The 4th International Autonomic Symposium

Interfacing Man and Machine: Neuroprosthetics for managing autonomic function after spinal cord injury

February 22, 2017 Vancouver, BC

	Program 1 (Full Day)		**Program 2 (Half Day)**		**Program 3 (Café Scientifique)**
08:00 - 18:00	**Registration** + Pre-Event Survey; Coffee/Tea Provided				
09:00 - 09:15	**Opening Remarks**				
09:16 - 10:45	**Session #1:** Novel Technology, motor, and cardiovascular control				
10:46 - 11:05	**Break** - Coffee/Tea Provided				
11:06 - 12:30	**Session #2:** Sacral Root Stimulation – Part 1				
12:31 - 14:00	**Lunch and Research Poster Competition**	12:31 - 18:00	**Registration** + Pre-Event Survey; Lunch provided		
14:01 - 14:50	**Session #3:** Sacral Root Stimulation – Part 2	14:01 - 14:09	**Opening Remarks**		
15:00 - 16:27	**Session #4:** Trainee Research Presentations	14:10 - 16:33	**Session:** Health after spinal cord injury		
16:30 - 16:59	**Networking Break**			16:30 - 18:00	**Registration** + Pre-Event Survey
Café Scientifique at the 2017 Autonomic Symposium					
17:00 - 17:59	**Panel presentation follow by an interactive session (Q and A)**				
18:00 - 18:30	**Roundtable Stations:** Opportunity to talk to the keynote speakers				
Evening Reception					
18:31 - 20:00	Wine tasting, beer tasting, and hors d'oeuvres accompanied by Musicians of the Vancouver Adapted Music Society				

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Interfacing Man and Machine: Neuroprosthetics for managing autonomic function after spinal cord injury
February 22, 2017 Vancouver, BC

Mr. Pierre Asselin

Health Science Specialist, James J Peters
VA Medical Center Bronx, NY

Marie Carlson
Sexual Health Clinician, BC Center for Sexual Medicine, GF Strong Rehab Centre
Co-Chair Disability & Rehab Ethics Committee

Dr. David Darrow

Resident PGY4, Department of Neurosurgery
University of Minnesota, MN, USA

Dr. Stacy Elliott

Clinical Professor, Departments of Psychiatry and Urologic Sciences; Medical Director, BC Centre for Sexual Medicine
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Mrs. Leslie Houle

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Dr. Alex Kavanagh

Clinical Assistant Professor, Department of Urologic Sciences
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Dr. Andrei Krassioukov
Professor, Division of Physical Medicine and Rehabilitation; Director, ICORD Autonomic Research Unit;
Staff physician, GF Strong Rehabilitation Centre
University of British Columbia, Canada

Dr. Klaus Krogh

Clinical Professor, Department of Hepatology and Gastroenterology
Aarhus University, Aarhus, Denmark

Dr. Aaron Phillips

Assistant Professor, Department of Clinical Neurosciences
University of Calgary, Canada

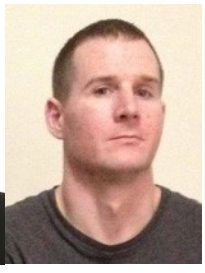
Dr. Ramesh Sahjpaul

Clinical Associate Professor, Division of Neurosurgery;
Neurosurgeon, Lions Gate Hospital
University of British Columbia, Canada

Dr. Christopher West

Assistant Professor, School of Kinesiology
University of British Columbia, Canada

Ms. Theresa Thorson
and
Mr. Isaac Darrel
Individuals
with
spinal cord injury



Program 1 - Full Day
Detailed Schedule

8:00 - 18:00	**Registration** at ICORD (at Blusson Spinal Cord Centre, 818 W. 10th Avenue, Vancouver) **- Coffee/Tea Provided**
9:00 - 9:15	Opening Remarks *Dr. Wolfram Tetzlaff, Dr. Jennifer Yao, Dr. Phalgun Joshi*
Session #1: Novel technology, motor, and cardiovascular control	
9:16 - 9:40	*Dr. David Darrow, University of Minnesota, MN, USA* TOPIC: Latest advances in the use of epidural stimulation following spinal cord injury.
9:41 - 10:00	*Dr. Andrei Krassioukov, University of British Columbia/GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver, Canada* TOPIC: Integration at the spinal cord: How motor and sensory systems are interact with autonomic control?
10:01 - 10:20	*Dr. Stacy Elliott, University of British Columbia/Vancouver General Hospital, Vancouver, Canada* TOPIC: Implants and Sexual Health
10:21 - 10:45	*Mr. Pierre Asselin, Veteran Affairs Medical Centre, Bronx, NY, USA* TOPIC: Benefits for cardiovascular control of rehabilitation interventions with exoskeletons.
10:46 - 11:05	**Break - Coffee/Tea Provided**
Session #2: Sacral Root Stimulation – Part 1	
11:06 - 11:30	*Dr. Klaus Krogh, Aarhus University, Aarhus, Denmark* TOPIC: Sacral root stimulation and bowel dysfunctions after spinal cord injury.
11:31 - 11:45	*Dr. Aaron Phillips, University of British Columbia, Vancouver, Canada* TOPIC: Transcutaneous stimulation for improvements of cardiovascular outcomes after spinal cord injury.
11:46 - 12:00	*Dr. Christopher West, University of British Columbia, Vancouver, Canada* TOPIC: Epidural stimulation for improvements of cardiovascular outcomes after spinal cord injury.
12:01 - 12:30	*Interactive session: Individuals from the spinal cord injury community on life with autonomic dysreflexia.*
12:31 - 14:00	**Lunch**
12:31 - 14:00	**Poster Session During Lunch Break**

