Pain Neuroscience & Its Clinical Implications
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RESOURCES

Websites

- TED talks (that I prescribe to patients)
  - Lorimer Moseley – Why Things Hurt
  - Anil Seth – Our Brains Hallucinate
  - Lorimer's lecture IFOMPT 2016
- www.bodyinmind.org
- www.noijam.com
- www.TameTheBeast.org

Podcasts

- abc.net.au/radionational/programs/healthreport/the-brains-role-in-pain/7735610

Blog posts

- https://noijam.com/2015/03/12/dim-sims/

Books

- Explain Pain (2nd edition), and Explain Pain Supercharged - Butler and Moseley
- The Explain Pain Handbook, The Protectometer, by David Butler and Lorimer Moseley
- Painful Yarns, by Lorimer Moseley
Facebook Group

- Explaining Pain Science

Online Patient Resources

- Understanding Pain
- DocMikeEvans (introduction)
- Low Back Pain

Opioid resources

- Opioid Taper Support
- Opioid Taper CME
- Brainman stops his opioids
- Opioids

LECTURE NOTES

Pain – the most burdensome non-fatal condition facing our species

How does pain work?

- Pain is a protector
- Pain is all about context

Pain is NOT nociception

- Nociception does NOT hurt
- Can have pain WITHOUT nociception
- Can have nociception WITHOUT pain
- Bullet found in neck http://news.bbc.co.uk/2/hi/uk_news/scotland/2770777.stm
- A tale of 2 nails: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2908292/
Pain is all about context (neurologically speaking)

What is remarkable is to see how the language of Neuroscience has built a bridge to the physical medicine community, and that it’s actually the progressive end of the Physical Therapy community that is leading this change over the last fifteen years.

- Visual illusion of stretching finger/knee improves stiffness and pain in OA
- Recounting being bullied increases pro-inflammatory cytokine released by submerging arm in ice bath
- Rubber hand illusion – autonomic and innate immune changes in real arm!

“Neurotags” and the “Cortical body matrix”

Neuroimmune science of pain

- Neuro: Whole range of detectors via - C, Aδ, and Aβ
  - Primary nociception & “optimal stimulus”
  - Free Nerve endings (Noxious Mech, Chem, Temp)
  - Optimal stimuli - Noxious: byproducts of damaged tissue or something that could damage tissue
  - Really good at protection - don’t need receptors: High intensity mechanical (nose hairs), decreased pH (acid in your butt cheeks right about now), marked increase in temperature
  - Not just Aδ and C(aress) - also Aβ (and all this changes)
  - Don’t localize very well (referred pain)
- Immune: How inflammation changes nociception
- Nociceptors go both ways! - Axonal Reflex (Back out all the other branches) & Antidromic Activation (Starting in DRG)
- Tripartite synapse
  - Half the brain is immune cells
  - The immune cells “eavesdrop” on every interaction between nerves
- Dorsal Horn
• Microglia - neuron
• Astrocyte - neuron
• Cross-talk

• TLR4 & the immune set point – Homer Simpson and locomotives!
  • Toll-Like Receptors: ‘remember’ what a dangerous event ‘looks like’ (and they’re over-reactive)
  • Pathogen-associated Molecular Proteins (PAMPs) – bacteria, viruses, etc.
  • DAMPs (Damage) - cytokines, heat shock proteins, STP, uric and lactic acid
  • XAMPs (Xenobiotic) - drugs: exogenous morphine
  • BAMPs (Behavior) – Somatic Marker Hypothesis
  • CAMPs? (Cognition)

• NeuroImmune Coupling

• Central Sensitization
  • “a mass of neurotags collaborating and competing for influence” ... think probability gradient
  • Increased responsiveness of protective neurotags
  • Smudging neurotags: Herta Flor and Lips
  • Tx: Graded Motor Imagery
  • Sensory/Tactile Discrimination Training (SDT)
    • Cortical reorganization: increased pain and decreased acuity associated with all kinds of persistent pain conditions
    • Sensory Discrimination Training (e.g. 2-point moving vs 2-point sharp stimuli), has shown promise in decreasing pain and increasing function

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4818915/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4818915/)
**Placebo** - Latin for “I shall please”

- “a kind of loose family of different phenomena that are just yoked together by this term,”
  - Franklin Miller, retired NIH bioethicist


How does placebo work?

