UNIVERSITÀ
DI PARMA

Dipartimento di Scienze Medico-Veterinarie

Corso di Laurea Magistrale a Ciclo Unico in Medicina Veterinaria

USE OF ACUPUNCTURE FOR THE TREATMENT OF CHRONIC PAIN IN DOGS

USO DELL'AGOPUNTURA PER IL TRATTAMENTO DEL DOLORE CRONICO NEL CANE

Relatore: Chiar.mo Prof. Fabio Leonardi

Correlatrice: Dott.ssa Margherita Gazzola

Laureanda: Camilla De Bernardinis

A.A. 2022/2023

SUMMARY

ABSTRACT

In the last few decades, companion animals have gained increasing importance in our society and now live longer lives than before. This is associated, though, with the development of chronic illnesses. One of the most debilitating chronic disease is chronic pain. This condition originates from the hyperstimulation of both peripheral and central nervous system as a consequence of a prolonged damage to the nervous fibres. It is not easy to treat chronic pain and it often requires multimodal therapy protocols, which include conventional drug treatments and non-conventional medicine. One of the most utilized non-conventional treatment is acupuncture. This is a technique from Traditional Chinese Medicine used to treat different conditions through the insertion of fine needles in the derma in specific points located along meridians. Traditionally, acupuncture's effect is based on the balancing of energy flows within the body. The aim of this work is to study the state of the art regarding the scientific basis of acupuncture and to introduce the interested public to this traditional practice, as well as giving an example of the possible use of acupuncture to treat chronic pain. In this study are reported 5 clinical cases of dogs suffering from chronic pain mainly related to osteoarthrosis (3) and intervertebral disk disease (2). The data were gathered with the owners' consent and have, in this study, a mere expository purpose. The acupuncture protocol used was personalized and based upon the Traditional Chinese Veterinary Medicine diagnosis. Each patient underwent several acupuncture sessions, one per month approximately, showing improvements from the 3rd or 4th session. The results of the treatment were based merely on the patient's clinical state and the owner's assessment. The dogs showed a distended and calm behaviour both during and after the treatment, with improved posture and gait. All the owners reported satisfaction with the acupuncture treatment and the improvements obtained in their dog's conditions. In conclusion, acupuncture might be a valuable treatment to be used alone or in association with conventional therapies for the improvement of the conditions of patients suffering from chronic pain, particularly osteoarticular or neurological pain.

RIASSUNTO

Negli ultimi decenni gli animali da compagnia hanno guadagnato sempre più spazio all'interno della società e, ad oggi, cani e gatti vivono una vita più lunga rispetto al passato. Una vita più lunga si accompagna però a malattie che possono diventare croniche, come il dolore. Il dolore cronico è una condizione estremamente debilitante per i nostri animali che si origina da una iperstimolazione del sistema nervoso periferico e centrale, a seguito di un danno prolungato alle fibre nervose. Non è semplice trattare il dolore cronico e spesso vengono intrapresi degli approcci terapeutici multimodali che includono terapie mediche e alternative. Tra le terapie non convenzionali più utilizzate si riconosce l'agopuntura, una tecnica di Medicina Tradizionale Cinese che permette di trattare diverse patologie attraverso la puntura del derma in specifici punti lungo i meridiani. Tradizionalmente l'effetto dell'agopuntura è basato sul riequilibrio dei flussi energetici all'interno del corpo. L'obiettivo di questo studio è quello di indagare lo stato dell'arte riguardante le basi scientifiche dell'agopuntura, introdurre questa pratica tradizionale ad un pubblico interessato e fornire un esempio del suo possibile utilizzo per il trattamento del dolore cronico. Nello studio sono riportati 5 casi clinici di cani affetti da dolore cronico relativo principalmente ad osteoartrosi (3) e patologie del disco intervertebrale (2). I dati sono stati raccolti con il consenso dei proprietari ed hanno il solo scopo illustrativo. Il protocollo di agopuntura utilizzato è personalizzato e adattato in base alla diagnosi di Medicina Veterinaria Tradizionale Cinese. Ogni paziente è stato sottoposto a diverse sessioni di agopuntura, circa una al mese, ed ha iniziato a mostrare miglioramenti dalla 3ª o 4ª seduta. I risultati sono basati sulla clinica del paziente e sulle osservazioni del proprietario. I cani hanno mostrato un atteggiamento calmo e disteso sia durante che dopo il trattamento, con un miglioramento più o meno evidente di postura e andatura. Tutti i proprietari hanno riportato un buon livello di soddisfazione riguardo il trattamento e i miglioramenti ottenuti nelle condizioni dei loro cani. In conclusione, l'agopuntura può essere un valido trattamento da utilizzare da solo o in associazione a terapie convenzionali per il miglioramento delle condizioni di pazienti che soffrono di dolore cronico, particolarmente di tipo osteoarticolare o neurologico.

INTRODUCTION

Dogs and cats are part of one's family nowadays and are thus worthy of receiving any form of care they may need when ill or in pain. In addition to that, companion animals have gained in the past decades longer lives than they used to have, not only thanks to a development in veterinary medicine resources but also to a changed perception of them as, in fact, family members. A longer life is indeed associated with chronic illnesses that can affect our pets, and one of the most debilitating conditions that they can suffer of is chronic pain. Chronic pain is a common symptom that can be related to various different pathologies (e.g. musculoskeletal, neurological, gastrointestinal, renal, immune-mediated, etc.). It is extremely invalidating for the animal, being in most cases the worst element of the underlying illness, since it can hamper its main organic functions (e.g. feeding, walking and playing). Before starting one's career, the practitioner must take an oath that declares the use of scientific knowledge and skills for the relief of animal suffering, to act as advocates for the well-being of animals (Fox S., 2014). Veterinary medicine has increasingly grown its consideration for pain management during the last couple of decades, both because of broadening of scientific knowledge about pain mechanisms and treatments in animals and, as previously reported, because of changed hankerings of pet owners. It is not easy to treat chronic pain because it often results in neuropathic mechanisms that do not respond to usual painkillers or other kinds of pharmacological pain therapies. Thus, it most likely needs what is called "multimodal therapy", which is a therapy that includes various sources of treatment; these can indeed be not only drugs and supplements but also alternative and complementary treatments such as physiotherapy, laser-therapy, stem cells treatments, ozone-therapy and acupuncture. The latter has gained more and more interest and consideration in veterinary medicine over the past thirty years, and is by now a common and useful treatment for many different diseases that affect companion animals. One of the main uses of acupuncture is the treatment of pain, given its well-known and studied analgesic effect. Acupuncture has its deep roots in ancient Chinese medicine and is based on

four main philosophical theories that are: yin and yang, Qi (energy), Zang Fu (organs) and Meridians or Channels. According to Chinese philosophy, everything in the macrocosm and microcosm – that is the human or animal body – is ruled by Tao which generates yin and yang, two opposite but complementary forces that are required to maintain own body in balance. When yin and yang are in balance, the energy Qi flows smoothly through each organ, following the meridians that connect the Zang Fu, and that is called a state of health. When yin and yang are not in balance, the Qi cannot properly flow and a state of illness comes.
In fact, it is by the stimulation of certain points on the body's surface with fine needles – acupuncture – that it's possible to treat those states of illness and to bring the microcosm back to its initial balance. Oriental medicine basis theories may sound fanciful and hard to comprehend to westerners, therefore many studies have been performed over almost a century to scientifically prove acupuncture's effectiveness and efficacy. Not only articles but also reviews have been written to study how the use of needles affects the nervous system, the release of chemical substances and the perception of pain, with particular interest in comparing the effects of stimulation of real acupuncture points versus the stimulation of sham points. The aim of this work is to study the mechanisms of acupuncture, both according to Traditional Chinese Medicine and to modern western medicine, to better understand how this emerging therapy can be used by Veterinarians to treat chronic pain in pets. This work will also suggest some acupuncture protocols that have been used in clinical practice to treat chronic pain caused by different pathologies.

1. PAIN IN VETERINARY MEDICINE

1.1 What is pain?

According to the International Association for the Study of Pain (IASP), the definition of pain, as revised in 2020 after the definition of 1979, is the following: "An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" (Raja et al., 2020). It is not yet clear if humans and animals do experience pain in the same way, since the latter cannot verbally express the feeling of pain in its emotional part, that is suffering. Considering this, it would be incorrect to talk about "pain" in animals, as non-verbal beings, and it would rather be better to refer to it as nociception. Nonetheless, the very same IASP also previously stated that: "The inability to communicate in no way negates the possibility that an individual is experiencing pain and is in need of appropriate pain-relieving treatment" (Merskey & Bogduk, 1994).

The experience of pain can be divided in three components, in humans and animals indiscriminately:

1) A sensory component, which is nociception, characterized by the presence of a stimulus that is perceived by specific receptors and translated into an electrical signal that is sent to the brain. These receptors are called nociceptors and are sensitive to pressure, heat and chemical stimuli that might as well be noxious, causing a certain degree of damage.

2) A sensing component, since there must be a functional brain for the noxious stimuli to be processed and interpreted as actual pain. Even though nociception is still present, in anesthetised humans or animals – that are therefore unconscious – the perception of pain is temporarily suppressed. Reflex responses, such as an increased heart rate or blood pressure, will surely follow a noxious stimulus but there will not be any conscious feeling of pain.

3) An emotional component, which is the response of the animal to the feeling of pain; it most likely results in a change in behaviour, both for avoidance of further damage but especially for awareness of the damage itself and memory of it, as an unpleasing and hurting experience. This

change in behaviour can involve resistance, fleeing, whining and even aggression when exposed to the very damage causing pain (Robertson, 2002; Walters, 2018).

Pain is therefore a complex phenomenon that involves not only a pathophysiologic component but also a psychological one that are equally difficult to recognize and interpret in animals (Fox, 2014). In addition, pain response is remarkably variable in each individual, depending on age, gender, species, breed and not least health status. To avoid this issue, for a long time in clinical practice the principle of analogy (Hellebrekers, 2000) has been used to prevent animal suffering, assuming that what is painful for a human being must be considered to be painful for animals as well. In the past decades, this empirical method has been superseded by pain assessment scales that are mostly based on behavioural changes in the observed patient. In fact, it has been revealed that changes in behavioural patterns are linked to actual signs of distress and pain states (Fox, 2014).

1.2 Classification of pain

Pain can be classified in different terms, for example according to its duration, anatomical presentation, aetiology, intensity and pathophysiology, and due to its heterogeneity it is often necessary to combine different classifications in order to accurately assess a patient's pain (Robertson, 2002).

We can distinguish a somatic and a visceral pain, according to its anatomical location. Somatic pain derives from skin, muscles, bones, joints, ligaments, tendons and connective tissue and is relative to the actual site of damage; visceral pain arises from internal organs but is more difficult to localise it because of the low density of nociceptors in the viscera and extensive divergence of visceral input within the central nervous system, thus it is said to be a diffused pain (Sikandar & Dickenson, 2012).
Another classification takes into consideration the pathophysiology of pain, as we can distinguish nociceptive, neuropathic and nociplastic pain. Nociceptive pain is the normal physiological response to tissue damage and is also essential for survival. The IASP defines nociceptive pain as "Pain

that arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors" (IASP Task Force on Taxonomy, 1994). Neuropathic pain is, on the other side, a kind of pain that arises from a damage of the somatosensory nervous system, whether it is a primary lesion or malfunction in the peripheral or central nervous system. It is also called neurogenic, deafferentiation or dysesthetic pain but the two key concepts are an inappropriate activity in nociceptive fibres – injured or uninjured – and central changes in sensory processing that arise from these abnormalities (Fox, 2014). Lastly, nociplastic pain is defined as central sensitisation which is pain that arises from altered nociception despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors, or evidence for disease or lesion of the somatosensory system causing the pain (IASP Task Force on Taxonomy, 1994).

According to its duration, pain can be described as acute or chronic: acute pain, also called physiologic pain, is the body's response to a strong and short-lasting noxious stimulus and it's fundamental for survival since it protects against potentially further damage. Acute pain is self-resolving as it lasts only until the stimulus or tissue damage is present. Chronic pain is traditionally defined as pain lasting more than 3-6 months and is characterised by no actual purpose to the organism, is frequently difficult to treat and not related to any pathology that can explain its presence or extent (Fox, 2014).

1.3 Physiology of pain

The sensation of pain as perceived by the subject is processed at different levels in the brain, following the occurrence of a noxious stimulus at a peripheral injury site. The neural pattern that leads to the experience of pain is defined as nociceptive pathway, and is based upon a three-neurons linkage starting from the peripheral nervous system (PNS) and ending in the central nervous system (CNS). Given this statement, it is possible to recognise different events that occur along the three stages of the nociceptive pathway: transduction (from noxious stimulus to 1st-order neuron), transmission (from 1st to 2nd-order neuron), perception (from 2nd

to 3rd-order neuron) and modulation (additional descending inhibitory systems that withhold 2nd-order neurons) *(Figure 1)*.

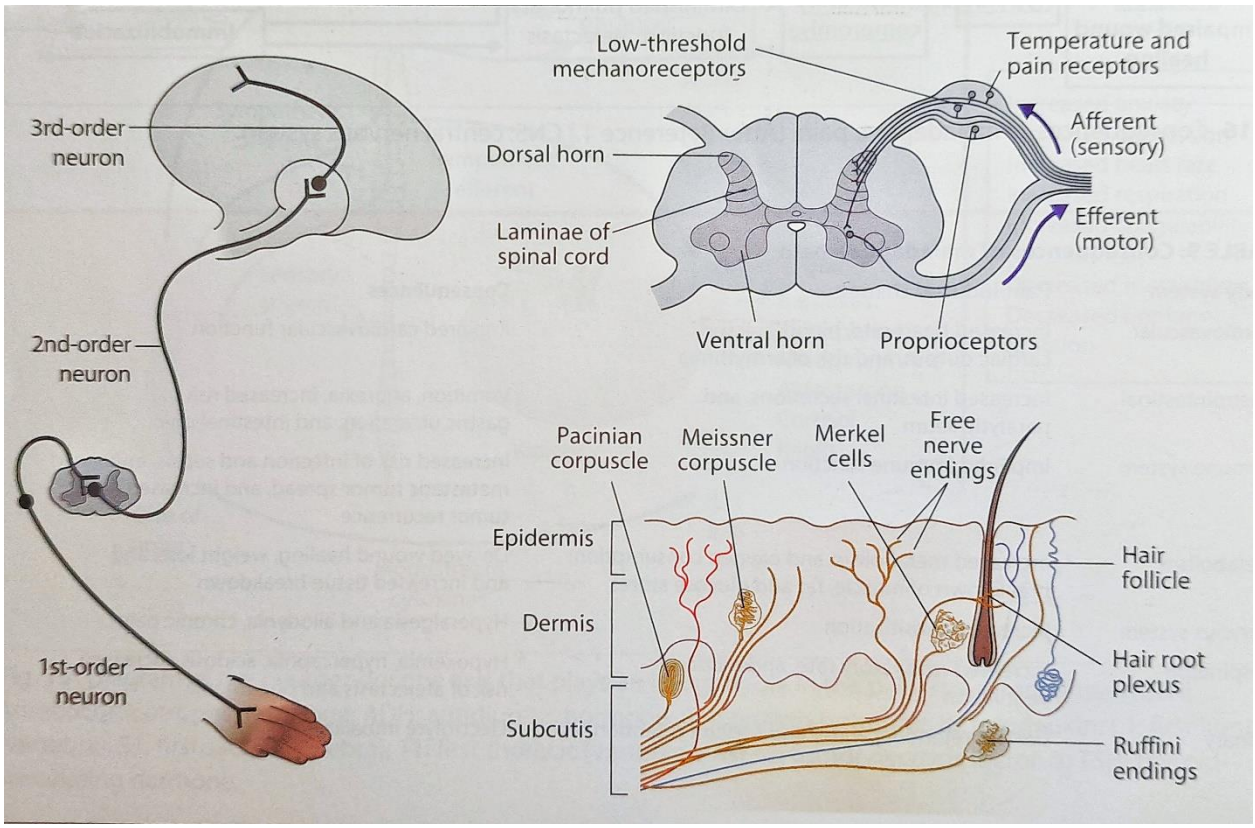

Figure 1: Pathway from insult to perception of pain. (Fox, 2014 – Chapter 4, page 50)

1.3.1 Transduction

Nociception gets started at the damage site where peripheral receptors transduce noxious or proprioceptive stimuli to be transmitted by 1st-order neurons – which are sensory afferent fibres – in the dorsal root ganglion of the spinal cord. Transduction is, in other words, the conversion of one physical quantity to another, for example temperature or pressure to an electrical signal that is action potential (Kendroud et al., 2022). An action potential can be elicited in a nerve fibre by almost any factor that suddenly increases the permeability of the nerve membrane to sodium ions: mechanical compression, action of chemicals, thermal or electrical stimulation and any other event that disturbs the resting state of the membrane (Fox, 2014).

The resting state of cell membranes is characterized by a continuous flow of ions through specialized pumps that are permeable to sodium and

potassium ions. Normally, three sodium ions are pumped on the outside while only two potassium ions are pumped on the inside of the membrane, having more positive ions being moved out of the cell than into it. In addition to that, inside the membrane is a quite large number of anions that cannot diffuse towards the outside. This condition leads to the creation of an electronegative environment on the inside of the cell and, oppositely, an electropositive one on the outside.

When the cell membrane of a nerve fibre is excited by a suitable stimulus, the action potential occurs. This is the result of rapid changes in membrane permeability to sodium and potassium ions: the permeability to sodium increases about 5000-fold at the onset of the action potential, carrying enough positive charges to the inside of the membrane to cause a change in its normal resting state environment that is electronegative, developing thus a positive state on the inside while a negative one sets on the outside. This phase is called depolarization. The abrupt change in membrane charges starts from one precise point but immediately excites adjacent portions of the membrane itself, with the propagation of the action potential in both directions from the origin until the entire membrane is depolarized.
Almost instantaneously after depolarization, the membrane becomes quite impermeable to sodium ions but also considerably more permeable to potassium, which flows back on the outside of the membrane by means of concentration gradient (given the high concentration of potassium on the inside of the cell). This results in the repolarization of the membrane, that is the return to the normal distribution of electrical charges that identifies the resting state.

The transduction of noxious stimuli to action potential starts from cell receptors that are specifically called nociceptors, and are found on relatively unspecialized nerve cell endings in all parts of the body (Purves et al., 2001). These receptors are various and abundant, and their response to stimulation can be influenced by different cytokines and chemokines in the surrounding area (Fox, 2014).

1.3.2 Transmission

Free nerve endings are considered the 1st-order neurons and are responsible for the transmission of the action potential – and specifically of the noxious stimulus – to the dorsal horn of the spinal cord, where they make a synapsis with 2nd-order neurons.

These fibres are classified according to the properties of their axons: while sensory receptors which recognize innocuous stimuli are associated with relatively large and myelinated axons, nociceptors, in contrast, are followed by small and slight myelinated or unmyelinated nerve fibres which, thus, conduct the electrical stimuli very slowly. These fibres are Aδ and C fibres: the former are small but lightly myelinated nerve fibres that respond to mechanical and thermal stimuli, they carry rapid, sharp pain and are responsible for the initial reflex response to acute pain; the latter are the smallest type of primary afferent fibres, they are unmyelinated, thus carry the slowest conduction, and are also called "polymodal" since they respond to chemical, mechanical and thermal stimuli, leading to slow, burning pain (Reddi et al., 2012). In addition, there are Aβ fibres that possess large and myelinated axons which allow rapid signal conduction, responding to light touch and transmit non-noxious stimuli. *(Table 1)*.

	Aβ Fibres	**Aδ Fibres**	**C Fibres**
Diameter	> 5 µm	2 – 5 µm	< 2 µm
Myelination	Highly myelinated	Thinly myelinated	Unmyelinated
Conduction velocity	> 40 m/s	5 – 15 m/s	< 2 m/s
Receptor activation threshold	Low	High and low	Low
Sensation and stimulation	Non-noxious, light touch	Rapid, sharp, localized pain; burning, freezing; stretch	Slow, diffuse, dull pain; slow burning, cold temperature

Table 1: Characteristics of primary afferent fibres. (Reddi et al., 2012 – Page 2)

They are involved in the Gate Control Theory of pain by Melzack and Wall (1996) which states that activity in large non-nociceptive fibres can inhibit the perception of activity in small nociceptive fibres, as well as

descending activity from the brain. In other words, large myelinated fibres carry fast action potentials that are able to activate inhibitor neurons in the dorsal horn of the spinal cord which, in turn, shut down 2nd-order neurons before slower, nociceptive signals can reach and suppress the same inhibitor neurons via unmyelinated fibres (Fox, 2014). Aβ and other myelinated fibres are able to transmit signals this fast thanks to Schwann cells, which provide an insulating covering that is called myelin, and to nodes of Ranvier, which separate each Schwann cell and provide rapid axon "saltatory conduction", with the action potential jumping from node to node (Fox, 2014) *(Figure 2)*. This theory explains why, even in the occurrence of the transduction of a nociceptive stimulus, when rubbing or gently pressing the site of injury, it is possible to block or attenuate the sensation of pain.