Session #3: Sacral Root Stimulation Part 2	
14:01 - 14:25	*Dr. Ramesh Sahjpaul, University of British Columbia/Lion's Gate Hospital, Vancouver, Canada* TOPIC: Spinal cord stimulation via implants for the treatment of chronic pain in individuals with spinal cord injury.
14:26 - 14:50	*Dr. Alex Kavanagh, University of British Columbia/Vancouver General Hospital, Vancouver, Canada* TOPIC: Sacral nerve modulation for improvement of urinary bladder dysfunctions after spinal cord injury.
Session #4: Trainee Research Presentations	
15:00 - 15:07	*Mr. Cameron Gee: Cardiovascular responses to heat acclimatization in athletes with spinal cord injury.*
15:08 - 15:15	*Dr. Huayi Xing: Training Outcome of the International Standards to document remaining autonomic function after spinal cord injury (ISAFSCI) among Medical Students: Baseline knowledge and post-training results.*
15:16 - 15:23	*Ms. Diana Hunter: The level of spinal cord transection affects the relationship between bladder pressure and non-voiding contractions.*
15:24 - 15:31	*Ms. Mengyao Jia: Passive Cycling of the Hind Limbs Restores Cerebrovascular Health after Complete High-thoracic Transection*
15:32 - 15:39	*Dr. Nan Liu: Challenges in learning the International Standards to document remaining autonomic function after spinal cord injury (ISAFSCI) among Medical Students: Suggestions for clarification and improvement.*
15:40 - 15:47	*Mr. Hirmand Nouraei: Valsalva maneuver reliability in spinal cord injury.*
15:48 - 15:55	*Dr. Malihe Poormasjedi: Spinal cord injury induced systolic dysfunction is associated with cardiomyocyte atrophy and increased proteolysis.*
15:56 - 16:03	*Dr. Rahul Sachdeva: Combined Regenerative and Rehabilitative Strategy for Cardiovascular Recovery after Spinal Cord Injury*
16:04 - 16:11	*Dr. Ryan Solinsky: Foundational research for a next-generation, optogenetics based bladder neuroprosthesis for individuals with spinal cord injury.*
16:12 - 16:19	*Dr. Matthias Walter: The relationship between the lesion level and prevalence of autonomic dysreflexia during urodynamic investigation in individuals with spinal cord injury.*
16:20 - 16:27	*Mr. Alexander Wilson: Falls during inpatient rehabilitation: why, who, how?*
16:30 - 16:59	**Networking Break**

Café Scientifique at the 2017 Autonomic Symposium	
17:00 - 17:05	Opening Remarks at ICORD (at Blusson Spinal Cord Centre, 818 W. 10th Avenue, Vancouver) *Mr. John Chernesky and Dr. Andrei Krassioukov*
Panel presentation	
17:06 - 17:11	*Mr. Isaac Darrell: An individual with spinal cord injury, Vancouver, BC* TOPIC: A personal story.
17:12 - 17:17	*Dr. David Darrow, University of Minnesota, MN, USA* TOPIC: Latest advances in the use of epidural stimulation following spinal cord injury.
17:18 - 17:23	*Dr. Andrei Krassioukov, University of British Columbia/GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver, Canada* TOPIC: Effects of epidural stimulation on cardiovascular dysfunctions following spinal cord injury.
17:24 - 17:29	*Mr. Pierre Asselin, Veteran Affairs Medical Centre, Bronx, NY, USA* TOPIC: Benefits for cardiovascular control of rehabilitation interventions with exoskeletons.
17:30 - 17:35	*Dr. Klaus Krogh, Aarhus University, Aarhus, Denmark* TOPIC: Sacral root stimulation and bowel dysfunctions after spinal cord injury.
17:36 - 17:41	*Dr. Alex Kavanagh, University of British Columbia/Vancouver General Hospital, Vancouver, Canada* TOPIC: Sacral nerve modulation for improvement of urinary bladder dysfunctions after spinal cord injury.
17:42 - 17:47	*Marie Carlson, GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver, Canada* TOPIC: Sexual health and technology
17:48 - 17:53	*Ms. Theresa Thorson: An individual with spinal cord injury* TOPIC: AD and Me
17:54 - 17:59	Interactive Question & Answer Session with the Audience
Roundtable Stations	
18:00 - 18:30	Your chance to visit with the key note speakers
Evening Reception at the 2017 Autonomic Symposium	
18:31-20:00	**Wine tasting, beer tasting, and hors d'oeuvres accompanied by Musicians of the Vancouver Adapted Music Society**