**Regression to the mean**

- Treatment is usually sought with more severe sx
- Natural history is that many things improve over time without treatment
- Estimated at 30% of effect can be regression

**Confirmation bias**

- *Hope to get better when they’re in treatment*
- *-> Change focus - paying closer attention to signs of improvement and ignore signs that they’re getting worse.*
- *Relatedly, there’s the Hawthorne effect: We change our behavior when we know we’re being watched.*

**Expectations and learning (m opioid, dopamine D2 and D3, CCK-A and CCK-B)**

- Pain relief is stronger and more immediate when morphine is injected out in the open.
  - Colloca, L. *The Lancet Neurology*
- Sacred Healing: In search of a cure, a man makes a journey to a healing place, where he’ll undergo a fasting rite, don ceremonial garb, ingest mind-altering substances and be anointed with liquids before a masked healer takes him through a physical ritual intended to vanquish his pain.
  - Aschwanden, Christie *Surgery is One Hell of a Placebo* 19 July 2017 *Knee arthroscopy for DJD* “Taken together, these findings do not support the practise of arthroscopic surgery for middle aged or older patients with knee pain with or without signs of osteoarthritis.” (2015)
- *Wartolowska K. et al. Use of placebo controls in the evaluation of surgery: systematic review* BMJ 2014; 348  In 39 out of 53 (74%) trials there was improvement in the placebo arm and in 27 (51%) trials the effect of placebo did not differ from that of surgery. In 26 (49%) trials, surgery was superior to placebo but the magnitude of the effect of the surgical intervention over that of the placebo was generally small. Serious
adverse events were reported in the placebo arm in 18 trials (34%) and in the surgical arm in 22 trials (41.5%); in four trials authors did not specify in which arm the events occurred. However, in many studies adverse events were unrelated to the intervention or associated with the severity of the condition. The existing placebo controlled trials investigated only less invasive procedures that did not involve laparotomy, thoracotomy, craniotomy, or extensive tissue dissection.

- **Sham surgery for pain:**
  Mean improvement in sham groups relative to active treatment was 78% in pain-related conditions! Jonas WB, Crawford C, Colloca L, et al. To what extent are surgery and invasive procedures effective beyond a placebo response? A systematic review with meta-analysis of randomised, sham controlled trials BMJ Open 2015

- **Acupuncture:** Vase l. et al, Specifying the non-specific components of acupuncture analgesia, Pain 2013 Sep; 154(9)
  https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3981538/

Pharmacological conditioning:

- ‘A neurobiological phenomenon’

  Colloca, L. will switch drug with placebo and see continued response - in pain drugs, Parkinson drugs, psychiatric meds, etc. !


  OLP enhanced pain reduction by 1.49 points on a 0 to 10 scale compared to a 0.24 point change with continued standard treatment without the added placebo.

  OLP produced approximately 30% additional pain reduction of baseline pain and disability ratings.

  https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5113234/figure/F2/

**Nocebo effects**


- Italian ‘lactose’: 44% and 26% had GI sx

- Acupuncture is least effective if performed by a non-Chinese woman on a Chinese man outside China.

- Round pills < square tablets with missing corners < colored tablets < white beads < transparent capsules with colored beads
• **This Video Will Hurt**

**Words That Harm, Words That Heal**

• Consider Translating for the patient

• Words that harm - words that heal

Recovering from Pain is about Language

• Radiologists aren't talking to patients

• Please don’t let your nurse read MRI reports to patients

• You are talking to their limbic system

“Fear should not be used, even inadvertently, to encourage patients to comply with a treatment plan. A better approach is to provide patients with the range of options and each option’s outcomes, benefits, and risks. Patients can use that information and combine it with their preferences and values to help them decide what is best for them.”

Pain and fear are two protective outputs of the brain

• Fear of Damage
  
  • Your back is Shot
  
  • What a Train Wreck
  
  • Worst I’ve ever seen

• Fear of the Future
  
  • Lucky to Not be Paralyzed
  
  • You’ll end up In a wheelchair

• Fear Sells
  
  • You’ll end up Needing Surgery

Need to Compensate for patients’

• Negative Attention Bias

• Catastrophizing

• Fear-avoidance

• Low self-efficacy
• False beliefs about pain

Education as treatment

• Fifteen Years of Explaining Pain: The Past, Present, and Future

• The efficacy of pain neuroscience education on musculoskeletal pain: A systematic review of the literature.

