform connecting you to health research in BC

Amanda Chisholm.

REACH BC is the online provincial platform that connects health researchers to British Columbians who are interested in participating in health research. REACH BC will create more public awareness about available health research opportunities and provide an easy way for the public to connect with health research that is important to them. Our goal is to connect researchers with members of the public who are interested in contributing to health research that can advance health care and improve health outcomes in BC.

PODIUM SESSION TWO:

1500

ABSTRACT 10

An examination of the acute relationships between exercise and neuropathic pain among adults with spinal cord injury

Kendra R. Todd & Kathleen A. Martin Ginis.

Purpose: Neuropathic pain (NP) affects approximately 50% of individuals with a spinal cord injury (SCI), with many reporting pain as more disabling than the injury itself. Currently, treatments are primarily pharmaceutical, however exercise may alleviate NP symptoms. Daily fluctuations in NP are not well understood, specifically in relation to exercise participation. The purpose of this study was to utilize ecological momentary assessment to measure intra-individual diurnal variations in NP sensations. This study aimed to provide a deeper understanding of how NP differs over time and changes from pre- to post-exercise.

Methods: Six physically active individuals with SCI participated in this 6-day protocol. They responded to six daily prompts between 9:00 AM and 9:00 PM, and before and after exercising, using the Smartphone application mEMA. The prompts required participants to answer a modified version of the Neuropathic Pain Scale. NP scores were averaged into a composite score and data were analyzed by plotting NP scores over the 6 days.

Results: All participants experienced a decrease in NP (Mchange= -0.203, SD= 0.627) following completion of at least one bout of exercise. However, two participants experienced an increase in NP sensations following participation in at least one bout of high intensity wheeling, or isometric resistance training.

Conclusion: Overall, these results suggest that exercise can reduce NP symptoms. When promoting exercise as a treatment option, however, it is important to consider that different types of exercise and higher intensity exercise may increase NP in some individuals.

1513

ABSTRACT 11

Prevalence and functional impact of suprascapular nerve injury pre and post-operatively in the setting of chronic, massive rotator cuff tears: A pilot study

Richard Ho, William D. Regan, Russell O'Connor, & Michael Berger.

Background: Massive rotator cuff tears (RCTs) are common, but have poorly understood heterogeneous clinical presentations—some patients have well-preserved function while others experience severe impairment. Given the proximity of the suprascapular nerve to the rotator cuff muscles, it is proposed that massive tears involving these muscles could lead to traction injury on the suprascapular nerve, causing a suprascapular neuropathy (SSN). The prevalence of SSN in the setting of specifically chronic massive rotator cuff tears is unclear, and the effect of routine surgical RCT repair on both pain and dysfunction, as well as on electrodiagnostic findings at the suprascapular nerve has been little-studied.

Objective: To investigate the prevalence of suprascapular neuropathy (SSN) in the setting of chronic, massive rotator cuff tears using electrodiagnostic studies, followed by re-evaluation of these patients after routine RCT repair with regards to pain, dysfunction, and electrodiagnostic data changes.

Design/Methods: Cross-sectional study. Appropriate candidates will be evaluated for SSN at the GF Strong Electrodiagnostic laboratory before surgery; and then again 12 months after surgery. The main outcome measure will be electrodiagnostic evidence of neurogenic changes at the suprascapular nerve, and changes around these findings post-operatively.

Results/Conclusions: Currently in progress.

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ABSTRACT 12

The brain activation associated with 'active' and 'passive' gait: Considerations for exoskeleton use in gait retraining

Sue Peters, Dennis R. Louie, Shannon B. Lim, Chieh-ling Yang, & Janice J. Eng.

Objective: Robotic exoskeletons are currently used in neurorehabilitation; yet, it is unclear what role the brain plays to control gait within an exoskeleton. Functional near-infrared spectroscopy (fNIRS) can be used during overground exoskeletal gait to record brain activation. The aim of this study was to delineate the brain activation associated with 'active' and 'passive' overground gait compared with a control condition (no exoskeleton) using fNIRS.

Intervention: Ten healthy adults performed a 10-meter walk test under active-exo (instruction to work with the exoskeleton), passive-exo (instruction to be as relaxed as possible), and no-exo (speed matched to condition 1 & 2) conditions.

Outcome Measures: fNIRS recorded brain activation over bilateral frontal and parietal regions. Electromyography (EMG) of biceps femoris and rectus femoris were recorded bilaterally.

Results: EMG was highest in the active-exo (mean 119.7% of no-exo) and lowest in the passive-exo condition (70.9% of no-exo). The no-exo condition showed greater levels of activation in motor planning (versus active-exo and passive-exo conditions) and sensorimotor areas (activeexo condition only). Despite lower EMG in passive-exo, neural activity was higher in the lateral primary sensorimotor (versus no-exo), and sensorimotor, motor planning, and somatosensory association areas (versus active-exo).

Conclusions: In 'passive' exoskeleton-assisted gait, sensorimotor regions were activated above that in 'active' and 'no-exo' gait. This finding may support use of robotic exoskeletons in neurorehabilitation with individuals who cannot walk independently, as a way to increase gait-related brain activity. Future work may explore how brain activation may change as a result of retraining gait using a robotic exoskeleton

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ABSTRACT 13

Casting as an adjunct to botulinum toxin injection for limb spasticity in adults: A systematic review

Jordan Farag, Rajiv Reebye, Carl Ganzert, & Patricia Mills.

Objective: To determine current evidence for casting as an adjunct therapy following botulinum toxin (BoNT) injection for adult limb spasticity.

