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TITLE: Biomarkers of Spontaneous Recovery from Traumatic Spinal Cord Injury

PRINCIPAL INVESTIGATOR: Ona Bloom, PhD

CONTRACTING ORGANIZATION: Feinstein Institute for Medical Research
Manhsset, NY 11030

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Ona Bloom, PhD (PI)

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The Feinstein Institute for
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350 Community Drive
Manhasset, NY 11030

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13. SUPPLEMENTARY NOTES

14. ABSTRACT Immediately after SCI, a person confronts 3 major questions: (1) how much function have they lost, (2) what treatments promote recovery, (3) how much physical recovery can they expect over time? To answer the 1st question, a clinical exam tests motor and sensory function throughout the body. The 2nd question is still largely unanswered: standard rehabilitation focuses on maximizing preserved function and managing medical complications of living with SCI. Currently, there is no FDA-approved drug to promote recovery after SCI. The 3rd question is also unanswered; there is no standardized model to predict functional recovery, which occurs mostly within the 1st year after SCI. Surprisingly little is known about biological processes influencing recovery after SCI. Experiments indicate that inflammation worsens the initial damage and inhibits physical recovery. Signs of inflammation occur in people newly injured and in people living with SCI for many years. Our hypothesis is that some inflammatory factors are higher in individuals with SCI that achieve less physical recovery. We are performing a prospective, longitudinal study to measure circulating biochemical responses and functional recovery throughout the 1st year after SCI, in the same individuals. The goal is to build an easy-to-implement, predictive

15. SUBJECT TERMS
traumatic SCI, spinal cord, spontaneous recovery, functional recovery, inflammation, biomarkers, trauma

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1. **INTRODUCTION:** Immediately after a traumatic spinal cord injury (SCI), a person confronts 3 major questions: (1) how much function have they lost, (2) what treatments promote recovery, and (3) how much physical recovery can they expect over time? To answer the first question, a clinical exam tests motor and sensory function throughout the body. The second question is still largely unanswered: standard rehabilitation focuses on maximizing preserved function and managing medical complications of living with SCI. Currently, there is no FDA-approved drug to promote recovery after SCI. The third question is also unanswered; there is no standardized model to predict functional recovery, which occurs mostly within the first year after SCI. Surprisingly little is known about the biological processes influencing recovery after SCI. Experiments indicate that inflammation worsens the initial area of damage and inhibits physical recovery. Signs of inflammation occur in people newly injured and in people living with SCI for many years. Our hypothesis is that some inflammatory factors are higher in individuals with SCI that achieve less physical recovery. To test this hypothesis, we are performing a multi-site prospective, longitudinal study to measure circulating biochemical responses and functional recovery throughout the 1st year after SCI, within the same individuals. Data will be collected at least once within 0-3 days post injury (dpi), and then at 3, 6, and 12 months after SCI. The goal is to use these data to build an easy-to-implement, predictive multi-scale model of functional recovery after SCI that incorporates biomarkers related to inflammation. *This project is in its forth year. To date, we have screened 751 participants and enrolled 36 participants by recruiting across 6 different institutions*.
2. **KEYWORDS:**

   traumatic spinal cord injury, spinal cord, inflammation, biomarkers, spontaneous recovery, functional recovery, trauma
3. **ACCOMPLISHMENTS:**

- **What were the major goals of the project?**

The major goals are described below.
Site 1: The Feinstein Institute for Medical Research (of Northwell Health),
Site 2: Kessler Foundation,
Site 3: University (Univ.) of Louisville.
Site 4: Thomas Jefferson University
Site 5: University of British Columbia (ICORD)
Site 6: Ohio State University Medical Center

Major Task 1: Obtain IRB and HRPO/ACURO permission for study
Subtask 1: Submit documents for local IRB review
Subtask 2: Submit IRB approval and necessary documents for HRPO review

Major Task 2: Create Infrastructure and Obtain All Supplies/Training for Performance of Outcome Measures.
Subtask 1: Instruction or Review of Functional Outcome measures.
Subtask 2: non-NRN site personnel visit NRN site(s) for observational case study learning.
Subtask 3: Create custom clinical database for data entry
Subtask 4: Create SOP for clinical team, including data entry forms and instruction on use
Subtask 5: Send sample collection supplies, SOP and shipping supplies to all sites

Major Task 3: Human Subject Study Enrollment
Subtask 1: Recruit, consent and enroll subjects at acute time points, study visit 1
Subtask 2: Obtain Biological Samples (blood) from subjects, study visits 1-4
Subtask 3: Process and store biological samples, study visits 1-4
Subtask 4: Perform ISNCSCI exams and determine AIS grades

Subtask 5: Administer SCIM and determine scores, study visits 2-4
Subtask 6: Administer NRS and determine scores, study visits 2-4

Major Task #4: Data Analysis, Modeling and Interpretation
Subtask 1: Pilot Study: Perform biochemical assays on biological samples from subset of subjects
Subtask 2: Pilot Study: Perform data analysis, statistical modeling and interpretation of data
Subtask 3: Larger/Complete Set of Study Samples: Perform biochemical assays on biological samples from subset of subjects.

- **What was accomplished under these goals?**

1) Major Activities:
Major activities were focused on perfoming Major Task 3, Human Subject Study Enrollment, and initiating Major Task #4, performing a pilot study of data analysis, modeling and interpretation.

At Site 1, we continue to receive electronic daily alerts for ICD10 codes relevant to patients admitted with a possible traumatic SCI, communicate daily in-person with key personnel at our level 1 trauma center, and are also screening from a level 2 trauma center within our health system. We continue to offer to conduct study visits at home if a participant prefers, we communicate with study participants between visits, and we arrange for local participant travel to study visits.

We have screened and recruited the following # of participants in total (Yr1-4):
Site 1 Northwell: N=138 screened, 17 enrolled
Site 2 Kessler: N=44 screened, 3 enrolled
Site 3 Univ. of Louisville: N=130 screened, 7 enrolled
Site 4 Thomas Jefferson Univ.: N=19 screened, 2 enrolled
Site 5 ICORD: N= 377 screened, 7 enrolled
Site 6 OSUMC: N=7 screened, 0 enrolled

2) Specific Objectives of the Project

- Major Task 1 was accomplished at Sites 1-6.
- Major Task 2 was accomplished at Sites 1-6.
- Major Task 3 is ongoing at Sites 1-6:
    - Year 1: Sites 1-3, a combined total of 29 participants were screened and 5 were enrolled.
    - Year 2: Sites 1-3, a combined total of 103 participants were screened and 9 were enrolled.
    - Year 3: Sites 1-5, a combined total of 218 participants were screened and 11 were enrolled.
    - Year 4: Sites 1-6, a combined total of 91 participants were screened and 13 were enrolled.
    - *Total to date*: Sites 1-6, a combined total of 751 participants were screened and 36 were enrolled.
- Major Task 4 is ongoing:

  To perform a pilot study of the relationship of gene expression in blood and functional outcomes, we first optimized the biological analysis pipeline on samples from the first five participants who completed the full year of participation in the study.

