The reign of pain lies mainly in the brain: Emerging concepts in neuropsychology

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There is nothing more deceptive than an obvious fact.

(Hidden in plain sight.)

--Sherlock Holmes

(Sir Arthur Conan Doyle)
35 year old man with bilateral hand pain for 3 years, now incapacitated, no diagnosis despite seeing several specialists

52 year old woman with daily headache for 37 years, has been to several headache specialists, treated with over 20 medications, to no avail

House or Osler?
32 year old woman with chronic low and mid back pain for 2 years. It began suddenly while lifting something at work. It was initially only in the lower back on both sides, but has spread to the mid back, bilaterally. The pain seems to vary in intensity, sometimes worse in the lower back, sometimes worse in the mid back. Normal neurological exam. She has been treated with PT twice, massage, acupuncture, and chiropractic. She has been told that she has lax ligaments, alignment problems, disc disease, scoliosis. Nothing has helped. Her pain levels are in the 6-8 range. She has stopped running and other exercise.
There is mild levocurvature. Vertebral body height and alignment are maintained. No focal herniated disc central canal stenosis or significant neural foraminal narrowing is identified at any level. There is mild to moderate facet hypertrophy more prominent in the lower thoracic region. There is mild disc dehydration at T8-T9.

Vertebral body height appears maintained. There is dextrocurvature of the lumbar spine. Mild disc space narrowing and loss of hydration seen at L5/S1. There is no central canal compromise. There is mild bilateral neural foraminal narrowing at L5/S1. There is multilevel mild facet arthropathy worst at L4/5. Surgery? Advice?
She saw a neurosurgeon who she reported told her this:

“You have a bad back, it is damaged. You have a bulging disc and other problems. This is probably due to a genetic problem. I cannot help you. You will probably have to live with back pain the rest of your life. You should think about not having children.”
# Prevalence of degenerative spine imaging findings in asymptomatic patients, n=3300

<table>
<thead>
<tr>
<th>Imaging Finding</th>
<th>20</th>
<th>30</th>
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<td>23%</td>
<td>35%</td>
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Institute of Medicine Report:

110 million Americans in chronic pain

Back pain: 30%, Headaches: 15%,
Neck pain: 15%, IBS: 10%,
Facial pain: 5%, CWS: 2-4%

Costs greater than for CA, CV dz and DM combined; >$600 Billion/year

Trends in LBP in the US

Rates of increase in Medicare costs (last decade):

- Epidural steroid injections—629% increase
- Opioids for back pain—423% increase
- Lumbar MRI—307% increase
- Spinal fusion surgery—220% increase
- Change in disability and pain—25% increase

Surgical Treatment for Chronic Non-specific Low Back Pain

Several studies have found no difference in long term outcomes between surgery and conservative forms of therapy, including PT, observation, and exercise.

No sham trials as yet, unlike meniscal tear trials.

Fusion vs. cognitive therapy/exercises

Figure 2. Mean values for Oswestry Disability Index (ODI) in each study group. The ODI was the predefined main outcome variable and the study was designed to detect a difference in change of at least 10 points between groups. This measure consists of 10 questions about pain, pain related disability of activities of daily life and social participation. The total score ranges from 0 (no pain and disability) to 100 (worst possible pain and disability).

Early discectomy vs. waiting/no surgery

No difference in a Finnish trial as well

SPORT Trial—ITT Analysis

Figure 2. Mean Scores Over Time for SF-36 Bodily Pain and Physical Function Scales and Oswestry Disability Index

Age- and sex-weighted population normative scores are plotted for Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) scales. To enhance readability, the plot symbols and error bars for the surgical group are slightly offset. Error bars indicate 95% confidence intervals.

Case-control study of WC in Ohio

Reoperation rate = 27%; Complication rate = 36%;
Days off work: 1140 vs. 316

Meta-analysis: review of epidural injections for back pain

Evidence on efficacy of epidural injections specifically for spinal stenosis, low back pain without radiculopathy, or failed back surgery syndrome is sparse and inconclusive, but showed no clear benefit.

Opioids for chronic pain?

Little data showing efficacy of long term treatment
Risks of addiction, overdose, death
(16,000 per year in the US)
Sensitization of receptors can lead to increasing pain over time

What we now know about whiplash

Not found in certain countries, e.g., Lithuania

Expectations of chronic pain varies by country, as does prevalence

Degree of damage of the vehicle, headrests not related to persistence of pain

Degree of neck damage inversely related to persistence of pain

A simulated car accident causes neck pain one month later in 10%

Demolition derby drivers have many MVAs, but few get chronic neck pain

MRI vs. Psych as predictors of LBP

The development of serious LBP disability strongly predicted by baseline psychosocial variables.

Structural variables on both MRI and discography testing at baseline had only weak association with back pain episodes and no association with disability or future medical care.

Norwegian study of pain in the workplace

This study demonstrated cross-sectional and prospective relations of a variety of factors with back pain severity. The most robust predictors were decision control, empowering leadership and fair leadership. Physical workload, using one’s arms at or above the shoulders, and chronicity of physical work were not correlated with the development of back pain at a 2-year follow up.

