ACUPUNTURA AND THE TREATMENT OF PAIN

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Objetives

1. Introduction
2. Terminology
3. Neurophysiology of pain
4. Analgesic mechanisms of acupuncture
5. Theories about analgesia
6. Effects of acupuncture
7. Types of pain to treat with acupuncture
8. Diagnostic and recognition of pain

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1. Introduction

IASP (International Association for the Study of Pain)

"It is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"

It is a sign to stop & to prevent further damage, it forces to rest

An animal may or may not experience pain in response to nociception as it is a unique emotional sensation

Nociception	Pain
It is the detection, transduction, and transmission of noxious stimuli (i.e during general anaesthesia)	It is the conscious perception of a nociceptive signal

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2. Terminology

- **Noxious:** painful, harmful
- **Nociceptive stimulus:** stimulus which activates nociceptors (pression, cold/warm, chemical substances)
- **Nociceptor / pain receptor:** it is a sensory neuron that responds to damaging or potentially damaging stimuli by sending "possible threat" signals to the spinal cord and the brain.
- **Pain threshold:** minimal intensity required by an stimulus to be considered painful
- **Pain tolerance:** maximal intensity of a painful stimulus that and individual can cope with in a determined moment

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2. Terminology

- **Nociception:** neurologic process generated by the simulation of pain receptors
- **Analgesia:** loss of sensibility to pain
- **Allodynia:** pain evoked by a stimulus that doesn't normally cause pain
- **Dysesthesia:** an abnormal unpleasant sensation felt when touched, caused by damage to peripheral nerves

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2. Terminology

- **Hyperalgesia:** an increased or exaggerated response to a stimulus that is normally painful either at the site of injury (1ary) or in surrounding undamaged tissue (2ary). Stimulated nociceptors respond to noxious stimuli more vigorously and at a lower threshold
- **Hyperesthesia:** increased sensitivity to sensation
- **Hypoalgesia:** decreased sensitivity to pain
- **Hypoesthesia:** decreased sensitivity to stimulation

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2. Terminology

- **Paresthesia:** abnormal sensation evoqued by an stimulus which is not unpleasant
- **Neuritis:** inflammation of a nerve
- **Sensitization:** a non-associative learning process in which repeated administration of a stimulus results in the progressive amplification of a response even when the stimulus is considered normal or of lower threshold

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2. Terminology

- **Central sensitization:** an increase in the excitability and responsiveness of nerves in the central system, particularly the spinal cord
- **Peripheral sensitization:** an increase in the activity, excitability, and responsiveness of peripheral nerve terminals

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2. Terminology – Types of pain

Classification by topographic origen

- **Superficial somatic pain:** Pain initiated by activation of nociceptors in the skin or other superficial tissue; it is sharp, well-defined, and clearly located which can be quick (transmitted by Aδ fibers, primary) or slow (by C fibers,secondary)
- **Deep somatic pain:** occurs when stimuli activate pain receptors deeper in the body including tendons, joints, bones, muscles or vessels (i.e ischemia). It feels more like "aching" and "dull" than superficial somatic pain.
- **Visceral pain:** is pain that results from the activation of nociceptors of the thoracic, pelvic, or abdominal viscera (organs). Visceral structures are highly sensitive to distension (stretch), ischemia and inflammation, but relatively insensitive to other stimuli that normally evoke pain such as cutting or burning. It is dull pain which can be diffused, well located (i.e. appendicitis) or referred on a dermatome

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2. Terminology – Types of pain

Clasification by duration

- **Acute pain:** pain that disappears when the stimulus is removed or shortly afterwards (it can last days to weeks). It dissapears with healing, it is slef-limiting, beneficial and protective
- **Chronic pain:** pain that lasts several weeks to months and persists beyond the expected healing time, when nonmalignant in origin. Depending on the author it is longer than 3 to 6 months. It is not a protective mechanism of the body. It can alter resting and normal behaviour

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2. Terminology – Types of pain

Clasification by etiology

- **Nociceptive pain:** is the pain from physical damage or potential damage to the body. Examples might be the pain felt from a sports injury, a dental procedure, or arthritis. Nociceptive pain is the most common type of pain animals experience. It is transmitted by Aδ and C fibers. It can be somatic or visceral
- **Neuropathic pain:** pain that originates from injury or involvement of the peripheral or central nervous system, possibly associated with motor, sensory or autonomic deficits. I.e diabetic neuropathy
- **Psychological pain:** also called mental or emotional pain. It is an unpleasant feeling (a suffering) of a psychological, non-physical origin

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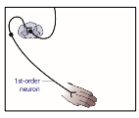
2. Terminology – Nervous pathways

Afferent pathways

It is neuronal systems which carry information from peripheral receptors until the spinal cord and upper centers. It includes:

- **1st order neurons:** from the sensitive receptor until the CNS. It is the Aα, Aβ, Aδ and C fibers



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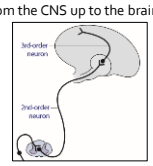
2. Terminology – Nervous pathways

Afferent pathways

It is neuronal systems which carry information from peripheral receptors until the spinal cord and upper centers. It includes:

- **2nd order neurons:** from the CNS up to the brainstem (talamus)



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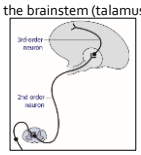
2. Terminology – Nervous pathways

Afferent pathways

It is neuronal systems which carry information from peripheral receptors until the spinal cord and upper centers. It includes:

- **3rd order neuron:** from the brainstem (talamus) up to the cerebral cortex



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2. Terminology – Nervous pathways

Efferent pathways

It is motor responses with origin in the cerebral cortex and cerebellum. They go down through the brainstem until motor units of the cranial and spinal nerves until they reach the effector organs by peripheral nerves. It includes:

- Descendent mechanism to control pain (modulation of descendent pain)
- Periaqueductal grey area (PGA): encephalins release. Inhibit the ascendent pathway
- raphe nucleus magnum (RNM): serotonin release. Inhibit the ascendent pathway
- Endogenous opioid peptides: endorphins and encephalin release

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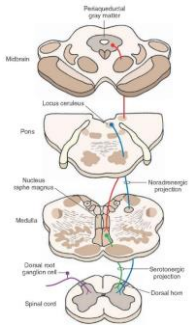

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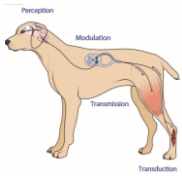
3. Neurophysiology of pain

The painful stimulus gets translated into an electric signal (transduction) which reaches the spinal cord (transmission) where it is modulated and reaches upper centers (projection) to be perceived

Detection
Transduction
Transmission
Modulation
Projection
Perception



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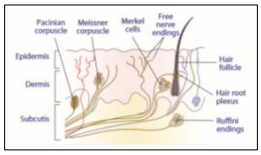
Detection Transduction Transmission Modulation Projection Perception

3. Neurophysiology of pain
Detection

Peripheral receptors (specialized nerve cell terminals in skin) transduce nociceptive (noxious) and proprioceptive (innocuous) events for processing by first-order sensory neurons in the segmental dorsal root ganglion terminating in the dorsal horn of the spinal cord.