  Participants ranged in age from 28-83, had cervical or thoracic level injuries (N=4, 1 respectively), that were neurologically complete or incomplete (N=2, 3 respectively, see Table 1 below). Blood samples were collected in PAXgene Blood RNA tubes within the first days post injury (dpi) and then at 3, 6- and 12-months post injury (mpi). RNA was isolated from peripheral leukocytes using standard methods and the manufacturer's protocol (Qiagen QIAcube, Venlo, The Netherlands). RNA was amplified using Illumina RNA Total Prep Amplification Kit (Life Technologies, Carlsbad, CA). RNA-Seq was performed on the Illumina HiSeq platform. For comparison, the same sequencing and bioinformatics pipeline was run on RNA isolated from blood samples previously collected from age/gender matched able-bodied persons (N=3). Using Partek Genomics Flow software, unaligned RNA-Seq reads were trimmed, aligned using the STAR algorithm and aligned reads were quantified to the reference human genome.

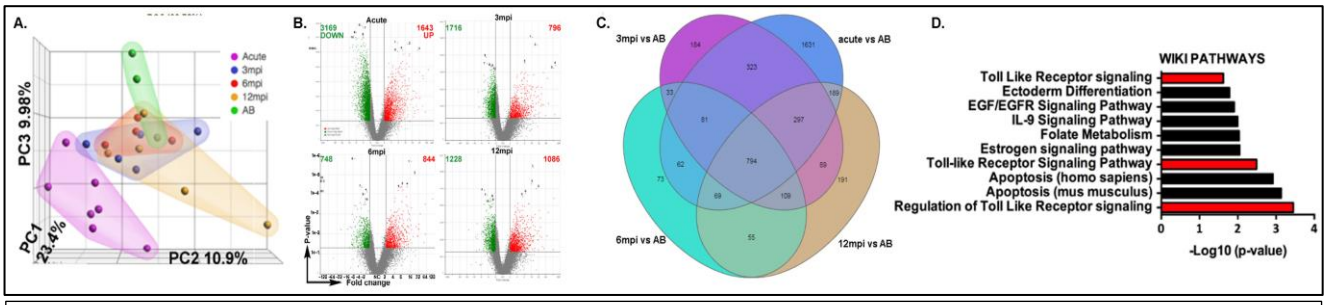

Fig. 1. **Inflammation, including TLR related genes, is elevated in persons throughout the 1st year after SCI**. (A) Principal component (PCA) analysis of whole blood gene expression from participants without (able-bodied, AB, N=3) or with SCI (N=5). Acute SCI samples were clustered most distinctly from others; intermediate SCI time points overlapped. (B) Volcano plots show number of differentially expressed genes over time compared to AB. (C) Venn diagram shows distinct and shared genes differentially expressed genes after SCI. (D) Pathway analysis (WIKI bioinformatics platform) identified TLR signaling as highly enriched in differentially expressed genes shared over time (N=794) after SCI.

Transcript counts were normalized and gene specific enrichment analysis performed. Unsupervised principal component analysis (PCA) of whole blood gene expression generated sample clusters that correlated to injury status and to time post SCI, with acute SCI samples clustered furthest away from able-bodied (AB) samples; acute (0-4dpi) and AB samples formed the most distinct clusters, while samples collected at 3-12mpi had both overlapping and distinct components (Fig. 1A). Volcano plots show up- (red) or down-regulated (green) differentially expressed genes at each time point compared to AB, FDR=0.05 (Fig. 1B).

Consistent with our earlier discoveries of elevated systemic HMGB1 protein, an endogenous Toll Like Receptor (TLR) 4 ligand, (Papatheodorou et al J Neurotrauma 2017) and elevated TLR gene expression in persons with chronic SCI (Herman et al J Neurotrauma 2018, Herman and Bloom, Neural Regen Research 2018), at each study time point, TLR genes were differentially expressed, confirming this observation in an independent cohort using unbiased bioinformatic methods. TLR signaling is pro-inflammatory and chronic states of inflammation can induce immunosuppression. We are also performing analysis of inflammatory proteins in plasma from the same participants using commercially available ELISAs and find that in agreement with our previous study, HMGB1 is elevated after SCI (data not shown). These preliminary data thus suggest that TLR signaling may be a novel therapeutic target for reducing inflammation and improving immune function throughout the first year after SCI. Additional samples from participants who have completed all study visits are now being added to this pipeline, so that correlation analyses can be performed with clinical and functional outcome measured collected.

3) Significant or key outcomes: major findings, developments or conclusions:

Preliminary Data Analysis: The first major development of Year 4 was performance of preliminary analysis on data from the first participants who completed the study and continue to meet the challenges in recruitment and retention. As described above, our preliminary analysis indicates that the major pro-inflammatory TLR signaling pathway is significantly elevated in participants throughout the first year after SCI. If this observation holds up with continued sample analysis, then it would support, together with our additional published data on the elevation of this pathway in acute or chronic SCI individuals, exploration of this pathway as a novel therapeutic target in SCI.

Second No Cost Extension Received: The second major development was that on June 25, 2019 we applied for a second no cost extension to continue Major Tasks 3 and 4 of this study, which we received on August 29, 2019. We are grateful to the DOD CDMRP program for its continued support of this project.

4) Other achievements:

What opportunities for training and professional development has the project provided?

Enhanced Scientific Exchange via SCI Related Conference Attendance: To enhance coordination between sites and to provide additional opportunities for scientific exchange related to SCI research, Dr. Bloom, (PI) discussed the study coordination and progress with key personnel from The Kessler Foundation (Site 2), the Univ. of Louisville (Site 3), University of British Columbia (Site 5) and Ohio State University Medical Center (Site 6) at SCI related scientific conferences (see professional development below). The PI met with in person several times throughout

the year at conferences discussed study coordination with Dr. Forrest (Site 2 site PI), Dr. Boakye (Site 3 site PI) and Dr. Harkema (Site 3 co-I), Dr. Kwon (Site 5 Site PI) and Dr. Schwab (Site 6 site PI).

Professional Development:

- As in Year 3, Dr. Bloom and other study personnel attended several professional conferences to present SCI related work ongoing in their labs and to learn about other ongoing efforts and topics related to this study. Dr. Bloom also met with key personnel from each site at some of the meetings below. These are listed in the dissemination section below.