Program 2 - Half Day
Detailed Schedule

12:31-18:00	**Registration** at ICORD (at Blusson Spinal Cord Centre, 818 W. 10th Avenue, Vancouver) - **Lunch provided**
14:01-14:09	Opening Remarks (at Eye Care Centre Auditorium, 2550 Willow Street, Vancouver) *Dr. Andrei Krassioukov, Ms. Maureen McGrath*
Session on Health after Spinal Cord Injury	
14:10-14:25	*Dr. Andrei Krassioukov, University of British Columbia/GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver, Canada* TOPIC: Integration at the spinal cord: How motor and sensory systems are interact with autonomic control?
14:26-14:41	*Mr. Pierre Asselin, Veteran Affairs Medical Centre, Bronx, NY, USA* TOPIC: Benefits for cardiovascular control of rehabilitation interventions with exoskeletons.
14:42-14:57	*Dr. Ramesh Sahjpaul, University of British Columbia/Lion's Gate Hospital, Vancouver, Canada* TOPIC: Spinal cord stimulation via implants for the treatment of chronic pain in individuals with spinal cord injury.
14:58-15:13	*Dr. David Darrow, University of Minnesota, MN, USA* TOPIC: Latest advances in the use of epidural stimulation following spinal cord injury.
15:14-15:29	*Dr. Klaus Krogh, Aarhus University, Aarhus, Denmark* TOPIC: Sacral root stimulation and bowel dysfunctions after spinal cord injury.
15:30-15:45	*Dr. Alex Kavanagh, University of British Columbia/Vancouver General Hospital, Vancouver, Canada* TOPIC: Sacral nerve modulation for improvement of urinary bladder dysfunctions after spinal cord injury.
15:46-16:01	*Dr. Aaron Phillips, University of British Columbia, Vancouver, Canada* TOPIC: Transcutaneous stimulation for improvements of cardiovascular outcomes after spinal cord injury.
16:02-16:17	*Dr. Christopher West, University of British Columbia, Vancouver, Canada* TOPIC: Epidural stimulation for improvements of cardiovascular outcomes after spinal cord injury.
16:18-16:33	*Marie Carlson and Mrs. Leslie Houle, Sexual Health Clinicians, GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver Canada* TOPIC: Sexual Health and Technology

Café Scientifique at the 2017 Autonomic Symposium	
17:00 - 17:05	Opening Remarks at ICORD (at Blusson Spinal Cord Centre, 818 W. 10th Avenue, Vancouver) *Mr. John Chernesky and Dr. Andrei Krassioukov*
Panel presentation	
17:06 - 17:11	*Mr. Isaac Darrell: An individual with spinal cord injury, Vancouver, BC* TOPIC: A personal story.
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17:42 - 17:47	*Marie Carlson, GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver, Canada* TOPIC: Sexual health and technology
17:48 - 17:53	*Ms. Theresa Thorson: An individual with spinal cord injury* TOPIC: AD and Me
17:54 - 17:59	Interactive Question & Answer Session with the Audience
Roundtable Stations	
18:00 - 18:30	Your chance to visit with the key note speakers
Evening Reception at the 2017 Autonomic Symposium	
18:31-20:00	**Wine tasting, beer tasting, and hors d'oeuvres accompanied by Musicians of the Vancouver Adapted Music Society**

Program 3 - Café Scientifique at the 2017 Autonomic Symposium

Detailed Schedule

16:30 - 18:00	**Registration** at ICORD (at Blusson Spinal Cord Centre, 818 W. 10th Avenue, Vancouver)
17:00 - 17:05	Opening Remarks at ICORD *Mr. John Chernesky and Dr. Andrei Krassioukov*
Panel presentation	
17:06 - 17:11	*Mr. Isaac Darrell: An individual with spinal cord injury, Vancouver, BC* TOPIC: A personal story.
17:12 - 17:17	*Dr. David Darrow, University of Minnesota, MN, USA* TOPIC: Latest advances in the use of epidural stimulation following spinal cord injury.
17:18 - 17:23	*Dr. Andrei Krassioukov, University of British Columbia/GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver, Canada* TOPIC: Effects of epidural stimulation on cardiovascular dysfunctions following spinal cord injury.
17:24 - 17:29	*Mr. Pierre Asselin, Veteran Affairs Medical Centre, Bronx, NY, USA* TOPIC: Benefits for cardiovascular control of rehabilitation interventions with exoskeletons.
17:30 - 17:35	*Dr. Klaus Krogh, Aarhus University, Aarhus, Denmark* TOPIC: Sacral root stimulation and bowel dysfunctions after spinal cord injury.
17:36 - 17:41	*Dr. Alex Kavanagh, University of British Columbia/Vancouver General Hospital, Vancouver, Canada* TOPIC: Sacral nerve modulation for improvement of urinary bladder dysfunctions after spinal cord injury.
17:42 - 17:47	*Marie Carlson, GF Strong Rehabilitation Centre/Vancouver General Hospital, Vancouver, Canada* TOPIC: Sexual health and technology
17:48 - 17:53	*Ms. Theresa Thorson: An individual with spinal cord injury* TOPIC: AD and Me
17:54 - 17:59	Interactive Question & Answer Session with the Audience
Roundtable Stations	
18:00 - 18:30	Your chance to visit with the key note speakers
Evening Reception at the 2017 Autonomic Symposium	
18:31-20:00	**Wine tasting, beer tasting, and hors d'oeuvres accompanied by Musicians of the Vancouver Adapted Music Society**