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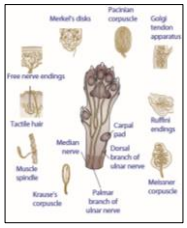
3. Neurophysiology of pain
Detection

Proprioceptive receptors include:

- Merkel's disks (pressure; Aα, Aβ)
- Pacinian corpuscles (vibration; Aα, Aβ)
- Meissner's corpuscles (stroking; Aα, Aβ)
- Ruffini's end-organs (skin stretch; Aα, Aβ)
- Golgi tendon apparatus (muscle contraction and degree of tension in tendons; Aα)
- Muscle spindle (muscle length and stretch; Aα, Aβ)



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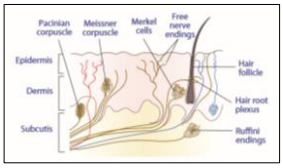
3. Neurophysiology of pain
Detection

Nociceptors terminate as free nerve endings (stretch, thermal, noxious; Aδ and C fibers) and can be found at :

- Skin
- Periosteum
- Joints
- Muscles
- Viscera



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3. Neurophysiology of pain
Detection

- The holy organs react mostly to distension. The lung has a peculiarity incorporation "J" nerve fibers, which present the same characteristics as the C fibers and react to distension, compression, inflammation and external irritants
- The "J" reflex: stimulation of J fibers
  - Bradycardia + Hypotension + Hyperpnoea + skeletal muscle weakness

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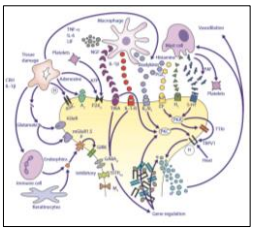
3. Neurophysiology of pain
Detection

The free nerve endings are plenty of receptors that generate action potentials



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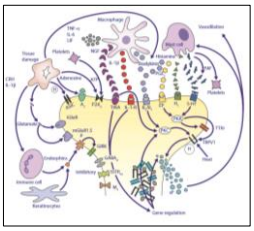
3. Neurophysiology of pain
Detection

5-HT: 5-hydroxytryptamine; A2: adenosine receptor; ASIC: acid-sensing ion channel; ATP: adenosine triphosphate; B2/B1: bradykinin B2/B1 receptors; CRH: corticotrophin-releasing hormone; EP: prostaglandin E2 receptor; GABA: γ-aminobutyric acid; GIRK: G protein-coupled inwardly-rectifying potassium channel; H: hydrogen ion; H1: histamine receptor; iGluR: ionotropic glutamate receptor; IL: interleukin; IL-R: interleukin receptor; LIF: leukemia inhibitory factor; M2: muscarinic receptor; mGluR1-5: metabotropic glutamate receptor 1-5; NGF: nerve growth factor; PAF: plateletactivating factor; PGE: prostaglandin E; PKA: protein kinase A; PKC: protein kinase C; P2X3: ATP receptor; sP: substance P; SSTR: somatostatin receptor; TNF: tumor necrosis factor; TrKA: tyrosine kinase A; TRPV1: transient receptor potential vanilloid V1; TTX: tetrodotoxin-resistant sodium channel.



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3. Neurophysiology of pain
Transduction

The information from the peripheral receptors is converted from one physical quantity into another i.e. pressure or temperature is converted to an electrical signal

Threshold of a receptor is the minimal stimulus required to elicit an action potential

75 % Aδ fibers are low-threshold
Initiation of pain "acute pain" (pricking and sharp qualities)

90 % C fibers are high-threshold
"slow-onset pain" (burning and aching qualities)

Both the Aδ and C nerve fibers contain "silent" nociceptors which can be activated by tissue-damaging events

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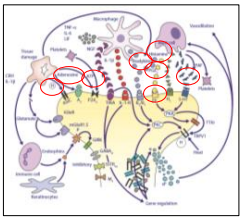
Detection **Transduction** Transmission Modulation Projection Perception

3. Neurophysiology of pain
Transduction

- Following damage, chemical substances are released and they trigger an action potencial
- These chemical substances are the "inflammatory soup": serotonin, histamine, ATP, noradrenalin, nitric oxide, bradykinin and P substance



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Detection **Transduction** Transmission Modulation Projection Perception

3. Neurophysiology of pain
Transduction

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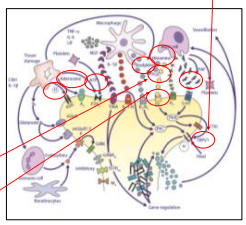
Capsaicin

AINEs
Corticosteroids
Grapiprant



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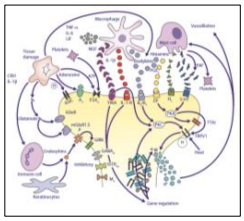
Detection **Transduction** Transmission Modulation Projection Perception

3. Neurophysiology of pain
Transduction

- Each stimuli produces activation of different ionic channels:
  - Temperature >45ºC activates vanilloid receptors (TRPV1 & Vr-1) and it is related to Ca^{++}
  - Temperatur 8 – 25ºC activates CMR1-M8 receptors and menthol
  - Mechanoreceptors (pression, distention, cut) activate non-specific ionic receptors which changes Na^{+}, K^{+} and/or Ca^{++} flux



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3. Neurophysiology of pain Transmission

Classification of nerve fibers (afferent & efferent)

Group	Innervation	Myelination	Velocity (m/s)
Aα	Motor to skeletal muscle	myelinated	70 – 120
Aβ	Sensory (touch, pressure, vibration, proprioception)	myelinated	30 – 70
Aγ	Motor to muscle spindles	myelinated	15 – 30
Aδ	Sensory (nociceptors, mechanoreceptors, thermoreceptors)	Thinly myelinated	12 – 30
B	Sympathetic preganglionic	unmyelinated	3 – 15
C	Sensory (Nociceptors, mechanoreceptors, thermoreceptors) Sympathetic postganglionic	unmyelinated	0.5 – 3

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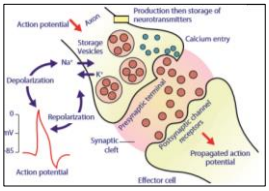
3. Neurophysiology of pain Transmission

When the action potential reaches the presynaptic membrane, there is Ca^{2+} and Na^{+} influx which allows release of vesicles with neurotransmiters to run the synapsis



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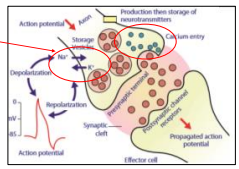
3. Neurophysiology of pain Transmission

When the neurotransmiters bind the postsynaptic membrane, metabolic changes happen. These effects act on the genetic expression to produce receptors with different properties which allows the prolongation of the pain sensation (sensitization and hyperalgesia)

Local anaesthetics



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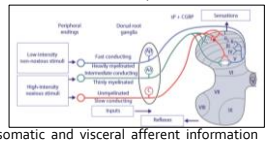
3. Neurophysiology of pain Modulation

The 1st order neurons end up at the dorsal horn where they interact with 2nd order neurons

Aδ fibers end at the laminae I and V

C fibers end at the laminae II and V



At the laminae V there are both somatic and visceral afferent information which explains the "referred pain" (heart infart)

Synapsis between 1st & 2nd order neurons are afected by inhibitory & excitatory systems which modulate the signal

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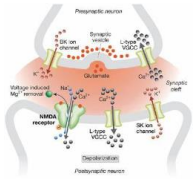
3. Neurophysiology of pain Modulation

The neurotransmitters and receptors involved at the spinal cord are:

- Ca^{2+} channels
- Presynaptic receptors:
  - GABA (γ-aminobutiric acid)
  - α-2 adrenergic
  - Opioids
  - Serotoninergics



L-Type VGCC
Low voltage calcium channel.

