
- I have no financial interests or conflicts to disclose.
- Of the drugs discussed in pain treatment section, only pregabalin has been FDA approved for treatment of neuropathic pain after SCI.



Image courtesy of Gary Larson

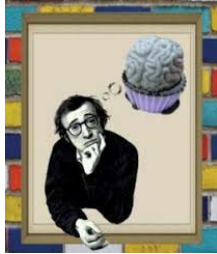
- Identify main subtypes of SCI pain.
- Provide brief overview of SCI Pain Basic Dataset and how to use it.
- Discuss prevention and treatment options for common subtypes of SCI pain.
- Discuss the brain's role in pain and how this can be used in SCI pain management.



Image courtesy of Gary Larson

Disclosures

My brain? That's my
second favorite organ.
- Woody Allen

A painting of Woody Allen sitting at a desk, looking at a brain that is floating in the air above him. The brain is depicted with a face and is wearing a purple party hat. The background is a colorful, abstract pattern.

The logo for the Kessler Foundation, featuring a stylized 'K' and the text 'KESSLER FOUNDATION'.

Introduction to Spinal Cord Injury (SCI) Pain

The logo for the Kessler Foundation, featuring a stylized 'K' and the text 'KESSLER FOUNDATION'.

What is Pain?

"An unpleasant sensory and
emotional experience
associated with actual or
potential tissue damage, or
described in terms of such
damage."

-IASP

The painting 'The Scream' by Edvard Munch, depicting a figure standing on a bridge over a body of water, with a turbulent, orange and red sky above.

The logo for the Kessler Foundation, featuring a stylized 'K' and the text 'KESSLER FOUNDATION'.

International Association for the Study of Pain (IASP)
Munch, *The Scream* 1893-1910

Pain after SCI

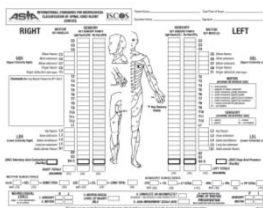
- Common: overall prevalence ~26 to 96%¹
 - Gender *not* associated with pain prevalence
 - Level of injury *not* associated with pain prevalence
 - Completeness *not* associated with pain prevalence
- “Debilitating or disabling pain” = 11 to 34%²
- Causes distress and limitations in ADL (sleep, work)
- Most important factor for decreased quality of life
- Highly complex - multiple types of pain experienced simultaneously



¹Dijkers, J Rehabil Res Develop 2009
²Mehta, SCIRE Version 5.0 2014

Classification

- Classification of pain helps guide treatment.
- Classification schemes generally rely on:
 - Neurological Level of Injury (NLI)
 - Pain location(s): above, at, or below NLI
 - Pain qualities: burning, aching, stabbing



asia-spinalinjury.org

Classification of SCI Pain

- Lack of a consistent definition until recently
- Over 29 different schemes
 - Bryce/Ragnarsson SCI Pain Taxonomy
 - Cardenas SCI Pain Taxonomy
 - International Association for the Study of Pain (IASP) Taxonomy
- Most classify pain as nociceptive or neuropathic, and based on location in relation to NLI (at-level, below-level)
- International SCI Pain (ISCIP) Classification
 - consensus classification based on international input
 - includes elements from previous taxonomies
 - classifies pain in three tiers according to type of pain and source



Bryce, Spinal Cord 2012

International SCI Pain (ISCIP) Classification

Three-tier hierarchy:

1. Tier 1: Pain *type*
 - Nociceptive
 - Neuropathic
 - Other
 - Unknown
2. Tier 2: Pain *subtypes*
 - Nociceptive: Musculoskeletal, Visceral, or Other
 - Neuropathic: At-level, Below-level, or Other
3. Tier 3: Pain *source/pathology*

Year 1: Pain type	Year 2: Pain subtype	Year 3: Primary pain source and/or pathologies (nerve or type 1)
Neuropathic pain	① Musculoskeletal pain	e.g., glenohumeral arthritis, lateral epicondylitis, compartmental forearm pain, quadratus lumborum muscle pain
	② Visceral pain	e.g., myocardial infarction, abdominal pain due to bowel obstruction, diverticulitis
	③ Other nociceptive pain	e.g., intracerebral haemorrhage, ischaemic bowel, surgical skin incision
Neuropathic pain	① At least 1 SCI pain	e.g., spinal cord compression, nerve root compression, cauda equina compression
	② Below level SCI pain	e.g., spinal cord ischaemia, spinal cord compression
	③ Other neuropathic pain	e.g., central neural synapses, segmental neuritis, diabetic polyneuropathy
Other pain		e.g., fibromyalgia, Complex Regional Pain Syndrome type I, interstitial cystitis, irritative bowel syndrome
Unknown pain		