Training Opportunities:

The New York State Spinal Cord Injury Research Board (NYSCIRB) supported 2 opportunities that the PI was eligible to apply for because of this DOD funded study:

- Individual Predoctoral and Postdoctoral Fellowships in SCI Research (round 2): This RFA supports 3 years of training (salary) for an early stage postdoctoral fellow to be mentored by a PI with SCI funded research. One of the mentoring activities included was the opportunity to use the DOD SCIMARK study to introduce a trainee to human subject research, the SCI specific outcome measures and the biological data analysis methods. The application was funded and initiated 9/1/2017. A postdoctoral fellow, Dr. Jake Deckert, who received his PhD in exercise physiology from Univ. of Kansas, was hired and introduced to SCI clinical care and research. Dr. Deckert applied his training to initiate a pilot study of biomarkers in pediatric patients with acute SCI, in partnership with our health system's ACS-verified acute Level 1 pediatric trauma center at Cohen Children's Medical Center. Dr. Deckert just departed the lab to accept an Instructor (faculty) position at Gonzaga University, Spokane, WA.
- Institutional Support for SCI Research (Round 6: Non-competitive Funding Opportunity): This RFA provides 5 years of institutional support to expand existing SCI research projects or to establish new ones. In order to qualify for this RFA, the PI must have federally funded SCI related research, directly enabled by this DOD grant. The DOD funded Aim 1 is to perform: a) multiplex immunoassays to determine elevated inflammatory proteins in blood; b) microarray analysis of mRNA from whole blood. At Site 1 only, some NYSCIRB funds supported expansion of immune outcome measures to include analysis of circulating immune cells by multicolor flow cytometry and to collection/analysis of additional acute biological samples beyond 0-3dpi, as the DOD programmatic reviewers had originally requested. These samples, which may be obtained from as early as the day of SCI, enhance the scope and impact of the study. Using flow cytometry, we observed reduced CD4+T cell and NK cell, as well as expanded monocyte populations, from SCIMARK participants (data presented at Society for Neuroscience annual meeting (October 19, 2019).

How were the results disseminated to communities of interest?

- As in Year 3, Dr. Bloom and other study personnel attended several professional conferences to present SCI related work ongoing in their labs and to learn about other ongoing efforts and topics related to this study. Dr. Bloom also met with key personnel from each site at some of the meetings below. (Note: Travel to these meetings was not funded by the DOD):
    1. Oral Presentation: Fox Vision Research Symposium, University of Pittsburgh Medical Center, Nemacolin Woodlands, PA. October 11-12, 2018
    2. Oral Presentation: NY State Spinal Cord Injury Research Board Symposium, The Rockefeller University, NY, NY. October 17, 2018
    3. Poster Presentation: Herman P, Bank M, Griffin D, Chory A, Stein A, Lee A, Gregersen P, Boakye M, Harkema SJ, Forrest G, Kirshblum S, Kwon B, Harrop J, Schwab J, Bloom O. *Biomarkers of Spontaneous Recovery from Traumatic SCI*. NIH SCI2020: Launching a Decade for Disruption in SCI Research, Bethesda, MD. 2/12-2/13, 2019
    4. Oral Presentation (and workshop organizer): *Translational Studies of Immune System Dysfunction after SCI*, Annual meeting, American Spinal Injury Association. Waikiki, HI. April 4, 2019
    5. Institutional Seminar Presentation: *Immune Dysfunction after SCI*, UBC/ICORD and visit with Dr. Kwon (site PI) and ICORD study personnel, June 6, 2019.
    6. Oral Presentation: CNS Injury and Repair Gordon Research Conference, *Biomarkers of Spontaneous Recovery from Traumatic SCI*, Waterville Valley, NH. June 18, 2019.
    7. Grand Rounds Oral Presentation: Division of Infectious Diseases, Northwell Health, *Immune Dysfunction after SCI*: August 9, 2019.

8. Data from this study was also accepted in abstract form at the annual ASCIP and ISRT conferences, that the PI was unfortunately unable to attend due to professional conflicts, so the data was not presented.

What do you plan to do during the next reporting period to accomplish the goals?

We expect to complete all Major tasks at all sites, including publication of a larger pilot study of data, building on the data shown in Fig. 1, to complete a full analysis of all completed samples within the study timeframe, to present the data at upcoming scientific meetings and to submit the full study results to a peer-reviewed journal for publication.

4. IMPACT:

- **What was the impact on the development of the principal discipline(s) of the project?**
  After this reporting period, the PI presented the preliminary data shown in Fig. 1 to gain feedback from the SCI and related research communities at the conference mentioned above.
  Based on feedback from the audience in both settings, the potential impact of the data on identifying biomarkers of recovery and also potential new therapeutic targets in SCI was appreciated.
- **What was the impact on other disciplines?** Nothing to report.
- **What was the impact on technology transfer?** Nothing to report.
- **What was the impact on society beyond science and technology?** Nothing to report.

5. CHANGES/PROBLEMS:

Changes in approach and reasons for change

As described above and previously, we received permission from the DOD to extend the study for a 4th year and to add 3 additional sites. The reason for this was continued challenges with recruitment and retention, which we are mitigating (at least partly) by our inclusion of additional sites of excellence from within the SCI research community.

Actual or anticipated problems or delays and actions or plans to resolve them

- As described above, we made several new efforts at Site 1 aimed to increase recruitment and retention, which are still ongoing. We continue to have monthly conference calls with key personnel and research coordinators at all sites to maintain consistent regular communication. The PI has also met in person with site PIs as described above.

Changes that had a significant impact on expenditures

- In 2018, we added 3 new recruitment sites with receipt of the first no cost extension. We have now received a second no cost extension to continue recruitment of participants and analysis of data. Each site will submit invoices to the overall PI (Dr. Bloom) for costs of recruiting actual participants. This enables us to accommodate expenses incurred at all 6 sites. Again, we are grateful for the continued support of this project.

- **Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents-**Not applicable.
- **Significant changes in use or care of human subjects -**Not applicable.
- **Significant changes in use or care of vertebrate animals**-Not applicable.
- **Significant changes in use of biohazards and/or select agents-**Not applicable.

6. PRODUCTS:

- **Publications, conference papers, and presentations.** Nothing to Report
- **Journal publications.** Nothing to Report
- **Books or other non-periodical, one-time publications.** Nothing to Report
- **Other publications, conference papers, and presentations.** Nothing to Report
- **Website(s) or other Internet site(s)**: This study is listed on clinicaltrials.gov:

https://clinicaltrials.gov/ct2/show/NCT02731027?term=biomarkers+of+spinal+cord+injury&rank=2

- **Technologies or techniques**-Not applicable**.**

- **Inventions, patent applications, and/or licenses**- Not applicable**.**
- **Other Products:** Nothing to Report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