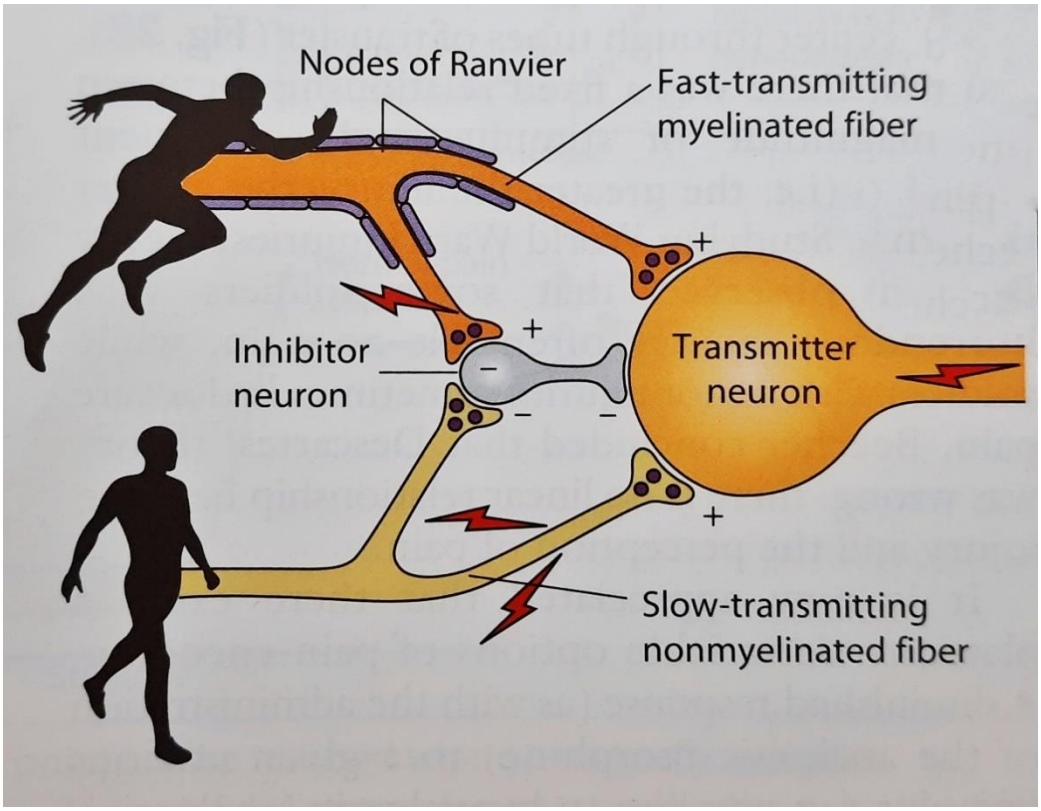

Figure 2: Melzack and Wall's Gate Theory of pain. Signals conducted through the fast-transmitting myelinated fibre reach the inhibitor neuron faster than those from the slow-transmitting unmyelinated fibre. The inhibitor neuron then shuts down the transmitter neuron, rendering the signal from the slow-transmitting unmyelinated fibres ineffective. (Fox, 2014 – Chapter 4, page 61)

The 1st-order neurons have their cell body inside the segmental dorsal root ganglion (DRG) and extend their branches into the grey matter of the dorsal horn of the spinal cord, where they make a synapsis with 2nd-

order neurons. The dorsal horn is divided in several zones or laminae containing the 2nd-order neurons, which altogether form columns extending the length of the spinal cord up to the brain stem (Muir III & Woolf, 2001) *(Figure 3)*. These neurons differ in type and function: interneurons, involved in local processing and modulation of nociception and of excitatory or inhibitory nature; reflex arcs neurons, stimulating efferent motor fibres or sympathetic fibres that determine the release of cytokines at the injury site; projection neurons, ascending up the spinal cord into the fore and midbrain; nociceptive-specific neurons and wide dynamic range neurons, responding respectively to Aδ and C fibres only, and to Aβ fibres also. All these types of 2nd-order neurons interact and take part in the overall processing and integration of nociceptive information that leads to the animal's perception and response to pain (Fox, 2014).

The ascending neurons – projection neurons – have their fibres decussate a few segments after they synapse in the dorsal horn of the spinal cord, which means that their axons carry the information up to the contralateral side of the spinal cord to the brain, thus nociceptive inputs from the right side of the body travel on the left side of the CNS and vice versa (PerioperativeCPD Team, 2022).
In their pathway to the brain, these fibres form several tracts or columns, of which the most relevant are the spinothalamic (STT) and the spinoreticular (SRT) tract. The STT is located in the white matter of the spinal cord and carries mostly Aδ fibres through the brain stem to the thalamus, focusing on information about temperature, crude touch, firm pressure and pain, with 3rd-order neurons then projecting to the somatosensory cortex *(Figure 3)*. The SRT carries C fibres to the reticular formation and then to the thalamus and limbic system, being involved in the memory and emotional component of pain (Yam et al., 2018). The STT also sends projections to the periaqueductal gray matter

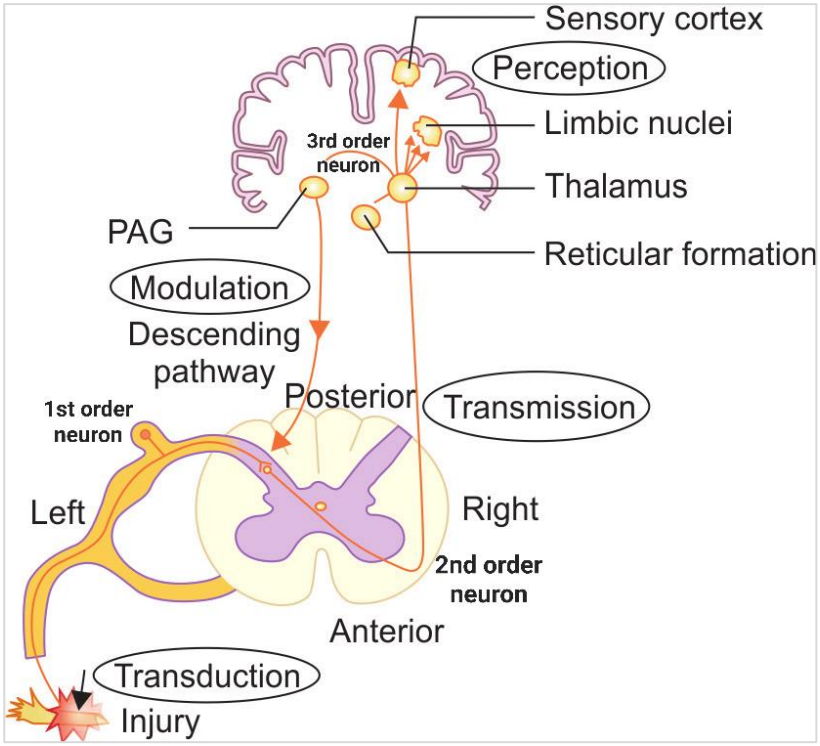

Figure 3: Pain pathways (Courtesy, basics of pain management by Guntam Das)(Das, n.d.)

(PAG) that is involved, as well as the SRT itself, in descending inhibitory systems that modulate the incoming nociceptive signals.

1.3.3 Perception

Perception is the last step in the nociceptive pathway and is defined as the conscious processing of pain. The somatic sensory information converges to the thalamus from the diverse nerve circuits as previously described and from there to the somatosensory cortex, which in turn projects the same information not only to adjacent areas of the cortex itself but also to the limbic system and frontal lobe. The somatosensory cortex is responsible for the identification of the nature of noxious stimulus, such as its location, intensity and duration, before it triggers a secondary efferent pathway that is the response to that pain perception. The limbic system[1] and frontal lobe are on the other hand involved in the emotional experience of pain, relating the perception to past experiences,

[1] The limbic system includes: the cingulate gyrus (involved with behaviour and emotion), amygdala (conditioned fear and anxiety), hippocampus (memory), hypothalamus (sympathetic autonomic activity), locus coeruleus (arousal, vigilance, behaviour), and portions of the periaqueductal gray matter (fight or flight response, stress induced analgesia), (Muir III & Woolf, 2001).

memories and cognitive activities. Recent studies on human brain based on positron emission tomography (PET) and magnetic resonance imaging (MRI) have also shown a change in blood oxygenation in specific cortex areas during acute pain experiences. These areas include the primary and secondary somatosensory cortices (S1 and S2), the anterior cingulate cortex (ACC) and the insular cortex (Bridgestock & Rae, 2013), the prefrontal cortex (PFC), insula, amygdala, thalamus, cerebellum and the mesolimbic reward circuit (Ossipov et al., 2014). This may be referred to as a complex network of neural associations that is called "pain neuromatrix", since pain can be considered to be a multidimensional experience produced by characteristic patterns of nerve impulses generated by this brain network (Cantón-Habas et al., 2022). These patterns can indeed be triggered by somatosensory stimuli but may also be elicited independently of them. The autonomous trigger of the pain neuromatrix is thought to be involved in chronic pain mechanisms, especially regarding chronic physical and psychological stress (Melzack, 2001).

1.3.4 Modulation

The nociceptive signals coming from the periphery to the CNS are not immutable but undergo a modulation operated by different agents along the pain pathway. As important as the ascending sensory system are fibres that descend from the brainstem to the spinal cord which modulate, as said, the incoming signals (Fox, 2014). Modulation can explain why different individuals can respond differently to the same painful stimulus and also why the activation of pain neurons and the sensory experience of pain do not always coincide (Kirkpatrick et al., 2015).

The primary centre of control for descending pain modulation is the periaqueductal gray (PAG) – a portion of gray matter that encloses the cerebral aqueduct, located in the midbrain – which receives fibres and inputs from the cortex, the thalamus and the limbic system, before signalling to the rostral ventromedial medulla (RVM) to activate the descending inhibitory pathways. The PAG is also an endogenous opioids-

producing site, thus being involved in descending opioid-mediated inhibition of nociceptive ascending inputs. This brain site therefore creates interactions with ascending and descending projections from numerous sites and is a primary agent in the modulation of nociceptive inputs and pain perception (Ossipov et al., 2014).
The endogenous opioid system includes three opioid peptide families that are endorphins, enkephalins and dynorphin; the PAG is characterized by the presence of, mainly, enkephalinergic neurons (Saraswati & Forshing, 2022). These peptides carry out their action by stimulating specific receptors that are μ-, κ- and δ-opioid receptors, with differences in affinity and selectivity for the different peptides. Among the various effects of opioid stimulation is pain suppression, regarding both ascending and descending pain pathways: in the dorsal horn of the spinal cord there are interneurons that produce endogenous opioids, which are able to stimulate postsynaptic opioid-receptors with hyperpolarisation of ascending Aδ and C fibres – thus blocking the propagation of the nociceptive stimulus – and to activate presynaptic sites, inhibiting the release of glutamate and substance P (excitatory neurotransmitters).
The descending pain suppression pathway is also modulated by the PAG's production of endogenous enkephalins that act as suppressors for the release of GABA (gamma-aminobutyric acid), which would in turn inhibit the PAG itself. With opioids permissive action, neurons in the PAG then activate serotoninergic and noradrenergic fibres from the Nucleus Raphe Magnus (NRM) and RVM respectively, ensuring an inhibiting effect at the spinal cord level.

The descending inhibitory systems include different brainstem nuclei that produce notable neurotransmitters – such as norepinephrine (NE) and serotonin (SE) – with an antinociceptive effect when reaching the dorsal horn of the spinal cord. The PAG indeed connects with the RVM from which these NE- and SE-releasing fibres descend to the dorsal horn of the spinal cord, inducing inhibitory or analgesic effects (Fox, 2014). The RVM provides a bidirectional pain modulatory effect, both inhibiting and facilitating pain. In this brain site can in fact be found

"on-cells" and "off-cells" with descending projections to the spinal dorsal horns, that respectively increase their activity and cease firing after a noxious stimulus; in addition, opioids inhibit on-cells and stimulate off-cells. The RVM contains the serotoninergic Nucleus Raphe Magnus (NRM) and Nucleus Reticularis Gigantocellularis (NRG), as well as GABAergic and glycinergic neuronal populations, but it is not yet clear whether these neurotransmitters are all produced by the on- and off-cells or there are specialized populations for each one (Winkler et al., 2006). However, sufficient evidence is present to indicate that the activation of descending projections from the RVM results in the release of serotonin in the dorsal horns of the spinal cord, either from direct projection terminals or from spinal interneurons. Spinal serotonin (5-hydroxytriptamine, 5-HT) can though have both an antinociceptive and pronociceptive effect, according to the receptor subtype activated: activation of the 5-HT1A, 5-HT1B, 5-HT1D and 5-HT7 receptors tends to be antinociceptive (Suzuki et al., 2004).

The RVM also receives projections from the locus coeruleus and other pontine noradrenergic nuclei, with the former being the major norepinephrine-producing site in the brain. Various animal studies have shown that electrical or chemical stimulation of these noradrenergic nuclei, as well as the PAG or the RVM, determines the release of NE into the cerebrospinal fluid, producing analgesia that was blocked by spinal administration of α2-adrenergic receptors antagonists. It is then clear that the activation of spinal α2-adrenergic receptors can inhibit nociceptive transmission, both presynaptically and postsynaptically, and also show synergic action with opioids (Ossipov et al., 2014).

1.4 Chronic pain mechanisms

Adaptive or nociceptive pain has a useful purpose since it protects the organism from further potential damage, is usually acute and lasts until the noxious stimulus ceases to act. In contrast, maladaptive pain is persistent and often arises from injury to the peripheral or central nervous system (Fox, 2014). The development of chronic pain provides for a transition from adaptive to maladaptive pain, which begins with a physiological phase of acute, nociceptive pain, resulting from the normal processing of a noxious

stimulus. The stimulus can though be very intense or prolonged, leading to a phase of inflammatory pain caused by the maturation of inflammation and tissue damage at the peripheral injury site. This condition determines a change in the ascending nociceptive pathway in the CNS which, as a result, moves to a more excitable state that is defined as hyperalgesia. Hyperalgesia can interest the very site of injury, then termed primary hyperalgesia, but also the surrounding areas of normal tissue, as secondary hyperalgesia, and is characterized by an enhanced perception of pain (Yam et al., 2018). This kind of alteration is termed peripheral sensitization.

Peripheral sensitization is a state of hypersensitivity of nociceptive nerve fibres and peripheral nociceptors to noxious stimulation, and can also lead to a reduction in the pain threshold, so that stimuli that are not normally noxious can come to be so (allodynia). This state is caused by the release, in the site of injury, of the contents of damaged tissues into the extracellular environment, as well as products from inflammatory cells such as neutrophils, mast cells, macrophages, and lymphocytes (Muir III & Woolf, 2001). It is in fact the action of prostaglandins (PGs) and cytokines that induces a lowering in the firing threshold of Aδ and C afferent at the site of injury.
When the disruption of pain pathways and central systems persists, a phase of chronic, abnormal pain can occur as the consequence of a primary lesion or dysfunction of the neural processes within peripheral nerves or within the CNS (Fox, 2014). This is called maladaptive pain and is often, indeed, neuropathic. The prolonged phase of lowered threshold in peripheral nociceptors leads to heightened excitability of dorsal horn neurons, that are continuously stimulated by the increased action potential firing and release of neurotransmitters. This increased sensitivity of dorsal horn neurons is termed central sensitization, and is also associated with the recruitment of N-methyl-D-aspartate (NMDA)-type glutamate receptors, which activation triggers signalling pathways and changes in gene expression that leads to a long-term shift in the activity of nociceptive circuits. In addition, active microglia of the dorsal horns release a mediator called brain-derived neurotrophic factor which reduces the effects of GABA and glycine, the main inhibitory central neurotransmitters, and an increase

in glutamatergic transmission occurs, causing the death of inhibitory interneurons (Scholz, 2014). Another change that has been demonstrated to occur during central sensitization is a phenotypic rearrangement of Aβ fibres in cutaneous tissues: these fibres usually carry sensory stimuli such as light touch and pressure, but in the presence of chronic stimulation (e.g. inflammation) begin to produce neuropeptides that are normally associated with C fibres (Courtney et al., 2017).

The consequence of all these alterations is then a major imbalance between inhibitory and excitatory pathways, regarding both central and peripheral nervous system *(Figure 4)*. This imbalance is indeed responsible for a deficiency in pain modulation and control, thus potentially leads to the development of chronic pain.

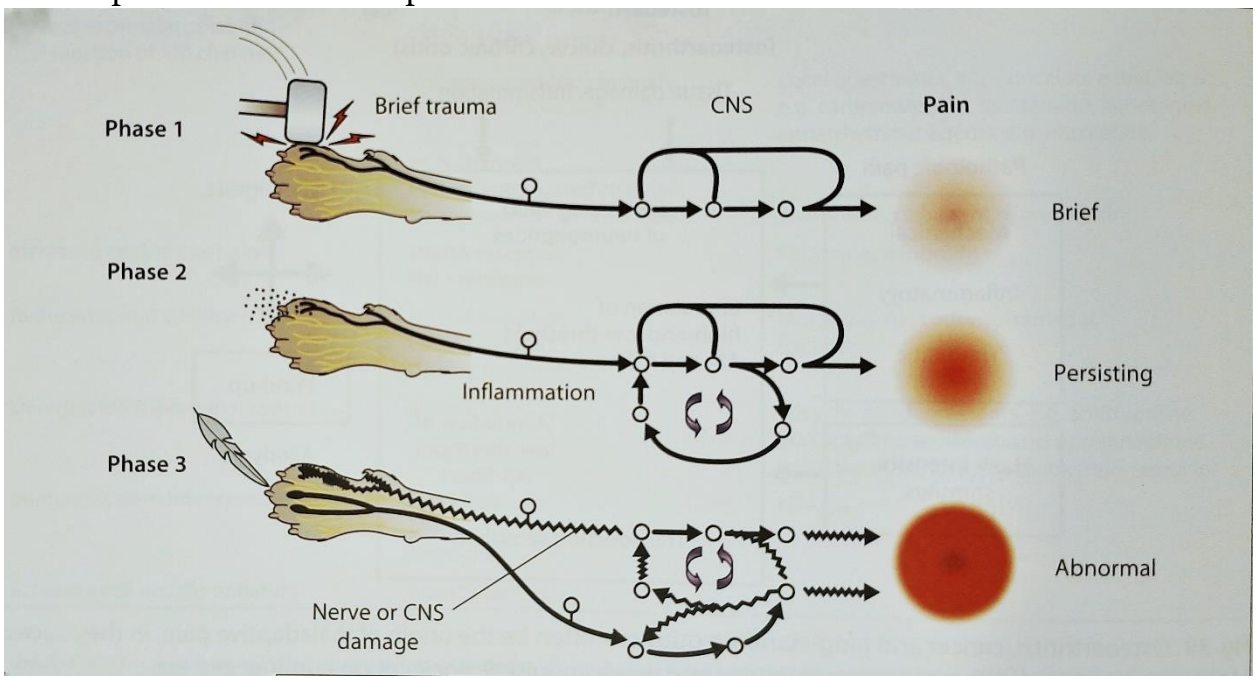

Figure 4: Progression of adaptive to maladaptive pain. (CNS: Central Nervous System)(Fox, 2014 – Chapter 4, page 78)

2. ACUPUNCTURE IN VETERINARY MEDICINE

2.1 Historical notes

Acupuncture is an ancient healing method belonging to Eastern cultures and specifically to Traditional Chinese Medicine (TCM). It is based on the use of fine needles to puncture the dermis in specific points called "acupoints" that correspond to the superficial route of an individual's energy vessels. In fact, according to TCM acupuncture may be used to treat pathological conditions that are caused by an alteration or imbalance in the flow of energy in the organism.
Although acupuncture is often called an "ancient" tradition, there is no archaeological or historical evidence that needles were used therapeutically in China prior to the 2nd century BC. The earliest reference to "needling" is found in the historical text *Shiji* by *Sima Qian*, dated circa 90 BC, but it could merely refer to lancing abscesses or blood-letting and not to the usage of needles following meridians and insertion points to obtain a specific healthcare (Ramey & Buell, 2004). Later, approximatively between 320 BC and 260 AD (Unschuld, 2003), the *Huangdi Neijing* ("The Inner Classic of Huangdi" or "The Yellow Emperor Classic of Internal Medicine") introduced the practice that later became human acupuncture commonly understood, implying the manipulation of energy flow in channels by means of needling. Actually, the text gives instruction on how to treat diseases by blood-letting but does not deal about specific skin points at which needles can be inserted. However, it is theorised that the practice developed into acupuncture since the aim went from removing altered blood from the body to regulating the imperceptible Qi energy (Ramey & Buell, 2004). During the following centuries acupuncture continued to be developed and gradually became a standard therapy in China, alongside the use of herbs, massage, diet and moxibustion. Although many different esoteric theories about acupuncture emerged and tried to prevail on one another, during the Min Dynasty (1368 – 1644 AD) the text *Zhen jiu da cheng* ("The Great Compendium of Acupuncture and Moxibustion") introduced the methodology of acupuncture using different types of needles (*Figure 5*) and

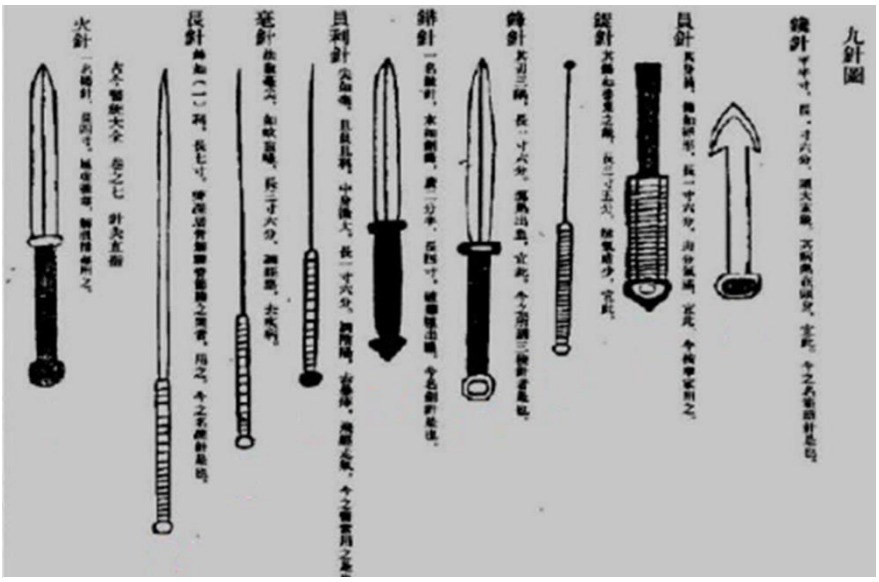

Figure 5: Illustration of nine needles in Gu Jin Yi Tong Da Quan ("Great collection of ancient and modern medicine) by Xu Chunfu, dated in the Ming Dynasty. (Hu & Liu, 2020)

the treatment of illnesses. It reported accurate description of all 365 acupoints that are still in use, as well as various herbal medicines (White & Ernst, 2004). From the 17th century onwards, interest in acupuncture begun to decline as it was regarded as esoteric and irrational "medicine" and it was excluded from the Imperial Medical Institute by the Emperor himself in 1822. When Western medical knowledge begun to spread around Eastern countries, at the beginning of the 20th century, the practice of acupuncture and other forms of traditional medicine were eventually outlawed in 1929. Nevertheless, TCM was reintegrated twenty years later during the communist government just to provide basic level of health to the massive population, especially in rural areas where actual modern medical sources were not available. Since then, acupuncture research institutes were established throughout China and the treatment became available also in Western-style hospitals. It was also promoted by continuous scientific studies on this traditional practice and integration of Western medical knowledge into it. In the meantime, interest in acupuncture in Europe was flourishing already at the beginning of the 16th century, when Europeans became generally aware of this practice thanks to the return of early missionaries from the Chinese interior and the Chinese Imperial Court (Ramey & Buell, 2004). Over time, acupuncture saw several waves of interest not only in Europe but also in the USA. The traditional theories have been largely challenged by westerners, with the ancient concepts of Qi

and meridians displaced by neurological and hormonal models (White & Ernst, 2004).