• The Effect of Neuroscience Education on Pain, Disability, Anxiety, and Stress in Chronic Musculoskeletal Pain

Explain Pain Supercharged, Butler and Moseley (2017)

• The ‘Twin peaks’ model

• Explain pain

 noigroup.com

It's not surprising that when this can be explained to patients in a way that doesn't stigmatize or alienate them, current evidence supports that it will reduce pain and improve function and lower disability, reduce psychosocial factors, enhance movement, and minimize healthcare utilization.

High-value healthcare: Low cost intervention yields remarkable savings, even in post-surgical utilization.

Preoperative pain neuroscience education for lumbar radiculopathy:

Multicenter randomized controlled trial with 1-year follow-up showed 45% less healthcare expenditure compared with the control group in the 1-year follow-up period, and 37% less in years 2 and 3. Estimated medical expenses in U.S. dollars (means and standard deviations) related to the lumbar surgery after 1 and 3 years.

Understanding pain science improves pain

Skill Development:

Break into groups of 2-3 and role play a dialogue. Patient asks about the diagnosis of their low back pain (MRI findings?) and proposed treatment

Physician: Answer the question with new language.
ACP Guidelines for Low Back Pain

- **Recommendation 1:** Given that most patients with acute or subacute low back pain improve over time regardless of treatment, clinicians and patients should select nonpharmacologic treatment with superficial heat (moderate-quality evidence), massage, acupuncture, or spinal manipulation (low-quality evidence). If pharmacologic treatment is desired, clinicians and patients should select nonsteroidal anti-inflammatory drugs or skeletal muscle relaxants (moderate-quality evidence). (Grade: strong recommendation)

- **Recommendation 2:** For patients with chronic low back pain, clinicians and patients should initially select nonpharmacologic treatment with exercise, multidisciplinary rehabilitation, acupuncture, mindfulness-based stress reduction (moderate-quality evidence), tai chi, *yoga*, motor control exercise, progressive relaxation, electromyography biofeedback, low-level laser therapy, operant therapy, cognitive behavioral therapy, or spinal manipulation (low-quality evidence). (Grade: strong recommendation)

- **Recommendation 3:** In patients with chronic low back pain who have had an inadequate response to nonpharmacologic therapy, clinicians and patients should consider pharmacologic treatment with nonsteroidal anti-inflammatory drugs as first-line therapy, or tramadol or duloxetine as second-line therapy. Clinicians should only consider opioids as an option in patients who have failed the aforementioned treatments and only if the potential benefits outweigh the risks for individual patients and after a discussion of known risks and realistic benefits with patients. (Grade: weak recommendation, moderate-quality evidence)

**Yoga for chronic low back pain**


- Yoga and PT showed almost the same amount of improvement in pain, activity limitation, satisfaction and quality of life over time, even after 1 year.

- Education was better than Yoga in terms of improvement in pain and activity limitation at 3 months.

- Participants in both the yoga and physical therapy groups were less likely to use pain medications at 3 months compared with the education group.

**55p Participant Guidebook for Patients**

http://self-compassion.org/

- “I take mindfulness practice a bit further and educate in self-compassion, because mindfulness is just one of the elements of self-compassion. I’ve been using Kristen Neff’s research and her self-compassion test for years and every single one of my pain clients tests low, often very, very low. Her site, book and research have been extremely helpful in guiding clients to develop self care, mindfulness, and self-efficacy skills. She also has guided meditations and free downloadable exercises. Worth the look.”

Opioids for Chronic Pain?

- “The titrate-to-effect principle has value when treating acute and end-of-life pain where pain is predictable, short lived, and responds well to opioids. But applying this principle to chronic pain has led to unrealistic and potentially damaging expectations for patients, and therapeutic disappointment for clinicians. It is time to abandon the idea that every high pain score needs to be reduced, and that clinicians are failing in their duty or practicing unethically if they don’t respond to every high pain score with an opioid.” Ballantyne 2015


Exercise:

Break into groups of 2-3 and role play a dialogue. Patient asks:

- How do I know if my pain system is being over-protective?
- How can I train my pain system to be less protective?
- How do I know if I am safe to move?
- Will I re-injure myself?
- Will I get better?
- What can I do to help myself recover more quickly?
- Where can I learn how to best recover?

Physician: Explain with new language.

Other(s): Offer feedback on word choice, metaphor, etc.

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