Abstracts for Trainee Research Presentations

Cardiovascular responses to heat acclimatization in athletes with spinal cord injury

Cameron M. Gee; Melissa A. Lacroix; Wendy A. Pethick; Patrick Côté; Trent Stellingwerff; Christopher R. West. - University of British Columbia, School of Kinesiology

Purpose: To determine the effect of heat acclimatisation (HA) training on blood profile and resting cardiac function in athletes with spinal cord injury (SCI).

Methods: Eleven athletes (10m, 1f) completed a five-day isothermic HA protocol whereby core body temperature (Tc) was elevated to and maintained at ~38.5 degrees Celsius (°C) for sixty minutes via intermittent exercise. Blood samples were collected pre- and post-HA to determine changes in plasma volume (PV). Doppler ultrasound of the left-ventricular outflow tract and 2-d speckle tracking echocardiography were performed in a subset of athletes (n=5) to determine indices of resting left-ventricular function and mechanics, respectively. Differences in all indices were assessed using dependent samples t-tests. Significance was set at $p<0.05$.

Results: Ten athletes were successfully able to raise Tc to 38.5 °C. PV showed a trend to increase with HA training (ΔPV%: 3.0±5.4%, p=0.086). Following HA, resting HR decreased (64±4 vs. 57±5 bpm, p=0.002), velocity time integral (21.4±2.7 vs. 23.7±3.0 cm, p=0.045) and stroke volume increased, (64.8±7.6 vs. 70.2±10.5 mL, p=0.055) and twist (6.1±3.1 vs. 13.4±0.8 degrees (p=0.030)) and twist velocity (81.5±9.8 vs. 121.9±22.1 (p=0.049)) were higher.

Conclusion: This is the first study to examine HA in elite athletes with SCI. Our findings suggest a short-term HA protocol in athletes with SCI can induce beneficial changes in plasma volume and indices of resting cardiac function and mechanics. Future studies on HA in athletes with SCI should focus on determining mechanisms of adaptation and performance outcomes.

Training Outcome of the International standards to document remaining autonomic function after spinal cord injury (ISAFSCI) among Medical Students: Baseline knowledge and post-training result

Liu Nan[1]; Xing H[1]; Krassioukov AV[2]; Biering-Sørensen F[3] - [1]Department of Rehabilitation Medicine, Peking University Third Hospital, Beijing, China; [2]International Collaboration on Repair Discoveries (ICORD), Department of Medicine, University of British Columbia, Vancouver, British Columbia, Canada; [3]Clinic for Spinal Cord Injuries, Rigshospitalet, University of Copenhagen, Copenhagen, Denmar

Introduction: To investigate the baseline knowledge of the concept of autonomic functions and specifically the International standards to document remaining autonomic function after spinal cord injury (ISAFSCI) and to examine the learning outcomes and retention of knowledge on ISAFSCI among medical students

Methods: 37 medical students attended the training session. Before training, a questionnaire including 24 concepts was administrated to the students to investigate their baseline knowledge. Then students were divided into 2 groups. One group had a one-hour self-study (N=19), while the other group received a one-hour lecture based learning (LBL) about the ISAFSCI (N=18). After self-study/LBL, all students were examined by a 15-question test paper on the knowledge of ISAFSCI.

Results: Before training, students were familiar with only 8 out of the 24 concepts within the questionnaire (demonstrating baseline knowledge rate beyond 50%). After training, all questions within the test paper except the one regarding hypohydrosis were answered with an excellent outcome (defined as a post-training accuracy rate of not less than 80%) with the lowest rate as 83.3% in LBL group. However, in self-study group, only 5 out of the 15 questions acquired an excellent outcome.

Conclusion: The baseline knowledge of the concepts related to autonomic function and ISAFSCI is relatively poor in medical students. The training outcome of LBL is better than self study. Therefore, utilization of formal lecture or presentation is recommended to improve the effectiveness when teaching the ISAFSCI to medical students.

The level of spinal cord transection affects the relationship between bladder pressure and non-voiding contractions.

Hunter, D.V. and Ramer, M.S. - International Collaboration on Repair Discoveries (ICORD), Blusson Spinal Cord Centre, University of British Columbia, Vancouver, Canada

Introduction: Proper control of filling and emptying of the urinary bladder requires the coordination of the autonomic, somatic, and sensory nervous systems. Spinal cord injury (SCI) interrupts the proper coordination of these systems and can result in significant dysfunction within the urogenital tract. Non-voiding contractions (NVCs) are low-amplitude contractions that occur within the bladder as the pressure increases. Previous studies have demonstrated a relationship between pressure within the bladder, amplitude of the NVC and activation of sensory fibers. Here we look at how different levels of complete spinal cord transection can differentially affect the relationship between bladder pressure and NVCs.