- **What individuals have worked on the project?**

What Individuals have worked on the project? ≥ 1 person month this year	**Site 1: Feinstein Institute for Medical Research**
Name:	Ona Bloom, PhD
Project Role:	Overall PI
Researcher Identifier (e.g. ORCID ID):	0000-0002-8340-2392
Nearest person month worked:	3
Contribution to Project:	Dr. Bloom is responsible for overseeing all aspects of the project, supervises and participates in all on-site tasks and Site 1 personnel, and coordinates between study sites.
Funding Support:	DOD (3 calendar months), NY State Spinal Cord Injury Research Board, institutional support round 6, and institutional support. She is also supported by NIAMS for another project.
Name:	Matthew Bank, MD
Project Role:	Co-investigator, Site 1, (No Change from original submission)
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	
Contribution to Project:	Dr. Bank is responsible for the identification of acute SCI patients at the local trauma center. He is present during the consent process and is available during the participants' acute hospital length of stay.
Funding Support:	DOD (this grant). He is also supported by departmental funding.
Name:	Adam Stein, MD
Project Role:	Co-investigator, Site 1, (No Change from original submission)
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	
Contribution to Project	Dr. Stein is responsible for the evaluation of study participants in the visits following hospital discharge.
Funding Support:	DOD (this grant). He is also supported by departmental funding.
Name:	Martin Lesser, PhD
Project Role:	Director, Biostatistics Unit, Site 1, (No Change from original submission)
Researcher Identifier (e.g. ORCID ID):	0000-0002-0318-5739
Nearest person month worked:	
Contribution to Project:	

Funding Support:	DOD (this grant). He is also supported by NIH and departmental funding for work on other projects.
Name:	Cristina Sison, PhD
Project Role:	Assistant Director, Biostatistics Unit, Site 1
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	
Contribution to Project:	
Funding Support:	DOD (this grant). She is also supported by NIH and departmental funding for work on other projects.
Name:	James Tsang
Project Role:	Biostatistics Support
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	1.2
Contribution to Project:	Supervised by Dr. Lesser, created and is maintaining the custom clinical database, developed plans for data monitoring, data management and reporting
Funding Support:	DOD (this grant). He is also supported by NIH grants and departmental funding for work on other projects.
Name:	Ashley Chory
Project Role:	Research Coordinator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	6
Contribution to Project:	Ms. Chory submitted and maintained local IRB regulatory binder and correspondence, maintained all HRPO/ACURO related documents and correspondence, participated in development of case report forms, input data to clinical database, performed sample processing, biochemical assays shipped supplies to other sites, coordinated communication with other sites (monthly conference calls), trained other site personnel on how to use database for submitting data and participated in data analysis.
Funding Support:	DOD (this grant). NY State Spinal Cord Injury Research Board, institutional support round 6 and institutional funds for this and other projects.
What Individuals have worked on the project? ≥ 1 person month this year	**Site 2: Kessler and University Hospital**
Name:	Dr. Forrest is responsible for overseeing this project at site 2, supervises site 2 personnel, and participates in all on-site tasks.
Project Role	DOD (This project) She is also supported by NJCSCR, USAMRAA, NIH and departmental funding.

Researcher Identifier (e.g. ORCID ID):	LeighAnn Martinez
Nearest person month worked:	Research Coordinator
Contribution to Project:	2.4
Funding Support:	Ms. Martinez submitted and maintained local IRB regulatory binder and correspondence and related documents, participates in monthly study personnel conference calls
Name:	DOD (this project). For other projects, she is supported by: NJCSCR, NIH, NIDILRR.
Project Role:	
Researcher Identifier (e.g. ORCID ID):	Peter Yonclas, MD
Nearest person month worked:	Site 2 (University Hospital) PI
Contribution to Project:	
Funding Support:	1.2
	Peter Yonclas is responsible for overseeing the project at University Hospital, Newark NJ, supervises site 2 personnel, and participates in all on-site tasks.
Name:	DOD (this grant) and departmental funding.
Project Role:	
Researcher Identifier (e.g. ORCID ID):	Kenechi Onwubalili, MD, MPH
Nearest person month worked:	Clinical Research Associate
Contribution to Project:	
Funding Support:	2.4
Name:	Kenechi Onwubalili, MD, MPH
Project Role:	Clinical Research Associate
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	2.4
Contribution to Project:	Dr. Onwubalili submitted and maintained local IRB regulatory documents, correspondence and related documents and participates in monthly study personnel conference calls.
Funding Support:	DOD (this grant) and departmental funding.
What Individuals have worked on the project? ≥ 1 person month this year	**Site 3: University of Louisville**
Name:	Max Boakye, MD (No Change from original submission)
Project Role:	Site 3 (Univ. of Louisville) PI (No change from original submission.)
Researcher Identifier (e.g. ORCID ID):	0000-0002-1758-9136
Nearest person month worked:	1.2
Contribution to Project:	Dr. Boakye is responsible for overseeing this project at site 3, supervises site 3 personnel, and participates in all on-site tasks.

Funding Support:	DOD (this grant). He is also supported by Helmsley trust grants and departmental funding for work on other projects.
Name:	Debra Williams
Project Role:	Research Coordinator (No change from original submission.)
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	1
Contribution to Project:	Ms. Williams submitted and maintained local IRB regulatory binder and correspondence and related documents, submitted data for case report forms to custom database, participates in monthly study personnel conference calls.
Funding Support:	DOD (this grant). She is also supported by Reeve foundation grants and departmental funding for work on other projects.
Name:	Anna Williford
Project Role:	Research Nurse Coordinator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	1
Contribution to Project:	Ms. Williford participates in screening participants, research coordination, collecting data for case report forms and submitting them to custom database, participates in monthly study personnel conference calls
Funding Support	She is supported by departmental funding.
Nearest person month worked:	1.5
What Individuals have worked on the project? ≥ 1 person month this year	**Site 4: Thomas Jefferson University**
Name:	James Harrop, MD
Project Role:	Site PI
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	0.60
Contribution to Project:	Dr. Harrop is responsible for overseeing this project at site 4, supervises site 4 personnel, and participates in all on-site tasks.
Funding Support:	Please see active support below
Name:	Sara Thalheimer
Project Role:	Research Coordinator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	0.72
Contribution to Project:	Ms. Thalheimer submitted and maintained local IRB regulatory binder and correspondence and related documents, participates in monthly study personnel conference calls
Funding Support:	

Name:	Sean Behnke
Project Role:	Research Coordinator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	0.24
Contribution to Project:	Mr. Behnke submitted and maintained local IRB regulatory binder and correspondence and related documents, participates in monthly study personnel conference calls
Funding Support:	
Name:	Dr. Ralph Marino
Project Role:	Co-Investigator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	0.24
Contribution to Project:	Dr. Marino is the physiatrist on the project at Site 4 and participates in rehabilitation related outcome measures.
Funding Support:	
What Individuals have worked on the project? ≥ 1 person month this year	Site 5: University of British Columbia
Name:	Dr. Brian Kwon
Project Role:	Principal Investigator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	0.25
Contribution to Project:	Dr. Kwon is responsible for participant screening, reviewing & signing off on CRFs and completing patient assessments.
Funding Support:	• Canada Research Chairs Program • US Dept of Defense SCIRP, W81XWH-16-1-0602 (Log Number: SC150178) 10% • US Dept of Defense SCIRP, W81XWH-16-1-0786 (Log Number SC160165) 5% • US Dept of Defense SCIRP, W81XWH-16-SCIRP-TRA (Log Number: SC160098) 5% • Craig H. Neilsen Foundation Pilot Grant 5% • Rick Hansen Institute 5% • Brain Canada Multi-Investigator Research Initiative (MIRI) 10%
Name:	Angela Tsang
Project Role:	Clinical Research Nurse
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	2
Contribution to Project:	Ms. Tsang is responsible for participant screening, obtaining consent, blood sample collection, completing patient assessments and study documentation.

