Pain & The ‘Second Brain’: The Importance of Understanding, & Applying, Modern Pain Science To GI Related Pain

Kevin Cuccaro, D.O.
Faculty Disclosure:

The speaker, Dr. Kevin Cuccaro, has declared they have no relevant financial disclosures.
Learning Objectives

• Define modern pain science using a new conceptual model.

• Describe how to assess and ‘deconstruct’ pain to direct treatment.

• Apply constructed thinking to pain-related GI disorders (e.g. Functional GI Disorders)
Goals:
Challenge Beliefs
‘Categorical Awareness’

Think Differently

Outline:
1. Intro Pain Science
2. Risk Factors & Amplifiers
3. FGID & Pain
Kevin Cuccaro, D.O.

**Before:**
- Anesthesiology (Univ. of Chicago)
- ‘Pain Medicine’ (Univ. of Michigan)
- Assoc. Program Dir. (NMCSD)
- Board Certified ‘Pain Injection Specialist’

“Why aren’t people better?”

**Now:**
- Pain Specialist & Consultant
  - Healthcare Systems/PCPCH’s
  - OHA Clinical Innovations Fellow
  - Oregon Pain Management Commission
  - OHA HERC Chronic Pain Task Force
Understanding Pain & Modern Pain Science
(Part 1)
Three ‘Key’ Pain Concepts:

• **Key Concept #1:** (The Purpose of Pain & How People Can Hurt Even If It Appears “Nothing’s Wrong”)

• **Key Concept #2:** (The Most Common Misconception About Pain Almost Everyone Makes & Which Causes Treatments To Fail)

• **Key Concept #3:** (How To Think Differently For Safe & Effective Treatment)
“We cannot solve our problems with the same thinking we used when we created them.”
Opioid…Or Pain Problem?

**Pain**

- Common presenting symptom
- Most common disability
- $600+ Billion annually
- ‘100 Million Americans’

**Back Pain**

- 2nd Most Common Reason for ALL Physician Visits
- Lifetime Prevalence of 60-90%
- Industrialized & Developing World
- *Disability Rates Very Different*


Cost & Benefit

What We Did…

• ↑ MRI’s 300%
• ↑ Procedures 130-700+%
• ↑ Surgeries 300+%  
• ↑ Opioids 690+%  

What We Got…

• ↑ Disability Rates
• ↑ Complication Rates
• ↑ Healthcare Costs

No Improvement in Self Reports

Overall Results

2000 U.S. Population
45 Million Chronic Pain

2010 U.S. Population (↑9.6%)
100 Million Chronic Pain

↑122%

122%?!?
Despite More Treatment?

How?
What Is Pain?

Key Pain Concept #1: (The Purpose of Pain & How People Can Hurt Even If It Appears “Nothing’s Wrong”)
Pain or No Pain?
Pain or No Pain?

Who Has Pain?
How can someone...

Severe pain in their foot… but no spike?

Have a nail in their thumb… but little pain?

‘Spinal deformity’… but no pain?

‘Normal’ X-Rays… but tremendous pain?
What Is Pain?

“Pain is an unpleasant sensory & emotional experience associated with actual or potential tissue damage or described in terms of such damage.”

IASP 1994

Unpleasant Sensory AND Emotional Bodily Experience In Response To Perceived Danger

Key Pain Concept #1

The Purpose of Pain Is Protection Not Punishment

“Hurt ≠ Harm”
Protection

NOT Punishment

‘Danger’

NOT ‘Damage’
Protection Not Punishment
(“Hurt” ≠ “Harm”)

‘Harm WITHOUT Hurt’
- Distraction
- Life or Death Events
- Belief of Harmlessness
- General Anesthesia

‘Hurt WITHOUT Harm’
- High (But Not Too High) Threat
- Expectation of Harm or
‘Vulnerable’ Expectation
- Belief of Harm

Urquhart DM, Bell RJ, Cicuttini FM, Cui J, Forbes A, Davis SR. Negative beliefs about low back pain are associated with high pain intensity and high level disability in community-based women. BMC Musculoskelet Disord. 2008;9:148
There is a common belief that wounds are inevitably associated with pain, and, further, that the more extensive the wound the worse the pain. Observation of freshly wounded men in the Combat Zone showed this generalization to be misleading. If one may speak of such a subjective experience as pain in exact terms, the generalization can be said to hold in only about one-quarter of severely wounded men; it fails in the remaining three-quarters. There are practical reasons for examining this problem, for a clear appreciation of its nature will lead to improved treatment of the distress of the wounded.
Pain ≠ Damage!