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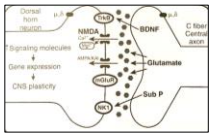
3. Neurophysiology of pain Modulation

The neurotransmitters and receptors involved at the spinal cord are:

- Postsynaptic receptors:
  - **AMPA** (4-isoxazole propionic acid) receptors, neurokinin (**NK1**): the excitatory amino acid, glutamate, activates these inotropic receptors (Na^+ influx) and are responsible for the location, intensity and duration of the nociceptive peripheral stimuli
  - **NMDA** (N-Methyl D-Aspartate) receptors: glutamate activates these inotropic receptors which are responsible for the slow and long-term painful processes (central sensitization). The activation is facilitated by the AMPA receptors and the elimination of Mg^{2+} from the NMDA channel



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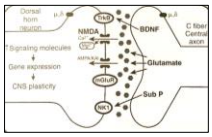
Detection Transduction Transmission **Modulation** Projection Perception

3. Neurophysiology of pain Modulation

The neurotransmitters and receptors involved at the spinal cord are:

- Glutamate metabotropic receptor (**mGluR**): it stimulates the production of second messengers (DAG & NO), increases intracelular Ca^{2+}, potentiates the synaptic transmission and the genetic expression (central neuroplasticity)
- **GABA** (ácido γ-aminobutyrico) & **glicina receptors**: the activation of these inhibitory receptors reduces the excitatory effects of the impuls at the dorsal horn



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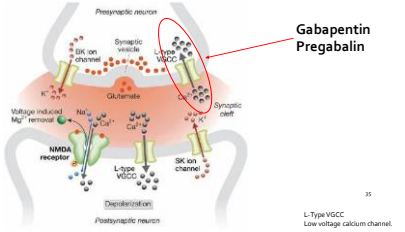
Detection Transduction Transmission **Modulation** Projection Perception

3. Neurophysiology of pain Modulation



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L-Type VGCC
Low voltage calcium channel.

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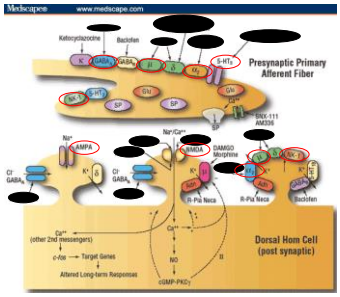
Detection Transduction Transmission **Modulation** Projection Perception



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L-Type VGCC
Low voltage calcium channel.

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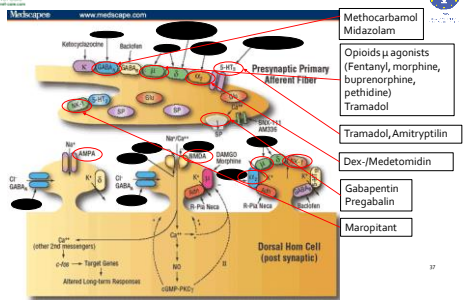

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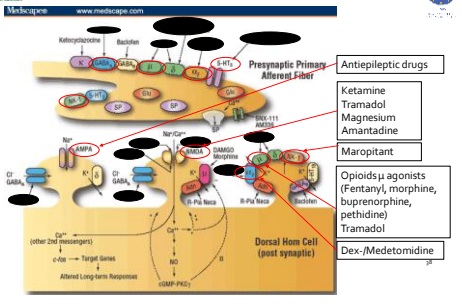

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3. Neurophysiology of pain Modulation Theories

The complexity of the system suggests a balance between the information of the peripheral nerves and the excitatory / inhibitory descendent influences from upper centers:

1. **Gate Control Theory**: the activation of the low-threshold Aβ fibers (innocuous stimulus) increases the effect of inhibitory interneuron on projection neurons, thereby reducing the transmission of painful stimuli to the brain. The gate is located at the dorsal horn of the spinal cord. The action potentials from the fast fibers arrive first to the gate inhibiting the one from painful signal

Cold / Warm	
Manual therapies	**Acupuncture**

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3. Neurophysiology of pain Modulation Theories

The complexity of the system suggests a balance between the information of the peripheral nerves and the excitatory / inhibitory descendent influences from upper centers:

2. **Endogenous opioids and endocannabinoids**: painful stimuli initiate the release of endogenous opioids (ENK, END, Dynorphin) and endocannabinoids, which supress the responses in the periphery, spinal cord and brain.

TENS low frequency / long pulse
Cannabinoids and blockade of CB2

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3. Neurophysiology of pain Modulation Theories

The complexity of the system suggests a balance between the information of the peripheral nerves and the excitatory / inhibitory descendent influences from upper centers:

3. **Theory of central biases:** The inhibitory descending neurons get activated by stimulation of Aδ and C fibers, cognitive processes, anxiety, depresion and expectations. Those produce release of encephalins at the PAG and serotonine which both stimulate the interneuron blocking the signal of the Aδ and C fibers at the grey matter

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3. Neurophysiology of pain Modulation Theories

The complexity of the system suggests a balance between the information of the peripheral nerves and the excitatory / inhibitory descendent influences from upper centers:

4. **GABA, opioids, serotonin, and norepinephrine inhibit excitatory synaptic** transmission, whereas **ATP, substance P, and prostanoids are facilitative**. The supra-spinal modulation includes serotoninergic and noradrenergic neurons in the brain which do synapsis with opioid inhibitory interneurons. Stress (pain, fear, hypoxia) produces this kind of opioid like analgesia

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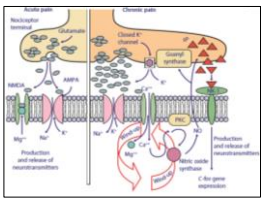
Detection Transduction Transmission **Modulation** Projection Perception

3. Neurophysiology of pain Modulation

Which is the difference between acute and chronic pain?



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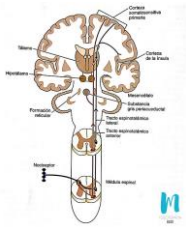
Detection Transduction Transmission Modulation **Projection** Perception

3. Neurophysiology of pain Projection

The nociceptive information arrives to upper centers through the pathways going out from the dorsal horn:

- **Spinothalamic tract:** it is the main nociceptive ascending path. Its origin it the lamina I and IV to VII. It contains axons from specific nociceptive neurons and wide dynamic range (WDR) neurons which are responsible for the response to painful and noxious stimuli. They can only generate one response each time. The end is the Thalamus



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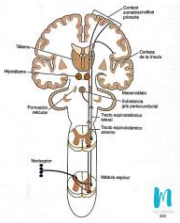
Detection Transduction Transmission Modulation **Projection** Perception

3. Neurophysiology of pain Projection

- **Spinoreticular tract:** it originates at the lamina I and IV to VII, like the spinothalamic tract. It ends at the Thalamus and the reticular formation