Design: MEDLINE, EMBASE, CINAHL, and Cochrane Central Register of Controlled Trials databases were searched for English language human studies from 1990 to August 2018. Full-text studies using a casting protocol following BoNT injection on adult participants for limb spasticity management were included. Studies were graded according to Sackett's levels of evidence, and outcome measures were categorized using domains of the International Classification of Disability, Functioning and Health.

Results: Five studies involving a total of 98 participants met the inclusion criteria (2 randomized controlled trials, 1 pre-post study, 1 case series and 1 case report). Casting protocols varied widely between studies; all were on casting of the lower limbs. There is level 1 evidence that casting following BoNT injection improves spasticity outcomes compared to stretching and taping, that casting after either BoNT or saline injections is better than physical therapy alone, and that less adverse events occur if casting is administered following BoNT versus saline injection.

Conclusions: The evidence suggests that adjunct casting of the lower limbs may improve outcomes following BoNT injection. Casting protocols vary widely in the literature and priority needs to be given to future studies that determine what protocol yields the best results.

1552

ABSTRACT 14

Toward evidence-based medicine for spasticity management: Canadian physician survey on the use of adjunct therapies after botulinum toxin injection.

Alvin Ip, Chetan Phadke, Chris Boulias, Farooq Ismail, & Patricia Mills.

Objective: To determine current physician practice patterns on adjunct therapy use following botulinum toxin injection for spasticity management.

Design: Cross-sectional survey.

Setting/Participants: Academic and community physicians practicing across Canada.

Interventions: Online questionnaire on the use of 20 adjunct therapies identified from the literature and 9 potential barriers, using quantitative and qualitative methods.

Main outcome measures: Physician and practice demographics, physician use of adjunct therapies, perceived barriers to use of adjunct therapies.

Results: There were 46 participants (43 physiatrists, 3 neurologists) from 6 of the 7 provinces surveyed. Their median length of clinical experience was 13.5 years (range 1-40 years). The most commonly prescribed adjunct therapy was a home-based stretching program, followed by splinting and an active home exercise program. However, these three adjuncts were also the most common ones for patients to refuse. The least prescribed adjuncts were extracorporeal shockwave therapy, segmental muscle vibration, and zinc supplementation. Most commonly cited barriers to the use of any adjunct therapy included physician/clinic resources, patients' resources, and physician time constraints. Participants perceived that zinc supplementation, magnesium supplementation, and dietary change recommendations to have a lack of evidence from the literature. They also noted a lack of evidence from their clinical experience to be barriers to taping, magnesium supplementation, and zinc supplementation. The top three adjuncts that physicians wanted to see further research toward were in the immediate category (within 60 minutes of injection): active movement, electrical stimulation, and passive stretching.

Conclusions: The most and least commonly prescribed adjunct therapies, and the most common barriers to their use were identified. This will help prioritize efforts toward knowledge translation, further research, and overcoming barriers in the management of spasticity.

1605

SPECIAL PRESENTATION

Complicated wounds in patients with spinal cord injuries.

Dr. Aziz Ghahary.

Despite all advancements made in this field, current therapies have neither improved the healing outcomes of these wounds, nor decreased their prevalence. This is mainly because conventional skin grafts, scaffolds, and even sheets of skin substitute are ineffective due to their inability to fill up all void spaces seen within these wounds. Thus, these patients have an increased rate of morbidity and prolonged hospital stays due to wound infection and treatment difficulties. For this reason, a new strategy for treating these difficult-to-heal wounds is needed to ease patients' suffering and reduce the socio-economic burden associated with these wounds.

To address the aforementioned difficulties, we have recently developed a shelf-ready collagen based powdered, reconstitutable liquid skin substitute called MeshFill. It is made of natural skin proteins and remains liquid at low temperature and solidifies within 20 minutes of application to the wound site and thereby filling up all voids and cavities within wounds from bottom up.

We have already shown that, when MeshFill is applied to delayed wounds it fills up all cavities and generates a nutritional environment for skin cells from the edge of their wounds to migrate within and on the surface of the resultant scaffold and accelerate the healing process with a significantly better clinical outcome. In a human feasibility pilot study, we have also shown that some deep surgical wounds can be treated with Liquid MeshFill with a very promising results.

Results: 1) Powder to be shipped to any place, 2) Liquid to fill up all cavities, 3) Nutritional for skin cells to migrate in and proliferate, 4) Cost effective and its easy use makes MeshFill very effective in

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improving non-healing wounds in general and surgical and diabetic wounds in particular.

In this presentation, the challenges and solutions for treating non-healing wounds in general and surgical wounds in patients with spinal cord injuries will be outlined.

Funding: This study has been supported by a grant from the Canadian Institute of Health Research and iCORD Seed grant.

POSTER PRESENTATIONS:

Comparing skill performance between indoor and outdoor environments among experienced scooter users

Sharon Jang, Laura Hurd Clarke, Bill Miller, & Ben Mortenson.

Background: The Wheelchair Skills Test (WST) has been developed to assess scooter users' skill performance and mobility confidence. Traditionally, the WST has been performed using a standardized indoor course; however, it has been suggested that a community-based setting may be a suitable alternative.

Objectives: To compare WST performance in the indoor and outdoor environments, to determine the utility of performing the WST in the community, and to learn about users' perspectives of performing the WST in different environments.