2.2 Traditional Chinese Veterinary Medicine and Acupuncture

The history of Traditional Chinese Veterinary Medicine (TCVM) is not as noticeable as human's, but there are a few evidences that prove an interest and care towards animals in ancient times. In fact, under the West Zhou dynasty in China (1111 – 771 BC) a Veterinary Department was established as animal and human health were considered of equal importance (Balieva & Kostadinova, 2016). Many medicinal and therapeutic veterinary texts were written in the following centuries and the most detailed one, which includes also notions on animal acupuncture, is the above-mentioned *Huangdi Neijing* ("The Inner Classic of Huangdi" or "The Yellow Emperor Classic of Internal Medicine"). Later on, during the Common Era, TCVM started to flourish and developed itself as a separate branch of medicine, with many important textbooks published on the matter. The most regarded species were working animals, especially horses (*Figure 6*), since they were employed in farms as well as in war and thus they were highly considered.

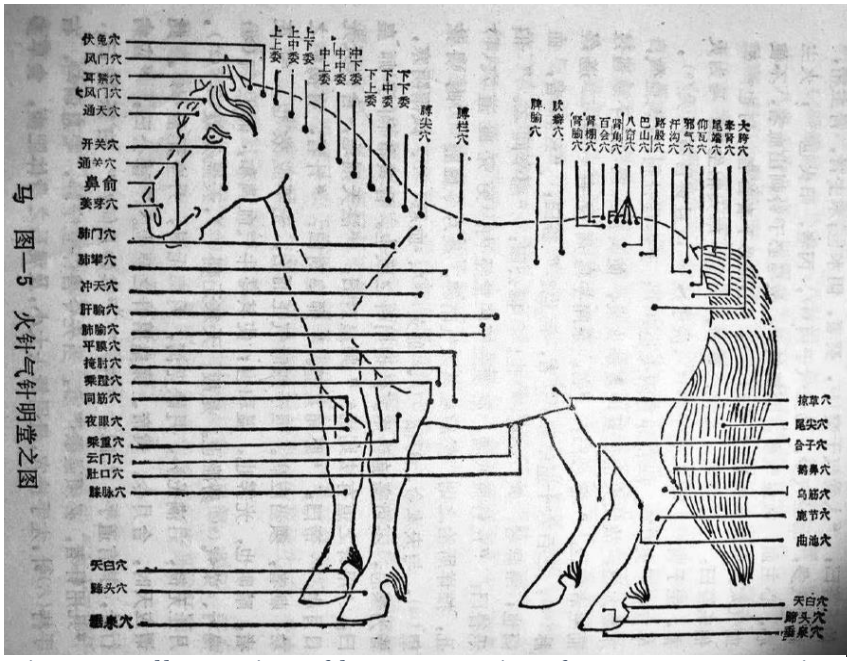

Figure 6: Illustration of horse acupoints from Yuan Heng Liao Ma Ji ("Yuan Heng's Classical Collection on the Treatment of Equine Diseases", 1608 AD), in which one of the chapters was devoted to the application of acupuncture in the treatment of equine diseases. (Hu & Liu, 2020)

During the Tang dynasty (618 – 907 AD) a highly-developed veterinary system was established and also the first veterinary college, the Tai Pou Shi, was founded (Lin & Panzer, 1994). Over time, the TCVM techniques were upgraded also for other species and the *Chuan Ya Shouyi Fang* ("Compiled Veterinary Formula") was published during the Qing dynasty (1644 – 1911). It concerned teachings on treatment of horses, cattle, goats, sheep, dogs, cats, deer, elephants, chickens, birds, goldfishes and turtles (Balieva & Kostadinova, 2016). In 1904, at the end of the Qing dynasty, the first Western-style veterinary school was established in Hebei province. Though, the process of modernization of Chinese ancient medical techniques pressed onward until it was banned, along TCM, during the Cultural Revolution (1966 – 1976). After this period of neglect, traditional Chinese medicine and its veterinary counterpart regained importance throughout China and in 1979 a group of practitioners founded the National Association for Chinese Medicine (Balieva & Kostadinova, 2016).

Veterinary acupuncture, being part of the TCVM's practices, has not been historically studied in depth either, thus there is not precise and coherent information about it. What is clear is that acupuncture as it is performed today is a relatively modern practice, since cats and dogs, as the most common domestic species, were not considered so in Eastern countries until a few decades ago. The few historical sources that describe veterinary acupuncture as an antique Chinese tradition are actually unsupportable because of a misleading translation of ancient textbooks. The practice of "needling" (from the Chinese word *zhen*) was very much distant from the use of needle we picture today, following a complex chart of points and meridians that are linked with one another. It was rather referring to lancets or blades used for phlebotomy or lancing abscesses and other lesions. Furthermore, the word "points" (Chinese *xue*) used in these texts might be confusing since it does not actually refer to an organised and connected series of points and the theoretical system developed in human acupuncture is entirely lacking in veterinary acupuncture (Ramey & Buell, 2004). It appears then that much of the "historical" practice of human and veterinary acupuncture is indeed recent and of modern origin. For example, the association of Qi as a form of energy and the coining of the term

"meridian" is dateable to 1939, while animal acupuncture channels date only to the 1970s and were actually invented at the insistence of Western practitioners (Ramey & Buell, 2004). The acupoints and meridians currently employed in animals are therefore a transposition from human charts, even though this transposition fails to find any agreement between such charts and traditional Chinese animal illustrations (Panzer, 1993), that merely regarded working animals such as horses and cattle.

2.3 Use of Veterinary Acupuncture

The use of acupuncture today is often considered under the term Complementary and Alternative Veterinary Medicine (CAVM), or also Integrated Medicine, since most of the practitioners add acupuncture as an additional therapeutic tool along conventional medical therapies. After the modernization of Chinese medicine, acupuncture too has been influenced by a more scientific and evidence-based approach, thus being used mainly in the areas of analgesia and anaesthesia – where, indeed, its effectiveness has been scientifically proven. However, there are still some practitioners that are confident to the traditional use of acupuncture. In fact, according to the classical theory acupuncture is used to correct an imbalance in an individual's energy flows, that causes illness. This energy is called Qi and travels through channels, or meridians, that cross the whole body creating connections between different Zang and Fu (organs and bowels) and reaching the surface of the body to create, by means of acupoints, a contact with the outside. Qi originates from the interaction of Yin and Yang, two polarities that are opposite but also complementary to each other and that govern the outside universe and the inside universe (the organism of living beings) as well. When these two forces are equal and balanced there is a healthy state, but when an alteration of this balance occurs and Yin prevails on Yang – or vice versa – the illness arises. The use of needles in this case is capable of re-establishing the balance of Yin and Yang in the body and the correct flow of Qi through the stimulation of acupoints. Pathology and syndromes in TCM are very complex and multifaceted and require a thorough study and diagnosis analysis. The easiest way to describe a disease is by means of the eight principles (Yin – Yang, interior – exterior, heat – cold, deficiency – excess) but other

classifications can be used, such as Qi, Blood and Fluids syndromes, external pathogens syndromes, five movements syndromes, and six energetic levels syndrome. According to the eight principles and the TCM in general, we are to treat the organism as a whole and not the disease in itself. Acupuncture does not treat a distinct affection of a single organ or apparatus but realigns the body's energy and status of health. Consequently, acupuncture cannot be indicated just for a specific disease.

Speaking in modern terms instead, acupuncture is used with a scientific approach and following neural patterns rather than meridian flows. Western practitioners take into consideration the various local and central effect of acutherapy to treat specific conditions mainly in the areas of analgesia and anaesthesia. Nonetheless, scientific studies prove the efficacy of acupuncture for the treatment of reproductive disturbances (Chan et al., 2001) and dermatological conditions (Schoen et al., 1986).

2.4 Acupuncture for pain management

Acupuncture is a highly valid method to treat pain and its use is expanding among small animals' practitioners. It is often used as an adjunct to conventional practices or as an alternative treatment when common therapies fail to resolve the patient's pain. Acupuncture can be taken into consideration also when the practitioner is seeking a drug-free treatment, given possible underlying conditions of his patient (Huntingford & Petty, 2022). The most updated WSAVA guidelines regarding canine and feline pain management included acupuncture as a non-pharmaceutical treatment for small animal pain of different nature (Monteiro et al., 2022).
According to TCVM pain is caused by a blockage of Qi's flow or the complete absence of energy around a specific area. Through the positioning of needles (or other means of stimulation) in specific acupoints it is possible to resolve this energy imbalance and treat the pain. Not all the acupoints that can be treated are located in the area in which pain origins but many acupoints are distributed on the meridian's pathway. In fact, the stimulation of an acupoint can produce effects not only on the affected organ but also on various parts of the organism (Xie & Preast, 2007). TCVM uses metaphorical/philosophical language to describe patterns of

disease, treatment and pathophysiology. However, the terminology can be translated into scientific principles that can be understood by the conventionally trained veterinarians. In modern scientific terms, the placement of needles into the dermis produces local, segmental ad suprasegmental effects that include the release of cytokines and neurotransmitters such as NGF (nerve growth factor), endogenous opioids, encephalin, endorphins and serotonin. Consequently, it is clear that acupuncture can relieve pain not only through a local relaxation of muscles and connective tissue but also with central “analgesic” effects on the spinal cord and brain nuclei (Huntingford & Petty, 2022). The most of the scientific researches on acupuncture for analgesia and pain management concern humans or laboratory animals but there are many recent clinical studies in companion animals too. These studies showed the effectiveness of acupuncture at mitigating pain for musculoskeletal diseases such as hip dysplasia, cranial cruciate ligament disease (Silva et al., 2017) and osteoarthritis (Janssens, 1986). Other studies tested the effectiveness of acupuncture to treat pain associated with cervical neurological diseases (Liu et al., 2016) and as pre-emptive treatment for ovariohysterectomy in cats (Sousa et al., 2012). Another interesting study compared the effects of electroacupuncture (EAP) and laseracupuncture (LAP) on 31 dogs with degenerative joint disease (DJD). These treatments demonstrated statistically significant hip pain reduction and an increase in ROM (range of motion) on both flexion and extension angles that suggests that hip joints gain flexibility after EAP and LAP (Chomsiriwat & Ma, 2019).

3. ACUPUNCTURE IN TRADITIONAL CHINESE VETERINARY MEDICINE

According to Traditional Chinese Veterinary Medicine (TCVM), acupuncture is a technique traditionally used to re-establish a condition of balance of the energy flows within channels throughout the body. The whole basis of TCVM lays in the philosophical and religious thought of Taoism and the principle of Tao. The energy, called Qi, and channels, or meridians, are two of the five most important principles of TCVM. The others are Yin and Yang, the five movements and Zang Fu. These five elements are fundamental to explain how the macrocosm and the microcosm function (Xie & Preast, 2007).

3.1 Tao

Traditional Chinese Veterinary Medicine is based upon a deductive approach that has its starting point in the principle of Tao. Tao is the primordial entity from which everything origins. This concept is described in the *Tao Te Ching*, a collection of poetry and sayings from around the 3rd and 4th centuries BC that guides Taoist thought and actions (National Geographic Society, 2023). Its author is traditionally believed to be Lao Tzi, but it is now commonly assumed that this text is an anthology of previously orally transmitted materials (Moeller, 2012).
As Lao Tzu said, before all else there was a transcendental, heterogeneous "non-being", the origin, the Mother, the Tao. It gave birth to being, as mother of all creatures and of the world as it is known. The ideogram of Tao presents two roots that are a foot and a face that produces radiations. The foot symbolizes a journey, while the face is likely emitting a thought. Tao is then the way that must be followed to accomplish oneself.

"Tao gives birth to One,
One gives birth to Two,
The Two gives birth to Three,
The Three gives birth to all universal things.
All universal things shoulder the Yin and embrace the Yang.
The Yin and Yang mingle and mix with each other to beget the harmony."
(Lao Tzu, 1996)

In the beginning Tao was in the state of "Wuji", which means absence of limits or extremes and can then be translated as infinite, unlimited, boundless or limitless. Wuji refers to the unmanifest aspect of Tao: Tao-in-stillness, which is essentially nondual and represented by an empty circle. At one point though, inside the Tao itself, two polarities of opposite sign originated. These were the fundamentals of the universe: Yin and Yang (Giussani, 2015).

3.2 Yin and Yang

Tao, in the original state of Wuji, generated the two polarities Yin and Yang that were fundamental to create the movement. They are represented by the symbol of the *Taijitu* where "Taiji" refers to Tao-in-motion, the spark of movement. The symbol is composed of a sphere divided in two identical sinusoidal halves that merge into one another *(Figure 7)*. The black half is Yin and the white one is Yang, but each one embraces a seed of the opposite colour, meaning that nothing is Yin or Yang exclusively. The two polarities are indeed complementary and opposite at the same time. One is active and the other is passive, one creates and contains the other but Yin could not exist without Yang and vice versa. They permeate all the universe and their balance determines the universal harmony of the macro- and microcosm. In addition, the Taijitu helps us to understand how

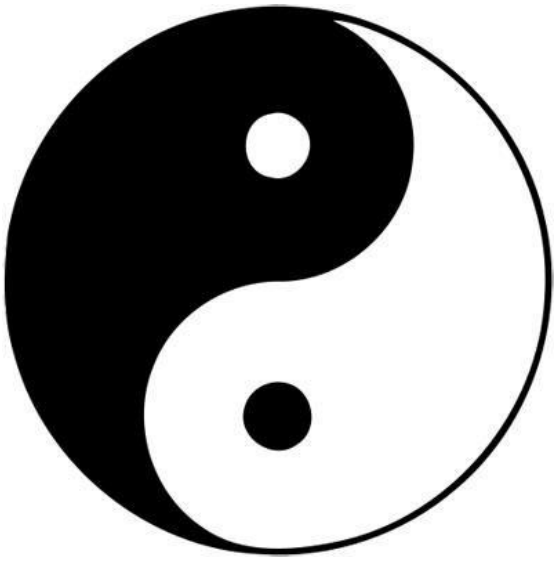

Figure 7: Taijitu, the most popular Yin Yang diagram. It is said the symbol was revised by Taoist sage Chen Tuan (872-989 CE) based on the Taiji image in the Book of Changes (Yi Jing). (D. Zhang, 2019)

Yin grows to its maximum, reaches its peak and exactly while doing that it starts to merge into Yang (Giussani, 2015).

The characters of Yin and Yang represent respectively the overcast (north) and the sunlit (south) side of a mountain. Yin contains three elements that symbolize a hill, people under a roof and clouds. Yang is also divided in three elements that represent again a hill along with a sun over the horizon and light beams (or steam) that point upwards *(Figure 8)*. Yang, that is light, sun and sky, develops during the day, reaches its maximum at midday and then it starts to leave its place to Yin that is contained in itself. Yin gradually becomes manifest with darkness, moon and earth, and then it decreases and returns to being Yang (Giussani, 2015). The cycle of transformation of Yin and Yang is continuous and perpetual, each one contains the root of the other. They are complementary because they form a unit and nothing is absolute Yin or absolute Yang, one mutes into the other and vice versa (Xie & Preast, 2002).

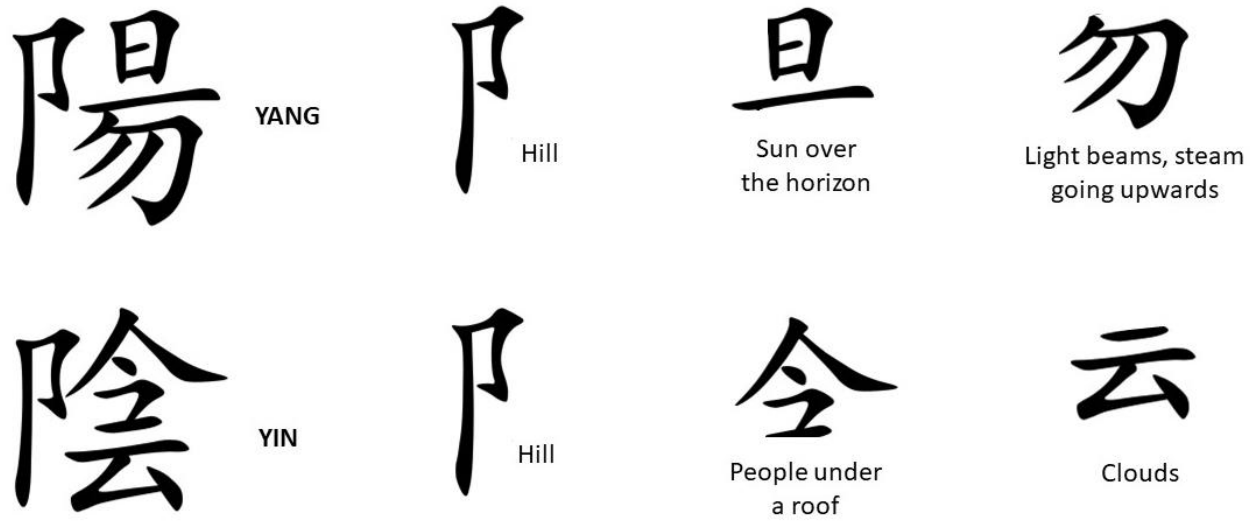

Figure 8: Yin Yang Chinese ideograms or characters explained. (Wikimedia Commons, 2016)

Yin and Yang are tied by four basic principles: opposition, interdependence, mutual consumption and inter-transformation. They are opposite states of a cycle, the opposition is the engine of every rearrangement, transformation and decay. Yin and Yang are interdependent since one cannot exist without the other and they mutually consume one another because one grows while the other decreases, always in a dynamic balance. Furthermore, Yin constantly transforms into Yang and vice versa, in a limitless circle of inter-transformation (Xie & Preast, 2002).

3.3 Qi

The Two gives birth to Three: Qi is the product of Yin and Yang as vital energy, breath, vapor, force, ether, power in movement. Qi is at the root of every phenomenon that occurs in the universe, it can be found everywhere, it flows unobstructedly and is constantly moving. It represents continuity between raw, material elements and thin, intangible energies. The Chinese character of Qi contains two elements that represent ascending vapor and a bundle of rice *(Figure 9)*. The vapor symbolizes immaterial dispersion towards the sky, while the rice is a material element capable of generating energy when cooked (Giussani, 2015).

Figure 9: Qi Chinese ideogram or character. (Wikimedia Commons, n.d.)

Qi persistently reveals itself by means of the interaction of Yin and Yang, present in any natural and human phenomenon. All that exists is made of energy. This energy is necessary to living beings and to the universe to keep existing and maintain a movement. It freely flows and when it does, all the vital processes are active, harmonious and balanced. For humans and animals, this condition of balance and harmony constitutes the healthy state. If this energy encounters a disharmony and its balance gets impaired, then it will manifest itself with illness (Xie & Preast, 2002).

3.4 Five Agents

From the Chinese word "*Wuxing*" – where Wu stands for "five" and Xing stands for "walking" – the five movements do not represent natural elements but rather five rules of motion that govern the macro- and microcosm. Just as Qi and Yin Yang, the five movements are fundamental processes or phases of a cycle, possibilities of change of a phenomenon. They are the ways through which Qi expresses itself and through which

humans and animals interact with nature (Giussani, 2015). The alternation of Yin and Yang in Qi's flow and following the movement of Wuxing represents the healthy state, the dynamic balance and the harmonious transformation that can be experienced in life (CRIBES, 2019). The five movements or agents are: wood, fire, earth, metal and water. They are indissolubly tied and synthesize the perpetual movement. Their interaction generates harmony and everything that surrounds them is in order. They also represent the different phases of transmutation of Yin and Yang and each Wuxing is characterized by a dominant polarity (Xie & Preast, 2002).

Wood represents energy, growth, expansion, flexibility, creativity. The ideogram is representative of wood itself: a stem that emerges from the soil reaching the sky with its branches, though still remaining tied deep in the earth with its roots. Wood represents the perfect dialectic hardness/flexibility – trunk/branches but it is also the emblem of the life cycle that renovates itself in spring. Wood wakes up from winter (Yin) torpor and comes back to its life and growth (Yang) in the passing moment that is spring. Wood is in fact considered minor Yang and is associated with spring and east.

Fire represents light, heat, vitality, movement, transformation. It is one of the two cardinal elements according to TCVM. It is contradictory since it contains a transmuting force: it brings warmth and light but at the same time it can burn and destroy. For the Chinese, Fire is the symbol of transformation and rebirth, destruction of what is material to obtain the pure spiritual essence. It is a supreme Yang element but it contains a Yin part that is manifested when the Yang side gets tamed, for example when the fire is contained inside the hearth. Fire is the major manifestation of life, it brings about bliss, joy of living and quest for happiness. This element is associated with supreme Yang, summer and south. It is so important that it owns a Complementary Fire that helps, sustains and protects the supreme one.