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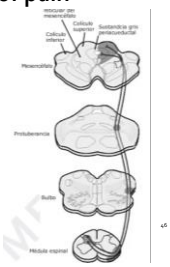
Detection Transduction Transmission Modulation **Projection** Perception

3. Neurophysiology of pain Projection

- **Spinomesencephalic tract:** It originates at the lamina I and V of the dorsal horn. It ends at the mesencephalon which includes the PAG, the limbic system and the hypothalamus



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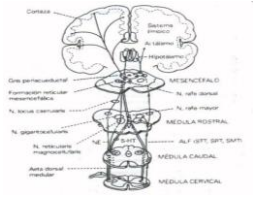
Detection Transduction Transmission Modulation **Projection** Perception

3. Neurophysiology of pain Projection

- **Spinohypothalamic tract:** it originates at the lamina III and IV. It ends at the hypothalamus and the ventral part of the proencephalus



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Detection Transduction Transmission Modulation Projection **Perception**

3. Neurophysiology of pain Perception

- The perception and reaction to pain are affected by external factors (environment, culture, society)
- Both the limbic system and the cerebral cortex are involved in the conscious awareness (perception) of pain
- The recognition of the location, intensity and pain quality is mediated by the processing of signals from the spinothalamic tract, the thalamus and the somatosensitiv cortex
- The processing of pain at the brainstem, mesencephalon and the limbic system is responsible for the affective, emotional, motivating and behavioural response related to the painful stimulus

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Detection Transduction Transmission Modulation Projection **Perception**

3. Neurophysiology of pain Perception

The integration, processing, and recognition of sensory information occurs in multiple specific areas of the brain:

- PAG (modulation) ← **Anaesthetics**
- reticular formation (antinociception) ← **Opioids, α2-agonists**
- hippocampus (memory) ← **Benzodiazepines**
- hypothalamus (autonomic) ← **Anaesthetics**
- amygdala (fear, anxiety) ← **Benzodiazepines**
- thalamus (integration) ← **Anaesthetics**
- cingulate gyrus (behaviour, emotion) ← **Phenothiazines**
- cortex (perception). ← **Anaesthetics**

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4. Analgesic mechanisms of acupuncture

The 1st studies showing the effects of acupuncture are from the 70s. Since then, it has been demonstrated that its action involves different mechanisms, receptors and neurotransmitters at diverse levels:

1. Local analgesic effect

- The analgesic effect of acupuncture starts when inserting the needle. It produces arteriolar vasodilation, calicrein activation which stimulates bradykinin production acting on the nociceptive fibers
- It produces an increase in the local adenosine concentration up to 24 times higher than baseline. Adenosine has antinociceptive and anti-inflammatory properties inhibiting the action potentials

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4. Analgesic mechanisms of acupuncture

2. Peripheral analgesic effect

- One of the most known and studied mechanisms is the relationship between acupuncture and the release of endogenous opioids (increase of β-endorphins concentration) at the site of inflammation.
- Acupuncture inhibits COX-2 as it decreases PGE-2 plasma levels. It also acts at the hypothalamic-hypophysis-adrenal axis producing pain relieve

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4. Analgesic mechanisms of acupuncture

3. Spinal analgesic effect

- There is a high concentration of endogenous opioids following acupuncture treatment. The concentration has been measured at the plasma levels and the cerebrospinal liquid and this analgesic effect is reverted by naloxone
- The use of electro acupuncture induces the release of different opioids; low frequency (2-15Hz) releases β-endorphins and high frequencies (80-120Hz) activates dynorphins

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4. Analgesic mechanisms of acupuncture

3. Spinal analgesic effect

- Acupuncture acts over the PAG and the Raphe Magnus. It sends signals through the dorsolateral tract of the spinal cord producing release of noradrenalin, serotonin and monoamines
- These neurotransmitters inhibit pre & post-synaptic pain. The blockade of serotonin receptors disminish the pain relief effect caused by acupunture

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4. Analgesic mechanisms of acupuncture

3. Spinal analgesic effect

- *Segmentary acupuncture*: At the embryo there are different segments named somites from which derives the dermatomes, sclerotomes & myotomes. They migrate during the embryonary development to reach the final destination. In adults we can find areas far away from each other with the innervation coming from the same somite in the embryo phase. The connection is done by the spinal nerve roots and the sympathetic nervous system

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4. Analgesic mechanisms of acupuncture

3. Spinal analgesic effect

- *Segmentary acupuncture*: It has been described that diseases from internal organs projects to the superficial segment originating signs of pain. The viscera – superficial segment relationship is reproducible and can be used to diagnose disease of internal organs

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4. Analgesic mechanisms of acupuncture

3. Spinal analgesic effect

- *Segmentary acupuncture*: In acupuncture, part of the diagnostic is based on this theory. Therefore the Back-Shu and Mu points allows identification of internal organ diseases according to palpation (cold, warm, depressed, painful). Visceral pain can be controlled stimulation acupuncture points located at the same body segment

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4. Analgesic mechanisms of acupuncture

4. Central analgesic effect

- With the development of MR & PET-CT, it could be shown that acupuncture stimulates the limbic system, nucleus arcuate, thalamus, PAG, cerebellum, basal ganglia and the brainstem. It also inhibits the amygdala, cortex and the anterior cingula
- Those changes originated at the CNS depends on the selected acupuncture point, the method (manual or electroacupuncture) and the duration of the stimulus

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4. Analgesic mechanisms of acupuncture

4. Central analgesic effect

- In order to get the described analgesic effect of acupuncture, the nervous system needs to be intact
- The analgesic effect is blocked by:
  - Local anaesthetics inoculated at the acupuncture point
  - The use of naloxone or antibodies against endorphins systemically
  - Any lesion at the PAG or the arcuate nucleus

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5. Theories about analgesia

1. Simple pain control hypothesis

- **Path 1:** Following acupuncture the action potential runs through the peripheral nerves up to the lamina II of the dorsal horn of the spinal cord. The second order neurons project the information until the thalamus through the spinothalamic or spinomesencephalic tract. The third degree neurons connect with upper centres such as the limbic system or the prefrontal cortex
- **Path 2:** Same as path 1 with the addition that when approaching the thalamus, the information runs through lateral connections to the brainstem and hypothalamus

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5. Theories about analgesia

1. Simple pain control hypothesis

- Some descendent excitatory neurons from upper centres connect with the lamina II & III of the spinal cord activating inhibitory ascendant signals from the lamina II of the path 1
- At the brainstem there are collateral projections to the PAG and the locus ceruleus. The monoaminergic neurons from these centers activate inhibitory interneurons which inhibit the ascendant pain signals from the lamina II

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5. Theories about analgesia

2. Upper center hypothesis

- Magnetic resonance studies have shown the activation of limbic structures and hypothalamic centers related to the production of β-endorphins, which is has been meant to activate the hypothalamus
- The relevance of this finding is the need of upper centers integration such as the limbic area in order to produce endocrine & autonomic homeostatic responses

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5. Theories about analgesia

3. Hypothesis of the Integrated model

- According to the effects acupuncture has it is improbable that the simple pain control hypothesis explains its mechanism of action. Acupuncture produces humoral and homeostatic changes, releases neuropeptides and affect autonomic responses
- The homeostatic changes happens through the stimulation of monoaminergic centers and endorphins which are produced at the brainstem. It has been shown that the limbic system, the cerebral cortex and the hypothalamus are also involved