Methods: A pressure transducer placed within the lumen of the bladder measured NVCs in control rats and in rats 2 days after spinal cord transections at the third thoracic or second lumbar segment. Saline was infused into the bladder at a controlled rate to examine the relationship between bladder pressure and the amplitude of the NVCs.

Results: We find that by 2-days post lumbar SCT the NVCs reach an amplitude of 1mmHg at a lower pressure when compared to naïve controls. Additionally, the linear relationship between the pressure within the bladder and the amplitude of the NVCs was altered with both levels of spinal cord transection.

Conclusion: These differential changes within NVCs after different levels of spinal cord transection may help to understand the role of different neural pathways in the physiological and morphological changes within the bladder after SCI.

Passive Cycling of the Hind Limbs Restores Cerebrovascular Health after Complete High-thoracic Transection

Jia, M[1]; Phillips, AA[1]; Matin, N[2]; Yung, A[1]; Zheng, MMZ[1]; Lee, A[1]; Monga, A[1]; Kozlowski, P[1]; Dorrence, A[2]; Krassioukov, AV[1,3]. - [1]International Collaboration on Repair Discoveries, University of British Columbia, Vancouver, BC; [2]Pharmacology, Michigan State University, East Lansing, MI, USA. [3]G.F. Strong Rehabilitation Center, Vancouver, BC

Introduction: Individuals living with chronic spinal cord injury exhibit a 3-4 fold increased risk of stroke. Previously, we have reported impairment in cerebrovascular health following experimental high-thoracic spinal cord injury, including cerebrovascular reactivity declines, as well as inward remodelling and profibrosis of the middle cerebral artery. Passive hind-limb exercise after spinal cord injury has been shown to restore systemic cardiovascular function, however it has never been explored for improving cerebrovascular health.

Methods: Male Wistar rats (n=45) were uninjured, T3-level complete transected or T3-transected with passive exercise. Six days after surgery, the hind-limb passive cycling intervention was initiated and lasted for five weeks. Six weeks after surgery, magnetic resonance imaging was performed to evaluate baseline cerebral blood flow. middle cerebral arteries were then harvested for functional and structural assessments, including *in vitro* pressure myography and immunohistochemistry.

Results: There was a 44% reduction in global cerebral blood flow (p=0.001) after spinal cord injury, which was restored with passive exercise. Passive exercise also prevented the endothelial dysfunction seen after spinal cord injury (p=0.046). Profibrotic remodelling of middle cerebral arteries demonstrated by increased collagen (95%, p=0.004), was also reversed by passive exercise.

Conclusion: Passive hind-limb cycling is effective in restoring healthy brain blood flow, endothelial function, and preventing profibrosis in the cerebral vasculature. Clearly, passive exercise is a promising pre-clinical therapy to restore cardiovascular health after spinal cord injury, and the present data extend these benefits even to the brain.

Challenges in learning the International standards to document remaining autonomic function after spinal cord injury (ISAFSCI) among Medical Students: Suggestions for clarification and improvement

Liu Nan[1]; Xing H, M.D[1]; Krassioukov AV[2]; Biering-Sørensen[3] - [1] Department of Rehabilitation Medicine, Peking University Third Hospital, Beijing, China; [2]International Collaboration on Repair Discoveries (ICORD), Department of Medicine, University of British Columbia, Vancouver, British Columbia, Canada; [3]Clinic for Spinal Cord Injuries, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark

Introduction: To present the challenges in learning of the International standards to document remaining autonomic function after spinal cord injury (ISAFSCI), and to illustrate confusions in option selection of several items within the ISAFSCI

Methods: A total of 37 medical students attended a training session regarding the ISAFSCI. Following the training, interactive group discussion on the difficulties during the learning process was performed with the tutor. After one-hour's discussion, difficulties raised by the students were collected, summarized and categorized into three main topics as: definition, expression, and confusion for the option selection of items in the ISFASCI.

Results: Students encountered difficulties in the definitions of three items within the ISAFSCI: supine hypotension, orthostatic hypotension and autonomic dysreflexia (AD). Misunderstanding occurred with the inconsistent expressions in five items: supine hypertension, supine/resting hypotension, neurogenic shock, temperature dysregulation and ejaculation. Confusions arose for the documentation of items within ISAFSCI which are related to heart, blood pressure and broncho-pulmonary system, AD episode with reflex bradycardia or sweating, as well as choosing scores for urinary and fecal incontinence, and voluntary anal sphincter contraction.

Conclusion: Difficulties during learning of the ISAFSCI summarized according to the discussion and feedback from the medical students may provide information to improve the ISAFSCI, including further clarification, which would eventually contribute to facilitate the use of ISAFSCI across the world.

Valsalva maneuver reliability in spinal cord injury

Nouraei, H, Berger, MJ, Krassioukov, A - Department of Undergraduate Medicine, University of British Columbia

Introduction: A simple non-invasive approach for assessing baroreflex sensitivity (BRS) is the Valsalva maneuver (VM). VM has been shown to provide acceptable reproducibility for arterial baroreflex sensitivity assessment in healthy controls. The purpose of our study is to measure the test-retest reliability of the qualitative and quantitative parameters of the VM in individuals with traumatic high-level (above T6) spinal cord injuries.