Methods: For this mixed-methods study, 20 scooter users who have used their devices for ≥ 3 months were recruited. Each participant completed the WST twice – once in their community and once indoors within a two-week period. While testing in the community, detailed observations were made on the setting. Semi-structured interviews were conducted after completion of the WST in both environments. **Results:** Preliminary analysis revealed no differences in participants' WST performance scores between the two environments; however, participants were more confident performing in the community. When searching for WST obstacles in the community, the majority were easily found. While most participants preferred performing the WST in their community due to convenience and familiarity, they also perceived the indoor course as reflective of their community setting. **Conclusion:** These findings suggest that skills testing in the community is feasible; however, skills testing in indoor and outdoor settings are not comparable. Community-based testing may have better ecological validity, but testing in unfamiliar settings may encourage users to use their devices in novel settings.

Urodynamics and histological evaluation of the bladder in a porcine model of spinal cord injury

Martin S. Keung, Megan Webster, Emily G. Deegan, Femke Streijger, C. Morrison, Neda Manouchehri, Katelyn Shortt, Kitty So, Kyoung-Tae Kim, Leslie C. Sherwood, April Herrity, Charles Hubscher, Dena R. Howland, Maxwell Boakye, Lynn Stothers, & Brian K. Kwon.

Background: One of the most disabling and impactful consequences of spinal cord injury (SCI) is neurogenic bladder (NB) dysfunction. Studies on NB dysfunction have primarily utilized the rodent model of SCI. However, such small animal models of SCI are not suitable for the development and translation of novel human-sized devices.

Objective: In this study, we investigated the functional and morphological changes occurring in the urinary bladder of SCI pigs to assess their applicability as a large animal model of NB dysfunction. Design: SCI was induced by a T10 weight-drop contusion on female Yucatan pigs. Urodynamic pressure-flow studies were performed in awake, slightly restrained pigs on various weeks post-SCI. Voiding efficiency was calculated as the ratio between voided and infused volume.

Results: During micturition, pre-SCI pigs demonstrated voiding bladder contractions and a decrease in external urethral sphincter activity which resembles the normal human micturition cycle. In contrast, SCI pigs demonstrated signs of NB dysfunction such as detrusor overactivity. Furthermore, a 10-fold reduction in voiding efficiency was observed in the SCI pigs. Hematoxylin and eosin staining of the bladder post-mortem showed marked detrusor hypertrophy.

Conclusions: A T10 contusion injury in Yucatan pigs induced bladder dysfunction similar to human bladder dysfunction after SCI. Overall, our pig model of SCI allows for repetitive measurements of bladder function at different time points in the same animal under fully awake conditions.

Measuring the effects of mean arterial pressure changes on spinal cord hemodynamics in a porcine model of acute spinal cord injury using a novel optical technique

Amanda Cheung.

Objectives: Current clinical guidelines suggest augmenting the mean arterial pressure (MAP) of acute spinal cord injury (SCI) patients to increase spinal cord perfusion and preserve neurologic function. However, it is difficult for clinicians to hemodynamically manage acute SCI patients without real-time physiologic information about the effect of MAP augmentation within the injured cord. In this study, we developed an implantable optical sensor, based on Near Infrared Spectroscopy (NIRS), for non-invasive real-time monitoring of spinal cord tissue oxygenation and hemodynamics after acute SCI.

Methods: Nine Yorkshire pigs received a T10 contusion/compression injury. A multi-wavelength NIRS system with a customized optical sensor was implanted extradurally at T9. To validate the NIRS measures, the standardized method using an invasive intraparenchymal (IP) O₂/blood flow sensor was inserted directly into the spinal cord at T11. Using NIRS, the spinal cord tissue oxygenation percentage (TOI%) and concentrations of oxygenated, deoxygenated, and total hemoglobin were monitored and compared to the IP measurements. Episodes of MAP alterations were performed to simulate the types of hemodynamic changes SCI patients experience post-injury.

Results/Conclusions: The non-invasive NIRS sensor identified changes in spinal cord hemodynamics and oxygenation levels in all subjects, in which measurements correlated with the invasive IP sensor. This pre-clinical demonstration of the potential of NIRS is the first step in developing a clinically applicable device that spine surgeons can use to monitor spinal cord tissue hemodynamics post-injury and optimize clinical MAP management.

Lower body negative pressure: A pre-clinical model of orthostatic hypotension following spinal cord injury

Arshdeep S. Marwaha, Kiran Pawar, & Andrei V. Krassioukov.

Spinal Cord Injury (SCI) is a devastating condition that permanently impacts quality of life. Majority of individuals with cervical or high thoracic SCI suffer from debilitating cardiovascular impairments that are the leading cause of disability and death among this population. On daily basis, a common challenge faced by individuals with SCI is of unstable blood pressure (BP) control. During assumption of an upright posture from a supine position, the BP drops to abnormally low levels, a condition called orthostatic hypotension (OH). The BP during OH can fall to dangerously low levels (even below 50 mmHg) and often results in blurred vision, dizziness, loss of consciousness, cognitive deficits, and an elevated risk of stroke. Occurrence of OH during standard rehabilitation procedures decreases the ability of individuals with SCI to participate in rehabilitation interventions. Despite OH leading to alarming increases in morbidity and mortality following SCI, there remains to be limited knowledge on therapeutic approaches for its management and prevention. This is due in part to the difficulty of generating an animal model of OH after SCI. We present lower-body negative pressure (LBNP) as a robust and clinically-relevant animal model of OH. Using a well-characterized rat model of T3 SCI, we evaluated the efficacy of LBNP to reduce BP. At 8 weeks post-SCI, a wireless pressure transducer was implanted into the femoral artery. The lower body of the anesthetized animal was placed in the LBNP chamber connected to a vacuum source. The basal mean arterial pressure was recorded. Consistent with the clinical definition of OH, we observed a LBNP-induced decrease of 20.2 ± 6.0 mmHg and 15.1 ± 5.1 mmHg in systolic and diastolic BP, respectively. These findings suggest that an LBNP chamber may be a valuable tool to test the efficacy of various treatment strategies for mitigating OH.