Earth represents nourishment, stability, sustain, fertility, centre. The main quality of this element is reception and dedication, it is the nourishing mother of all the other agents. Every movement has a deep relation with Earth: each one is born, thrives and dies into Earth's reign. This agent occupies a central position in the dynamics of Wuxing. It is the vital core from which all the other movements gain the energy that is necessary to their mutual transformation. It is the engine of movement, all that it receives and produces is in constant expansion towards all directions. Earth is mother to all the cycles and periodical manifestations, such as birth and death. Its centrality represents the point of balance of all the forces. Earth is associated with the season of late summer, when all the other Wuxing are contemporarily present and all concurring to the formation of life. It has not a defined polarity thus it is not Yin or Yang but central.

Metal is associated with value, structure, substance, communication, exchange, limits and boundaries. This agent characterizes the Earth's products, fortune as a personal value, such as integrity and judgement. Its nature is that of change, obedience to the master forger's will in virtue of its plasticity, hardness but also malleability. Metal represents a moment of stagnation and decay, as a period that precedes autumn thus when the year has surpassed its peak and slowly prepares for winter. It is considered minor Yin and it is associated with autumn and west.

Water is associated with life, deepness, flow, fluidity, purification, momentum. This element is representative of primordial chaos and it encloses an infinite potentiality. Water does not have precise qualities, it does not have shape, dimension or direction but it constitutes the basis of the universe. Every living essence depends upon water, it represents life itself. Water is capable of acquiring new shapes each time, in its natural movement of descent towards what's lower, deeper. It contains though a double dialectic of low/high: rain and rivers slide downwards but water vapor lifts towards the sky. Water is defined as major Yin and is associated with winter and north.
(CRIBES, 2019; Giussani, 2015; Xie & Preast, 2002)

3.4.1 Five agents' relationships

The five movements are ruled by four basic laws that explain their relationships: generation, control, overacting and insulting. The cycle of generation or nourishing cycle (*Sheng*) is also named "mother-child relationship" since it represents the relationship between the element that generates and the one that is generated. This cycle is represented graphically with a pentagon (*Figure 10*). Wood, as mother, with a sparkle generates Fire, which burns leaving only ashes that give birth to the Earth. Earth in its depths produces Metal which, passing to a liquid state, generates Water. The latter eventually nourishes the soil and gives birth to Wood, completing the cycle. The controlling or regulating cycle (*Ke*) is represented graphically with a five-pointed star (*Figure 10*). It has a balancing action on the cycle of generation, ensuring perfect balance and harmony on the flow of life. Wood dominates Earth, Earth controls Water, Water dominates Fire, Fire dominates Metal and eventually Metal controls Wood.

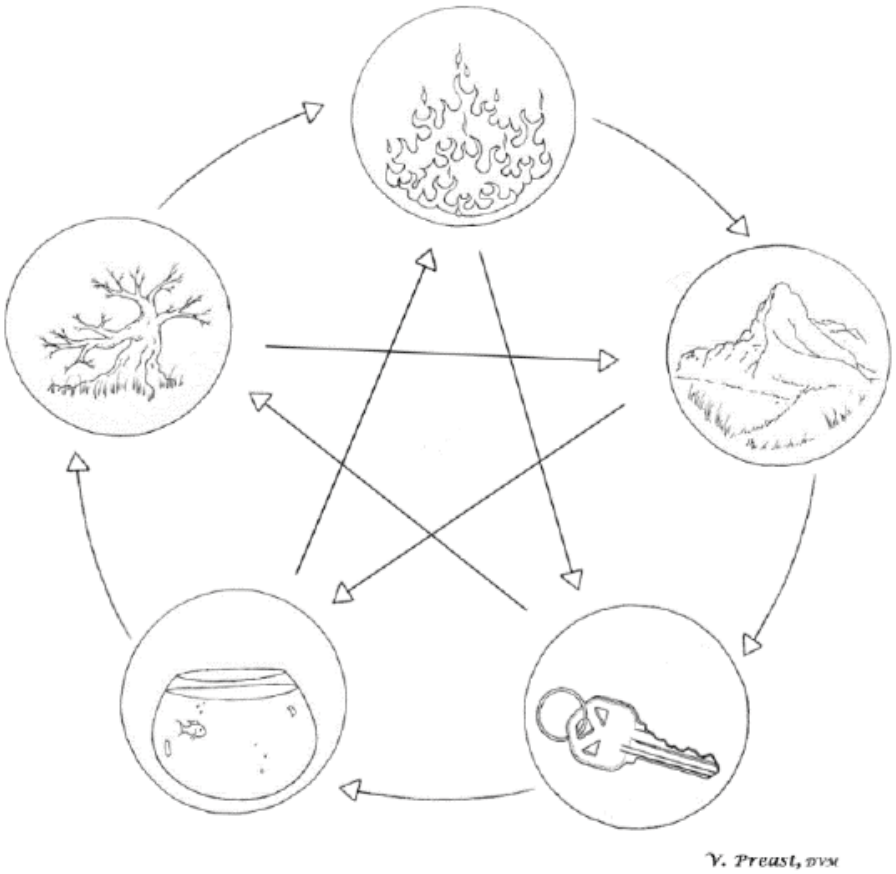

Figure 10: The cycle of generation (external clockwise pentagon) and the controlling cycle (internal five-pointed star route. (Xie & Preast, 2002)

When the control is excessive, the overacting or destructive cycle begins. It can happen for weakness of the generated movement or for hyperactivity of the controlling movement. This situation can though revolt itself, becoming an insulting cycle, when the controlled agent, for an excess of movement, rebels towards the controlling agent (Xie & Preast, 2002).

3.5 Zang Fu

In TCVM organs (Zang) and bowels (Fu) are two different entities. They have a specific function and a function related to the flow of Qi, blood and fluids. Zang Fu allow the development of life. They are solid and internal structures, thus intrinsically Yin. They get their names from real organs but are actually representative of a function of the system body-mind-spirit. Zang Fu are interfaced with external stimuli towards the meridians or channels that circulate throughout the body (*Table 2*).

	Polarity	***Characteristics***	***Organs***
Zang (organs)	Yin	Solid	Spleen, liver, kidneys, lungs, heart, pericardium
Fu (bowels)	Yang	Hollow	Stomach, gallbladder, bladder, large intestine, small intestine, triple heater

Table 2: List of Zang and Fu divided by polarity (Ross, 1985).

In some cases a physiological relationship can be found between the actual organ and its energetic counterpart, but not all the Zang Fu exist in western anatomy such as the Triple Heater. This can be explained by the fact that ancient Chinese studied physiological processes from the outside to define the inside and the related organs (CRIBES, 2019).

Zang organs are Yin and are also called “treasure organs”. Their function is that of producing, transforming, regulating and storing Qi, blood, fluids

and the other two treasures (*Jing* and *Shen*)[2]. Fu bowels are Yang and they are in charge of breaking up, adsorbing, transporting and eliminating the nourishment and its waste. There are also organs called "curious organs" that are in fact linked to the eight extraordinary or curious meridians. These are: brain, marrow, uterus, bones, blood vessels and gallbladder (as the unique Fu organ that links the curious organs to the primary channels) (Ross, 1985).

Following, the various functions of each paired Zang Fu will be briefly debated:

- Spleen (*Pi*): Rules transformation and transportation of Qi, as well as muscles and limbs. It governs blood, holds up the Zang, opens into the mouth and manifests in the lips. The spleen influences the separation of pure and impure fractions from the digestion and the former is sent up by the Spleen itself to the Lungs, where it is converted into Qi, Blood and fluids. If Spleen function is harmonious, there are sufficient substances for the needs of the body.
- Stomach (*Wei*): Responsible for receiving and ripening food and drink. The purer part goes via Pi to Fei where it becomes Qi, blood and fluids. The denser part is sent to the small intestine for further digestion and separation. The power of Wei is descending thus, if disturbed, it rebels upwards with nausea, vomiting and epigastric pain.

- Liver (*Gan*): Rules free-flowing of Qi and its smooth, unobstructed movement. It also stores blood and rules the tendons. It opens into the eyes and manifests in the nails. The Liver rules the smooth, unobstructed movement of substances throughout the body and hence the harmony an regularity of body functions and of behaviour.
- Gallbladder (*Dan*): Stores the bile produced by the Liver and releases it periodically to the small intestine to aid digestion. Dan is considered a Curious Organ since it resembles a Yang organ, being hollow, but also

[2] The Three Treasures, according to TCVM, are: Qi, Jing and Shen. Qi is vital energy or life force. Jing is the essence of life as related to one's genes and is inherited from one's parents. Shen is related to the emotional and spiritual side and is considered the divine spirit, a connection to a higher dimension. (Ute, n.d.)

resembles a Yin organ, storing a pure fluid. It is also closely linked to Liver and the two systems are both involved in the same disorders.

• Kidneys (*Shen*): Storing of Jing that rules birth, growth, development and reproduction along ruling the bones. It is also the foundation of Yin Yang, it rules the element Water and the reception of Qi. Kidneys open into the ears and manifest in the hair.
• Bladder (*Pang Guang*): It receives, stores and transforms fluids from the kidneys, prior to their excretion from the body as urine. This ability of the bladder is strongly dependent from Qi and Yang of the kidneys.

• Lungs (*Fei*): Rule Qi and govern respiration. They have dispersing and descending function, they move and adjust the water channels and rule the exterior of the body. Lungs open into the nose and manifest in the body hair.
• Large Intestine (*Da Chang*): Receives turbid fraction of the transformation products of food and fluid from the Small Intestine. It absorbs water and eliminates the remainder as faeces. Although it is paired with Lungs, Large Intestine is closely linked to Liver, Spleen, Stomach and Small Intestine and thus most of its disharmonies relate to the other digestive Zang Fu.

• Heart (*Xin*): Rules blood and vessels and stores Shen (mind). It opens into the tongue and manifests in the face. The Heart is the residence of Shen which is, in TCVM, the seat of consciousness. If the Heart receives adequate blood and Yin, Shen is hold properly and is harmonious, the mind is calm and peaceful with clear consciousness and mental activity.
• Small intestine (*Xiao Chang*): Receives the transformation products of food and drink from the Stomach and has the function of separating the pure from the impure. The pure part is sent to the Spleen while the turbid fraction in sent downwards to the Large Intestine. This bowel is though closely linked to the named organs in physiology and pathology.

• Pericardium (Xin Bao): It is the outer shield of the Heart, protecting it from invasion by external pathological factors. In clinical practice, points on the Xin Bao channel can be used almost interchangeably with points from Xin channel.
• Triple Heater (San Jiao): It is the most difficult Fu to understand and is characterized by controversy, both in China and in the West. It is said that San Jiao "has a name but no bodily shape". It can be divided into three Jiao which are upper, middle and lower Jiao, but it has different interpretation and functions according to different theories such as the Three Divisions of the body, the Fu system or the Jing Luo system.
(Ross, 1985)

3.6 Meridians

The *Jing-Luo* system – translated as "meridians system" by French diplomatic scholar George Soulié de Morant, who brought acupuncture to Europe in the early 1900s after spending years in China – can be considered as a complex map of the body with connections between each Zang Fu . It is so important that an ancient Chinese text from around 200 BC (*Ling-Shu* or "Spiritual Axis") states: "Jing-Luo determines life and death, treats all the diseases, and regulates both the Deficiency and Excess Patterns" (Xie & Preast, 2007). The Jing-Luo system is the pathway through which Qi and blood circulate. It regulates and connects the Zang Fu, providing also a connection with the external environment through superficial channels. This system forms a network that links the tissues and organs into an organic whole. Meridians represent the energetic manifestation of Zang Fu. They are not only linked to an organ's function but also to emotions, moods, mental and spiritual dimension (Ross, 1985).

This system is characterized by two main components that are *Jing-Mai* and *Luo-Mai*. "Mai" means vessels, while "Jing" means channel or main trunk and "Luo" means collateral or branch. Therefore, it is clear that Jing-Mai refers to major channels while Luo-Mai refers to smaller, collateral vessels. Jing-Mai consists mainly of 12 regular channels and 8 extraordinary channels. Luo-Mai is characterized by 15 collaterals, small branches and

superficial branches (Xie & Preast, 2007).

The 12 regular channels get their names from the organs and bowels they are linked to, and they have thus Yin or Yang qualities. Furthermore, each one of the five agents is associated with a pair of Zang Fu and consequently with a pair of meridians (*Table 3*).

Agent	***Yin meridian***	***Yang meridian***
Metal	Lung channel	Large intestine channel
Earth	Spleen channel	Stomach channel
Fire (major)	Heart channel	Small intestine channel
Fire (complementary)	Pericardium channel	Triple Heater channel
Wood	Liver channel	Gallbladder channel
Water	Kidney channel	Bladder channel

Table 3: List of agents and respective Yin and Yang meridians (and organs). (Xie & Preast, 2007)

These channels move longitudinally and are arranged symmetrically on both halves of the body. There are thus 24 paths, 12 on the left and 12 on the right side of the body. On the regular channels' pathways are located the points used in acupuncture, in fact these channels are the only ones to have their own acupoints. They actually possess two pathways: a deep one that enters the pertinent Zang Fu and a superficial one that meets the external environment through acupoints.

Each group of six Yin and Yang meridians can be further divided in three channels of the hand (Shou) and three channels of the foot (Zu). This division is based upon the fact that a channel begins or ends in the hand or foot (*Table 4*) (Giussani, 2015).

	Organs	***Pathway***
Shou Yin	Lung (LU), Pericardium (PC), Heart (HT)	They begin in the thorax, flow on the ventral part of the arm and end on the fingertips
Zu Yin	Spleen (SP), Liver (LR), Kidney (KI)	From the extremity of the foot's fingers these channels run on the inner part of the leg and end on the thorax
Shou Yang	Large intestine (LI), Triple Heater (TE), Small intestine (SI)	These channels begin at the hand's fingertips and circulating on the dorsal and lateral part of the arm they end on the head
Zu Yang	Stomach (ST), Gallbladder (GB), Bladder (BL)	From the head, these channels run on the posterior and lateral face of the body to reach the foot extremity. Only exception is the Stomach channel that crosses the thorax

Table 4: Yin and Yang meridians of the hand and of the foot. (Giussani, 2015)

The regular channels can also be divided according to different theories. One theory is called *Biao-Li* (from the Chinese "internal-external") and is linked to the five agents. Each agent owns a pair of channels, one internal (Yin) and one external (Yang). The channels are connected right where the energy passes from one meridian to the other. Another theory is called *Liu-Qi* and is based upon energetic levels. The Liu-Qi considers the anatomical position of each channel and divides the body into six levels of different depth. In this case, the pairing is external-external and internal-internal, thus two Yin channels and two Yang channels respectively are paired together (Xie & Preast, 2007).

3.6.1 Extraordinary Channels

The extraordinary channels are eight: Du, Ren, Chong, Dai, Yang-qiao, Yin-qiao, Yang-wei and Ying-wei (*Table 5*). They are not pertain to any Zang Fu and are not related to each another. These meridians also do not have their own acupoints, except for Du and Ren. The extraordinary channels act as "assistants" to the regular channels, they acquire in fact functions similar to nearby meridians. They coordinate and balance Qi and blood that circulate through the regular channels they are linked to,

thus facilitating the communication between them. The extraordinary channels also control, store and regulate Qi and blood (Xie & Preast, 2007).

Channel name	***Location***	***Meridian connections***
Du – Governing Vessel (GV)	Dorsal midline	CV, ST
Ren – Conception Vessel (CV)	Ventral midline	GV, ST
Chong – Penetrating	Parallel to kidney meridian	KI
Dai – Girdle	Encircling lumbar region	GB
Yang-qiao – Yang motility	Lateral hind limb extremities, shoulder and head	SI, BL, LI, ST, GB
Yin-qiao – Yin motility	Medial hind limb extremities, eye	KI, SI
Yang-wei – Yang linking	Lateral stifle, shoulder	GV, SI, BL, TE, GB, ST
Yin-wei – Yin linking	Medial hind limb, neck	CV, GB, SP, LR

Table 5: Distribution of the 8 Extraordinary Channels. (Xie & Preast, 2007)

The most important extraordinary channels are *Du mai* and *Ren mai*, which are sometimes considered as two complementary regular channels. They are also called respectively Governing vessel (GV) and Conception vessel (CV). Unlike the 12 regular channels, GV and CV are not symmetrically distributed in both halves of the body, in fact they are unpaired. The GV runs along the dorsal midline, while the CV courses along the ventral midline. The Du mai is named “sea of Yang” because of its attitude to coordinate the activity of all Yang meridians and regulating their Qi. The Ren mai is called “sea of Yin” since it connects and coordinates all Yin meridians and their energy. The GV and CV have their own acupoints and are fundamental for energy balancing techniques, being the two central channels of one’s Qi (Giussani, 2015; Xie & Preast, 2007).

3.6.2 Circadian Cycle of Qi

The 12 regular channels join with one another in a fixed order. Along this course there is a cyclical and endless flow of Qi inside the meridians that follows a specific order. However, each channel has got an energetic maximum at designated times that lasts 2 hours before passing on to the next channel (*Figure 11*). The cycle begins with the Lung meridian at 3:00 AM and continues with the Large Intestine channel. The Qi then moves to the Stomach channel and then to the Spleen channel. In this way the energy moves from thoracic Yin to thoracic Yang, to pelvic Yang and eventually to pelvic Yin. At the hand's and foot's fingers happens the change of polarity. In the hand the energy goes from a Yin meridian to a Yang and in the foot from a Yang meridian to a Yin. To the head meet two Yang channels and to the chest meet two Yin channels.

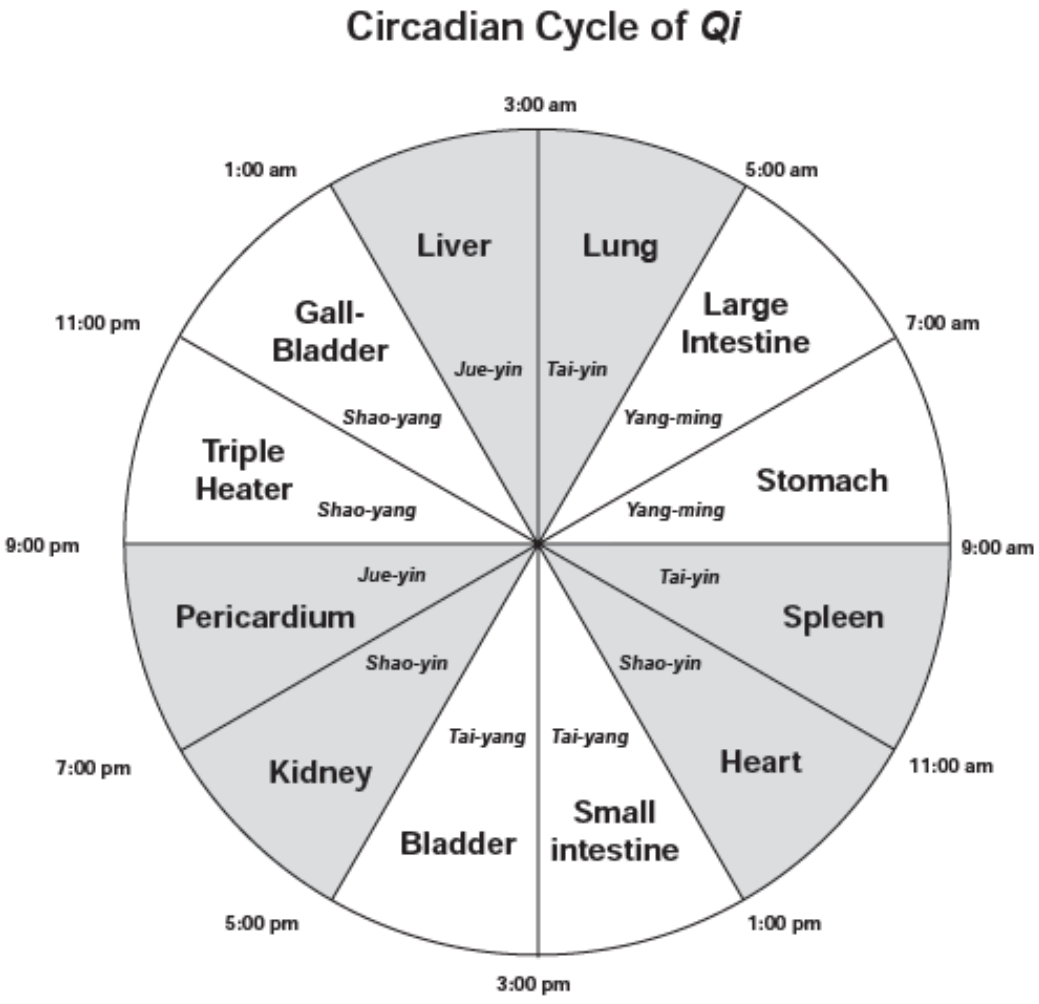

Figure 11: TCVM circadian clock of the 12 regular channels (Xie & Preast, 2002).

The Qi makes a complete circuit around the body for three times during the day. After the Spleen channel, the energy flows to the Heart meridian,

followed by Small Intestine, Bladder and Kidney channels. The last circuit is composed by Pericardium, Triple Heater, Gallbladder and Liver channel (Xie & Preast, 2007).

3.7 Causes of disease

According to TCVM the causes of disease, hence of energetic imbalance and disharmony of Qi's flow, are three:

- Internal
- External
- Miscellaneous

The internal factors are represented by seven emotions linked to five Zang organs. The external causes consist of six climatic factors. Miscellaneous causes are vary and include genetics, parasites and poisons, physical trauma, diet and nutrition, over exertion and incorrect treatment (Ross, 1985).