Funding Support:	She is supported by departmental funding.

Name:	Allan Aludino
Project Role:	Spine Research Program Manager
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	1
Contribution to Project:	Mr. Aludino is responsible for participant screening, obtaining consent and study documentation.
Funding Support:	He is supported by departmental funding.
Name:	Leilani Reichl
Project Role:	Research Coordinator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	1.5
Contribution to Project:	Ms. Reichl is responsible for participant screening, obtaining consent and study documentation.
Funding Support:	DOD (this grant) and departmental funding.

- **Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?**

Note: For all personnel listed below, the information provided is in addition to this DOD grant "*Biomarkers of Spontaneous Recovery from Traumatic Spinal Cord Injury".*

Site 1: Feinstein Institute for Medical Research

Ona Bloom PhD, Principal Investigator (The Feinstein Institute):

Active Support:

1R43AI142983-01 (PI: Babich, Olga) 05/01/2019-10/31/2019, NIAID Role: Consultant, estimated 10 hours/yr
The Use of Selective NAV1.7 Inhibitors to Treat Inflammation Post-Surgery $224, 551 total direct costs
The study will test effects of a first-in-class analgesic drug to treat post-surgical inflammation and pain by selectively targeting the peripheral, inactivated NaV1.7 channel. The goal is to identify molecular or cellular evidence to explain an observed reduction in edema with the inhibitors and suggest possible mechanisms of action. Inflammatory parameters will be measured within the paw.

1R03HD097709-01 (PI: Wu, Yu-Kuang) 09/19/2019-08/30/2021 Role: Consultant, estimated 0.36 CM
Effects of Remote Ischemic Conditioning On Hand Use in Individual with Spinal Cord Injury: a Preliminary Study $117,500 annual direct costs
The study will use remote ischemic conditioning (RIC) to promote neuroplasticity and functional recovery in persons with chronic incomplete spinal cord injury. RIC is proposed to promote neuroplasticity via a systemic anti-inflammatory mechanism. The project will be the first to study RIC in the spinal cord injury population. There are 3 aims: (1) to investigate the synergistic effects of RIC with physical training on corticospinal excitability, (2) measure changes in inflammatory mediators after RIC, (3) observe in real time the responses of heart rate, blood pressure, oxygen saturation during RIC. $235,000 total direct costs

DOH01-PART2-2017-00069, C33275GG (PI, Bloom) 6/1/2018-2/29/2020 0.6 CM
NY State Spinal Cord Injury Research Board $87,298 Annual Direct Costs
Impact of Exoskeletal-Assisted Walking on the Immune System of Persons with Chronic SCI
Powered exoskeletons are a relatively new type of technology now available to enable walking by persons with SCI. Data from a few limited research studies suggests that for persons with SCI, walking with assistance from an exoskeleton is a light to moderate intensity physical activity. However, it is currently unclear if exoskeletal-assisted walking will provide health benefits similar to exercise in able-bodied persons. The goal of this study is to measure if exoskeletal-assisted walking reduces signs of chronic inflammation, which is common in persons with SCI. Participants are recruited from a study led by Dr. Ann Spungen of the JJPVAMC. $222,870 Total Direct Costs

DOH01-ISSCI6-2016-00018, C32254GG (PI: Bloom) 3/1/2017-2/28/2022 0.24 CM
NY State Spinal Cord Injury Research Board $25,000 current Annual Direct Costs
Institutional Support for SCI Research, round 6 This is a grant to support expansion of 3 separate, ongoing projects that aim to improve our understanding of factors that influence physical recovery and wellness in persons with spinal cord injury (SCI). The Projects are: (1) "*Biomarkers of Spontaneous Recovery from Traumatic SCI*," (2) "*Biomarkers in Pediatric Spinal Cord Injury/Abnormalities*," and (3)"*Strive for Wellness Research Outcomes*," Project 1 is supported by the US DOD. Funding is provided here for non-overlapping aims. Projects 2 and 3 are not supported by any other external funds. Role: PI $242,500 Total Direct Costs.

7R01AR069668-01 (PI: Chahine) 8/31/2018-8/31/2022 0.6 CM
NIAMS $220,000 Annual Direct Costs, $11,946 subaward annual direct costs
Mechanobiology of Inflammation in the Intervertebral Disc
Mechanobiology of inflammation in the intervertebral disc. Disability and pain from degenerated intervertebral discs (IVD) affects >40% of U.S adults, costs >$100 billion annually and the etiology is unknown. The aim of this study is to investigate the mechanobiology of the inflammatory cytokine high mobility group box 1 protein (HMGB1) signaling in the pathophysiology and mechanotransduction of the intervertebral disc. Role: Co-I. $1,760,000 total costs.

Martin Lesser PhD, Key Personnel
New Active Support: None

New Completed Support: None

Peter Gregersen MD, Key Personnel:

New Active Support: None

New Completed Support:
NIH 1UG30D023391-01 09/21/16-08/31/19
ECHO – Environmental Influences on Childhood Health Outcomes - Prenatal Autoimmune and Inflammatory Risk Factors for Autism Spectrum Disorders. Gregersen (PI), Diamond (co-Investigator) $561,801 1.2 calendar months
This project focuses on the role of *in utero* exposure to maternal autoimmunity in determining neurodevelopmental outcomes of the offspring.

Mathew Bank MD, Co-Investigator (3 calendar months): Nothing to Report

Adam Stein MD, Co-Investigator (0.6 calendar months): Nothing to Report

Site 2: Kessler Foundation and University Hospital

Gail Forrest PhD, Site PI (Kessler):

Active Support:
90SIMS0001 (Rymer, PI) 9/30/17 – 9/29/22 .60 CM (5%)
DHHS/ACL/NIDILRR
Rehabilitation Institute of Chicago
"A Multi-Center Clinical Trial to Evaluate the Effectiveness of Intermittent Hypoxia Therapy in Individuals with Spinal Cord Injury"
Aims: Goal is to examine effectiveness of Hypoxia Therapy for improvement in upper extremity function.
Role: Site PI

Sponsor POC: Dr. Kenneth Wood, Program Officer, (202) 795-7469
W81XWH-17-1-0157 (Heinemann, PI) 9/30/17 – 9/29/19 1.20 CM (10%)
Department of Defense
Rehabilitation Institute of Chicago
"Evaluating the Utilization and Efficiency of Wearable Exoskeletons for SCI Rehabilitation"
Aims: Examine what users and Physical Therapists view about about exoskeletons.
Role: Site PI.
Sponsor POC: Ms. Amber Stillrich, Grant Specialist, (301) 619-7071