Funding support: Rick Hansen Foundation (AVK), Heart and Stroke Foundation (AVK), Craig H. Neilsen Postdoctoral Fellowship (RS).

Near-infrared spectroscopy as a novel spasticity outcome measure: A systematic review

Eric Chow, Jessie McDougall, Luke Harris, & Patricia Branco Mills.

Objective: To determine whether NIRS can: 1) detect differences between spastic and non-spastic muscles; 2) detect changes in spasticity in response to interventions; 3) correlate with other outcome measures of spasticity.

Background: Spasticity, characterized by involuntary muscle activation, can occur in over 60% of individuals with brain or spinal cord disorders. Despite current therapies, spastic muscle overactivity can result in pain, joint contractures, functional impairments and decreased quality of life. There is a need to identify novel outcome measures for improved spasticity research. NIRS uses non-invasive optical methods for assessing real-time muscle hemodynamics (e.g. blood flow: total hemoglobin, [tHb]) and metabolism (e.g. muscle oxygenation: oxygenated Hb, [O₂Hb]), which could be affected in spastic muscles.

Methods: A systematic search of MEDLINE, CINAHL, and EMBASE was conducted up to November 2018. Inclusion criteria: 1) humans/animals with limb spasticity; 2) NIRS used to examine spastic muscle hemodynamics and metabolism; 3) English language. Two authors independently reviewed the studies to determine eligibility, assessed risk of bias, and extracted data.

Results: Of 34 studies identified, five were deemed eligible for inclusion. NIRS was placed over muscles for monitoring at rest and during interventions intended to cause physiological change in musculature. NIRS parameters [O₂Hb] and [tHb] were different between spastic and non-spastic muscles, in response to interventions, and correlated with other spasticity outcome measures (e.g. electromyography).

Conclusion: There is level 4 evidence that NIRS may be a novel objective outcome measure to provide real-time, non-invasive monitoring of spasticity. Further research in this field is warranted.

Biomaterial scaffold-based strategies for spinal cord repair

Kiran Pawar, Rahul Sachdeva, Norbert Weidner, Aileen Anderson, & Andrei V. Krassioukov.

After spinal cord injury (SCI) sensory, motor and autonomic functions are impaired and spontaneous regeneration and functional recovery is limited. Substantial recovery of function following SCI depends on longitudinally directed axon regeneration across the injury site, which requires a mechanical guidance providing scaffold. Biomaterial-based biodegradable implants using natural and synthetic material such as natural polysaccharide - alginate and synthetic co-polymer - poly(Lactide-co-glycolide) (PLG) were used to create bridges as a carrier scaffold to support the regeneration of axons after SCI. Alginate-based anisotropic capillary hydrogels with defined capillary diameter formed via self-organizing process driven by unidirectional diffusion of divalent cations into sodium alginate solution. Axon outgrowth and cell migration were investigated in term of axon length/density and cell density within the capillary structure. PLG based porous microchannel bridges were cast using gas foaming and salt leaching techniques. Aligned capillary and microchannel structures analyzed for axon outgrowth and cell migration in CNS in vitro and in vivo rodent spinal cord injury model. Robust regeneration of descending corticospinal tract was observed through PLG bridge crossing lesion site. Regenerated GFP fibers were co-localized with different neuronal markers. Finally, regeneration through implanted bridges was associated with functional recovery.

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Radial palsy in an individual with high level chronic spinal cord injury

Nathan Hitchman, Heather Finlayson, & Andrei V. Krassioukov.

Prolonged compression is a common cause of radial neuropathy in able-bodied individuals but has not been reported in individuals with chronic spinal cord injury (SCI). We present a case of a 48-year-old man with a C6 AIS A SCI from an accident 22 years earlier who had a new onset compressive radial neuropathy after falling out of his wheelchair. At first assessment 7 days after this incident he complained of significant pain and paresthesia along the lateral aspect of his right arm from axilla to wrist, accompanied by new wrist extensor

weakness. Clinical examination showed a new wrist-drop (MRC grade 2/5; previous baseline 4/5). Nerve conduction studies obtained 4 weeks post-injury revealed severe reductions in action potential amplitude of the sensory and motor divisions of the radial nerve with normal conduction velocities and latencies. The patient was managed with mobility exercises and Vitamin B supplementation and showed full recovery of motor and sensory function to baseline at follow-up 4 months post-injury. Follow-up nerve conduction studies at 9 months post-injury revealed partial electrophysiologic recovery. Unlike able-bodied individuals who can reposition to alleviate nerve compression, individuals with SCI may be unaware of nerve compression or unable to reposition themselves, as was the case with our patient. This highlights the need for precautionary measures in this population, which may include the combination of maneuvers and devices to provide trunk and limb stability and medical alert devices that allow individuals to access timely help.

Using EEG as an objective motor function evaluation

Xin Zhang, Ryan D'Arcy, & Carlo Menon.