Methods: Fourteen participants underwent VM testing at two time points separated by 1 week. Intra-rater reliability is determined by the intra-class correlation coefficient (ICC), standard error of measurement (SEM) and minimal detectable difference (MDD95) with 95% confidence intervals (CI) for the Valsalva ratio (VR), pressure recovery time (PRT), vagal (BRSv) and adrenergic baroreflex sensitivity (BRSa1) parameters. Qualitative reliability based on comparing the tracings for the first and second VM tests is assessed.

Results: Quantitative parameters display variable test-restart reliability. SEM represents response stability, and MDD represents responsiveness. Valsalva ratio, PRT, $BRSa_1$ and BRSv are assessed. In terms of qualitative reliability, five subjects (36%) demonstrate an “M” pattern at both time points and the other nine subjects (64%) demonstrate a “V” pattern at both time points.

Conclusion: Quantitate parameters demonstrate variable test-retest reliability, response stability and responsiveness. VR, which is representative of the cardiovagal BRS, demonstrates good reliability. $BRSa_1$ and PRT demonstrates moderate reliability, whereas BRSv demonstrates poor reliability. Qualitative reliability is found to be consistent between trials. The VM is a useful way for assessing cardiovagal and sympathetic adrenergic autonomic response in individuals with SCIs.

Spinal cord injury induced systolic dysfunction is associated with cardiomyocyte atrophy and increased proteolysis

M-S. Poormasjedi-Meibod [1,2], J.W. Squair [1,3], M. Mansouri [1], V. Yuen [4], J.H. McNeill [4], C. R. West [1,2] - [1]International Collaboration on Repair Discoveries (ICORD), Faculty of Medicine, UBC, Canada, [2]School of Kinesiology, UBC, Canada, [3]MD/PhD Training Program, Faculty of Medicine, UBC, [4]Faculty of Pharmaceutical Sciences, UBC, Canada

Introduction: Spinal cord injury (SCI) causes autonomic dysfunction, altered neurohumoral control and profound hemodynamic changes, leading to maladaptive cardiac remodeling and subsequent increased risk of cardiovascular disease (CVD). Although higher prevalence of cardiac dysfunction has been reported post-SCI the underlying mechanisms remain poorly understood. Therefore, here we investigated the cellular and molecular mechanisms underlying post-SCI cardiac dysfunction.

Method: We conducted T3 complete SCI in male Lean Zucker rats (SCI; n = 9) and compared responses against an uninjured Lean Zucker group (CON, n = 9). Twelve weeks post-injury, cardiac function was examined in vivo using direct left ventricular catheterization. Blood and tissue samples were collected for further analysis.

Results: Compared to CON, SCI exhibited a significant reduction in left ventricular (LV) dimensions and cardiac mass to femur length ratio, indicating the presence of cardiac atrophy post-SCI. Moreover, blood pressure, stroke volume and contractility were dramatically reduced post-SCI. Histological analysis indicated a significant decrease in length and width of cardiomyocytes in SCI vs. CON. Cardiac gene expression analysis showed that different components of the ubiquitin–proteasome system (UPS) (i.e. MuRF1 and MAFbx), and autophagy (i.e. Beclin1 and ATG12), were significantly up-regulated post-SCI. Lastly, blood profiling revealed a significant decrease in plasma norepinephrine and a simultaneous increase in plasma angiotensin II post-SCI.

Conclusion: SCI is associated with impaired systolic function that is accompanied by cardiomyocyte atrophy, the latter of which is accompanied by UPS and autophagy upregulation. Cardiomyocyte atrophy is likely a response to the change in circulatory profile of norepinephrine and angiotensin II.

Combined Regenerative and Rehabilitative Strategy for Cardiovascular Recovery after Spinal Cord Injury

Sachdeva R., Gopaul R., Jia M., Hutton G., Monga A., Ramer M., Krassioukov A.V. - ICORD, UBC, Vancouver, BC, Canada

Introduction: SCI causes debilitating cardiovascular (CV) dysfunction primarily by (a) loss of medullary control of sympathetic pre-ganglionic neurons and, (b) the aberrant sprouting of nociceptive afferent fibers within the spinal cord. We used a triple combination approach to simultaneously enhance supraspinal axon regeneration and to reduce nociceptive sprouting to promote CV recovery after SCI.

Methods: Male Wistar rats (n=40) received a T3 spinal transection. The treatment included peripheral nerve grafts (PNGs) spanning the lesion, intrathecal chondroitinase enzyme and cycling exercise (1 hr/day, 5 days/week). Resting blood pressure (BP), heart rate and pressor response to colorectal distension (CRD) was terminally assessed using radiotelemetry. Functional regeneration across PNGs was determined using stimulus-driven units below the lesion upon electrical stimulation at cervical level.