3.7.1 Internal causes

The internal causes of disease are seven emotions. They are not pathogenic per se but sudden, intense or prolonged stimulation of the emotions may result in disturbances to the flow of Qi. They are considered by TCVM one of the major pathological factors of endogenous diseases and are closely related to five Zang organs and the Wuxing. The seven emotions are: anger, joy, pensiveness, fear, fright, sorrow and grief. Each emotion has a specific action on Qi's flow and despite being linked to a specific organ they all impact on the heart (Giussani, 2015).

Anger impairs the Liver. It causes Qi to rise and move upwards, thus clinical manifestations include headache, dizziness, irritability and also bleeding such as haematemesis. Excessive rage can determine a transverse movement of Liver Qi that can result in gastric and abdominal pain and other gastroenteric symptoms such as vomiting and diarrhoea.

Joy impairs the Heart. Normally this emotion can relax or relieve mental tension and stress, smoothing the circulation of Qi and blood. However,

excessive joy and mania can result in scattering of Heart Qi. Clinical manifestations include weakness, distraction, palpitations, asthenic breathing and, in serious cases, mental disorders.

Pensiveness impairs the Spleen. An excess of thinking and worry can cause stagnation or blockage of Qi. Spleen is the centre of processing and transformation of the food's energy, thus anxiety can affect the digestive functions and clinical manifestations include poor appetite, indigestion, loose stool or diarrhoea.

Fear impairs the Kidney. This emotion makes the Qi descend or sink and it becomes unconsolidated. Fear can lead to urinary and faecal incontinence, soreness and weakness of the bones.

Fright impairs the Gallbladder. It causes turbulences of Qi and can lead to paralysis of fear. This usually manifests as palpitations, restlessness, insomnia and susceptibility.

Sorrow and grief impair the Lungs. These emotions cause the consumption or dissolving of Qi. Clinical manifestations include difficult breathing, asthma, frequent colds and flu, skin problems (CRIBES, 2019; Giussani, 2015; Ross, 1985).

3.7.2 External causes

The external causes of disease are six climatic factors. Under normal conditions the organism can adapt to the changes of climate that normally occur in nature. If the harmonious relationship between the individual and nature is disturbed, the body is unable to adjust itself to these changes and disease can occur. The climatic factors become thus pathogenic. The six climatic factors are: wind, dampness, cold, dryness, heat and fire. These factors often present themselves collectively and may combine together causing complex syndromes.

Wind is related to spring and tends to cause disease during this season. It is a pathogenic factor of Yang nature thus it is light and characterized

by floating and dispersion. Wind disease in fact mainly involves the upper parts of the body and the skin with clinical manifestations such as fever, nasal obstruction, sore or itchy throat and headache. It is also a mobile factor and its disease are often changing, such as migratory pain in joints and limbs. Wind tends to be complicated by other pathogenic factors since it easily attacks the body, thus the other climatic factors can more easily follow it. According to TCVM in fact, wind is the leading cause of all diseases.

Cold is best represented in winter thus cold diseases usually emerge during this season. The invasion of cold into the body is due to cold weather and lack of control measures but also to drench, exposure to cold water or wind. This factor tends to impair Yang, both superficial and internal Yang, causing Qi, blood and fluid to coagulate bringing pain. Furthermore, cold pertains to Yin and tends to restrain the activity of Qi leading to contracture of muscles, tendons and vessels. If cold attacks the organs, the visceral Qi will stagnate causing abdominal pain; if cold attacks the superficies, Qi and blood in muscles and joints will coagulate and contract bringing pain and spasm.

Fire heat is a Yang factor associated with summer but it can occur in any season. It tends to rise and affect the upper body, damaging the Yin and its function such as cooling, moistening, nourishing and resting. Fire heat dries up the fluids, resulting in reduced, darker and thicker secretions and excretions. It also causes a “reckless movement” of blood with haemorrhages and skin eruptions. This external factor can lead to insomnia, irritability and anger and rapid pulse.

Dampness is associated with late summer rainy season and is a Yin factor. This factor can actually occur in any season and is associated with damp environments, such as living in humid areas, misty rooms or damp grounds. Like cold, dampness causes slackening and stagnation of Qi. Dampness pain is characterized by dullness and heaviness and, unlike wind, it is associated with lingering and fixed signs. Clinical signs of external dampness include lethargy, loss of appetite, nausea,

indigestion, diarrhoea, abdominal oedema, skin eruptions, cloudy urine and vaginal discharge.

Dryness is a Yang factor and is associated with late autumn. It impairs Yin and fluids thus is characterized by signs that include rough, dry, chapped skin, dry nose and mucosae, little secretions and dry stool. Dryness often occurs along fire heat and may be potentiated by wind. *Summer heat* is a Yang factor that consumes Qi and Yin. This factor traditionally occurs only in summer and is associated with prolonged exposure to the heat of the sun or a hot room. Summer heat is said to be dispersive and expansive, with an upward direction. Clinical signs associated with this factor may be sudden fever, excessive perspiration, red dry skin, shortness of breath and concentrated urine (CRIBES, 2019; Giussani, 2015; Ross, 1985).

3.7.3 Miscellaneous causes

Miscellaneous causes are disease factors that are neither internal nor external. These include: constitution, nutrition, overwork, exercise, relationships, trauma and parasites. All these factors provide for a relation between body and environment. Constitution may be considered the most important factor and it is defined as the general level of health and strength of the body at any given time. It consists of the genetic inheritance of the individual and its continuous interaction with the environment. An individual's basic constitution is largely determined at conception, thus the parent's health at that time is a crucial factor. However, if the ancestral Qi that is passed on to the foetus is weak, the individual can actually develop and strengthen its Qi with an adequate lifestyle. The latter includes all the other miscellaneous causes. In fact, malnutrition, excess of food or unwise eating habits can lead to Yin and Yang imbalances that are associated with internal cold or heat. Exercise, just like food, may be insufficient, excessive or incorrect and can lead to weakening and deficiency of Qi. Trauma can be emotional or physical but either way it always includes an internal component. In fact, emotional trauma inevitably leads to an internal disease regarding the seven emotions, while physical accidents may be

due to an underlying emotional distress. Parasitic diseases are a vague, general term that includes infections and infestations. These are actually considered external diseases factors but are well distinct from the six climatic factors and quite as able to invade even a healthy individual (Ross, 1985).

4. ACUPUNCTURE IN MODERN WESTERN MEDICINE

Whereas TCVM acupuncture aims to restore the balance of Qi, Western Medical acupuncture looks at restoring physiologic homeostasis utilizing biological mechanisms of the animal to relieve pain. Acupuncture has evolved over centuries, both in Eastern and Western cultures, to become a scientifically driven and medically appropriate therapy for human and veterinary patients. In fact, the underlying scientific mechanisms and its place in modern medicine have enormously progressed (Fry et al., 2014).

4.1 Scientific basis

Acupuncture involves the stimulation of specific anatomical locations called acupoints to create local, segmental and general physiological effects that are mediated by neuromodulation. According to TCVM acupoints correspond to the areas where the superficial route of channels meets the outside and their stimulation can resolve an imbalance or blockage of energy. Studies have shown that acupoints are actually neurovascular bundles consisting of a concentrated area of free nerve endings, lymphatics, small arterioles, venioles and mast cells. It has been demonstrated that areas that are richly innervated and contain a high number of somatic afferent fibres frequently contain many acupoints. These areas also show a higher electrical conductance, lower impedance and a higher capacitance than the surrounding tissue (Huntingford & Petty, 2022).

Acupuncture points can be divided into 4 types:

- Type 1 points are termed motor points (67% of all acupoints). These are areas in a muscle that, when electrically stimulated, produce maximum contraction with minimal stimulation.
- Type 2 points are located on superficial nerves, on the dorsal and ventral midline of the body.
- Type 3 points are located at high density foci of superficial nerves and nerve plexi all over the body.

- Type 4 points are located at muscle-tendon junctions where the Golgi tendon organ is located. (Schoen et al., 1986)

Acupuncture points can be stimulated by the insertion of a thin sterile needle for the practice of dry needling. Other techniques imply the use of pressure, heat (moxibustion) or laser light (laseracupuncture). Acupuncture needles can also be stimulated manually by twisting them or applying a small electric current through electrodes as in electroacupuncture (Huntingford & Petty, 2022). When a needle stimulates an acupoint, it activates neural and neuroactive components that have been defined as neural acupuncture units (NAUs). Local effects start immediately at the site of insertion and cause collagen and elastin fibres to wind around the needle. Fibroblasts, local nerve endings and vasculature are involved as well. Fibroblasts start to release biochemical substances and the local axon reflex is triggered in the nerve endings. This response is thought to cause the De Qi sensation which correspond to the activation of the acupuncture point and releasing of energy (Huntingford & Petty, 2022). In humans the De Qi is described as a dull or achy sting at the insertion site while in animals it can be recognized when the patient has skin fasciculations, ear or lip movements or when it looks at the needle or acupuncturist (Xie & Preast, 2007). The analgesic effects of acupuncture can be conceptually divided into local,

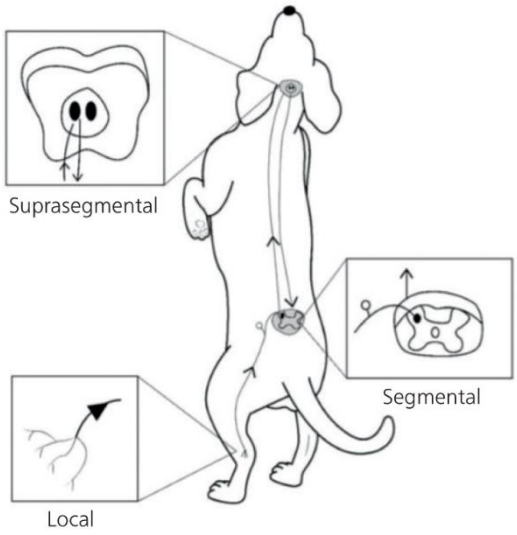

Figure 12: Analgesic effects of acupuncture divided into local, segmental and suprasegmental.

segmental (spinal) and suprasegmental (central) effects (*Figure 12*) (Dewey & Xie, 2021).

4.1.1 Local effects

Local analgesic effects start immediately at the site of needle insertion and are considered as a method of counter-irritation that provide sensory stimulation to local tissues (*Figure 13*) (Dewey & Xie, 2021). The needle creates microtrauma which activates Hageman's tissue factor XII. This causes the activation of the coagulation cascade as well as the complement cascade, leading to the production of plasminogen, protein kinins and prostaglandins. The microtrauma also causes mast cells degranulation with the consequent release of histamine, heparin, proteases and bradykinin. Acupuncture also induces a local release of endogenous opioids from lymphocytes, macrophages and granulocytes into the tissue. These opioids act on peripheral nerves to suppress the tissue nociceptors and to release more endogenous opioids into the area. Other effects observed include an increase in cannabinoid CB2 receptors that cause the upregulation of endogenous opioids, decreasing levels of local inflammatory cytokines, including tumor necrosis factor-α (TNFα), interleukin 1β (IL-1β), and interleukin 6 (IL-6), as well as the inhibition of cyclooxygenase-2 (COX2) and prostaglandins production

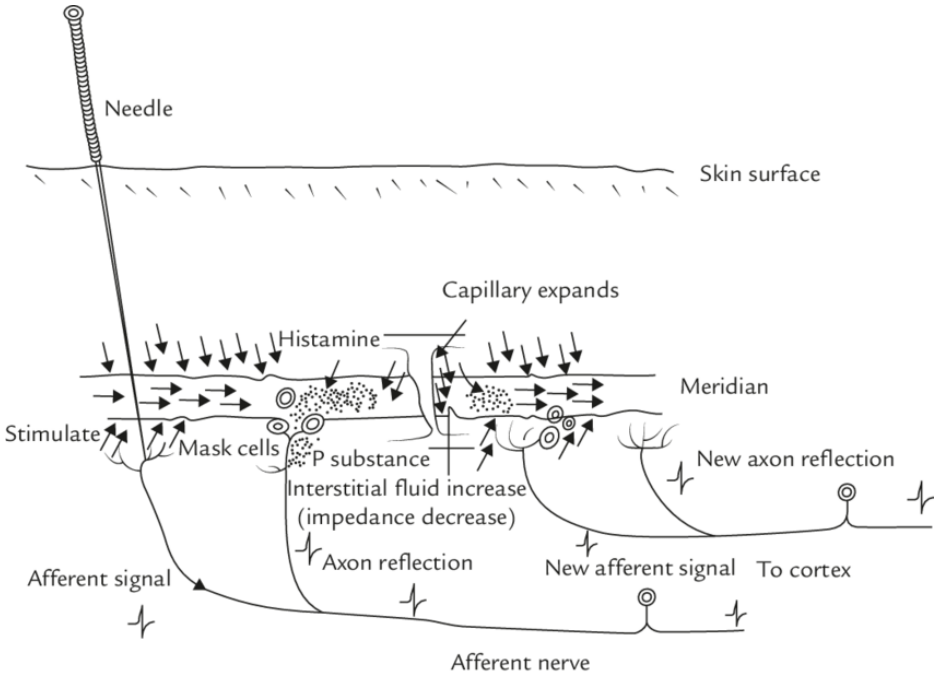

Figure 13: Local effects of acupuncture. (Zhang et al., 2008)

(Dewey & Xie, 2021). All these local reactions ultimately result in an increased blood flow and local immune responsiveness, which help to relieve pain and reduce inflammation and oedema (Huntingford & Petty, 2022).

4.1.2 Segmental effects

Acupuncture can induce many anti-nociceptive effects at the segmental or spinal level. One of the first effects induced by acupuncture is the gate control mechanism by Melzack and Wall described in Chapter 1. The non-noxious stimulus provided by needling stimulates A-β fibres and effectively closes the substantia gelatinosa (SG) cells in the dorsal horn of the spinal cord, preventing the pain signal from traveling further up to the CNS. In addition to the gating mechanism, acupuncture determines an increase in endogenous opioids, noradrenaline and serotonin levels. These molecules cause dampening of NMDA receptors' activity in spinal cord dorsal horn neurons. The increase in serotonin levels also accentuates the ability of GABA to inhibit pain signal transmission. (Huntingford & Petty, 2022) Furthermore, it has been demonstrated that GABA concentration in the dorsal root ganglion is elevated after electroacupuncture treatment (Chen et al., 2020). Acupuncture stimulation also reduces spinal glial cells activation, thus reducing the release of inflammatory cytokines such as IL-1B, IL-6, TNFα, COX2 and PGE2 (Dewey & Xie, 2021).
The segmental effects of acupuncture extend to visceral analgesia as well as musculoskeletal and neurological analgesia. Visceral-referred pain is referred to the surface of the body innervated by the general somatic afferent (GSA) neurons whose axons terminate in the same spinal cord segment and on the same neuronal cell bodies as the general visceral afferent neurons (GVA). Visceral and somatic afferent fibres converge in the dorsal horn, thus if the appropriate somatic receptors at the segmental level are stimulated, then visceral pain can be suppressed as well (Huntingford & Petty, 2022).

4.1.3 Suprasegmental effects

The mechanisms for brain effects of acupuncture in companion animals are not as well understood as the segmental effects (Huntingford & Petty, 2022). This is primarily based on the stimulation of a descending anti-nociceptive network that projects from several brain regions to the dorsal horn of the spinal cord segments (Dewey & Xie, 2021). The involved brain segments include the cerebral cortex, the hypothalamus, the PAG, the locus coeruleus and part of the medulla. These regions are directly or indirectly responsible for the suppression of nociceptive spinal cord dorsal horn neurons thanks to the release of several chemical messengers such as β-endorphins, enkephalins, noradrenaline, dopamine, and serotonin. Other molecules that may be involved in this process are ACTH and oxytocin produced by the pituitary gland, both of which have analgesic effects. The specific brain regions that are activated after acupuncture stimulation have been identified by many studies on functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) carried out on humans and experimental animal models. Specific examples of suprasegmental effects of acupuncture – especially EA – include the activation of serotoninergic nucleus raphe magnus, the noradrenergic locus coeruleus of the pons and the stimulation of the hypothalamus to release β-endorphin, as well as the activation of descending neurons of the PAG (Gong & Liu, 2019; Kong et al., 2006; Zhao, 2008). The most remarkable central effect of acupuncture involves beneficial CNS neuroplasticity. Chronic pain can induce an alteration of both chemical and structural organization of CNS – called neuroplasticity – via neurotransmitters and neurotrophins. These changes are considered maladaptive since they facilitate pain transmission in the CNS. Acupuncture can though induce clinically beneficial neuroplasticity through its ability to prevent and reverse the maladaptive alteration caused by chronic pain (Dewey & Xie, 2021).

4.2 Scientific evidence for chronic pain management

Acupuncture's effect has been and is still being evaluated from a scientific point of view since the practice became popular in Western Medicine. The studies include many randomized placebo-controlled trials. Acupuncture

has been studied mostly for its analgesic effect, not only on acute and chronic pain but also on intraoperative pain (Still, 2005). Most of the painful conditions evaluated in the studies were musculoskeletal and neurological disorders. One of the first studies (Janssens, 1986) reviewed 61 cases of chronic osteoarthritis (OA) in dogs treated with acupuncture. The treatment consisted in weekly acupuncture needling sessions for a minimum of three treatments or until a satisfactory result was obtained. Most animals had already been treated with anti-inflammatory drugs, corticosteroids or both. The most affected joints were hip and knee and the results of the treatment were evaluated on a 5 points scale where (1) was equal to no improvement and (5) was perfect outcome. The total number of acupuncture treatments was 318 in 61 dogs, of which 29 relapsed and were retreated. The results were excellent (5) and very good (4) in 62% of the cases.

It is clear that acupuncture has a potent effect on muscle and joint stiffness related to OA, since it is caused by a hypertonicity of flexor and extensor muscles around the joints. This hypertonicity is secondary to an activation of Aδ and C fibres caused by inflammation and local release of kinins in muscles and tendons. As previously reported, acupuncture stimulation can reduce local swelling, pain and inflammation and thus it is a valuable treatment for osteoarthritic dogs.

Another study by Silva et al. (2017) evaluated the effects of acupuncture on chronic pain and quality of life in dogs with neurological or musculoskeletal diseases. In this prospective study 181 dogs were treated with acupuncture alone or combined with analgesics for up to 24 weeks. The outcomes of the treatment were assessed by owners and the scores before and after the onset of treatment were evaluated using different tests (e.g. Wilcoxon test and Kaplan-Meier curves). Animals were selected based on physical, neurological, and orthopaedic examination and complementary diagnostics such as radiography, computed tomography, magnetic resonance imaging (MRI), electroneuromyography, and clinical pathology tests. The patients were divided into two group. The first group was subjected to once-weekly acupuncture sessions – which included dry needling and related techniques (electroacupuncture, laseracupuncture, ozone and/or pharmacopuncture, moxibustion) – for about 20 minutes. The second group was treated with

alternative medicine associated with adjuvant analgesics (NSAIDs, SAIDs, opioids, gabapentin, amitriptyline). The maximum trial period was 24 weeks. Once animals improved, the acupuncture sessions were conducted every other week and dogs were discharged if the treatment was successful before 24 weeks. The owners answered after each treatment session 2 validated questionnaires: the HCPI (Helsinki Chronic Pain Index) and QLA (health-related Quality of Life scale for dogs with cancer pain), and the VAS (Visual Analogue Scale) for pain and locomotion. Results showed how there was no difference between the two groups at the beginning of treatment. At the end there was no difference in QLA and VAS between the two groups, while HCPI scores were lower in the first group. According to HCPI and VAS for locomotion though, dogs with musculoskeletal diseases improved faster that those with neurological diseases. The results suggest, like previous ones, that when used alone or in combination with analgesics or adjuvant analgesics, acupuncture is a relevant conservative treatment to alleviate pain and improve quality of life in dogs with neurological and/or musculoskeletal diseases. This also allows to reduce doses of conventional analgesics and therefore their adverse effects.
Another study (Telxeira et al., 2016) evaluated owners' assessment of chronic pain intensity in dogs with hip dysplasia (HD) treated with acupuncture, carprofen or a placebo. This is a randomized placebo-controlled clinical trial that included dogs with radiographic evidence of HD, signs of pain as assessed by the owners and at least 2 clinical signs of the disease. An HD-free group of dogs was also evaluated for all the variables of the study. The 54 HD-affected dogs that were included in the study were randomly divided into 3 groups that were to be treated with acupuncture, carprofen or placebo. Acupuncture-treated dogs underwent once-weekly sessions with a total of 5 sessions within a period of 30 days. The acupoints were selected on the basis of their functional effects in traditional Eastern Medicine. Carprofen-treated dogs (positive control group) received 4.4 mg of carprofen/kg orally once daily, while placebo-treated dogs (negative control group) received capsules containing lactose (1 mg/kg) orally once daily. Treatment-effect evaluations were performed at 2, 4, and 6 weeks after the beginning of treatment. At each evaluation, every dog was assessed by the owner and underwent a kinetic evaluation.

Each owner evaluation involved 3 assessment instruments: the CBPI (Canine Brief Pain Inventory), the HCPI, and VAS regarding pain and locomotion. Lameness was evaluated by kinetic analysis. According to the CBPI questionnaire data, the comparison of the effects of acupuncture, carprofen, or placebo on pain intensity and lameness in dogs with HD in the study revealed that only acupuncture alleviated signs of pain at 4 weeks. This improvement also persisted for 2 weeks after cessation of treatment. Even though NSAIDs showed later positive effects on HD-related signs of pain, they appear to have smaller effects on lameness. The kinetic evaluation in this study did not show any significant difference between HD-affected dogs – that underwent treatment – and HD-free dogs. This may be related to the fact that HD causes complex alterations in gait that often complicate kinetic evaluations. This study shows how both acupuncture and carprofen decreased lameness in dogs with HD, but only acupuncture alleviates HD-related pain in the short period. Therefore, acupuncture appears to be a viable option for improving the quality of life of dogs with HD and chronic pain.

5. DIAGNOSIS AND SYNDROMES IN TRADITIONAL CHINESE VETERINARY MEDICINE

Since TCVM's aim is not to treat a symptom but rather to treat the organism in its entirety, it is fundamental for the practitioner to thoroughly evaluate the patient before coming up with an acupuncture treatment. There are different diagnostic tools that the practitioner can rely on to understand the syndrome that is affecting the patient and to reach a diagnosis.

