From nociception to perception
The complex nature of pain
Dr Daniel Harvie
The challenge

Acute pain difficult to manage:
  • Mean procedural pain 8.5/10, background 5.6/10 (Esfahlan 2010).

Chronic pain is common:
  • 36-52% of burn victims experience chronic pain years beyond injury (Edwards 2007).
Diabetes
Heart disease
Chronic pain
<table>
<thead>
<tr>
<th>Imaging Finding</th>
<th>Age (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Disk degeneration</td>
<td>37%</td>
</tr>
<tr>
<td>Disk bulge</td>
<td>30%</td>
</tr>
<tr>
<td>Disk protrusion</td>
<td>29%</td>
</tr>
<tr>
<td>Facet degeneration</td>
<td>4%</td>
</tr>
</tbody>
</table>

Brinjikji et al. 2015. Imaging features of spinal degeneration *American J. Neuroradiology*.
Blyth et al. 2001. Chronic pain in Australia: a prevalence study. PAIN
Despite no tissue damage, the patient experienced extreme pain and had to be sedated.

1664
René Descartes

1800s
Ramón y Cajal

1965
Melzak and Wall

1980s
Woolf

350BC
Aristotle/Plato

The 5 senses
Dualisms
The Neuron
Pain Gate
Central Sensitization
Neuromatrix
SM Incongruence
Imprecision Hypothesis
Bayesian models
Psychoneuroimmunology
1. PREMOTOR/MOTOR CORTEX
2. CINGULATE CORTEX
3. PREFRONTAL CORTEX
4. AMYGDALA
5. SENSORY CORTEX
6. HYPOTHALAMUS/THALAMUS
7. CEREBELLUM
8. HIPPOCAMPUS
9. SPINAL CORD

*Pain neurosignature activated by an evaluation threat to body tissue
Biggest shift in thinking over the last 30 years: **Pain is an output, not an input.**

**Pain**
An unpleasant sensory and emotional **EXPERIENCE** (output of the brain into conscious perception)

**Nociception**
**TRANSDUCTION** of noxious stimulus (an actually or potentially tissue-damaging event transduced and encoded by nociceptors).
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Nociception
**TRANSDUCTION** of noxious stimulus (an actually or potentially tissue-damaging event transduced and encoded by nociceptors).

- Pain-stimulus
- Pain-reception/detection
- Pain-nerve
- Pain-signal
- Nociceptive/noxious stimulus
- Nociception
- Nociceptor
- Nociceptive signal

Excludes the important role of the thing that processes and interprets Input, and produces conscious sensations: THE BRAIN
Biggest shift in thinking over the last 30 years: Pain is an output, not an input.

Pain
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TRANSDUCTION of noxious stimulus (an actually or potentially tissue-damaging event transduced and encoded by nociceptors).

Excludes the important role of the thing that processes and interprets Input, and produces conscious sensations...

THE BRAIN

Leaves room for central processes, the mind, PERSON
The role of nociception

- Clearly nociception is important, especially in the acute and sub acute phases: Inflammation and ischaemia.

- Nociception is a potent signal of danger.

- The brain has the final say: Nociception is neither sufficient, nor necessary for pain (Moseley).

- Should not be a reason to approach pain more broadly.
Can pain be learned?
Sensitisation is a learning process whereby repeated stimulation results in an increasing response to the same stimulus.
Can pain be learned?
Do pain-associated cues modulate pain sensitivity?
Associative learning

Can things associated with nociception, contribute to pain?

“Neurons that fire together, wire together.”
– Donald Hebb
Perception is not a linear result of input.

Perception is dependent on **past experience**. Learned? Or at least influenced by learning.
STIMULUS

CONSCIOUS EXPERIENCE
Bogus Visual Feedback Alters Onset of Movement-Evoked Pain in People With Neck Pain

Movement understated
Movement accurately stated
Movement overstated

Change in pain free movement
Change in pain free movement

** p=0.01

Movement understated

Movement accurately stated

Movement overstated
Change in pain free movement

- Movement understated
- Movement accurately stated
- Movement overstated

**p=0.01  **p<0.00
Jensen (2012). Nonconscious activation of placebo and nocebo pain responses. PANAS
Jensen (2012). Nonconscious activation of placebo and nocebo pain responses. PANAS
Pain is increased when stimulus paired with a pain associated cue.
From nociception to perception

The complex nature of pain

30 - mins
From the gate to the neuromatrix
Ronald Melzack

REVIEW
Pain: A Statistical Account
Abby Tabor1, Michael A. Thacker2,3, G. Lorimer Moseley3,4, Konrad P. Körding3

Topical Review
Beyond nociception: the imprecision hypothesis of chronic pain
G. Lorimer Moseleyab, Johan W. S. Vlaeyencd