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5. Theories about analgesia

3. Hypothesis of the Integrated model

- The effect of acupuncture in these lately described centers is extremely important mostly in chronic pain patients as it can produce psychological changes: the animals are more quiet, sleep better and therefore rest more improving their mood and happiness

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6. Effects of acupuncture

1. It stimulates the own protective mechanisms by activing the nervous, cardiovascular, endocrine and immune systems through the micro traumas created puncturing
2. It stimulates tissue regeneration
3. It promotes the blood and nutrients flow by increasing the irrigation to repair the micro trauma
4. It reduces the acute and chronic inflammation, increases the amount of white cells and the production of IL-2 by modulation the painful signal and the immune response
5. It reduces acute and chronic pain by releasing endorphins, norepinephrine and encephalin

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6. Effects of acupuncture

6. It reduces discomfort related to chronic pain affecting the rest and the emotional status. It is possible that acupuncture also reduces or eliminates the pain memory
7. It reduces the stress response. It is atributted to the release of oxytocine which regulates the parasympathetic nervous system
8. It restablishes the homeostatic function i.e. the glucose level, the arterial blood pressure or a muscle fiber tear
9. It regulates the autonomic nervous system
10. It regulates the organs internal functions

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7. Types of pain to t ure

- **Chronic osteoarthrosic pain**

Acupuncture is effective producing pain relief, improving the mobility of the animal and the mood and behaviour

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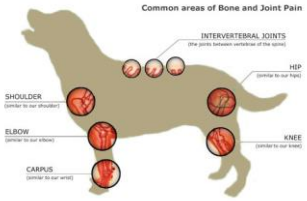
7. Types of pain to treat with acupuncture



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7. Types of pain to treat with acupuncture

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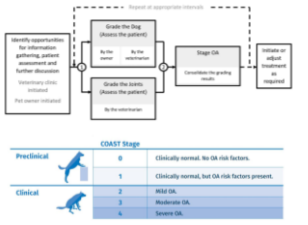
7. Types of pain to treat with acupuncture



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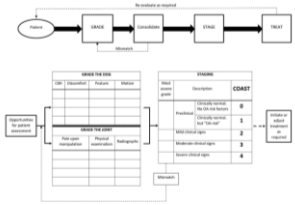
7. Types of pain to treat with acupuncture



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7. Types of pain to treat with acupuncture

Canine OsteoArthritis Staging Tool (COAST) assessment parameters for 'Grade the dog'.

Pet owner observations Homeclinic environment				Evaluations by a veterinarian Veterinary clinic		
Clinical metrology instrument	Degree of dog's discomfort	Effect on posture (static)	Additional descriptors	Effect on motion	Additional descriptors
If or very low score or 'not clinically affected' ☐	None ☐	Normal ☐	Static posture appropriate for breed Appropriate limb loading Appropriate body weight distribution between forelimbs and hindlimbs	Normal ☐	Symmetry Appropriate weight bearing Appropriate body weight distribution Fluent gait
Low score or 'mildly affected' ☐	Low level ☐	Mildly abnormal ☐	Subtle abnormality of limb loading Subtle shift in static body weight distribution	Mildly abnormal (subtle changes) ☐	Motion possibly affected at some gaits or with some activities Subtle stiffness in gait Subtle changes in body weight distribution Subtle asymmetry Subtle lameness
Medium score or 'moderately affected' ☐	Moderate level ☐	Moderately abnormal ☐	Obvious abnormality in limb loading Obvious shift in static body weight distribution	Moderately abnormal (obvious changes) ☐	No difficulty rising (getting up) Consistent subtle lameness in motion at all gaits and activities Obvious stiffness in gait Obvious changes in body weight distribution Obvious reduction in use of affected limb
High score or 'severely affected' ☐	Unbearable ☐	Severely abnormal ☐	Restless when standing Reluctance (difficulty) to stop standing Severe shift in static body weight distribution Severely abnormal limb loading	Severely abnormal (very obvious changes) ☐	Obvious decrease in stance phase Some difficulty rising (getting up) Struggles to move/reluctant to move Severe lameness usually present Severe weight shift Marked difficulty rising (getting up)

☐ = check mark box.

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7. Types of pain to treat with acupuncture

Canine OsteoArthritis Staging Tool (COAST) assessment parameters for 'Grade the joint. Ideally each joint should be graded so that disease progression can be independently and accurately monitored over time. The evaluation chart can be annotated to identify the joint being assessed.

Evaluations by a veterinarian Veterinary clinic				
Pain upon manipulation	Passive range of movement	Additional descriptors	Radiography	Additional descriptors
None ☐	Normal ☐	Normal	No radiographic signs of OA ☐	If preclinical 'at risk', the dog may have radiographic evidence of risk factors such as dysplasia and/or trauma
Mild ☐	Mildly abnormal ☐	Minimally reduced ROM No crepitus Slight joint thickening	Mildly abnormal (subtle changes) ☐	Early signs of OA Minimal osteophytes
Moderate ☐	Moderately abnormal ☐	Obvious decrease in ROM Muscle atrophy Obvious joint thickening	Moderately abnormal (obvious changes) ☐	Obvious osteophytes
Severe ☐	Severely abnormal ☐	Extremely limited ROM Crepitus Extreme muscle atrophy Severe joint thickening Loss of anatomical normality upon palpation Anatomical misalignment	Severely abnormal (very obvious changes) ☐	Advanced osteophytes Remodeling

☐ = check mark box.

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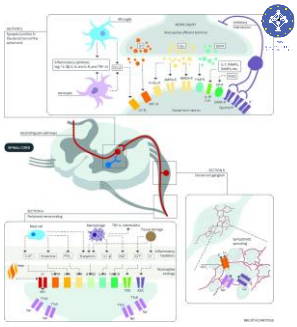
7. Types of pain to



- **Neurologic pain**

There are several clinical studies in dogs and cats with intervertebral disc disease showing that the use of acupuncture alone or in combination with drugs produces pain relief and improves neurological recovery

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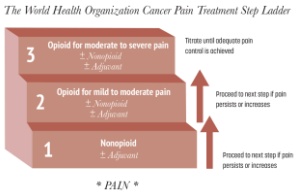
7. Types of pain to treat with acupuncture

- **Oncologic pain**

Oncologic patients receiving acupuncture have reduced side effects from chemotherapy and radiotherapy and relieves pain



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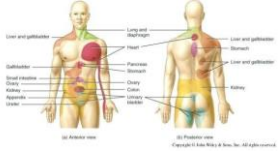
7. Types of pain to treat with acupuncture

- **Visceral pain**. Acupuncture affects the blood flow going to a viscera and the autonomic nervous system to produce pain relief



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7. Types of pain to treat with acupuncture

- **Myofascial pain**

Acupuncture can be used to treat trigger points and myofascial pain. This kind of pain follows a segmental pattern involving one or several muscles that can be separated from the trigger point

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points**
  - They are local hyper irritated spots at the muscular tissue and/or associated to fascia which produces referred pain and an autonomic response
  - The substance produced during the extreme contraction is acetylcholine
  - The excess of acetylcholine produces sarcomere shortening
  - The trigger points have neurovascular bunches including remote motor nervous endings which during contraction it is sensed liked a knot