Bryce, *Spinal Cord* 2012

Nociceptive Pain

- **Type: Nociceptive pain**
 - Pain arising from activation of nociceptors'
- **Subtypes:**
 - **Musculoskeletal** – (e.g. arthritis, fractures, tendinopathies)
 - areas of preserved sensation, but can incl. area below NLI
 - 'dull' or 'aching'; related to movement/position; tenderness on palpation
 - **Visceral pain** (e.g. constipation/impaction, UTI, cholecystitis)
 - visceral structures in thorax, abdomen, or pelvis
 - "cramping", "dull", "tender"; temporal relationship to visceral fct.; tenderness on palpation; associated nausea/sweating
 - **Other (nociceptive) pain** (e.g. AD headache, pain from pressure ulcer, migraine)
 - Nociceptive pain that is not musculoskeletal or visceral pain

***Nociceptor** = a peripheral nerve ending or a sensory receptor that is capable of transducing and encoding noxious stimuli.

Bryce, *Spinal Cord* 2012

Neuropathic Pain

- **Type: Neuropathic pain**
 - Pain caused by lesion/disease affecting the somatosensory system (central or peripheral).
 - sensory deficits, allodynia/hyperalgesia within pain distribution
 - “hot-burning”, “tingling”, “pins & needles”, “electric”, etc.
 - **Subtypes:**
 - **At-level SCI pain**
 - Neuropathic pain ≤3 dermatomes below NLI; not any lower; (except: damage to cauda equina)
 - must be due to injury of spinal cord/nerve roots
 - **Below-level SCI pain**
 - Neuropathic pain >3 dermatomes below NLI (may incl. NLI dermatome)
 - must be due to injury/disease of spinal cord
- 



Bryce, Spinal Cord 2012

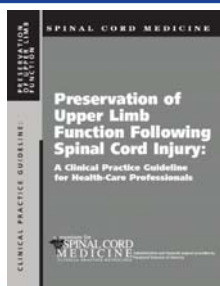
- Allows clinicians to collect same basic information:
 - Location of pain
 - Type of pain
 - Intensity of pain
 - Duration of pain
 - Pain Interference
- Can be used to collect information on a patient's 3 worst pain problems

Management of Spinal Cord Injury Pain



Management of Upper Limb Pain

- ↓ Acute pain
 - rest (relative)
 - pharmacological interventions (NSAIDs, etc.)
 - injections
 - modalities (ice/heat, TENS, ultrasound)
- Address 2^o disabilities
- Prevention
 - Consortium Guidelines
- Avoid surgery if possible



Consortium for Spinal Cord Medicine, *J Spinal Cord Med* 2005
-available in its' entirety for free download at www.gva.org

Management of Upper Limb Pain

- Ergonomics
 - ↓ frequency/force UL tasks
 - ↓ extreme/injurious joint positions
- Equipment selection (and set-up)
 - manual WC of lightest possible material
 - WC set-up: rear axle as far forward as possible
 - Position the rear axle so elbow 100-120°
 - Consider power WC or power add-ons
- Education & equipment training
 - Use long, smooth strokes
 - Promote appropriate seated posture
 - Transfer training



Consortium for Spinal Cord Medicine, 2005

Management of Upper Limb Pain

• Exercise

- Flexibility exercises to maintain normal glenohumeral motion & pectoral muscle mobility.
 - Anterior shoulder muscles
- Resistance training (balanced program with strengthening of the posterior musculature) that emphasizes 4 main areas.
 1. Scapular stabilizers (trapezius and serratus anterior);
 2. Rotator cuff muscles (supraspinatus, infraspinatus, teres minor, and subscapularis);
 3. Shoulder adductors
 4. Primary humeral head movers (deltoid, pectoralis major, & latissimus dorsi)



Management of Neuropathic Pain

Spinal Cord 2016; 34, 514-525
Official Journal of the International Spinal Cord Society
www.spinalcord.com

OPEN

GUIDELINES

The CanPain SCI Clinical Practice Guidelines for Rehabilitation Management of Neuropathic Pain after Spinal Cord: Recommendations for treatment

SD Guy^{1,2}, S Mehra^{3,4}, A Casolino⁵, I Côté⁶, A Knaflitz⁷, DE Moulton^{8,9}, AG Parent^{10,11}, P Potter¹², C Short¹³, R Tassell^{14,15}, CL Bradbury¹⁶, TN Brice¹⁷, BC Craven¹⁸, NB Finnerup¹⁹, D Harvey²⁰, SL Hitting^{21,22}, B Liao²³, PW Middleton²⁴, C O'Connell^{25,26}, S O'Connor²⁷, PJ Siddall²⁸, A Townsend²⁹, C Trachten³⁰, E Widensjö-Noga³¹, D Wolfe³² and E Leht³³

Study design: Clinical practice guidelines.