Results: The PNG and chondroitinase combination led to significant CV recovery compared to the untreated group. Specifically during CRD, the PNG+chondroitinase group showed 51.2% reduction in systolic BP elevation (66.5 vs. 32.4mmHg, $p<0.0001$), 45.7% reduction in diastolic BP elevation (37.4 vs. 20.3mmHg, $p<0.001$), 48.2% reduction in mean arterial pressure elevation (47.1 vs. 24.4mmHg, $p<0.001$) and abolishment of bradycardia (-86.3 vs. +5.4bpm, $p<0.01$). Stimulus-driven neuronal activity across PNGs confirmed the functional re-connection of regenerating axons. Surprisingly, no effect of exercise was seen in any of the groups. Ongoing histological studies will investigate the mechanisms underlying recovery.

Conclusion: The combination approach leads to significant recovery of CV function after SCI, which is likely mediated by vasomotor regeneration.

Foundational research for a next-generation, optogenetics based bladder neuroprosthesis for individuals with spinal cord injury

Solinsky, R. Richner, T. Moritz, C. - Kessler Institute for Rehabilitation/ University of Washington Department of Rehabilitation Medicine

Introduction: Restoration of bladder function is a leading priority for individuals with neurogenic bladder after spinal cord injury (SCI), and it remains a primary source for worsening of complications, mortality, health care expenditures and quality of life. Prior functional electrical stimulation based bladder neuroprostheses have had minimal success, due partially to their off-target effects, complicated surgical implantation, and unidirectional stimulation limitations.

Methods: In a rat model, we have designed a bidirectional bladder neuroprosthesis with the goal of interfacing with the pelvic and pudendal nerves. This device would record and process neural signals, stimulate to cause detrusor contractions on demand, and block innapropriate activity. Our approach leverages optogenetics, light activated ion channels (opsins), delivered through a viral vector. We tested the ability to use these opsins to selectively generate and block action potentials in voiding relevant organs.

Results: Modest viral transfection of excitatory opsins was demonstrated, with the ability to generate increased detrusor pressures (without off-target colonic pressure variations) in response to optical stimulation. Further, in cultured neurons, we have selectively blocked spontaneous action potentials with optical illumination of inhibitory opsins. This block can subsequently be reversed on demand via illumination with a different wavelength of light.

Conclusion: While preliminary, this data suggests the feasibility of optogenetic based neuroprostheses for improved specificity in blocking and stimulation of voiding componentry. When paired with neural recording and signal processing capabilities, this lays the foundation for a potential new generation of smart neuroprostheses to improve functional status for individuals with SCI.

The relationship between the lesion level and prevalence of autonomic dysreflexia during urodynamic investigation in individuals with spinal cord injury

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Introduction: Urodynamic investigation (UDI), the gold standard to assess neurogenic lower urinary tract dysfunction (NLUTD) in individuals with spinal cord injury (SCI), may induce autonomic dysreflexia (AD). We aimed to determine predictors for AD during UDI.

Methods: Between 2011 and 2015, continuous non-invasive cardiovascular monitoring synchronized to the ongoing UDI was performed in individuals with SCI.

Results: 300 individuals were included in our study (41 females, mean age 51 years, mean injury duration 10 years). Multivariable logistic regression analyses revealed lesion level as the only significant independent predictor of the occurrence of AD during UDI. A lesion at T6 or above was associated with significant increased odds of AD during UDI (odds ratio (OR): 5.5, 95% confidence interval (CI) 3.2-9.4) compared to T7 or below. These heightened odds persisted after additional adjustment for sex, completeness and stage of injury (adjusted OR (AOR): 6.6, 95% CI 3.8-11.7). Further stratification by lesion level showed significant increased odds for following lesions compared to at T7 or below: C1-C4 (AOR: 16.2, 95% CI 5.9 to 57.9), C5-C8 (AOR: 12.2, 95% CI 4.9 to 35.8), T1-T3 (AOR: 5.2, 95% CI 2.1 to 14.5), and T4-T6 (AOR: 2.6, 95% CI 1.3 to 5.2).

Conclusion: There is a significant relationship between lesion level and prevalence of AD during UDI in individuals with SCI suffering from NLUTD. Considering the high risks involved with sudden hypertension such as stroke or even death, we strongly recommend continuous cardiovascular monitoring during UDI, particularly in individuals with lesions at T6 or above.

Falls during inpatient rehabilitation; why, who and how?

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Introduction: Rehabilitation hospital inpatients face a significant risk of falling. Falls can lead to injury, decreased quality of life, prolonged hospitalization, and increased costs. The goal of this study is to compare the causes, consequences, as well as the risk factors for, inpatient falls across three patient groups at GF Strong Rehabilitation Center (GFS).

Methods: The study consists of inpatients (237) admitted between January 1, 2011 to January 1, 2016 that fell during their stay at GFS. Only subjects that were in the Spinal Cord Injury (SCI), Acquired Brain Injury (ABI), and Neuromusculoskeletal (NMS) inpatient units were included in this study. Subjects were identified through an online incident report system and fall information was extracted from electronic patient charts.