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points**
  - It contains blood vessels and nociceptive, afferent proprioceptive, and sympathetic fibers
  - The local contraction produces an increase in the oxygen demand and the local circulation gets altered
  - The muscular fibers continue contracting liberating substances that produces pain and stimulates the autonomic nervous system
  - This produces a positive feedback at the motor end plate which continues producing excess of acetylcholine

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. Why do they appear?**
  1. Mechanical overwhelming
  2. Direct trauma
  3. Cold air stream
  4. Referred pain with the origin in a viscera
  5. Infectious or inflammatory process in a joint
  6. Intervertebral disc disease
  7. Radiculopathy
  8. Emotional stress
  9. Patients with hyperthyroidism are more prone to it

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points** caused by referred pain

Diseased organ	Musculature
Heart	Pectoral, Scapular musculature
Lung	Cervical musculature
Liver	Cervical, thoracic & abdominal musculature
Gall bladder	Shoulder and abdominal musculature
Stomach, Small intestine	Abdominal musculature
Kidney	Abdominal, lumbar and pelvic musculature

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. Which alterations can they cause?**
  1. Local pain
  2. Referred pain
  3. Paraesthesia & hyperalgesia
  4. Abnormal Posture
  5. Sleeping disorders
  6. Abnormal gait
  7. Visceral dysfunction: Vomiting, diarrhoea, constipation
  8. Behavioural changes

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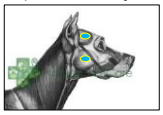
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Head**
    - **Masseter m.:** Dysfunction temporomandibular joint following dental procedure
    - **Temporal m.:** Dysfunction temporomandibular joint following dental procedure



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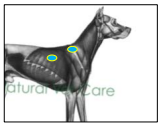
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Thoracic area**
    - **Trapezium m.:** Problem at the fore- &/or hind limbs
    - **Latissimus dorsi:** Problem at the fore- &/or hind limbs. Ipsilateral & contralateral



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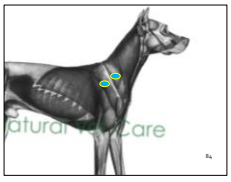
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Foreleg**
    - **Supraespinatus m.:** Problems in the shoulder, Hind leg, thoracic and shoulder pain
    - **Infraespinatus m. :**Problems in the shoulder, Hind leg, thoracic and shoulder pain



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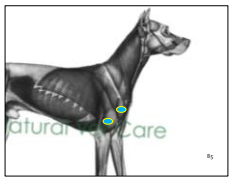
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Foreleg**
    - **Deltoid m.:** Problems at the shoulder, elbow & hind limb, thoracic pain
    - **Triceps braquialis m.:** Problems at the shoulder & elbow, contralateral foreleg & hind limb pain



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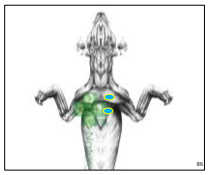
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Ventral area**
    - **Pectoralis superficialis:** Problems at the thoracic area, back or elbow pain
    - **Deep pectoralis:** Problems at the thoracic & pelvic area, back pain



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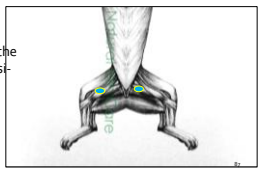
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Ventral area**
    - **Pectineus m.:** Dysfunction of the coxofemoral joint, hip pain. Ipsi- and/or contralateral
    - **Sartorius:** Dysfunction of the coxofemoral joint, hip & knee pain



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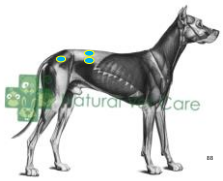
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Lumbosacral area**
    - **Erector espinalis m. :** Foreleg, hind limb and back pain
    - **Quadratus lumbaris:** Foreleg, hind limb and back pain
    - **Gluteal m.:** Lumbosacral pain Ipsi- and/or contralateral



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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Hind limb**
    - **Tensor fascia lata:** Lumbosacral, hip, knee pain
    - **Biceps femoralis:** Knee pain

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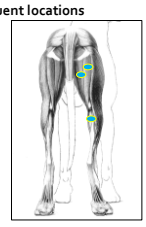
7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**
  - **Hind limb**
    - **Semimembranosus m.:** Lumbosacral, hip and knee pain
    - **Semitendinosus m.:** Lumbosacral, hip and knee pain
    - **Gastrocnemius:** Knee and tarsal pain



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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**

Where would you find trigger points in a patient with bicipital tendinitis?

1. Supraspinatus
2. Infraspinatus
3. Triceps
4. Pectoral superficialis
5. Deep pectoralis

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**

Where would you find trigger points in a patient with elbow disease?

1. Infraspinatus
2. Triceps
3. Deltoid m.
4. Pectoral superficialis

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**

Where would you find trigger points in a patient with cervical vertebral problems?

1. Trapezium
2. Latissimus dorsi

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**

Where would you find trigger points in a patient with thoracic vertebral problems?

1. Trapezium
2. Latissimus dorsi
3. Pectoral superficialis
4. Deep pectoralis

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**

Where would you find trigger points in a patient with lumbosacral problems?

1. Longissimus dorsi
2. Gluteal m.
3. Tensor fascia lata
4. Pectineal m.
5. Sartorius
6. Triceps braquialis

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7. Types of pain to treat with acupuncture

- **Myofascial pain - trigger points. The most frequent locations**

Where would you find trigger points in a patient with hip problems?

1. Gluteal m.
2. Tensor fascia lata
3. Semitendinosus
4. Semimembranosus
5. Pectineal m.
6. Sartorius
7. Triceps braquialis

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8. Diagnostic and recognition of pain

- There is no stablished method neither in human nor in veterinary medicine to assess pain
- Scales have been developed in order to monitor the evolution of the patient and the efficacy of the pain treatment
- The scales are species specific and are only valid for the type of pain developed.

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8. Diagnostic and recognition of pain

- The scales include the evaluation of different behaviours, which are all subjective and possibly biased.
- The physiological parameters most frequently included are the ones which become altered when the patient is in pain:
  - heart and respiratory rate, arterial blood pressure and pupillary diameter
- However, these can also be altered for other reasons which difficult the reliability of the methods.