Key Concept #1: The Purpose of Pain Is Protection

“Hurt ≠ Harm”
Key Pain Concept #2

(The Most Common Misconception About Pain Almost Everyone Makes & Which Causes Treatments To Fail)
Dr. Ignaz Semmelweis 1818-1865

Women Are Dying!
We Must Wash Our Hands!
No!
We are ‘Gentleman’!
(& Threw Him Into An Insane Asylum)
Assumptions & Misconceptions Can Be Harmful
So Let’s Test Some…
Where Is The Pain “Coming From...?”
Where Is The Pain "Coming From...?"
Where Is The Pain “Coming From…?”
IF Pain “Came From…”

...Then structural imaging or examination would consistently & predictably detect who is & who isn’t experiencing pain

But is this true?
Table 2: Age-specific prevalence estimates of degenerative spine imaging findings in asymptomatic patients

<table>
<thead>
<tr>
<th>Imaging Finding</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk degeneration</td>
<td>37%</td>
<td>52%</td>
<td>68%</td>
<td>80%</td>
<td>88%</td>
<td>93%</td>
<td>96%</td>
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<tr>
<td>Disk signal loss</td>
<td>17%</td>
<td>33%</td>
<td>54%</td>
<td>73%</td>
<td>86%</td>
<td>94%</td>
<td>97%</td>
</tr>
<tr>
<td>Disk height loss</td>
<td>24%</td>
<td>34%</td>
<td>45%</td>
<td>56%</td>
<td>67%</td>
<td>76%</td>
<td>84%</td>
</tr>
<tr>
<td>Disk bulge</td>
<td>30%</td>
<td>40%</td>
<td>50%</td>
<td>60%</td>
<td>69%</td>
<td>77%</td>
<td>84%</td>
</tr>
<tr>
<td>Disk protrusion</td>
<td>29%</td>
<td>31%</td>
<td>33%</td>
<td>36%</td>
<td>38%</td>
<td>40%</td>
<td>43%</td>
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<tr>
<td>Annular fissure</td>
<td>19%</td>
<td>20%</td>
<td>22%</td>
<td>23%</td>
<td>25%</td>
<td>27%</td>
<td>29%</td>
</tr>
<tr>
<td>Facet degeneration</td>
<td>4%</td>
<td>9%</td>
<td>18%</td>
<td>32%</td>
<td>50%</td>
<td>69%</td>
<td>83%</td>
</tr>
<tr>
<td>Spondylolisthesis</td>
<td>3%</td>
<td>5%</td>
<td>8%</td>
<td>14%</td>
<td>23%</td>
<td>35%</td>
<td>50%</td>
</tr>
</tbody>
</table>

*a* Prevalence rates estimated with a generalized linear mixed-effects model for the age-specific prevalence estimate (binomial outcome) clustering on study and adjusting for the midpoint of each reported age interval of the study.

IF Pain “Came From…”

...Then cutting, poking, popping, drugging, ‘Pain Pus Pathways’ would consistently & predictably work with sustained results...

But is this true?
"No subset of patients with chronic LBP could be identified for whom spinal fusion is a predictable and effective treatment."

Current Treatment Model

What We Do…

• ↑ MRI’s 300%
• ↑ Procedures 130-700+%  
• ↑ Surgeries 300+%  
• ↑ Opioids 690+%  

What We Get…

• ↑ Disability Rates  
• ↑ Complication Rates  
• ↑ Healthcare Costs  

No Improvement in Self Reports

Maybe Our Model Needs An Update...?

17th Century

21st Century

Key Pain Concept #2

Pain Does NOT “Come From…” The Body

Pain Is “Constructed” In The Brain
How We Construct Pain

Unpleasant Sensory AND Emotional Bodily Experience In Response To Perceived Danger

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Confusing? Not Really

All Fires Are Constructed

- Fuel
- Oxygen
- Heat
Pain Is Similar

Fire Triangle

Pain Triangle

Cognition/Attention (“Heat”)
- Threat Appraisal
- Accidental vs. Intentional
- Uncertainty & Anxiety

Sensation/Transmission (“Fuel”)
- A-Beta vs. A-Delta vs. C-fibers
- Interoceptive, Exteroceptive, Proprioceptive...
- ‘Top-Down’ Influences

Emotion/ Meaning (“Oxygen”)
- Fear & Loss Meaning
  - Ex. Abd Pain
- Anger & Injustice
- Loss & Depression
All Pain Is Constructed

- Sensation/Transmission ("Fuel")
- Cognition/Attention ("Heat")
- Emotion/Meaning ("Oxygen")
Important: What Is This?
Structure OR Sensation Alone ≠ Pain

& NOCICEPTION
Is NOT Pain!
Nociception ≠ Pain

Nociception

• *Specific* nerve stimulation that conveys information to the brain of *potential tissue damage*

• *Inferred* from structure.