5.1 Diagnosis

To reach a diagnosis in Chinese Medicine are employed most of the commonly enumerated sensory organs: eyes, ears, nose, tongue and touch. Four essential diagnostic techniques were already recorded in *Huangdi bashiyi nanjing* ("The Yellow Emperor's Classic of Difficult Questions", c. 2nd century CE): *wang* (visual inspection), *wen* (hearing and smelling), *wen* (inquiring), *qie* (palpating) (Lo et al., 2022).

The term *wang* refers to looking at the complexion of the patient and especially the tongue and its colour. Wang also refers to the visual inspection not only of the overall body appearance but also of the patient's movements and posture, drinking, eating and ejections.
The evaluation of the tongue allows the practitioner to understand many aspects of the disease of his patient. Furthermore, changes in the body or in the coat of the tongue can aid diagnosis and prognosis both initially and throughout the course of a treatment. In fact, the tongue can be divided into different areas that reflect the different Zang Fu (*Figure 14*). The extreme tip of the tongue corresponds to the heart while the tip to the lungs. The sides of the tongue represent liver and gallbladder. The centre refers to spleen and stomach, while the base of the tongue corresponds to kidneys. This differentiation of the tongue can be a useful guideline, for example red dots along the sides may accompany relatively chronic liver and gallbladder disharmonies. However, the tongue is a less liable diagnostic method than

the palpation of the pulse but it can still give information in terms of the Eight Principles of disease.

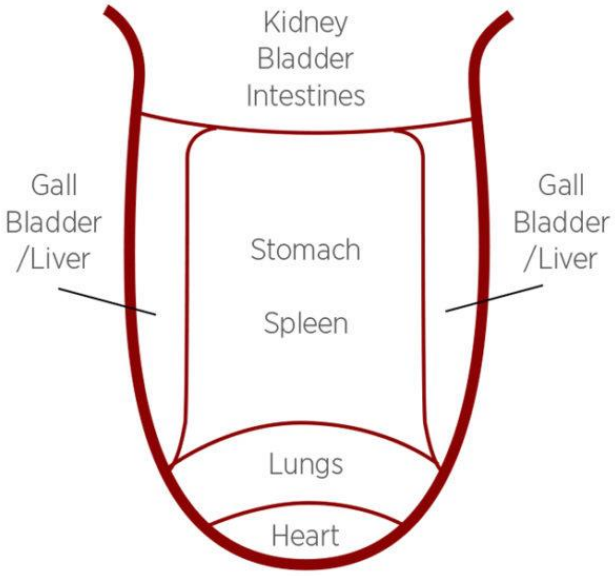

Figure 14: The tongue can be divided into different areas that refer to different Zang Fu.

Another important aspect of the tongue's inspection is the evaluation of colour, coating and volume of the tongue. A normal tongue should be pink (with different shades depending on the animal species) with a low amount of clear saliva, no cracks in the body, neither swollen nor atrophied and with a thin white coating on top. Alteration such as a thick coating, cracks along the body of the tongue, a deep red or purple colour are all signs of a disharmony that has to be further investigated (*Table 6*).

Colour	**Body**	**Coating**	**Diagnosis**
Pink	Not too swollen or flaccid, no cracks	Thin white	Healthy individual
Red	Large, swollen	Yellow, greasy coat	Heat, Damp heat, Deficient Yin
Dark red – purple	Swollen, with spots	Moist, pale	Stagnant blood, Cold obstructing
Pale	Thin, flaccid	Pale, white, thin and dry	Deficient Qi, deficient blood, Cold, deficient fluids

Table 6: Examples of some tongue alteration patterns and related diagnosis. (Ross, 1985)

Wen has two meanings: it can refer to hearing and smelling or inquiring. Wen (聞), meaning hearing and smelling, aims to identify a medical condition by listening to the patient's voice and breathing as well as smelling the patient's odour of the body, breathing and discharges.
Wen (問), meaning inquiring, aims to get an idea of the animal's health status, case history and symptoms by asking to the owner. It is important to evaluate current condition and previous treatments, as well as any dietary programs followed by the patient, its management and also its origin (Lo et al., 2022).

Qie refers to the touch and in particular to the palpation of the pulse, a skill highly prized for its diagnostic capabilities. Palpation aims to understand the internal conditions by feeling the patient's pulse and palpating other body areas. The pulse is another fundamental tool to reach a diagnosis. It is perceived by the practitioner at the femoral artery in small animals with three fingers straight on the pulse. The three parts of the pulse are called *cun*, *guan* and *chi* and represent different Zang organs. The left-sided pulse refers to heart, liver and kidney yin. The right-sided pulse refers to lung, spleen and kidney yang. Pulse-taking according to TCVM is in terms of only five Zang since Pericardium is included with Heart and the Fu systems are generally incorporated into their paired Zang organs. The pulse has 28 qualities, three depths and six positions so this is a very flexible system that allows classification of illness in terms of Yin Yang, Eight Principles' Patterns, disease factors, substances and Zang Fu (Lo et al., 2022; Ross, 1985). Some examples of pulse patterns of common disharmonies are reported in *Table 7*.

Pulse quality	**Disharmony**		**Pulse quality**	**Disharmony**
Empty	Deficiency		Superficial, empty	Summer heat
Full	Excess		Superficial	Wind
Deep	Internal		Superficial, rapid	Wind heat
Superficial	External		Superficial, tight	Wind cold
Slow, tight	Cold		Slippery	Damp
Fast	Heat		Slippery, rapid	Damp heat
Deep, slow	Deficient Yang		Slippery, slow	Damp cold
Thin, rapid	Deficient Yin		Slippery	Phlegm
Thin, choppy	Deficient blood		Choppy, wiry	Stagnant blood

Table 7: Examples of some pulse patterns related to common disharmonies (Ross, 1985).

The overall history of the patient together with the observation of the tongue and evaluation of the pulse allow the practitioner to understand what syndrome is affecting the patient and to create the ideal therapy protocol with acupuncture.

5.2 Syndromes

In Traditional Chinese Veterinary Medicine syndromes can be classified following different criteria. The most common and utilized is the identification by the eight rules. This allows to divide the syndromes into yin-yang, excess-deficiency, cold-heat, interior-exterior (Giussani, 2015).

Yin and Yang are the basis of physiology, pathology and differential diagnosis and thus are used to define general patterns of disharmony and to obtain a global visualization of the patient's traits. The Yin pattern of disharmony can be subdivided into the patterns of cold, interior and deficiency, while the Yang patterns of disharmony can be identified in the patterns of heat, exterior and excess (Ross, 1985).

Interior and exterior refer to the depth of the disease and also its direction of development. External diseases pertain to superficial layers of the body and tend to move inwards. Related patterns are generally associated with the invasion of the organism by one or more of the external disease factors. Such patterns are usually acute, of sudden onset, short duration and include signs as aversion to cold and wind, fever, chills, nasal congestion and superficial pulse (Ross, 1985). Two external syndromes can be identified: Biao Syndromes, which regard skin and muscles and have a fast onset, and Bi Syndromes, which regard joints and meridians and have a more progressive development (Vangermeersch & Pei-Lin, 1994). Internal diseases on the contrary relate to the inner parts of the body and may originate at deeper levels. Interior patterns may arise either from penetration by external disease factors from the surface of the body to the interior, from direct invasion of the Zang Fu by external factors or from internal disharmonies of the Zang Fu. These patterns are generally more serious and chronic, of longer duration and more gradual onset. There is usually high fever, vomit, deeper pulse, change in the excretions and in the

body of the tongue and its coat (Ross, 1985).

Patterns of cold and heat may refer to the invasion of the body by such external disease factors or to a deficit of one of the two elements that makes the other prevail. Cold is secondary to a prevalence of Yin. True cold patterns are associated with external factors such as cold, wind and damp that sum to the already present Yin. When cold is related to internal patterns such as deficient Yang or deficient Qi of the organism or of a certain organ it is called false cold.
Heat is related to the prevalence of Yang. Patterns of true heat may arise from the invasion of the body by related external factors such as heat, summer heat, wind, dryness and damp. There can also be a false heat that derives from internal patterns such as deficient Yin or Damp heat (Giussani, 2015). Clinical signs of heat usually include hot red skin, aversion to heat, reduced excretions, constipation, thirst, excitability, rapid pulse and red tongue with yellow coating. Discomfort is generally increased by heat and reduced by cold (Ross, 1985).

Deficiency and excess patterns refer to the quantity of energy contained into the organism or in a part of it. Deficit is defined as a condition of lacking of a certain substance but in particular of Qi, Yin or Yang. Deficiency is more likely to be a chronic internal condition, with weakness and tiredness, inconsistent voice, breathing and movements, weak and empty pulse, little or no coating on the tongue. Excess can be referred to both internal or external factors. Internal excess is caused by overactivity of one or more Zang Fu with a blockage or stagnation of energy in another area. External excess is caused by a pathogen factor that penetrates into the organism creating a surplus of energy. Overall excess is more likely to be acute, with heavy breathing and movements, discomfort aggravated by pressure, strong and full pulse, thick coating on the tongue (Giussani, 2015; Ross, 1985).

Syndromes can furthermore be identified according to:
- The three substances Qi, blood and fluids. This pattern allows to describe

the disharmonies based on the quantity and quality of circulation of the three substances.

- The Zang Fu. It is the most precise method of identification of the syndromes since it establishes precisely what organ is affected.
- The external pathogens. It refers to the pathogen factors that have affected the organism and thus the syndrome varies according to the manifested symptoms.
- The twelve energetic channels. It is the most ancient method and it considers the whole pathway of a meridian and its related organ. This method is used mostly to define a disharmony of external origin that affects a specific meridian on which the symptoms are manifested.
- The five movements. Syndromes are classified according to the disruption of the movements of generation and control that can become indeed pathological.
- The six energetic stages. This method is used to define the depth of affection of cold diseases. According to the manifested symptoms, syndromes are classified from the most superficial to the deeper level.
- The four levels. This method is specifically used to define infectious fever diseases. It considers the level of penetration of excess heat according to the four levels Wei, Ying, Qi and Xue.
- The three heathers. This criterion refers to the pathogen wind-heat and defines the affected heather.

(Giussani, 2015)

Not all the criteria are necessary to reach a correct diagnosis but each of them can give a piece of information about the patient's condition. Every method of identification of a syndrome also suggests how to treat it. The practitioner thus has many tools to choose the suitable treatment, which will be different and personalized for every patient.

5.3 Bi Syndromes and chronic pain

When discussing about chronic pain in TCVM, a rightful focus must be done about Bi Syndromes. These are also known as Painful Obstructive Syndromes, in fact the Chinese word *Bi* means "obstruction". They are

characterized by the obstruction of Qi and blood in the meridians due to the invasion of external pathogenic factors Wind, Cold and Damp. According to TCVM theory, pain will indeed arise if the meridians are obstructed and the flow of energy is blocked (E. Q. Zhang, 2010). Clinically, Bi Syndromes correspond to many different acute and chronic diseases in Western medicine, especially rheumatic diseases. These include inflammatory disorders (e.g. acute/chronic rheumatic arthritis, systemic lupus erythematosus, polyarthritis chronica evolutiva, etc.), degenerative diseases (e.g. osteoarthritis, osteoarthrosis deformans, periarthritis, adhesive capsulitis, etc.) and metabolic disorders (gouty arthritis). Bi Syndromes also include neuralgia (e.g. lumbar neuralgia, sciatica, intercostal neuralgia, etc.), peripheral vascular diseases (e.g. thromboangeitis obliterans) and sequelae of trauma (Vangermeersch & Pei-Lin, 1994). From a traditional point of view, Bi Syndromes can be caused either by external pathogenic factors Wind, Cold and Damp or by internal factors with general weakness of the body as well as Qi. In fact, in prolonged cases of Painful Obstructive Syndrome the external pathogens do cause an obstruction of Qi or blood circulation but other pathological condition may play a role in the development of the disease. For instance, phlegm may develop and it will lead to a blood stasis. The stasis of blood in the channels further obstruct proper circulation and therefore represents another cause of pain. The ache becomes more or less constant and more severe and the stagnant blood produces stiffness due to its inability to nourish and moisten sinews (Maciocia, 2019).

Bi Syndromes can be classified according to aetiology:
- Wind Painful Obstruction Syndrome (*Wandering Bi*): caused by Wind and characterized by soreness and pain of muscles and joints, limitation of movement, pain moving from joint to joint.
- Damp Painful Obstruction Syndrome (*Fixed Painful Bi*): caused by Dampness and characterized by pain, soreness and swelling in muscles and joints with a feeling of heaviness and numbness of the limbs, the pain being fixed in one place and aggravated by damp weather.

• Cold Painful Obstruction Syndrome (*Aching Painful Bi*): caused by Cold and characterized by severe pain in a joint or muscle, limitation of movement, usually unilateral.
• Heat Painful Obstruction Syndrome (*Febrile Bi*): originates from any of the previous 3 types when the pathogenic factor turns into Heat in the Interior. There is usually an underlying Yin deficiency. Characterized by pain and heat in the joints which feels hot to touch, redness and swelling of the joints, limitation of movement and severe pain.
• Phlegm Painful Obstruction Syndrome (*Bony Bi*): Develops from any of the previous four types and is only ever chronic. Characterized by muscular atrophy, swelling and deformity of the bones in the joints.
(Maciocia, 2019)

Bi Syndromes can manifest with different symptoms and affect different organs. The most common causes of chronic painful symptoms are Bone Bi and Kidney Bi. Bone Bi (*Gu Bi*) mainly deals with joints and bones and it is characterized by numbness and heaviness of body and limbs, stiffness and difficulty in the movement. This causes the affected joints failing to perform their functions of flexion and extension. The TCVM aetiology is linked to the Kidneys since they control the bones. In fact, if Kidney Qi is deficient, Bone Bi easily occurs when pathogenic factors Wind-Cold-Damp attack the organism. Kidney Bi (*Shen Bi*) mostly occurs after a prolonged Bone Bi, with specific symptoms such as curved back and waist, stiff and swollen joints, anchyloses, impairment of flexion and extension of knees, elbows, limbs and trunk. It is also characterized by weakness of lower limbs and difficulty walking. This is considered Zang Bi and is the deepest stage of Bi Syndromes, considering Internal Yin Organs involvement. Especially Kidney Bi appears after a very chronic evolution, since Kidney invasion is the deepest and ultimate stage among all the Yin Organs Syndromes (Vangermeersch & Pei-Lin, 1994).

6. ACUPUNCTURE TREATMENT – CASE REPORT

CASE 1 – KEY

Key (M)

Border Collie

8 years old

Key was born in 2015 at his owner's house and did not show any sign of illness until his second year of life. The only curious trait was a marked incoordination in his gait. The owner then decided to start a K9 cross training journey with Key to improve his proprioception and use of his body, which was indeed beneficial. He was also being trained for obedience and at 3 years old he started competing. During a competition he was assessed by an osteopath who identified a problem at his front right limb and suggested to perform a radiographic exam to check the palmar sesamoid bones. Key was brought to a veterinary clinic where he was thoroughly visited and did not show any issue to the front limbs. However, the veterinarian who visited him found a neurological deficit to his left hind limb which showed slowed reflex response and dorsiflexion of the foot. The problem was not further investigated until 2019 when the dog started to have multiple injuries to his left leg. Each time he underwent ultrasound exams that showed inflammatory lesions to his thigh muscles, started a rehabilitation program, went back to training and then injured again. A year later he suffered a major injury and temporarily he would not use his left leg at all, so the owner decided to bring him to the veterinary clinic. Key was assessed by a neurologist who found an intermittent limp to his left hind leg, lumbosacral pain and intermittent kyphosis, pain at hip extension and generally reduced reflexes. The dog also underwent a magnetic resonance imaging (MRI) exam that showed a disk protrusion at L7-S1 with compression of cauda equina and L7 nerve which appears increased in volume (sign of neuritis) (*Figure 15*). Since then, Key was retired from his training and started monthly acupuncture sessions to improve his condition of chronic pain.

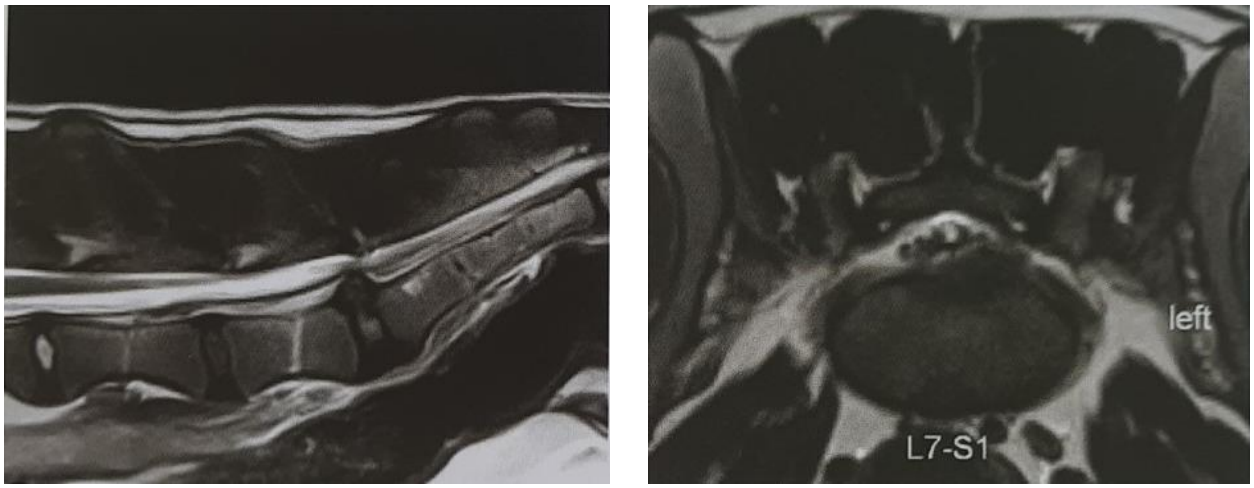

Figure 15: Key's MRI scan showing a disk protrusion ad L7-S1 with compression of cauda equina and L7 nerve, which appears increased in volume (neuritis).

TCVM diagnosis

According to TCVM, Key is a Wood character type. This personality is dominant, competitive, aggressive and intolerant. Wood types are leaders and tend to be great athletes, they are alert and respond quickly to stimuli. When unbalanced though, Wood individuals are prone to get irritated and angry, they are stressed by changing conditions and may experience Liver or Gallbladder problems. Key also showed imbalances in the Gallbladder and Kidney fields. Among other problems, both GB and KI deficiency include back pain and soreness.

Acupuncture treatment

Key receives monthly sessions of acupuncture for about 20 minutes (*Figure 16*). The points used to treat his condition are: GV-4, GV-20, Bai Hui, BL-11, BL-23, BL-31 (*Figure 17*).

GV-4: It is a most commonly used acupoint. It is located in the depression along the dorsal midline at the intervertebral space between L2 and L3. This point is used to treat Yang deficiency, diarrhoea and back pain.
GV-20: It is a commonly used sedation point, located on the dorsal midline on a line drawn from the tips of the ears to the ear canals. It is the crossing point of GV and BL channels. GV-20 is also indicated for the treatment of shen disturbances, epilepsy, sleep disorders and prolapse of the anus.

Figure 16: Key undergoing acupuncture treatment.

Bai Hui: It is a classical acupoint, very commonly used. It is located on the dorsal midline between L7 and S1 vertebrae. It is used to treat Yang deficiency (especially Kidney Yang), pelvic limb paresis or paralysis, lumbosacral pain, lumbosacral intervertebral disk disease, coxofemoral joint pain, abdominal pain and diarrhoea.

BL-11: This point is located at the cranial edge of the scapula, lateral to the dorsal spinous process of T1. The needle is inserted midway between the spinous process and the medial border of the scapula. It is an influential point for treating bones, indicated for osteoarthritis, intervertebral disk disease, cervical pain, thoracolumbar pain, shoulder pain, thoracic limb lameness and also cough and fever.

BL-23: It is located on the dorsolateral aspect of the spine, lateral to the caudal border of the dorsal spinous process of L2. This point is indicated to treat Kidney Yin and Qi deficiency, renal diseases, urinary incontinence, oedema, thoracolumbar intervertebral disk disease, pelvic limb weakness, coxofemoral joint osteoarthritis.

BL-31: It is located at the caudal border of the dorsal spinous process of L7 halfway between the point BL-27 and the dorsal midline. This point is used to treat pelvic limb paresis or paralysis, as well as urinary incontinence, bladder atonia and retained testicle.

(Xie & Preast, 2007)

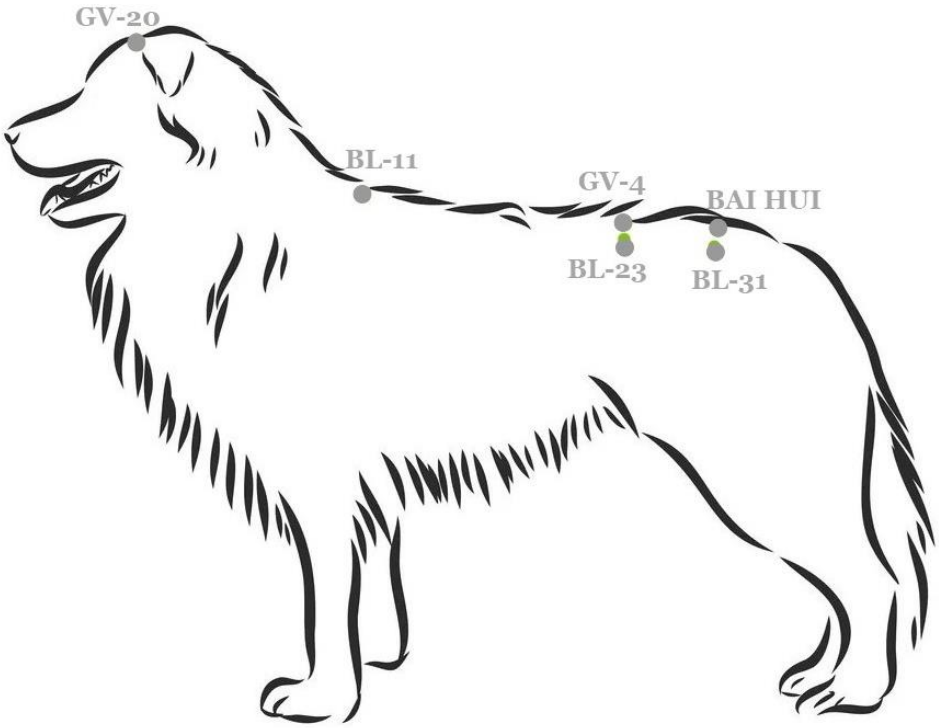

Figure 17: A schematic representation of Key's acupuncture protocol.