Motor function was generally measured with standard motor tasks and scoring on the performance. The inevitable subjective effect was involved in the evaluation process. Additionally, the one-to-one assessment paradigm between the examiner and examinee greatly limited the throughput of the motor assessment. In the literature, there have been several studies showing some features in EEG may correlate with the motor function performance. In this work, we investigate the feasibility of translating EEG data as motor function assessment using artificial neural network. 26 participants were recruited in this study, with 14 of them were suffering from chronic stroke, the rest participants were healthy. EEG data were recorded while the participants were performing mouse clicking every self-estimated 10 seconds. Artificial neural network models were built and trained based on the Fugl-Meyer Assessment score collected from the participants on the same day of the EEG data collection. The result suggested the proposed method yield very high accuracy in both within ($r = 0.9931$, $p = 8.0751 \times 10^{-24}$) and cross ($r =$

0.9590 , $p = 1.2098 \times 10^{-14}$) participant test. The proposed method could potentially be used as a substitute for the traditional questionnaire-based motor function assessments.

Improving ISNCSCI classification using a computerized algorithm: Reach, use and usefulness of a new technology

Glenys MacIsaac.

Objectives: Challenges in accurately classifying the level and severity of spinal cord injury (SCI) using the International Standards for Neurological Classification of SCI (ISNCSCI) have identified the need for computerized algorithms. The Rick Hansen Institute-ISNCSCI Algorithm (developed in 2012) is a validated, freely-available website with a downloadable open source code. The objective of this study was to evaluate the reach, use, and usefulness of the Algorithm.

Design: A user survey was available through the Algorithm website between September 2016-December 2017. Google analytics from the Algorithm website and integration request tracking were also used.

Setting: N/A

Participants: 76 respondents from 27 countries completed the user survey; majority were physical therapists and physiatrists working in a hospital setting.

Interventions: N/A

Main outcome measures: N/A

Results: Between August 2012-February 2019 there were 68,399 Algorithm website users from 168 countries. The source code for the Algorithm was downloaded 1499 times and has been embedded into four SCI registries and six electronic medical records. User survey respondents reported that 43% use it for educational purposes and 46% to confirm a clinical ISNCSCI Classification. 49% have incorporated it into their regular workflow. 86% report it is "very useful" to their work. 74% report it has increased their use of the ISNCSCI while 78% report it has increased their understanding. 84% report it has improved their access to support for conducting and classifying an ISNCSCI assessment. Areas highlighted for improvement were export capabilities and additional availability on tablet and iOS/Android apps.

Conclusions: The Algorithm has provided an international resource to support learning and classification of the ISNCSCI assessment.

A longitudinal analysis of neurological recovery based on timing of early post-injury neurologic assessment in acute spinal cord injury

Nader Fallah, Carly Rivers, Vanessa Noonan, Zeina Waheed, Christiana Cheng, Brian Kwon, Charles Fisher, & Marcel F. Dvorak.

Objectives: The trajectory of neurological recovery following traumatic spinal cord injury (tSCI) is not well characterized. Due to the potential for early neurological recovery post-injury, differences between baseline exam times can introduce bias in clinical research. Our *objectives were to:* 1.Characterize neurological recovery after cervical tSCI by severity and neurological level of injury. 2. Make recommendations for study design and interpretation.

Design: Two different longitudinal analyses of motor scores during the first six months post-injury were used to generate the trajectory of neurological recovery. Data was stratified by severity (American Spinal Injury Association Impairment Scale [AIS]) and neurological level of injury. Age, sex, motor score and time of exam were analyzed.

Setting: VGH.

Participants: 194 persons with acute tSCI admitted between 2004-2012.

Interventions: N/A

Main Outcome Measure: Changes in motor score.

Results: Results indicate different trajectories of neurological recovery based on severity and level of injury. Differences in baseline exam time were significantly important in AIS C/D injuries whereas AIS A/B injuries had no significant effect in the first two weeks. Level of injury was an important factor depending on AIS. Age and sex were non-significant.

Conclusions: To our knowledge, no previous longitudinal study has reported on the importance of the timing of the baseline neurological exam on early neurological improvement trajectory, particularly during the first two weeks. In AIS C/D injuries there are significant motor score improvements over the first few days which should be accounted for in research studies. Our results

support earlier work emphasizing appropriate controls to reduce error when analysing and reporting tSCI clinical research studies.

Association between peak oxygen uptake and left ventricular systolic function in individuals with cervical and upper-thoracic spinal cord injury

Abdullah A. Alrashidi, Tome E. Nightingale, Shane Balthazaar, Katherine D. Currie, Kathleen A. Martin Ginis, & Andrei V. Krassioukov.

Background and aim: Individuals with spinal cord injury (SCI), particularly those with injuries at or above the sixth thoracic level (T₆), are less physically active and exhibit reduced cardiorespiratory fitness (CRF). This is due to multiple factors, including disrupted cardio-vascular sympathetic supraspinal control, cardiac unloading, and reliance on relatively smaller muscle mass (i.e. upper extremities). A recent meta-analysis revealed that SCI has a negative impact on left ventricular (LV) mass, as well as altered some of global systolic function, compared to able-bodied individuals. This study aims to investigate the associations between CRF, expressed both in absolute and relative peak oxygen uptake ($\dot{V} O_{2peak}$), and resting echocardiographic measures of systolic function in individuals with SCI at or above T₆.

Methods: Thirty-two participants, aged 40 ± 11 years, with motor-complete, chronic (> 1 year) SCI between the fifth cervical and the T₅ were recruited. $\dot{V} O_{2peak}$ was measured at volitional exhaustion during incremental arm-crank exercise testing using a metabolic gas analyzer. Indices of systolic function were obtained by echocardiography with participants resting in the supine position.