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8. Diagnostic and recognition of pain
Pain scales

a) Subjetive for acute and portoperative pain
   1. VAS
b) Physiological for acute and portoperative pain
   1. The Glasgow Composite Measure Pain Scale – short form (GCMPS-SF) for dogs
   2. UNESP-Botucatu multidimensional composite pain scale for acute postoperative pain in cats
   3. The feline grimace scale (FGS) for acute postoperative pain in cats
c) Chronic pain
   1. Canine brief pain inventory (BPI-CBPI) for dogs (osteoarthrosis & osteosarcoma)
   2. Liverpool Osteoarthritis in Dogs (LOAD)
   3. Client-specific outcome measures for dogs & cats – COSMcanine and COSMfeline
   4. Health Related Quality of life – HRQoL

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8. Diagnostic and recognition of pain

a)1. Visual analogue scale (VAS)

- Subjective for acute and postsurgical pain
- It is a quantitative scale to define the intensity of pain
- It must be always done by the same observer which evaluates the patient in order to develop a tendency
- It is a line 100mm long which in both ends can be seen either absence of pain or maximal pain possible

Absence of pain — Maximal pain possible

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8. Diagnostic and recognition of pain

b) 1. The Glasgow Composite Measure Pain Scale – short form (GCMPS-SF) for dogs

- It is a quick and practical clinical guide for acute pain
- The maximal is 24 points with a cut out when analgesia should be administered

SHORT FORM OF THE GLASGOW COMPOSITE PAIN SCALE

Download: http://www.newmetrica.com/wp-content/uploads/2016/09/Reid-et-al-2007.pdf

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8. Diagnostic and recognition of pain

b) 2. UNESP Botucatu multidimensional composite scale for postoperative acute pain in cats

- Physiological for acute and postsurgical pain
- The very first validated scale in cats
- A maximal of 28 points can be reached:
  - psychomotor state (position, comfortability, activity, mental state and other behaviours)
  - reaction to wound palpation
  - physiological parameters (appetite and systolic arterial blood pressure)
  - vocalization

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8. Diagnostic and recognition of pain

Descargar: http://www.animalpain.com.br/assets/upload/escala-en-us.pdf

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8. Diagnostic and recognition of pain

b) 3. The feline grimace scale (FGS) for acute postoperative pain in cats

- The researchers categorized, tested, and scored five facial action units indicative of pain in cats:
  - Ear position: Ears facing forward, ears slightly pulled apart, or ears flattened and rotated outward
  - Orbital tightening: Eyes opened, eyes partially opened, or eyes squinted
  - Muzzle tension: Muzzle relaxed (round), muzzle mildly tense, or muzzle tense (elliptical)
  - Whisker position: Whiskers loose and curved, whiskers slightly curved or straight, or whiskers straight and moving forward
  - Head position: Head above the shoulder line, head aligned with the shoulder line, or head below the shoulder line or tilted

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8. Diagnostic and recognition of pain

b) 3. The feline grimace scale (FGS) for acute postoperative pain in cats

- Each facial action unit gets a score of 0, 1, or 2.
  - 0: absence of the facial action unit
  - 1: moderate appearance or uncertainty
  - 2: obvious appearance
  - ≥ 4: The cat is in pain and needs analgesia.
  - The maximum total score is 10

(Images of cats in which pain was absent, moderately present, or markedly present)

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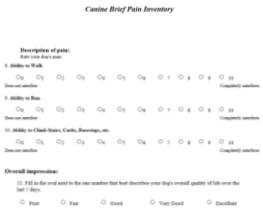
8. Diagnostic and recognition of pain

c) 1. Canine brief pain inventory (BPI-CBPI) for dogs

- Validated for osteoarthrosis and osteosarcoma
- Scale for chronic pain
- It is a combination of 10 questions graded from 1 to 10 to evaluate the evolution of the patient including an assessment overview.


Canine Brief Pain Inventory

Description of pain:

Overall Impression:

Poor Fair Good Very Good Excellent

Download: http://www.vet.upenn.edu/docs/default-source/VCIC/canine-bpi.pdf?sfvrsn=6fd20eba_0

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8. Diagnostic and recognition of pain

c) 2. Liverpool osteoarthritis in dogs – LOAD

- Validated for elbow osteoarthritis
- Scale for chronic pain
- It includes the anamnesis and 13 questions about mobility which end up with a score useful for the follow up of the treatment.

Download: http://www.brayvet.com/wp-content/uploads/2014/02/LOAD-Initial-Visit-Questionnaire.pdf

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8. Diagnostic and recognition of pain

c) 3. Client-specific outcome measures – COSMcanine and COSMfeline

- Chronic pain
- Validated for osteoarthritic chronic pain
- It is for owners to fill in in order to detect activities which have changed
- During the pain treatment, these activities will be evaluated over time to assess the efficacy of the treatment.

My dog/cat was _____ years old when it could perform these activities.

Problematic activities	No problem	A bit problematic	Quite problematic	Very problematic	Impossible
1.					
2.					
3.					
4.					
5.					

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8. Diagnostic and recognition of pain

c) 4. Health Related Quality of life (HRQoL)

- Chronic pain
- Developed for patients with cardiac disease, cancer, chronic pain, spinal cord lesions and atopic dermatitis.
- They mostly include social interaction with other animals and/or the owner and the ability to find comfort.

Download: http://www.newmetrica.com/vetmetrica-hrql/

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QUESTIONS

https://pixabay.com. Galliger

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QUESTIONS

1. The initial response following acupuncture treatment is related to afferent nociceptive fibers which carry information from …
   a) Temperature
   b) Position
   c) Relaxation/Contraction
   d) Pain
   e) Touch

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QUESTIONS

1. The initial response following acupuncture treatment is related to afferent nociceptive fibers which carry information from …
   a) Temperature
   b) Position
   c) Relaxation/Contraction
   d) **Pain**
   e) Touch

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QUESTIONS

2. Which nociceptive fibers carry on the information from slowly burning pain?
   a) Aα
   b) Aβ
   c) Aγ
   d) Aδ
   e) C

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QUESTIONS

2. Which nociceptive fibers transport the information from slowly burning pain?
   a) Aα
   b) Aβ
   c) Aγ
   d) Aδ
   e) C

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QUESTIONS

3. Which neurotransmitters are related to acupuncture?
   a) Only serotonin and endorphins
   b) Only acetylcholine and serotonin
   c) Only dopamine
   d) Only catecholamine
   e) Catecholamine, acetylcholine and some prostaglandins

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QUESTIONS

3. Which neurotransmitters are related to acupuncture?
   a) Only serotonin and endorphins
   b) Only acetylcholine and serotonin
   c) Only dopamine
   d) Only catecholamine
   e) Catecholamine, acetylcholine and some prostaglandins

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QUESTIONS

4. Which are the effects of acupuncture in degenerative joints?
   a) Endorphins release
   b) Pain relief
   c) Increase microcirculation, endorphins release, neuromodulation, activation of the inhibitory descendent path with secondary pain relief
   d) Serotonin & epinephrine release and an increase in microcirculation
   e) Reduction of spams and epinephrine release

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QUESTIONS

4. Which are the effects of acupuncture in degenerative joints?
   a) Endorphins release
   b) Pain relief
   c) Increase microcirculation, endorphins release, neuromodulation, activation of the inhibitory descendent path with secondary pain relief
   d) Serotonin & epinephrine release and an increase in microcirculation
   e) Reduction of spams and epinephrine release

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QUESTIONS

5. Which are the effects of GV 26?
   a) Parasimpaticolitic & endorphin stimulation
   b) Parasimpaticomimetic & dopamine stimulation
   c) Simpaticomimetic & epinephrine stimulation
   d) Simpaticomimetic & encephalin stimulation
   e) Simpaticolitic & norepinephrine stimulation

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QUESTIONS

5. Which are the effects of GV 26?
   a) Parasimpaticolitic & endorphin stimulation
   b) Parasimpaticomimetic & dopamine stimulation
   c) Simpaticomimetic & epinephrine stimulation
   d) Simpaticomimetic & encephalin stimulation
   e) Simpaticolitic & norepinephrine stimulation