Objectives: To develop the first Canadian clinical practice guidelines for treatment of neuropathic pain in people with spinal cord injury (SCI).

Setting: The guidelines are relevant for inpatient and outpatient SCI rehabilitation settings in Canada.

Methods: The CanPain SCI Working Group reviewed the evidence for different treatment options and achieved consensus. The Working Group then developed clinical considerations for each recommendation. Recommendations for research are also included.

Results: Twelve recommendations were developed for the management of neuropathic pain after SCI. The recommendations address both pharmacologic and nonpharmacologic treatment modalities.

Conclusions: An expert Working Group developed recommendations for the treatment of neuropathic pain after SCI that should be used to inform practice.

Spinal Cord 2016; 34, 514-525, doi:10.1038/sc.2016.90



Guy et al. CanPain SCI, Spinal Cord 2016

Management of Neuropathic Pain

• First-Line Therapy:

1. Pregabalin: first choice of first-line medications (only FDA-approved drug for neuropathic pain in SCI)
 - Dose: 150-600 mg/day; starting dose 50 mg twice daily
 - Side effects: somnolence and dizziness (mild/moderate intensity)
2. Gabapentin: next option if pregabalin not available or ineffective
 - Dose: 1,800-3,600 mg/day; starting dose 100 mg 3-4 times daily
 - Side effects: somnolence and dizziness
3. Amitriptyline: can be used if pregabalin & gabapentin ineffective
 - Dose: 1,800-3,600 mg/day; starting dose 100 mg 3-4 times daily
 - Side effects: somnolence and dizziness



Guy et al. CanPain SCI, Spinal Cord 2016

Management of Neuropathic Pain

- Second-Line Therapy:
 1. Tramadol: can be used for reduction of neuropathic pain in SCI
 - Dose: 400 mg daily; starting dose 50 mg once or twice daily
 - Side effects: sedation, nausea, constipation
 2. Lamotrigine: may be considered in those with incomplete SCI only
 - Dose: titrated to max dose 400 mg/day
 - Side effects: somnolence and dizziness, headache, and rash; "black box" warning by FDA for skin rashes (Stevens-Johnson Syndrome)



Guy et al. CanPain SCI, Spinal Cord 2016

Management of Neuropathic Pain

- Third-Line Therapy:
 1. Transcranial direct current stimulation (tDCS)
 2. Combined visual illusion with tDCS
- Fourth-Line Therapy
 1. Oxycodone
 2. Dorsal root entry zone (DREZ) procedure
 - Considered in exceptional circumstances and as a last resort for reducing neuropathic pain in SCI
 3. Levetiracetam should not be used for reducing neuropathic pain in SCI
 4. Mexiletine should not be used for reducing neuropathic pain in SCI



Guy et al. CanPain SCI, Spinal Cord 2016

Is this as good as it gets?



Mind-Body Connection in SCI Pain



Definition of Pain



“An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”



Slide courtesy of Dr. Jeanne Zanca

Definition of Pain



“An unpleasant sensory and emotional **experience** associated with actual or potential tissue damage, or described in terms of such damage.”

Key Points:

Pain is by definition an **experience**

While most often there is some physical cause, pain is also a psychological phenomenon



Slide courtesy of Dr. Jeanne Zanca

Definition of Pain



Key Points:

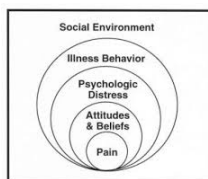
Both sensory and emotional components are required for pain to be "pain"

"An unpleasant **sensory and emotional** experience associated with actual or potential tissue damage, or described in terms of such damage."