• Feedback Mechanisms ↑ or ↓

• Anesthesia INDEPENDENT

• OBJECTIVE (‘Cause-Effect’)

Pain

• Perception & *Response* to Sensory Information

• Genetics, prior learning, current psychological status, sociocultural influences, etc.

• Anesthesia DEPENDENT

• SUBJECTIVE (‘Constructed’)

WALL, PD.; McMAHON, SB. The relationship of perceived pain to afferent nerve impulses. Trends in Neurosciences. 1986;96: 254-255
Key Pain Concept #2: Pain is Constructed. It Does Not “Come From…”

(Nociception Is One of Many Sensory Inputs)
So Far...

• **Key Pain Concept #1**

  The Purpose of Pain Is **Protection** Not Punishment

  “Hurt ≠ Harm”

• **Key Pain Concept #2**

  Pain Does NOT “*Come From...*” The Body

  Pain Is “*Constructed*” In The Brain

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Key Pain Concept #3

(How To Think Differently For Safe & Effective Treatment)
Kuwait 1991
All Fires Extinguished... (9 months)
Key Pain Concept #3

If You Know **What** You’re Treating…

You Know **How** To Treat It
Firefighters **Understand** Fire

Then ‘Deconstruct’ It To Target Treatment

(e.g. They don’t spray water on every fire!!!)
The Same Applies To Pain

‘Pain Fire’ Examples...
Spike In Boot

**Sensation/Transmission (“Fuel”)**
- ‘Tissue Issues’ or No?

**Cognition/Attention (“Heat”)**
- Threat, Uncertainty, Anxiety?

**Emotion/Meaning (“Oxygen”)**
- Fear, Loss/Harm Meaning?
Nail In Thumb

Sensation/Transmission ("Fuel")
  – 'Tissue Issues' or No?

Cognition/Attention ("Heat")
  – Threat, Uncertainty, Anxiety?

Emotion/meaning ("Oxygen")
  – Fear, Loss/Harm Meaning?
‘Normal Spine’

Sensation/Transmission ("Fuel")
- ‘Tissue Issues’ or No?

Cognition/Attention ("Heat")
- Threat, Uncertainty, Anxiety?

Emotion/ Meaning ("Oxygen")
- Fear, Loss/Harm Meaning?
Scoliosis

Sensation/Transmission ("Fuel")
  - 'Tissue Issues' or No?

Cognition/Attention ("Heat")
  - Threat, Uncertainty, Anxiety?

Emotion/ Meaning ("Oxygen")
  - Fear, Loss/Harm Meaning?
No Pain
Why This Matters

What We Assume About Pain  So We Focus Treatment Here.

“Your Pain is coming from...”

- MRI’s 300%
- Procedures 130-700+%  
- Surgeries 300+%  
- Opioids 690+  
- Structure-Focused Therapy  
- Body-Focused Messaging
But Structure ≠ Pain

(& ‘Acute Pain’ ≠ ‘Wood Burning’)

(& ‘Chronic Pain’ ≠ ‘Brain Fire’)

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The Pain Course
However...

“Structure” or “Fuel” Are NOT Irrelevant! (Especially ‘Acute’ Scenarios)

But “Structure” or “Fuel” Often NOT 1° Contributor (Usually ‘Chronic’ Scenarios)
Different Thinking
(For Different Categories)

- **Structural Pathology**: Yes/No 1 Dimension
- **Function or Process**: Cause/Effect 2 Dimensions
- **Constructed Experience**: Constructed 3 Dimensions

**Examples**:
- "Broken Bone"
- "Nociception"
- "Pain"
Different Thinking is more than ‘Acute’ vs. ‘Chronic’...

‘Acute’?

