Foot Health Conference 2013
Acupuncture in Podiatry

Jennie Longbottom MSc MMEd BSc FCSP BMAS
Learning Objectives

• An introduction to the TCM model and neural mechanisms of acupuncture analgesia
• An introduction to the biomechanical effects on connective tissue to needle stimulation
• Implications for clinical practice
• Conclusions and critiques of integrating acupuncture into podiatry management
What happens?
Definition

- A therapeutic technique whereby thin needless are inserted into the skin with mechanical, electrical and physical stimulation (WHO).

- Acupuncture nomenclature (TCM) was established during B.C 400-A.D 1740’s

- Acupoints are situated on meridians that communicate to all parts and tissues of the body (Jing-Qi)

- Stagnation of this meridian system is the principle factor in the pathogenesis of disease

- Needling unblocks this stagnation (Zhou et al 2010)
TCM Model

- Stimulation of acupuncture points at various stages on a meridian
- De Qi stimulation to move Qi, unblock any stagnation and restore homeostasis
- Used as a proactive, prophylactic source to maintain health
- Used as a remedial intervention to restore balance
Basic Philosophies

• Qi
• Meridians
• Patterns
• Syndromes
• Tongue
• Pulse
Qi

• Ancestral Qi
  – Pre / Post Heaven
• Organ Qi
• Meridian Qi
• Nutritive Qi
• Protective Qi
Concept of Qi in WA

- DNA
- Immune response
- Recovery
- Healing
- CNS
Disharmonies of Qi

• Deficient Qi
• Excess Qi
• Collapsed Qi
• Stagnant Qi
• Rebellious Qi
• Rising Qi
Western Interpretation

- DNA
- Disease
- Infection
- Trauma
- Age
- Outside Influences
Meridians

1. Governing Vessel
2. Large Intestine
3. Conception Vessel
4. Kidney
5. Pericardium
6. Heart
7. Stomach
8. Kidney
9. Spleen
10. Liver
11. Lung
12. Gall Bladder
13. Bladder
14. Governing Vessel
15. Bladder (Inner line)
16. Bladder (outer line)
17. Small Intestine
18. San Jiao
Meridian Function

- Movement of Qi and Blood
- Nourishment
- Healing
- Balance
- Harmony
- Health
- Fitness
Patterns of Musculo-skeletal Dysfunction

• Excess

• Stagnation

• Deficiency
Yin and Yang

- Continuous harmony
- Opposing but complementary
- Interior / Exterior
- Male / Female
- Hot / Cold
Properties of Acupoints

• Most acupuncture points are situated on peripheral nerve trunks
• Meridians appear to have some correlation with peripheral nerves
• No evidence of any specific structures under points but skin on acupuncture points possesses distinct electrical properties
The Neural Acupuncture Unit

• Inserting a fine needle into the skin elicits a local and neuroactive mechanism (NAM)

• Stimulates encapsulated cutaneous receptors (Merkel, Meissner, Ruffini & Pacian corpuscles)
• Free nerve endings
• Muscle spindles and tendon organs
• 4 fold higher in GB 34; St 36: LI4 (Lu et al 1997)
Free nerve endings
Merkel disc ending
Meissner’s corpuscle
Ruffini’s corpuscle
Pacinian corpuscle
Muscle spindles
Non Neuronal Tissue Response

• Mast Cell release
• Vasodilation of sympathetic blood vessels
• Vasodilation lymphatic vessels
• Histamine, Sub P, bradykinin, prostaglandins
  – Macrophages
  – Fibroblasts
  – Lymphocytes
  – Platelets
• Inhibitory or excitatory mediators
<table>
<thead>
<tr>
<th>Mediator</th>
<th>Non-neural cells</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serotonin</td>
<td>Platelets, mast cells</td>
<td>Positive</td>
</tr>
<tr>
<td>Noradrenalin</td>
<td>SN vessels</td>
<td>Negative</td>
</tr>
<tr>
<td>Acetycholine</td>
<td>Injured tissue</td>
<td></td>
</tr>
<tr>
<td>Histamine Sub P Bradykinin Prostaglandins</td>
<td>Mast cells</td>
<td>Positive</td>
</tr>
<tr>
<td>Glutamate</td>
<td>Fibroblasts, leukocytes</td>
<td></td>
</tr>
<tr>
<td>GABA</td>
<td>Macrophages, lymphocytes</td>
<td>Negative</td>
</tr>
<tr>
<td>ßendorphin</td>
<td>Macrophages, lymphocytes</td>
<td>Negative</td>
</tr>
<tr>
<td>Nitric Oxide</td>
<td>Local tissue</td>
<td>Negative</td>
</tr>
<tr>
<td>Cytokines</td>
<td>Local tissue</td>
<td>Positive</td>
</tr>
</tbody>
</table>
Mechanical response