Cochrane review: Psych Tx for Chronic Low Back Pain

CBT and BT have weak effects in improving pain, minimal effects on disability associated with chronic pain, but are effective in altering mood outcomes.

Eccleston, et. al., Cochrane Library, April 15, 2009.
DOI: 10.1002/14651858.CD007407.pub2
CBTs provided a small incremental benefit over control interventions in reducing pain (0.6-0.7), negative mood (0.7-1.3) and disability (0.7-1.2 pts./10 pt. scale) at the end of treatment and at long-term follow-up.

Hauser, et. al., Cochrane Library, January, 29, 2009. DOI: 10.1002/art.24276
Psychological therapies for chronic pain

Often directed at the consequences of pain, not cause of pain, diagnostic ambiguity.

Often directed towards thoughts and behaviors, rather than emotions.

Geared to function rather than pain itself.

CBT, mindfulness and ACT have not been shown to be better than relaxation therapy.
What we now know about whiplash

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Is LBP Contagious?

We hypothesize that back pain is a communicable disease and suggest a harmful influence of back-related beliefs and attitudes transmitted from West to East Germany via mass media and personal contacts.

Success of lumbar surgery based upon degree of childhood trauma

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MRI showed grade 1 spondylolisthesis, severe disc space narrowing at L4-L5, disc desiccation at L2-L3 & L3-L4

Disc bulging w/ compression of the thecal sac, bilateral neural foraminal narrowing and facet hypertrophy at L2-3, L3-4, L4-5, and L5-S1

Right L4 and L5 nerve root compression due to bulging discs
“Houston, we have a problem.”

Solutions are obviously difficult. But there is some reason for hope.
QUIZ TIME

The Institute of Medicine has estimated that the number of Americans who have chronic pain is:

A. 2 million
B. 10 million
C. 50 million
D. Over 100 million
Back surgery has been shown to be an effective intervention for individuals with chronic back pain when compared to conservative therapies, such as physical therapy and exercise.

True
False

Injection treatments for chronic back pain have been shown to be superior to placebo injections.

True
False
Cognitive behavioral therapy for pain has been shown to be better than relaxation therapy, leading to large reductions in pain.

True
False

Which of these symptoms are not likely to be caused by PPD?

Foot drop
Irritable bowel syndrome
Fibromyalgia
Interstitial cystitis
Migraine headaches
Which one of the following statements is false?

A. The amygdala can be sensitized by traumatic early life events
B. Pain can be learned by the brain in the form of neural pathways
C. Acute injuries always result in pain
D. All pain occurs in the conscious brain and is a message being sent by the subconscious brain
D. Stress can trigger acute pain in the absence of any tissue damage
Two things I didn’t learn in medical school:

The power of the mind
The nature of pain
The power of the (subconscious) mind

Conversion
Contagious symptoms
Hallucinations
Stress-related symptoms
Death?
Vision is constructed
A Story to Explain Pain
Pain is a dynamic process

- All pain is real. There is not real pain and imaginary pain.
- All pain is actually activated by the brain.
- Pain can be triggered or generated by either tissue damage and also by neural pathways (in the absence of tissue damage)
Conscious
Subconscious
Signal
Injury
Danger
No Danger
Pain Pathway
Established
Pain
Emotional
Injury/Threat
On
Off
Heals
Predictive coding/Interoception

Tim Noakes: pain/fatigue with exercise due to the central governor function of the brain
Persistent quiescence concept of brain enforced rest and recovery
Exteroception is how the brain determines what you actually see
Interoception is how the brain determines what you feel

Can the brain create pain?

Derbyshire, et. al. Neuroimage. 2004, S2, 23:392-401. 1=thalamus, 2=ACC, 3=pACC, 4=cerebellum, 5=Sensory cortex, 6=insula. T scores of ACC—PI pain=6.3; HI pain=4.3, Imagined pain=0.0
The pain of fibromyalgia is real

Chronic back pain and fibromyalgia pain share central pain amplification.
Emotional pain equals physical pain

Social exclusion activates ACC and pain pathways

Overlap between PTSD and FM/IBS

PTSD rates in patients with FM and IBS of up to 37% and many more show subclinical symptoms.

In 129 military veterans with PTSD, 80% reported chronic pain

FM association with childhood victimization

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>n</th>
<th>Rate, %</th>
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<td>Van Houdenhove et al. [25*]</td>
<td>2001</td>
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Association of victimization and pain

Childhood adversities (divorce, family conflict, sexual abuse, physical abuse, etc.) and adulthood experience of conflict and victimization are elevated in people with migraine headaches, interstitial cystitis or painful bladder), pelvic pain (and irritable bowel syndrome

Goodwin, et. al. 2003; Sumanen, et. al. 2007; Latthe, et. al. 2006;Meltzer-Brody et al., 2007; Mayer, et. al., 2001
Back pain chronification: Emotions at onset linked to lack of recovery

Functional connectivity between NAc and PFC predicts chronic back pain

Emotion-related circuitry increases in persistent back pain

Hashmi, et. al., Brain 2013: 136; 2751–2768
Changes in muscle activity with anger recall in back pain patients

Table 2
Means (and Standard Deviations) of EMG and Cardiovascular Values During the ARI

<table>
<thead>
<tr>
<th>Variable and status</th>
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<td>R12</td>
<td>R45</td>
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<td>Patients SBP values</td>
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<td>Patients DBP values</td>
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<td>Patients HR values (bpm)</td>
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Note. EMG = electromyography; BL = baseline; ARI = Anger Recall Interview; R12 = first and second minutes during recovery; R45 = fourth and fifth minutes during recovery; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate.