‘Chronic’?
Same *Primary* ‘Target’?
Only One Way To ‘Treat’?
But What About Risk Factors?
That’s Next

Understanding Pain

& Risk Factors

(Part 2)
Fire Season
‘Pain Fire’ Risk Factors (& Amplifiers)

- Genetic/Epigenetic
- Developmental
  - Childhood Illness, Abuse, Neglect
- Adult Victimization/PTSD
- High Stress
  - Early Life
  - Chronic Stress
  - Acute Stressors
- Anxiety
- Depression
- Pain Beliefs & Expectations
- Maladaptive Coping
  - Pain Intensity
  - Nonorganic Signs
  - High Baseline Impairment

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‘Pain Fire’ Risk Factors (& Amplifiers)

- Genetic/Epigenetic
- Developmental
  - Childhood Illness, Abuse, Neglect
- Adult Victimization/PTSD
- High Stress
  - Early Life
  - Chronic Stress
  - Acute Stressors

**Changes:**

**Structure**

(Hippocampus, Amygdala, ACC, PFC, etc.)

**Connections & Network**

(LC-NE, HPAA, DMN, Salience)

**Function**

‘Threat Sensitivity & Reactivity’


Threat Sensitivity & Reactivity
(Stressed Physiology)

Cognition/Attention ("Heat")

- ↑ Threat Appraisal

   Threat Sensory Focus

Sensation/Transmission ("Fuel")

- Nociceptive Δ’s (cortical/spinal)
- Interoceptive, Exteroceptive, Proprioceptive...
- ‘Top-Down’ Influences

Emotion/meaning ("Oxygen")

- Fear & Harm Association
- Emotional Reactivity & Decision making

‘High Heat’, ‘High O2’ (Not ‘Fuel’)
‘High Heat’, ‘High O2’
(aka ‘Central Sensitivity’ Syndrome)

Fibromyalgia, Chronic low-back pain, Myofascial Pain Syndrome, Tension-Type Headache, Migraine, Chronic Fatigue, *Irritable Bowel Syndrome*, Restless Legs Syndrome, Multiple Chemical Sensitivity, TMD,

---

“Okay, But I don’t treat ‘Chronic Pain’…”

What happens when this person has surgery or breaks a leg?
“Okay, But I don’t treat ‘Chronic Pain’…”

Or what happens if someone else throws ‘water’ on the wrong fire...& they’re back in your office?
“Okay, But I don’t treat ‘Chronic Pain’…”

Or what if they don’t have chronic pain (yet)...but are high risk?
“Okay, But I don’t treat ‘Chronic Pain’…”

Or what affects do you think this has with other health conditions?
“Okay, But I don’t treat ‘Chronic Pain’…”

And what if they present with symptoms in their belly?
Understanding Pain & Functional GI Disorders (Part 3)
What Are FGID’s?
(Functional Gastrointestinal Disorders)

• Disorders of “Gut-Brain Interaction.” (33 adult, 20 pediatric)

• Classified by any combination of GI symptoms related to:
  “motility disturbance, visceral hypersensitivity, altered mucosal and immune function, altered gut microbiota, and altered CNS processing”

• Organized by anatomic region (esophageal, gastroduodenal, bowel, etc.)

What Are FGID’s?
( Functional Gastrointestinal Disorders )

• Most common Irritable Bowel Syndrome & Functional Dyspepsia
• Characterized by disturbed Brain-Gut Axis (Stress) physiology
• Overlap w/ other ‘functional’ disorders (FMS, TMD, CFS, etc).
‘High Heat’, ‘High O2’
(aka ‘Central Sensitivity’ Syndrome)

Fibromyalgia, Chronic low-back pain, Myofascial Pain Syndrome, Tension-Type Headache, Migraine, Chronic Fatigue, **Irritable Bowel Syndrome**, Restless Legs Syndrome, Multiple Chemical Sensitivity, TMD,

FGID Risk Factors, Influencers

- Genetic
- Environmental Exposure
- Sociocultural Influences
- High Stress
  - Early Life Stress
  - Chronic
  - Acute
- Anxiety
  - Attentional Bias, Hypervigilance
- Depression
- Illness Beliefs
- Brain-Gut Axis
  - Physiology Δ's
    - Abnormal Motility
    - Immune dysregulation, Inflammation, barrier dys.
  - Microbiome Δ's

Threat Sensitivity & Reactivity

Cognition/Attention ("Heat")

- ↑ Threat Appraisal
  Symptom-specific Anxiety

Sensation/Transmission ("Fuel")