Slide courtesy of Dr. Jeanne Zanca

Biopsychosocial Model of Pain



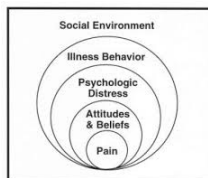
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242011/figure/F1/>
International vs Biopsychosocial Model of Disease which is based on how much pain

- Pain no longer viewed as a phenomenon driven only by physical factors
- Experience and consequences of pain influenced by:
 - Physical pathology or dysfunction
 - Cognitions (thoughts, attitudes)
 - Affective states (emotions, mood)
 - Behaviors
 - Social factors (support and interactions)
 - Demographics



Slide courtesy of Dr. Jeanne Zanca

Biopsychosocial Model of Pain



<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242011/figure/F1/>
International vs Biopsychosocial Model of Disease which is based on how much pain

- Poor functioning in people with SCI and other disabling conditions is associated with:
 - **Catastrophizing** (thoughts of pain being unbearable or never-ending)
 - **Maladaptive coping responses** (such as guarding or excessive rest)
 - **Sollicitous responses** (others showing interest or concern about pain)
 - **Fear-avoidance** beliefs and behaviors
 - **Poor pain acceptance**
 - **Low self-efficacy**
 - **Low perceived control** of pain
 - **Poor perceptions of ability** to function
 - **Pain intensity**

(Harrison et al 2015; Jensen et al 2011; Rudy et al 2003; Osborne et al 2007; Turner et al 2002)



Slide courtesy of Dr. Jeanne Zanca

Pain Processed in Multiple Regions

How the Mind Processes Pain

ANTERIOR CINGULATE CORTEX
Regulates emotional feelings about pain, either physically or emotionally. It is involved in the pain experience.

SOMATOSENSORY CORTEX
Regulates which body parts are in pain and the intensity of that pain. It is involved in the pain experience.

INSULAR CORTEX
Regulates sensory, emotional and cognitive aspects of pain. It is involved in the pain experience.

THALAMUS
Regulates sensory input and relays it to higher brain regions. It is involved in the pain experience.

FRONTAL CORTEX
Regulates cognitive aspects of pain. It is involved in the pain experience.

AMYGDALA
Regulates emotional aspects of pain. It is involved in the pain experience.

PREFRONTAL CORTEX
Regulates cognitive aspects of pain. It is involved in the pain experience.

MEDIAL PREFRONTAL CORTEX
Regulates emotional aspects of pain. It is involved in the pain experience.

NUCLEUS ACCUMBENS
Regulates emotional aspects of pain. It is involved in the pain experience.

From Beck, 2011
Accessed at:
<http://www.wsj.com/articles/SB10001424052970204323904577038041207168300>

Slide courtesy of Dr. Jeanne Zanca

- Includes areas involved in:
 - Sensation
 - Emotion
 - Executive function
- Signals flow both ways
 - Ascending nociceptive input changes brain activity
 - Descending signals from brain modulate input

Brain Characteristics and Chronic Pain

• Survey and imaging studies reinforce each other

Psychosocial factors are associated with degree of disability among people with chronic pain

↔

Activity in emotion and cognition-related circuits is associated with chronic pain development and treatment response

KESSLER FOUNDATION

Slide courtesy of Dr. Jeanne Zanca

Implications for Pain Management

- Multiple targets for intervention
 - Structural or physiological condition that is producing nociceptive input
 - Perception of nociceptive input
 - Beliefs, thoughts, attitudes about pain
 - Behaviors (including skills that promote pain coping)

(Tracey and Mantyh 2007)

KESSLER FOUNDATION

Slide courtesy of Dr. Jeanne Zanca

Implications for Pain Management

- Multiple targets for intervention
 - Structural or physiological condition that is producing nociceptive input
 - Perception of nociceptive input
 - Beliefs, thoughts, attitudes about pain
 - Behaviors (including skills that promote pain coping)



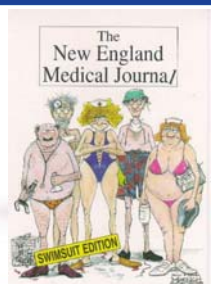
(Tracey and Mantyh 2007)



Slide courtesy of Dr. Jeanne Zanca

Comprehensive Pain Management

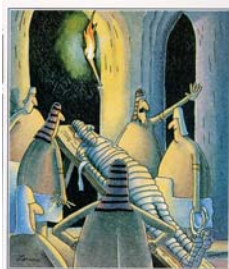
- Successful pain management requires:
 - Combination of approaches that address multiple targets
 - Customization to individual needs and priorities
- Multi-disciplinary



Slide courtesy of Dr. Jeanne Zanca

Questions?

- Funding:
 - NJ Commission on SCI Research
 - Craig H. Neilsen Foundation
 - National Institute on Disability, Independent Living, & Rehabilitation Research
 - Kessler Foundation
- Special thanks to:
 - Dr. Jeanne Zanca



"Oh, hello... it's a wing!"

Image courtesy of Gary Larson



tdysonhudson@kesslerfoundation.org