Follow up

Although he has been retired from agonistic activity and any form of training, Key has visibly improved. His gait is more even, the pain in his back and left hind limb is controlled and he has not suffered further injuries.

CASE 2 - WILLY

Willy (M)

Miniature Poodle

13 years old

Willy is a lively miniature Poodle who lives between the city and the mountains during summer. He was very active and full of energy until he started having walking issues when he was 8 years old. Willy experienced limping, shaking and staggering especially on his hind limbs. He was brought to a veterinarian who visited him and suggested to take a radiographic exam of his spine. Willy was diagnosed with spondylosis deformans and spondylarthrosis, as well as different degenerated intervertebral disks. The dog was treated with anti-inflammatory plus analgesic drugs but he relapsed many times. He started a chronic therapy with gabapentin which gave a brief improvement of his pain but eventually stopped being effective. In the early summer of 2023 Willy experienced a serious episode of ambulation difficulties with extreme pain, kyphosis and his tail kept low under the abdomen. He was brought to a different veterinary clinic where he was treated with corticosteroids and again anti-inflammatory and analgesic drugs. He felt fairly better but was still very uncertain in his gait and the kyphotic posture did not improve. Willy's owner decided then to start an acupuncture treatment.

TCVM diagnosis

In TCVM terms, Willy suffers from Spleen and Kidney deficiency as well as a Bi syndrome. Spleen deficiency is related to digestive problems as well as poor quality of the excretions, but other symptoms include weakness and heaviness in the four limbs. Kidney deficiency in this case is represented by back weakness, lumbago and hind limbs heaviness.

Acupuncture treatment

Willy started receiving two acupuncture treatments a week, which were gradually reduced to monthly treatments. At the moment, Willy undergoes 20-25 minutes' sessions of acupuncture and laser acupuncture combined.

The treated acupoints are: BL-20, GV-8, BL-25, CV-12, PC-6 on the left thoracic limb and SP-4 on the right hind limb (Figure 18).

BL-20: It is a very commonly used point. It is located on the dorsolateral aspect of the spine, lateral to the caudal border of the dorsal spinous process of T12. This point is indicated to treat Spleen deficiency, damp syndromes, thoracolumbar intervertebral disk disease and many digestive disorders.

GV-8: This point is located on the dorsal midline, in the depression between the dorsal spinous process of the T9-T10 vertebrae. It is indicated for the treatment of thoracolumbar intervertebral disk disease, epilepsy and jaundice.

BL-25: This is a very commonly used point. It is located on the dorsolateral aspect of the spine, lateral to the caudal border of the dorsal spinous process of L5. This is a back-shu association point for the Large Intestine and it is indeed indicated for the treatment of diarrhoea, constipation and abdominal pain. It is also indicated to treat thoracolumbar intervertebral disk disease and lumbar pain.

CV-12: This point is located on the ventral midline, halfway between the xiphoid and umbilicus. It is an alarm point for stomach and an influential point for Fu organs. It is used to treat diarrhoea, vomiting, jaundice and gastric ulcers, as well as generalized weakness.

PC-6 left: It is a commonly used point ad it is located on the medial side of the thoracic limb, proximal to the transverse carpal crease in the groove between the flexor carpi radialis and the superficial digital flexor muscles. This point is used to treat Shen disturbances, anxiety, internal Wind, nausea and vomiting, vestibular disorders, thoracic pain and thoracic limb paresis or paralysis.

SP-4 right: This point is located on the caudomedial side of the pelvic limb, in the depression distal to the proximal base of the second metatarsal bone. It is used to treat abdominal pain, gastric pain, diarrhoea and vomiting.

(Xie & Preast, 2007)

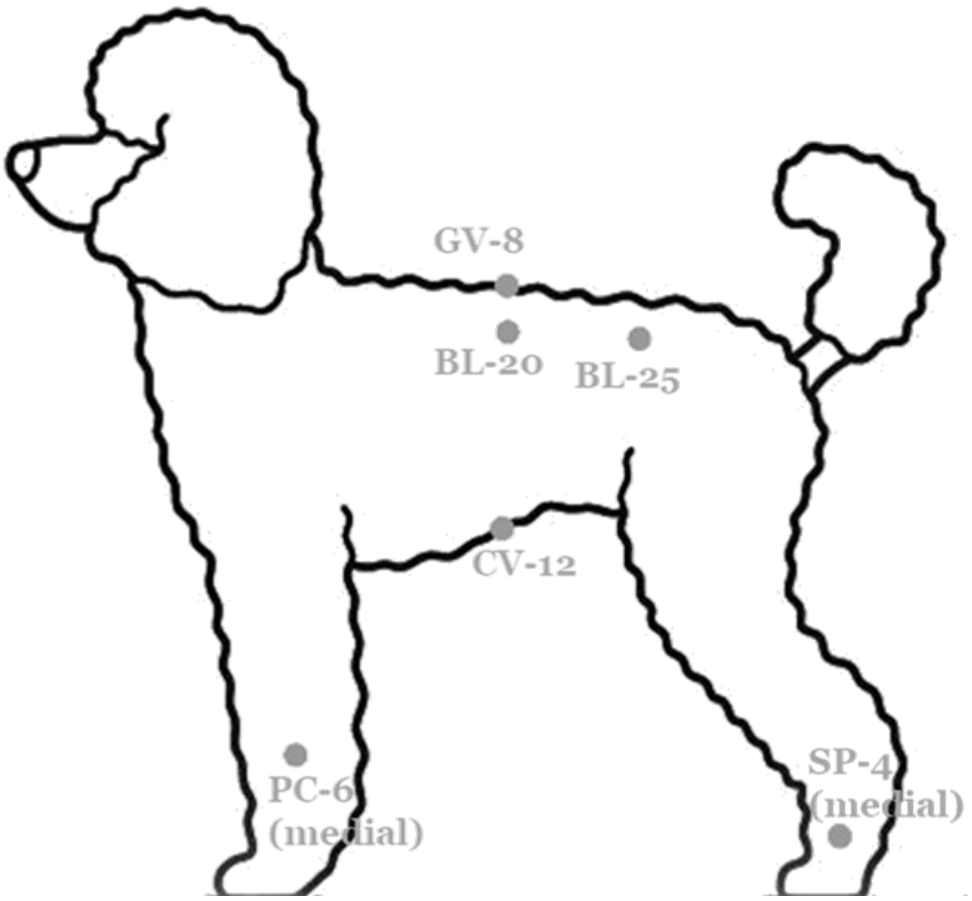

Figure 18: A schematic representation of Willy's acupuncture protocol.

Follow up

Willy's condition notably improved after the first couple of treatments, with a resolution of his back kyphosis and an improved gait and motility. He is now completely comfortable and his pain is controlled. A slight stiffness in his posture persists but he is being helped with monthly acupuncture.

CASE 3 – SAMI

Sami (M)

French Bulldog

10 years old

Sami is a playful French Bulldog who was diagnosed in 2016 with hemivertebra at T9 (*Figure 19*) and syringomyelia from the first thoracic vertebrae to L3. He did not have particular problems due to his back condition and he practiced dog agility at a professional level. Lately he was shifted to a lighter activity in dog balance training. At the beginning of 2023, Sami fell off the stairs and landed on his back. At first, he had difficulty getting up and whined in pain, but then he started walking normally. Later that day he was put on the bed but could not get down from it and cried in pain. He kept whining every time his owner tried to touch his back and so he was brought to the veterinary clinic. Sami was clinically assessed and started a corticosteroid therapy without any specialized exam, linking his pain to his already diagnosed back problems. In March 2023 Sami was referred to an acupuncturist and started getting acutherapy once every month.

Figure 19: Sami's radiography exam showing a hemivertebra at T9.

TCVM diagnosis

Kidney and Spleen deficiency.

Acupuncture treatment

Sami receives acupuncture treatments each month or every month and a half (*Figure 20*). He undergoes sessions of around 30 minutes each, with the treatment of the following acupoints: BL-11, BL-20, BL-23, CV-12, GV-14, GV-9, BL-62 right, SI-3 left (*Figure 21*).

Figure 20: Sami undergoing an acupuncture session.

BL-20: It is located on the dorsolateral aspect of the spine, lateral to the caudal border of the dorsal spinous process of T12. It is a back-shu association point for the Spleen and it is used to treat Spleen deficiency, dampness, pancreatic and digestive disorders, vomiting and diarrhoea as well as thoracolumbar intervertebral disk disease.

CV-12: This point is located midway between the xiphoid and umbilicus. It is an alarm point for stomach and an influential point for Fu organs. It is used to treat diarrhoea, vomiting, jaundice and gastric ulcers, as well as generalized weakness.

GV-14: This point is located in the depression along the dorsal midline at the cervicothoracic intervertebral space C7-T1. It is the crossing point of GV with the Six Yang channels. This point is used to clear heat and to treat Yin deficiency, cervical pain, intervertebral disk disease, as well as fever, cough, dyspnoea, epilepsy and immune deficiency.

GV-9: It is located on the dorsal midline in the depression between the dorsal spinous processes of the T7-T8 vertebrae.

SI-3 left: This point is located proximal to the metacarpophalangeal joint on the lateral side of the fifth metacarpal. It is a Shu-stream point (wood character) and mother (tonification) point for deficiency disease patterns. It represents the confluent point of Governing Vessel channel. This point is used to treat cervical pain, intervertebral disk disease, thoracolumbar pain, shoulder pain as well as epilepsy, mania and pharyngitis.

BL-62 right: It is located on the lateral side of the pelvic limb at the hock, in a depression directly distal to the lateral malleolus of the fibula with the foot in dorsiflexion. This point is confluent to the Yang-qiao extraordinary channel. It is used to treat ataxia and weakness of all four limbs, pelvic limb ataxia and weakness, sleep disorders and ocular disorders.

(Xie & Preast, 2007)

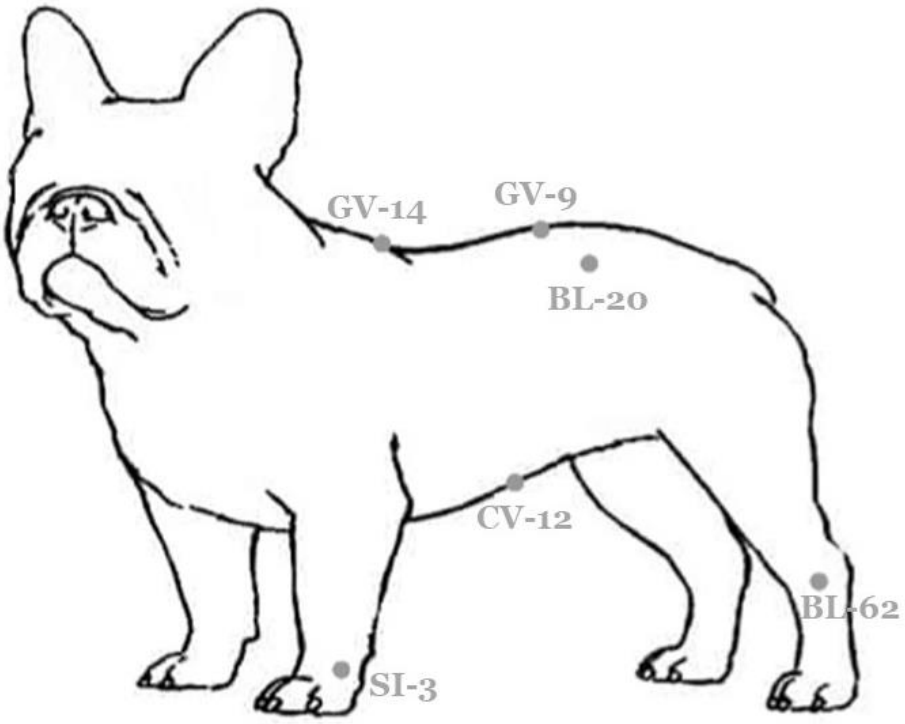

Figure 21: A schematic representation of Sami's acupuncture protocol.

Follow up

Sami rapidly improved after the first acupuncture sessions with a ceasing of his pain-related vocalizations, an improvement in his posture and flexibility. As of today, Sami is a very active and playful dog, his pain is well controlled and acupuncture is being used as a maintenance treatment.

CASE 4 – MICHELE

Michele (M)

Border Collie

14 years old

Michele is an old Border Collie with a difficult story. He is a biting dog and changed many owners before finding his actual family. However, he lived a full and happy life until he developed inevitable diseases of the old age. Michele has generalised arthrosis, spondylosis especially at the thoracic and lumbar segments, and hip dysplasia. He was also diagnosed with hypothyroidism and developed a vestibular syndrome with left head-tilt over the summer of 2023. He has been doing periodical acupuncture therapy session for the last four years, along with Western medicine treatments for his conditions. Michele is under tramadol for his osteoarticular pain and propentofylline. The pain management treatment he was under was not effective, so the veterinarian added cannabinoid oil to his therapy, which brought a little improvement in Michele's gait and pain control.

TCVM diagnosis

Wood character, Kidney deficiency, Liver Yang. Liver Yang deficiency is often correlated to Kidney deficiency and manifests especially with irritability, anger and headaches.

Acupuncture therapy

Michele receives monthly acupuncture treatments, but they can be closer in time when the pain worsens. The acupoints used in his last session were: Tay Yang, Yin Tang, BL-13, GV-14, CV-22, BL-15, TH-5 left, GB-41 right, Bai Hui post, BL-33 (*Figure 22*).

Tai-Yang: It is a classical acupoint located in the depression on the sides of the head, beside of the lateral canthus of the eye. This point is used to treat headache, Wind Heat, facial paralysis and acute ocular disorders.

Yin Tang: It is an acupoint located between the eyebrows and it is known to have a mentally stabilizing and anxiety relieving effect. It is part of the extraordinary acupoints of head and neck.

BL-13: This is a most commonly used point. It is located at the caudal edge of the scapular cartilage or eighth intercostal space, lateral to the dorsal midline. It is a back-shu association point for LU and it is used to treat cough, asthma, nasal congestion and tidal fever.

GV-14: This point is located in the depression along the dorsal midline at the cervicothoracic intervertebral space C7-T1. It is the crossing point of GV with the Six Yang channels. This point is used to clear heat and to treat Yin deficiency, cervical pain, intervertebral disk disease, as well as fever, cough, dyspnoea, epilepsy and immune deficiency.

CV-22: This point is located on the ventral midline at the tip of the manubrium of the sternum. It is indicated to treat thyroid disorders, thoracic pain, cough and dyspnoea.

BL-15: This point is located on the dorsolateral aspect of the spine, lateral to the caudal border of the dorsal spinous process of T5. It is a back-shu association point for the heart and it is used indeed to treat cardiac disorders, thoracic pain, cardiac arrhythmias, Shen disturbances, cognitive dysfunctions and epilepsy.

TH-5 left: This is a very commonly used point. It is located on the lateral side of the thoracic limb, proximal to the carpus in the interosseous space between the radius and ulna. It is indicated to treat Qi deficiency, thoracic limb lameness, paresis or paralysis, otitis, cervical pain, carpal pain and intervertebral disk disease.

GB-41 right: This point is located on the lateral side of the pelvic limb distal to the hock, on the dorsum of the foot proximal to the metatarsophalangeal joint, distal to the junction of the fourth and fifth metatarsal bones. It is a shu-stream point (wood) and it is indicated to treat metatarsal pain and tendonitis, auditory dysfunction, lateral costal pain, hip pain and lateral pelvic limb pain.

Bai Hui: It is a classical acupoint, very commonly used. It is located on the dorsal midline between L7 and S1 vertebrae. It is used to treat Yang deficiency (especially Kidney Yang), pelvic limb paresis or paralysis,

lumbosacral pain, lumbosacral intervertebral disk disease, coxofemoral joint pain, abdominal pain and diarrhoea.

BL-33: This point is not commonly used. It is located between S2 and S3 at the dorsal midline. It is used to treat constipation and diarrhoea.

(Xie & Preast, 2007)

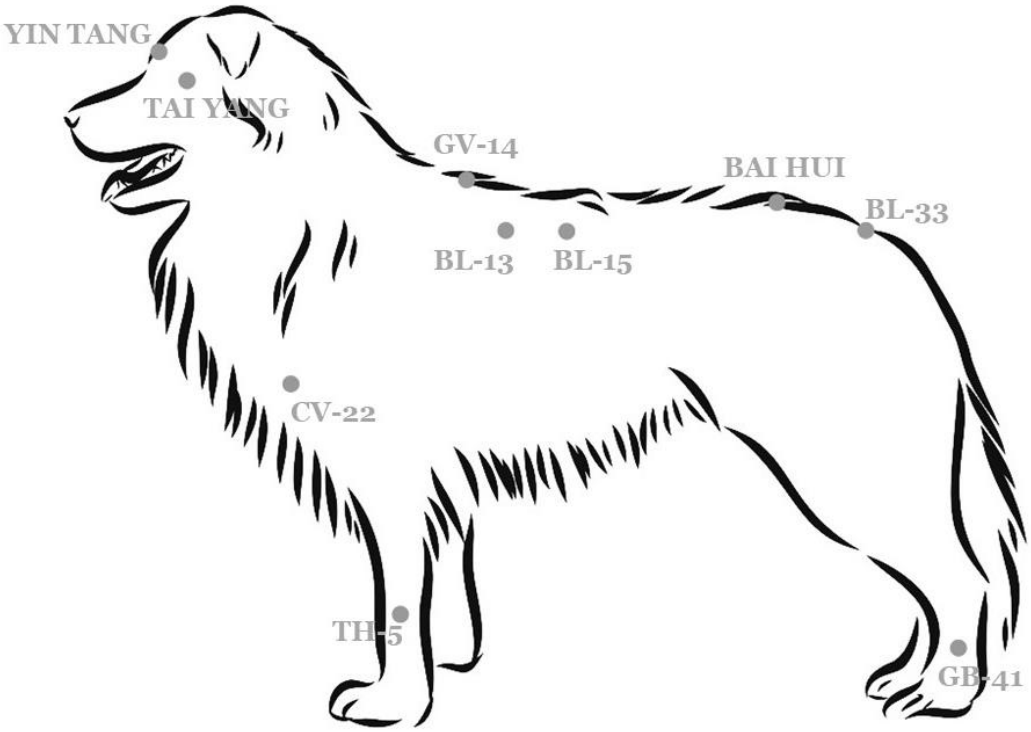

Figure 22: A schematic representation of Michele's acupuncture protocol.

Follow up

After the treatment Michele showed visibly improved gait and ambulation. His left head-tilt did not significantly improve but he could keep his neck straighter and higher than before treatment. The owner refers that after every acupuncture treatment Michele looks much more comfortable and active.

CASE 5 – HEIDI

Heidi (F)

Mixed breed

10 years old

Heidi is a troubled dog who lived her first year of life on the streets. She was followed from afar by volunteers from a local animal shelter and she was found after a bad accident. Heidi was amputated on both front and hind limb on the right side, probably from a car accident. She was captured and cured at the local shelter since she was also anaemic, full of parasites and wounded. She was a very phobic dog so she was brought home by her actual owner because she could not bear living at the shelter anymore. When home, she was feeling pretty well physically and could easily walk and run despite her amputated limbs. In 2015 though, she had a bad fall and injured. At first, she could barely move but eventually she started walking again after some time. The clinical evaluation and radiographic exams did not show anything abnormal. After that episode, Heidi suffered periodical relapses with a lot of pain. In 2022, after another relapse, she underwent a CT exam that showed many areas of disk protrusion, spondylosis and herniation. She started a life-long therapy with gabapentin, tramadol, meloxicam, cannabis oil and boswellia.

TCVM diagnosis

Kidney and Spleen deficiency.

Acupuncture treatment

Heidi receives desultory acupuncture treatments, usually when her pain is less controlled or worsens. The acupoints used are: BL-11, GV-20, GV-14, CV-22, BL-25, Bai Hui, SI-3 left, BL-62 right (*Figure 23*).

BL-11: This point is located at the cranial edge of the scapula, lateral to the dorsal spinous process of T1. The needle is inserted midway between the spinous process and the medial border of the scapula. It is an influential point for treating bones, indicated for osteoarthritis, intervertebral disk

disease, cervical pain, thoracolumbar pain, shoulder pain, thoracic limb lameness and also cough and fever.

GV-20: It is a commonly used sedation point, located on the dorsal midline on a line drawn from the tips of the ears to the ear canals. It is the crossing point of GV and BL channels. GV-20 is also indicated for the treatment of Shen disturbances, epilepsy, sleep disorders and prolapse of the anus.

GV-14: This point is located in the depression along the dorsal midline at the cervicothoracic intervertebral space C7-T1. It is the crossing point of GV with the Six Yang channels. This point is used to clear heat and to treat Yin deficiency, cervical pain, intervertebral disk disease, as well as fever, cough, dyspnoea, epilepsy and immune deficiency.

CV-22: This point is located on the ventral midline at the tip of the manubrium of the sternum. It is indicated to treat thyroid disorders, thoracic pain, cough and dyspnoea.