- Local tissue injury
- Positive biomechanical feedback
- Axon reflex
- Modulation afferent fibre transmission
Spinal Effects
Axon Reflex
The Licorice Allsort Law
De Qi

- Manual manipulation of the needle causes De Qi causing a stress induced displacement of tissue
- Affects stretch receptors, mechanoreceptors and deep barroreceptors
- Activates $\beta$, $\delta$ and C fibre activity
- Excitation of neural effects 25-45 mm from needle point (Dong et al 2002; Kong 2005; )
Segmental and Supra-spinal Effects

A\(\delta\), C fibre mediated

ACUPUNCTURE

Pain Inhibitory Systems
- Supra –spinal
- Segmental
- Opioids
- Non-Opioid

Descending Gate
Inhibition Control

PAIN RELIEF
# Receptor Stimulation

<table>
<thead>
<tr>
<th>Type</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle spindle</td>
<td>Situated at all acupoints</td>
</tr>
<tr>
<td>Cutaneous receptors</td>
<td>Distributed in cutaneous tissue especially hands and feet</td>
</tr>
<tr>
<td>Tendon –organ</td>
<td>Tendon organs, Ruffini, Pacinian corpuscles</td>
</tr>
<tr>
<td>Afferent fibres</td>
<td>Nociceptors, Aδ, C fibres</td>
</tr>
<tr>
<td>Stimulation mode</td>
<td>Shallow needling, High frequency, EA, Heat +Acupuncture</td>
</tr>
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</table>
Supraspinal Cortex
Supraspinal responses

• Trigeminal sensory pathway (Skokljev & Koruga 1998)
• Signals relayed to brainstem, subcortical and cortical areas
• Spinothalamic and spinoreticular tracts activating DNIC and inhibitory information
  – PAG
  – NRM
  – LC
• Dorsal column medial lemniscus tract
Strong points
Trigeminal sensory pathway

- Closer connection with brainstem
- Major sources of 5HT
- Regulation of sensation, cognition, emotion, visceral information processing (Monti 2010; Singewald 1998)
- EA increases 5HT and suppresses stress induced c-fos and tyrosine hydroxylase expression in LC (Park 2010)
Associated Central Effects

• Widespread modulation of cortical, limbic, subcortical, brainstem areas (Dhond 2007)
  – ST 36
  – GB 34
  – LI 4
  – Liv 3
  – GB 37
  – PC 6
<table>
<thead>
<tr>
<th>Brain Region</th>
<th>FMRI Response</th>
<th>Acupuncture associated effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somatosensory cortex</td>
<td>Activity</td>
<td>Pain inhibition effects</td>
</tr>
<tr>
<td>Prefrontal cortex</td>
<td>Activity</td>
<td>Cognition and Emotion</td>
</tr>
<tr>
<td>Insula</td>
<td>Activity/ deactivation</td>
<td>Pain</td>
</tr>
<tr>
<td>Anterior Cingulate nucleus</td>
<td>Deactivation</td>
<td>Pain attention, memory</td>
</tr>
<tr>
<td>Hypothalamus</td>
<td>Activity</td>
<td>Autonomic, neuroendocrine, visceral function, stress processing</td>
</tr>
<tr>
<td>Hippocampus</td>
<td>Activity</td>
<td>Encoding emotional signals short term memory</td>
</tr>
<tr>
<td>Thalamus</td>
<td>Activity</td>
<td>Sensory input</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>Activity</td>
<td>Co-ordination, cognition &amp; emotion</td>
</tr>
<tr>
<td>PAG</td>
<td>Activity</td>
<td>Pain, sleep &amp; Consciousness</td>
</tr>
</tbody>
</table>
Homeostasis

• Restoration of MRI evidence for acupuncture in
  – Chronic pain (Napadow 2007; Newberg 2008; Zhang 2010))
  – GAD (Duan 2009; Zhang 2008;2005)
  – Heroin addiction (Lui 2007)

• Visceral dysfunction
  – GI disorders (Yin 2010; Takahashi 2006)
  – Hypertension (Li 2010)
  – Urinary incontinence (Thomas 2008)
  – Asthma (Martin 2002)
SNS / PSNS balance