PTE site is Rutgers University (NJMS) 9/30/17 – 9/29/22 .96 CM (8%)
90ARHF0002 (Yue, PI)
"Advanced Rehabilitation Research Training Center (ARRT) in Rehabilitation Neuroscience and Engineering"
Aims: Mentor Postdoctoral Fellows during their postdoctoral research training at Kessler Foundation.
Role: Mentor
Sponsor POC: Dawn Carlson, Program Officer, (202) 795-7323
Role: Co-Director

CSCR18ERG004 (Saleh, PI) 6/01/18 – 5/31/20 .72 CM (6%)
New Jersey Commission on Spinal Cord
Injury Research
"Cortical Control of Walking; Brain Plasticity Following Exoskeleton Training in Incomplete Spinal Cord Injury"
Aims: This exploratory study aims to detect brain signals during walking and determine the effect of exoskeleton training on brain plasticity using mobile brain imaging techniques.
Role: Co-Investigator
Sponsor POC: Mary Ray, Program Officer, (609) 943-5405, Mary.Ray@doh.nj.gov

W81XWH-18-10728 (Adrowis, PI) 9/15/18 – 9/14/21 .12 CM (1%)

Department of Defense
"The Efficacy of Upper Extremity Wearable Robotic Orthosis on Improving Upper Extremity Motor Function and Activities of Daily Living in Persons with Spinal Cord Injury"
Role: Co-Investigator
Sponsor POC: Amber Stillrich, Grant Specialist, Phone: 301-619-1195

SC170311 (Plow, PI) 9/30/18 – 9/29/22 2.40 CM (20%)
Department of Defense via Subaward from
Cleveland Clinic Foundation $778,349 (requested total award)
"Improving Spinal Cord Injury Rehabilitation Interventions by Retraining the Brain"
Aims: The proposed project seeks to offer interventions aimed at restoring motor function of the paretic upper limbs in tetraplegia to impact the most widely reported cause of disability in SCI.
Role: Site PI
Sponsor POC:

Steven Kirshblum, MD (Key Personnel, Kessler)
New Active Support
Nothing to report

Peter Yonclas, MD, Site PI (University Hospital): Nothing to report

Site 3: University of Louisville

Max Boakye, MD Site PI (University of Louisville):

Active Support:
ES_BI-2017 Harkema (PI) 3/23/17-2/22/22 $9,360,000
Christopher and Dana Reeve Foundation
Task and physiological specific stimulation for recovery of autonomic function, voluntary movement and standing using epidural stimulation and training after severe spinal cord injury.
The major goal is to determine the level of functional gain that can be achieved in voluntary control of movements below the level of injury and autonomic nervous system function as a result of activation of spinal circuits with epidural stimulation with or without task-specific training in humans with complete motor paralysis.

Craig H. Neilsen Foundation Boakye (PI) 07/31/18-07/30/21 $600,000
Myelotomy with Hemorrhagic Necrosis Removal in a Porcine SCI Model
The goal of this project is to use a large animal model to evaluate the safety and effectiveness of MIHN as a potential treatment for SCI by examining effects on tissue sparing as well as locomotor and bladder function recovery.

CTN11 Harkema (PI) Boakye Co-Investigator) 06/01/17-12/31/18 $72,727
Department of Defense/Christopher & Dana Reeve Foundation
North American Clinical Trials Network (NACTN)
The major goal of this project is to achieve clinical trials capable of indicating effectiveness of promising spinal cord injury (SCI) therapies.

2016PG-MED005 Harkema (PI) Boakye (Co-I) 12/15/15-12/14/19
Leona M & Harry B Helmsley Charitable Trust $15,000,000 12% effort
Helmsley Center for Restorative Medicine
The goal of this project is to define the temporal profile of cardiac, pulmonary, vascular, and metabolic dysfunction after SCI and develop novel therapeutic approaches to treat those conditions.

Completed Support:
Helmsley Charitable Trust Harkema (PI) Boakye (Co-Investigator) 02/15/12-06/30/18
Recovery of Function, Health and Quality of Life for People with Paralysis $12,000,153

The major goal is to restore motor function and quality of life in patients with spinal cord injury using epidural stimulation and locomotor training therapies.

SC170100 Boakye (PI) 09/01/18-08/31/20 $770,000
Department of Defense/Spinal Cord Injury Research Program (SCIRP)
Improving Outcomes Using Myelotomy with Intramedullary Hemorrhagic Necrosis Removal in Porcine Model of Acute Thoracic Cord Injury
Our goal is test the hypothesis that MIHN with scaffold is superior (gait outcomes, lesion and spared tissue volumes, and bladder function) to MIHN without scaffold and no treatment (non-myelotomy) without an increase in adverse outcomes.

Susan Harkema, PhD Co-Investigator (Louisville):

Active Support:

1OT2OD024898-01 Hubscher (PI) Harkema (Co-PI) 9/20/17-8/31/20
National Institute of Health
Functional Mapping with Lumbosacral Epidural Stimulation for Restoration of Bladder Function After Spinal Cord Injury
The major goal is to determine whether spinal cord circuits responsible for walking are also important for bladder and sexual functions and reorganize in response to Locomotor Training and/or epidural stimulation after SCI to improve these functions and alter important chemicals in the body.

ES_BI-2017 Harkema (PI) 3/23/17-2/22/22 $9,360,000
Christopher and Dana Reeve Foundation
Task and physiological specific stimulation for recovery of autonomic function, voluntary movement and standing using epidural stimulation and training after severe spinal cord injury.
The major goal is to determine the level of functional gain that can be achieved in voluntary control of movements below the level of injury and autonomic nervous system function as a result of activation of spinal circuits with epidural stimulation with or without task-specific training in humans with complete motor paralysis.

New Completed Support:
10/5/04-5/31/18 $1,229,550
Center for Disease Control/Christopher & Dana Reeve Foundation (continuation pending)
Development of NeuroRecovery Network (NRN)
The major goal of this project is to develop specialized centers that provide standardized activity-based therapy care based on current scientific and clinical evidence for people with spinal cord injury and other selected neurological disorders.

Helmsley Charitable Trust Harkema (PI) 2/15/12-6/30/18 $12,000,153
Recovery of Function, Health and Quality of Life for People with Paralysis
The major goal is to restore motor function and quality of life in patients with spinal cord injury using epidural stimulation and locomotor training therapies.

Helmsley Charitable Trust Behrman (PI) Harkema (Co-I) 4/1/14-7/31/17
Advancing a New Trajectory of Outcomes for Children with Paralysis through Activity-Based Rehabilitation
The major goal is to restore motor function and quality of life in patients with paralysis using activity-based rehabilitation therapies.