Results: There were significant associations between absolute $\dot{V} O_{2peak}$ with LV end-diastolic and end-systolic volumes [$r=0.492$, ($P=0.004$) and $r=0.382$, ($P=0.031$), respectively] and stroke volume ($r=0.454$, $P=0.010$). Relative $\dot{V} O_{2peak}$ was significantly associated with intraventricular septal wall thickness-diastole ($r=-0.405$, $P=0.021$).

Conclusion: These associations between $\dot{V} O_{2peak}$ and indices of LV systolic function, while potentially mediated by body size, indicate the importance of maintaining a high CRF to minimise LV systolic

dysfunction in individuals with cervical and upper-thoracic SCI.

Long-term neurogenic lower urinary tract dysfunction: A case of cardiovascular nightmares

Andrea L. Ramirez, Amanda H. Lee, Andrei V. Krassioukov, & Matthias Walter.

Context: In addition to sensorimotor impairment, individuals with spinal cord injury (SCI) may suffer from profound autonomic dysfunctions, such as autonomic dysreflexia (AD) and neurogenic detrusor overactivity (NDO). AD is highly prevalent in those with SCI at or above T6 and can occur more than 40 times per day. As blood pressure can rise above 250mmHg during a single episode of AD, consequences can be devastating and lead to stroke, myocardial infarction, or even death. Considering these health risks in this population, it is imperative to ascertain and minimize triggers of AD where possible. One leading trigger of AD is NDO, which is characterized by involuntary detrusor contractions which can occur several times a day. Both AD and NDO place a tremendous burden on individuals with SCI. Therefore, amelioration of cardiovascular and bladder function is of primary importance. Recently, we have shown that AD can effectively be treated with intradetrusor onabotulinumtoxinA (BOTOX[®]). Herein, we present a complex case to highlight the treatment's potential limitations to ameliorate AD and improve bladder function in this population.

Findings: A 46-year old man, who was relying on an indwelling urethral catheter for bladder emptying due to severely impaired hand function following a SCI (C5, AIS B) sustained 30 years ago, underwent intradetrusor BOTOX[®] (200 UI) injections for treatment of refractory NDO and associated AD. Although bladder function slightly improved (i.e. cystometric capacity increased while detrusor pressure was reduced), severe bladder-related AD persisted post treatment.

Conclusions: This case raises awareness of serious considerations when treating NDO-related AD in individuals with longstanding bladder dysfunction and compromised dexterity following SCI. Given the little improvement in bladder function and persistence of severe AD, more invasive treatment options should be considered to protect the

individual long-term (to effectively ameliorate AD and to minimize associated potentially life-threatening health risks).

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Near infrared spectroscopy for non-invasive monitoring of muscle hemodynamic and metabolic changes following botulinum toxin injection for spasticity management

Jessica McDougall, Eric Chow, Patricia B. Mills, & Luke R. Harris.

Background: Spasticity, a form of involuntary muscle activation, is a physiological consequence of many neurological disorders and/or injury to the central nervous system. Injection of botulinum neurotoxin (BoNT) into spastic muscles is a well-documented and somewhat successful management strategy for spasticity. However, there is currently no objective clinical measure for spasticity, impacting our determination of what successful spasticity management looks like. Near-infrared spectroscopy (NIRS) is a non-invasive instrument that assesses muscle hemodynamics and metabolics, both of which are affected in spastic muscle.

Objectives: 1) To systematically compare the hemodynamic and metabolic properties of spastic versus non-spastic muscles in the lower limb. 2) Examine physiological and hemodynamic changes of spastic muscle in response to BoNT.

Design: 12-week observational study with three timepoints.

Setting: Out-patient spasticity clinic.

Participants: Three groups: (1) Healthy controls, (2) persons with hemiplegic lower limb spasticity that were receiving BoNT injections for the first time, and (3) persons with unilateral lower limb spasticity that have never received BoNT injections in the lower limb.

Interventions/Methods: NIRS recordings of the spastic and non-spastic limbs were taken during Modified Ashworth Scale and range of motion tests at each of the three timepoints: Baseline, 4-6 weeks, and 10-12 weeks.

Results: Preliminary results of participants in group 1 and 3 will be presented. Within our timeframe, no clinic patients were recruited into group 2. Results suggest differences in the hemodynamic and metabolic properties of spastic and non-spastic limbs, between- and within- participants.

Pediatric spinal cord injury in Canada

Nancy Thorogood, Jennifer Lee, Carly Rivers, Melody Chen, Penny Clarke-Richardson, & Vanessa Noonan.

Objectives: The objective of this project was to describe pediatric spinal cord injury (SCI) in Canada by examining the state of pediatric SCI research, identifying knowledge gaps and priorities opportunities, and estimating incidence for future research.

Design: Key informant interviews

Setting: Canada

Participants: Key informants (n=33) included clinicians, administrators, consumers and community organizations.

Interventions: Informants were recruited using snowball sampling and interviewed regarding awareness, priorities, and gaps in pediatric SCI research.

Outcome Measure: A thematic analysis was performed by coding key points and collating them into themes. Administrative data from the Canadian Institute for Health Information was used to calculate incidence of traumatic SCI.

Results: Few centres conduct pediatric SCI research with a lack of multi-centre studies; single centre studies included participants with other neurological conditions, as well as adults. Research topics included ambulation/mobility, adaptive equipment, wheelchair skills, and urological studies. The estimated incidence of traumatic SCI in children under 4 years of age was 1.6/million, increasing to 28.3/million in adolescence 15 to 19 years of age.

Rehabilitation and community priorities included access to care, type and intensity of training, specialized equipment, clinician training, discharge plans, and community support.