Results: Of the 1492 patients admitted during the study period, 15.88% experienced at least one fall. The incidence rate for the SCI, ABI and NMS cohorts were 20.17%, 17.67% and 9.75% respectively. In total, 33% of the falls resulted in injury, and the ABI group had significantly more moderate to severe injuries ($p<0.05$). Transfers were the most common cause of fall (37.89%). ABI patients had the lowest total admission functional independence scores (AFIM) ($p\leq0.05$) and SCI patients had higher instances of polypharmacy ($p\leq0.05$).

Conclusion: SCI patients have higher incidences of falls and increased risk due to polypharmacy whereas ABI patients are more likely to suffer severe injury and have increased risk by having lower AFIM scores. Targeted interventions should be developed to address transferring activity as well as population specific risks.

Titles of Research Poster Presentations

1. Normalization of cardiac function with minocycline following experimental spinal cord injury

Chau E[1,2], Squair JW[1,3], Gopaul R[1], Liu J[1], Krassioukov AV[1,4,5], West CR[1,2] - *[1]International Collaboration on Repair Discoveries, [2]School of Kinesiology, [3]MD/PhD Training Program, [4]Department of Medicine, Division of Physical Medicine and Rehabilitation, University of British Columbia, [5]GF Strong Rehabilitation Centre, Vancouver Health Authority, Vancouver, Canada*

2. Chronic Autonomic Dysreflexia After T3 Spinal Cord Injury Results Impaired Vascular Function in Femoral Rat Arteries

Lee, A.H.X., Zheng, M.M.Z., Phillips, A. A., & Krassioukov, A.V. - University of British Columbia/ICORD, Experimental Medicine

3. Manesh, Sohrab[*1], Duncan, Greg J [*1], Hilton, Brett J [1], Assinck, Peggy [1], Plemel, Jason R [2], Chau, Phillip [1], Naderi-Azad, Sheida [1], Liu, Jie [1], Bergles, Dwight E. [3] and Tetzlaff, Wolfram [1] - [*] Authors Contributed Equally to this Work. -

[1]International Collaboration on Repair Discoveries (ICORD), University of British Columbia, Vancouver, BC, Canada; [2]Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta Canada; [3]The Solomon H Snyder Department of Neuroscience, John Hopkins University, Baltimore, Maryland, USA

4. Effect of minocycline in preserving neuronal innervation of myocardium after Spinal cord injury

Mansouri, MM, Squair, JWS, Ruiz, IAR, Sachdeva, RS, West, CW, **-** *University of Western Sydney school of medicine, ICORD*

5. Moderate-to-Vigorous Physical Activity is Related to Cardiac Function In Adults with Spinal Cord Injury
McCracken, L., Ma, J.K., Voss, C., Chan, F., Martin Ginis, K.A., West, C.R. - *ICORD, School of Kinesiology, University of British Columbia*

6. Profibrotic remodeling within the Cerebrovasculature as a Result of Chronic Repetitive Transient Hypertension
Monga, A, Phillips, A, Sachdeva, R, Krassioukov, A - *University of British Columbia, Vancouver, BC*

7. Using a Collagen Composite Hydrogel to Facilitate Treatment of Non-Healing Wounds
Pakyari, M[1], Pourghadiri, A[1], Ghahary, A[1]. - *[1] Department of Surgery, Division of Plastic Surgery, University of British Columbia*

8. Incidence and natural progression of neurogenic shock following traumatic spinal cord injury
Ruiz, I., Squair, J., Phillips, A., Lukac, C., Huang, D., Oxciano, P., Yan, Dong., Krassioukov, A. - *International Collaboration on Repair Discoveries, University of British Columbia*

9. The dawn of cardiovascular neuroprosthetics: Epidural spinal cord stimulation acutely restores cardiovascular function in persons with clinically complete spinal cord injury
Sarafis, ZK,[1,3] Phillips, AA,[1,2] West, CR,[1,3] Squair, JW,[1,4] Angeli, C,[5,6], Harkema, S,[5,6,7], Krassioukov, AV.[1,2,8]
[1]International Collaboration on Repair Discoveries, UBC, Vancouver. Canada: [2]Faculty of Medicine, UBC: [3]Kinesiology, UBC: [4]MD-PhD Training Program, UBC: [5]Frazier Rehab, Louisville, Kentucky: [6]Kentucky Spinal Cord Injury Center, University of Louisville: [7]Dept Neurological Surgery, University of Louisville: [8]GF Strong Rehab, Vancouver.

10. Impact of intravesicular lidocaine to decrease blood pressure in those with SCI at risk for autonomic dysreflexia.
Solinsky, R. Linsenmeyer, T. - *Kessler Institute for Rehabilitation*

11. Minocycline partially restores blood pressure regulation after experimental spinal cord injury
Squair, J.W., Ruiz, I., Zheng, M.M., Gopaul, R, Liu, J, West, C.R., Krassioukov, A.V - *ICORD, UBC*

12. Degron Peptide Mediated Inhibition of PTEN as a non-genetic Approach for mTOR Activation after SCI
Peter (Botao) Tan, Sahir Moosvi, Wenfang Bai, Brett Hilton, Jie Liu, Xi Chen, Yu-Tian Wang, and Wolfram Tetzlaff - *International Collaboration on Repair Discoveries, ICORD, Vancouver, BC, Canada*

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