Site 4: Thomas Jefferson

James Harrop, MD Site PI (Thomas Jefferson): Since this is a new site, all active support is listed.

Active Support:
Title: Systemic Hypothermia in Acute Cervical Spinal Cord Injury – A Prospective, Multicenter
PI: Dr. James Harrop
Case – Controlled Study

Time Commitment: 0.24 calendar months
Supporting Agency: DOD thru University of Miami
Period of Performance: 9/30/2016-9/29/2020
Funding Amount: $286,860 Direct Costs
Brief description project goals/list of aims: This study is a prospective multi-center trial designed to determine the safety profile and efficacy of modest (33ºC) intravascular hypothermia following acute cervical (C1 to C8) Spinal Cord Injury (SCI).

Title: North American Clinical Trial Trials Network (NATCN) for Treatment of Spinal Cord Injury
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: DOD thru Christopher Reeve Foundation
Period of Performance: 6/1/2018-12/31/2019
Funding Amount: $43,750 Direct Costs
Brief description project goals/list of aims: The NACTN Spinal Cord Injury Registry is a network of clinical centers collecting de-identified data from patients admitted through the Emergency Department of a NACTN center at the time of injury with an initial (first time) spinal cord injury (SCI).

Title: Metal Artifact Characterization in Spinal Cord Injury
PI: Dr. Feroze Mohamed
Time Commitment: 0.12 calendar months
Supporting Agency: Craig H. Neilsen Foundation
Period of Performance: 8/31/2016-08/30/2020
Funding Amount: $581,963 Direct Costs
Brief description project goals/list of aims: our goal to test the state-of-the-art MRI pulse sequence, which are increasingly becoming available in the modern MR systems, on the spinal cord to assess its effectiveness in visualizing the spinal cord in the presence of the metallic hardware currently being used in clinical SCI management.

Title: Pilot Study of Clinical Safety and Feasibility of the PLGA Poly-LLysine Scaffold for the Treatment of Complete (AIS A) Traumatic Acute Spinal Cord Injury
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: Invivo Therapeutics Holding Co.
Period of Performance: 3/4/2016-03/03/2019
Funding Amount: $213,927 Direct Costs
Brief description project goals/list of aims: Pilot Study of Clinical Safety and Feasibility of the PLGA Poly-LLysine Scaffold for the Treatment of Complete (AIS A) Traumatic Acute Spinal Cord Injury

Title: A multi-center, prospective comparative study of anterior vs. posterior surgical treatment for lumbar isthmic spondylolisthesis
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: AOSpine North America
Period of Performance: 6/21/2016-6/20/2019
Funding Amount: $31,220 Direct Costs
Brief description project goals/list of aims: A multi-center, prospective comparative study of anterior vs. posterior surgical treatment for lumbar isthmic spondylolisthesis

Title: A Phase 2b, Randomized, double-blind, placebo-controlled study to evaluate the safety and efficacy of staphylococcus aureus 4-antigen vaccine (SA4Ag) in adults undergoing elective open posterior spinal fusion procedures with multilevel instrumentation
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: Pfizer, Inc.
Period of Performance: 1/27/2017-1/26/2020
Funding Amount: $96,442 Direct Costs

Brief description project goals/list of aims: A Phase 2b, Randomized, double-blind, placebo-controlled study to evaluate the safety and efficacy of staphylococcus aureus 4-antigen vaccine (SA4Ag) in adults undergoing elective open posterior spinal fusion procedures with multilevel instrumentation

Title: A Phase 1/2a Dose Escalation Study of AST-OPC1 in Subjects with Cervical Sensorimotor Complete Spinal Cord Injury
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: Asterias Biotherapeutics
Period of Performance: 3/20/2017-3/19/2020
Funding Amount: $259,470 Direct Costs
Brief description project goals/list of aims: A Phase 1/2a Dose Escalation Study of AST-OPC1 in Subjects with Cervical Sensorimotor Complete Spinal Cord Injury

Title: A Long-term Follow-up Study of Subjects with Cervical Spinal Cord Injuries Who Received AST-OPC1 in ProtocolAST-OPC1-01
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: Asterias Biotherapeutics
Period of Performance: 5/8/2017-5/7/2020
Funding Amount: $90,101.47 Direct Costs
Brief description project goals/list of aims: A Long-term Follow-up Study of Subjects with Cervical Spinal Cord Injuries Who Received AST-OPC1 in ProtocolAST-OPC1-01

Title: A Phase 2b/3, Double-blind, Randomized, Placebo-Controlled, Multicenter Study to Assess the Efficacy and Safety of VX-210 in Subjects With Acute Traumatic Cervical Spinal Cord Injury
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: Vertex Pharmaceuticals, Inc.
Period of Performance: 10/26/2017-10/25/2020
Funding Amount: $227,092 Direct Costs
Brief description project goals/list of aims: A Phase 2b/3, Double-blind, Randomized, Placebo-Controlled, Multicenter Study to Assess the Efficacy and Safety of VX-210 in Subjects With Acute Traumatic Cervical Spinal Cord Injury

Title: A Multi-Center, Randomized, Placebo-Controlled, Double-Blind, Trial of Efficacy and Safety of Riluzole in Acute Spinal Cord Injury
PI: Dr. James Harrop
Time Commitment: 0.12 calendar months
Supporting Agency: AOSpine North America
Period of Performance: 7/22/2014-7/21/2019
Funding Amount: $60,275 Direct Costs
Brief description project goals/list of aims: A Multi-Center, Randomized, Placebo-Controlled, Double-Blind, Trial of Efficacy and Safety of Riluzole in Acute Spinal Cord Injury

New Completed Support:

Site 5: University of British Columbia

Brian Kwon, MD/PhD Site PI (UBC):

Active Support:

Title: ***Offsetting Cardiac Dysfunction in Acute Spinal Cord Injury to Optimize Neurological Outcome***
PI: Dr. Chris West, University of British Columbia
Role: Co-I
Time Commitment: 5% (0.6 CM)
Supporting Agency: US Dept of Defense SCIRP, W81XWH-16-SCIRP-TRA (Log Number: SC160098)
Performance Period: 09/2017 – 08/2020
Funding Amount: USD$1,500,00 over 3 years (Direct Costs)

Our **overall objective** is to characterize how cardiac dysfunction develops after acute traumatic SCI, such that we can ultimately inform hemodynamic management practices that will improve intra-parenchymal spinal cord perfusion and optimize neurologic outcome.

Title: ***Acute cardiac and vascular responses to spinal cord injury in a novel porcine model***
PI: Dr. Chris West, University of British Columbia
Role: Co-I
Time Commitment: 5% (0.6 CM)
Supporting Agency: Craig H. Neilsen Foundation Pilot Grant
Performance Period: 05/2017 – 04/2019
Funding Amount: USD$251,000 over 2 years
Our overall objective is to develop a T2 model of SCI in the pig and then characterize the acute hemodynamic effects after acute injury at this level.