BL-25: This is a very commonly used point. It is located on the dorsolateral aspect of the spine, lateral to the caudal border of the dorsal spinous process of L5. This is a back-shu association point for the Large Intestine and it is indeed indicated for the treatment of diarrhoea, constipation and abdominal pain. It is also indicated to treat thoracolumbar intervertebral disk disease and lumbar pain.

Bai Hui: It is a classical acupoint, very commonly used. It is located on the dorsal midline between L7 and S1 vertebrae. It is used to treat Yang deficiency (especially Kidney Yang), pelvic limb paresis or paralysis, lumbosacral pain, lumbosacral intervertebral disk disease, coxofemoral joint pain, abdominal pain and diarrhoea.

SI-3 left: This point is located proximal to the metacarpophalangeal joint on the lateral side of the fifth metacarpal. It is a Shu-stream point (wood character) and mother (tonification) point for deficiency disease patterns. It represents the confluent point of Governing Vessel channel. This point is used to treat cervical pain, intervertebral disk disease, thoracolumbar pain, shoulder pain as well as epilepsy, mania and pharyngitis.

BL-62 right: It is located on the lateral side of the pelvic limb at the hock, in a depression directly distal to the lateral malleolus of the fibula with the foot in dorsiflexion. This point is confluent to the Yang-qiao extraordinary

channel. It is used to treat ataxia and weakness of all four limbs, pelvic limb ataxia and weakness, sleep disorders and ocular disorders.
(Xie & Preast, 2007)

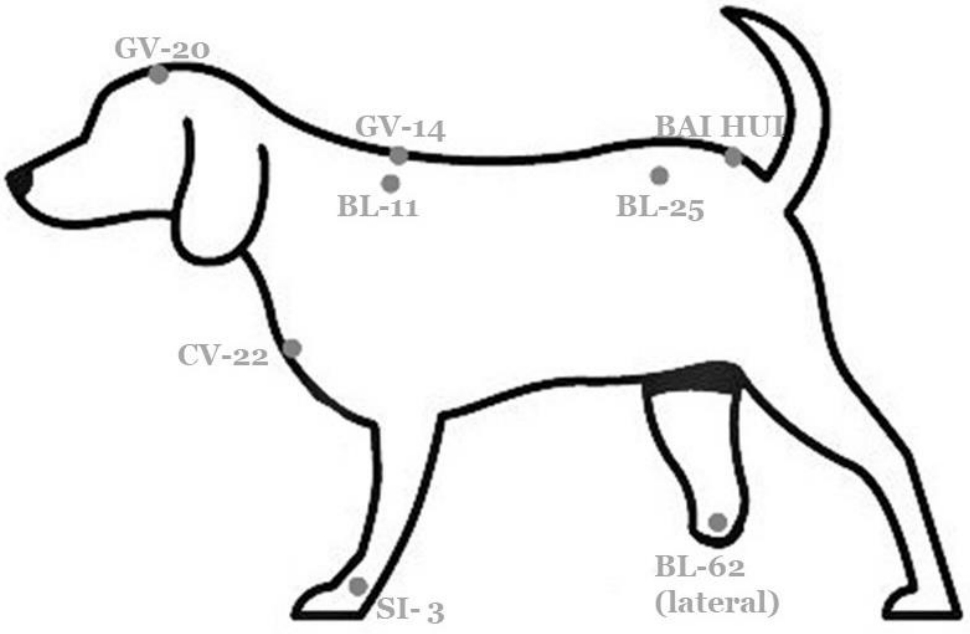

Figure 23: A schematic representation of Heidi's acupuncture protocol.

Follow up

The improvements in Heidi's condition are very slow and may seem imperceptible since she does not properly walk and gets often carried on a stroller. However, Heidi's owner refers that after every treatment she appears calmer, distended and she manages to stand straighter on her front leg.

DISCUSSION AND CONCLUSIONS

Acupuncture is one of the most known and approached forms of alternative or complementary medicine used in Western countries. In spite of that, many modern practitioners are sceptical or do not believe at all in acupuncture's effectiveness. This is probably due either to the fact that they do not know and are not interested in the subject or they just rely on modern western medicine. The latter argument is fairly agreeable, since it is very difficult for a modern science-based mind to mould and understand such unworldly and philosophical concepts like the Traditional Chinese Medicine's theory. This can be considered one of the main limitations to the recognition of acupuncture and other forms of alternative medicine in the daily practice. Another limitation is the fact that TCM and its Veterinary counterpart are very vast and complex subjects to study and one must work hard before getting to a good degree of competence and mastery. This is fairly unfortunate since acupuncture can really be a useful tool to reach to when treating certain conditions. As previously treated, acupuncture and its mechanisms of action have been thoroughly studied and evaluated since its advent in the West. It has been shown that needling produces not only local beneficial effects but also spinal and central effects. Whether to comply with the traditional theory of the flow of Qi and meridians is up to the practitioner, but it is undoubted that the positioning of needles into the dermis determines the release of many analgesic and anti-inflammatory factors that produce a beneficial effect. In fact, acupuncture is mainly used to treat various painful conditions characterised by the concurrent presence of pain, inflammation and local tissue alterations. In traditional terms, these diseases are caused by a blockage of the energy's flow together with the accumulation of external pathogenic factors such as cold, damp, heat or wind. In modern terms, the conditions most commonly treated with acupuncture are osteoarticular and musculoskeletric diseases as well as dermatological and neurological diseases.
The aim of this work was to introduce interested amateurs into the discipline of acupuncture and to display some clinical applications of it, especially referred to chronic pain conditions. The clinical cases collected

for this work are all referred to patients suffering from chronic pain of different origin. They include cases of osteoarthritis, spondylarthrosis, intervertebral disk degeneration and/or herniation, spondylosis deformans and neuritis. All the patients have a full diagnosis in Western medicine and were following or underwent in the past different medical treatments. They were then evaluated by a certified acupuncture practitioner to reach a TCVM diagnosis and arrange a treatment protocol. The results of the treatment were merely evaluated in clinical terms, judging by the improvement of posture, gait and flexibility as well as the owner's impression. Worse cases of generalized osteoarthritis and backache like Michele (case 4) showed a slight improvement after one single treatment. However, other patients who suffered a lighter type of chronic pain like Sami (case 3) felt immediately better after needling and were more fluid in their movements. Furthermore, acupuncture treatment was sought for in some cases of reduced response to analgesic or ani-inflammatory drugs. This alternative therapy allowed to reduce the dose of medications and in some cases to even put them off completely. The results of acupuncture are not immediate and often not repeatable, meaning that each individual may respond differently to the stimulation of the same acupoint. It is also clear that not every disease can be treated with acupuncture alone, but it can be a useful tool to consider when approaching a multimodal therapy for certain patients. Chronic pain conditions are indicated to be treated with acupuncture as an adjunct therapy, along with conventional treatments that may include analgesic and anti-inflammatory drugs, phytotherapics and physical therapy.

ACKNOWLEDGEMENTS

I would like to extend my sincere thanks to main supervisor, Professor Leonardi Fabio, who allowed me to choose a subject which was dear to me and followed me through every step in the making of this work. I would also like to express my deepest gratitude to my second supervisor, Doctor Gazzola Margherita, who gently introduced me to veterinary acupuncture and allowed me to follow her while doing her job and to gather all the clinical cases.

REFERENCES

Balieva, G. N., & Kostadinova, L. (2016). Traditional Chinese Veterinary Medicine. *International Journal of Science and Research (IJSR)* , *5*(6), 578–582. https://doi.org/10.21275/v5i6.NOV164157

Bridgestock, C., & Rae, C. P. (2013). Anatomy, physiology and pharmacology of pain. In *Anaesthesia and Intensive Care Medicine* (Vol. 14, Issue 11, pp. 480–483). Elsevier Ltd. https://doi.org/10.1016/j.mpaic.2013.08.004

Cantón-Habas, V., Martínez-Martos, J. M., Rich-Ruiz, M., Ramirez-Éxposito, M. J., & del Pilar Carrera-González, M. (2022). Chapter 45 - Cognitive impairment, pain, and analgesia. In R. Rajendram, V. B. Patel, V. R. Preedy, & C. R. Martin (Eds.), *Features and Assessments of Pain, Anaesthesia, and Analgesia* (pp. 493–506). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-818988-7.00004-2

Chan, W.-W., Chen, K.-Y., Liu, H., Wu, L.-S., & Lin, J.-H. (2001). Acupuncture for General Veterinary Practice. In *J. Vet. Med. Sci* (Vol. 63, Issue 10). http://www.ivas.org

Chen, T., Zhang, W. W., Chu, Y. X., & Wang, Y. Q. (2020). Acupuncture for Pain Management: Molecular Mechanisms of Action. *American Journal of Chinese Medicine*, *48*(4), 793–811. https://doi.org/10.1142/S0192415X20500408

Chomsiriwat, P., & Ma, A. (2019). Comparison of the effects of electro-acupuncture and laser acupuncture on pain relief and joint range of motion in dogs with coxofemoral degenerative joint disease. *American Journal of Traditional Chinese Veterinary Medicine*, *14*(1), 11–20.

Courtney, C. A., Fernández-de-las-Peñas, C., & Bond, S. (2017). Mechanisms of chronic pain–key considerations for appropriate physical therapy management. *Journal of Manual and Manipulative Therapy*, *25*(3), 118–127. https://doi.org/10.1080/10669817.2017.1300397

CRIBES. (2019). *Medicina Tradizionale Cinese - Manuale Studenti*.

Das, G. (n.d.). Pain Pathways. In *Scientific Figure on ResearchGate*. Retrieved June 4, 2023, from

https://www.researchgate.net/figure/Afferent-pain-pathway-Courtesy-basics-of-pain-management-by-Gautam-Das-reprinted-with_fig1_324776320

Dewey, C. W., & Xie, H. (2021). The scientific basis of acupuncture for veterinary pain management: A review based on relevant literature from the last two decades. *Open Veterinary Journal*, *11*(2), 203–209. https://doi.org/10.5455/OVJ.2021.V11.I2.3

Fox, S. M. (2014). *Pain management in small animal medicine*. CRC Press.

Fry, L. M., Neary, S. M., Sharrock, J., & Rychel, J. K. (2014). Acupuncture for analgesia in veterinary medicine. In *Topics in Companion Animal Medicine* (Vol. 29, Issue 2, pp. 35–42). W.B. Saunders. https://doi.org/10.1053/j.tcam.2014.03.001

Giussani, G. (2015). *Le basi della medicina tradizionale cinese*. Edizioni Enea.

Gong, C., & Liu, W. (2019). Advanced research validates classical principles—the neurobiological mechanisms involved in acupuncture for pain management. *Longhua Chinese Medicine*, *2*, 16–16. https://doi.org/10.21037/lcm.2019.10.02

Hellebrekers, L. J. (2000). *Animal Pain*. Van Der Wees Uitgeverij.

Hu, Y., & Liu, Z. (2020). Historical facts of acupuncture and traditional chinese veterinary medicine—A letter to the editor Re: Magalhães-Sant'Ana, M. Animals 2019, 9, 168. In *Animals* (Vol. 10, Issue 7). MDPI AG. https://doi.org/10.3390/ani10071196

Huntingford, J. L., & Petty, M. C. (2022). Evidence-Based Application of Acupuncture for Pain Management in Companion Animal Medicine. In *Veterinary Sciences* (Vol. 9, Issue 6). MDPI. https://doi.org/10.3390/vetsci9060252

IASP Task Force on Taxonomy. (1994). *Classification of Chronic Pain, Second Edition - Part III: Pain Terms, A Current List with Definitions and Notes on Usage* (H. Merskey & N. Bogduk, Eds.; Second). Stationery Office.

Janssens, L. A. A. (1986). Observations on acupuncture therapy of chronic osteoarthritis in dogs: a review of sixty-one cases. *Journal of Small Animal Practice*, *27*, 825–837. https://doi.org/10.1111/j.1748-5827.1986.tb02247.x

Kendroud, S., Fitzgerald, L. A., Murray, I. V., & Hanna, A. (2022). Physiology, Nociceptive Pathways. *StatPearls* . https://www.ncbi.nlm.nih.gov/books/NBK470255/

Kirkpatrick, D. R., Mcentire, D. M., Hambsch, Z. J., Kerfeld, M. J., Smith, T. A., Reisbig, M. D., Youngblood, C. F., & Agrawal, D. K. (2015). Therapeutic Basis of Clinical Pain Modulation. *Clinical and Translational Science*, *8*(6), 848–856. https://doi.org/10.1111/cts.12282

Kong, J., Gollub, R. L., Rosman, I. S., Megan Webb, J., Vangel, M. G., Kirsch, I., & Kaptchuk, T. J. (2006). Brain activity associated with expectancy-enhanced placebo analgesia as measured by functional magnetic resonance imaging. *Journal of Neuroscience*, *26*(2), 381–388. https://doi.org/10.1523/JNEUROSCI.3556-05.2006

Lao Tzu. (1996). *Tao Te Ching - Translations* (B. Boisen, Ed.). Gnomad Publishing.

Lin, J. H., & Panzer, R. (1994). Use of Chinese herbal medicine in science: history and perspectives. *Scientific and Technical Review of the Office International Des Epizooties (Paris)*, *2*(13), 425–432. https://doi.org/10.20506/rst.13.2.768

Liu, C. M., Chang, F. C., & Lin, C. T. (2016). Retrospective study of the clinical effects of acupuncture on cervical neurological diseases in dogs. *Journal of Veterinary Science*, *17*(3), 337–345. https://pubmed.ncbi.nlm.nih.gov/26645331/

Lo, V., Stanley-Baker, M., & Yang, D. (2022). *ROUTLEDGE HANDBOOK OF CHINESE MEDICINE* (1st ed.). Routledge.

Maciocia, G. (2019). *Bi Syndrome*.

Melzack, R. (1996). Gate control theory: On the evolution of pain concepts. *Pain Forum*, *5*(2), 128–138. https://doi.org/https://doi.org/10.1016/S1082-3174(96)80050-X

Melzack, R. (2001). Pain and the neuromatrix in the brain. *Journal of Dental Education*, *65*(12). https://pubmed.ncbi.nlm.nih.gov/11780656/

Merskey, H., & Bogduk, N. (1994). *Classification of pain. 2nd ed.*

Moeller, H. G. (2012). Taoism. In R. Chadwick (Ed.), *Encyclopedia of Applied Ethics (Second Edition)* (2nd ed., pp. 298–305). Academic Press. https://doi.org/10.1016/B978-0-12-373932-2.00217-9.

Monteiro, B. P., Lascelles, B. D. X., Murrell, J., Robertson, S., Steagall, P. V. M., & Wright, B. (2022). 2022 WSAVA guidelines for the recognition, assessment and treatment of pain . *Journal of Small Animal Practice*. https://doi.org/10.1111/jsap.13566

Muir III, W. W., & Woolf, C. J. (2001). Mechanisms of pain and their therapeutic implications. *JAVMA*, *219*(10).

National Geographic Society. (2023, January 30). *Taoism*. https://education.nationalgeographic.org/resource/taoism/

Ossipov, M. H., Morimura, K., & Porreca, F. (2014). Descending pain modulation and chronification of pain. In *Current Opinion in Supportive and Palliative Care* (Vol. 8, Issue 2, pp. 143–151). Lippincott Williams and Wilkins. https://doi.org/10.1097/SPC.0000000000000055

Panzer, R. (1993). A Comparison of the Traditional Chinese Versus Transpositional Zangfu Organ Association Acupoint Locations in the Horse. *The American Journal of Chinese Medicine*, *21*(2), 119–131. https://doi.org/10.1142/S0192415X93000157

PerioperativeCPD Team. (2022). *An Introduction to Pain Pathways*. https://www.periopcpd.com/wp-content/uploads/An-Introduction-to-Pain-Pathways-2022.pdf

Purves, D., Augustine, G., & Fitzpartick, D. (2001). Neuroscience 2nd Ed. In *Neuroscience* (2nd ed.). Sinauer Associates. https://www.ncbi.nlm.nih.gov/books/NBK10965/

Raja, S. N., Carr, D. B., Cohen, M., Finnerup, N. B., Flor, H., Gibson, S., Keefe, F. J., Mogil, J. S., Ringkamp, M., Sluka, K. A., Song, X.-J., Stevens, B., Sullivan, M. D., Tutelman, P. R., Ushida, T., & Vader, K. (2020). The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. *PAIN*, *161*(9). https://journals.lww.com/pain/Fulltext/2020/09000/The_revised_International_Association_for_the.6.aspx

Ramey, D. W., & Buell, P. D. (2004). *Acupuncture and "traditional Chinese medicine" in the horse. Part 1: A historical overview*.

Reddi, D., Curran, N., & Stephens, R. (2012). Pain Pathways Introduction. In *University College London*. UCL.

Robertson, S. A. (2002). What is pain? *Journal of the American Veterinary Medical Association*, *221*(2).

Ross, J. (1985). *ZANG FU - The Organ Systems of Traditional Chinese Medicine* (2nd ed.). Churchill Livingstone.

Saraswati, S. S., & Forshing, L. (2022). *Biochemistry, Endogenous Opioids*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK532899/

Schoen, A. M., Janssens, L., & Rogers, P. A. (1986). Veterinary Acupuncture. *Seminars in Veterinary Medicine and Surgery (Small Animals)*, *1*(3), 224–229. https://www.researchgate.net/publication/19837937

Scholz, J. (2014). Mechanisms of chronic pain. *Molecular Pain*, *10*(Suppl 1), O15. https://doi.org/10.1186/1744-8069-10-s1-015

Sikandar, S., & Dickenson, A. H. (2012). Visceral pain: The ins and outs, the ups and downs. In *Current Opinion in Supportive and Palliative Care* (Vol. 6, Issue 1, pp. 17–26). https://doi.org/10.1097/SPC.0b013e32834f6ec9

Silva, N. E. O. F., Luna, S. P. L., Joaquim, J. G. F., Coutinho, H. D., & Possebon, F. S. (2017). Effect of acupuncture on pain and quality of life in canine neurological and musculoskeletal diseases. *The Canadian Veterinary Journal*, *9*(58), 941–951. https://pubmed.ncbi.nlm.nih.gov/28878418/

Sousa, N. R. de., Luna, S. P. L., Cápua, M. L. B. de., Lima, A. F. da M., Oliveira, F. A. de., Viveiros, B. M. de., & Barbosa, L. (2012). Analgesia of preemptive pharmacopuncture with meloxicam or aquapuncture in cats undergoing ovariohysterectomy. *Ciência Rural*, *7*(42). https://doi.org/10.1590/S0103-84782012000700015

Still, J. (2005). Acupuncture for Surgical Analgesia. *World Small Animal Veterinary Association World Congress Proceedings*.

Suzuki, R., Rygh, L. J., & Dickenson, A. H. (2004). Bad news from the brain: descending 5-HT pathways that control spinal pain processing. *Trends*

in Pharmacological Sciences, *25*(12), 613–617. https://doi.org/10.1016/j.tips.2004.10.002

Telxeira, L. R., Luna, S., Matsubara, L., Càpua, M., Santos, B., Mesquita, L., Faria, L., Agostinho, F., & Hielm-Bjorkman, A. (2016). Owner assessment of chronic pain intensity and results of gait analysis of dogs with hip dysplasia treated with acupuncture. *JAVMA*, *249*(9), 1031–1039.

Unschuld, P. U. (2003). *Huang Di Nei Jing Su Wen: Nature, Knowledge, Imagery in an Ancient Chinese Medical Text: With an appendix: The Doctrine of the Five Periods and Six Qi in the Huang Di Nei Jing Su Wen* (1st ed.). University of California Press. https://www.jstor.org/stable/10.1525/j.ctt1ppf4w

Ute, A. (n.d.). *Jing Qi Shen - The Three Treasures*. Retrieved June 25, 2023, from https://threetreasurestcm.com/jing-qi-shen/

Vangermeersch, L., & Pei-Lin, S. (1994). *Bi-Syndromes or Rheumatic disorders treated by traditional chinese medicine* (1st ed., Vol. 1). SATAS s.a.

Walters, E. T. (2018). Defining pain and painful sentience in animals. *Animal Sentience*, *3*(21). https://doi.org/10.51291/2377-7478.1360

White, A., & Ernst, E. (2004). A brief history of acupuncture. *Rheumatology*, *43*(5), 662–663. https://doi.org/10.1093/rheumatology/keg005

Winkler, C. W., Hermes, S. M., Chavkin, C., Drake, C. T., Morrison, S. F., & Aicher, S. A. (2006). Kappa opioid receptor (KOR) and GAD67 immunoreactivity are found in OFF and NEUTRAL cells in the rostral ventromedial medulla. *Journal of Neurophysiology*, *96*(6), 3465–3473. https://pubmed.ncbi.nlm.nih.gov/17005613/

Xie, H., & Preast, V. (2002). *Traditional Chinese Veterinary Medicine* (T. Jing, Ed.; Vol. 1).

Xie, H., & Preast, V. (2007). *Xie's Veterinary Acupuncture* (Vol. 1). Blackwell Publishing Professional.

Yam, M. F., Loh, Y. C., Tan, C. S., Adam, S. K., Manan, N. A., & Basir, R. (2018). General pathways of pain sensation and the major neurotransmitters involved in pain regulation. In *International*

Journal of Molecular Sciences (Vol. 19, Issue 8). MDPI AG. https://doi.org/10.3390/ijms19082164

Zhang, D. (2019). Cultural Symbols in Chinese Architecture. *Architecture and Design Review*, *1*(1). https://www.researchgate.net/figure/The-most-popular-Yin-Yang-symbol-It-is-said-the-symbol-was-revised-by-Daoist-sage-Chen_fig1_325229254

Zhang, E. Q. (2010). Bi syndrome (Arthralgia syndrome). *Journal of Traditional Chinese Medicine*, *30*(2), 145–152. https://doi.org/10.1016/s0254-6272(10)60032-5

Zhao, Z. Q. (2008). Neural mechanism underlying acupuncture analgesia. In *Progress in Neurobiology* (Vol. 85, Issue 4, pp. 355–375). https://doi.org/10.1016/j.pneurobio.2008.05.004