• Somato-autonomic reflex (Cho 2006; Kagitani 2010; Noguchi 2010)

• Restores pro and anti-inflammatory factors

• Re-establishes immunological balance

• Restores Yin and yang balance
Chronic Pain... some facts

- 1 in 4 adult Americans are diagnosed with CP (Mcneil et al 2001)
- 1 in 5 adult Europeans (Breivik et al 2006)
- One third are addicted to pain medication (Breivik et al 2006; Shi et al 2007)
- 81% in UK GP’s believe CP patients receive suboptimal pain management (Shi et al 2007)
- 74% GP’s cite the drugs as causing the main barrier to management (Stannard et al 2007)
- Patients report difficulty communicating with health professionals as the major barrier to management (Breivik et al 2006; Shi et al 2007)
Acupuncture

• Most commonly used to treat CP
• Relatively safe
• Cost effective
• Often offered within the Europe & UK NHS
• BUT…..
• Is it clinically reasoned?
• Tailored to the pain mechanism
• Of sufficient length, depth and De qi stimulation to last?
Is it a Placebo?

“Acupuncture is not associated with clinical effects beyond a powerful placebo response.” (Ernst 2006)
Acupuncture and systematic reviews limited to 2003-2008 and humans (n=105)

Systematic reviews of specific CP conditions identified (n=15)

Systematic reviews retrieved for more detailed evaluation (n=9)

- Appropriate reviews (n=8)
  - LBP=2
  - Knee pain =4
  - Headache=2

Reviews excluded
- Not specific to CP
  - N=90

Reviews excluded
- No pooled data
  - N=6

Reviews excluded
- Acupuncture injecting bee venom
  - N=1
<table>
<thead>
<tr>
<th>Reference</th>
<th>Total Number Studies</th>
<th>Sham trials (Pooled Participants)</th>
<th>Outcome</th>
<th>+/-ve for Acup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furlan et al (2005) LBP</td>
<td>35</td>
<td>4 (314)</td>
<td>STPR</td>
<td>Yes</td>
</tr>
<tr>
<td>Manheimer et al 2005) OA knee</td>
<td>33</td>
<td>2 (154)</td>
<td>LTPR</td>
<td>No</td>
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<tr>
<td>Kwon et al (2006) OA</td>
<td>18</td>
<td>4 (343)</td>
<td>STPR</td>
<td>Yes</td>
</tr>
<tr>
<td>Bjordal et al (2007)</td>
<td></td>
<td>4 (746)</td>
<td>STPR</td>
<td>Yes EA</td>
</tr>
<tr>
<td>White et al 2007) Knee</td>
<td>13</td>
<td>3 (1,304) 5 (1,334) 3 (1,178)</td>
<td>STPR  LTPR  LTPR</td>
<td>Yes Yes Yes</td>
</tr>
<tr>
<td>Davis et al (2008) Headache</td>
<td>8</td>
<td>5 (838) 4 (723)</td>
<td>LTPR headache days per month</td>
<td>No Yes</td>
</tr>
<tr>
<td>Sun et al 2008) Headache</td>
<td>31</td>
<td>14 (1,790) 2 (428)</td>
<td>STPR (HRR) LTPR (HRR)</td>
<td>Yes Yes</td>
</tr>
</tbody>
</table>
The Biopsychosocial Model of acupuncture

- Interoceptive sensory stimuli and emotions are integrated in limbic and frontal brain regions to allow emotional responses to feedback from the body and provide the individual with a ‘sense of self’. A strong connection with brainstem nuclei modulating output transfer systems allows emotions to regulate homeostatic balance.

- Acupuncture may be interpreted as an interoceptive stimulus by the brain.
- Neuroscience research has shown that acupuncture can modulate neural activity in similar brain regions to those processing emotional responses to sensory inputs.

- Psychological factors such as depression, stress, and fear impact on homeostatic physiological processes in the human body.
  (Lane et al 2009; Cameron et al 2009; Williams et al 2009; Dedovic et al 2009; O’Connor et al 2009)
The Evidence from MRI fMRI

- Sensory inputs are integrated with emotional awareness within brain regions processing the ‘affective–emotive’ component of sensation (Seifert et al 2009)
- Include limbic system nuclei such as the insula, anterior cingulate cortex (ACC), and amygdala along with regions of the prefrontal cortex (PFC).
- The insula processes emotional, cognitive, and memory-related aspects of pain and may play a role in somatisation disorders (Seifert et al 2009; Tracey et al 2007)
• The PFC is involved in working memory, behavioural goal setting, emotional appraisal, and regulation, to generate behaviour appropriate for existing circumstances in the external environment.