Title: ***The Canadian Multicenter CSF Pressure Analysis and Biomarker Study (CAMPER)***
Role: PI
Time Commitment: 5% (0.6 CM)
Supporting Agency: Rick Hansen Institute
Performance Period: 10/ 2010 – 03/2019
Funding Amount: CDN$2,466,794
This is a multicenter initiative to have 6 centers across Canada insert intrathecal catheters and obtain CSF samples from acute SCI patients, with the intention of evaluating CSF pressure changes in acute human SCI, and also to validate IL-6, IL-8, MCP-1, tau, S100□, and GFAP as injury-severity biomarkers in the CSF of human SCI patients.

Title: ***Biomarkers for Crossing the Translational Divide in Acute Spinal Cord Injury***
Role: PI
Time Commitment: 10% (0.12 CM)
Supporting Agency: Brain Canada Multi-Investigator Research Initiative (MIRI)
Performance Period: 04/2015 – 03/2019
Funding Amount: CDN$3,000,000 over 3 years
This project seeks to characterize the proteomic, metabolomic, lipidomic, and genomic changes that occur after acute SCI in both human patients and in our pig model of SCI

Title: ***An "omics" approach to biomarker discovery after acute SCI***
Role: PI
Time Commitment: 5% (0.6 CM)
Supporting Agency: Craig H. Neilsen Foundation
Performance Period: 10/2015 – 09/2018
Funding Amount: USD $450,000 over 3 years
This project seeks to characterize the proteomic, metabolomic, lipidomic, and genomic changes that occur after acute SCI in both human patients and in our pig model of SCI

New Completed Support:

Title: ***Acute cardiac and vascular responses to spinal cord injury in a novel porcine model***
PI: Dr. Chris West, University of British Columbia
Role: Co-I
Time Commitment: 5% (0.6 CM)
Supporting Agency: Craig H. Neilsen Foundation Pilot Grant
Performance Period: 05/2017 – 04/2019
Funding Amount: USD$251,000 over 2 years
Our overall objective is to develop a T2 model of SCI in the pig and then characterize the acute hemodynamic effects after acute injury at this level.

Title: ***The Canadian Multicenter CSF Pressure Analysis and Biomarker Study (CAMPER)***
Role: PI
Time Commitment: 5% (0.6 CM)
Supporting Agency: Rick Hansen Institute
Performance Period: 10/ 2010 – 03/2019
Funding Amount: CDN$2,466,794

This is a multicenter initiative to have 6 centers across Canada insert intrathecal catheters and obtain CSF samples from acute SCI patients, with the intention of evaluating CSF pressure changes in acute human SCI, and also to validate IL-6, IL-8, MCP-1, tau, S100□, and GFAP as injury-severity biomarkers in the CSF of human SCI patients.

- **What other organizations were involved as partners?** There are 6 organizations collaborating in this study (Sites 1-6).

  Organization 1 Name: Feinstein Institute for Medical Research (of Northwell Health)

  Location of Organization: *Manhasset, NY*

  Partner's contribution to the project *(identify one or more)*

  Financial support; Some institutional salary support is provided for the PI and additional study personnel.

  In-kind support *(e.g., partner makes software, computers, equipment, etc., available to project staff)*

  Computers and equipment are available to project staff as needed.

  Facilities *(e.g., project staff use the partner's facilities for project activities)*: Facilities are available for the project staff.

  Collaboration *(e.g., partner's staff work with project staff on the project)*: This is the site of the overall PI. We have participated in all aspects of study design and tasks included in Major Tasks 1-4.

  Organization 2 Name: The Kessler Foundation

  Location of Organization: *West Orange, NJ*

  Partner's contribution to the project *(identify one or more)*

  Financial support:

  In-kind support *(e.g., partner makes software, computers, equipment, etc., available to project staff)*; Computers and equipment are available to project staff as needed.

  Facilities *(e.g., project staff use the partner's facilities for project activities)*: Facilities are available for the project staff.

  Collaboration *(e.g., partner's staff work with project staff on the project)*: Personnel have participated in all aspects of study design and Major Task 1-2. They are performing Major Tasks 3-4.

  Organization 3 Name: University of Louisville

  Location of Organization: *Louisville, KY*

  Partner's contribution to the project *(identify one or more)*

  Financial support:

  In-kind support *(e.g., partner makes software, computers, equipment, etc., available to project staff)*; Computers and equipment are available to project staff as needed.

  Facilities *(e.g., project staff use the partner's facilities for project activities)*: Facilities are available for the project staff.

Collaboration *(e.g., partner's staff work with project staff on the project)*: Personnel are collaborating on the project. They have participated in all aspects of study design and tasks included in Major Tasks 1-3. This site is actively screening and enrolling participants. They are performing Major Tasks 3-4.

Organization 4 Name: Thomas Jefferson University
Location of Organization: *Philadelphia, PA*
Partner's contribution to the project *(identify one or more)*
Financial support:
In-kind support *(e.g., partner makes software, computers, equipment, etc., available to project staff)*; Computers and equipment are available to project staff as needed.
Facilities *(e.g., project staff use the partner's facilities for project activities)*: Facilities are available for the project staff.
Collaboration *(e.g., partner's staff work with project staff on the project)*: Personnel are collaborating on the project. This site is actively screening and enrolling participants. They are performing Major Tasks 3-4.

Organization 5 Name: University of British Columbia
Location of Organization: *BC, Canada*
Partner's contribution to the project *(identify one or more)*
Financial support:
In-kind support *(e.g., partner makes software, computers, equipment, etc., available to project staff)*; Computers and equipment are available to project staff as needed.
Facilities *(e.g., project staff use the partner's facilities for project activities)*: Facilities are available for the project staff.
Collaboration *(e.g., partner's staff work with project staff on the project)*: Personnel are collaborating on the project. This site is actively screening and enrolling participants. They are performing Major Tasks 3-4.

Organization 6 Name: Ohio State University Medical Center
Location of Organization: *Columbus, Ohio*
Partner's contribution to the project *(identify one or more)*
Financial support:
In-kind support *(e.g., partner makes software, computers, equipment, etc., available to project staff)*; Computers and equipment are available to project staff as needed.
Facilities *(e.g., project staff use the partner's facilities for project activities)*: Facilities are available for the project staff.
Collaboration *(e.g., partner's staff work with project staff on the project)*: Personnel are collaborating on the project. This site is actively screening and enrolling participants. They are performing Major Tasks 3-4.

8. SPECIAL REPORTING REQUIREMENTS

COLLABORATIVE AWARDS: *NOT APPLICABLE-THIS IS A SINGLE PI AWARD.*

QUAD CHARTS: Please see attached.

9. APPENDICES: none

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ADDITIONAL NOTES:

MARKING OF PROPRIETARY INFORMATION: Not applicable.