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QUESTIONS

6. Which neurotransmitters are released at the dorsal horn when the descending inhibitory path is activated?
   a) Acetylcholin
   b) Substance P y Prostaglandins
   c) Serotonin y norepinephrine
   d) Proencephalins
   e) Epinephrine & endocannabinoids

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QUESTIONS

6. Which neurotransmitters are released at the dorsal horn when the descending inhibitory path is activated?
   a) Acetylcholin
   b) Substance P y Prostaglandins
   c) Serotonin y norepinephrine
   d) Proencephalins
   e) Epinephrine & endocannabinoids

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QUESTIONS

7. What are the β endorphins?
   a) amino acid
   b) Polypeptide
   c) Fatty acid
   d) Hydrocarbon
   e) Free radical

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QUESTIONS

7. What are the β endorphins?
   a) amino acid
   b) Polypeptide
   c) Fatty acid
   d) Hydrocarbon
   e) Free radical

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QUESTIONS

8. Where is the gelatinous substance?
   a) Thalamus
   b) Hypothalamus
   c) Dorsal horn of the spinal cord
   d) Ventral horn of the spinal cord
   e) Afferent & efferent nervous fibers

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QUESTIONS

8. Where is the gelatinous substance?
   a) Thalamus
   b) Hypothalamus
   c) Dorsal horn of the spinal cord
   d) Ventral horn of the spinal cord
   e) Afferent & efferent nervous fibers

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QUESTIONS

9. How is the mechanism called which explains the inhibition of the painful sensation?
   a) Referred pain
   b) Descending inhibitory control
   c) Somatovisceral reflex
   d) Sensation propagation
   e) Gate control theory

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QUESTIONS

9. How is the mechanism called which explains the inhibition of the painful sensation?
   a) Referred pain
   b) Descending inhibitory control
   c) Somatovisceral reflex
   d) Sensation propagation
   e) Gate control theory

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QUESTIONS

10. Which substance is liberated at the descending inhibitory path?
    a) Acetylcholine
    b) Norepinephrine
    c) Calcium
    d) Adenosine
    e) Glutamate

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QUESTIONS

10. Which substance is liberated at the descending inhibitory path?
    a) Acetylcholine
    b) Norepinephrine
    c) Calcium
    d) Adenosine
    e) Glutamate

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QUESTIONS

11. The inhibitory descendent path starts at the brainstem. Where does it end?
    a) Hypothalamus
    b) Grey substance at the dorsal horn of the spinal cord
    c) Free nerve endings
    d) Spinothalamic tract
    e) White substance at the ventral horn of the spinal cord

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QUESTIONS

11. The inhibitory descendent path starts at the brainstem. Where does it end?

a) Hypothalamus
b) Grey substance at the dorsal horn of the spinal cord
c) Free nerve endings
d) Spinothalamic tract
e) White substance at the ventral horn of the spinal cord

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QUESTIONS

12. Which term defines the pain caused by stimuli which usually are not painful?

a) Allodynia
b) Hyperesthesia
c) Hyperalgesia
d) Sensitization
e) Hypoalgesia

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QUESTIONS

12. Which term defines the pain caused by stimuli which usually are not painful?

a) Allodynia
b) Hyperesthesia
c) Hyperalgesia
d) Sensitization
e) Hypoalgesia

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QUESTIONS

13. Which terms are related to each other?
    a) Grapiprant – receptor EP_4
    b) Referred pain – lamina V
    c) Hyperalgesia – receptor NMDA
    d) a, b, c do not relate
    e) a, b, c are right

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QUESTIONS

13. Which terms are related to each other?
    a) Grapiprant – receptor EP_4
    b) Referred pain – lamina V
    c) Hyperalgesia – receptor NMDA
    d) a, b, c do not relate
    e) a, b, c are right

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QUESTIONS

14. Where do the efferent paths start?
    a) At the nociceptive stimulus
    b) At the PAG & the raphe
    c) At the free nerve endings
    d) At the upper centers
    e) Only at the Thalamus

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QUESTIONS

14. Where do the efferent paths start?
    a) At the nociceptive stimulus
    b) At the PAG & the raphe
    c) At the free nerve endings
    d) At the upper centers
    e) At the Thalamus

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QUESTIONS

15. Which receptors are involved at the spinal cord?
    a) Calcium channels
    b) GABA receptors
    c) AMPA receptors
    d) NMDA receptors
    e) All of them

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QUESTIONS

15. Which receptors are involved at the spinal cord?
    a) Calcium channels
    b) GABA receptors
    c) AMPA receptors
    d) NMDA receptors
    e) All of them

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QUESTIONS

16. On which receptors act tramadol?
   a) Mu opioid
   b) Serotonin & noradrenaline reuptake inhibition
   c) Adrenaline & histamine reuptake inhibition
   d) A y B are correct
   e) A y C are correct

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QUESTIONS

16. On which receptors act tramadol?
   a) Mu opioid
   b) Serotonin & noradrenaline reuptake inhibition
   c) Adrenaline & histamine reuptake inhibition
   d) A y B are correct
   e) A y C are correct

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QUESTIONS

17. Which is the most relevant lamina at the dorsal horn of the spinal cord related to the effect of acupuncture on pain relief?
   a) Lamina I
   b) Lamina II
   c) Lamina III
   d) Lamina IV
   e) Lamina V

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QUESTIONS

17. Which is the most relevant lamina at the dorsal horn of the spinal cord related to the effect of acupuncture on pain relief?
    a) Lamina I
    b) Lamina II
    c) Lamina III
    d) Lamina IV
    e) Lamina V

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QUESTIONS

18. Where can you find trigger points in bicipital tendinitis?
    a) Supra- & infraespinatus
    b) Deep & superficial pectoral m.
    c) Triceps
    d) A y b are correct
    e) A, b y c are correct

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QUESTIONS

18. Where can you find trigger points in bicipital tendinitis?
    a) Supra- & infraespinatus
    b) Deep & superficial pectoral m.
    c) Triceps
    d) A y b are correct
    e) A, b y c are correct

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QUESTIONS

19. Which kind of pain can you treat with acupuncture?
   a) Only osteoarthrosic & neuropathic pain
   b) osteoarthrosic, neuropathic, visceral, oncologic &myofascial pain
   c) Acute & chronic pain
   d) B y c are correct

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QUESTIONS

19. Which kind of pain can you treat with acupuncture?
   a) Only osteoarthrosic & neuropathic pain
   b) osteoarthrosic, neuropathic, visceral, oncologic &myofascial pain
   c) Acute & chronic pain
   d) B y c are correct

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QUESTIONS

20. Which scales include the owner to evaluate chronic pain?
   a) Health Related Quality of life – HRQoL
   b) Client-specific outcome measures – COSMcanine and COSMfeline
   c) Liverpool osteoarthritis in dogs – LOAD
   1. Canine brief pain inventory (BPI-CBPI) for dogs (osteoarthrosis & osteosarcoma)
   a) A y b are follow up surveys for the owner

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QUESTIONS

20. Which scales include the owner to evaluate chronic pain?
   a) Health Related Quality of life – HRQoL
   b) Client-specific outcome measures – COSMcanine and COSMfeline
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   1. Canine brief pain inventory (BPI-CBPI) for dogs (osteoarthrosis & osteosarcoma)

   a) A y b are follow up surveys for the owner

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