Conclusions: No pediatric SCI network exists; most individuals are unaware of what others are doing, therefore, a network or community of practice is needed to inform research and care. It is hoped that this scan will inform the pediatric SCI community.

Further investigation into the state of pediatric SCI in Canada is required and should address the identified priorities to improve the lives of persons affected by pediatric SCI.

Left ventricular function in individuals with acute and chronic spinal cord injury

Shane J.T. Balthazar, Tom E. Nightingale, Matthias Walter, Katharine D. Currie, Christopher R. West, & Andrei V. Krassioukov.

Chronic spinal cord injury (SCI) results in impaired cardiac function. However, there is still very limited knowledge of whether cardiac dysfunction is present in humans during the acute phase post SCI. Therefore, the goal of this study was to compare various cardiac indices using a cross-sectional study design between acute SCI (<5 months) and chronic SCI (>1 year). Seventy-one participants (age: 18-60 years) with acute (96 ± 33 days, n=33) and chronic (13 ± 21 years, n=38) motor-complete SCI (C4-T6, AIS A/B) underwent echocardiography. These groups were age-matched. Left ventricular internal diameter in diastole (LVIDd) was measured in the parasternal long axis view. Left ventricular ejection fraction, stroke volume, end systolic volume and septal S' tissue Doppler velocity (i.e., systolic function) were calculated by using a one plane volumetric assessment by method of disks (4 chamber, apical view). Diastolic function was assessed using early septal annular velocities (E'). Groups were then subdivided into cervical and thoracic for comparison. A Mann-Whitney U test was used to assess significant differences between groups. A two-tailed Mann-Whitney U Test revealed a significantly higher EDV ($p = 0.039$), higher ESV ($p = 0.010$), SV ($p = 0.025$), and Q ($p = 0.005$) in the acute group compared to the chronic group. When groups were further divided into cervical and thoracic subgroups, a significantly higher EDV ($p = 0.040$), ESV ($p = 0.020$), SV ($p = 0.017$), and Q ($p = 0.025$) was found in the acute cervical subgroup compared to the chronic cervical subgroup. Q was significantly higher ($p = 0.024$) in the acute thoracic group compared to the chronic thoracic group, while other parameters did not reveal significance between thoracic subgroups. Heart rate revealed significant difference in the acute group as cervical was significantly lower compared to thoracic ($p = 0.006$) but was not different in the chronic group.

Results suggest that ventricular size and cardiac output may change over time following SCI. Diminished cardiac function in cervical groups may be due to the loss of supraspinal sympathetic control. These data suggest changes in different cardiac function indices are seemingly dependent upon lesion level, i.e. reduction in LVID (thoracic SCI) versus reduction in contractile tissue velocity (cervical SCI).

So, your physical activity intervention was successful, now what? Considerations for implementation in the physiotherapist setting

Jasmin Ma, Nicholas A. Antoniuk, Linda C. Li, & Kathleen A. Martin Ginis.

Background: The ProACTIVE SCI intervention has demonstrated the largest improvements in physical activity following a behavioural intervention among people with physical disabilities in a randomized controlled trial to date. Identifying the key behaviour change techniques and delivery considerations responsible for these impressive results will help scale the intervention and increase implementation effectiveness in real-world settings.

Method: All physical activity coaching sessions (n=123), involving a researcher provider and 14 participants, were recorded and transcribed verbatim. Sessions were coded independently by two trained reviewers using the Behaviour Change Technique Taxonomy V1. Semi-structured interviews were conducted following the intervention. Participants were probed for whether and how the intervention addressed previously identified key delivery components for intervention effectiveness as well as the emergence of new themes using an abductive thematic analysis.

Results: Twenty-six unique behaviour change techniques were delivered across the intervention. The most commonly delivered techniques included feedback on behaviour, instructions on how to perform a behaviour, social support (emotional and practical), action planning, and problem solving. The semi-structured interviews revealed the intervention aligned with previous patient-identified key delivery components for intervention effectiveness including diversity of the intervention and importance of communication. Three

additional themes were abductively identified including organized communication, addressing the whole person, and confidence of the interventionist.

Conclusion: These findings help to focus the key behaviour change techniques and delivery factors to consider when implementing the ProACTIVE SCI physical activity intervention. These findings will be used to inform the training and implementation of the intervention among physiotherapists in British Columbia's largest rehabilitation hospital.

Cannabis use in women with spinal cord injury: Physician and patient perspectives

Amanda H.X. Lee, Matthias Walter, Thomas E. Nightingale, Rahul Sachdeva, & Andrei V. Krassioukov.

Setting: Other countries have explored cannabis treatment for chronic pain, spasticity and other secondary conditions after spinal cord injury (SCI). In non-SCI populations, cannabis is reported to alleviate anxiety, insomnia and neuropathic pain. Given the recent legalization of marijuana in Canada, it is imperative to evaluate cannabis use after SCI.

Objectives: Characterize cannabis use by women with SCI and evaluate physician knowledge of cannabis use by patients with SCI.

Design/Participants: Women with SCI (n=20) completed an anonymous, online survey on their cannabis use. Physiatrists at GF Strong Rehabilitation Centre (n=15) completed a survey on their knowledge of cannabis to manage SCI.

Results: Before sustaining SCI, 21% (n=4) of respondents used cannabis products compared to 35% (n=7) of women after SCI (35%). Primary reasons for cannabis use following SCI included: managing tone/spasticity (n=5), pain relief (n=3) and depression/anxiety (n=2). Two women used cannabis while pregnant or breastfeeding as a sleep aid or relief for morning sickness. The most commonly reported adverse effect was difficulty obtaining consistent, desirable effects (n=5). Between 47-87% of physicians described their knowledge on SCI-related cannabis use as "none, very little or poor". Physicians' top priorities for future research included: compound composition, quality control and establishing a central database of available products.

