Introduction

• 17,000 new cases of spinal cord injury (SCI) per year in U.S, majority are cervical

• Primary spinal cord injury—mechanical impact ²

• Secondary spinal cord injury—pathological damage to neural tissue following mechanical impact ²

1 National Spinal Cord Injury Statistical Center, 2018 SCI Data Sheet
Introduction

• Ultrafast contrast-enhanced ultrasound (CEUS) allows for real-time visualization of hemodynamic changes.
Introduction

Acute perfusion deficits correlate with chronic functional outcomes

Our unique ability to visualize perfusion deficits and their correlated functional outcomes has meaningful implications for cervical SCI patients.
Our Study

Procedure
• Laminectomy
• Pre-injury CEUS
• Unilateral contusion
• Post-injury CEUS

Measurements

Longitudinal
• Area of perfusion deficit

Cross-sectional
• Area of perfusion deficit
• Segmental deficit differences
• Cross sectional area changes
Lesion area analysis using longitudinal acquisitions

<table>
<thead>
<tr>
<th>Sample</th>
<th>Area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Injury</td>
<td>4.6</td>
</tr>
<tr>
<td>Post-Injury</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
</tr>
</tbody>
</table>

Lesion area analysis using longitudinal acquisitions
Lesion area analysis using cross-sectional acquisitions

Pre-Injury

Post-Injury

Analysis of cross sections may provide more consistent estimates due to better visualization of lateral cord

Area (mm²)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.1</td>
</tr>
<tr>
<td>2</td>
<td>3.4</td>
</tr>
<tr>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>4</td>
<td>2.8</td>
</tr>
<tr>
<td>5</td>
<td>3.5</td>
</tr>
<tr>
<td>Average</td>
<td>3.2</td>
</tr>
</tbody>
</table>
Segmental perfusion deficits

Cross-section segmental data consistent with qualitative observations in longitudinal acquisitions

C4 C5 C6

Segmental perfusion deficits
Segmental area analysis for comparison of swelling and spared tissue

Segmental cross section area analysis

C4 C5 C6

Contralesional
Ipsilesional

Area (mm²)

C5 cross sectional area analysis

Contralesional
Ipsilesional

Area (mm²)

Perfusion

C4

C5

C6

UNIVERSITY of WASHINGTON
Future analysis
Acknowledgements

Hofstetter Lab:
• Christoph Hofstetter, MD, PhD
• Zin Khaing, PhD
• Matt Bruce, PhD
• Lindsay Cates
• Jeff Hyde
• Brian Nguyen

Funding:
• NIH NINDS Grant
• Department of Neurological Surgery
• Craig Neilsen Foundation
• CDMRP DoD
• Raisbeck Foundation

Neurological Surgery Summer Student Program
• Chair & Program Director: Richard G. Ellenbogen, MD, FACS
• Program Executive Advisor: Sandra Ellenbogen, RN
• Department Director: Jana Pettit, MBA
• Program Administrators: Christine MacDonald; PhD & Jim Pridgeon, MHA; Sylvia Zavatchen, MEd
• Program Coordinator: Julie Bould
• Jeff Ojemann, MD