- Visceral Hypersensitivity
- ‘Top-Down’ Influences

Emotion/meaning ("Oxygen")

- Fear & Harm Association


'Heat' & 'Oxygen'

- Genetic/Epigenetic
- Developmental
- Early Life Stress
- Chronic Stress
- Acute Stressors
- Victimization/PTSD

'Heat'
- Threat Appraisal
- Threat Sensory Attentive
- Uncertainty
- Anxiety
- Organic Pain Beliefs (i.e., 'Pain = Damage')

'Oxygen'
- Fear
- Harmful Meaning
- Fear
- Depression
- Anger, Perceived Injustice

'Threat Sensitivity'
& Reactivity

'Fuel'
- Primary nociception (inflammation)
- Spinal nociception
- Aberrant sensory information (Neuropathy)
- Exteroceptive input
- Interoceptive input
Functional GI Disorders
**Key To Treatment Is Different Thinking**

<table>
<thead>
<tr>
<th>Primary domain</th>
<th>Organ morphology</th>
<th>Organ function</th>
<th>Illness experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion</td>
<td>Pathology (disease)</td>
<td>Altered motility</td>
<td>Symptoms</td>
</tr>
<tr>
<td>Measurement</td>
<td>Histology</td>
<td>Motility</td>
<td>Motility</td>
</tr>
<tr>
<td></td>
<td>Pathology</td>
<td>Visceral sensitivity</td>
<td>Visceral sensitivity</td>
</tr>
<tr>
<td></td>
<td>Endoscopy</td>
<td></td>
<td>Symptom criteria (Rome)</td>
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<tr>
<td></td>
<td>Radiology</td>
<td></td>
<td>Psychosocial</td>
</tr>
<tr>
<td>Examples</td>
<td>Esophagitis</td>
<td>Diffuse esophageal spasm</td>
<td>Esophageal chest pain</td>
</tr>
<tr>
<td></td>
<td>Peptic ulcer</td>
<td>Gastroparesis</td>
<td>Functional dyspepsia</td>
</tr>
<tr>
<td></td>
<td>IBD</td>
<td>Pseudo-obstruction</td>
<td>IBS</td>
</tr>
<tr>
<td></td>
<td>Colon cancer</td>
<td>Colonic inertia</td>
<td>Functional constipation</td>
</tr>
</tbody>
</table>
What ‘Category’ is Primary Treatment Focus?

Table 1. Major Clinical Domains in Gastroenterology

<table>
<thead>
<tr>
<th>Primary domain</th>
<th>Organic GI disorder</th>
<th>Motility disorder</th>
<th>Functional GI disorder</th>
</tr>
</thead>
</table>
| Criterion      | Structural Pathology | Motility and/or Sensitivity | Symptoms
| Measurement    | Pathology          | Visceral sensitivity | Experience |
|                | Endoscopy          |                   |                         |
|                | Radiology          |                   |                         |
|                | Esophagitis        |                   |                         |
|                | Peptic ulcer       |                   |                         |
|                | IBD                |                   |                         |
|                | Yes/No             |                   |                         |
|                | Colonic cancer     |                   |                         |
|                |                    | Diffuse esophageal spasm | Symptom criteria (Rome) |
|                |                    | Gastroparesis      |                         |
|                |                    | Pseudo-obstruction | Functional dyspepsia |
|                |                    | Colonic inertia    |                       |

While recognizing what else is present...
Easy, Right?

“The product of the interacting effects of the brain and GI tract in any individual with an FGID relates to the clinical expression of illness; namely, the symptom experience, its severity, and subsequent illness-related behaviors.”

“All of these factors can be addressed and potentially modified by the physician’s ability to listen, engage, and effect good communication skills, ...regardless of the diagnostic condition.”

Challenges

“Symptom Experiences” =

Different (Constructed) Thinking

Medical Treatments are Limited

Awareness, Understanding, Communication, & Engagement, are Crucial
Questions?

Goals:
Challenge Beliefs
‘Categorical Awareness’
Think Differently

Summary
1. The Purpose of Pain Is Protection NOT Punishment.
2. Pain Is Constructed, (3 Dimensions-Not 1)
3. Understand Pain & How It Is Constructed to ‘Target’ ‘Treatments’
4. Risk Factors (& Amplifiers) are Heat & O2
5. FGID = Symptom (Constructed) Experience
   (Constructed Thinking)


J P Fisher et al. BMJ 1995;310:70 (Boot & Nail Image)