Conclusions: Women with SCI in this pilot study used cannabinoid products primarily to relieve pain and spasticity. Several women used cannabis while pregnant or breastfeeding, indicating a need to evaluate impact on infant development. Safety and efficacy of medicinal cannabis use after SCI must be determined.

Exploring somatization in adolescents with persistent post-concussive symptoms

Katherine Green, Amrit Dhariwal, Noah Silverberg, Jacqueline Purtzki, Andrea Chapman, & Tim Oberlander.

Background: Persistent post-concussive symptoms are a prevalent and impairing concern among adolescents after concussion. Somatization, the process whereby emotional distress is expressed as physical symptoms, may play a role in these persistent post-concussive symptoms. If so, identifying and treating somatization is of great importance, as left untreated, it poses risks to adolescent development and functioning. However, effective clinical identification of somatization in adolescents with persistent post-concussive symptoms is impeded by a lack of understanding surrounding the characteristics of somatization in this population.

Objective: To describe the characteristics of adolescents with persistent post-concussive symptoms affected by somatization, and to evaluate differences between these adolescents and those with persistent post-concussive symptoms unaffected by somatization.

Methods: This study involved a review of medical records of adolescents referred to a tertiary care concussion clinic between January 2016 and May 2018. Demographics, injury characteristics, post-concussive symptoms, mental health, medical service use, and school attendance was extracted from charts. Adolescents with physician-identified somatization were compared to those without somatization.

Results: Adolescents with somatization had more severe and unusual post-concussive symptoms, were more likely to have a history of chronic pain or medically unexplained symptoms, have had neuroimaging done after injury, had seen more health care providers after injury, and had worse

post-injury school attendance than those without somatization.

Conclusions: Adolescents with persistent post-concussive symptoms affected by somatization differ from those unaffected in post-concussive symptoms, medical service use, and school attendance. These findings may help lay the groundwork for improved clinical identification and treatment of somatization in youth following a concussion.

The evolution of a revolution: A noninvasive neuroprosthesis for cardiovascular recovery following spinal cord injury

Rahul Sachdeva, Kiran Pawar, Arshdeep Marwaha, & Andrei V. Krassioukov.

Objective: Spinal cord injury (SCI) results in life-threatening cardiovascular impairments that are among the highest priorities of recovery in this population. Majority of individuals with an SCI above T6 suffer from autonomic dysreflexia, a devastating condition where systolic BP can abruptly rise up to 300 mmHg in response to daily stimuli (e.g. full bladder), resulting in cerebral hemorrhage, seizures and even death. Because these BP fluctuations are rapid, current pharmacological options to manage BP are undesirable as they are slow-acting and exert prolonged unwanted effects. The objective of this study was to develop a noninvasive, fast-acting therapy to manipulate BP following an experimental SCI.

Methods: Adult male Wistar rats received a complete transection SCI at third thoracic spinal segment. Eight weeks post injury, transcutaneous electrical stimulation was delivered at 30Hz, 1ms pulses by electrodes placed on the skin at mid and lower thoracic levels. Hemodynamics were recorded at rest as well as during experimental autonomic dysreflexia (colorectal distension).

Results: Autonomic dysreflexia was mitigated (55 ± 16 vs. 13 ± 21 mmHg rise in systolic BP) when stimulation was turned on prior to colorectal distension. Furthermore, already elevated BP during an autonomic dysreflexia episode was immediately ameliorated as soon as stimulation was turned on during the episode.

Conclusion: Transcutaneous spinal cord stimulation is a reliable, noninvasive, fast-acting and clinically adaptable therapy for potentially fatal cardiovascular consequences of SCI.

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understanding of the beneficial and detrimental effects of cannabis in individuals with SCI.

The therapeutic potential of cannabis in persons with spinal cord Injury: A systematic review

Kylie J. Nabata, Emmanuel Tse, Amanda Lee, M, Janice J. Eng, Matthew Queree, Matthias Walter, Tom E. Nightingale, & Andrei V. Krassioukov.

Objective: This systematic review aims to: 1) understand usage patterns and reasons for cannabis use, and 2) the treatment efficacy and safety of cannabis use, in individuals with SCI.

Methods: Studies reporting on cannabis use in individuals with SCI were searched electronically via PubMed, Embase and Web of Knowledge. 6,700 studies were screened and 26 were included in this review. Eighteen studies addressed questions regarding cannabis usage in individuals with SCI. Eight studies investigated the therapeutic potential of cannabis on secondary medical conditions commonly experienced by individuals with SCI, such as pain, spasticity and bladder dysfunction.

Results: Studies investigating cannabis use; concluded that the most common usage method was smoking and the frequency of use was predominantly daily in individuals with SCI. Relief of spasticity and recreation were the most common reasons for use. Although the magnitude of effects were inconsistent, the overarching evidence reports cannabis can be used to reduce pain and spasticity in individuals with SCI. Despite these promising results, cannabis use was also associated with adverse events such as sedation and psychosis.

Conclusion: Current evidence suggests that cannabis is effective in the management of pain and spasticity in individuals with SCI. However, at present there is a lack of rigorously designed, high quality evidence in this population. Longer-term, double-blind, randomized controlled trials, assessing a wider-range of outcomes, should be conducted in the future to further our