• Interactions between PFC and the limbic structures provide a candidate pathway for the conscious awareness of emotions to drive physical responses and behaviours. (Pollatos 1999)

• Vital for continuing homeostasis and survival of the organism.
(A) psychological states; (B) brain activity; (C) information transfer systems including autonomic, immune, and endocrine systems; and (D) physical health or end-organ function.
Interoception?

- Interoception provides a cortical representation of the ‘state of the body’ by providing continuous homeostatic feedback through small-diameter sensory and autonomic nerve afferents.

- Interoceptive feedback allows the individual to perceive their body and the position it occupies in space to provide a ‘sense’ of their physical condition.

- Small-diameter afferents relay homeostatic information from all tissues of body to the cerebral cortex regarding sensations such as temperature, mechanical stress, pain, local metabolism, and muscle work via ergoreceptors to lamina I in the spinal cord.

- From here, they can either project to spinal autonomic cells contributing to somato-autonomic reflexes (somato-visceral), to brainstem autonomic sites forming spino-bulbo-spinal loops or ascend to the parabrachial nucleus in the upper brainstem.

- Signals ascend via the thalamus, periaqueductal grey, and hypothalamus to the ACC and insula that generate an emotional awareness of the physical condition to the individual.
Interoception, Emotional Processing, and Acupuncture

- Acupuncture could be considered an ‘interoceptive stimulus’ as it also stimulates small diameter fibres and ergoreceptors.

- Acupuncture may therefore serve to ‘normalize’ the internal sensory representation of an injured or disabled body part and the associated negative emotional response.

- Somatization pain disorders, or disease caused by stress or negative emotional processing, afferent input via the interceptive processing regions in the brain may help to normalize output from brainstem homeostatic control centres.

- Acupuncture can modulate autonomic and immune activity in disease states, useful when these systems are affected by negative emotions.
• Acupuncture can modulate activity of the limbic–paralimbic neocortical network and both positive and negative brain default networks.

• Acupuncture was also found to modulate prefrontal cortical activity leading to the suggestion that increased cognitive load and PFC activity may be a component of acupuncture analgesia.

• Asking subjects to focus on the acupuncture sensation increased activity in prefrontal cortex and cingulate cortex, indicating dual activation of both cognitive and emotional / interoceptive cortical regions.
Emotional integration centres in brain?

- 30-40 min & strong stimulation
- Focus attention to acup sensation and set positive expectation
- ‘Big’ points
  - ST 36, LI 4, LR 2, 3, ST 44, PC 6, SP 6, GB 34, 40 LU 5
- Du 20, Shenmen, LI 4, LI 11, Sp 6, Liv 3, GB 34 and bilateral St 36
- Specific homeostatic/immune points
MYOFASCIAL PAIN

• SENSORY
• MOTOR
• AUTONOMIC SYMPTOMS

• PRODUCED BY MYOSCIAL TRIGGER POINTS
Motor End Plate
• Action potential along motor neuron depolarises nerve plasma, opening sensitive calcium channels

• Excess ACTH released

• Increased Calcium release

• Sarcomere contraction

• Compression of surrounding blood vessels

• Sensitization
Muscle fibre
Sensory nerve
Motor nerve
Sympathetic nerve
Motor endplate
Blood vessels

Needle disruption of dysfunctional endplates
Mechanical effects
Evidence


References

- Kawakita K, Okada K; 2006, Mechanisms of action of acupuncture for chronic pain relief- polymodal receptor are the key candidate, Acupuncture in medicine, Vol24 Ps58-66
- Longbottom J; 2010, Acupuncture in manual therapy, Elsever, Europe
References


• Ji R, Kohno T, Moore K, Woolf CJ. Central Sensitization and LTP: Do pain and memory share similar mechanisms? Trends Neuroscience 26 (12): 696-705


References


Future Applications

• Local and distal points addresses the complex neural mechanisms of activation and deactivation
• Inhibition and excitation
• Increases brain regional activity
• A valid control MUST block the production of neural acupuncture afferent impulses and does not exist
• Inadequate dose is one factor contributing to failure, most clinical trials do not include criteria for qualitative or quantitative adequacy of acupuncture treatment regimes

(Benham & Johnson 2009)
Does it work?

YES
Yes but ....
Contact Details

• **jennie@alied.co.uk**

• **www.alied.co.uk**

• 01480 394947