Increases in para-spinal muscle tension without increases in BP, HR or other muscle group tension

Outcome Data from Providence Hospital Mind Body Program

75 patients, mean age 51, mean pain duration 8.8 years, baseline pain 5.1/10, 57% with significant childhood trauma, mean # of Sx 13.5, CC: 45% FM, 45% neck and back pain

>30% Improvement: Post-tx 64%; 6-mo. 67%

>50% Improvement: Post-tx 43%; 6-mo. 53%

Multi-site RCT for Fibromyalgia

- NIH-funded, 2-site, 3-arm, allegiance-controlled RCT (Wayne State University; University of Michigan, Providence Hosp.)

- Patients: n = 230 (94% female, M = 49 years old); 8 sessions, 90-min, once per week, small group

- Assessments: Baseline, post-treatment, and 6-month follow-up

Lumley, Schubiner, et al., submitted
Psychological therapies for chronic pain

Often directed at the consequences of pain, not cause of pain, diagnostic ambiguity

Often directed towards thoughts and behaviors, rather than emotions

Geared to function rather than pain itself

How many studies have shown one psychological therapy to be superior to another for pain?
Allegiance-controlled Treatments

- Emotional Awareness and Expression Therapy (Mark Lumley, PhD & Howard Schubiner, MD)
- Cognitive-behavioral therapy for FM (Dave Williams, PhD)
- FM Education (control) (Dan Clauw, MD & Nancy Lockhart, MSN)
- Different set of 3 therapists for each; skilled in and committed to that model
Emotional Awareness and Expression Therapy

- Brain – emotion-(reversible) symptom model
  - Symptom-stress life review
  - Developing comfort with anger and its expression
  - Sharing private experiences (secrets)
  - Experiential expression exercises (repeated)
  - Developing intimacy and connection with others
    - Touch, praise, gratitude, forgiveness
  - Learning to honestly confront troubled relationships
- Homework: WED, daily recordings, relationship exercises
Cognitive-Behavioral Therapy

- Skill-based symptom management and lifestyle modification
  - Self-assessment: self-monitoring
  - Fatigue: time-based pacing
  - Pain: relaxation and problem solving
  - Sleep: behavioral sleep modification, goal setting
  - Mood: pleasant activity scheduling
  - Dyscognition: memory boosters, cognitive reappraisal
- Functional status: combining skills
- **Homework**: practice skills each week
Knowledge about FM increases power, decreases uncertainty, and reduces defensiveness

- Provision of relevant information about FM in supportive group context
- Fibromyalgia: definitions and diagnoses
- Pain: physiology and assessment
- Central sensitization syndromes
- Medications for FM
- Complementary and alternative FM treatments
- Using the internet
- Research methods in FM studies
Percentage of Patients in Each Treatment with 50% Pain Reduction (BPI) from Pre-treatment at Post-treatment and 6-Month Follow-up

- Emotional Awareness and Expression Therapy: 21.9%
- Cognitive Behavioral Therapy: 8.5%
- FM Education: 11.4%

NNT = 7
Changes in Widespread Pain Index (Modified ACR 2010 FM) for Treatments from Pre-treatment to Post-Treatment and 6-month Follow-up

Mean WPI Score Changes in Widespread Pain Index (Modified ACR 2010 FM) for Treatments from Pre-treatment to Post-Treatment and 6-month Follow-up

- Emotional Awareness and Expression Therapy
- Cognitive Behavioral Therapy
- FM Education

EAET < CBT, Educ

EAET < CBT, Educ
Percentage of Patients in Each Treatment Fulfilling ACR 2010 Criteria for Fibromyalgia at Post-treatment and 6-Month Follow-up

- Emotional Awareness and Expression Therapy
- Cognitive Behavioral Therapy
- FM Education

NNT = 4
Many patients, especially those with central pain, have unresolved trauma, relational problems, conflicts.

Pain is connected to emotions.

Patients usually need help processing their emotions.

Experiencing and expressing avoided adaptive, primary emotions reduces symptoms. --Some people have major improvements.

EAET is superior to CBT for significant pain reduction.
17 year old male with chronic severe abdominal pain
An extensive medical workup that was negative
Resting fMRI focus on Default Mode Network
10 weeks post-treatment
Educational and Behavioral Intervention
The reign of pain lies
....mainly in the brain
(Some decoding required)